

Technical Report

Demostrating Ansible in Lab On Demand

Louis Pauls and Yaron Regev, NetApp  
August 2019

TABLE OF CONTENTS

[1 Introduction 3](#_Toc17989941)

[2 Setting Up the Demo Environment 3](#_Toc17989942)

[3 Ansible Ad-hoc Commands 4](#_Toc17989943)

[4 Using Ansible Playbooks 5](#_Toc17989944)

[4.1 Configuring *cluster1* using the Ansible Playbook 6](#_Toc17989945)

[4.2 The Idempotent Nature of Ansible 7](#_Toc17989946)

[4.3 Using Ansible to Deploy Trident 8](#_Toc17989947)

[5 Using Ansible with NetApp Roles 9](#_Toc17989948)

[5.1 Configuring *cluster1* using the Ansible Playbook and NetApp Roles 11](#_Toc17989949)

[Appendix A: Alternative Method to Installing Ansible 12](#_Toc17989950)

[Appendix B: Configuration Files Used in the Demo 12](#_Toc17989951)

# Introduction

Ansible is an open-source automation engine which can greatly improve consistency, scalability and reliability of an hybrid-cloud environment. Ansible is primarily used for three types of tasks: configuration management (modify the configuration files across many hosts, switches, cloud providers, etc.), application deployment, especially in the Devops world (automating the deployment of applications); and provisioning (i.e. setting up servers/compute instances/storage arrays/switches etc. as part of initial deployment). Ansible can automate many tasks across many environment – traditional bare metal servers, virtualization platforms, or the cloud. If it has an API available, Ansible can automate tasks on the instance. Ansible was acquired by Red Hat in 2015. In additional to the open-source free version of Ansible, there is also a commercial version available (called Ansible Tower). Red Hat Ansible Tower provides a visual dashboard as well as other enterprise features like RBAC, job scheduling, a powerful notifivation engine, as well as a inventory management engine. There is also an upstream version of Tower available free to download named AWX. AWX is the open-source equivelant of Tower, but it is not supported by Red Hat and therefore should not be used in production environments (it is community supported). Features that are added to AWX through community contributions typically makes itself into Tower at some point.

As part of this exercise we will use the command line open-source version of Ansible. It is easily installable through native Linux/UNIX tools, as will be seen in the excercises.

There are many other competitors to Ansiblie in the Configuration Management space, most noteably Puppet and Chef. One of the major differentiators between Ansible and the other products is that Ansible is a based on a push architecture, and does therefore not require client software to be installed on the infrastructure it manages. It simply uses sh and Ansible modules to access the assets it’s task to manage.

Ansible modules, which will be discussed in detail later, is key to the architecture of Ansible. Ansible modules essentially do all the heavy lifting – it executes the code on the environment, using parameters passed to the modules from an Ansible playbook, in doing so abstracting the user from the underlying complexities. Red Hat introduced an Ansible Certification program in 2018, and NetApp was one of 6 companies that participated in this program since initiation (the only data management company).

Vendors that are part of this program submits their modules to Red Hat and Red Hat then tests, certifies and supports these modules. This is very important to bring up when having an Ansible conversation with customers. The NetApp modules are supported by Red Hat. For a list of all vendors that are members of this certification program please follow this [link](https://www.ansible.com/certified-partners).

# Setting Up the Demo Environment

The instructions provided in this section will work with Lab on Demand (LOD) lab “**Exploring the ONTAP REST API v1.0**”. If you are trying to use Ansible with a different LOD lab and the instructions do not work, see appendix A for an alternative way to deploy Ansible. Log into the Linux server you want to install Ansible on using PuTTY. In most LOD environments that will be *rhel1* with username *root* and password *Netapp1!*

1. Using git, download the lab files we will be using throughout the demo. Do this by typing the following commands:

[root@rhel1 ~]# **cd ~/**  
[root@rhel1 ~]# **git clone https://github.com/louispauls/ansible**

1. Install Ansible by typing the following command:

[root@rhel1 ~]# **yum install ansible -y**

1. Since Ansible modules are written in Python, in order to use the NetApp ONTAP modules we need to install the ONTAP python library. Do this by typing the following command:

[root@rhel1 ~]# **pip install netapp-lib**

1. The final step in configuring Ansible is to copy the hosts file (the file that contains the host names of the systems we want to access using Ansible) into the Ansible directory:

[root@rhel1 ~]# **mv ansible/lod/hosts /etc/ansible/**

when prompted, respond “y” to overwrite the existing (default) host file.

# Ansible Ad-hoc Commands

We can (and will later in this exercise) use *ansible* to configure the cluster. But before we do that, let’s look at some very basic functionality of *ansible* by executing some commands in an ad-hoc fashion on the two RedHat hosts *rhel1* and *rhel2*.

As an example, let’s use *ansible* to ask the question what version of *docker* is installed on the host *rhel1*:

[root@rhel1 ~]# **ansible rhel1 –a “docker –-version”**

**Note:** *ansible* uses *sh* to execute commands on hosts, and the first time one uses a remote sh command it will prompt for authentication (assuming public/private ssh key authentication is configured). Type *yes* when prompted. You will get a message that the host has been added to the lists of known hosts. You should see the response

**rhel1 | CHANGED | rc=0 >>**

**Docker version 17.05.0-ce, build 89658be**

Do the same for the *rhel2*, **so on the *rhel1* putty session** type the command:

[root@rhel1 ~]# **ansible rhel2 –a “docker –-version”**

and type “yes” (if prompted). This will now show the version of *docker* running on *rhel2* by using *ansible* installed on *rhel1.*

As part of setting up the demo environment the hosts file was copied to */etc/ansible*. In this file one can configure groups of hosts and pass the group name to *ansible* (as opposed to the host names as we’ve done in the examples above). The groups are defined in the */etc/ansible/hosts* file (and it was defined as part of the pre-configure step above). The */etc/ansible/hosts* file in our example looks like this:

[prod]

rhel1

rhel2

It defines a single group called prod that has as members the two hosts rhel1 and rhel2. To check the versions of docker running on these hosts using a single ansible command, simply execute:

[root@rhel1 ~]# **ansible prod –a “docker ––version”**

and the result is shown for both hosts in one output. It is easy to see how this can save one a tremendous amount of time when configuring (in this case) hosts. To scale, one can simply add more members to the *prod* group in */etc/ansible/hosts*, or add more groups (e.g. *web-servers*, *dev, oracle*) and execute commands on these *hosts* individually or on the *groups* or on *all* which will execute the command on all hosts in the hosts file.

As an exercise, go ahead and execute the following commands on the two hosts in prod:

df –h to see the file systems on each of the hosts

uname –a returns some system information on each host

Hint: execute the command *ansible prod –a “<command>”* in the putty session (replace <command> with the commands above, one at a time).

One can also use *ansible* to install software on hosts. Let’s assume we want to pull down the *docker* image *ubuntu* from the *docker hub*. To do so, simply execute the command:

[root@rhel1 ~]# **ansible prod –a “docker image pull ubuntu”**

and to verify the image is pulled down, execute:

[root@rhel1 ~]# **ansible prod –a “docker image ls”**

The ubuntu docker image should now be residing on both hosts in the group prod (sample output below):

**rhel2 | CHANGED | rc=0 >>**

**REPOSITORY TAG IMAGE ID CREATED SIZE**

**ubuntu latest a2a15febcdf3 2 weeks ago 64.2MB**

**rhel1 | CHANGED | rc=0 >>**

**REPOSITORY TAG IMAGE ID CREATED SIZE**

**ubuntu latest a2a15febcdf3 2 weeks ago 64.2MB**

# Using Ansible Playbooks

The question now becomes how does one execute many commands on a host (or a switch, or on a cloud object, or on a NetApp ONTAP, Santricity or Element instance) without typing the commands in one-by-one in an ad-hoc fashion as above? This is where the concept of an ***ansible* *playbook*** comes in. A playbook is simply a combination of tasks, and each task calls an *ansible* module. So as an example, to configure the NetApp cluster *cluster1*, one can execute an *ansible* playbook that will create aggregates, create SVMs, create LIFs, configure NFS etc.

The file *configure\_ontap\_playbook.yml* (in the *ansible/lod* folder on *rhel1*)is an ansible playbook that does exactly that, and more. Let’s look at this file in some detail (use the command more configure\_ontap\_playbook.yml to look at the file if you like).



This playbook consists of two plays.

* The first play configures the ONTAP Cluster. It consists of eight tasks (Create Aggregates, Create SVM, etc.) These tasks will be executed in order, starting at the top.
* The second play in this playbook configures the hosts in the ansible group *prod* (which in our example consists of the hosts *rhel1* and *rhel2*). It will install NFS on the hosts in *prod* (first task), and then mount a NFS export (second task) which was created by the first play on the NetApp cluster.

Before we execute the playbook, let’s look at the task that creates the SVM in more detail:



This task calls the module [*na\_ontap\_svm*](https://docs.ansible.com/ansible/latest/modules/na_ontap_svm_module.html#na-ontap-svm-module) and passes variables (*state, name, root\_volume*, etc.) to it. Everything in the curly brackets {{…}} are variables defined in the file *variables.yml* in the *ansible/lod* folder on *rhel1*. A full list of all supported NetApp modules can be found [here](https://docs.ansible.com/ansible/latest/modules/list_of_storage_modules.html#netapp). Scroll on this page to see modules published by Pure, EMC and others (note that NetApp has over 100 supported modules, many more than any of our competitors). The [Ansible Module Index](https://docs.ansible.com/ansible/latest/modules/modules_by_category.html) lists all the modules published to RedHat (click on *Cloud modules* for instance to see a list of all the cloud provider modules - AWS, Azure, GCP, others).

## Configuring *cluster1* using the Ansible Playbook

In order to now execute the playbook that will configure and setup *cluster1* and mount an export to the hosts *rhel1* and *rhel2*, simply execute the following command in the Putty session on *rhel1* (from within the *ansible/lod* folder)

[root@rhel1 ~]# **cd ~/ansible/lod**  
[root@rhel1 ~]# **ansible-playbook configure\_ontap\_playbook.yml**

As soon as the command completes, log into *cluster1* using System Manager and verify that a SVM (SVM\_NFS) is created, aggregates are created, NFS is configured etc. Also verify that the NFS export is mounted to *rhel1* and *rhel2* (the playbook mounted the export to /mnt/tmp on both hosts in the group *prod*). Easiest way to do that is to execute the command *df –h* on both hosts (by using ansible) so:

[root@rhel1 ~]# **ansible prod –a “df –h /mnt/tmp”**

You should see an entry on each of the hosts pointing to the export on the *LIF 192.168.0.145* on *SVM\_NFS* on *cluster1*:

**192.168.0.145:/NfsDataVolume 973M 256K 973M 1% /mnt/tmp**

*Note that the playbook did not apply any of the protocol and feature licenses to the cluster (since the LOD instance already had them installed). However, one can simply add a task to the playbook to call the module* [*na\_ontap\_license*](https://docs.ansible.com/ansible/latest/modules/na_ontap_license_module.html#na-ontap-license-module) *to accomplish this. (The same holds for the assignment of the disks ([na\_ontap\_disks](https://docs.ansible.com/ansible/latest/modules/na_ontap_disks_module.html" \l "na-ontap-disks-module))).*

## The Idempotent Nature of Ansible

Idempotency, simply put is a feature of ansible that allows one to make the same call repeatedly to an object (host, NetApp cluster, etc.) while producing the same result. In other words, making multiple identical requests has the same effect as making a single request. **This is a very powerful feature!** One can run the playbook *configure\_ontap\_playbook.yml* again and again, and it won’t fail second time around. Executing a script for instance to create an aggregate that already exists will fail with a message saying that the aggregate by that name already exists. But ansible being idempotent will not fail. It will simply skip that step, and move to the next step. To demonstrate this feature, go ahead and execute the playbook again (ansible-playbook configure\_ontap\_playbook.yml), and look at the output. All output is green. It essentially verifies that everything is exactly as it was configured when the playbook was executed the first time.

PLAY RECAP \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

localhost : ok=9 changed=0 unreachable=0 failed=0 skipped=0 rescued=0 ignored=0

rhel1 : ok=3 changed=0 unreachable=0 failed=0 skipped=0 rescued=0 ignored=0

rhel2 : ok=3 changed=0 unreachable=0 failed=0 skipped=0 rescued=0 ignored=0

This is an extremely powerful feature of ansible (the most important in my opinion). One can correct problems very fast using an *ansible* playbook.

To demonstrate, log into *cluster1* through System Manager and **delete** the data-serving LIF. One cannot simply delete the LIF – the LIF needs to be *Disabled* first. In order to do that, follow these two steps:

1. Go to (Network/Network Interfaces), highlight *nfs\_data\_lif1*, click on *Status* and select *Disable* it. Then do the same for *nfs\_data\_lif2.* With both nfs data LIFs disabled, click on *Refresh* and verify that the interface is disabled.
2. Select the two disabled interfaces and click on Delete and confirm that both are now deleted.



This will immediately cause the hosts *rhel1* and *rhel2* not to have access to the NFS export anymore. This can be verified by executing the command df on *rhel1*. The session will hang. Hit <Ctrl> C several times to break out of the hang condition. If you like, try to access */mnt/tmp* (the mount point for the NFS export) to prove it’s gone. If this should happen in a production environment, cases are opened with IT and NetApp to troubleshoot the problem.

A simple way to fix this is to simply run the *ansible* playbook that holds the original and tested configuration, in our case *configure\_ontap\_playbook.yml*. So go ahead and run the playbook again:

[root@rhel1 ~]# **cd ~/ansible/lod**  
[root@rhel1 ~]# **ansible-playbook configure\_ontap\_playbook.yml**

One can see that ansible will execute all the task, skipping most (**green**) with the exception of the two tasks that create the two deleted interfaces (**yellow**).

TASK [Create Aggregates (na\_ontap\_aggregate)] \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**ok: [localhost] => (item={u'node': u'cluster1-01', u'name': u'n1\_aggr1'})**

**ok: [localhost] => (item={u'node': u'cluster1-02', u'name': u'n2\_aggr1'})**

TASK [Create a SVM (na\_ontap\_svm)] \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**ok: [localhost]**

TASK [Create an Interface (na\_ontap\_interface)] \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**changed: [localhost]**

TASK [Create an Interface (na\_ontap\_interface)] \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**changed: [localhost]**

TASK [Configure NFS (na\_ontap\_nfs)] \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**ok: [localhost]**

TASK [Create default Export Policy Rule (na\_ontap\_export\_policy\_rule)] \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**ok: [localhost]**

After the playbook completes, the cluster should now be back in an operational state. Look at the list of interfaces on *cluster1* to verify that the interfaces are operational again. Also execute df on *rhel1* to verify normal operations.

## Using Ansible to Deploy Trident

As we discussed in Section 3, Ansbile can be used to install software packages across multiple systems. We have verified that docker is installed on *rhel1* and *rhel2* (by issuing the docker –version command through Ansible earlier). In this section, we will now deploy the NetApp Trident plugin for docker on the hosts *rhel1* and *rhel2* using an Ansible playbook called deploy\_trident.yml.

This playbook does two things:

1. It copies the Trident configuration file (*trident\_config\_file.json*) to the */etc/netappdvp/* folder on both hosts in the defined group *prod* ;
2. It installs the Trident plugin to docker on both hosts.

To perform these tasks, issue the following commands:

[root@rhel1 ~]# **cd ~/ansible/lod**  
[root@rhel1 ~]# **ansible-playbook deploy\_trident.yml**

After completion of the playbook run, validate the deployment of the NetApp Trident plugin by executing the following Ansible ad-hoc command:

[root@rhel1 ~]# **ansible prod –a “docker plugin ls”**

With output verifying that both hosts has the plugin installed:

**rhel2 | CHANGED | rc=0 >>**

**ID NAME DESCRIPTION ENABLED**

**724b93843897 netapp:latest Trident - NetApp Docker Volume Plugin true**

**rhel1 | CHANGED | rc=0 >>**

**ID NAME DESCRIPTION ENABLED**

**40fc16185753 netapp:latest Trident - NetApp Docker Volume Plugin true**

Let’s now use this plugin to create a persistent volume (pv) on the ONTAP cluster *cluster1* by using docker on *rhel1*:

[root@rhel1 ~]# **docker volume create -d netapp --name pv1**

Using ONTAP System Manager, verify that a new volume called docker\_pv1 was created under SVM\_NFS (Note: the storagePrefix “docker\_” was added to the volume name since it’s defined as such in the Trident configuration file trident\_config\_file.json).

Verify that the persistent volume pv1 is registered to docker:

[root@rhel1 ~]# **docker volume ls**

with output showing pv1 present and ready to be used by docker containers:

DRIVER VOLUME NAME

netapp:latest pv1

To remove this volume, simply issue the command

root@rhel1 ~]# **docker volume rm pv1**

which will remove it from both docker as well as SVM\_NFS.

# Using Ansible with NetApp Roles

Roles in Ansible allow for a much greater simplification and efficiency in documenting infrastructure as code by aggregating multiple steps and modules into a few steps, allowing for much greater quality, less likelihood for errors, and the opportunity to adhere to best practices.

Roles for NetApp Ansible modules are maintained by NetApp and needs to be downloaded from the NetApp github repository. Simply put, a role combines multiple Ansible modules, playbooks and code into a single call, to which a set of variables is passed. As of this writing there are five ONTAP roles, two ONTAP Select roles and one Santricity role defined. It is therefore important to do a git pull frequently on the repository to ensure that the latest version of the existing roles, as well as any newly defined roles are installed on the Ansible host.

To download the NetApp specific Ansible roles onto the Ansible host (*rhel1* in our example), do the following:

[root@rhel1 ~]# **git clone https://github.com/netapp/ansible /etc/ansible/roles**

This will clone the eight roles into the **/etc/ansible/roles** folder. Lookling at this folder will lists all the roles (folders highlighted in green below):

[root@rhel1 ~]# **ls -la /etc/ansible/roles**

**total 8**

**drwxr-xr-x 14 root root 4096 Aug 30 13:20 .**

**drwxr-xr-x 3 root root 48 Aug 30 13:19 ..**

**drwxr-xr-x 2 root root 21 Aug 30 13:20 defaults**

**drwxr-xr-x 8 root root 152 Aug 30 13:20 .git**

**drwxr-xr-x 2 root root 21 Aug 30 13:20 meta**

**drwxr-xr-x 8 root root 112 Aug 30 13:20 na\_ontap\_cluster\_config**

**drwxr-xr-x 8 root root 112 Aug 30 13:20 na\_ontap\_nas\_create**

**drwxr-xr-x 8 root root 112 Aug 30 13:20 na\_ontap\_san\_create**

**drwxr-xr-x 8 root root 98 Aug 30 13:20 na\_ontap\_snapmirror\_create**

**drwxr-xr-x 8 root root 112 Aug 30 13:20 na\_ontap\_vserver\_create**

**drwxr-xr-x 6 root root 92 Aug 30 13:20 na\_ots\_cluster**

**drwxr-xr-x 5 root root 60 Aug 30 13:20 na\_ots\_deploy**

**drwxr-xr-x 8 root root 103 Aug 30 13:20 nar\_santricity\_host**

**-rw-r--r-- 1 root root 84 Aug 30 13:20 README.md**

**drwxr-xr-x 2 root root 21 Aug 30 13:20 tasks**

Each of the folders defining a role contains what needs to be executed when a role is called. As an example, the tasks that the role *na\_ontap\_cluster\_config* should execute when called upon is defined by the information contained in the yml file */etc/ansible/roles/na\_ontap\_cluster\_config/tasks/main.yml.* Viewing this file (more */etc/ansible/roles/na\_ontap\_cluster\_config/tasks/main.yml*) looks very similar to the playbook discussed and run in the previous section.

Below shows the ONTAP roles, as well as whet they do, and the modules they reply on. Explore on your own the Tasks contained in the ONTAP Select roles as well as the Santricity roles.

|  |  |  |  |
| --- | --- | --- | --- |
| **ONTAP Roles** | **Role Description** | **Tasks Executed as part of Role** | **Ansible Modules Executed by theTasks** |
| na\_ontap\_cluster\_config | Configuring an ONTAP Cluster | Assign Disks  Set Login Message  Setup DNS  Set NTP Server  Create SNMP community  Create Aggregates  Remove ports from Default broadcast domain  Modify Net Port  Create Interface Group  Modify Net Port  Create VLAN  Create Broadcast Domain  Create Intercluster LIF | na\_ontap\_license  na\_ontap\_disks  na\_ontap\_motd  na\_ontap\_dns  na\_ontap\_ntp  na\_ontap\_snmp  na\_ontap\_aggregate  na\_ontap\_broadcast\_domain\_ports  na\_ontap\_net\_port  na\_ontap\_net\_ifgrp  na\_ontap\_net\_port  na\_ontap\_net\_vlan  na\_ontap\_broadcast\_domain  na\_ontap\_interface |
| na\_ontap\_nas\_create | Role for Creating NFS and CIFS Shares | Create Policy  Setup Rules  Create Volume  Create Share | na\_ontap\_export\_policy  na\_ontap\_export\_policy\_rule  na\_ontap\_volume  na\_ontap\_cifs |
| na\_ontap\_san\_create | Role for Creating LUNs | Create iGroup  Create Volume  Create LUN  Create LUN Mapping | na\_ontap\_igroup  na\_ontap\_volume  na\_ontap\_lun  na\_ontap\_lun\_map |
| na\_ontap\_snapmirror\_create | Create SnapMirror Relationship | Create Cluster Peer  Create vserver Peer  Validate FlexVol  Create SnapMirror | na\_ontap\_cluster\_peer  na\_ontap\_vserver\_peer  na\_ontap\_volume  na\_ontap\_snapmirror |
| na\_ontap\_vserver\_create | Create one or more SVMs | Create vserver  Setup FCP  Setup iSCSI  Modify Adapter  Create interface  Add Default Route  Create DNS  Create CIFS Server  Create NFS Server  Setup NFS Rule | na\_ontap\_svm  na\_ontap\_fcp  na\_ontap\_iscsi  na\_ontap\_ucadapter  na\_ontap\_interface  na\_ontap\_net\_routes  na\_ontap\_dns  na\_ontap\_cifs\_server  na\_ontap\_nfs  na\_ontap\_export\_policy\_rule |

## Configuring *cluster1* using the Ansible Playbook and NetApp Roles

The file *configure\_ontap\_roles.yml* (in the *ansible/lod* folder on *rhel1*)is an ansible playbook that contains a single play. This play in turn contains several tasks, but unlike in the previous example where each task that configured the ONTAP cluster called an Ansible module, in this case, some tasks calls Ansible modules, and some tasks import NetApp defined roles (which in turn calls Ansible modules). Looking at the file in more detail:



The first play Configures the ONTAP Cluster, and the second play configures the NFS hosts and mount NFS export. If one looks at the Task Create SVMs, unlike the case in the earlier example where this task simply executed a single Ansible module, in this case this task imports a role, as seen below:



The role (*na\_ontap\_vserver\_create*) in turn calls on 10 Ansible modules, as discussed above.

The playbook uses an additional file *(\_var\_roles.yml)* as the variables repository used during the configuration of the cluster. That file is easily readble and acts as a documentation of the infrastructure to deploy (also can be referred to as Infrastructure-as-code). Use the command more \_var\_roles.yml to look at its content.

This playbook that uses roles will do exactly what the playbook in the previous example did, but more. It will also create CIFS and iSCSI SVMs as well as volumes and LIFs associated with those SVMs. Beciase of the idempotent nature of Ansible, it will know that the NFS SVM (and aggregates, LIFs, etc.) are already present and will skip those steps.

To now fully build out the cluster, execute this playbook by typing the following commands:

[root@rhel1 ~]# **cd ~/ansible/lod**  
[root@rhel1 ~]# **ansible-playbook configure\_ontap\_roles.yml**

*Note: when prompt for domain admin, type administrator. When prompt for domain admin password, type Netapp1!*

Use ONTAP System Manager to view the configured cluster. As you can see, using roles and a global variables file is a great way to document the roll out of your infrastructure.

Appendix A: Alternative Method to Installing Ansible

Since using the yum install command on a RHEL system requires an active registered subscription manager, it is possible that this method will not work for some of the LOD labs that do not have an active subscription. It is fairly easy to identify if that is the cause for failed installation. Simply run the yum command and ovserve the output. If it is similar to the one below, you will need to use an alternative method for the installation.

[root@rhel1 ~]# **yum**

Loaded plugins: langpacks, product-id, search-disabled-repos, subscription-manager

This system is not registered to Red Hat Subscription Management. You can use subscription-manager to register.

The install Ansible in this case, follow the following steps:

1. Log into the Linux server you want to install Ansible on using PuTTY. In most LoD environments that will be *rhel1* with username *root* and password *Netapp1!*
2. Install pip by typing the following command:

[root@rhel1 ~]# **cd ~/**

[root@rhel1 ~]# **curl** [**https://bootstrap.pypa.io/get-pip.py -o get-pip.py**](https://bootstrap.pypa.io/get-pip.py%20-o%20get-pip.py)[root@rhel1 ~]# **python get-pip.py**  
[root@rhel1 ~]# **pip install ansible**

[root@rhel1 ~]# **mkdir /etc/ansible**

Appendix B: Configuration Files Used in the Demo

This section contains all the files provided as part of the Git repository.

* hosts

[prod]

rhel1

rhel2

* configure\_ontap\_playbook.yml

---

##[PLAY] Configure ONTAP Cluster

- hosts: localhost

name: Play [Configure ONTAP Cluster]

vars\_files:

- variables.yml

tasks:

# Create Aggregates

- name: Create Aggregates (na\_ontap\_aggregate)

na\_ontap\_aggregate:

state: "{{ state }}"

name: "{{ item.name }}"

nodes: "{{ item.node }}"

disk\_count: 13

raid\_size: 13

https: true

validate\_certs: false

hostname: "{{ hostname }}"

username: "{{ username }}"

password: "{{ password }}"

with\_items:

- { name: "n1\_aggr1", node: "cluster1-01" }

- { name: "n2\_aggr1", node: "cluster1-02" }

# Create a SVM

- name: Create a SVM (na\_ontap\_svm)

na\_ontap\_svm:

state: "{{ state }}"

name: "{{ vserver }}"

root\_volume: "{{ vserver}}\_root"

root\_volume\_aggregate: "{{ aggr }}"

root\_volume\_security\_style: unix

aggr\_list: n1\_aggr1,n2\_aggr1

hostname: "{{ hostname }}"

username: "{{ username }}"

password: "{{ password }}"

https: true

validate\_certs: false

# Create an Interface

- name: Create an Interface (na\_ontap\_interface)

na\_ontap\_interface:

state: "{{ state }}"

interface\_name: "{{ vserver }}\_mgmt\_data\_1"

home\_port: e0d

home\_node: cluster1-01

role: data

protocols: nfs

address: "{{ data\_lif }}"

netmask: 255.255.255.0

vserver: "{{ vserver }}"

hostname: "{{ hostname }}"

username: "{{ username }}"

password: "{{ password }}"

https: true

validate\_certs: false

# Configure NFS

- name: Configure NFS (na\_ontap\_nfs)

na\_ontap\_nfs:

state: "{{ state }}"

service\_state: started

vserver: "{{ vserver }}"

nfsv3: enabled

nfsv4: disabled

nfsv41: disabled

tcp: enabled

udp: enabled

vstorage\_state: disabled

hostname: "{{ hostname }}"

username: "{{ username }}"

password: "{{ password }}"

https: true

validate\_certs: false

# Setup Default Rules

- name: Create default Export Policy Rule (na\_ontap\_export\_policy\_rule)

na\_ontap\_export\_policy\_rule:

state: "{{ state }}"

policy\_name: default

vserver: "{{ vserver }}"

client\_match: 0.0.0.0/0

ro\_rule: any

rw\_rule: none

super\_user\_security: none

hostname: "{{ hostname }}"

username: "{{ username }}"

password: "{{ password }}"

https: true

validate\_certs: false

# Create Policy

- name: Create Export Policy (na\_ontap\_export\_policy)

na\_ontap\_export\_policy:

state: "{{ state }}"

name: "{{ policy }}"

vserver: "{{ vserver }}"

hostname: "{{ hostname }}"

username: "{{ username }}"

password: "{{ password }}"

https: true

validate\_certs: false

# Setup Rules

- name: Create Export Policy Rule (na\_ontap\_export\_policy\_rule)

na\_ontap\_export\_policy\_rule:

state: "{{ state }}"

policy\_name: "{{ policy }}"

vserver: "{{ vserver }}"

client\_match: "{{ client }}"

ro\_rule: any

rw\_rule: any

super\_user\_security: any

hostname: "{{ hostname }}"

username: "{{ username }}"

password: "{{ password }}"

https: true

validate\_certs: false

# Create Volume

- name: Create Volume (na\_ontap\_volume)

na\_ontap\_volume:

state: "{{ state }}"

name: "{{ volname }}"

aggregate\_name: "{{ aggr }}"

size: 1

size\_unit: gb

policy: "{{ policy }}"

junction\_path: "/{{ volname }}"

space\_guarantee: "none"

vserver: "{{ vserver }}"

hostname: "{{ hostname }}"

username: "{{ username }}"

password: "{{ password }}"

volume\_security\_style: unix

https: true

validate\_certs: false

##[PLAY] Mount NFS export to hosts in /etc/ansible/hosts

- hosts: prod

name: Play [Configure nfs on Linux Instances and Mount the nfs export]

vars\_files:

- variables.yml

tasks:

# Install NFS on Linux Instances

- name: Install nfs on all systems in /etc/ansible/hosts

package:

name: nfs-utils

state: present

# Mount ONTAP NFS export on all Linux Instances

- name: Mount nfs export on all systems in /etc/ansible/hosts

mount:

state: mounted

path: /mnt/tmp

src: "{{ data\_lif }}:/{{ volname}}"

fstype: nfs

* variables.yml

hostname: "192.168.0.101"

username: "admin"

volname: DataVolume

vserver: SVM\_NFS

policy: DataPolicy

aggr: n1\_aggr1

client: 0.0.0.0/0

data\_lif: 192.168.0.145

state: present

password: Netapp1!

* configure\_ontap.yml

---

##[PLAY] Configure ONTAP Cluster

- hosts: localhost

gather\_facts: no

vars\_prompt:

- name: admin\_user\_name

prompt: domain admin (enter if skipped)

- name: admin\_password

prompt: domain admin password (enter if skipped)

vars:

input: &input

hostname: "{{ netapp\_hostname }}"

username: "{{ netapp\_username }}"

password: "{{ netapp\_password }}"

file: globals.yml

vars\_files:

- "{{ file }}"

tasks:

# Gather facts about the ONTAP cluster

- name: Get ONTAP version

na\_ontap\_gather\_facts:

state: info

<<: \*input

https: true

validate\_certs: false

ontapi: 32

# Configure Cluster

- import\_role:

name: na\_ontap\_cluster\_config

vars:

<<: \*input

# Configure SVMs

- import\_role:

name: na\_ontap\_vserver\_create

vars:

<<: \*input

when: vservers != None

# Configure NAS volumes

- import\_role:

name: na\_ontap\_nas\_create

vars:

<<: \*input

when: nas != None

# Configure SAN volumes and LUNs

- import\_role:

name: na\_ontap\_san\_create

vars:

<<: \*input

when: luns != None

* globals.yml

cluster: cluster1

netapp\_hostname: 192.168.0.101

netapp\_username: admin

netapp\_password: Netapp1!

#license\_codes: XXX

disks:

- cluster1-01

- cluster1-02

#motd: "This cluster was set up using Ansible roles. Cool ha?"

dns:

- { dns\_domains: demo.netapp.com, dns\_nameservers: 192.168.0.253 }

ntp:

- { server\_name: dc1.demo.netapp.com, version: auto }

snmp:

- { community\_name: public, access\_control: ro }

aggrs:

- { name: n1\_aggr1, node: cluster1-01, disk\_count: 13, max\_raid: 13 }

- { name: n2\_aggr1, node: cluster1-02, disk\_count: 13, max\_raid: 13 }

ports:

- { node: cluster1-01, port: }

vservers:

- { name: SVM\_NFS, aggr: n1\_aggr1, protocol: nfs }

- { name: cifs\_svm, aggr: n1\_aggr1, protocol: cifs }

- { name: san\_svm, aggr: n2\_aggr1, protocol: iscsi }

vserver\_dns:

- { vserver: cifs\_svm, dns\_domains: demo.netapp.com, dns\_nameservers: 192.168.0.253 }

- { vserver: SVM\_NFS, dns\_domains: demo.netapp.com, dns\_nameservers: 192.168.0.253 }

lifs:

- { name: SVM\_NFS\_mgmt\_data\_1, vserver: SVM\_NFS, node: cluster1-01, port: e0d, protocol: nfs, address: 192.168.0.145, netmask: 255.255.255.0 }

- { name: SVM\_NFS\_mgmt\_data\_2, vserver: SVM\_NFS, node: cluster1-02, port: e0d, protocol: nfs, address: 192.168.0.144, netmask: 255.255.255.0 }

- { name: cifs\_data\_lif1, vserver: cifs\_svm, node: cluster1-01, port: e0d, protocol: cifs, address: 192.168.0.146, netmask: 255.255.255.0 }

- { name: cifs\_data\_lif2, vserver: cifs\_svm, node: cluster1-02, port: e0d, protocol: cifs, address: 192.168.0.147, netmask: 255.255.255.0 }

- { name: san\_data\_lif1, vserver: san\_svm, node: cluster1-01, port: e0d, protocol: iscsi, address: 192.168.0.148, netmask: 255.255.255.0 }

- { name: san\_data\_lif2, vserver: san\_svm, node: cluster1-02, port: e0d, protocol: iscsi, address: 192.168.0.149, netmask: 255.255.255.0 }

cifs:

- { vserver: cifs\_svm, cifs\_server\_name: netapp1, domain: demo.netapp.com, force: true }

nas:

- { name: CifsDataVolume, protocol: cifs, vserver: cifs\_svm, share: smbdata, aggr: n1\_aggr1, size: 10 }

igroups:

- { name: rhel1\_igroup, vserver: san\_svm, group\_type: iscsi, ostype: linux, initiator: "iqn.1994-05.com.redhat:rhel1.demo.netapp.com" }

luns:

- { name: lun1, vol\_name: SanDataVolume, vserver: san\_svm, size: 10, aggr: n2\_aggr1, ostype: linux, space\_reserve: false, igroup: rhel1\_igroup }

* deploy\_trident.yml

---

- hosts: prod

name: Play [Deploy Trident on Docker hosts]

tasks:

- name: Copy config.json file

copy:

src: ~/config.json

dest: /etc/netappdvp/config.json

backup: yes

- name: Install Trident on host

shell: docker plugin install --grant-all-permissions --alias netapp netapp/trident-plugin:latest

* config.json

{

"version": 1,

"storageDriverName": "ontap-nas",

"storagePrefix": "docker\_",

"managementLIF": "192.168.0.101",

"dataLIF": "192.168.0.145",

"svm": "SVM\_NFS",

"username": "admin",

"password": "Netapp1!",

"defaults": {

"size": "10G",

"spaceReserve": "none",

"exportPolicy": "DataPolicy",

"snapshotReserve": "0",

"snapshotDir": "true"

}

}

Refer to the [Interoperability Matrix Tool (IMT)](http://support.netapp.com/matrix/mtx/login.do) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.



NetApp provides no representations or warranties regarding the accuracy, reliability, or serviceability of any information or recommendations provided in this publication, or with respect to any results that may be obtained by the use of the information or observance of any recommendations provided herein. The information in this document is distributed AS IS, and the use of this information or the implementation of any recommendations or techniques herein is a customer’s responsibility and depends on the customer’s ability to evaluate and integrate them into the customer’s operational environment. This document and   
the information contained herein may be used solely in connection with the NetApp products discussed   
in this document.

© 2016 NetApp, Inc. All rights reserved. No portions of this document may be reproduced without prior written consent of NetApp, Inc. Specifications are subject to change without notice. NetApp, the NetApp logo, xxx, and xxx are trademarks or registered trademarks of NetApp, Inc. in the United States and/or other countries. <<Insert third-party trademark notices here.>> All other brands or products are trademarks or registered trademarks of their respective holders and should be treated as such. TR-XXXXi-MMYR