Using SUSE & Fortinet Automation to deploy an secured SAP Landscape on Azure Cloud Platform

Getting Started

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1 What is Project Mayerhofen

Project Mayerhofen is a secure automated SAP deployment on Azure.

As organizations upgrade there existing system 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 SAP system as they are not anymore in the own datacenter.

A very useful approach to start with in the cloud is infrastructure-as-code, as all steps of deployments can be automated from begin on.

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

It is the same workflow as with the normal SUSE SAP automation project, you only need to enable “with fortinet” to benefit from the additional installation of the Fortinet Fabric.

This document will walk you through a simple deployment of a HA SAP Landscape using the SUSE Automation Project for SAP Solutions Project and Fortinet’s secure fabric on Azure. The project could be quite extensive customized, but we want to showcase here a simple, easy to start-with example.

The project uses Terraform to build the Azure infrastructure, where the Fortinet part get deployed in a HUB and the SAP Landscape on SUSE in a SPOKE. The HUB virtual network is the connection point to your on-premises networks and central location for services used by SPOKE virtual networks. The SPOKE virtual networks are peering with the hub and be used to isolate workloads in there own virtual network.

The second part is using 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, please refer to the project documentation at https://github.com/SUSE/ha-sap-terraform-deployments and the Solution Architecture Document available in the SUSE Partner Program.

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

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

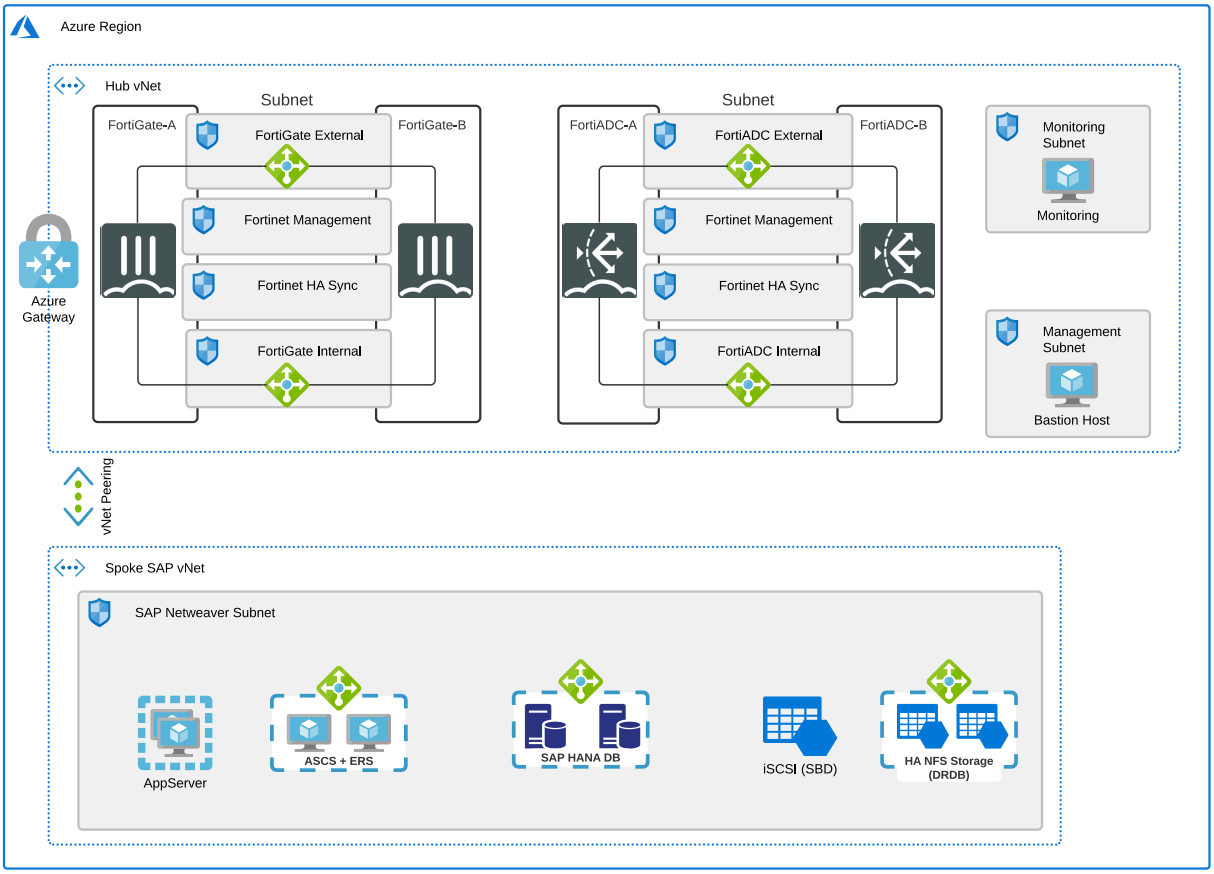


FIGURE 1: AZURE AUTOMATION ARCHITECTURE

The project will perform the following actions:

- Deploy a Azure VPN Gateway as entry point to the Azure Hub/Spoke network.
- Deploy a Azure Hub network
- Within the Hub there will be Fortigate and Fortiadc in a HA setup installed
- Deploy a Spoke-Network for the SAP Landscape
- Deploying instances SAP HANA Instance (in a HA setup)
- Deploy a SAP Netweaver/S4HANA Instances (in a HA scenario)
- Configuring the operating system for SAP workload If a HA scenario is chosen, additionally
- Configuring SAP HANA System Replication (HSR)

- Configure SAP Netweaver ENQ Replication
- Configuring SUSE Linux Enterprise High Availability cluster components

2 The Fortinet Solutions

2.1 Fortigate

FortiGate NGFWs enable security-driven networking and consolidate industry-leading security capabilities such as intrusion prevention system (IPS), web filtering, secure sockets layer (SSL) inspection, and automated threat protection. This deployment contain a HA Cluster of two FortiGate Instances which provides Segmentation within the Hub network and provides 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 their public IP and credentials output by the terraform deployment.

Further Information on the configuration can be found within the 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)

2.2 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 their public IP and credentials output by the terraform deployment.

Further Information on the configuration can be found within the 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 Configuring the Cloud Shell

Start an Azure Cloud Shell simply from the top menu within Azure Portal. Its the small icon with the commandline prompt.

After its started the first time you can select between "Bash" and "Powershell". Please use "Bash"

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

4 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.

5 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. The SAP Media needs to be made available so it can 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 due to extracting it during the process
2. The uncompressed/extracted media are the fastest install, but more files are copied to the cloud share, which also takes time in forehand as preparation.

We use here in the example the compressed archives for the install (exe/RAR) as its the easiest 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

It depends on the used way to download the SAP media. If multiple compressed files are downloads, the official SAP extract tool `SAPCAR` tool must be used to extract the SAP media.

A extracted SAP Media can contain a lot of extracted files. Depending on your network speed, it can consume a lot of time to upload the extracted SAP media files. The CSP's infrastructure provide normally a good network speed, but if you have problems a way would be to create a workstation machine in the cloud to download/upload the SAP media.

Tip

It's a good practice to have the SAP Media versioned on the cloud share in order to build a library for automatic installs and (re)deployments. So think about you SAP media structure.

As an **example**, here how a full SAP Application media tree (in a compressed format) for a S/4HANA version 1809 install would 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
       |   ├igshelper_4-10010245.sar
       |   ├igsexe_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.
```

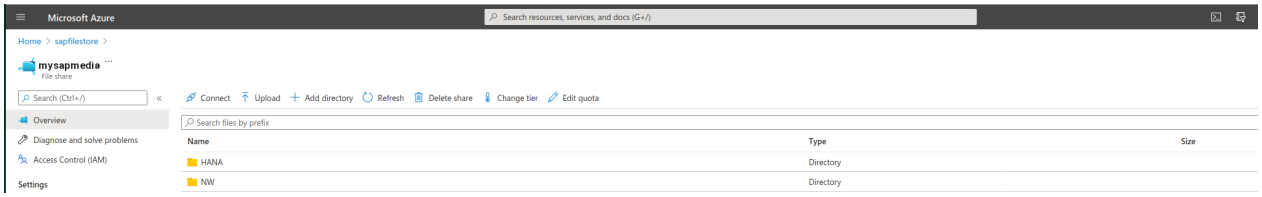
In the next steps we show as example a simple HANA install download.

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 folder within the Storage Account, for example "mysapmedia"
- Upload the SAP media files to the Storage Account

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



6 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/SUSE/Project-Mayerhofen.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
```

6.1 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:

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

A Terraform example template is provided. For a demo environment consisting of a simple SAP Szenario, 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 save 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 option possible, we will describe only one path which will setup the Fortinet appliances and a HANA HSR and a NW HA. 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 be 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.

Please 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. BUT if you want to use a BYOS image, you need to make sure that you provide the subscription key and email to register against SUSE Customer Center (SCC). This requires also that you have not blocked internet access in order 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 default created SSH keys:

```
# 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 need a Hub/Spoke network setup, please set the following

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

Please have a look at the other provided examples if you would like to use a existing hub/spoke network. 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 Jumphost server (Bastion Host Server) is enabled by default, and provide the public IP address to the database. Otherwise the deployed instances will all get a public ip

```
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_E4s_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" need to be set according to your settings of the file share you created before. e.g.

```
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, we need to set this parameter to true, otherwise only 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 as part of the deployment, find and uncomment the following:

```
monitoring_enabled = true
```

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

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

There is a similar set of variables needed for Netweaver as we had for HANA

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

The Netweaver product version which should be installed need to be set via product id Please have a look at the examples to pick the right one for your deployment

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

Again we need to 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/master"
```

And where the folders for the SAP installer are, relative to the mountpoint 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"]
```

In oder to additional deploy the fortinet services, remember we need to choose a HUB-SPOKE network scenario and enable the flag

```
fortinet_enabled=true
```

We need credentials for the fortinet applications too, please change it to your values

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

similar for the fortiadc system

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

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

If you want to use BYOL you need to copy the Fortinet license files into the directory

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

Here is a example tfvars file for a Fortinet deployment in the Hub, and a HA NW750 install with a 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
resource_group_hub_create = false
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 = "xxxxxxxx"
monitoring_enabled = true
drbd_enabled = true
netweaver_enabled = true
netweaver_app_server_count = 2
netweaver_master_password = "xxxxxxxx"
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    = "xxxxxxxxx"
fortiadc_vm_username    = "azureuser"
fortiadc_vm_password    = "xxxxxxxxx^"
```

7 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

8 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.

If successful, the output will be the public IP addresses for the cluster nodes like 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 = []
```

9 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

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