# **■** NetApp

## **Solution Automation**

**NetApp Solutions** 

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## **Solution Automation**

## **NetApp Solution Automation**

## Introduction

In providing solutions to meet today's business challenges, NetApp delivers solutions with the following goals:

- · Providing validated deployment and configuration steps,
- Providing solutions that are easily consumable,
- Providing solution deployment that has a predictable outcome, is easily repeated, and scalable across a customer's enterprise.

In order to achieve these goals, it is paramount that the deployment and configuration of infrastructure and/or applications delivered through our solutions is simplified through automation. NetApp is committed to simplifying solution consumption through automation.

Utilizing open-source automation tools such as Red Hat Ansible, HashiCorp Terraform, or Microsoft Powershell, NetApp solutions have the ability to automate application deployment, cloud provisioning, configuration management, and many other common IT tasks. NetApp's solutions take advantage of publicly available automation artifacts - as well as providing NetApp authored automation - to simplify the overall deployment of a solution.

Where automation capabilities are available, the solution collateral will guide the user through the process for automating the solution or solution steps via the specific automation tool(s).

## Getting Started with NetApp solution automation

NetApp solution automation provides simplicity and repeatability for many of the common tasks utilized by the NetApp Solutions.

Prior to running any solution automation, the environment must be configured for how the automation will be executed. There are options to run the automation from the command line or through a tool such as AWX or tower.

The following sections will outline the steps required to configure the environment for each of the specified environments.

#### Setup the Ansible Control Node for CLI deployments on RHEL / CentOS

- 1. Requirements for the Ansible control node,:
  - a. A RHEL/CentOS machine with the following packages installed:
    - i. Python3
    - ii. Pip3
    - iii. Ansible (version greater than 2.10.0)
    - iv. Git

If you have a fresh RHEL/CentOS machine without the above requirements installed, follow the below steps to setup that machine as the Ansible control node:

- 1. Enable the Ansible repository for RHEL-8/RHEL-7
  - a. For RHEL-8 (run the below command as root)

```
subscription-manager repos --enable ansible-2.9-for-rhel-8-
x86_64-rpms
```

b. For RHEL-7 (run the below command as root)

```
subscription-manager repos --enable rhel-7-server-ansible-2.9-rpms
```

2. Paste the below content in the Terminal

```
sudo yum -y install python3 >> install.log
sudo yum -y install python3-pip >> install.log
python3 -W ignore -m pip --disable-pip-version-check install ansible
>> install.log
sudo yum -y install git >> install.log
```

## Setup the Ansible Control Node for CLI deployments on Ubuntu / Debian

- 1. Requirements for the Ansible control node,:
  - a. A Ubuntu/Debian machine with the following packages installed:
    - i. Python3
    - ii. Pip3
    - iii. Ansible (version greater than 2.10.0)
    - iv. Git

If you have a fresh Ubuntu/Debian machine without the above requirements installed, follow the below steps to setup that machine as the Ansible control node:

1. Paste the below content in the terminal

```
sudo apt-get -y install python3 >> outputlog.txt
sudo apt-get -y install python3-pip >> outputlog.txt
python3 -W ignore -m pip --disable-pip-version-check install ansible
>> outputlog.txt
sudo apt-get -y install git >> outputlog.txt
```

#### Setup Ansible Tower or AWX for Tower / AWX deployments

This section describes the steps required to configure the parameters in AWX/Ansible Tower that prepare the environment for consuming NetApp automated solutions.

- 1. Configure the inventory.
  - a. Navigate to Resources → Inventories → Add and click Add Inventory.
  - b. Provide name and organization details and click Save.
  - c. In the Inventories page, click the inventory resources you just created.
  - d. If there are any inventory variables, paste them into the variables field.
  - e. Go to the Groups sub-menu and click Add.
  - f. Provide the name of the group, copy in the group variables (if necessary), and click Save.
  - g. Click the group created, go to the Hosts sub-menu and click Add New Host.
  - h. Provide the hostname and IP address of the host, paste in the host variables (if necessary), and click Save.
- 2. Create credential types. For solutions involving ONTAP, Element, VMware, or any other HTTPS-based transport connection, you must configure the credential type to match the username and password entries.
  - a. Navigate to Administration  $\rightarrow$  Credential Types and click Add.
  - b. Provide the name and description.
  - c. Paste the following content into the Input Configuration:

```
fields:
    - id: username
    type: string
label: Username
    - id: password
    type: string
label: Password
secret: true
    - id: vsadmin_password
    type: string
label: vsadmin_password
secret: true
```

a. Paste the following content into the Injector Configuration:

```
extra_vars:
password: '{{ password }}'
username: '{{ username }}'
vsadmin_password: '{{ vsadmin_password }}'
```

- 1. Configure credentials.
  - a. Navigate to Resources → Credentials and click Add.
  - b. Enter the name and organization details.
  - c. Select the correct credential type; if you intend to use the standard SSH login, select the type Machine or alternatively select the custom credential type that you created.
  - d. Enter the other corresponding details and click Save.
- 2. Configure the project.
  - a. Navigate to Resources → Projects and click Add.
  - b. Enter the name and organization details.
  - c. Select Git for the Source Control Credential Type.
  - d. Paste the source control URL (or git clone URL) corresponding to the specific solution.
  - e. Optionally, if the Git URL is access controlled, create and attach the corresponding credential in Source Control Credential.
  - f. Click Save.
- Configure the job template.
  - a. Navigate to Resources  $\rightarrow$  Templates  $\rightarrow$  Add and click Add Job Template.
  - b. Enter the name and description.
  - c. Select the Job type; Run configures the system based on a playbook and Check performs a dry run of the playbook without actually configuring the system.
  - d. Select the corresponding inventory, project, and credentials for the playbook.
  - e. Select the playbook that you would like to run as a part of the job template.
  - f. Usually the variables are pasted during runtime. Therefore, to get the prompt to populate the variables during runtime, make sure to tick the checkbox Prompt on Launch corresponding to the Variable field.
  - g. Provide any other details as required and click Save.
- 4. Launch the job template.
  - a. Navigate to Resources → Templates.
  - b. Click the desired template and then click Launch.
  - c. Fill in any variables if prompted on launch and then click Launch again.

## **NetApp Solution Automation**

## AWS Authentication Requirements for CVO and Connector Using NetApp Cloud Manager

To configure automated Deployments of CVO and Connectors using Ansible playbooks via AWX/Ansible Tower, the following information is needed:

#### **Acquiring Access/Secret Keys from AWS**

1. To deploy CVO and Connector in Cloud Manager, we need AWS Access/Secret Key. Acquire the keys in AWS console by launching IAM-→Users-→your username-→security credentials-→Create Access key.

2. Copy access keys and keep them secured to use in Connector and CVO deployment.



If you lose your key, you can create another access key and delete the one you lost



## **Acquiring Refresh Token from NetApp Cloud Central**

- 1. Login into your cloud central account using your account credentials at https://services.cloud.netapp.com/refresh-token
- 2. Generate a refresh Token and save it for deployments.



### **Acquiring Client ID**

- Access the API page to copy Client ID at https://services.cloud.netapp.com/developer-hub.
- 2. Click on "learn How to Authenticate", in the top right corner.
- 3. From the Authentication window that pops up, copy the Client ID from Regular Access if you require a username/password to login. Federated users with SSO should copy the client ID from the "Refresh Token Tab".



## **Acquiring Key Pair from AWS**

1. In AWS console, search for "Key Pair" and create a key pair with "pem". Remember the name of you key\_pair, we will use it to deploy the connector.



## **Acquiring Account ID**

1. In Cloud Manager, click on Account -> Manage Accounts and then copy the account id for use in variables for AWX.



## **Cloud Volumes Automation via Terraform**

This solution documents the automated deployments of Cloud Volumes on AWS (CVO Single Node, CVO HA and FSX ONTAP) and Azure (CVO Single Node, CVO HA and ANF) using Terraform modules. The code can be found at https://github.com/NetApp/na\_cloud\_volumes\_automation

## **Pre-requisites**

- 1. Terraform >= 0.13
- 2. Cloud Manager Account
- 3. Cloud Provider Account AWS, Azure
- 4. Host machine (any OS supported by Terraform)

## **Provider documentation**

The documentation of Terraform provider for Cloud Manager is available at: https://registry.terraform.io/providers/NetApp/netapp-cloudmanager/latest/docs

### Controlling the provider version

Note that you can also control the provider version. This is controlled by a required\_providers block in your Terraform configuration.

The syntax is as follows:

```
terraform {
  required_providers {
    netapp-cloudmanager = {
      source = "NetApp/netapp-cloudmanager"
      version = "20.10.0"
      }
  }
}
```

Read more on provider version control.

## **Running Specific Modules**

AWS	

#### **CVO Single Node Deployment**

## Terraform configuration files for deployment of NetApp CVO (Single Node Instance) on AWS

This section contains various Terraform configuration files to deploy/configure single node NetApp CVO (Cloud Volumes ONTAP) on AWS (Amazon Web Services).

Terraform Documentation: https://registry.terraform.io/providers/NetApp/netapp-cloudmanager/latest/docs

#### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation/
```

c. Configure AWS credentials from the CLI.

aws configure

- AWS Access Key ID [None]: accesskey
- AWS Secret Access Key [None]: secretkey
- Default region name [None]: us-west-2
- Default output format [None]: json
- d. Update the variable values in vars/aws cvo single\_node\_deployment.tfvar



You can choose to deploy the connector by setting the variable "aws\_connector\_deploy\_bool" value to true/false.

e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

terraform init

f. Verify the terraform files using terraform validate command.

terraform validate

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.aws_sn" -var
-file="vars/aws_cvo_single_node_deployment.tfvars"
```

h. Run the deployment

```
terraform apply -target="module.aws_sn" -var
-file="vars/aws_cvo_single_node_deployment.tfvars"
```

To delete the deployment

terraform destroy

## Recipies:

Connector

Terraform variables for NetApp AWS connector instance for CVO deployment.

Name	Туре	Description
aws_connector_ deploy_bool	Bool	(Required) Check for Connector deployment.
aws_connector_ name	String	(Required) The name of the Cloud Manager Connector.
aws_connector_r egion	String	(Required) The region where the Cloud Manager Connector will be created.
aws_connector_k ey_name	String	(Required) The name of the key pair to use for the Connector instance.
aws_connector_c ompany	String	(Required) The name of the company of the user.
aws_connector_i nstance_type	String	(Required) The type of instance (for example, t3.xlarge). At least 4 CPU and 16 GB of memory are required.
aws_connector_s ubnet_id	String	(Required) The ID of the subnet for the instance.
aws_connector_s ecurity_group_id	String	(Required) The ID of the security group for the instance, multiple security groups can be provided separated by ','.
aws_connector_i am_instance_pro file_name	String	(Required) The name of the instance profile for the Connector.

Name	Туре	Description
aws_connector_a ccount_id	String	(Optional) The NetApp account ID that the Connector will be associated with. If not provided, Cloud Manager uses the first account. If no account exists, Cloud Manager creates a new account. You can find the account ID in the account tab of Cloud Manager at https://cloudmanager.netapp.com.
aws_connector_ public_ip_bool	Bool	(Optional) Indicates whether to associate a public IP address to the instance. If not provided, the association will be done based on the subnet's configuration.

Single Node Instance

Terraform variables for single NetApp CVO instance.

Name	Type	Description
cvo_name	String	(Required) The name of the Cloud Volumes ONTAP working environment.
cvo_region	String	(Required) The region where the working environment will be created.
cvo_subnet_id	String	(Required) The subnet id where the working environment will be created.
cvo_vpc_id	String	(Optional) The VPC ID where the working environment will be created. If this argument isn't provided, the VPC will be calculated by using the provided subnet ID.
cvo_svm_passw ord	String	(Required) The admin password for Cloud Volumes ONTAP.
cvo_writing_spee d_state	String	(Optional) The write speed setting for Cloud Volumes ONTAP: ['NORMAL','HIGH']. The default is 'NORMAL'.

### **CVO HA Deployment**

## Terraform configuration files for deployment of NetApp CVO (HA Pair) on AWS

This section contains various Terraform configuration files to deploy/configure NetApp CVO (Cloud Volumes ONTAP) in high availability pair on AWS (Amazon Web Services).

Terraform Documentation: https://registry.terraform.io/providers/NetApp/netapp-cloudmanager/latest/docs

### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation/
```

c. Configure AWS credentials from the CLI.

aws configure

- AWS Access Key ID [None]: accesskey
- AWS Secret Access Key [None]: secretkey
- Default region name [None]: us-west-2
- Default output format [None]: json
- d. Update the variable values in vars/aws\_cvo\_ha\_deployment.tfvars.



You can choose to deploy the connector by setting the variable "aws\_connector\_deploy\_bool" value to true/false.

e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

terraform init

f. Verify the terraform files using terraform validate command.

terraform validate

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.aws_ha" -var
-file="vars/aws_cvo_ha_deployment.tfvars"
```

h. Run the deployment

```
terraform apply -target="module.aws_ha" -var
-file="vars/aws_cvo_ha_deployment.tfvars"
```

To delete the deployment

terraform destroy

### Recipies:

## Connector

Terraform variables for NetApp AWS connector instance for CVO deployment.

Name	Туре	Description
aws_connector_ deploy_bool	Bool	(Required) Check for Connector deployment.
aws_connector_ name	String	(Required) The name of the Cloud Manager Connector.
aws_connector_r egion	String	(Required) The region where the Cloud Manager Connector will be created.
aws_connector_k ey_name	String	(Required) The name of the key pair to use for the Connector instance.
aws_connector_c ompany	String	(Required) The name of the company of the user.
aws_connector_i nstance_type	String	(Required) The type of instance (for example, t3.xlarge). At least 4 CPU and 16 GB of memory are required.
aws_connector_s ubnet_id	String	(Required) The ID of the subnet for the instance.
aws_connector_s ecurity_group_id	String	(Required) The ID of the security group for the instance, multiple security groups can be provided separated by ','.
aws_connector_i am_instance_pro file_name	String	(Required) The name of the instance profile for the Connector.
aws_connector_a ccount_id	String	(Optional) The NetApp account ID that the Connector will be associated with. If not provided, Cloud Manager uses the first account. If no account exists, Cloud Manager creates a new account. You can find the account ID in the account tab of Cloud Manager at https://cloudmanager.netapp.com.
aws_connector_ public_ip_bool	Bool	(Optional) Indicates whether to associate a public IP address to the instance. If not provided, the association will be done based on the subnet's configuration.

## HA Pair

Terraform variables for NetApp CVO instances in HA Pair.

Name	Type	Description
cvo_is_ha	Bool	(Optional) Indicate whether the working environment is an HA pair or not [true, false]. The default is false.
cvo_name	String	(Required) The name of the Cloud Volumes ONTAP working environment.
cvo_region	String	(Required) The region where the working environment will be created.

Name	Type	Description
cvo_node1_subn et_id	String	(Required) The subnet id where the first node will be created.
cvo_node2_subn et_id	String	(Required) The subnet id where the second node will be created.
cvo_vpc_id	String	(Optional) The VPC ID where the working environment will be created. If this argument isn't provided, the VPC will be calculated by using the provided subnet ID.
cvo_svm_passw ord	String	(Required) The admin password for Cloud Volumes ONTAP.
cvo_failover_mo de	String	(Optional) For HA, the failover mode for the HA pair: ['PrivatelP', 'FloatingIP']. 'PrivateIP' is for a single availability zone and 'FloatingIP' is for multiple availability zones.
cvo_mediator_su bnet_id	String	(Optional) For HA, the subnet ID of the mediator.
cvo_mediator_ke y_pair_name	String	(Optional) For HA, the key pair name for the mediator instance.
cvo_cluster_float ing_ip	String	(Optional) For HA FloatingIP, the cluster management floating IP address.
cvo_data_floatin g_ip	String	(Optional) For HA FloatingIP, the data floating IP address.
cvo_data_floatin g_ip2	String	(Optional) For HA FloatingIP, the data floating IP address.
cvo_svm_floatin g_ip	String	(Optional) For HA FloatingIP, the SVM management floating IP address.
cvo_route_table_ ids	List	(Optional) For HA FloatingIP, the list of route table IDs that will be updated with the floating IPs.

## **FSx Deployment**

## Terraform configuration files for deployment of NetApp ONTAP FSx on AWS

This section contains various Terraform configuration files to deploy/configure NetApp ONTAP FSx on AWS (Amazon Web Services).

Terraform Documentation: https://registry.terraform.io/providers/NetApp/netapp-cloudmanager/latest/docs

## **Procedure**

In order to run the template:

a. Clone the repository.

git clone
https://github.com/NetApp/na\_cloud\_volumes\_automation.git

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation/
```

c. Configure AWS credentials from the CLI.

aws configure

- AWS Access Key ID [None]: accesskey
- AWS Secret Access Key [None]: secretkey
- Default region name [None]: us-west-2
- Default output format [None]:
- d. Update the variable values in vars/aws\_fsx\_deployment.tfvars



You can choose to deploy the connector by setting the variable "aws connector deploy bool" value to true/false.

e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

terraform init

f. Verify the terraform files using terraform validate command.

terraform validate

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.aws_fsx" -var
-file="vars/aws_fsx_deployment.tfvars"
```

h. Run the deployment

```
terraform apply -target="module.aws_fsx" -var
-file="vars/aws_fsx_deployment.tfvars"
```

To delete the deployment

terraform destroy

## Recipes:

Connector

Terraform variables for NetApp AWS connector instance.

Name	Туре	Description
aws_connector_ deploy_bool	Bool	(Required) Check for Connector deployment.
aws_connector_ name	String	(Required) The name of the Cloud Manager Connector.
aws_connector_r egion	String	(Required) The region where the Cloud Manager Connector will be created.
aws_connector_k ey_name	String	(Required) The name of the key pair to use for the Connector instance.
aws_connector_company	String	(Required) The name of the company of the user.
aws_connector_i nstance_type	String	(Required) The type of instance (for example, t3.xlarge). At least 4 CPU and 16 GB of memory are required.
aws_connector_s ubnet_id	String	(Required) The ID of the subnet for the instance.
aws_connector_s ecurity_group_id	String	(Required) The ID of the security group for the instance, multiple security groups can be provided separated by ','.
aws_connector_i am_instance_pro file_name	String	(Required) The name of the instance profile for the Connector.
aws_connector_a ccount_id	String	(Optional) The NetApp account ID that the Connector will be associated with. If not provided, Cloud Manager uses the first account. If no account exists, Cloud Manager creates a new account. You can find the account ID in the account tab of Cloud Manager at https://cloudmanager.netapp.com.
aws_connector_ public_ip_bool	Bool	(Optional) Indicates whether to associate a public IP address to the instance. If not provided, the association will be done based on the subnet's configuration.

## FSx Instance

Terraform variables for NetApp ONTAP FSx instance.

Name	Type	Description
fsx_name	String	(Required) The name of the Cloud Volumes ONTAP working environment.
fsx_region	String	(Required) The region where the working environment will be created.
fsx_primary_sub net_id	String	(Required) The primary subnet id where the working environment will be created.

Name	Туре	Description
fsx_secondary_s ubnet_id	String	(Required) The secondary subnet id where the working environment will be created.
fsx_account_id	String	(Required) The NetApp account ID that the FSx instance will be associated with. If not provided, Cloud Manager uses the first account. If no account exists, Cloud Manager creates a new account. You can find the account ID in the account tab of Cloud Manager at https://cloudmanager.netapp.com.
fsx_workspace_i	String	(Required) The ID of the Cloud Manager workspace of working environment.
fsx_admin_pass word	String	(Required) The admin password for Cloud Volumes ONTAP.
fsx_throughput_ capacity	String	(Optional) capacity of the throughput.
fsx_storage_cap acity_size	String	(Optional) EBS volume size for the first data aggregate. For GB, the unit can be: [100 or 500]. For TB, the unit can be: [1,2,4,8,16]. The default is '1'
fsx_storage_cap acity_size_unit	String	(Optional) ['GB' or 'TB']. The default is 'TB'.
fsx_cloudmanag er_aws_credentia l_name	String	(Required) The name of the AWS Credentials account name.

Azure	

#### **ANF**

#### Terraform configuration files for deployment of ANF Volume on Azure

This section contains various Terraform configuration files to deploy/configure ANF (Azure Netapp Files) Volume on Azure.

Terraform Documentation: https://registry.terraform.io/providers/hashicorp/azurerm/latest/docs

#### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation
```

c. Login to your Azure CLI (Azure CLI must be installed).

```
az login
```

d. Update the variable values in vars/azure anf.tfvars.



You can choose to deploy the ANF volume using an existing vnet and subnet by setting the variable "vnet\_creation\_bool" and "subnet\_creation\_bool" value to false and supplying the "subnet\_id\_for\_anf\_vol". You can also set those values to true and create a new vnet and subnet in which case, the subnet ID will automatically be taken from the newly created subnet.

e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

```
terraform init
```

f. Verify the terraform files using terraform validate command.

```
terraform validate
```

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.anf" -var
-file="vars/azure_anf.tfvars"
```

## h. Run the deployment

```
terraform apply -target="module.anf" -var
-file="vars/azure_anf.tfvars"
```

## To delete the deployment

terraform destroy

## Recipies:

Single Node Instance

Terraform variables for single NetApp ANF Volume.

Name	Туре	Description
az_location	String	(Required) Specifies the supported Azure location where the resource exists. Changing this forces a new resource to be created.
az_prefix	String	(Required) The name of the resource group where the NetApp Volume should be created. Changing this forces a new resource to be created.
az_vnet_address _space	String	(Required) The address space to be used by the newly created vnet for ANF volume deployment.
az_subnet_addre ss_prefix	String	(Required) The subnet address prefix to be used by the newly created vnet for ANF volume deployment.
az_volume_path	String	(Required) A unique file path for the volume. Used when creating mount targets. Changing this forces a new resource to be created.
az_capacity_pool _size	Integer	(Required) Capacity Pool Size mentioned in TB.
az_vnet_creation _bool	Boolean	(Required) Set this boolean to true if you want to create a new vnet. Set it to false to use an existing vnet.
az_subnet_creati on_bool	Boolean	(Required) Set this boolean to true to create a new subnet. Set it to false to use an existing subnet.
az_subnet_id_for _anf_vol	String	(Required) Mention the subnet id in case you decide to use an existing subnet by setting subnet_creation_bool to true. If set to false, leave it at the default value.
az_netapp_pool_ service_level	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.

Name	Type	Description
az_netapp_vol_s ervice_level	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.
az_netapp_vol_p rotocol	String	(Optional) The target volume protocol expressed as a list. Supported single value include CIFS, NFSv3, or NFSv4.1. If argument is not defined it will default to NFSv3. Changing this forces a new resource to be created and data will be lost.
az_netapp_vol_s ecurity_style	String	(Optional) Volume security style, accepted values are <code>Unix</code> or <code>Ntfs</code> . If not provided, single-protocol volume is created defaulting to <code>Unix</code> if it is <code>NFSv3</code> or <code>NFSv4.1</code> volume, if <code>CIFS</code> , it will default to <code>Ntfs</code> . In a dual-protocol volume, if not provided, its value will be <code>Ntfs</code> .
az_netapp_vol_st orage_quota	String	(Required) The maximum Storage Quota allowed for a file system in Gigabytes.

#### **ANF Data Protection**

### Terraform configuration files for deployment of ANF Volume with Data Protection on Azure

This section contains various Terraform configuration files to deploy/configure ANF (Azure Netapp Files) Volume with Data Protection on Azure.

Terraform Documentation: https://registry.terraform.io/providers/hashicorp/azurerm/latest/docs

#### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation
```

c. Login to your Azure CLI (Azure CLI must be installed).

```
az login
```

d. Update the variable values in vars/azure\_anf\_data\_protection.tfvars.



You can choose to deploy the ANF volume using an existing vnet and subnet by setting the variable "vnet\_creation\_bool" and "subnet\_creation\_bool" value to false and supplying the "subnet\_id\_for\_anf\_vol". You can also set those values to true and create a new vnet and subnet in which case, the subnet ID will automatically be taken from the newly created subnet.

e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

terraform init

f. Verify the terraform files using terraform validate command.

terraform validate

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.anf_data_protection" -var
-file="vars/azure_anf_data_protection.tfvars"
```

h. Run the deployment

```
terraform apply -target="module.anf_data_protection" -var
-file="vars/azure_anf_data_protection.tfvars
```

To delete the deployment

terraform destroy

## Recipies:

ANF Data Protection

Terraform variables for single ANF Volume with data protection enabled.

Name	Type	Description
az_location	String	(Required) Specifies the supported Azure location where the resource exists. Changing this forces a new resource to be created.
az_alt_location	String	(Required) The Azure location where the secondary volume will be created
az_prefix	String	(Required) The name of the resource group where the NetApp Volume should be created. Changing this forces a new resource to be created.
az_vnet_primary _address_space	String	(Required) The address space to be used by the newly created vnet for ANF primary volume deployment.
az_vnet_seconda ry_address_spac e	String	(Required) The address space to be used by the newly created vnet for ANF secondary volume deployment.

Name	Туре	Description
az_subnet_prima ry_address_prefi x	String	(Required) The subnet address prefix to be used by the newly created vnet for ANF primary volume deployment.
az_subnet_secon dary_address_pr efix	String	(Required) The subnet address prefix to be used by the newly created vnet for ANF secondary volume deployment.
az_volume_path_ primary	String	(Required) A unique file path for the primary volume. Used when creating mount targets. Changing this forces a new resource to be created.
az_volume_path_ secondary	String	(Required) A unique file path for the secondary volume. Used when creating mount targets. Changing this forces a new resource to be created.
az_capacity_pool _size_primary	Integer	(Required) Capacity Pool Size mentioned in TB.
az_capacity_pool _size_secondary	Integer	(Required) Capacity Pool Size mentioned in TB.
az_vnet_primary _creation_bool	Boolean	(Required) Set this boolean to true if you want to create a new vnet for primary volume. Set it to false to use an existing vnet.
az_vnet_seconda ry_creation_bool	Boolean	(Required) Set this boolean to true if you want to create a new vnet for secondary volume. Set it to false to use an existing vnet.
az_subnet_prima ry_creation_bool	Boolean	(Required) Set this boolean to true to create a new subnet for primary volume. Set it to false to use an existing subnet.
az_subnet_secon dary_creation_bo ol	Boolean	(Required) Set this boolean to true to create a new subnet for secondary volume. Set it to false to use an existing subnet.
az_primary_subn et_id_for_anf_vol	String	(Required) Mention the subnet id in case you decide to use an existing subnet by setting subnet_primary_creation_bool to true. If set to false, leave it at the default value.
az_secondary_su bnet_id_for_anf_ vol	String	(Required) Mention the subnet id in case you decide to use an existing subnet by setting subnet_secondary_creation_bool to true. If set to false, leave it at the default value.
az_netapp_pool_ service_level_pri mary	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.
az_netapp_pool_ service_level_se condary	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.
az_netapp_vol_s ervice_level_prim ary	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.
az_netapp_vol_s ervice_level_sec ondary	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.

Name	Туре	Description
az_netapp_vol_p rotocol_primary	String	(Optional) The target volume protocol expressed as a list. Supported single value include CIFS, NFSv3, or NFSv4.1. If argument is not defined it will default to NFSv3. Changing this forces a new resource to be created and data will be lost.
az_netapp_vol_p rotocol_secondar y	•	(Optional) The target volume protocol expressed as a list. Supported single value include CIFS, NFSv3, or NFSv4.1. If argument is not defined it will default to NFSv3. Changing this forces a new resource to be created and data will be lost.
az_netapp_vol_st orage_quota_pri mary	String	(Required) The maximum Storage Quota allowed for a file system in Gigabytes.
az_netapp_vol_st orage_quota_sec ondary	•	(Required) The maximum Storage Quota allowed for a file system in Gigabytes.
az_dp_replicatio n_frequency	String	(Required) Replication frequency, supported values are 10minutes, hourly, daily, values are case sensitive.

#### **ANF Dual Protocol**

## Terraform configuration files for deployment of ANF Volume with dual protocol on Azure

This section contains various Terraform configuration files to deploy/configure ANF (Azure Netapp Files) Volume with dual protocol enabled on Azure.

Terraform Documentation: https://registry.terraform.io/providers/hashicorp/azurerm/latest/docs

### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation
```

c. Login to your Azure CLI (Azure CLI must be installed).

```
az login
```

d. Update the variable values in vars/azure\_anf\_dual\_protocol.tfvars.



You can choose to deploy the ANF volume using an existing vnet and subnet by setting the variable "vnet\_creation\_bool" and "subnet\_creation\_bool" value to false and supplying the "subnet\_id\_for\_anf\_vol". You can also set those values to true and create a new vnet and subnet in which case, the subnet ID will automatically be taken from the newly created subnet.

e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

terraform init

f. Verify the terraform files using terraform validate command.

terraform validate

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.anf_dual_protocol" -var
-file="vars/azure_anf_dual_protocol.tfvars"
```

h. Run the deployment

```
terraform apply -target="module.anf_dual_protocol" -var
-file="vars/azure anf dual protocol.tfvars"
```

To delete the deployment

terraform destroy

## Recipies:

Single Node Instance

Terraform variables for single ANF Volume with dual protocol enabled.

Name	Type	Description
az_location	String	(Required) Specifies the supported Azure location where the resource exists. Changing this forces a new resource to be created.
az_prefix	String	(Required) The name of the resource group where the NetApp Volume should be created. Changing this forces a new resource to be created.
az_vnet_address _space	String	(Required) The address space to be used by the newly created vnet for ANF volume deployment.

Name	Туре	Description
az_subnet_addre ss_prefix	String	(Required) The subnet address prefix to be used by the newly created vnet for ANF volume deployment.
az_volume_path	String	(Required) A unique file path for the volume. Used when creating mount targets. Changing this forces a new resource to be created.
az_capacity_pool _size	Integer	(Required) Capacity Pool Size mentioned in TB.
az_vnet_creation _bool	Boolean	(Required) Set this boolean to true if you want to create a new vnet. Set it to false to use an existing vnet.
az_subnet_creati on_bool	Boolean	(Required) Set this boolean to true to create a new subnet. Set it to false to use an existing subnet.
az_subnet_id_for _anf_vol	String	(Required) Mention the subnet id in case you decide to use an existing subnet by setting subnet_creation_bool to true. If set to false, leave it at the default value.
az_netapp_pool_ service_level	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.
az_netapp_vol_s ervice_level	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.
az_netapp_vol_p rotocol1	String	(Required) The target volume protocol expressed as a list. Supported single value include CIFS, NFSv3, or NFSv4.1. If argument is not defined it will default to NFSv3. Changing this forces a new resource to be created and data will be lost.
az_netapp_vol_p rotocol2	String	(Required) The target volume protocol expressed as a list. Supported single value include CIFS, NFSv3, or NFSv4.1. If argument is not defined it will default to NFSv3. Changing this forces a new resource to be created and data will be lost.
az_netapp_vol_st orage_quota	String	(Required) The maximum Storage Quota allowed for a file system in Gigabytes.
az_smb_server_u sername	String	(Required) Username to create ActiveDirectory object.
az_smb_server_p assword	String	(Required) User Password to create ActiveDirectory object.
az_smb_server_n ame	String	(Required) Server Name to create ActiveDirectory object.
az_smb_dns_ser vers	String	(Required) DNS Server IP to create ActiveDirectory object.

## **ANF Volume From Snapshot**

## Terraform configuration files for deployment of ANF Volume from Snapshot on Azure

This section contains various Terraform configuration files to deploy/configure ANF (Azure Netapp Files) Volume from Snapshot on Azure.

Terraform Documentation: https://registry.terraform.io/providers/hashicorp/azurerm/latest/docs

#### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
\verb"cd na_cloud_volumes_automation"
```

c. Login to your Azure CLI (Azure CLI must be installed).

az login

 $\label{eq:continuous_def} \textbf{d. Update the variable values in } \texttt{vars/azure\_anf\_volume\_from\_snapshot.tfvars}.$ 



You can choose to deploy the ANF volume using an existing vnet and subnet by setting the variable "vnet\_creation\_bool" and "subnet\_creation\_bool" value to false and supplying the "subnet\_id\_for\_anf\_vol". You can also set those values to true and create a new vnet and subnet in which case, the subnet ID will automatically be taken from the newly created subnet.

a. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

terraform init

b. Verify the terraform files using terraform validate command.

terraform validate

c. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.anf_volume_from_snapshot"
-var-file="vars/azure_anf_volume_from_snapshot.tfvars"
```

d. Run the deployment

terraform apply -target="module.anf\_volume\_from\_snapshot"
-var-file="vars/azure\_anf\_volume\_from\_snapshot.tfvars"

## To delete the deployment

terraform destroy

## Recipies:

Single Node Instance

Terraform variables for single ANF Volume using snapshot.

Name	Туре	Description
az_location	String	(Required) Specifies the supported Azure location where the resource exists. Changing this forces a new resource to be created.
az_prefix	String	(Required) The name of the resource group where the NetApp Volume should be created. Changing this forces a new resource to be created.
az_vnet_address _space	String	(Required) The address space to be used by the newly created vnet for ANF volume deployment.
az_subnet_addre ss_prefix	String	(Required) The subnet address prefix to be used by the newly created vnet for ANF volume deployment.
az_volume_path	String	(Required) A unique file path for the volume. Used when creating mount targets. Changing this forces a new resource to be created.
az_capacity_pool _size	Integer	(Required) Capacity Pool Size mentioned in TB.
az_vnet_creation _bool	Boolean	(Required) Set this boolean to true if you want to create a new vnet. Set it to false to use an existing vnet.
az_subnet_creati on_bool	Boolean	(Required) Set this boolean to true to create a new subnet. Set it to false to use an existing subnet.
az_subnet_id_for _anf_vol	String	(Required) Mention the subnet id in case you decide to use an existing subnet by setting subnet_creation_bool to true. If set to false, leave it at the default value.
az_netapp_pool_ service_level	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.
az_netapp_vol_s ervice_level	String	(Required) The target performance of the file system. Valid values include Premium, Standard, or Ultra.
az_netapp_vol_p rotocol	String	(Optional) The target volume protocol expressed as a list. Supported single value include CIFS, NFSv3, or NFSv4.1. If argument is not defined it will default to NFSv3. Changing this forces a new resource to be created and data will be lost.

Name	Type	Description
az_netapp_vol_st orage_quota	String	(Required) The maximum Storage Quota allowed for a file system in Gigabytes.
az_snapshot_id	String	(Required) Snapshot ID using which new ANF volume will be created.

## **CVO Single Node Deployment**

## Terraform configuration files for deployment of Single Node CVO on Azure

This section contains various Terraform configuration files to deploy/configure Single Node CVO (Cloud Volumes ONTAP) on Azure.

Terraform Documentation: https://registry.terraform.io/providers/NetApp/netapp-cloudmanager/latest/docs

#### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation
```

c. Login to your Azure CLI (Azure CLI must be installed).

```
az login
```

- d. Update the variables in vars\azure cvo single node deployment.tfvars.
- e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

```
terraform init
```

f. Verify the terraform files using terraform validate command.

```
terraform validate
```

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan
-target="module.az_cvo_single_node_deployment" -var
-file="vars\azure_cvo_single_node_deployment.tfvars"
```

## h. Run the deployment

```
terraform apply
-target="module.az_cvo_single_node_deployment" -var
-file="vars\azure_cvo_single_node_deployment.tfvars"
```

## To delete the deployment

terraform destroy

## Recipies:

Single Node Instance

Terraform variables for single node Cloud Volumes ONTAP (CVO).

Name	Туре	Description
refresh_token	String	(Required) The refresh token of NetApp cloud manager. This can be generated from netapp Cloud Central.
az_connector_na me	String	(Required) The name of the Cloud Manager Connector.
az_connector_lo cation	String	(Required) The location where the Cloud Manager Connector will be created.
az_connector_su bscription_id	String	(Required) The ID of the Azure subscription.
az_connector_co mpany	String	(Required) The name of the company of the user.
az_connector_re source_group	Integer	(Required) The resource group in Azure where the resources will be created.
az_connector_su bnet_id	String	(Required) The name of the subnet for the virtual machine.
az_connector_vn et_id	String	(Required) The name of the virtual network.
az_connector_ne twork_security_g roup_name	String	(Required) The name of the security group for the instance.

Name	Туре	Description
az_connector_as sociate_public_ip _address	String	(Required) Indicates whether to associate the public IP address to the virtual machine.
az_connector_ac count_id	String	(Required) The NetApp account ID that the Connector will be associated with. If not provided, Cloud Manager uses the first account. If no account exists, Cloud Manager creates a new account. You can find the account ID in the account tab of Cloud Manager at <a href="https://cloudmanager.netapp.com">https://cloudmanager.netapp.com</a> .
az_connector_ad min_password	String	(Required) The password for the Connector.
az_connector_ad min_username	String	(Required) The user name for the Connector.
az_cvo_name	String	(Required) The name of the Cloud Volumes ONTAP working environment.
az_cvo_location	String	(Required) The location where the working environment will be created.
az_cvo_subnet_i d	String	(Required) The name of the subnet for the Cloud Volumes ONTAP system.
az_cvo_vnet_id	String	(Required) The name of the virtual network.
az_cvo_vnet_res ource_group	String	(Required) The resource group in Azure associated to the virtual network.
az_cvo_data_enc ryption_type	String	(Required) The type of encryption to use for the working environment: [AZURE, NONE]. The default is AZURE.
az_cvo_storage_t ype	String	(Required) The type of storage for the first data aggregate:  [Premium_LRS, Standard_LRS, StandardSSD_LRS]. The default is Premium_LRS
az_cvo_svm_pas sword	String	(Required) The admin password for Cloud Volumes ONTAP.
az_cvo_workspa ce_id	String	(Required) The ID of the Cloud Manager workspace where you want to deploy Cloud Volumes ONTAP. If not provided, Cloud Manager uses the first workspace. You can find the ID from the Workspace tab on https://cloudmanager.netapp.com.
az_cvo_capacity _tier	String	(Required) Whether to enable data tiering for the first data aggregate: [Blob, NONE]. The default is BLOB.
az_cvo_writing_s peed_state	String	(Required) The write speed setting for Cloud Volumes ONTAP: [NORMAL, HIGH]. The default is NORMAL. This argument is not relevant for HA pairs.
az_cvo_ontap_ve rsion	String	(Required) The required ONTAP version. Ignored if 'use_latest_version' is set to true. The default is to use the latest version.

Name	Туре	Description
az_cvo_instance _type	String	(Required) The type of instance to use, which depends on the license type you chose: Explore:[Standard_DS3_v2], Standard:[Standard_DS4_v2, Standard_DS13_v2, Standard_L 8s_v2], Premium:[Standard_DS5_v2, Standard_DS14_v2], BYOL: all instance types defined for PayGo. For more supported instance types, refer to Cloud Volumes ONTAP Release Notes. The default is Standard_DS4_v2.
az_cvo_license_t ype	String	(Required) The type of license to be use. For single node: [azure-cot-explore-paygo, azure-cot-standard-paygo, azure-cot-premium-paygo, azure-cot-premium-byol, capacity-paygo]. For HA: [azure-ha-cot-standard-paygo, azure-ha-cot-premium-paygo, azure-ha-cot-premium-byol, ha-capacity-paygo]. The default is azure-cot-standard-paygo. Use capacity-paygo or ha-capacity-paygo for HA on selecting Bring Your Own License type Capacity-Based or Freemium. Use azure-cot-premium-byol or azure-ha-cot-premium-byol for HA on selecting Bring Your Own License type Node-Based.
az_cvo_nss_acc ount	String	(Required) he NetApp Support Site account ID to use with this Cloud Volumes ONTAP system. If the license type is BYOL and an NSS account isn't provided, Cloud Manager tries to use the first existing NSS account.
az_tenant_id	String	(Required) Tenant ID of the application/service principal registered in Azure.
az_application_id	String	(Required) Application ID of the application/service principal registered in Azure.
az_application_k ey	String	(Required) The Application Key of the application/service principal registered in Azure.

## **CVO HA Deployment**

## Terraform configuration files for deployment of CVO HA on Azure

This section contains various Terraform configuration files to deploy/configure CVO (Cloud Volumes ONTAP) HA (High Availability) on Azure.

Terraform Documentation: https://registry.terraform.io/providers/NetApp/netapp-cloudmanager/latest/docs

### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na cloud volumes automation
```

c. Login to your Azure CLI (Azure CLI must be installed).

az login

- d. Update the variables in vars\azure\_cvo\_ha\_deployment.tfvars.
- e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

terraform init

f. Verify the terraform files using terraform validate command.

terraform validate

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.az_cvo_ha_deployment" -var
-file="vars\azure_cvo_ha_deployment.tfvars"
```

h. Run the deployment

```
terraform apply -target="module.az_cvo_ha_deployment" -var
-file="vars\azure_cvo_ha_deployment.tfvars"
```

To delete the deployment

terraform destroy

## Recipies:

HA Pair Instance

Terraform variables for HA pair Cloud Volumes ONTAP (CVO).

Name	Type	Description
refresh_token	String	(Required) The refresh token of NetApp cloud manager. This can be generated from netapp Cloud Central.

Name	Туре	Description
az_connector_na me	String	(Required) The name of the Cloud Manager Connector.
az_connector_lo cation	String	(Required) The location where the Cloud Manager Connector will be created.
az_connector_su bscription_id	String	(Required) The ID of the Azure subscription.
az_connector_co mpany	String	(Required) The name of the company of the user.
az_connector_re source_group	Integer	(Required) The resource group in Azure where the resources will be created.
az_connector_su bnet_id	String	(Required) The name of the subnet for the virtual machine.
az_connector_vn et_id	String	(Required) The name of the virtual network.
az_connector_ne twork_security_g roup_name	String	(Required) The name of the security group for the instance.
az_connector_as sociate_public_ip _address	String	(Required) Indicates whether to associate the public IP address to the virtual machine.
az_connector_ac count_id	String	(Required) The NetApp account ID that the Connector will be associated with. If not provided, Cloud Manager uses the first account. If no account exists, Cloud Manager creates a new account. You can find the account ID in the account tab of Cloud Manager at https://cloudmanager.netapp.com.
az_connector_ad min_password	String	(Required) The password for the Connector.
az_connector_ad min_username	String	(Required) The user name for the Connector.
az_cvo_name	String	(Required) The name of the Cloud Volumes ONTAP working environment.
az_cvo_location	String	(Required) The location where the working environment will be created.
az_cvo_subnet_i d	String	(Required) The name of the subnet for the Cloud Volumes ONTAP system.
az_cvo_vnet_id	String	(Required) The name of the virtual network.
az_cvo_vnet_res ource_group	String	(Required) The resource group in Azure associated to the virtual network.
az_cvo_data_enc ryption_type	String	(Required) The type of encryption to use for the working environment: [AZURE, NONE]. The default is AZURE.

Name	Туре	Description
az_cvo_storage_t ype	String	(Required) The type of storage for the first data aggregate: [Premium_LRS, Standard_LRS, StandardSSD_LRS]. The default is Premium_LRS
az_cvo_svm_pas sword	String	(Required) The admin password for Cloud Volumes ONTAP.
az_cvo_workspa ce_id	String	(Required) The ID of the Cloud Manager workspace where you want to deploy Cloud Volumes ONTAP. If not provided, Cloud Manager uses the first workspace. You can find the ID from the Workspace tab on https://cloudmanager.netapp.com.
az_cvo_capacity _tier	String	(Required) Whether to enable data tiering for the first data aggregate $[{\tt Blob}, {\tt NONE}]$ . The default is ${\tt BLOB}$ .
az_cvo_writing_s peed_state	String	(Required) The write speed setting for Cloud Volumes ONTAP: [NORMAL, HIGH]. The default is NORMAL. This argument is not relevant for HA pairs.
az_cvo_ontap_ve rsion	String	(Required) The required ONTAP version. Ignored if 'use_latest_version' is set to true. The default is to use the latest version.
az_cvo_instance _type	String	(Required) The type of instance to use, which depends on the license type you chose: Explore:[Standard_DS3_v2], Standard:[Standard_DS4_v2, Standard_DS13_v2, Standard_L8s_v2], Premium:[Standard_DS5_v2, Standard_DS14_v2], BYOL: all instance types defined for PayGo. For more supported instance types, refer to Cloud Volumes ONTAP Release Notes. The default is Standard_DS4_v2.
az_cvo_license_t ype	String	(Required) The type of license to be use. For single node: [azure-cot-explore-paygo, azure-cot-standard-paygo, azure-cot-premium-paygo, azure-cot-premium-byol, capacity-paygo]. For HA: [azure-ha-cot-standard-paygo, azure-ha-cot-premium-paygo, azure-ha-cot-premium-byol, ha-capacity-paygo]. The default is azure-cot-standard-paygo. Use capacity-paygo or ha-capacity-paygo for HA on selecting Bring Your Own License type Capacity-Based or Freemium. Use azure-cot-premium-byol or azure-ha-cot-premium-byol for HA on selecting Bring Your Own License type Node-Based.
az_cvo_nss_acc ount	String	(Required) he NetApp Support Site account ID to use with this Cloud Volumes ONTAP system. If the license type is BYOL and an NSS account isn't provided, Cloud Manager tries to use the first existing NSS account.
az_tenant_id	String	(Required) Tenant ID of the application/service principal registered in Azure.
az_application_id	String	(Required) Application ID of the application/service principal registered in Azure.
az_application_k ey	String	(Required) The Application Key of the application/service principal registered in Azure.

GCP	

## **CVO Single Node Deployment**

## Terraform configuration files for deployment of NetApp CVO (Single Node Instance) on GCP

This section contains various Terraform configuration files to deploy/configure single node NetApp CVO (Cloud Volumes ONTAP) on GCP (Google Cloud Platform).

Terraform Documentation: https://registry.terraform.io/providers/NetApp/netapp-cloudmanager/latest/docs

#### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation/
```

- c. Save the GCP authentication key JSON file in the directory.
- d. Update the variable values in vars/gcp cvo single node deployment.tfvar
  - $\bigcirc$

You can choose to deploy the connector by setting the variable "gcp\_connector\_deploy\_bool" value to true/false.

e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

```
terraform init
```

f. Verify the terraform files using terraform validate command.

```
terraform validate
```

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.gco_single_node" -var
-file="vars/gcp cvo single node deployment.tfvars"
```

h. Run the deployment

terraform apply -target="module.gcp\_single\_node" -var
-file="vars/gcp\_cvo\_single\_node\_deployment.tfvars"

# To delete the deployment

terraform destroy

# Recipies:

Connector

Terraform variables for NetApp GCP connector instance for CVO deployment.

Name	Туре	Description
gcp_connector_d eploy_bool	Bool	(Required) Check for Connector deployment.
gcp_connector_n ame	String	(Required) The name of the Cloud Manager Connector.
gcp_connector_p roject_id	String	(Required) The GCP project_id where the connector will be created.
gcp_connector_z one	String	(Required) The GCP zone where the Connector will be created.
gcp_connector_c ompany	String	(Required) The name of the company of the user.
gcp_connector_s ervice_account_e mail	_	(Required) The email of the service_account for the connector instance. This service account is used to allow the Connector to create Cloud Volume ONTAP.
gcp_connector_s ervice_account_ path	String	(Required) The local path of the service_account JSON file for GCP authorization purposes. This service account is used to create the Connector in GCP.
gcp_connector_a ccount_id	String	(Optional) The NetApp account ID that the Connector will be associated with. If not provided, Cloud Manager uses the first account. If no account exists, Cloud Manager creates a new account. You can find the account ID in the account tab of Cloud Manager at https://cloudmanager.netapp.com.

Single Node Instance

Terraform variables for single NetApp CVO instance on GCP.

Name	Type	Description
gcp_cvo_name	String	(Required) The name of the Cloud Volumes ONTAP working environment.

Name	Туре	Description
gcp_cvo_project _id	String	(Required) The ID of the GCP project.
gcp_cvo_zone	String	(Required) The zone of the region where the working environment will be created.
gcp_cvo_gcp_se rvice_account	String	(Required) The gcp_service_account email in order to enable tiering of cold data to Google Cloud Storage.
gcp_cvo_svm_pa ssword	String	(Required) The admin password for Cloud Volumes ONTAP.
gcp_cvo_worksp ace_id	String	(Optional) The ID of the Cloud Manager workspace where you want to deploy Cloud Volumes ONTAP. If not provided, Cloud Manager uses the first workspace. You can find the ID from the Workspace tab on https://cloudmanager.netapp.com.
gcp_cvo_license _type	String	(Optional) The type of license to use. For single node: ['capacity-paygo', 'gcp-cot-explore-paygo', 'gcp-cot-standard-paygo', 'gcp-cot-premium-paygo', 'gcp-cot-premium-byol'], For HA: ['ha-capacity-paygo', 'gcp-ha-cot-explore-paygo', 'gcp-ha-cot-standard-paygo', 'gcp-ha-cot-premium-paygo', 'gcp-ha-cot-premium-byol']. The default is 'capacity-paygo' for single node, and 'ha-capacity-paygo' for HA.
gcp_cvo_capacit y_package_name	String	(Optional) The capacity package name: ['Essential', 'Professional', 'Freemium']. Default is 'Essential'.

# **CVO HA Deployment**

# Terraform configuration files for deployment of NetApp CVO (HA Pair) on GCP

This section contains various Terraform configuration files to deploy/configure NetApp CVO (Cloud Volumes ONTAP) in high availability pair on GCP (Google Cloud Platform).

Terraform Documentation: https://registry.terraform.io/providers/NetApp/netapp-cloudmanager/latest/docs

#### **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation/
```

- c. Save the GCP authentication key JSON file in the directory.
- d. Update the variable values in vars/gcp\_cvo\_ha\_deployment.tfvars.



You can choose to deploy the connector by setting the variable "gcp connector deploy bool" value to true/false.

e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

terraform init

f. Verify the terraform files using terraform validate command.

terraform validate

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.gcp_ha" -var
-file="vars/gcp_cvo_ha_deployment.tfvars"
```

h. Run the deployment

```
terraform apply -target="module.gcp_ha" -var
-file="vars/gcp_cvo_ha_deployment.tfvars"
```

To delete the deployment

terraform destroy

## Recipies:

Connector

Terraform variables for NetApp GCP connector instance for CVO deployment.

Name	Type	Description
gcp_connector_deploy_bool	Bool	(Required) Check for Connector deployment.
gcp_connector_n ame	String	(Required) The name of the Cloud Manager Connector.
gcp_connector_p roject_id	String	(Required) The GCP project_id where the connector will be created.
gcp_connector_z	String	(Required) The GCP zone where the Connector will be created.

Name T	Туре	Description
gcp_connector_c Sompany	String	(Required) The name of the company of the user.
gcp_connector_s S ervice_account_e mail	String	(Required) The email of the service_account for the connector instance. This service account is used to allow the Connector to create Cloud Volume ONTAP.
gcp_connector_s S ervice_account_ path	String	(Required) The local path of the service_account JSON file for GCP authorization purposes. This service account is used to create the Connector in GCP.
gcp_connector_a S ccount_id	String	(Optional) The NetApp account ID that the Connector will be associated with. If not provided, Cloud Manager uses the first account. If no account exists, Cloud Manager creates a new account. You can find the account ID in the account tab of Cloud Manager at <a href="https://cloudmanager.netapp.com">https://cloudmanager.netapp.com</a> .

HA Pair

Terraform variables for NetApp CVO instances in HA Pair on GCP.

Name	Туре	Description
gcp_cvo_is_ha	Bool	(Optional) Indicate whether the working environment is an HA pair or not [true, false]. The default is false.
gcp_cvo_name	String	(Required) The name of the Cloud Volumes ONTAP working environment.
gcp_cvo_project _id	String	(Required) The ID of the GCP project.
gcp_cvo_zone	String	(Required) The zone of the region where the working environment will be created.
gcp_cvo_node1_ zone	String	(Optional) Zone for node 1.
gcp_cvo_node2_ zone	String	(Optional) Zone for node 2.
gcp_cvo_mediat or_zone	String	(Optional) Zone for mediator.
gcp_cvo_vpc_id	String	(Optional) The name of the VPC.
gcp_cvo_subnet _id	String	(Optional) The name of the subnet for Cloud Volumes ONTAP. The default is: 'default'.
gcp_cvo_vpc0_n ode_and_data_c onnectivity	String	(Optional) VPC path for nic1, required for node and data connectivity. If using shared VPC, netwrok_project_id must be provided.
gcp_cvo_vpc1_cl uster_connectivit y	String	(Optional) VPC path for nic2, required for cluster connectivity.

Name	Туре	Description
gcp_cvo_vpc2_h a_connectivity	String	(Optional) VPC path for nic3, required for HA connectivity.
gcp_cvo_vpc3_d ata_replication	String	(Optional) VPC path for nic4, required for data replication.
gcp_cvo_subnet 0_node_and_dat a_connectivity	String	(Optional) Subnet path for nic1, required for node and data connectivity. If using shared VPC, netwrok_project_id must be provided.
gcp_cvo_subnet 1_cluster_conne ctivity	String	(Optional) Subnet path for nic2, required for cluster connectivity.
gcp_cvo_subnet 2_ha_connectivit y	String	(Optional) Subnet path for nic3, required for HA connectivity.
gcp_cvo_subnet 3_data_replicatio n	String	(Optional) Subnet path for nic4, required for data replication.
gcp_cvo_gcp_se rvice_account	String	(Required) The gcp_service_account email in order to enable tiering of cold data to Google Cloud Storage.
gcp_cvo_svm_pa ssword	String	(Required) The admin password for Cloud Volumes ONTAP.
gcp_cvo_worksp ace_id	String	(Optional) The ID of the Cloud Manager workspace where you want to deploy Cloud Volumes ONTAP. If not provided, Cloud Manager uses the first workspace. You can find the ID from the Workspace tab on https://cloudmanager.netapp.com.
gcp_cvo_license _type	String	(Optional) The type of license to use. For single node: ['capacity-paygo', 'gcp-cot-explore-paygo', 'gcp-cot-standard-paygo', 'gcp-cot-premium-paygo', 'gcp-cot-premium-byol'], For HA: ['ha-capacity-paygo', 'gcp-ha-cot-explore-paygo', 'gcp-ha-cot-standard-paygo', 'gcp-ha-cot-premium-paygo', 'gcp-ha-cot-premium-byol']. The default is 'capacity-paygo' for single node, and 'ha-capacity-paygo' for HA.
gcp_cvo_capacit y_package_name	String	(Optional) The capacity package name: ['Essential', 'Professional', 'Freemium']. Default is 'Essential'.
gcp_cvo_gcp_vol ume_size	String	(Optional) The GCP volume size for the first data aggregate. For GB, the unit can be: [100 or 500]. For TB, the unit can be: [1,2,4,8]. The default is '1' .
gcp_cvo_gcp_vol ume_size_unit	String	(Optional) ['GB' or 'TB']. The default is 'TB'.

# **CVS Volume**

# Terraform configuration files for deployment of NetApp CVS Volume on GCP

This section contains various Terraform configuration files to deploy/configure NetApp CVS (Cloud Volumes Services) Volume on GCP (Google Cloud Platform).

Terraform Documentation: https://registry.terraform.io/providers/NetApp/netapp-gcp/latest/docs

## **Procedure**

In order to run the template:

a. Clone the repository.

```
git clone
https://github.com/NetApp/na_cloud_volumes_automation.git
```

b. Navigate to the desired folder

```
cd na_cloud_volumes_automation/
```

- c. Save the GCP authentication key JSON file in the directory.
- d. Update the variable values in vars/gcp cvs volume.tfvars.
- e. Initialize the Terraform repository to install all the pre-requisites and prepare for deployment.

```
terraform init
```

f. Verify the terraform files using terraform validate command.

```
terraform validate
```

g. Make a dry run of the configuration to get a preview of all the changes expected by the deployment.

```
terraform plan -target="module.gcp_cvs_volume" -var
-file="vars/gcp_cvs_volume.tfvars"
```

h. Run the deployment

```
terraform apply -target="module.gcp_cvs_volume" -var
-file="vars/gcp_cvs_volume.tfvars"
```

To delete the deployment

```
terraform destroy
```

## Recipies:

CVS Volume

Name	Туре	Description
gcp_cvs_name	String	(Required) The name of the NetApp CVS volume.
gcp_cvs_project _id	String	(Required) The GCP project_id where the CVS Volume will be created.
gcp_cvs_gcp_ser vice_account_pat h	String	(Required) The local path of the service_account JSON file for GCP authorization purposes. This service account is used to create the CVS Volume in GCP.
gcp_cvs_region	String	(Required) The GCP zone where the CVS Volume will be created.
gcp_cvs_network	String	(Required) The network VPC of the volume.
gcp_cvs_size	Integer	(Required) The size of volume is between 1024 to 102400 inclusive (in GiB).
gcp_cvs_volume _path	String	(Optional) The name of the volume path for volume.
gcp_cvs_protoco I_types	String	(Required) The protocol_type of the volume. For NFS use 'NFSv3' or 'NFSv4' and for SMB use 'CIFS' or 'SMB'.

# FSx for ONTAP Monitoring and Auto-Resizing using AWS Lambda Function

# Overview: Monitoring and Auto-Resizing FSx for ONTAP via AWS Lambda function

FSx for ONTAP is a first-party enterprise-grade cloud storage service available on AWS that provides highly reliable, scalable, high-performing and feature-rich file storage built on the popular NetApp ONTAP file system.

FSx for ONTAP provides a seamless deployment and management experience. No storage expertise is required to get started. To simplify monitoring, an AWS lambda function (to automate resizing of total storage capacity, volume size or LUN size based on threshold) can be used. This document provides a step-by-step guide to creating an automated setup that monitors FSx for ONTAP at regular intervals, notifies and resizes when a user-specified threshold is crossed and notifies the administrator of the resizing activity.

#### **Features**

The solution provides the following features:

- Ability to monitor:
  - Usage of overall Storage Capacity of FSx for ONTAP
  - Usage of each volume (thin provisioned / thick provisioned)
  - Usage of each LUN (thin provisioned / thick provisioned)
- · Ability to resize any of the above when a user-defined threshold is breached
- · Alerting mechanism to receive usage warnings and resizing notifications via email
- · Ability to delete snapshots older than the user-defined threshold
- · Ability to get a list of FlexClone volumes and snapshots associated
- · Ability to monitor the checks at a regular interval
- · Ability to use the solution with or without internet access
- · Ability to deploy manually or using AWS CloudFormation Template
- Ability to monitor multiple FSx for ONTAP filesystems in a single VPC

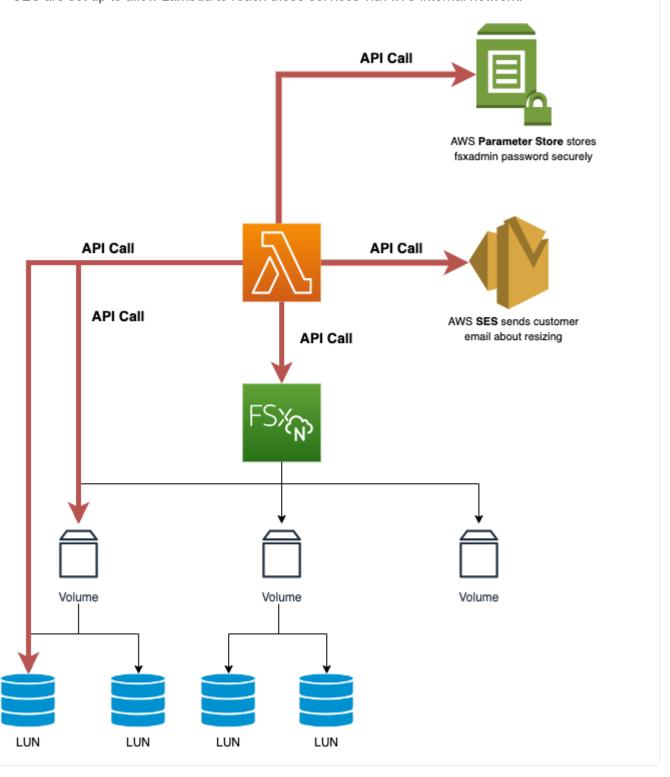
## **Pre-requisites**

Before you begin, ensure that the following prerequisites are met:

- · FSx for ONTAP is deployed
- · Private subnet with connectivity to FSx for ONTAP
- "fsxadmin" password has been set for FSx for ONTAP

## **High-Level Architecture**

- AWS Lambda Function makes API calls to FSx for ONTAP for retrieving and updating the size of Storage Capacity, Volumes and LUNs.
- "fsxadmin" password stored as secure string in AWS SSM Parameter Store for an added layer of security.
- AWS SES (Simple Email Service) is used to notify end-users when a resizing event occurs.
- If deploying the solution in a VPC without internet access, VPC Endpoints for AWS SSM, FSx and SES are set up to allow Lambda to reach these services via AWS internal network.



# **Solution Deployment**

# **Automated Deployment**



Covers single FSx for ONTAP filesystem.

Follow the series of steps to complete the automated deployment of this solution:

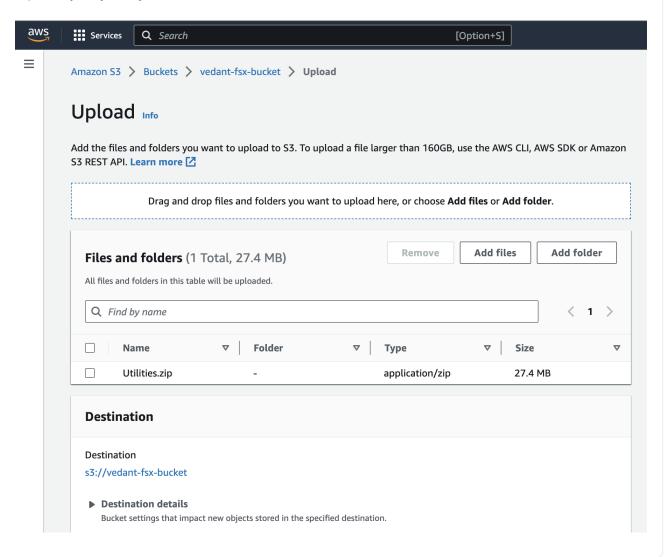
# **Step 1: Clone the GitHub repository**

Clone the GitHub repository on your local system:

git clone https://github.com/NetApp/fsxn-monitoring-auto-resizing.git

## Step 2: Setup an AWS S3 bucket

- 1. Navigate to AWS Console > **S3** and click on **Create bucket**. Create the bucket with the default settings.
- 2. Once inside the bucket, click on **Upload > Add files** and select **Utilities.zip** from the cloned GitHub repository on your system.



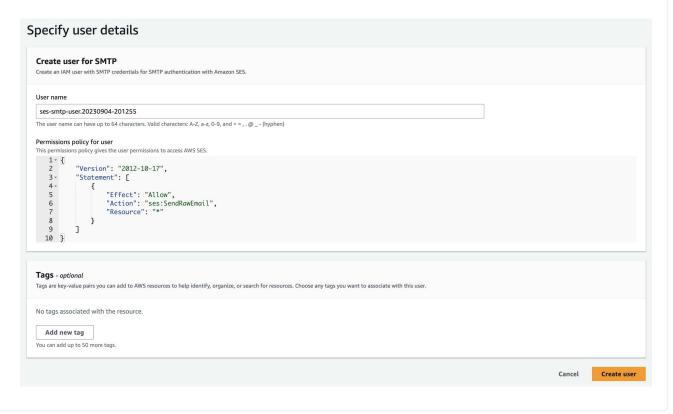
## Step 3: AWS SES SMTP Setup (required if no internet access available)

Follow this step if you want to deploy the solution without internet access (Note: There will be added costs associated with VPC endpoints being set up.)

- 1. Navigate to AWS Console > AWS Simple Email Service (SES) > SMTP Settings and click on Create SMTP credentials
- 2. Enter an IAM User Name or leave it at the default value and click on **Create User**. Save the **SMTP** user name and **SMTP** password for further use.



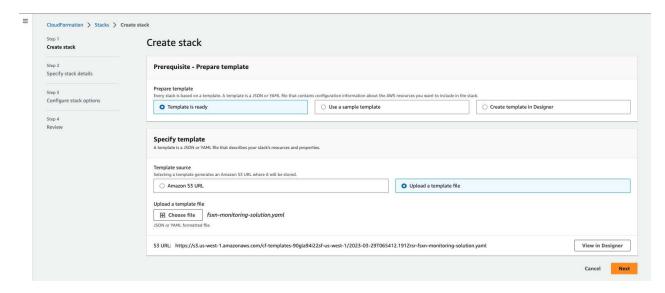
Skip this step if SES SMTP setup is already in place.



## **Step 4: AWS CloudFormation Deployment**

1. Navigate to AWS Console > CloudFormation > Create stack > With New Resources (Standard).

Prepare template: Template is ready
Specify template: Upload a template file
Choose file: Browse to the cloned GitHub repo and select fsxnmonitoring-solution.yaml

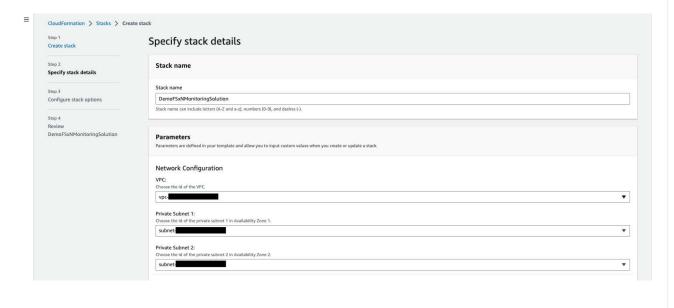


## Click on Next

2. Enter the stack details. Click on Next and check the checkbox for "I acknowledge that AWS CloudFormation might create IAM resources" and click on Submit.



If "Does VPC have internet access?" is set to False, "SMTP Username for AWS SES" and "SMTP Password for AWS SES" are required. Otherwise, they can be left empty.



FSx for ONTAP Configuration Management IP address

Enter the "Management endpoint - IP address" from the FSx for ONTAP console on AWS. 10.10.10.10 File System ID em ID\* from the FSx for ONTAP console on AWS. ONTAP Administrator Username

Enter the FSx for ONTAP "ONTAP administrator username" from FSx for ONTAP console on AWS. Resize Threshold (%) Enter the threshold percentage from 0-100. This threshold will be used to measure Storage Capacity, Volume and LUN usage and when the % use of any increases above this threshold, resize activity will occur. 90 **Enable Warning Notifications** Snapshot Age Threshold for Deletion (No. of Days) 30 General Configuration S3 Bucket Name Enter the name of the S3 Bucket wi True Does SSM VPC Endpoint already exist for the selected VPC?

If internet access is not available, set this variable to True if the VPC Endpoint for SSM already exists in the VPC. Set to False otherwise Does FSx VPC Endpoint already exist for the selected VPC?
If internet access is not available, set this variable to True lif the VPC Endpoint for FSx already exists in the VPC. Set to False otherwine. False Does SES VPC Endpoint already exist for the selected VPC?

If internal access is not available, set this variable to True if the VPC Endpoint for SES already exists in the VPC. Set to False otherwise False SMTP Username for AWS SES le, enter the smtp username for AWS SES. Enter String abc@xyz.com Receiver Email ID

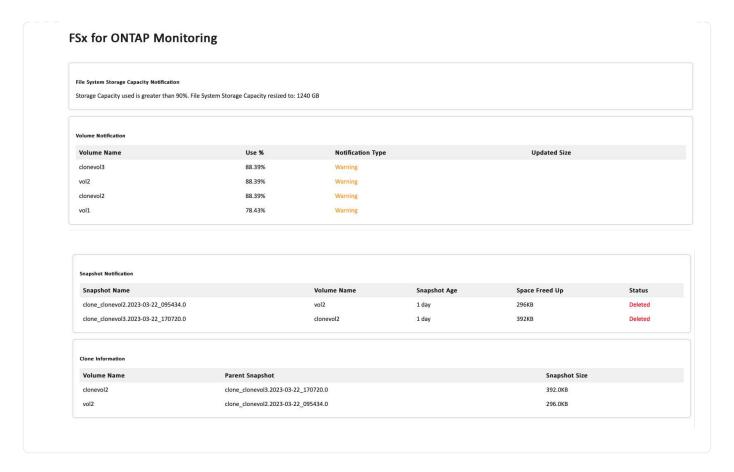
Enter the email ID on which you want to receive the alert notifications. abc@xyz.com Schedule Expression for frequency of running the solution

3. Once the CloudFormation deployment starts, the email ID mentioned in the "sender email ID" will get an email asking them to authorize the use of the email address with AWS SES. Click on the link to verify the email address.

rate(1 day)

4. Once the CloudFormation stack deployment is completed, if there are any warnings/notifications, an email will be sent to the recipient email ID with the notification details.

Cancel Previous Next



# **Manual Deployment**



Supports monitoring multiple FSx for ONTAP filesystems in a single VPC.

Follow the series of steps to complete the manual deployment of this solution:

# Step 1: Clone the GitHub repository

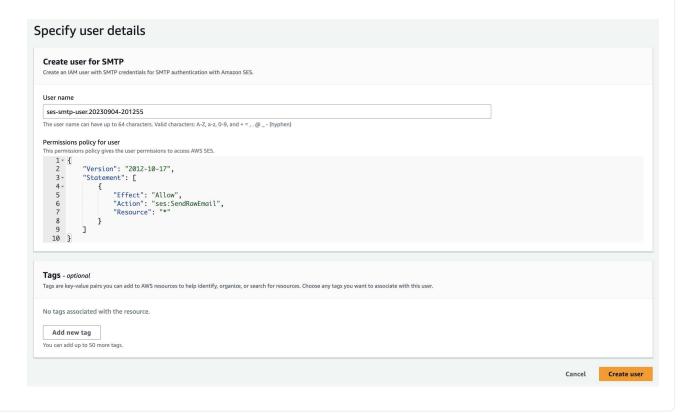
Clone the GitHub repository on your local system:

git clone https://github.com/NetApp/fsxn-monitoring-auto-resizing.git

## Step 2: AWS SES SMTP Setup (required if no internet access available)

Follow this step if you want to deploy the solution without internet access (Note: There will be added costs associated with VPC endpoints being set up.)

- Navigate to AWS Console > AWS Simple Email Service (SES) > SMTP Settings and click on Create SMTP credentials
- 2. Enter an IAM User Name or leave it at the default value and click on Create. Save the username and password for further use.



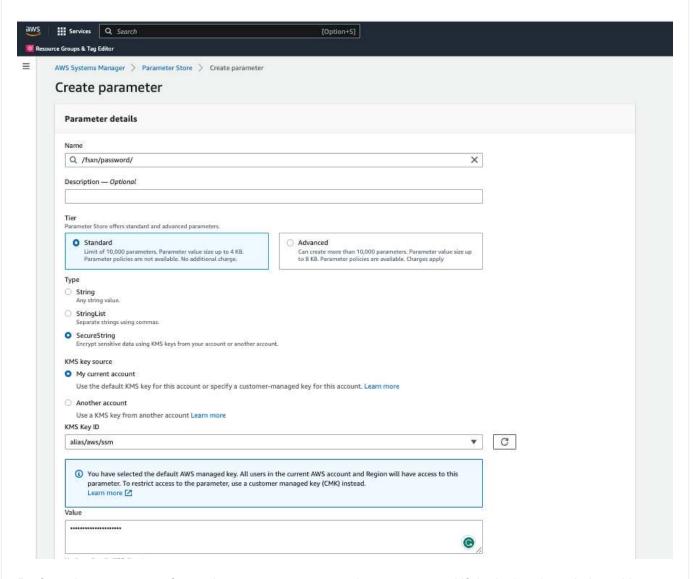
## Step 3: Create SSM parameter for fsxadmin password

Navigate to AWS Console > Parameter Store and click on Create Parameter.

```
Name: <Any name/path for storing fsxadmin password>
Tier: Standard
Type: SecureString
KMS key source: My current account
   KMS Key ID: <Use the default one selected>
Value: <Enter the password for "fsxadmin" user configured on FSx for ONTAP>
```

## Click on Create parameter.

Repeat the above steps for all FSx for ONTAP filesystems to be monitored.



Perform the same steps for storing smtp username and smtp password if deploying the solution without internet access. Otherwise, skip adding these 2 parameters.

# Step 4: Setup Email Service

Navigate to AWS Console > Simple Email Service (SES) and click on Create Identity.

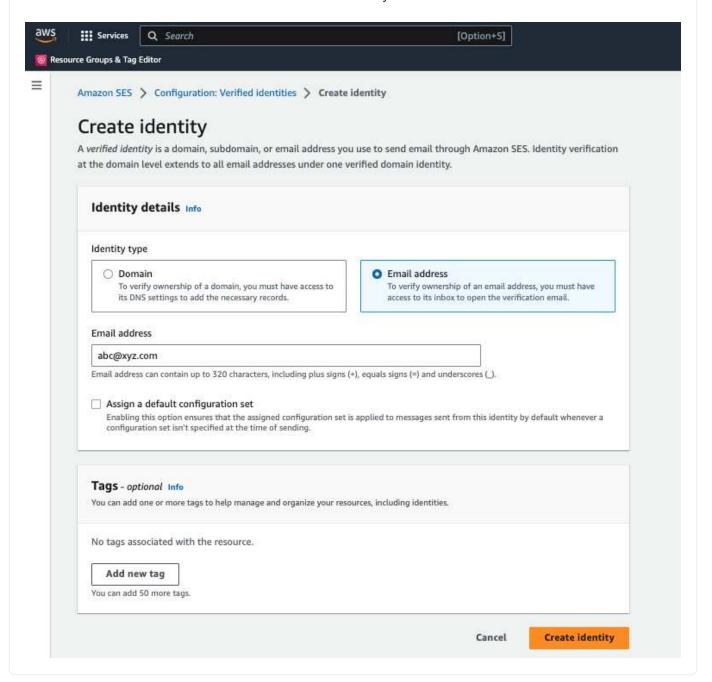
Identity type: Email address

Email address: <Enter an email address to be used for sending resizing

notifications>

## Click on Create identity

The email ID mentioned in the "sender email ID" will get an email asking the owner to authorize the use of the email address with AWS SES. Click on the link to verify the email address.





Required only if deployed without internet access. There will be additional costs associated with VPC endpoints.

1. Navigate to AWS Console > **VPC** > **Endpoints** and click on **Create Endpoint** and enter the following details:

Name: <Any name for the vpc endpoint>

Service category: AWS Services

Services: com.amazonaws.<region>.fsx

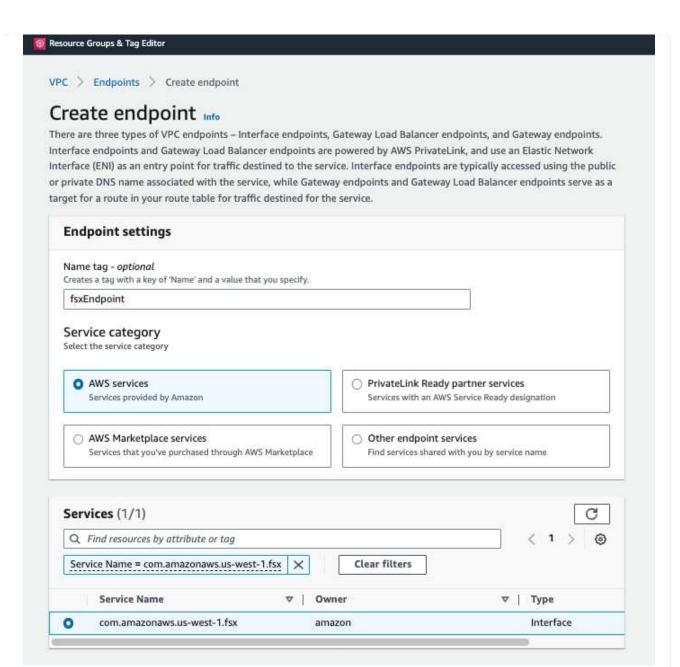
vpc: <select the vpc where lambda will be deployed>

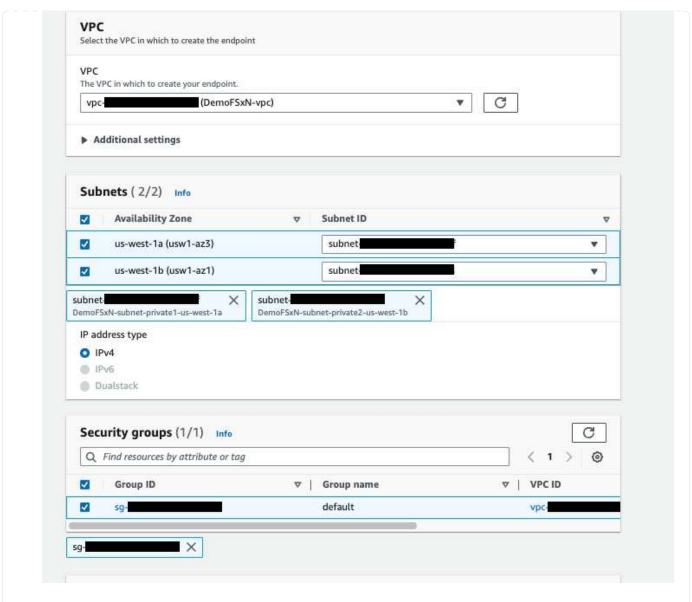
subnets: <select the subnets where lambda will be deployed>

Security groups: <select the security group>

Policy: <Either choose Full access or set your own custom policy>

Click on Create endpoint.





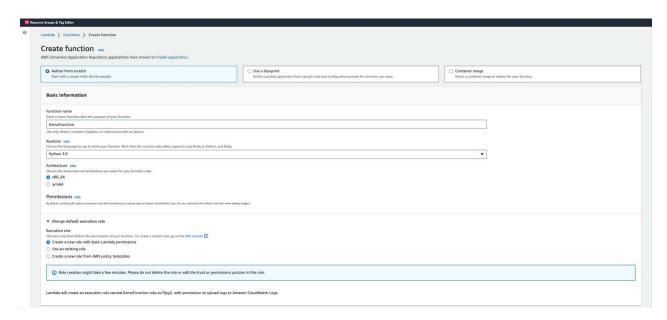
2. Follow the same process for creating SES and SSM VPC endpoints. All parameters remain the same as above except Services which will correspond to **com.amazonaws.<region>.smtp** and **com.amazonaws.<region>.ssm** respectively.

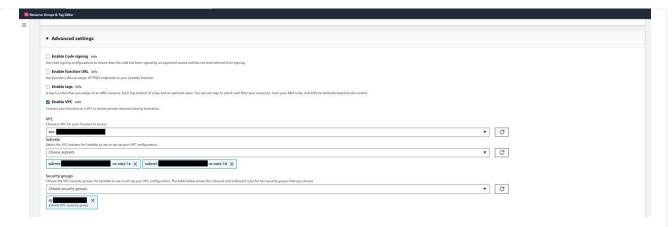
## Step 6: Create and setup the AWS Lambda Function

- Navigate to AWS Console > AWS Lambda > Functions and click on Create function in the same region as FSx for ONTAP
- 2. Use the default **Author from scratch** and update the following fields:

Function name: <Any name of your choice>
Runtime: Python 3.9
Architecture: x86\_64
Permissions: Select "Create a new role with basic Lambda permissions"
Advanced Settings:
Enable VPC: Checked
 VPC: <Choose either the same VPC as FSx for ONTAP or a VPC that can access both FSx for ONTAP and the internet via a private subnet>
 Subnets: <Choose 2 private subnets that have NAT gateway attached pointing to public subnets with internet gateway and subnets that have internet access>
 Security Group: <Choose a Security Group>

#### Click on Create function.

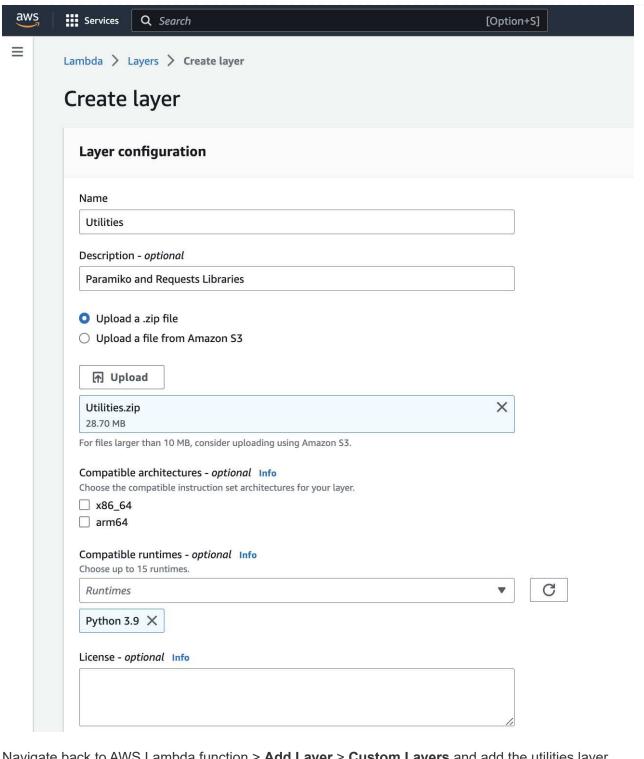




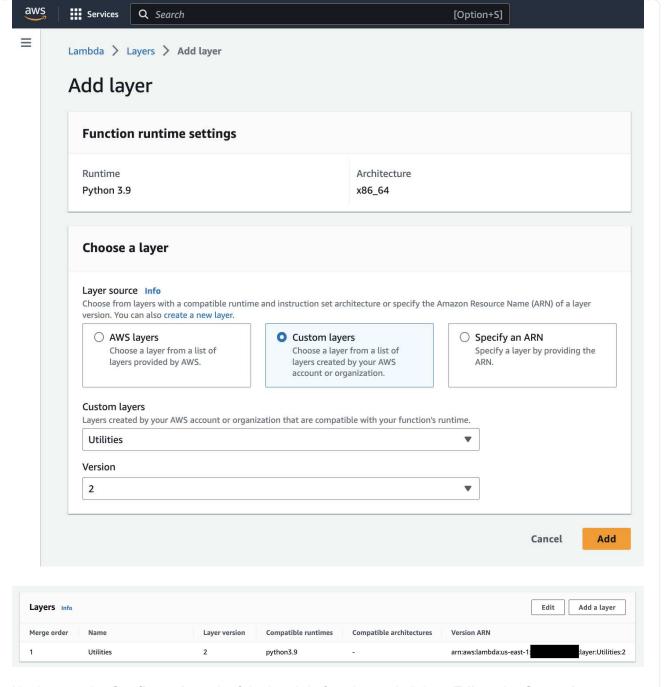
3. Navigate to the newly created Lambda function > Scroll down to the **Layers** section and click on **Add** a **layer**.



- 4. Click on create a new layer under Layer source
- 5. Create a Layer and upload **Utilities.zip** file. Select **Python 3.9** as the compatible runtime and click on **Create**.



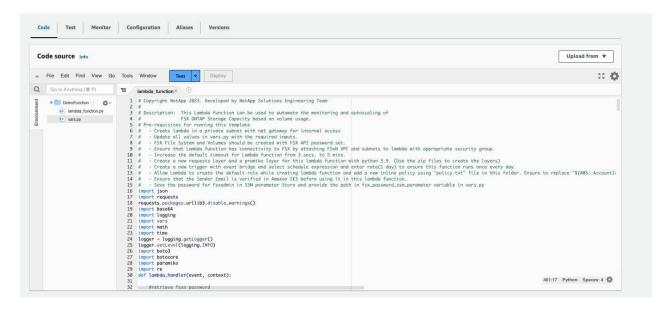
6. Navigate back to AWS Lambda function > Add Layer > Custom Layers and add the utilities layer.



- 7. Navigate to the **Configuration** tab of the Lambda function and click on **Edit** under **General Configuration**. Change the Timeout to **5 mins** and click **Save**.
- 8. Navigate to **Permissions** tab of the Lambda function and click on the role assigned. In the permissions tab of the role, click on **Add permissions** > **Create Inline policy**.
  - a. Click on the JSON tab and paste the contents of the file policy.json from the GitHub repo.
  - b. Replace every occurrence of \${AWS::AccountId} with your account ID and click on Review Policy
  - c. Provide a Name for the policy and click on Create policy
- 9. Copy the contents of **fsxn\_monitoring\_resizing\_lambda.py** from the git repo to **lambda\_function.py** in the AWS Lambda function Code Source section.
- 10. Create a new file in the same level as lambda\_function.py and name it vars.py and copy the contents of vars.py from the git repo to the lambda function vars.py file. Update the variable values in vars.py. Reference variable definitions below and click on **Deploy**:

Name	Туре	Description
fsxList	List	(Required) List of all FSx for ONTAP filesystems to be monitored. Include all the file systems in the list for monitoring and autoresizing.
fsxMgmtlp	String	(Required) Enter the "Management endpoint - IP address" from the FSx for ONTAP console on AWS.
fsxld	String	(Required) Enter the "File system ID" from the FSx for ONTAP console on AWS.
username	String	(Required) Enter the FSx for ONTAP "ONTAP administrator username" from FSx for ONTAP console on AWS.
resize_threshold	Integer	(Required) Enter the threshold percentage from 0-100. This threshold will be used to measure Storage Capacity, Volume and LUN usage and when the % use of any increases above this threshold, resize activity will occur.
fsx_password_ssm_paramete r	String	(Required) Enter the path name used in AWS Parameter Store for storing "fsxadmin" password.
warn_notification	Bool	(Required) Set this variable to True to receive a notification when Storage Capacity/Volume/LUN usage exceeds 75% but is less than the threshold.
enable_snapshot_deletion	Bool	(Required) Set this variable to True to enable volume level snapshot deletion for snapshots older than the value specified in "snapshot_age_threshold_in_days".
snapshot_age_threshold_in_d ays	Integer	(Required) Enter the number of days of volume level snapshots you want to retain. Any snapshots older than the value provided will be deleted and the same will be notified via email.

internet_access	Bool	(Required) Set this variable to True if internet access is available from the subnet where this lambda is deployed. Otherwise set it to False.
smtp_region	String	(Optional) If "internet_access" variable is set to False, enter the region in which lambda is deployed. E.g. us-east-1 (in this format)
smtp_username_ssm_parame ter	String	(Optional) If "internet_access" variable is set to False, enter the path name used in AWS Parameter Store for storing the SMTP username.
smtp_password_ssm_parame ter	String	(Optional) If "internet_access" variable is set to False, enter the path name used in AWS Parameter Store for storing the SMTP password.
sender_email	String	(Required) Enter the email ID registered on SES that will be used by the lambda function to send notification alerts related to monitoring and resizing.
recipient_email	String	(Required) Enter the email ID on which you want to receive the alert notifications.



- 11. Click on **Test**, create a test event with an empty JSON object and run the test by clicking **Invoke** to check if the script is running properly.
- 12. Once tested successfully, navigate to Configuration > Triggers > Add Trigger.

Select a Source: EventBridge Rule: Create a new rule Rule name: <Enter any name> Rule type: Schedule expression Schedule expression: <Use "rate(1 day)" if you want the function to run daily or add your own cron expression> Click on Add. Resource Groups & Tag Editor  $\equiv$ Lambda > Add trigger Add trigger Trigger configuration Info EventBridge (CloudWatch Events) aws events management-tools Pick an existing rule, or create a new one. Create a new rule Existing rules Enter a name to uniquely identify your rule. DemoFSxNRule Rule description Provide an optional description for your rule. Rule type Trigger your target based on an event pattern, or based on an automated schedule. O Event pattern Schedule expression Schedule expression Self-trigger your target on an automated schedule using Cron or rate expressions. Cron expressions are in UTC. rate(1 day)

# Conclusion

e.g. rate(1 day), cron(0 17 ? \* MON-FRI \*)

With the provided solution, it is easy to set up a monitoring solution that regularly monitors FSx for ONTAP Storage, resizes it based on a user-specified threshold and provides an alerting mechanism. This makes the process of using and monitoring FSx for ONTAP seamless freeing up administrators to focus on business-critical activities while storage grows automatically when required.

Lambda will add the necessary permissions for Amazon EventBridge (CloudWatch Events) to invoke your Lambda

function from this trigger. Learn more about the Lambda permissions model.

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