

SUSE Linux Enterprise Server for SAP applications

Using SUSE and Fortinet Automation to Deploy a Secured SAP Landscape on Azure Cloud Platform

Getting Started

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Date: March 30, 2022

This document provides a brief introduction to a solution build with Fortinet to enhance the SUSE SAP automation solution.

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1 Introduction

1.1 Motivation

What is Project Mayerhofen?

Project Mayerhofen is a secure automated SAP deployment on Azure. It is based on the SUSE initiated GitHub project [Automated SAP/HA Deployments in Public/Private Clouds with Terraform](https://github.com/SUSE/ha-sap-terraform-deployments) (<https://github.com/SUSE/ha-sap-terraform-deployments>)⁷.

As organizations upgrade their existing systems and migrate to S/4 HANA, there is the opportunity to migrate to Azure for more flexibility and scalability on demand. But this also shifts the attack surface for the SAP systems as they are no longer hosted in their own protected data center.

A very useful approach to start with in the cloud is Infrastructure-as-Code (IaS), as all steps of deployments can be automated right from the start.

Combining the SUSE SAP automation with an automated Fortinet Security Fabric provisioning results in an architecture which provides added security, optimized connectivity and faster roll-out of an SAP landscape in Azure.

Some key values of the solution are:

1. Simplifying SAP Cloud deployments on Azure
2. Increasing flexibility and scalability on demand
3. Improving builds and time to production
4. Using industry standards for automated deployment and configuration
5. Combining SUSE SAP automation with an automated Fortinet Security Fabric provisioning
6. Providing security, optimized connectivity and faster rollout of SAP landscapes

Adding the Fortinet deployment, it is the same workflow as with the normal SUSE SAP automation project. You only need to enable the “with fortinet” switch to benefit from the additional installation of the Fortinet Fabric.

1.2 Scope

This document will walk you through a simple deployment of an HA SAP Landscape using the SUSE Automation Project for SAP Solutions project and Fortinet's secure fabric on Azure. The project can be customized quite extensively. The goal of this document is to provide you with an easy-to-start example.

The first part of the project uses Terraform to build the Azure infrastructure where the Fortinet part is deployed in a HUB and the SAP Landscape is deployed on SUSE in a SPOKE. The HUB virtual network is the connection point to on-premises networks and serves as central location for services used by SPOKE virtual networks. The SPOKE virtual networks are peered with the HUB and can be used to isolate workloads in their own virtual network.

The second part of the project uses Salt to deploy and configure the operating system (SUSE Linux Enterprise Server for SAP applications), SAP software (SAP HANA and SAP Netweaver), and, if chosen, a SUSE Linux Enterprise High Availability (HA) cluster for the SAP applications. If extensive configuration and customization are required, refer to the project documentation at <https://github.com/SUSE/ha-sap-terraform-deployments> and the Solution Architecture Document available from the SUSE Partner Program.

For simplicity, this guide uses the Azure Cloud Shell to perform the deployment, as it provides easy access to most of the required tooling. It is possible to use a local Linux or macOS computer, but some commands may need modification or omission.

1.3 Audience

This document is targeted at everybody who wants to build a secure SAP landscape on Azure.

2 Technical overview

The architecture for the deployment is similar to the one below:

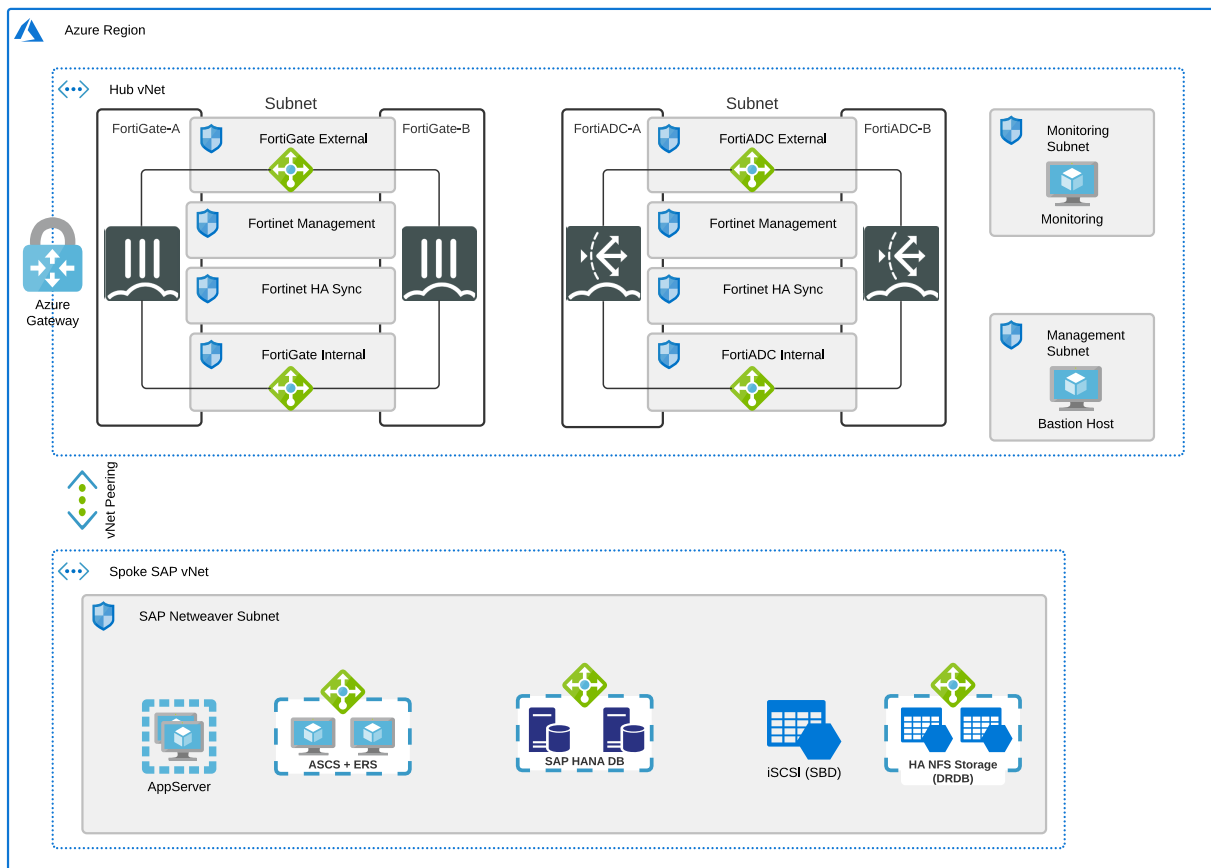


FIGURE 1: AZURE AUTOMATION ARCHITECTURE

The project performs the following actions:

- Deploying an Azure VPN Gateway as entry point to the Azure Hub/Spoke network
- Deploying an Azure Hub network
- Deploying FortiGate and FortiADC HA pairs in the HUB
- Deploying a Spoke-Network for the SAP Landscape
- Deploying instances SAP HANA Instance (in an HA scenario)
- Deploying SAP Netweaver/S4HANA Instances (in an HA scenario)
- Configuring the operating system for SAP workload

If an HA scenario is chosen, the following actions are performed in addition:

- Configuring SAP HANA System Replication (HSR)
- Configuring SAP Netweaver ENQ Replication
- Configuring SUSE Linux Enterprise High Availability cluster components

The minimum requirements to get started are




- an Azure account, to be able to deploy the solution.
- an SAP account, to get the needed SAP media for the solution you want to deploy.

2.1 The Fortinet Solutions

2.1.1 FortiGate

FortiGate *Next Generation Firewall* (NGFW) enables security-driven networking and consolidates industry-leading security capabilities such as *intrusion prevention system* (IPS), Web filtering, *secure sockets layer* (SSL) inspection, and automated threat protection. This deployment contains an HA cluster of two FortiGate instances which provides segmentation within the HUB network and segmentation and security inspection for communication to and from the SAP SPOKE network. The FortiGate Firewall cluster can be accessed via HTTPs or via SSH on its public IP and credentials output by the Terraform deployment.

Further Information on the configuration can be found in the following guides:




1. FortiGate Documentation for Azure (<http://docs.fortinet.com/document/fortigate-public-cloud/7.0.0/azure-administration-guide/128029/about-fortigate-vm-for-azure>) 
2. FortiGate Administration Guide (<https://docs.fortinet.com/document/fortigate/7.0.4/administration-guide/954635/getting-started>) 
3. Fortinet Solutions for SAP (<https://www.fortinet.com/sap>) 

2.1.2 FortiADC

FortiADC is an advanced *Application Delivery Controller* (ADC) that ensures application availability, application security, and application optimization. FortiADC offers advanced security features (WAF, DDoS, and AV) and application connectors for easy deployment and full visibility to your networks and applications.

FortiADC provides a dedicated connector specific for SAP to allow the same load balancing capabilities like SAP Web Dispatcher with the addition of a *Web Application Firewall* (WAF). This deployment contains a Cluster of two FortiADC Instances. The FortiADC cluster can be accessed via HTTPs or via SSH on its public IP and credentials output by the Terraform deployment.

Further Information on the configuration can be found in the following guides:

1. FortiADC Administration Guide (<https://docs.fortinet.com/document/fortiadc/6.2.2/handbook/105358/introduction>) 
2. FortiADC SAP Connector Configuration (<https://docs.fortinet.com/document/fortiadc/6.2.2/handbook/382594/sap-connector>) 
3. Fortinet Solutions for SAP (<https://www.fortinet.com/sap>) 

3 Installation

The overall process is visualized in the figure below:

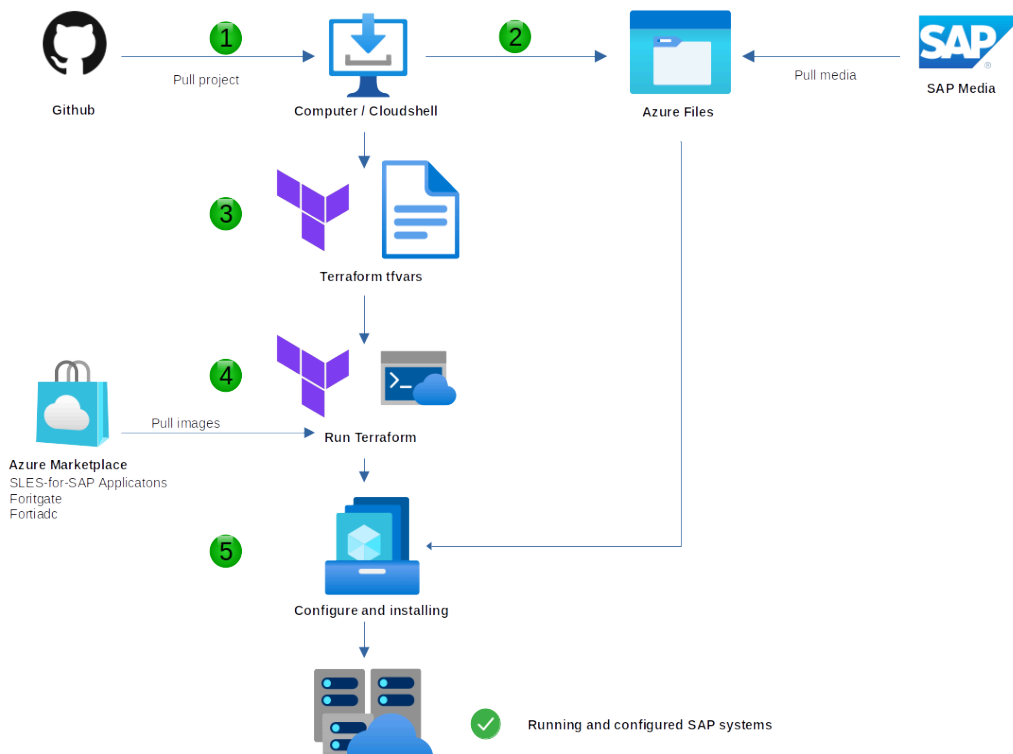


FIGURE 2: WORKFLOW OF THE AUTOMATION



Note

The project uses PAYG images by default. This means there is no need for subscriptions or license files to provide for an easy start. But you can use BYOS/BYOL, too. The required changes are mentioned in the *tfvars* example files.

3.1 Configuring the Cloud Shell

From the top menu of the Azure Portal, start an Azure Cloud Shell. To do so, use the small icon with the command line prompt.

When Cloud Shell is started the first time, you can select between "Bash" and "PowerShell". Use "Bash"

The Cloud Shell is a managed service by Microsoft. It comes with the most popular command line tools and needed language support. The Cloud Shell also securely authenticates automatically for instant access to your resources through the Azure CLI or Azure PowerShell cmdlets.

3.2 Ensuring Terraform is installed

Terraform is already deployed as part of the Azure Cloud Shell. The following command output shows the Terraform version used at the time of creating this guide:

```
$ terraform -v
Terraform v1.0.0
on linux_amd64
```

The project could run with higher versions, too, but you may get some warnings.

3.3 Preparing the SAP media

With the correct entitlement, SAP media can be downloaded from the SAP Web site at <https://support.sap.com/en/my-support/software-downloads.html> . Make the SAP Media available to be accessed during the deployment.

The SUSE Automation for SAP applications project allows for three methods for presenting the SAP media:

1. SAR file and SAPCAR executable (SAP HANA Database only)
2. Multipart exe/RAR files
3. Extracted media

The different formats have some benefits and drawbacks:

1. The compressed archives (SAR and RAR) provide a simple copy to the cloud but a longer install time because of extracting them during the process.
2. The uncompressed/extracted media are the fastest installation method. However, as more files are copied to the cloud share, this also takes time beforehand during preparation.

Here in the example, we use the compressed archives for the installation (exe/RAR) as this is the easiest method to download and upload to the cloud share.

This guide uses the most recent SAP HANA media, SAP HANA 2.0 SPS05. The SAP HANA media file name downloaded at the time of creating this guide is [51054623](#). Follow the SAP instructions to download the SAP HANA media.



Note

Extraction depends on the way used to download the SAP media. If multiple compressed files are downloaded, the official SAP extract tool [SAPCAR](#) tool must be used to extract the SAP media.

Extracted SAP Media will contain a lot of extracted files. Depending on your network speed, uploading the extracted SAP media files can take a lot of time. The CSP's infrastructure usually provides a good network speed. But if you encounter problems, a viable workaround would be to create a workstation machine in the cloud to download/upload the SAP media.

Also, have a look at how far away your share for the SAP media is from the region where you install the machines - it should preferably be the same region.



Tip

It is good practice to have the SAP Media versioned on the cloud share to build a library for automatic installs and (re)deployments. Thus, give some thought to your SAP media structure in advance.

As an **example**, see below how a full SAP application media tree (in a compressed format) for an S/4HANA version 1809 installation could look like:

```
<FS>/s4hana1809
|  |--SWPM_CD
|  |  |--SWPM20SP07_5-80003424.SAR
|  |  |--SAPCAR_721-20010450.EXE
|  |
|  |--EXP_CD
|  |  |--S4CORE104_INST_EXPORT_1.zip
|  |  |--S4CORE104_INST_EXPORT_2.zip
|  |  |--...
|  |--DBCLIENT_CD
|  |  |--IMDB_CLIENT20_005_111-80002082.SAR
|  |--BASKET_CD
|  |  |--SAPHOSTAGENT24_24-20009394.SAR
|  |  |--igsheper_4-10010245.sar
|  |  |--igsexex_1-80001746.sar
```

```

|   |SAPEXEDB_400-80000698.SAR
|   |SAPEXE_400-80000699.SAR
|   |HANA
|   |   |51053061_part1.exe
|   |   |51053061_part2.rar
|   |   |51053061_part3.rar
|   |   |51053061_part4.rar

```

HANA : contains the HANA Database install
 BASKET_CD : contains SAP kernel, patch + more like hostagent.
 DBCLIENT_CD: contains the package corresponding to DB CLIENT, e.g HANA
 EXP_CD : contains the package corresponding to EXPORT files
 SWPM_CD : must contain the .exe file corresponding to SAPCAR and the .sar file corresponding to SWPM.
 The file suffix must be .exe and .sar.

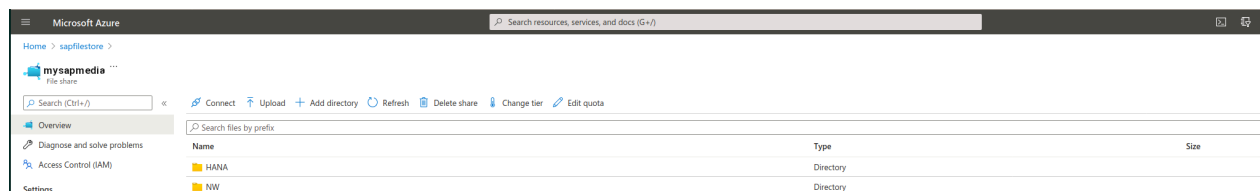
The next steps explain an example for a simple HANA install download.

For Azure, an Azure File Share is used to host the SAP media.

Using the Azure Portal or the Azure CLI, perform the following actions:

- Create a storage account.
- Create a directory within the Storage Account, for example *mysapmedia*.
- Upload the SAP media files to the Storage Account.

You will later need the Storage Account name and one key as password for the Terraform run.



3.4 Downloading and configuring the Automation code

The SUSE and Fortinet SAP Automation code is published in GitHub.

The following command will clone the project to the Cloud Shell ready for configuration:

```

$ git clone --depth 1 https://github.com/Project-Mayerhofen/ha-sap-terraform-deployments.git

```

The `--depth 1` make sure that you only get the latest commits and not the whole history for the project



Note

If the following SSH keys already exist, the next step can be skipped.

Then, generate SSH key pairs to allow for accessing the SAP HANA instances:

```
#optional if ssh-keys already exist
$ cd ~
$ ssh-keygen -q -t rsa -N '' -f ~/.ssh/id_rsa
```

3.4.1 Configuring the deployment options and modifying the Terraform variables

The files that need to be configured are contained in a subdirectory of the project. Use that as the working directory:

The project itself has code for several cloud service providers and virtual infrastructures, but currently the Fortinet addition is only available for Azure. Get in contact with us if you want to see it for others, too.

```
cd ~/ha-sap-terraform-deployments/azure
```

A Terraform example template is provided. For a demo environment consisting of a simple SAP Scenario, only a handful of parameters will need to be changed, as most of the possible values come with a useful default as a good and safe starting point.

Copy the Terraform example file to *terraform.tfvars*:

```
$ cp terraform.tfvars.example terraform.tfvars
```

Edit the `terraform.tfvars` file and modify it as explained below.

As there are many options possible, we will describe only one possible path, which will set up the Fortinet appliances and an HA HANA System and a Netweaver HA system. If you are duplicating the lines before modification, ensure the original is commented out, or the deployment will fail.

Choose the region for the deployment, for example:

```
# Region where to deploy the configuration
```

```
az_region = "westeurope"
```

The following parameters select the version of SUSE Linux Enterprise Server for SAP applications to deploy:



Note

The values shown would also be the defaults used. All defaults point to PAYG images for an easy start. So you only need to enable or change the variables if you want something different.

Set this variable to give the deployment a unique name, which will be shown at most resources as suffix, for example:

```
# The name must be unique among different deployments
deployment_name = "mydev123"
```

Provide a name for the OS user for the machines:

```
# Admin user for the created machines
admin_user = "cloudadmin"
```

If you want to go with the default PAYG image, you do NOT need to change anything here. However, if you want to use a BYOS image, you need to make sure that you provide the subscription key and e-mail to register against SUSE Customer Center (SCC). This requires also that you have not blocked Internet access to reach SCC.

```
#os_image = "sles-sap-15-sp2:gen2"
```

Next, enter the path for the public and private SSH keys that were generated earlier. Below is an example using the SSH keys created by default:

```
# SSH Public key location to configure access to the remote instances
public_key = "~/.ssh/id_rsa.pub"

# Private SSH Key location
private_key = "~/.ssh/id_rsa"
```

As the deployment needs a Hub/Spoke network setup, set the following variables:

```
network_topology = "hub_spoke"
vnet_hub_create = true
bastion_enabled = true
spoke_name = "sap-1"
```

To use an existing hub/spoke network, have a look at the other examples provided. The deployment with Fortinet **requires** the hub/spoke architecture.

To keep the cluster architecture and deployment simple and to provide additional packages needed to deploy, uncomment and set the following parameters:

```
ha_sap_deployment_repo = "https://download.opensuse.org/repositories/network:/ha-clustering:/sap-deployments:/v7/"
```

Then, enable the `pre_deployment` parameter:

```
pre_deployment = true
```

The Jump host server (Bastion Host Server) is enabled by default, and provides the public IP address to the database. Otherwise the deployed instances will all get a public IP.

With the Fortinet addition, it is mandatory to have the Bastion Host Server enabled:

```
bastion_enabled = true
```

Next, set which SAP HANA instance machine type should be selected. The default is set to some standard types, and you only need to enable and change the variable if you want other sizes.

```
#hana_vm_size = "Standard_E8s_v3"
```

Modify the following parameter to point to SAP media that was uploaded to the storage location:

```
storage_account_name = "YOUR_STORAGE_ACCOUNT_NAME"
storage_account_key = "YOUR_STORAGE_ACCOUNT_KEY"
```

The `"hana_inst_master"` needs to be set according to your settings of the file share you created before.

Example:

```
hana_inst_master = "//YOUR_STORAGE_ACCOUNT_NAME.file.core.windows.net/mysapmedia"

hana_archive_file = "s4hana1809/HANA/{hana_archive_version}.exe"
```

To create the cluster, you need to set this parameter to true, otherwise only a single system is created.

```
# Enable system replication and HA cluster
hana_ha_enabled = true
```

Finally, to ensure a fully automated deployment, it is possible to set passwords within the `terraform.tfvars` file. Uncomment and set the following parameters to your own value:

```
hana_master_password = "SAP_Pass123"
```



Note

If the parameters are not set in the *terraform.tfvars* file, they must be entered when running the deployment.



Important

All passwords must conform to SAP password policies, or the deployment will fail.

Optional: If a monitoring instance should be a part of the deployment, find and uncomment the following:

```
monitoring_enabled = true
```

As you want to deploy a Netweaver scenario, you need a highly available NFS-Share. To build one with Linux, use DRBD and pacemaker:

```
# Enable drbd cluster
drbd_enabled = true
```

There is a similar set of variables needed for Netweaver as it was for HANA:

```
netweaver_enabled = true
netweaver_app_server_count = 2
netweaver_master_password = "SuSE1234x"
```

The Netweaver product version which should be installed needs to be set via product ID. Have a look at the examples to pick the right one for your deployment:

```
netweaver_product_id = "NW750.HDB.ABAPHA"
```

Again, provide the file share for the Netweaver media, which normally are at the same share:

```
netweaver_storage_account_name = "YOUR_STORAGE_ACCOUNT_NAME"
netweaver_storage_account_key = "YOUR_STORAGE_ACCOUNT_KEY"
netweaver_storage_account = "///YOUR_STORAGE_ACCOUNT_NAME.file.core.windows.net/path/to/your/nw/installation/media"
```

Now define where the directories for the SAP installer are located, relative to the mount point of the Netweaver storage account:

```
netweaver_sapcar_exe = "your_sapcar_exe_file_path"
netweaver_swpm_sar = "your_swpm_sar_file_path"
```



```
netweaver_sapexe_folder = "your_download_basket"
netweaver_additional_dvds = ["your_export_folder", "your_hdbclient_folder"]
```

To additionally deploy the Fortinet services, remember you need to choose a HUB-SPOKE network scenario and enable the flag for Fortinet:

```
fortinet_enabled=true
```

You need credentials for the FortiGate instances, too. Ensure to change them to your values:

```
fortigate_vm_username = "azureuser"
fortigate_vm_password = "SuSE1234x"
```

Do the same for the FortiADC instances:

```
fortiadc_vm_username = "azureuser"
fortiadc_vm_password = "SuSE1234x"
```

All other values should be set by default and use the PAYG instances of Fortinet.

If you want to use BYOL with your Fortinet services, you need to buy and then copy the Fortinet license files into the directory:

```
cp *.lic ~/ha-sap-terraform-deployments/azure
```

Here is an example *tfvars* file for a Fortinet deployment in the Hub, and an HA NW750 installation with an HA HANA setup in the SPOKE:

```
az_region = "westeurope"
deployment_name = "psfn6"
admin_user = "cloudadmin"
public_key = "/home/<YOURUSER>/.ssh/azure.id_rsa.pub"
private_key = "/home/<YOURUSER>/.ssh/azure.id_rsa"
cluster_ssh_pub = "salt://sshkeys/cluster.id_rsa.pub"
cluster_ssh_key = "salt://sshkeys/cluster.id_rsa"
network_topology = "hub_spoke"
vnet_hub_create = true
bastion_enabled = true
spoke_name = "sap-1"
ha_sap_deployment_repo = "https://download.opensuse.org/repositories/network:/ha-clustering:/sap-deployments:/devel/"
pre_deployment = true
hana_count = "2"
storage_account_name = "<YOURSTORAGEACCOUNT>"
storage_account_key = "<YOURACCOUNTKEY>"
hana_inst_master = "//<YOURSTORAGEACCOUNT>.file.core.windows.net/sapbits/HANA/51054623"
```

```

hana_ha_enabled = true
hana_master_password = "xxxxxxx"
monitoring_enabled = true
drbd_enabled = true
netweaver_enabled = true
netweaver_app_server_count = 2
netweaver_master_password = "xxxxxxx"
netweaver_ha_enabled = true
netweaver_cluster_fencing_mechanism = "sbd"
netweaver_product_id = "NW750.HDB.ABAPHA"
netweaver_storage_account_name = "<YOURSTORAGEACCOUNT>"
netweaver_storage_account_key = "<YOURACCOUNTKEY>"
netweaver_storage_account = "<YOURSTORAGEACCOUNT>.file.core.windows.net/sapbits"
netweaver_sapcar_exe = "netweaver/SAPCAR"
netweaver_swpm_sar = "netweaver/SWPM10SP26_6-20009701.SAR"
netweaver_sapexe_folder = "netweaver/kernel_nw75_sar"
netweaver_additional_dvds = ["netweaver/51050829_3", "HANA/51054623/DATA_UNITS/
HDB_CLIENT_LINUX_X86_64"]
fortinet_enabled      = true
fortigate_vm_username = "azureuser"
fortigate_vm_password = "xxxxxxx"
fortiadc_vm_username  = "azureuser"
fortiadc_vm_password  = "xxxxxxx"

```



Note

Here you can see how parts of the Fortinet section look for using BYOL images:


```

..
fortinet_vm_license_type = "byol"

fortigate_a_license_file = "license_fortigate_a.lic"
fortigate_b_license_file = "license_fortigate_b.lic"
fortigate_os_image = "fortinet:fortinet_fortigate-vm_v5:fortinet_fg-vm:7.0.2"
..
fortinet_enabled      = true
fortigate_vm_username = "azureuser"
fortigate_vm_password = "xxxxxxx"
fortiadc_vm_username  = "azureuser"
fortiadc_vm_password  = "xxxxxxx"
..
fortiadc_a_license_file = "license_fortiadc_a.lic"
fortiadc_b_license_file = "license_fortiadc_b.lic"
fortiadc_os_image = "fortinet:fortinet-fortiadc:fad-vm-byol:6.1.3"
..

```

3.5 Finalizing the automation configuration

Ensure that the subscription used to host the SAP HANA HA cluster meets the infrastructure quota requirements. For more info, refer to <https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/get-started> 

3.6 Deploying the project

Terraform will create and name resources when running the deployment based on the "workspace" in use. It is highly recommended to create a unique workspace from which to run the deployment.

```
$ terraform init
$ terraform plan
$ terraform apply
```



Tip

The Cloud Shell has a timeout of around 20 minutes and the shell will close if left unattended, resulting in a failed deployment. It is strongly advised to retain focus on the Cloud Shell window to ensure the timeout does not occur, as a full deployment could take nearly four hours.

If successful, the output will be the public IP addresses for the cluster nodes, similar to the output below:

```
module.netweaver_node.module.netweaver_provision.null_resource.provision[3] (remote-
exec): Total states run:      38
module.netweaver_node.module.netweaver_provision.null_resource.provision[3] (remote-
exec): Total run time: 6339.329 s
module.netweaver_node.module.netweaver_provision.null_resource.provision[3] (remote-
exec): Tue Jan 25 19:12:24 UTC 2022::vmnetweaver04::[INFO] deployment done

Apply complete! Resources: 227 added, 0 changed, 0 destroyed.

Outputs:

bastion_public_ip = "20.2.3.43"
cluster_nodes_ip = [
  "10.74.1.10",
```

```

    "10.74.1.11",
  ],
]
cluster_nodes_name = [
  [
    "vmhana01",
    "vmhana02",
  ],
]
cluster_nodes_public_ip = [
  [],
]
cluster_nodes_public_name = [
  [],
]
drbd_ip = [
  "10.74.1.6",
  "10.74.1.7",
]
drbd_name = [
  "vmdrbd01",
  "vmdrbd02",
]
drbd_public_ip = []
drbd_public_name = []
fortiadc_a_url = "https://20.2.3.44:41443"
fortiadc_b_url = "https://20.2.3.44:51443"
fortigate_a_url = "https://20.2.3.41"
fortigate_b_url = "https://20.2.3.42"
fortigate_url = "https://20.2.3.44"
iscsi_srv_ip = [
  "10.74.1.4",
]
iscsisrv_name = [
  "vmiscsi01",
]
iscsisrv_public_ip = []
iscsisrv_public_name = []
monitoring_ip = ""
monitoring_name = ""
monitoring_public_ip = ""
monitoring_public_name = ""
netweaver_ip = [
  "10.74.1.60",
  "10.74.1.61",
  "10.74.1.62",
  "10.74.1.63",
]

```

```
]
netweaver_name = [
  "vmnetweaver01",
  "vmnetweaver02",
  "vmnetweaver03",
  "vmnetweaver04",
]
netweaver_public_ip = []
netweaver_public_name = []
```

3.7 Tearing down

When finished with the deployment, or even if the deployment has failed, ensure that Terraform is used to tear down the environment.

```
$ terraform destroy
```




This method will ensure all resource, such as instances, volumes, networks, etc. are cleaned up. You need to delete the following components manually: * Azure File Store

4 Summary

Combining the SUSE SAP automation with an automated Fortinet Security Fabric provisioning results in an architecture which provides added security, optimized connectivity and faster roll-out of an SAP landscape in Azure.

5 Additional resources


To learn more about the capabilities of Using SUSE and Fortinet Automation to Deploy a Secured SAP Landscape on Azure Cloud Platform: Getting Started, refer to the following resources:

- Fortinet Solutions for SAP (<https://www.fortinet.com/sap>) 
- SUSE Solutions for SAP (<https://www.suse.com/partners/alliance/sap/>) 
- SAP workload automation using SUSE on Azure (<https://docs.microsoft.com/en-us/azure/architecture/solution-ideas/articles/sap-workload-automation-suse>) 

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