SnapCenter for Databases

NetApp Solutions

NetApp
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SnapCenter Oracle Clone Lifecycle Automation

Allen Cao, Niyaz Mohamed, NetApp

This solution provides an Ansible based automation toolkit for configuring Oracle database High Availability and Disaster Recovery (HA/DR) with AWS FSx ONTAP as Oracle database storage and EC2 instances as the compute instances in AWS.

Purpose

Customers love the FlexClone feature of NetApp ONTAP storage for databases with significant storage cost savings. This Ansible based toolkit automates the setup, cloning, and refreshing of cloned Oracle databases on schedule using the NetApp SnapCenter command line utilities for streamlined lifecycle management. The toolkit is applicable to Oracle databases deployed to ONTAP storage either on-premisses or public cloud and managed by NetApp SnapCenter UI tool.

This solution addresses the following use cases:

- Setup Oracle database clone-specification configuration file.
- Create and refresh clone Oracle database on user defined schedule.

Audience

This solution is intended for the following people:

- A DBA who manages Oracle databases with SnapCenter.
- A storage administrator who manages ONTAP storage with SnapCenter.
- An application owner who has access to SnapCenter UI.

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Solution deployment

Prerequisites for deployment

Deployment requires the following prerequisites.

```
Ansible controller:
  Ansible v.2.10 and higher
  ONTAP collection 21.19.1
  Python 3
  Python libraries:
    netapp-lib
    xmltodict
    jmespath
```

```
SnapCenter server:
  version 5.0
  backup policy configured
  Source database protected with a backup policy
```

```
Oracle servers:
  Source server managed by SnapCenter
  Target server managed by SnapCenter
  Target server with identical Oracle software stack as source server
installed and configured
```

Download the toolkit

```
git clone https://bitbucket.ngage.netapp.com/scm/ns-
bb/na_oracle_clone_lifecycle.git
```

Ansible target hosts file configuration

The toolkit includes a hosts file which define the targets that an Ansible playbook running against. Usually, it is the target Oracle clone hosts. Following is an example file. A host entry includes target host IP address as well as ssh key for an admin user access to the host to execute clone or refresh command.

#Oracle clone hosts

```
[clone_1]
ora_04.cie.netapp.com ansible_host=10.61.180.29
ansible_ssh_private_key_file=ora_04.pem
```

```
[clone_2]
```

```
[clone_3]
```

Global variables configuration

The Ansible playbooks take variable inputs from several variable files. Below is an example global variable file vars.yml.

```
# ONTAP specific config variables
```

```
# SnapCtr specific config variables
```

```
snapctr_usr: xxxxxxxx
snapctr_pwd: 'xxxxxxxx'
```

```
backup_policy: 'Oracle Full offline Backup'
```

```
# Linux specific config variables
```

```
# Oracle specific config variables
```

Host variables configuration

Host variables are defined in host_vars directory named as {{ host_name }}.yml. Below is an example of target Oracle host variable file ora_04.cie.netapp.com.yml that shows typical configuration.

```
# User configurable Oracle clone db host specific parameters
```

```
# Source database to clone from
source_db_sid: NTAP1
source_db_host: ora_03.cie.netapp.com
```

```
# Clone database
clone_db_sid: NTAP1DEV
```

```
snapctr_obj_id: '{{ source_db_host }}\{{ source_db_sid }}'
```

Additional clone target Oracle server configuration

Clone target Oracle server should have the same Oracle software stack as source Oracle server installed and patched. Oracle user .bash_profile has $ORACLE_BASE, and $ORACLE_HOME configured. Also, $ORACLE_HOME variable should match with source Oracle server setting. Following is an example.

```
# .bash_profile
```

```
# Get the aliases and functions
if [ -f ~/.bashrc ]; then
        . ~/.bashrc
fi
```

```
# User specific environment and startup programs
export ORACLE_BASE=/u01/app/oracle
export ORACLE_HOME=/u01/app/oracle/product/19.0.0/NTAP1
```

Playbook execution

There are total of three playbooks to execute Oracle database clone lifecycle with SnapCenter CLI utilities.

1. Install Ansible controller prerequisites - one time only.

```
ansible-playbook -i hosts ansible_requirements.yml
```

2. Setup clone specification file - one time only.

```
ansible-playbook -i hosts clone_1_setup.yml -u admin -e
@vars/vars.yml
```

3. Create and refresh clone database regularly from crontab with a shell script to call a refresh playbook.

```
0 */4 * * * /home/admin/na_oracle_clone_lifecycle/clone_1_refresh.sh
```

For an additional clone database, create a separate clone_n_setup.yml and clone_n_refresh.yml, and clone_n_refresh.sh. Configure the Ansible target hosts and hostname.yml file in host_vars directory accordingly.

Where to find additional information

To learn more about the NetApp solution automation, review the following website NetApp Solution Automation

TR-4988: Oracle Database Backup, Recovery, and Clone on ANF with SnapCenter

Allen Cao, Niyaz Mohamed, NetApp

This solution provides overview and details for automated Oracle deployment in Microsoft Azure NetApp Files as primary database storage with NFS protocol and Oracle database is deployed as container database with dNFS enabled. Database deployed in Azure is protected using SnapCenter UI tool for simplified database management.

Purpose

NetApp SnapCenter software is an easy-to-use enterprise platform to securely coordinate and manage data protection across applications, databases, and file systems. It simplifies backup, restore, and clone lifecycle management by offloading these tasks to application owners without sacrificing the ability to oversee and regulate activity on the storage systems. By leveraging storage-based data management, it enables increased performance and availability, as well as reduced testing and development times.

In TR-4987, Simplified, Automated Oracle Deployment on Azure NetApp Files with NFS, we demonstrate automated Oracle deployment on Azure NetApp Files (ANF)in Azure cloud. In this documentation, we showcase Oracle database protection and management on ANF in Azure cloud with a very user-friendly SnapCenter UI tool.

This solution addresses the following use cases:

- Backup and recovery of Oracle database deployed on ANF in Azure cloud with SnapCenter.
- Manage database snapshots and clone copies to accelerate application development and improve data lifecycle management.

Audience

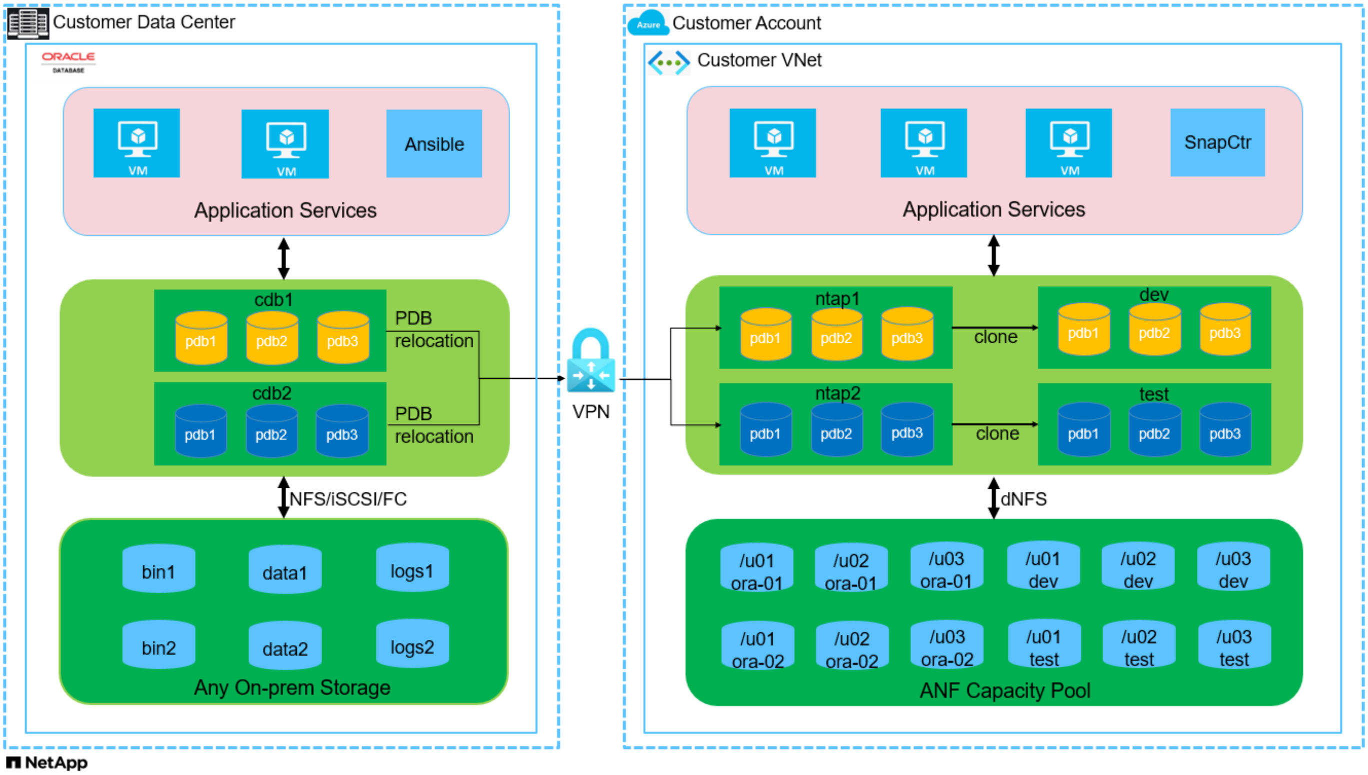
This solution is intended for the following people:

- A DBA who would like to deploy Oracle databases on Azure NetApp Files.
- A database solution architect who would like to test Oracle workloads on Azure NetApp Files.
- A storage administrator who would like to deploy and manage Oracle databases on Azure NetApp Files.
- An application owner who would like to stand up an Oracle database on Azure NetApp Files.

Solution test and validation environment

The testing and validation of this solution were performed in a lab setting that might not match the final deployment environment. See the section Key factors for deployment consideration for more information.

Architecture



Hardware and software components

Hardware

Azure NetApp Files	Current offering in Azure by Microsoft	A capacity pool with Premium service level
Azure VM for DB server	Standard_B4ms - 4 vCPUs, 16GiB	Two Linux virtual machine instances
Azure VM for SnapCenter	Standard_B4ms - 4 vCPUs, 16GiB	One Windows virtual machine instance
Software		
RedHat Linux	RHEL Linux 8.6 (LVM) - x64 Gen2	Deployed RedHat subscription for testing
Windows Server	2022 DataCenter; AE Hotpatch - x64 Gen2	Hosting SnapCenter server
Oracle Database	Version 19.18	Patch p34765931_190000_Linux-x86-64.zip
Oracle OPatch	Version 12.2.0.1.36	Patch p6880880_190000_Linux-x86-64.zip
SnapCenter Server	Version 5.0	Workgroup deployment
Open JDK	Version java-11-openjdk	SnapCenter plugin requirement on DB VMs
NFS	Version 3.0	Oracle dNFS enabled
Ansible	core 2.16.2	Python 3.6.8

Oracle database configuration in the lab environment

Server	Database	DB Storage
ora-01	NTAP1(NTAP1_PDB1,NTAP1_PDB2,NTAP1_PDB3)	/u01, /u02, /u03 NFS mounts on ANF capacity pool
ora-02	NTAP2(NTAP2_PDB1,NTAP2_PDB2,NTAP2_PDB3)	/u01, /u02, /u03 NFS mounts on ANF capacity pool

Key factors for deployment consideration

- **SnapCenter deployment.** SnapCenter can deploy in a Windows domain or Workgroup environment. For domain-based deployment, the domain user account should be a domain administrator account, or the domain user belongs to the local administrator's group on the SnapCenter hosting server.
- **Name resolution.** SnapCenter server needs to resolve the name to the IP address for each managed target database server host. Each target database server host must resolve the SnapCenter server name to the IP address. If a DNS server is unavailable, add naming to local host files for resolution.
- **Resource group configuration.** Resource group in SnapCenter is a logical grouping of similar resources that can be backed up together. Thus, it simplifies and reduces the number of backup jobs in a large database environment.
- **Separate full database and archive log backup.** Full database backup includes data volumes and log volumes consistent group snapshots. A frequent full database snapshot incurs higher storage consumption but improves RTO. An alternative is less frequent full database snapshots and more frequent archive logs

backup, which consumes less storage and improves RPO but may extend RTO. Consider your RTO and RPO objectives when setting up the backup scheme. There is also a limit (1023) of the number of snapshot backups on a volume.

- **Privileges delegation.** Leverage role based access control that is built-in within SnapCenter UI to delegate privileges to application and database teams if desired.

Solution deployment

The following sections provide step-by-step procedures for SnapCenter deployment, configuration, and Oracle database backup, recovery, and clone on Azure NetApp Files in the Azure cloud.

Prerequisites for deployment

Deployment requires existing Oracle databases running on ANF in Azure. If not, follow the steps below to create two Oracle databases for solution validation. For details of Oracle database deployment on ANF in Azure cloud with automation, referred to TR-4987: Simplified, Automated Oracle Deployment on Azure NetApp Files with NFS

1. An Azure account has been set up, and the necessary VNet and network segments have been created within your Azure account.
2. From the Azure cloud portal, deploy Azure Linux VMs as Oracle DB servers. Create an Azure NetApp Files capacity pool and database volumes for Oracle database. Enable VM SSH private/public key authentication for azureuser to DB servers. See the architecture diagram in the previous section for details about the environment setup. Also referred to Step-by-Step Oracle deployment procedures on Azure VM and Azure NetApp Files for detailed information.

   For Azure VMs deployed with local disk redundancy, ensure that you have allocated at least 128G in the VM root disk to have sufficient space to stage Oracle installation files and add OS swap file. Expand /tmplv and /rootlv OS partition accordingly. Ensure the database volume naming follows the VMname-u01, VMname-u02, and VMname-u03 convention.

   ```
   sudo lvresize -r -L +20G /dev/mapper/rootvg-rootlv
   ```

   ```
   sudo lvresize -r -L +10G /dev/mapper/rootvg-tmplv
   ```

3. From the Azure cloud portal, provision a Windows server to run the NetApp SnapCenter UI tool with the latest version. Refer to the following link for details: Install the SnapCenter Server.
4. Provision a Linux VM as the Ansible controller node with the latest version of Ansible and Git installed. Refer to the following link for details: Getting Started with NetApp solution automation in section - `Setup the Ansible Control Node for CLI deployments on RHEL / CentOS` or `Setup the Ansible Control Node for CLI deployments on Ubuntu / Debian`.

   The Ansible controller node can locate either on-premisses or in Azure cloud as far as it can reach Azure DB VMs via ssh port.

5. Clone a copy of the NetApp Oracle deployment automation toolkit for NFS. Follow instructions in TR-4887 to execute the playbooks.

   ```
   git clone https://bitbucket.ngage.netapp.com/scm/ns-bb/na_oracle_deploy_nfs.git
   ```

6. Stage following Oracle 19c installation files on Azure DB VM /tmp/archive directory with 777 permission.

```
installer_archives:
  - "LINUX.X64_193000_db_home.zip"
  - "p34765931_190000_Linux-x86-64.zip"
  - "p6880880_190000_Linux-x86-64.zip"
```

7. Watch the following video:

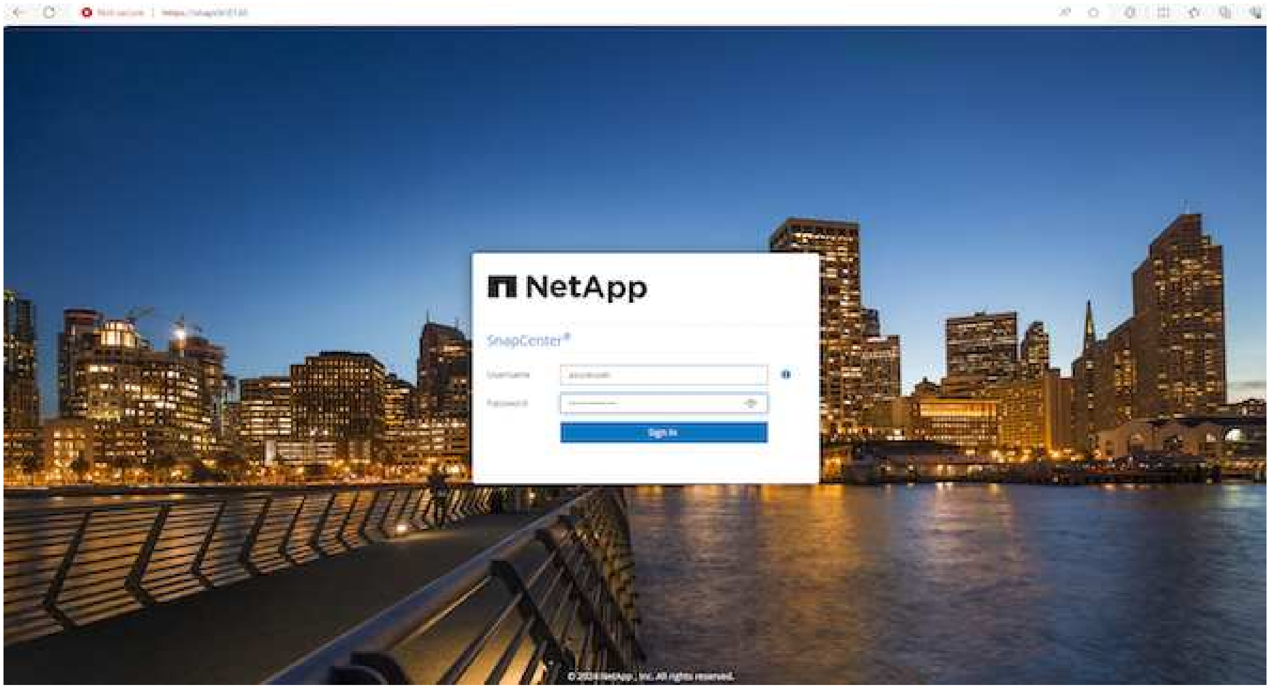
   Oracle Database Backup, Recovery, and Clone on ANF with SnapCenter

8. Review the `Get Started` online menu.

SnapCenter installation and setup

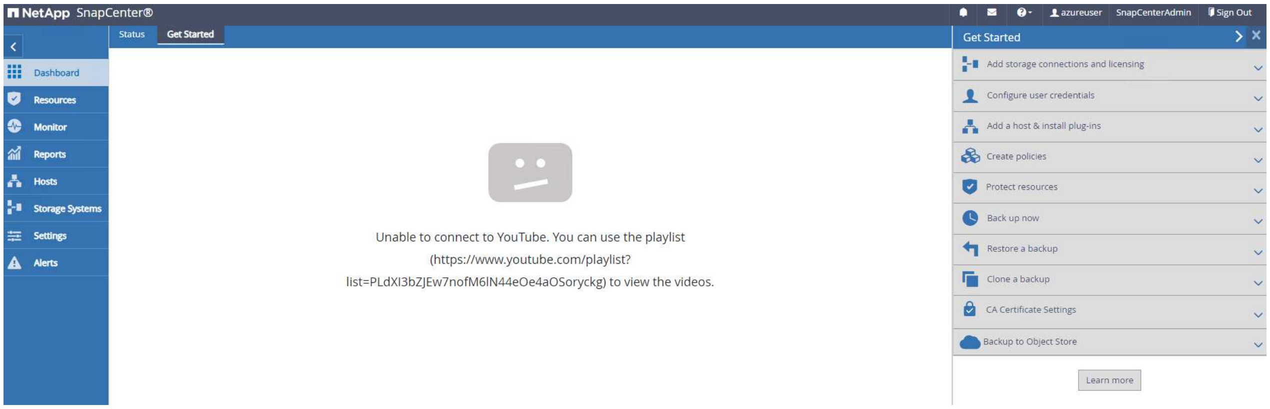
We recommend to go through online SnapCenter Software documentation before proceeding to SnapCenter installation and configuration: . Following provides a high level summary of steps for installation and setup of SnapCenter software for Oracle on Azure ANF.

1. From SnapCenter Windows server, download and install latest java JDK from Get Java for desktop applications.
2. From SnapCenter Windows server, download and install latest version (currently 5.0) of SnapCenter installation executable from NetApp support site: NetApp | Support.
3. After SnapCenter server installation, launch browser to login to SnapCenter with Windows local admin user or domain user credential via port 8146.



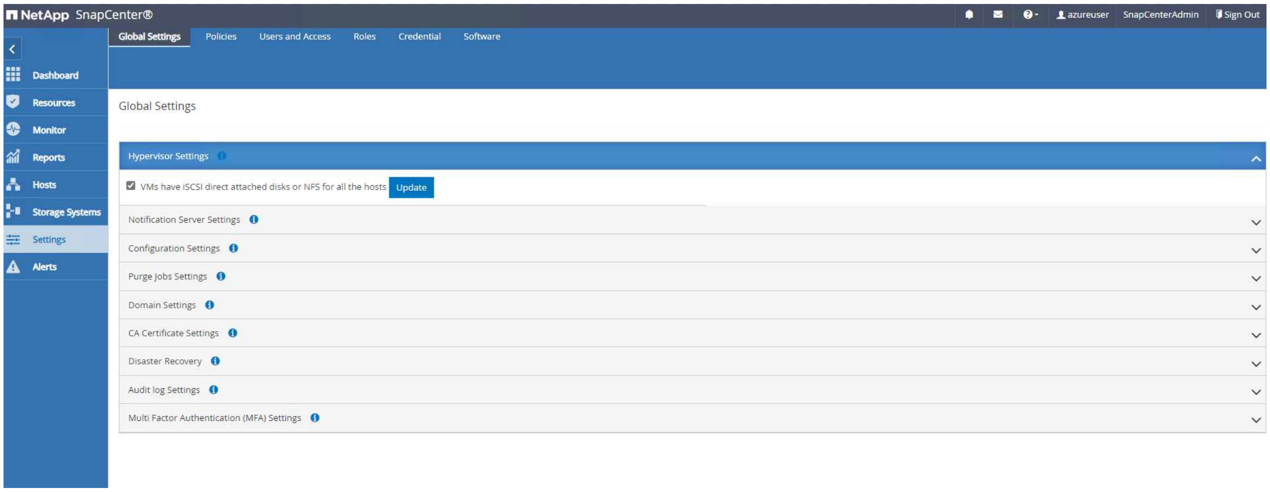
Username azureuser
Password

4. Review `Get Started` online menu.



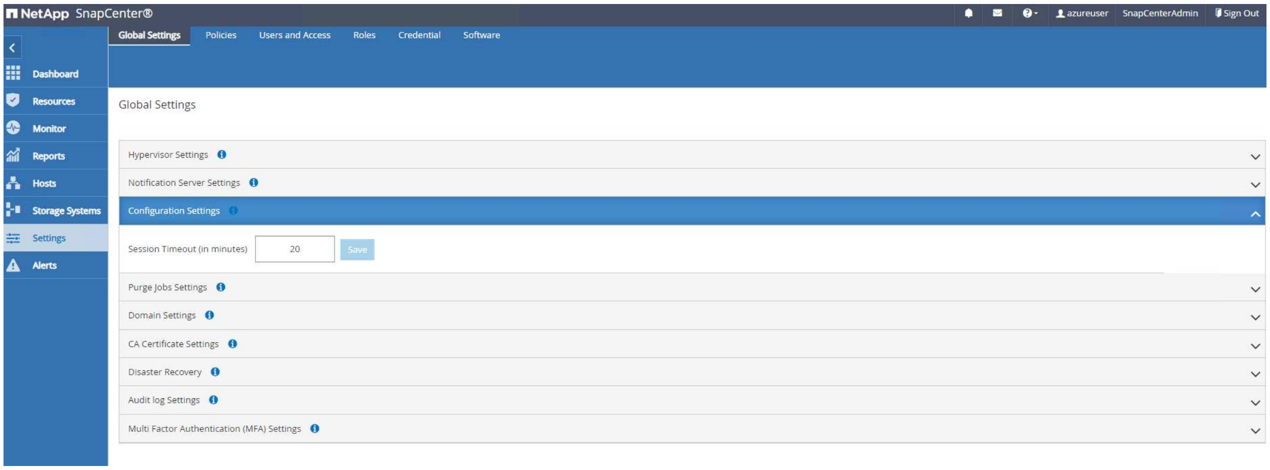
Unable to connect to YouTube. You can use the playlist (https://www.youtube.com/playlist?list=PLdXI3bZJEw7nofM6lN44eOe4aOSoryckg) to view the videos.

5. In `Settings-Global Settings`, check `Hypervisor Settings` and click on Update.



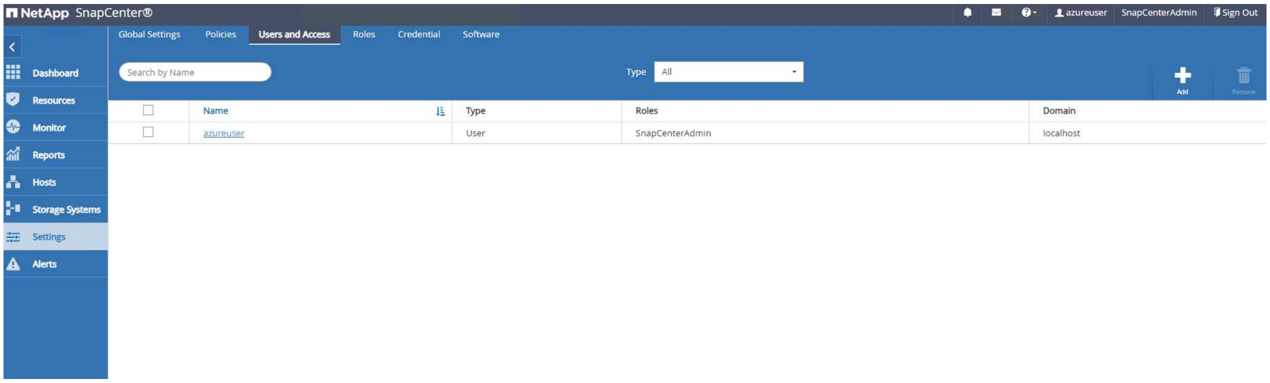
☑ VMs have iSCSI direct attached disks or NFS for all the hosts

6. If needed, adjust `Session Timeout` for SnapCenter UI to the desired interval.



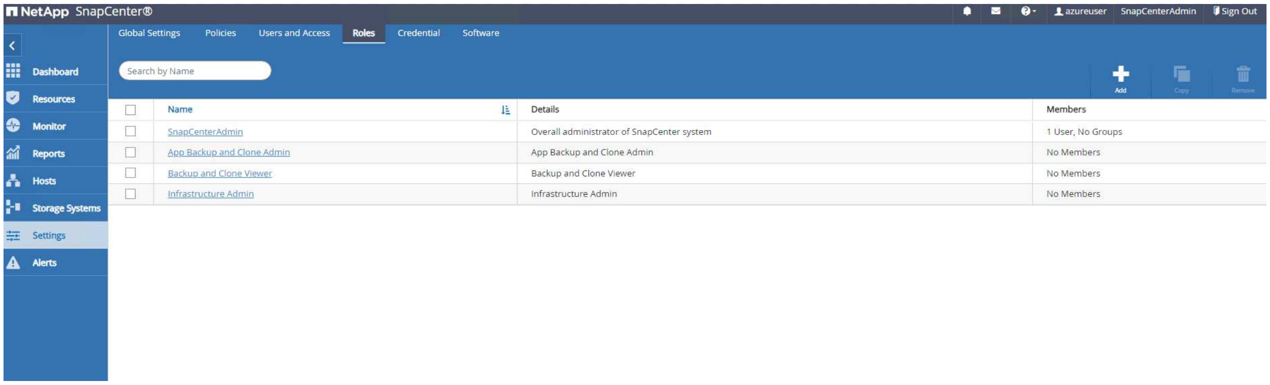
Session Timeout (in minutes) 20

7. Add additional users to SnapCenter if needed.



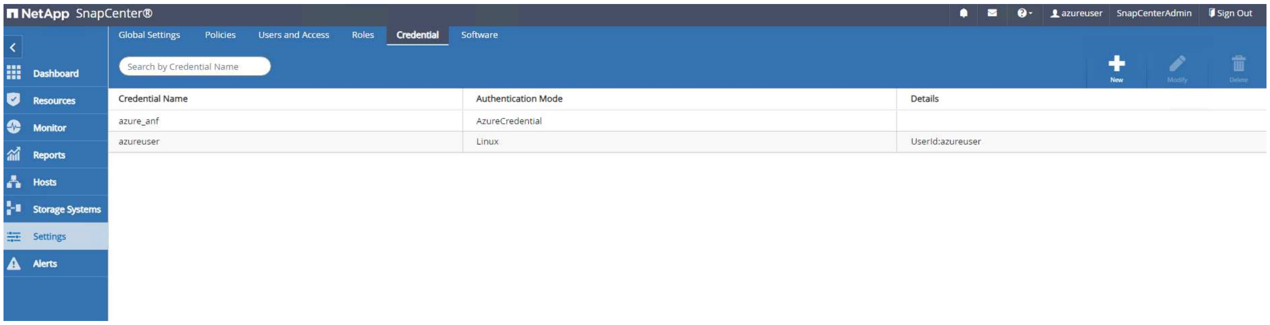
☐	Name	Type	Roles	Domain
☐	azureuser	User	SnapCenterAdmin	localhost

8. The `Roles` tab list the built-in roles that can be assigned to different SnapCenter users. Custom roles also can be created by admin user with desired privileges.

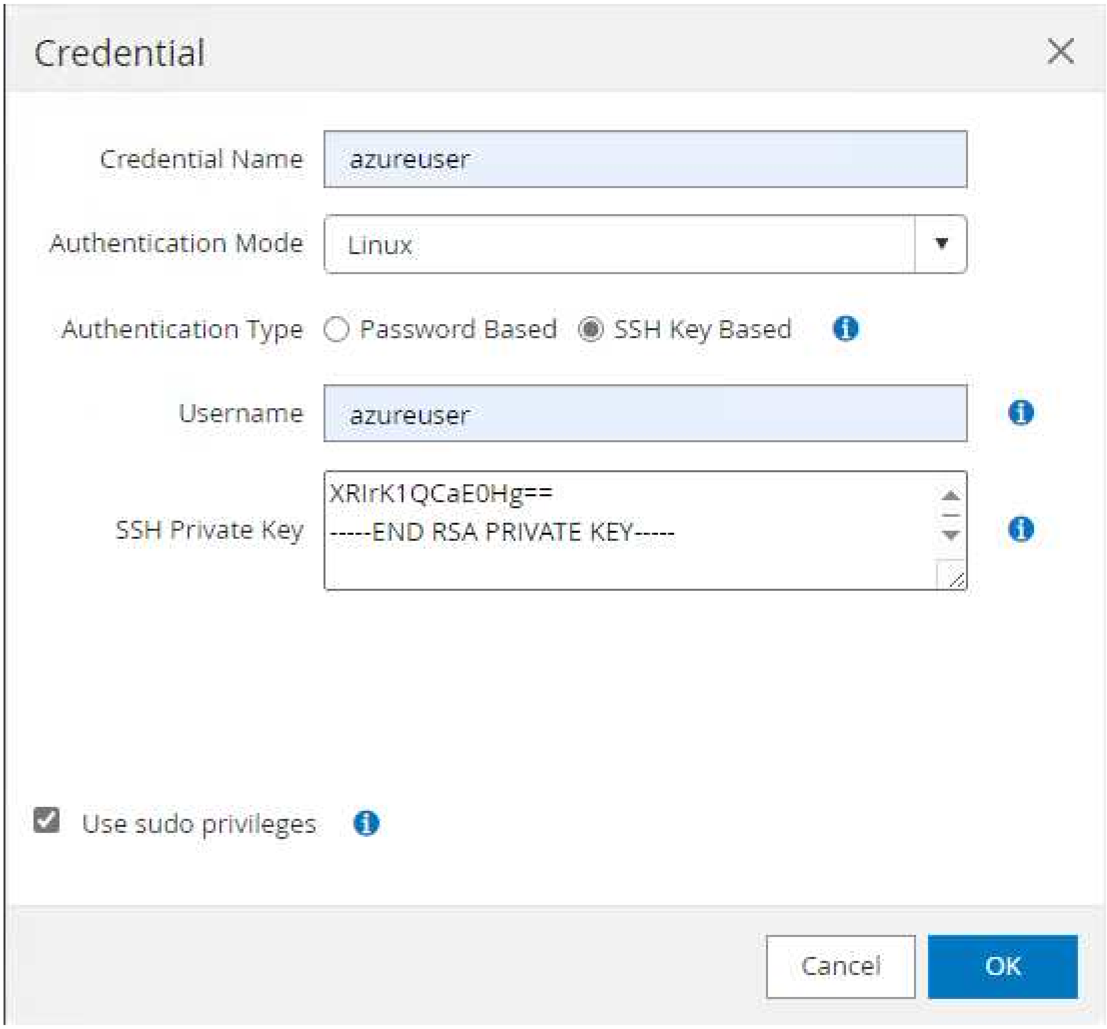


□	Name	Details	Members
□	SnapCenterAdmin	Overall administrator of SnapCenter system	1 User, No Groups
□	App Backup and Clone Admin	App Backup and Clone Admin	No Members
□	Backup and Clone Viewer	Backup and Clone Viewer	No Members
□	Infrastructure Admin	Infrastructure Admin	No Members

9. From `Settings-Credential`, create credentials for SnapCenter management targets. In this demo use case, they are linux user for login to Azure VM and ANF credential for capacity pool access.



Credential Name	Authentication Mode	Details
azure_anf	AzureCredential	
azureuser	Linux	UserId:azureuser


Credential

Credential Name: azureuser

Authentication Mode: Linux

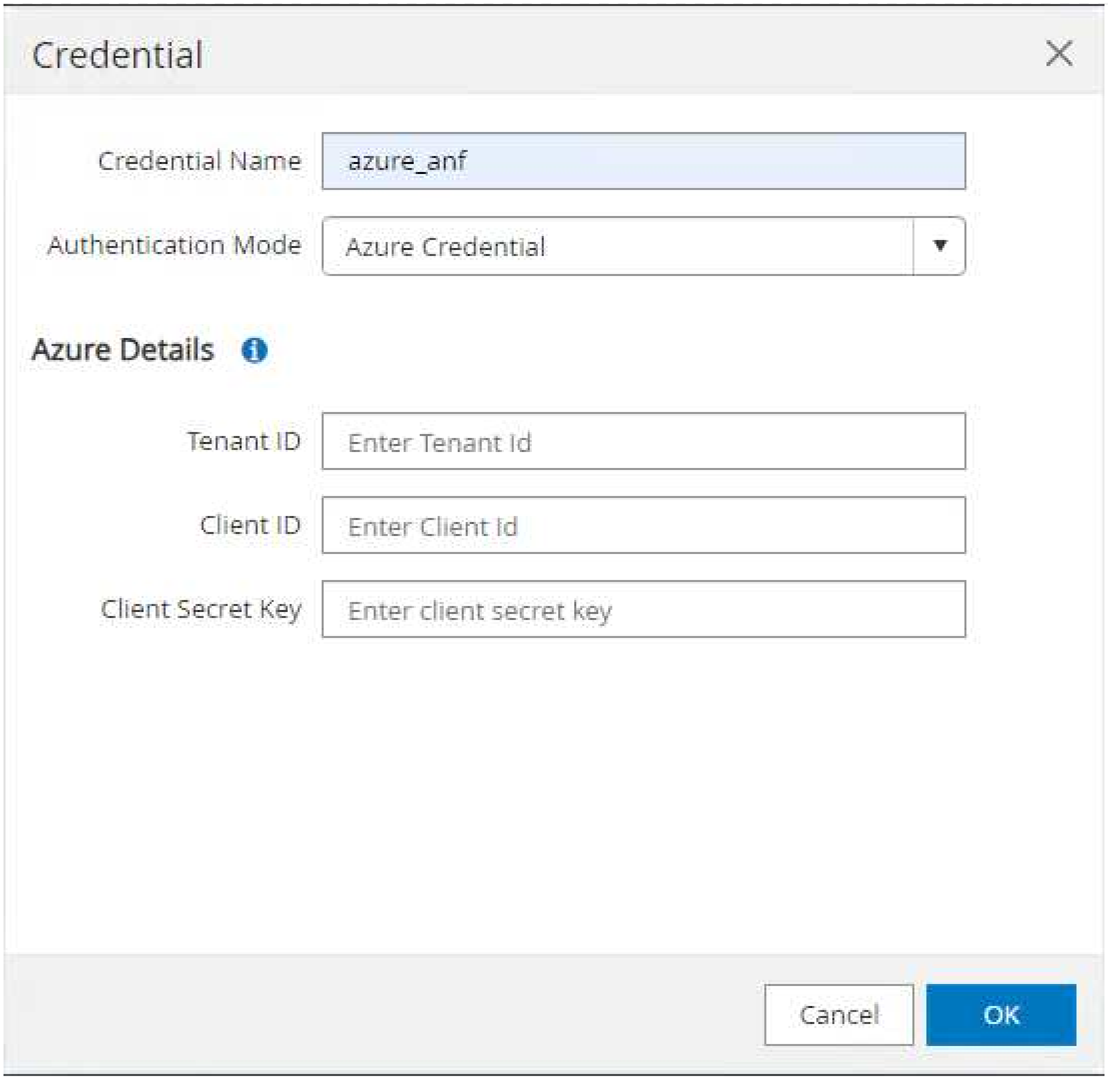
Authentication Type: ○ Password Based ● SSH Key Based

Username: azureuser

SSH Private Key:

```
XRIrK1QCaE0Hg==
-----END RSA PRIVATE KEY-----
```

☑ Use sudo privileges



Credential

Credential Name: azure_anf

Authentication Mode: Azure Credential

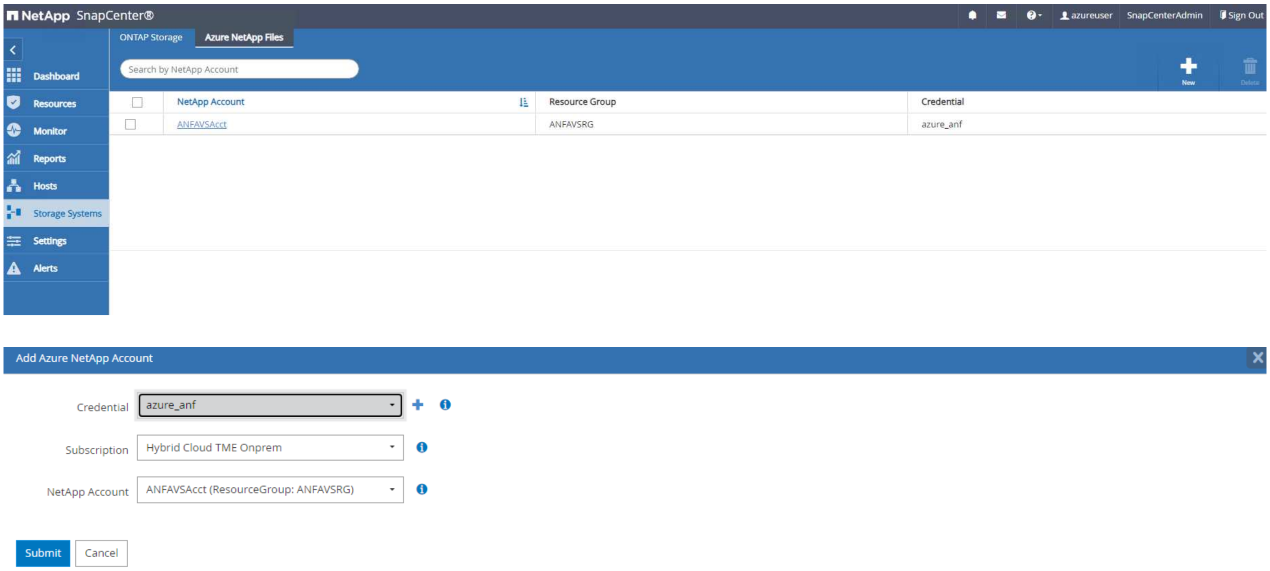
Azure Details

Tenant ID: Enter Tenant Id

Client ID: Enter Client Id

Client Secret Key: Enter client secret key

10. From `Storage Systems` tab, add `Azure NetApp Files` with credential created above.



□	NetApp Account	Resource Group	Credential
□	ANFAVSAcct	ANFAVSRG	azure_anf

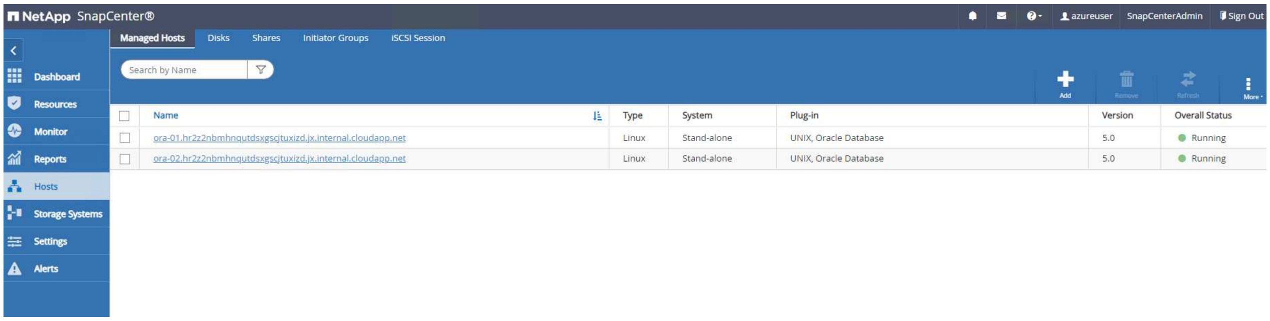
Add Azure NetApp Account

Credential: azure_anf

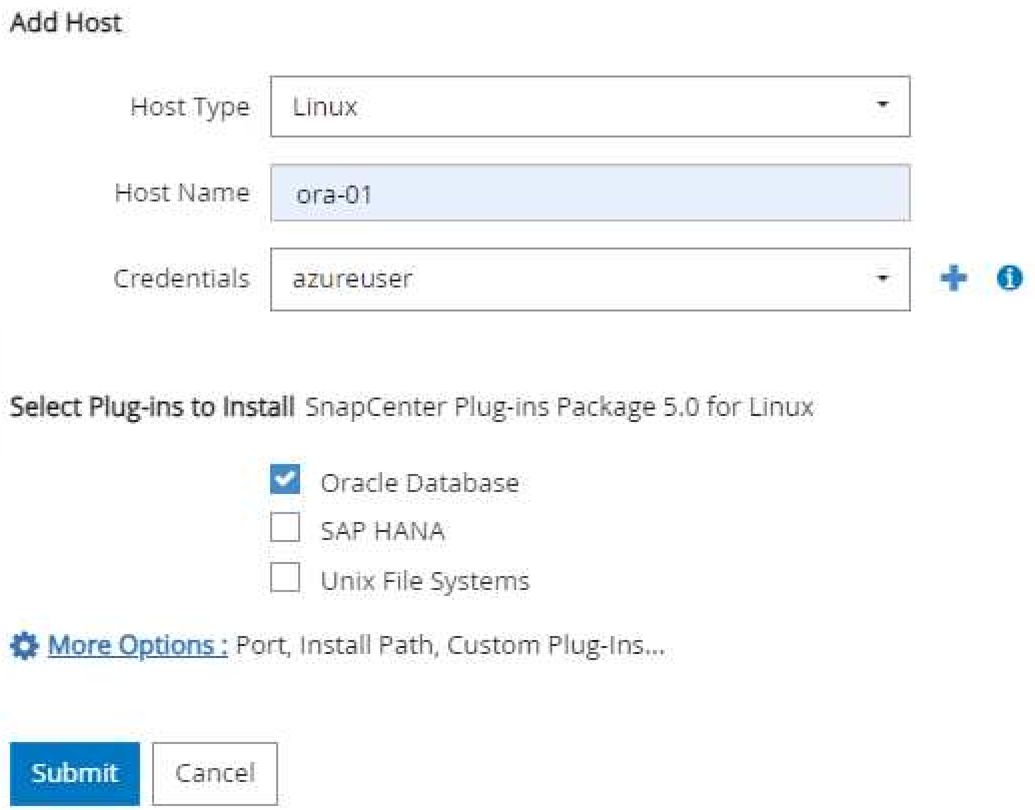
Subscription: Hybrid Cloud TME Onprem

NetApp Account: ANFAVSAcct (ResourceGroup: ANFAVSRG)

11. From `Hosts` tab, add Azure DB VMs, which installs SnapCenter plugin for Oracle on Linux.



	Name	Type	System	Plug-in	Version	Overall Status
□	ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net	Linux	Stand-alone	UNIX, Oracle Database	5.0	● Running
□	ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net	Linux	Stand-alone	UNIX, Oracle Database	5.0	● Running



Add Host

Host Type: Linux

Host Name: ora-01

Credentials: azureuser

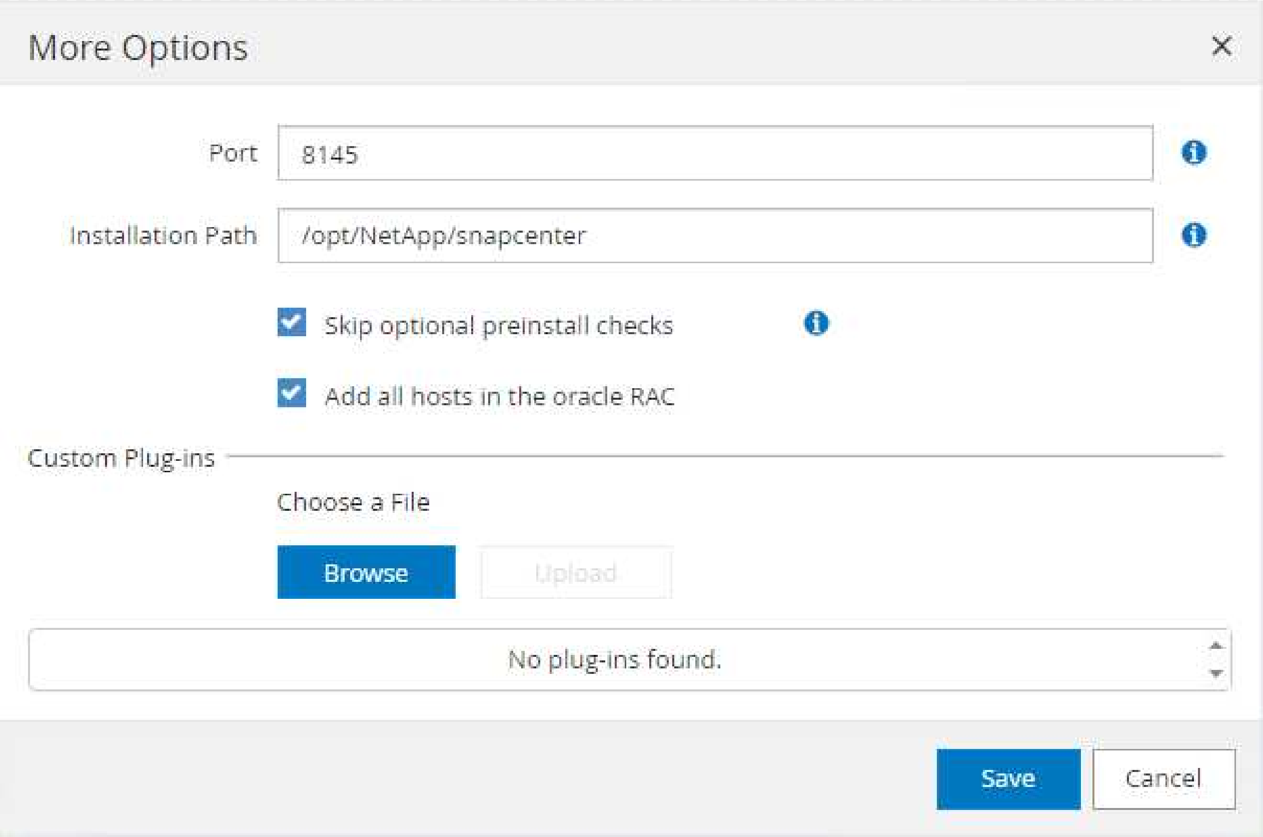
Select Plug-ins to Install SnapCenter Plug-ins Package 5.0 for Linux

☑ Oracle Database

□ SAP HANA

□ Unix File Systems

More Options : Port, Install Path, Custom Plug-Ins...



More Options

Port: 8145

Installation Path: /opt/NetApp/snapcenter

☑ Skip optional preinstall checks

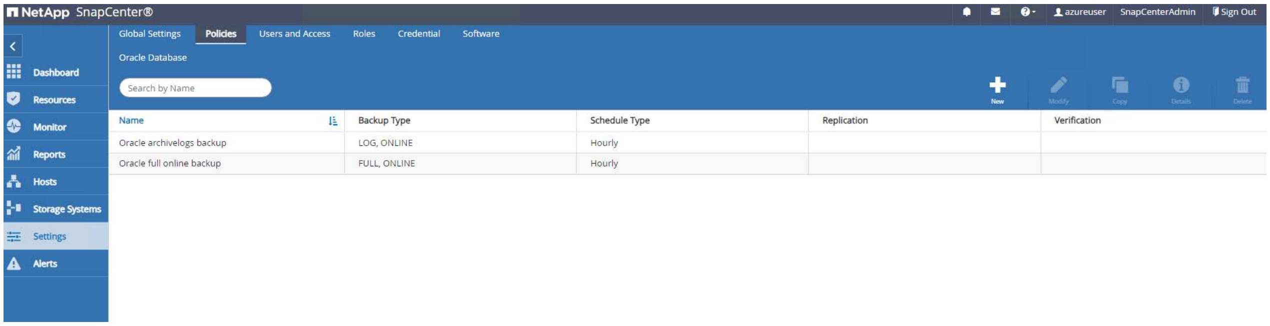
☑ Add all hosts in the oracle RAC

Custom Plug-ins

Choose a File

No plug-ins found.

12. Once host plugin is installed on DB server VM, databases on the host are auto discovered and visible in `Resources` tab. Back to `Settings-Polices`, create backup policies for full Oracle database online backup and archive logs only backup. Refer to this document Create backup policies for Oracle databases for detailed step by step procedures.



Oracle Database

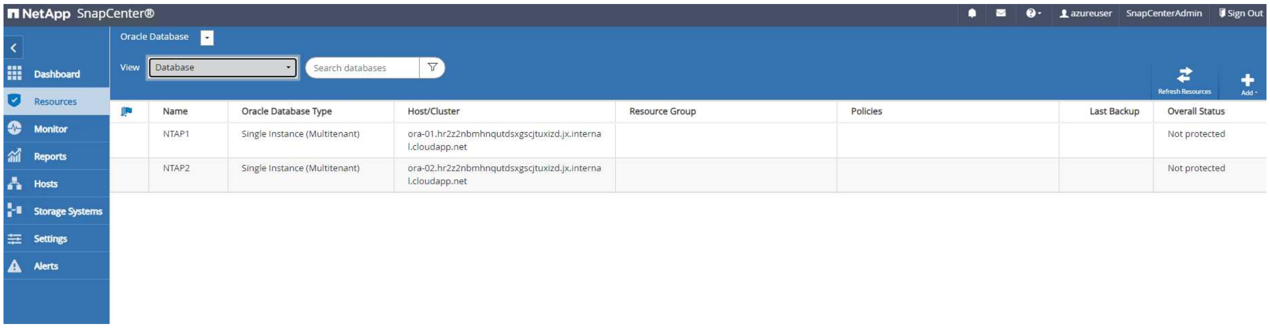
Search by Name

Name	Backup Type	Schedule Type	Replication	Verification
Oracle archivelogs backup	LOG, ONLINE	Hourly		
Oracle full online backup	FULL, ONLINE	Hourly		

Database backup

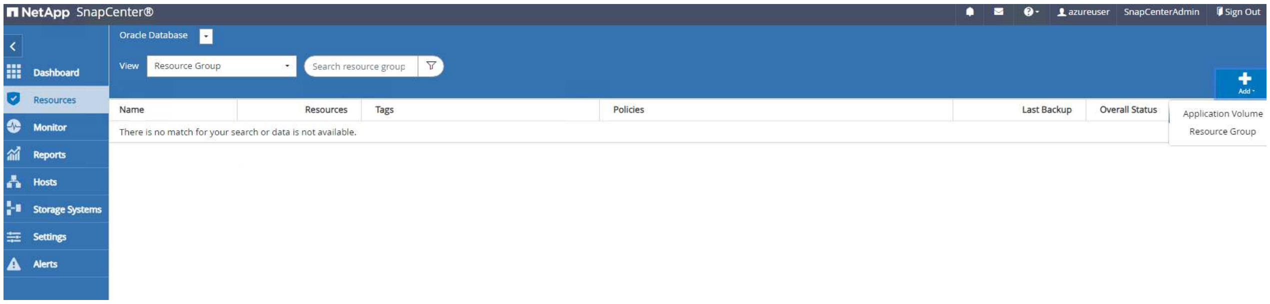
A NetApp snapshot backup creates a point-in-time image of the database volumes that you can use to restore in case of a system failure or data loss. Snapshot backups take very little time, usually less than a minute. The backup image consumes minimal storage space and incurs negligible performance overhead because it records only changes to files since the last snapshot copy was made. Following section demonstrates the implementation of snapshots for Oracle database backup in SnapCenter.

1. Navigating to `Resources` tab, which lists the databases discovered once SnapCenter plugin installed on database VM. Initially, the `Overall Status` of database shows as `Not protected`.



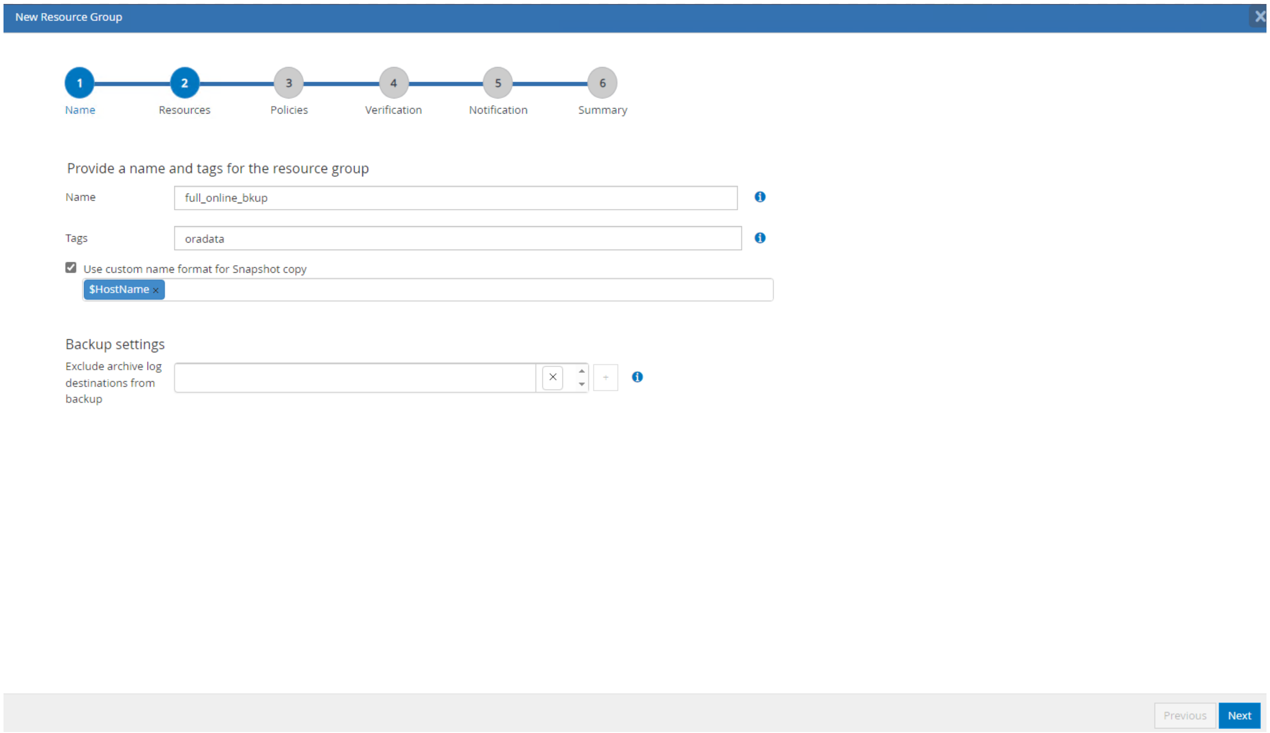
Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status
NTAP1	Single Instance (Multitenant)	ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net				Not protected
NTAP2	Single Instance (Multitenant)	ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net				Not protected

2. Click on `View` drop-down to change to `Resource Group`. Click on `Add` sign on the right to add a Resource Group.



Name	Resources	Tags	Policies	Last Backup	Overall Status
There is no match for your search or data is not available.					

3. Name your resource group, tags, and any custom naming.



New Resource Group

Provide a name and tags for the resource group

Name: full_online_bkup

Tags: oradata

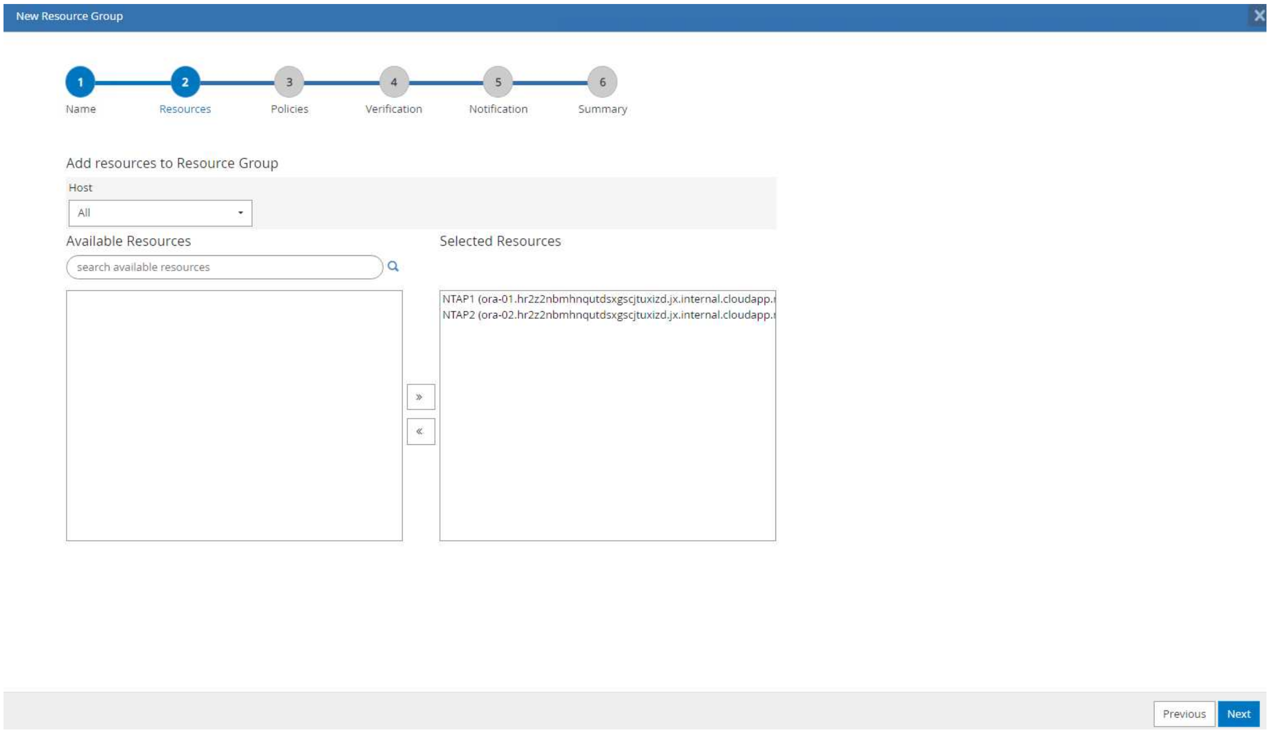
☑ Use custom name format for Snapshot copy

$HostName ×

Backup settings

Exclude archive log destinations from backup

4. Add resources to your `Resource Group`. Grouping of similar resources can simplify database management in a large environment.



New Resource Group

Add resources to Resource Group

Host: All

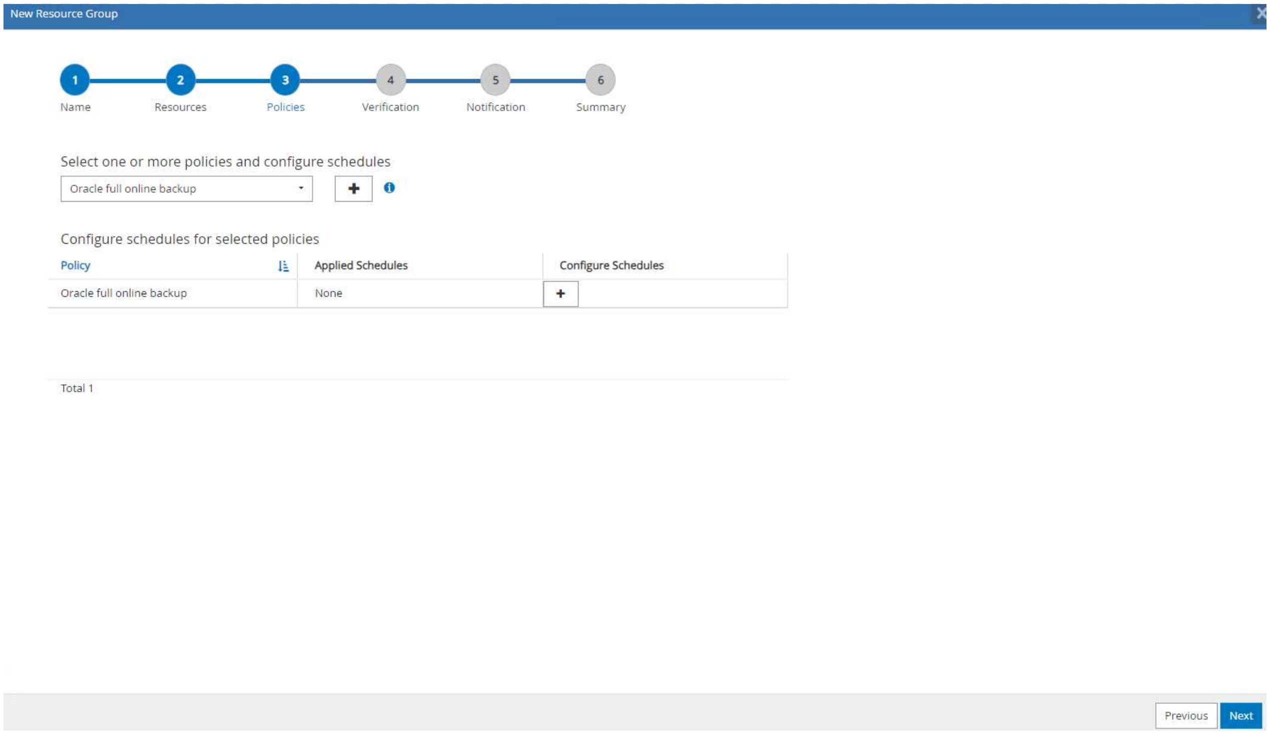
Available Resources

search available resources

Selected Resources

NTAP1 (ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.
NTAP2 (ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.

5. Select the backup policy and set a schedule by click on '+' sign under `Configure Schedules`.



New Resource Group

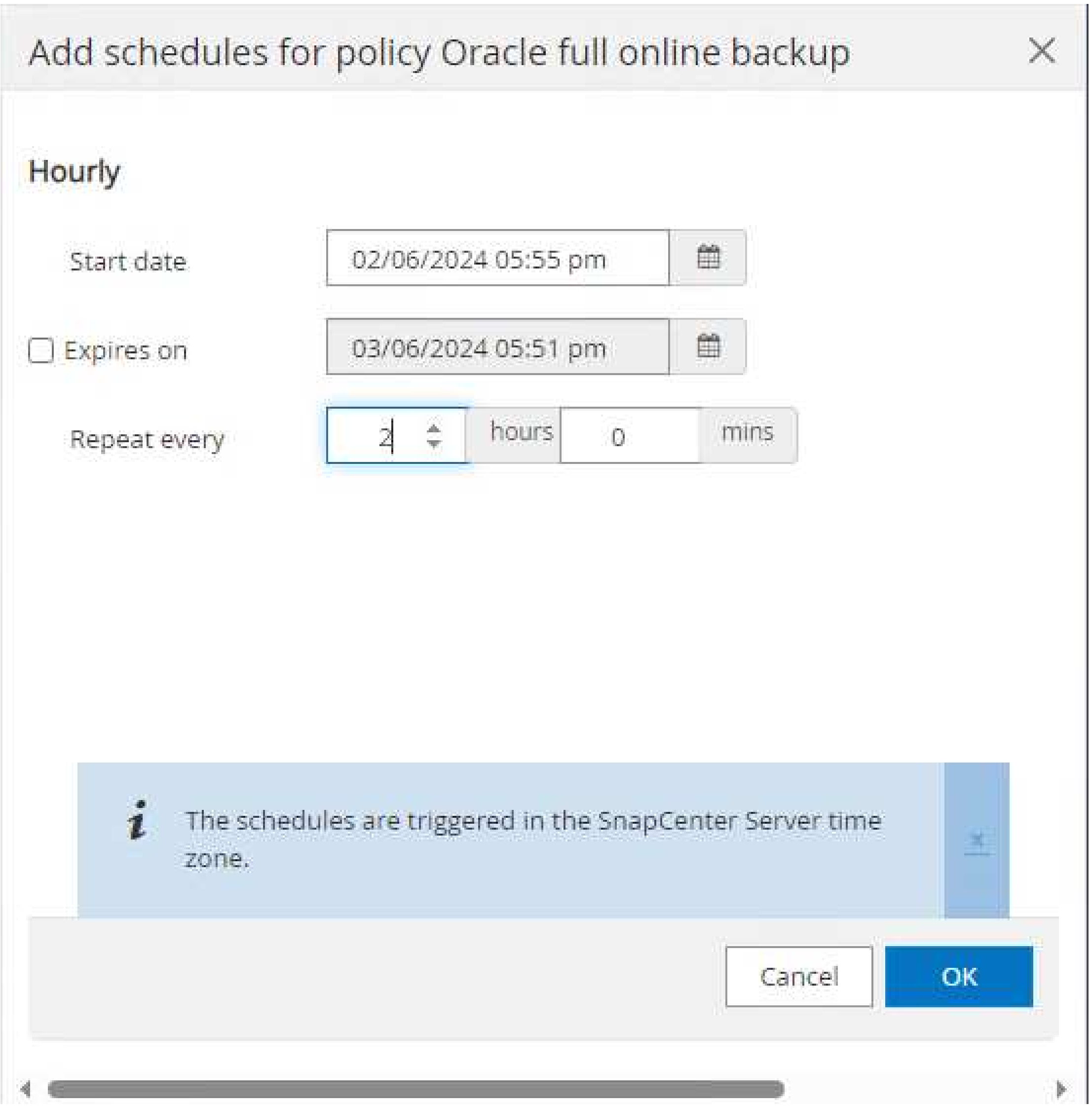
Select one or more policies and configure schedules

Oracle full online backup

Configure schedules for selected policies

Policy	Applied Schedules	Configure Schedules
Oracle full online backup	None	+

Total 1



Add schedules for policy Oracle full online backup

Hourly

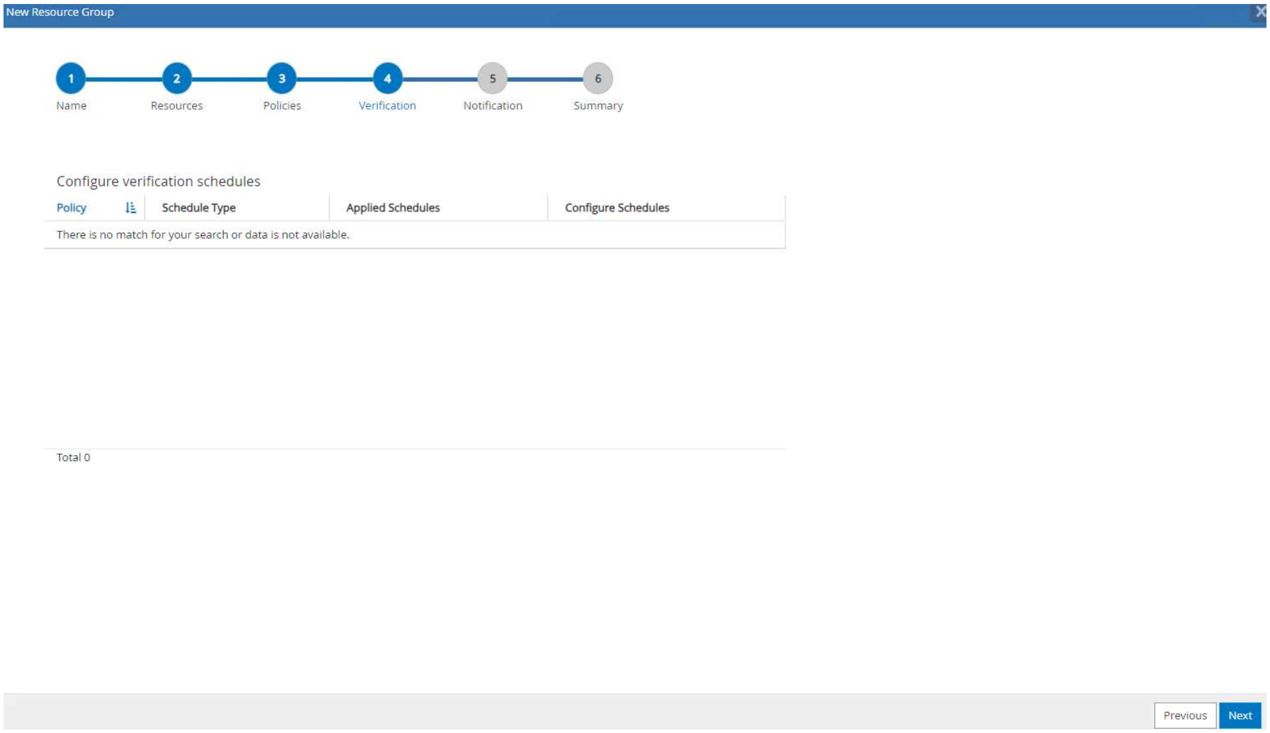
Start date: 02/06/2024 05:55 pm

□ Expires on: 03/06/2024 05:51 pm

Repeat every: 2 hours 0 mins

The schedules are triggered in the SnapCenter Server time zone.

6. If backup verification is not configured in policy, leave verification page as is.

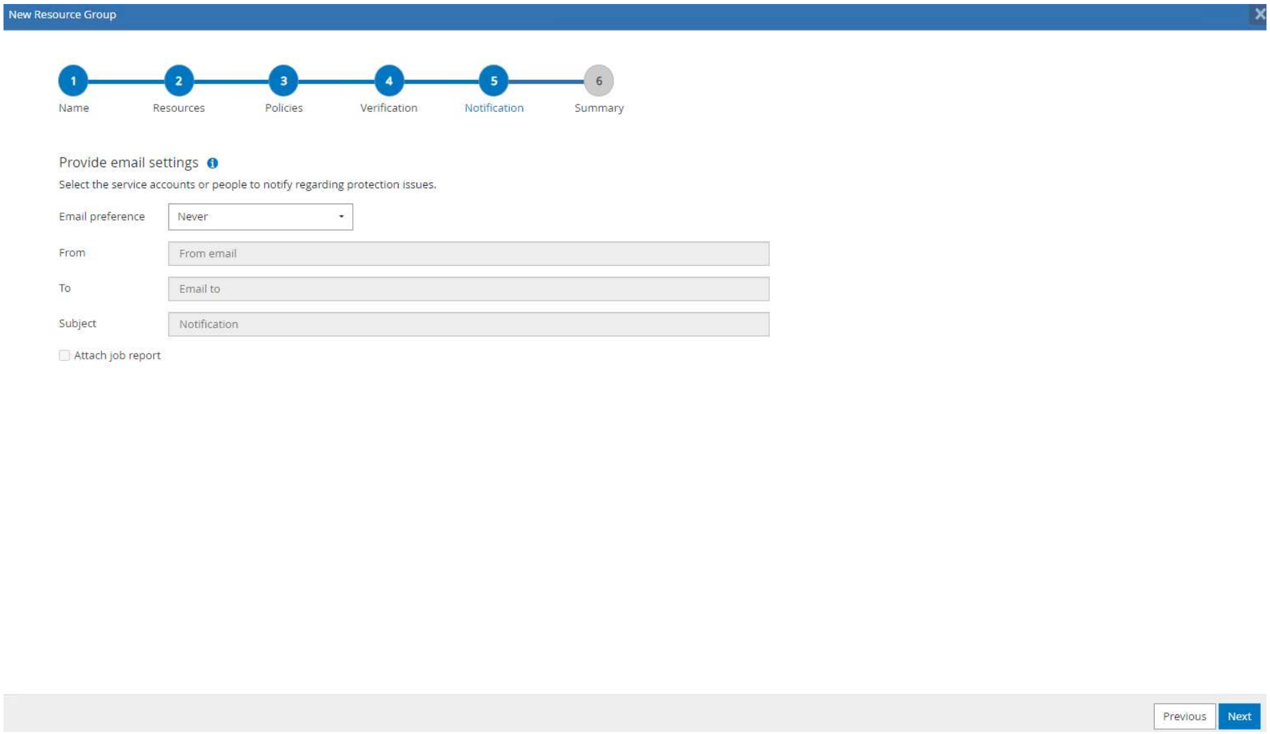


Configure verification schedules

Policy	Schedule Type	Applied Schedules	Configure Schedules
There is no match for your search or data is not available.			

Total 0

7. In order to email a backup report and notification, a SMTP mail server is needed in the environment. Or leave it black if a mail server is not setup.



Provide email settings

Select the service accounts or people to notify regarding protection issues.

Email preference: Never

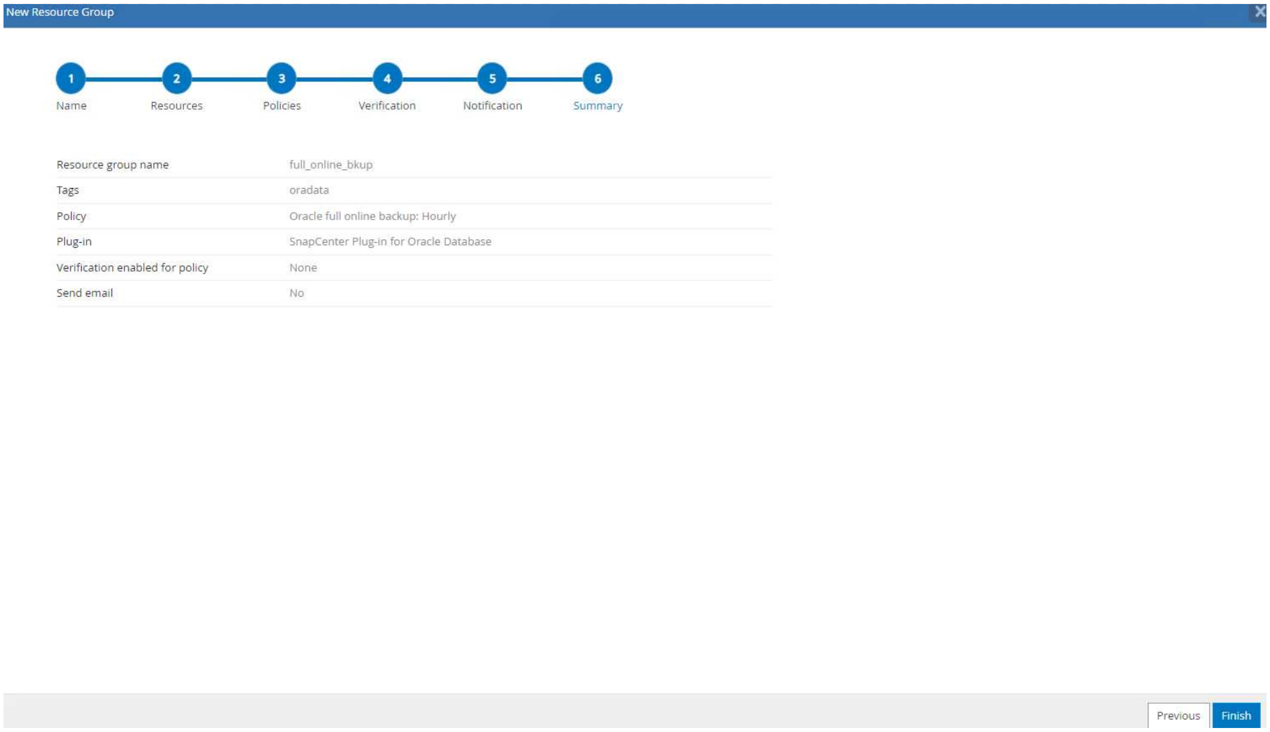
From: From email

To: Email to

Subject: Notification

□ Attach job report

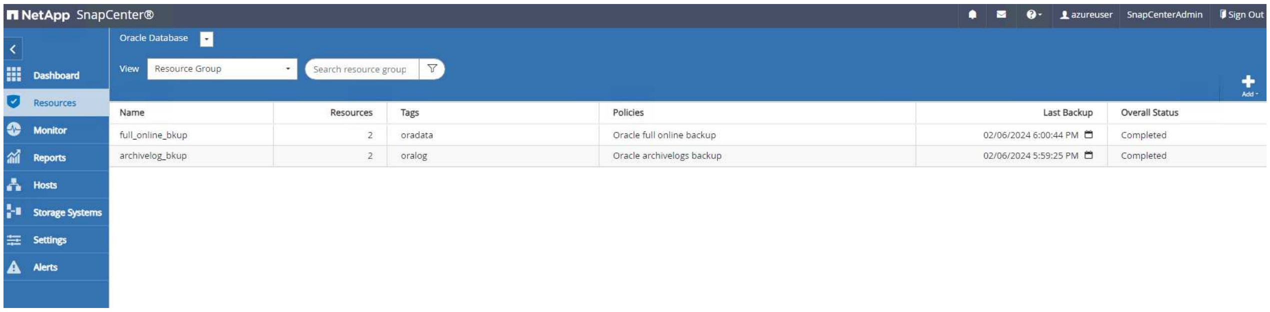
8. Summary of new resource group.



New Resource Group

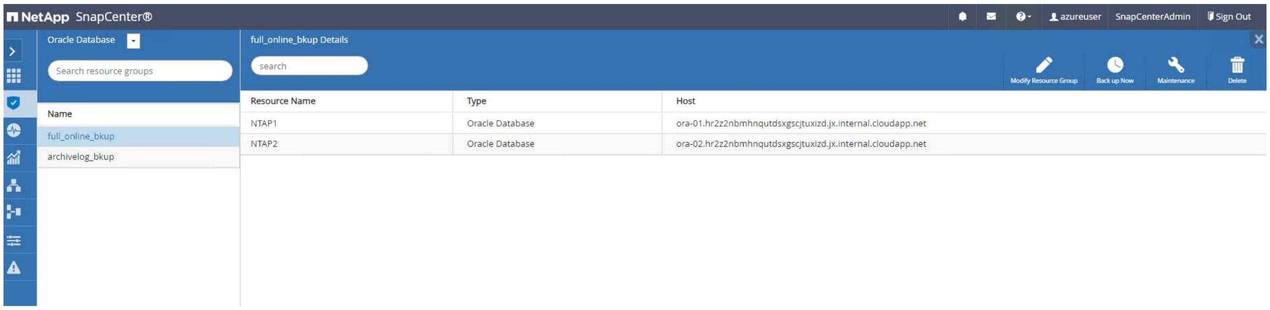
Resource group name	full_online_bkup
Tags	oradata
Policy	Oracle full online backup: Hourly
Plug-in	SnapCenter Plug-in for Oracle Database
Verification enabled for policy	None
Send email	No

9. Repeat the above procedures to create a database archive log only backup with corresponding backup policy.



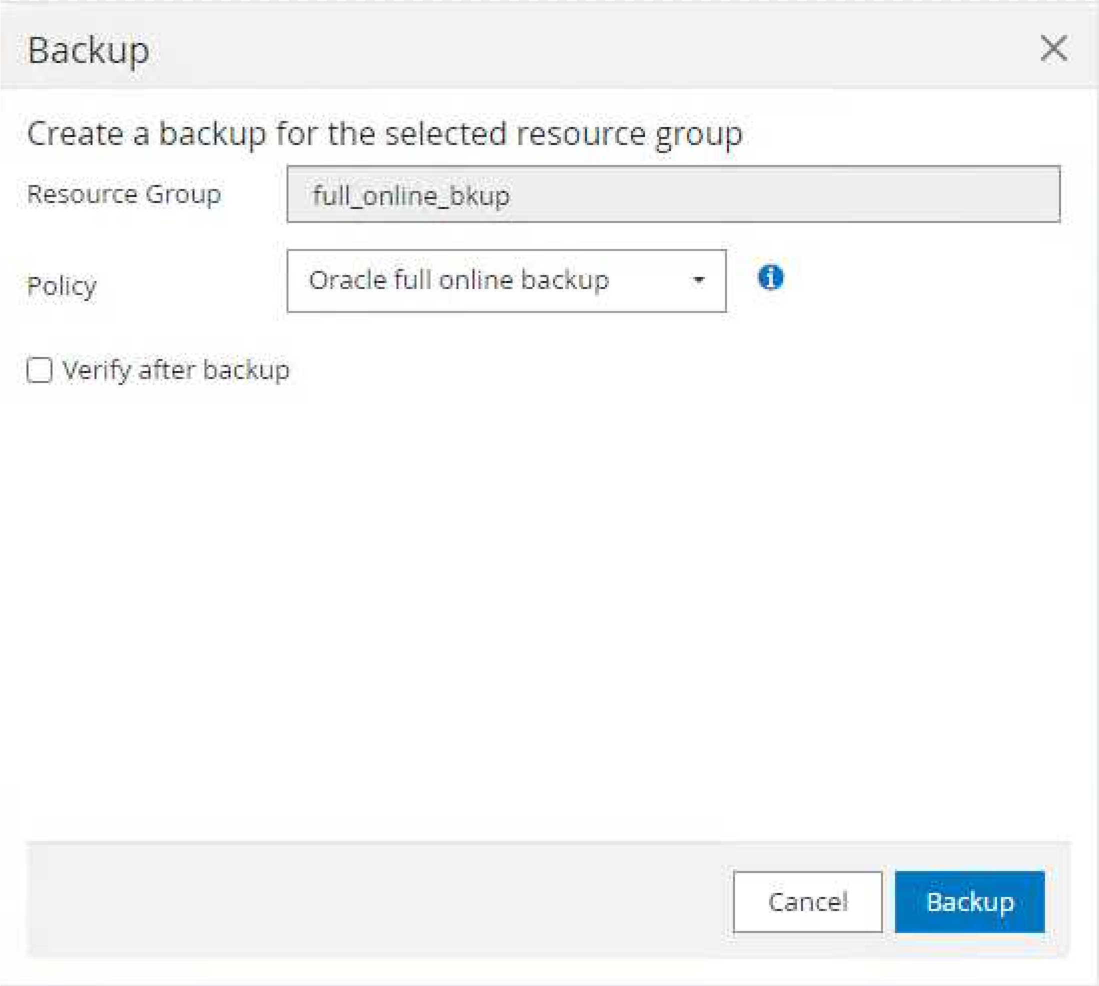
Name	Resources	Tags	Policies	Last Backup	Overall Status
full_online_bkup	2	oradata	Oracle full online backup	02/06/2024 6:00:44 PM	Completed
archivelog_bkup	2	oralog	Oracle archivelogs backup	02/06/2024 5:59:25 PM	Completed

10. Click on a resource group to reveal the resources it includes. Besides the scheduled backup job, an one-off backup can be triggered by clicking on `Backup Now`.



Name
full_online_bkup
archivelog_bkup

Resource Name	Type	Host
NTAP1	Oracle Database	ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net
NTAP2	Oracle Database	ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net



Backup

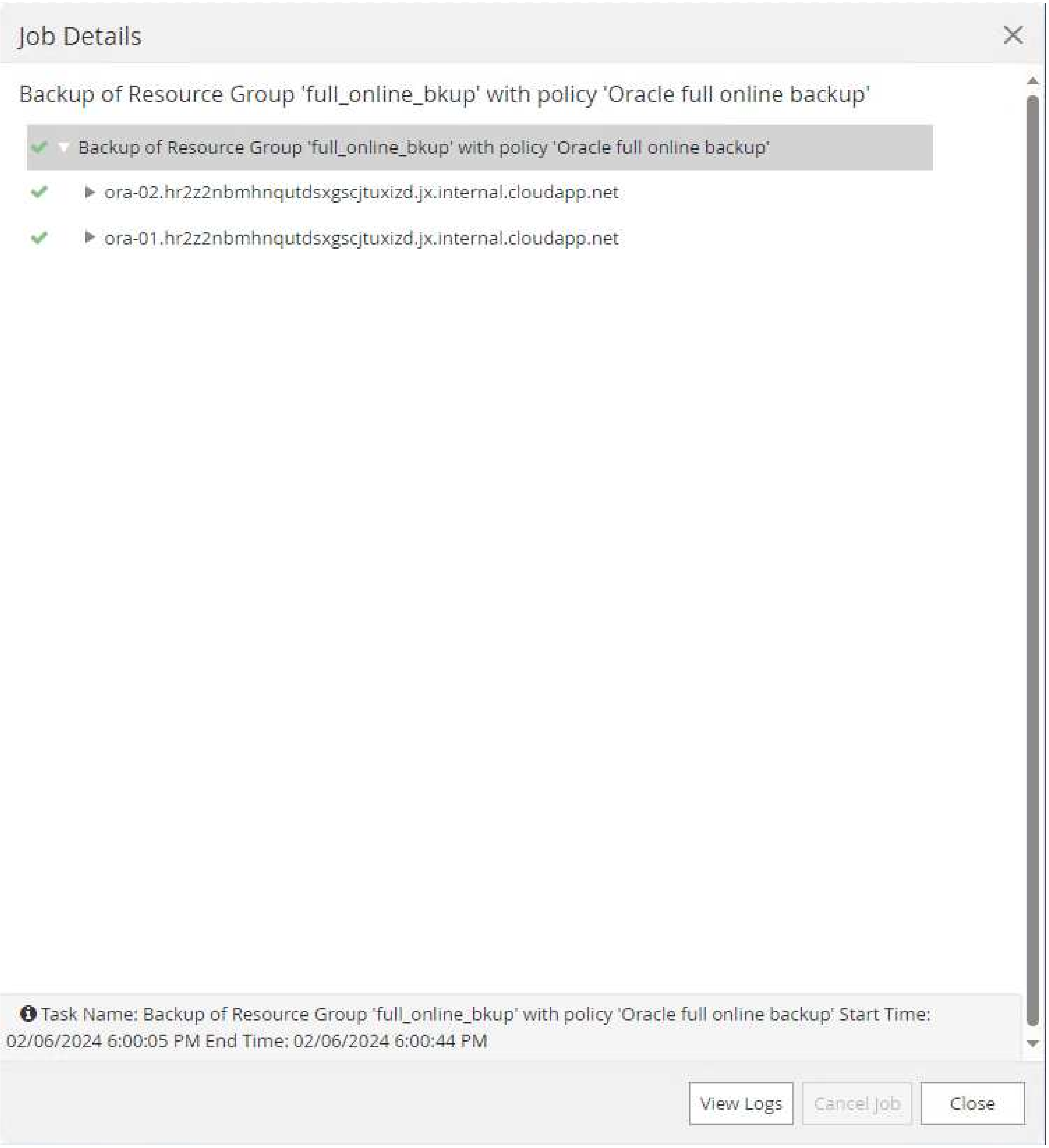
Create a backup for the selected resource group

Resource Group: full_online_bkup

Policy: Oracle full online backup

□ Verify after backup

11. Click on the running job to open a monitoring window, which allows the operator to track the job progress in real-time.



Job Details

Backup of Resource Group 'full_online_bkup' with policy 'Oracle full online backup'

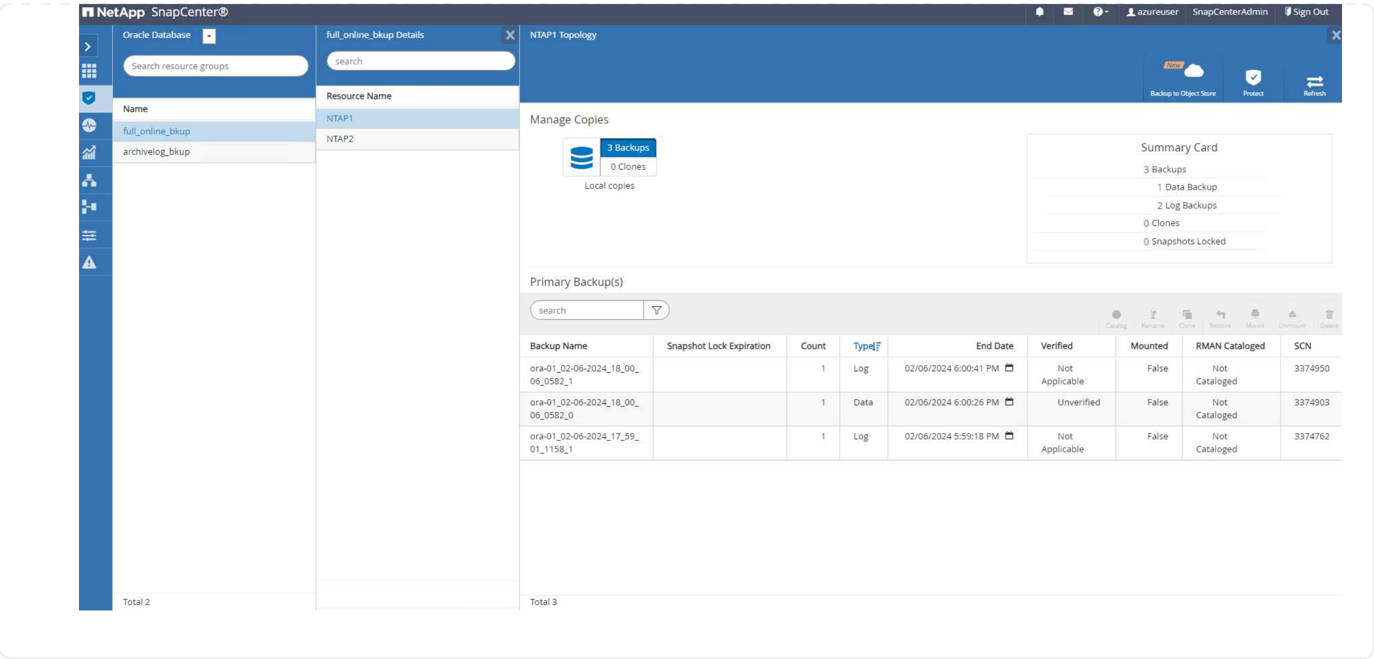
✓ Backup of Resource Group 'full_online_bkup' with policy 'Oracle full online backup'

✓ ▶ ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net

✓ ▶ ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net

Task Name: Backup of Resource Group 'full_online_bkup' with policy 'Oracle full online backup' Start Time: 02/06/2024 6:00:05 PM End Time: 02/06/2024 6:00:44 PM

12. A snapshot backup set appears under database topology once a successful backup job finishes. A full database backup set includes a snapshot of the database data volumes and a snapshot of the database log volumes. A log-only backup contains only a snapshot of the database log volumes.

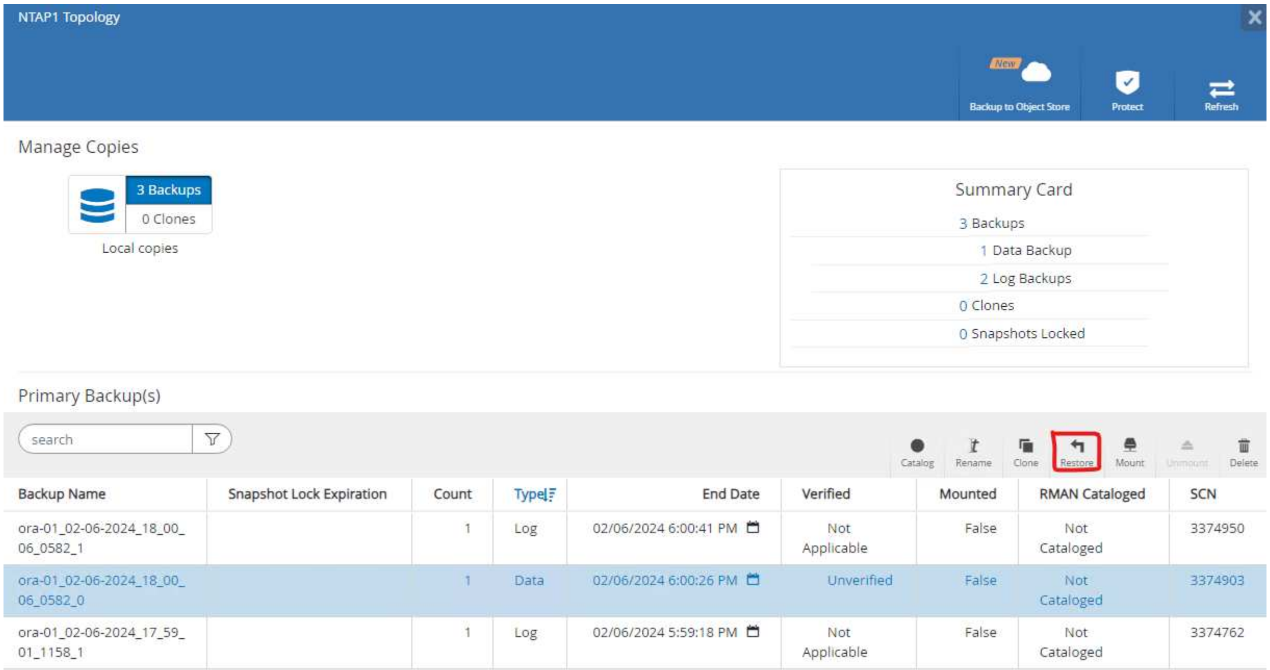


Backup Name	Snapshot Lock Expiration	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
ora-01_02-06-2024_18_00_06_0582_1		1	Log	02/06/2024 6:00:41 PM	Not Applicable	False	Not Cataloged	3374950
ora-01_02-06-2024_18_00_06_0582_0		1	Data	02/06/2024 6:00:26 PM	Unverified	False	Not Cataloged	3374903
ora-01_02-06-2024_17_59_01_1158_1		1	Log	02/06/2024 5:59:18 PM	Not Applicable	False	Not Cataloged	3374762

Database recovery

Database recovery via SnapCenter restores a snapshot copy of the database volume image point-in-time. The database is then rolled forward to a desired point by SCN/timestamp or a point as allowed by available archive logs in the backup set. The following section demonstrates the workflow of database recovery with SnapCenter UI.

1. From `Resources` tab, open the database `Primary Backup(s)` page. Choose the snapshot of database data volume, then click on `Restore` button to launch database recovery workflow. Note the SCN number or timestamp in the backup sets if you like to run the recovery by Oracle SCN or timestamp.



Manage Copies

3 Backups
0 Clones
Local copies

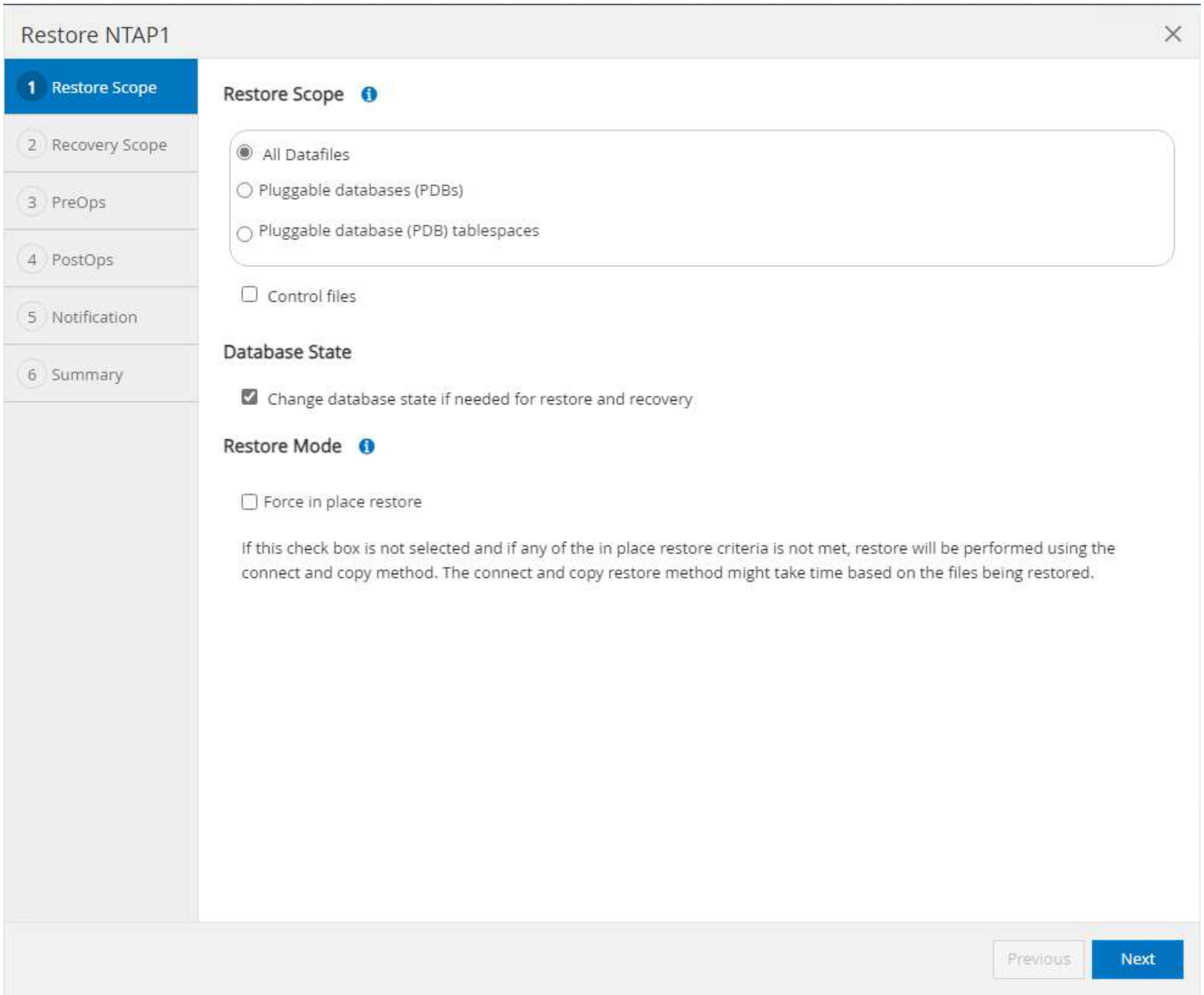
Summary Card

3 Backups
1 Data Backup
2 Log Backups
0 Clones
0 Snapshots Locked

Primary Backup(s)

Backup Name	Snapshot Lock Expiration	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
ora-01_02-06-2024_18_00_06_0582_1		1	Log	02/06/2024 6:00:41 PM	Not Applicable	False	Not Cataloged	3374950
ora-01_02-06-2024_18_00_06_0582_0		1	Data	02/06/2024 6:00:26 PM	Unverified	False	Not Cataloged	3374903
ora-01_02-06-2024_17_59_01_1158_1		1	Log	02/06/2024 5:59:18 PM	Not Applicable	False	Not Cataloged	3374762

2. Select `Restore Scope`. For a container database, SnapCenter is flexible to perform a full container database (All Datafiles), pluggable databases, or tablespaces level restore.



Restore Scope

● All Datafiles

○ Pluggable databases (PDBs)

○ Pluggable database (PDB) tablespaces

□ Control files

Database State

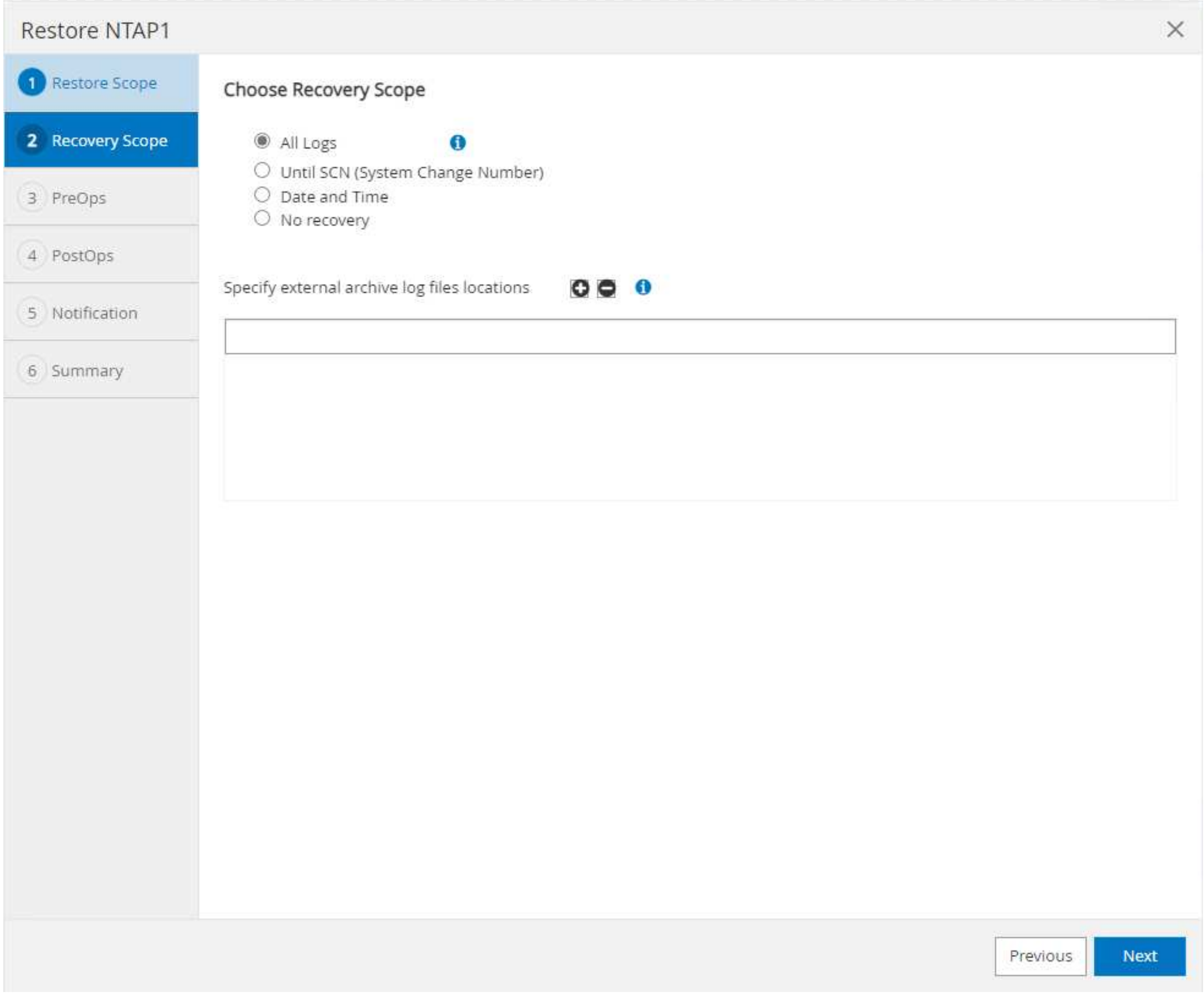
☑ Change database state if needed for restore and recovery

Restore Mode

□ Force in place restore

If this check box is not selected and if any of the in place restore criteria is not met, restore will be performed using the connect and copy method. The connect and copy restore method might take time based on the files being restored.

3. Select `Recovery Scope`. `All logs` means to apply all available archive logs in the backup set. Point-in-time recovery by SCN or timestamp are also available.



Restore NTAP1

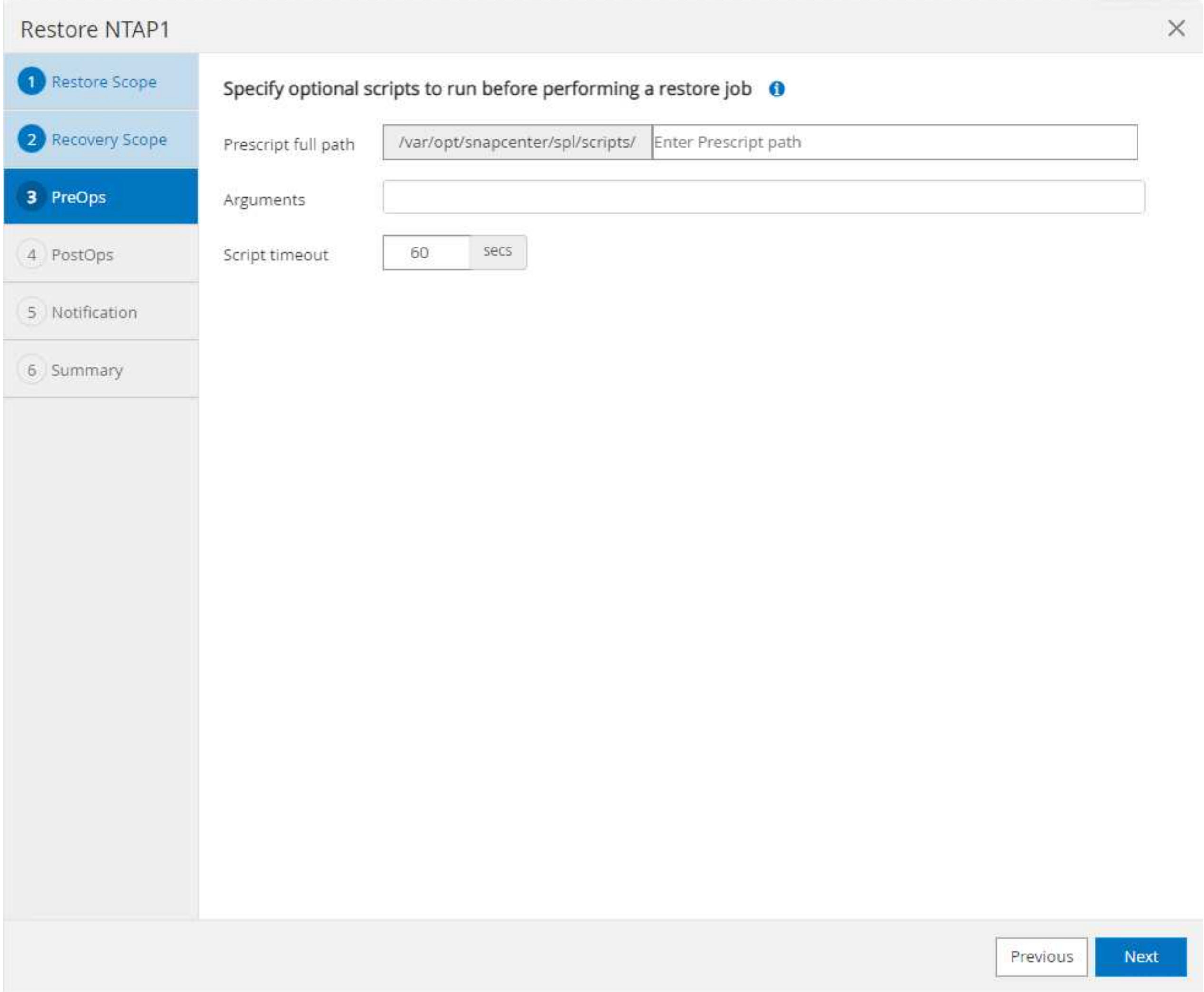
1 Restore Scope
2 Recovery Scope
3 PreOps
4 PostOps
5 Notification
6 Summary

Choose Recovery Scope

● All Logs
○ Until SCN (System Change Number)
○ Date and Time
○ No recovery

Specify external archive log files locations

4. The `PreOps` allows execution of scripts against database before restore/recovery operation.



Restore NTAP1

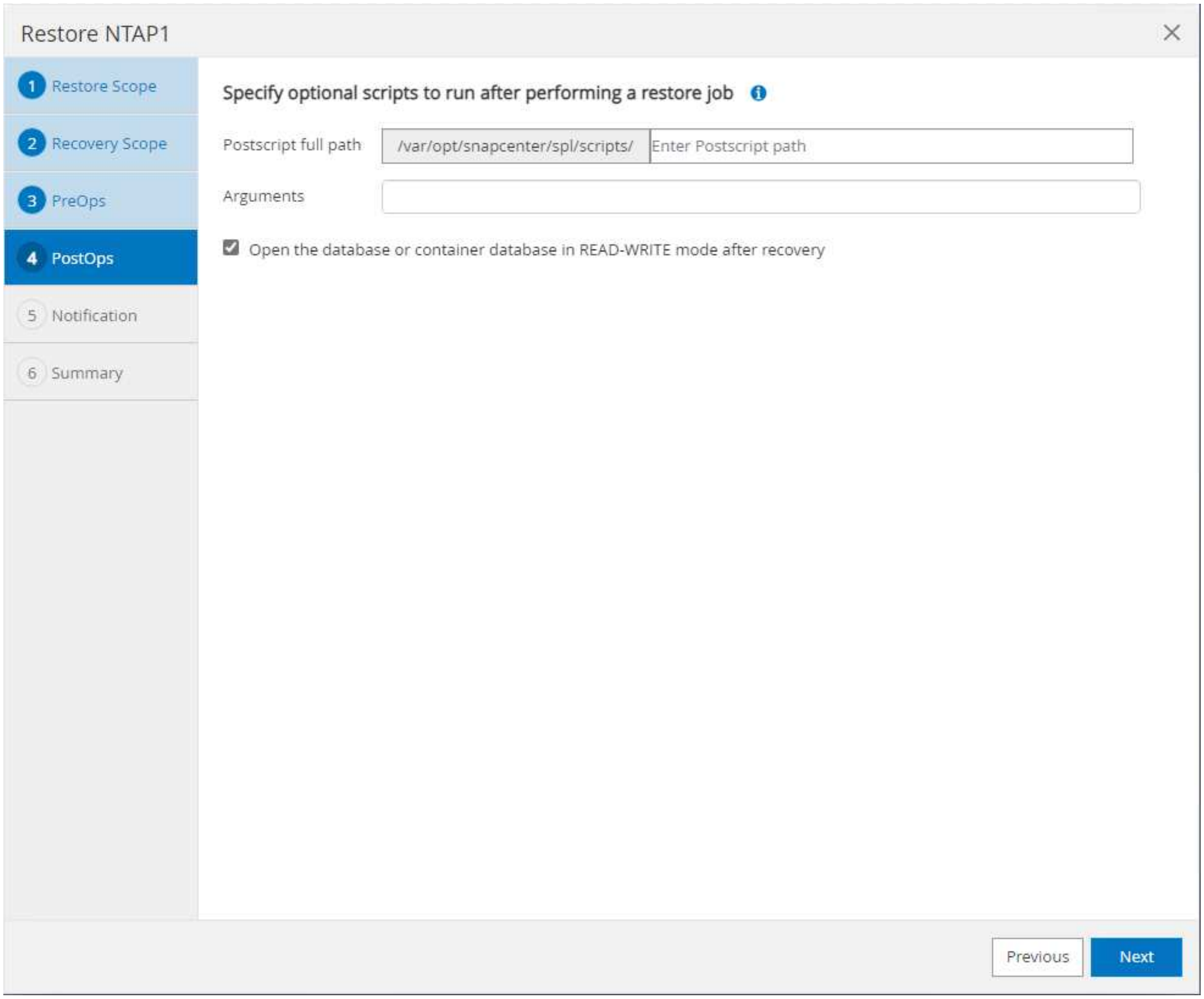
Specify optional scripts to run before performing a restore job

Prescript full path: /var/opt/snapcenter/spl/scripts/ Enter Prescript path

Arguments:

Script timeout: 60 secs

5. The `PostOps` allows execution of scripts against database after restore/recovery operation.



Restore NTAP1

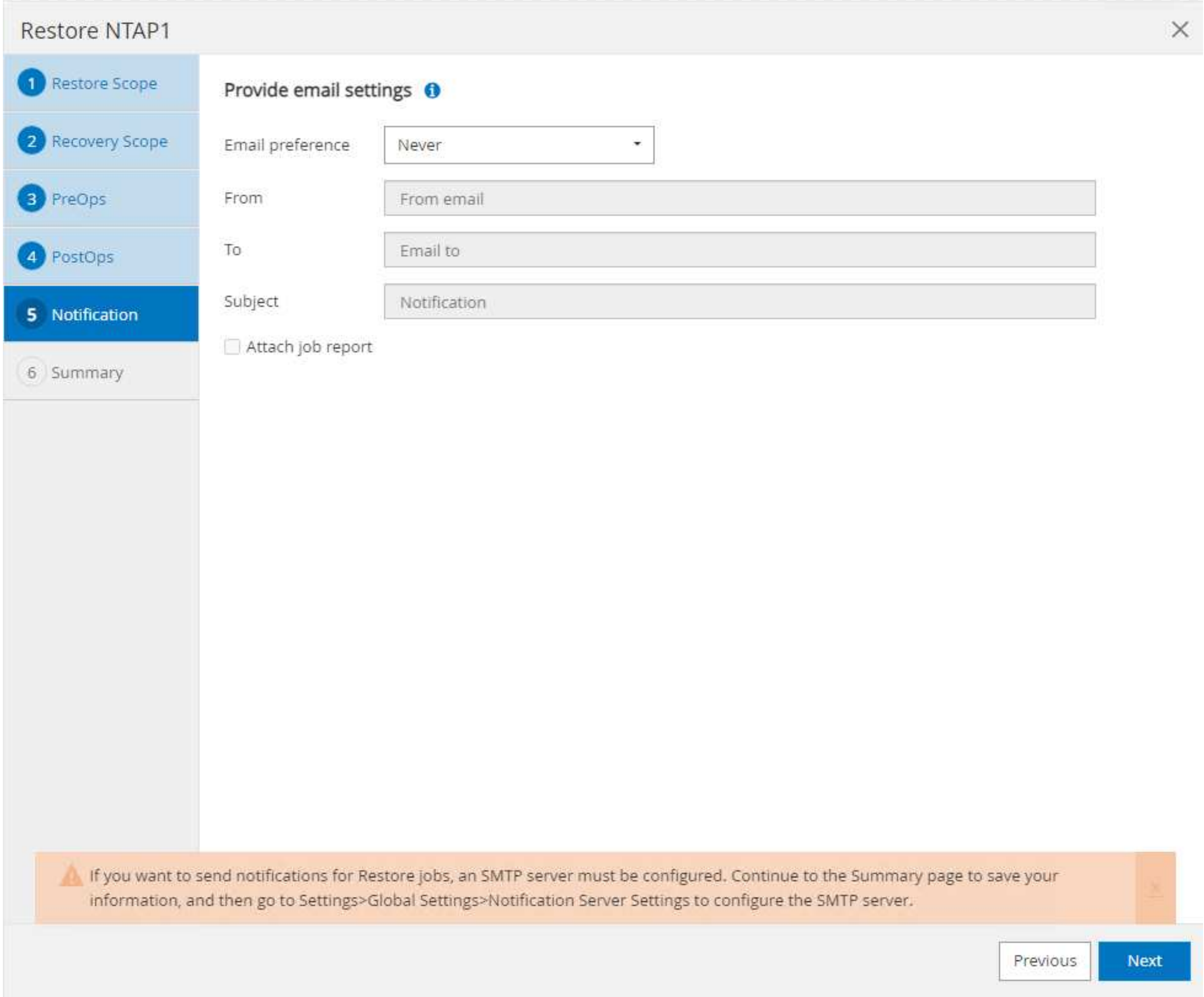
Specify optional scripts to run after performing a restore job

Postscript full path /var/opt/snapcenter/spl/scripts/ Enter Postscript path

Arguments

☑ Open the database or container database in READ-WRITE mode after recovery

6. Notification via email if desired.



Provide email settings

Email preference: Never

From: From email

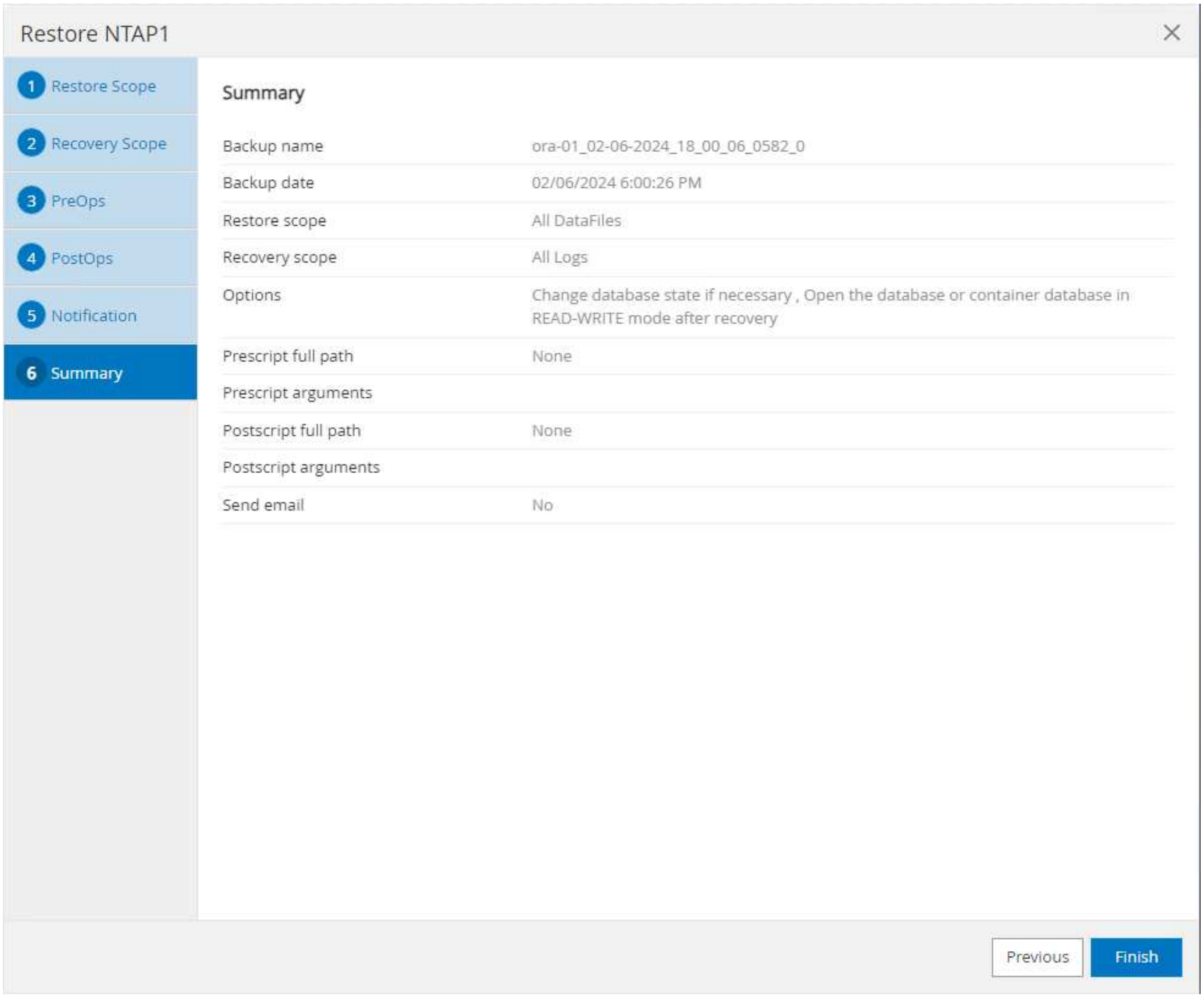
To: Email to

Subject: Notification

□ Attach job report

If you want to send notifications for Restore jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTP server.

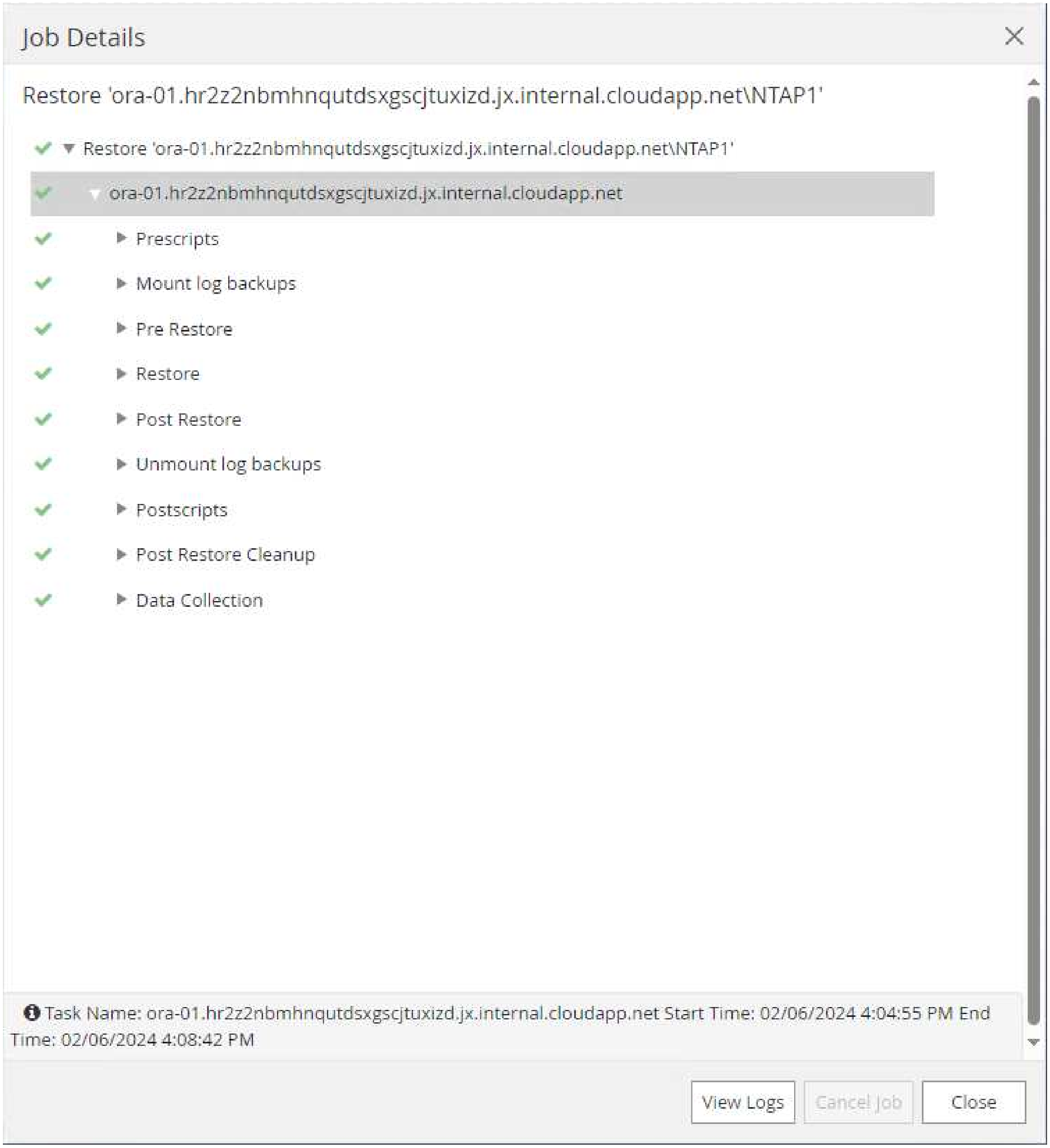
7. Restore job summary



Summary

Backup name	ora-01_02-06-2024_18_00_06_0582_0
Backup date	02/06/2024 6:00:26 PM
Restore scope	All DataFiles
Recovery scope	All Logs
Options	Change database state if necessary , Open the database or container database in READ-WRITE mode after recovery
Prescript full path	None
Prescript arguments	
Postscript full path	None
Postscript arguments	
Send email	No

8. Click on running job to open `Job Details` window. The job status can also be opened and viewed from the `Monitor` tab.



Job Details

Restore 'ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net\NTAP1'

✓ ▼ Restore 'ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net\NTAP1'

✓ ▼ ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net

✓ ▶ Prescripts

✓ ▶ Mount log backups

✓ ▶ Pre Restore

✓ ▶ Restore

✓ ▶ Post Restore

✓ ▶ Unmount log backups

✓ ▶ Postscripts

✓ ▶ Post Restore Cleanup

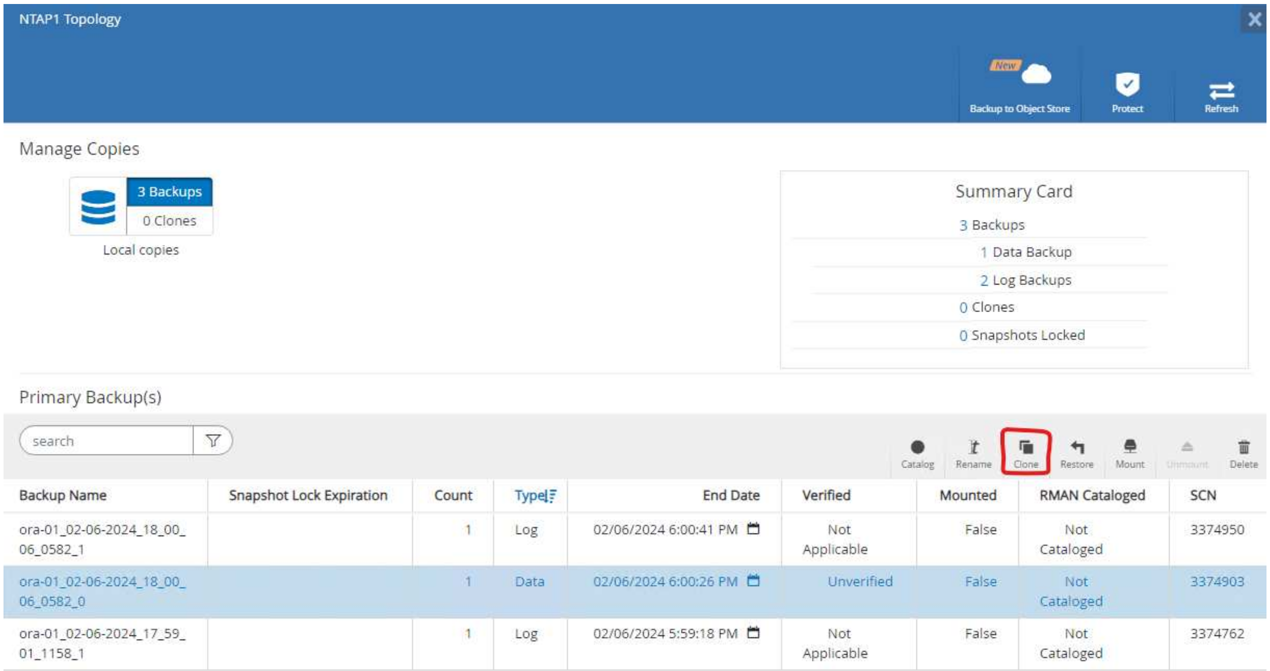
✓ ▶ Data Collection

Task Name: ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net Start Time: 02/06/2024 4:04:55 PM End Time: 02/06/2024 4:08:42 PM

Database clone

Database clone via SnapCenter is accomplished by creating a new volume from a snapshot of a volume. The system uses the snapshot information to clone a new volume using the data on the volume when the snapshot was taken. More importantly, it is quick (a few minutes) and efficient compared with other methods to make a cloned copy of the production database to support development or testing. Thus, dramatically improve your database application lifecycle management. The following section demonstrates the workflow of database clone with SnapCenter UI.

1. From `Resources` tab, open the database `Primary Backup(s)` page. Choose the snapshot of database data volume, then click on `clone` button to launch database clone workflow.



Manage Copies

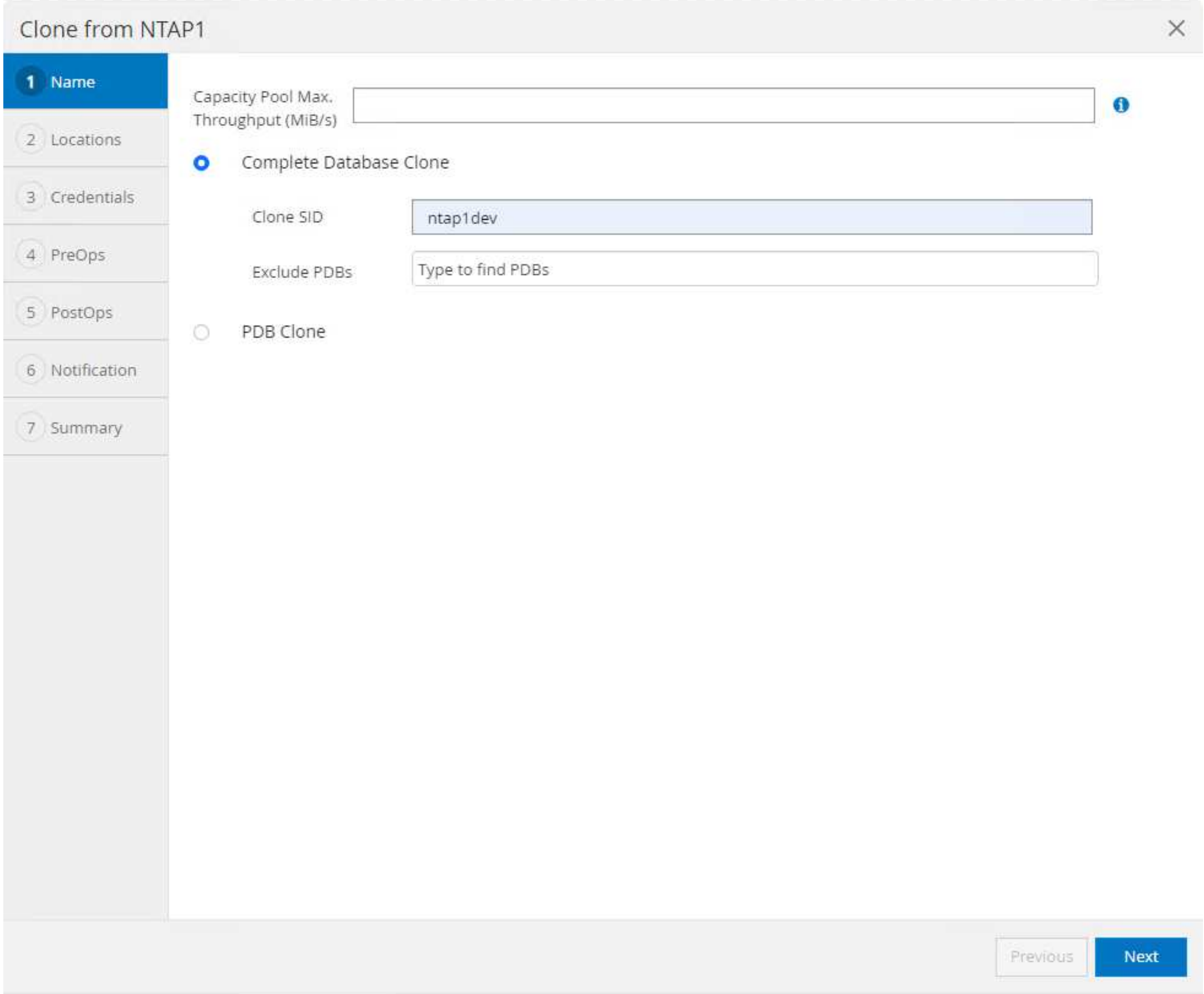
3 Backups
0 Clones
Local copies

Summary Card
3 Backups
1 Data Backup
2 Log Backups
0 Clones
0 Snapshots Locked

Primary Backup(s)

Backup Name	Snapshot Lock Expiration	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
ora-01_02-06-2024_18_00_06_0582_1		1	Log	02/06/2024 6:00:41 PM	Not Applicable	False	Not Cataloged	3374950
ora-01_02-06-2024_18_00_06_0582_0		1	Data	02/06/2024 6:00:26 PM	Unverified	False	Not Cataloged	3374903
ora-01_02-06-2024_17_59_01_1158_1		1	Log	02/06/2024 5:59:18 PM	Not Applicable	False	Not Cataloged	3374762

2. Name the clone database SID. Optionally, for a container database, clone can be done at PDB level as well.



Clone from NTAP1

Capacity Pool Max. Throughput (MiB/s)

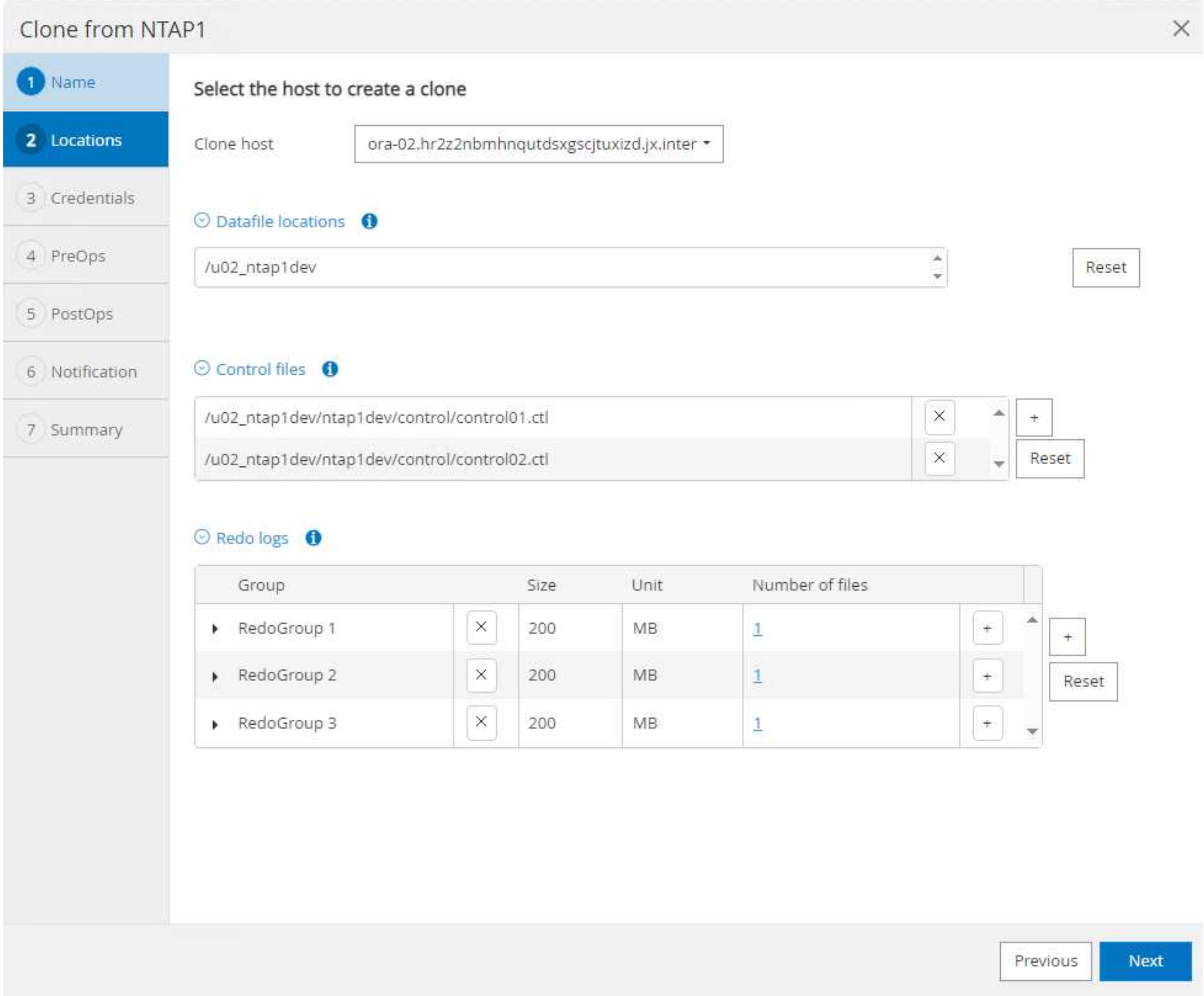
● Complete Database Clone

Clone SID: ntap1dev

Exclude PDBs: Type to find PDBs

○ PDB Clone

3. Select the DB server where you want to place your cloned database copy. Keep the default file locations unless you want to name them differently.



Clone from NTAP1

Select the host to create a clone

Clone host: ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.inter

Datafile locations

/u02_ntap1dev

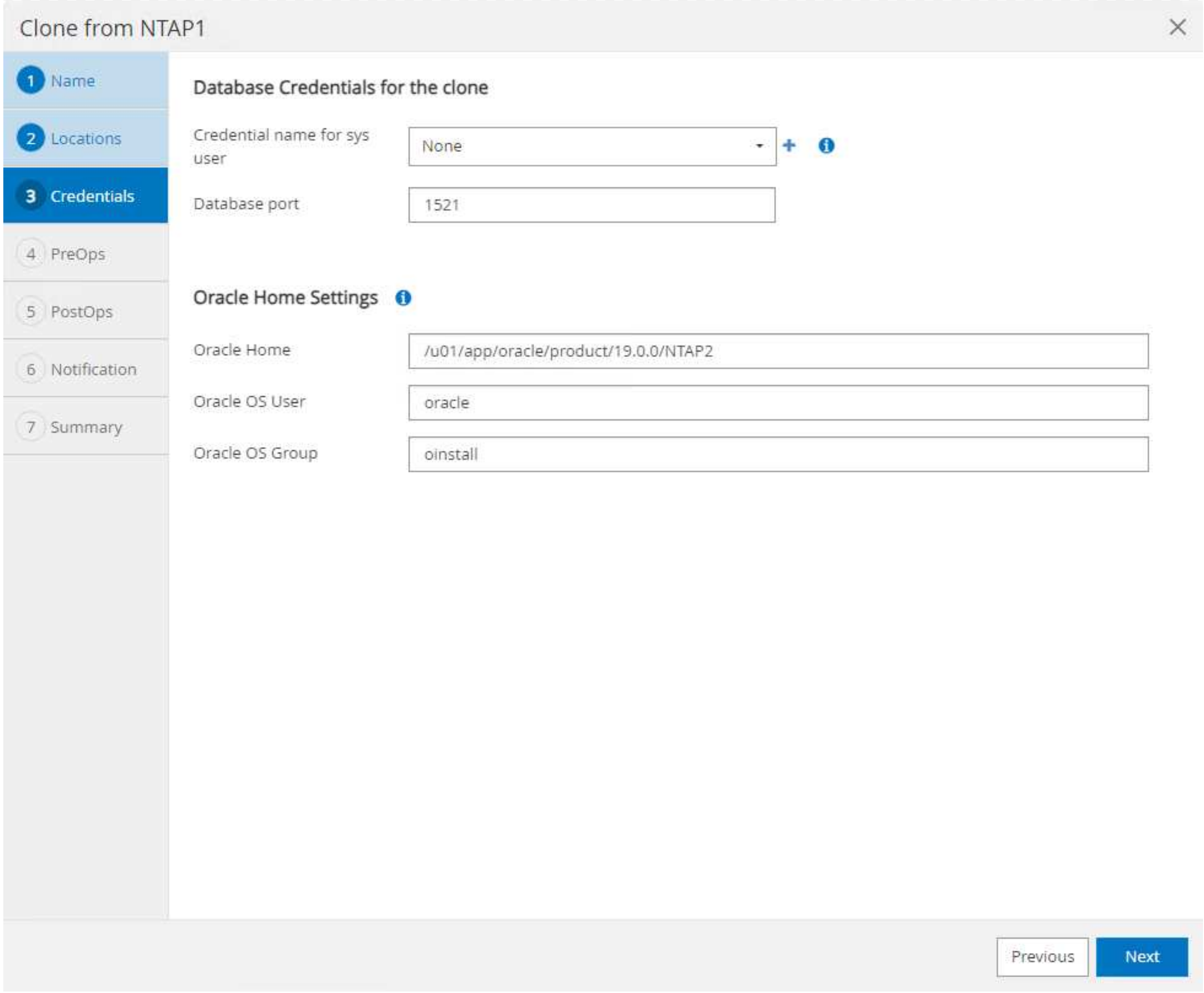
Control files

/u02_ntap1dev/ntap1dev/control/control01.ctl
/u02_ntap1dev/ntap1dev/control/control02.ctl

Redo logs

Group	Size	Unit	Number of files
RedoGroup 1	200	MB	1
RedoGroup 2	200	MB	1
RedoGroup 3	200	MB	1

4. Identical Oracle software stack as in source database should have been installed and configured on clone DB host. Keep the default credential but change `Oracle Home Settings` to match with settings on clone DB host.



Clone from NTAP1

Database Credentials for the clone

Credential name for sys user: None

Database port: 1521

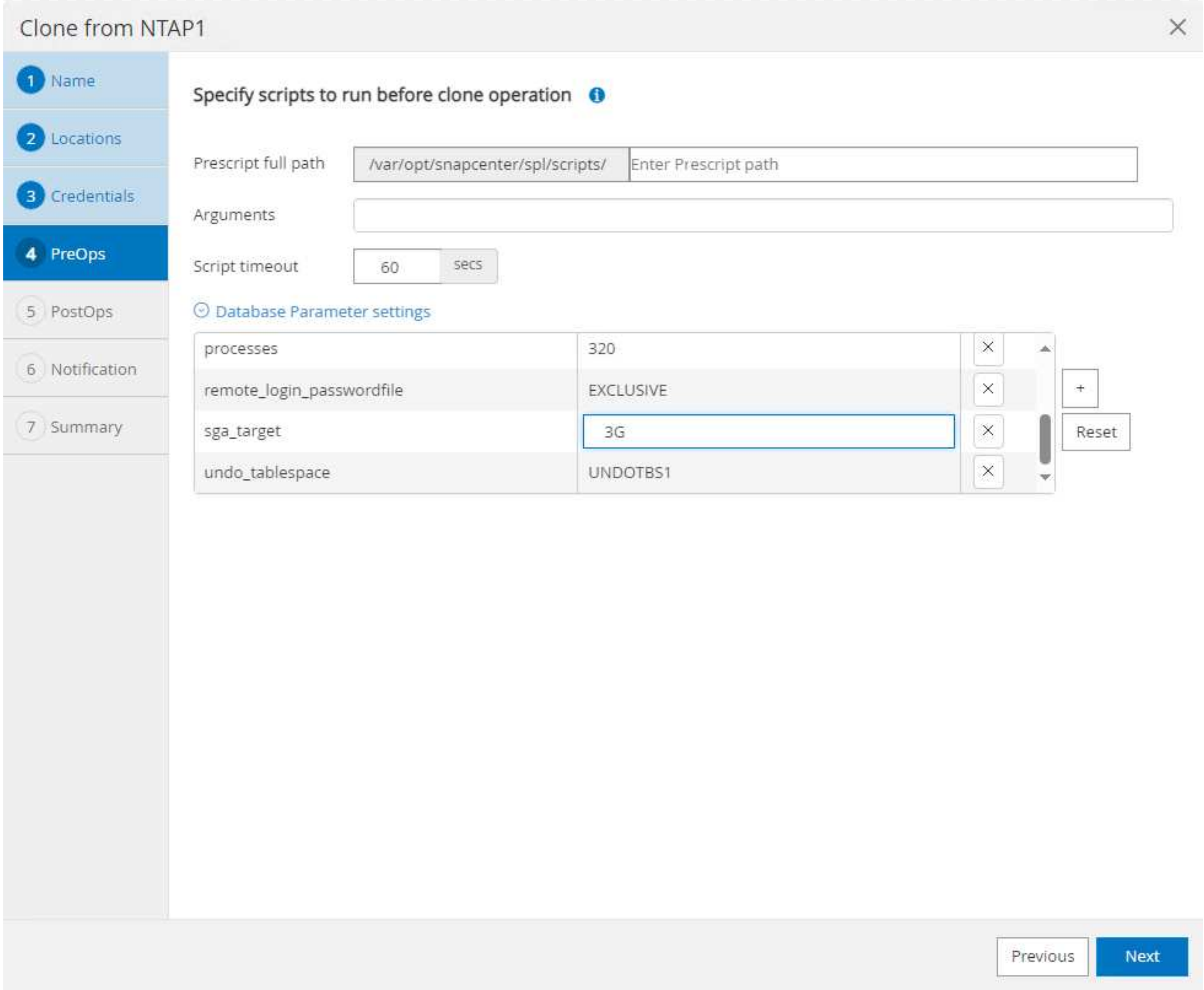
Oracle Home Settings

Oracle Home: /u01/app/oracle/product/19.0.0/NTAP2

Oracle OS User: oracle

Oracle OS Group: oinstall

5. The `PreOps` allows execution of scripts before clone operation. Database parameters can be adjusted to meet a clone DB needs as versus a production database, such as reduced SGA target.



Clone from NTAP1

Specify scripts to run before clone operation

Prescript full path: /var/opt/snapcenter/spl/scripts/ Enter Prescript path

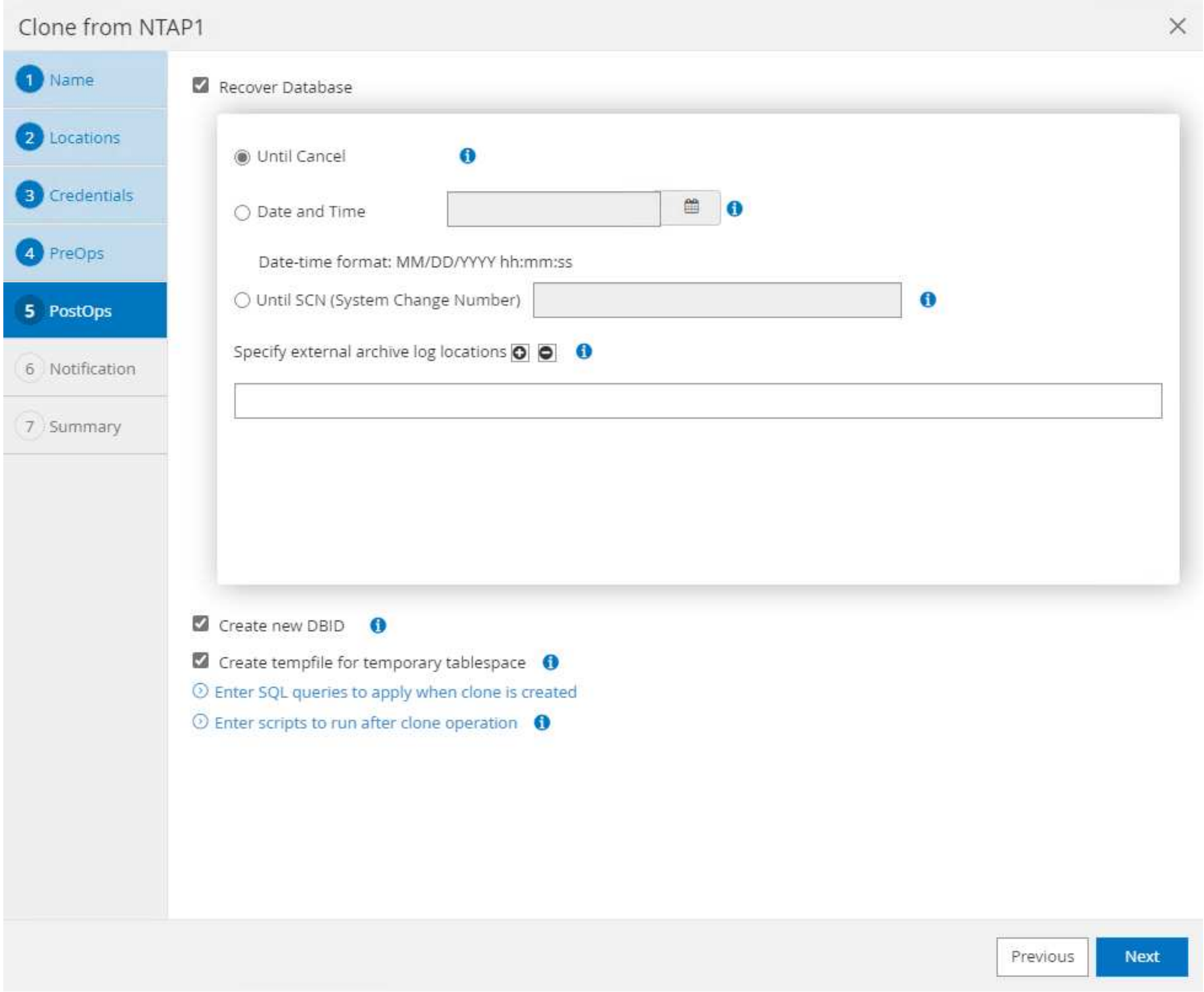
Arguments:

Script timeout: 60 secs

Database Parameter settings

processes	320
remote_login_passwordfile	EXCLUSIVE
sga_target	3G
undo_tablespace	UNDOTBS1

6. The `PostOps` allows execution of scripts against database after clone operation. Clone database recovery can be SCN, timestamp based, or Until cancel (rolling forward database to last archived log in the backup set).



Clone from NTAP1

☑ Recover Database

● Until Cancel

○ Date and Time

Date-time format: MM/DD/YYYY hh:mm:ss

○ Until SCN (System Change Number)

Specify external archive log locations

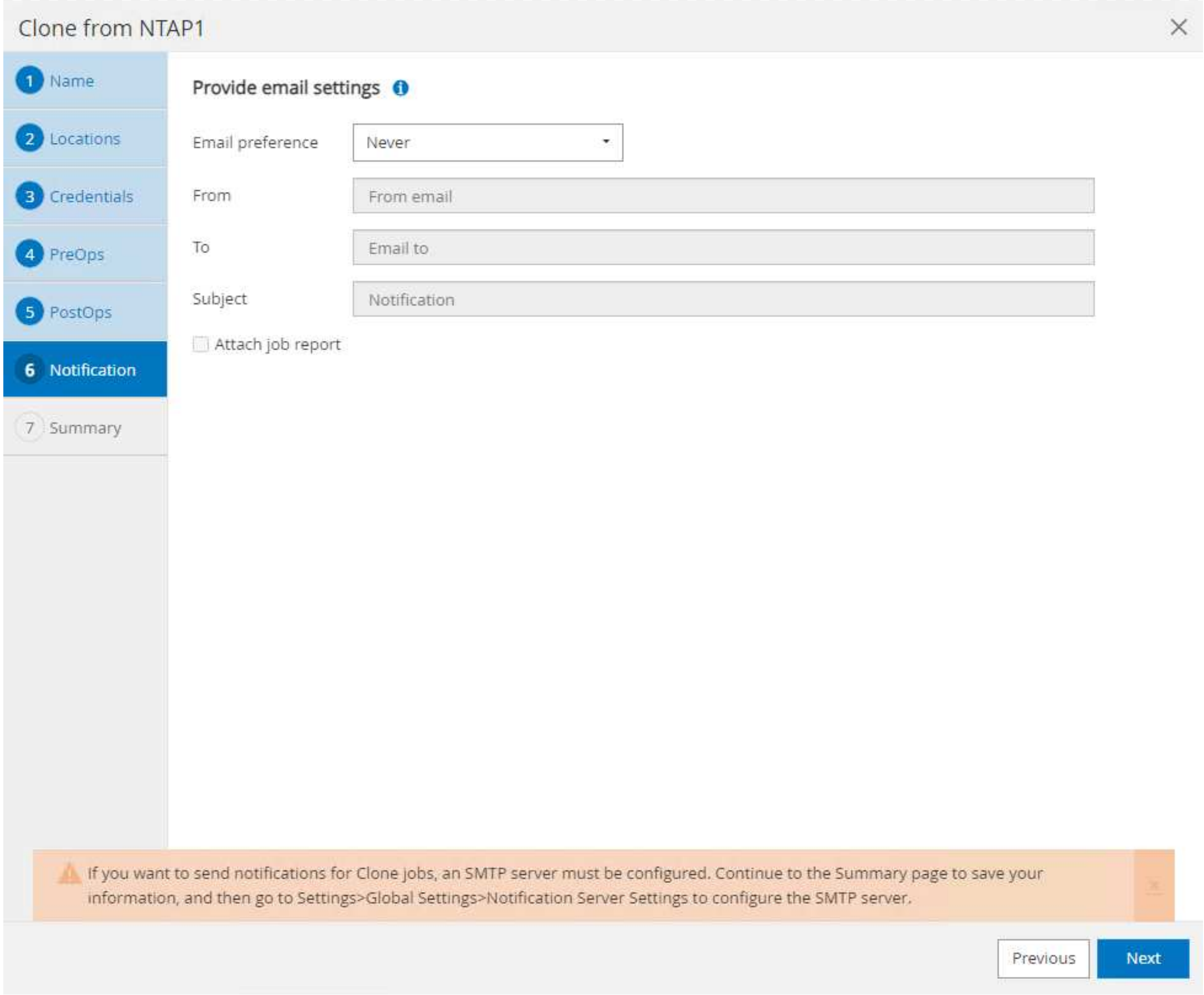
☑ Create new DBID

☑ Create tempfile for temporary tablespace

Enter SQL queries to apply when clone is created

Enter scripts to run after clone operation

7. Notification via email if desired.


Clone from NTAP1

Provide email settings

Email preference: Never

From: From email

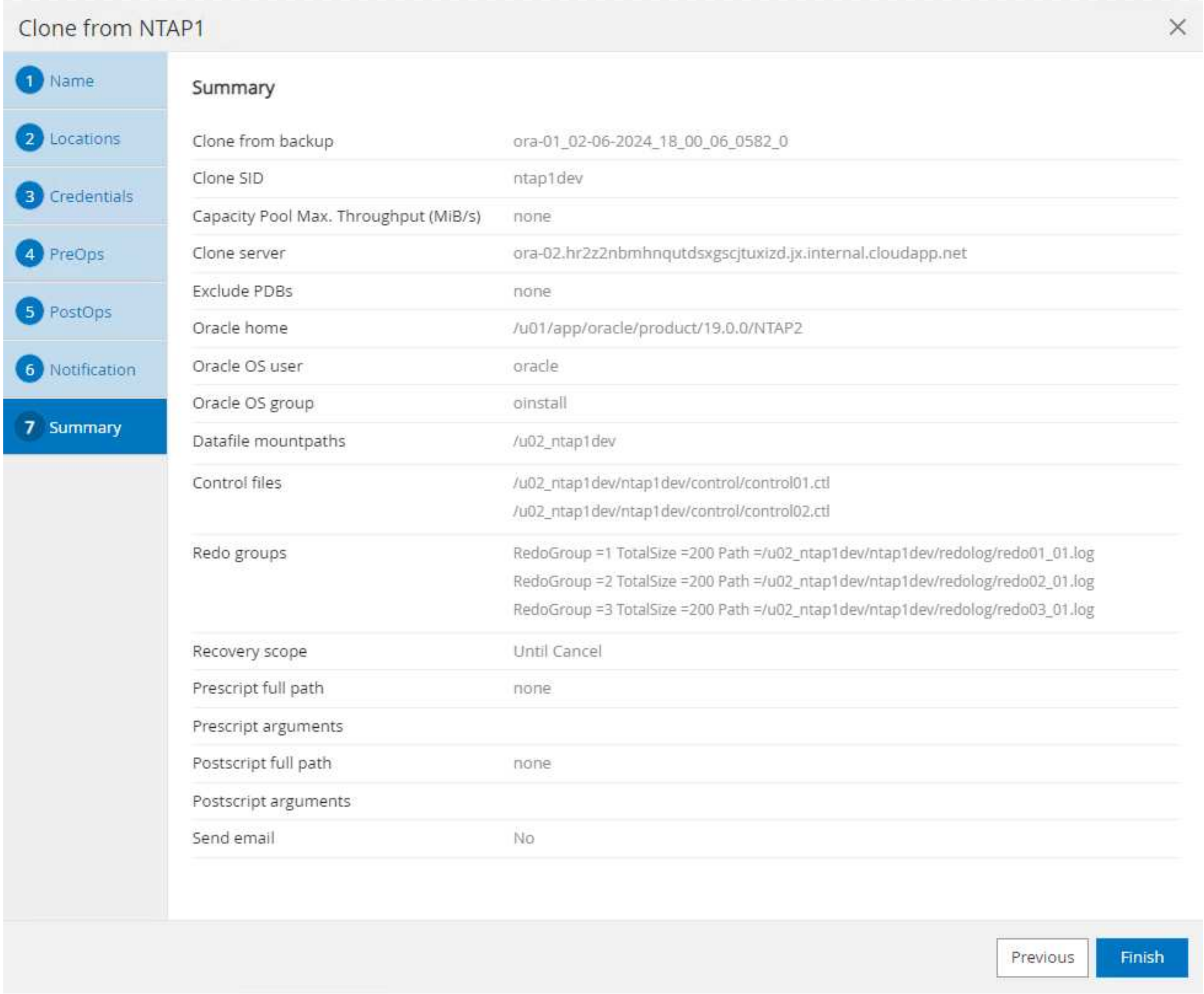
To: Email to

Subject: Notification

□ Attach job report

If you want to send notifications for Clone jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTP server.

8. Clone job summary.



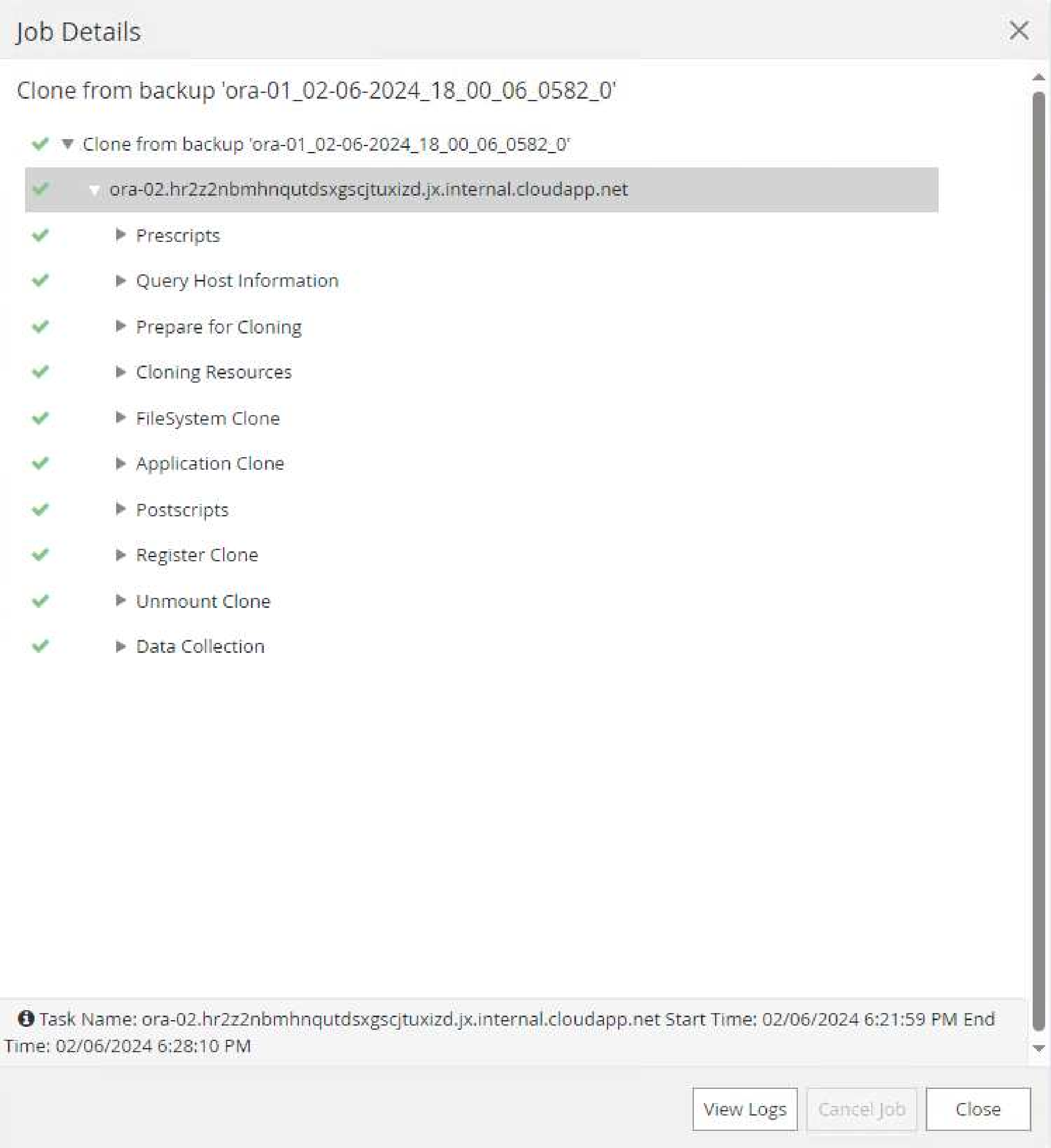
Summary

Clone from backup	ora-01_02-06-2024_18_00_06_0582_0
Clone SID	ntap1dev
Capacity Pool Max. Throughput (MiB/s)	none
Clone server	ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net
Exclude PDBs	none
Oracle home	/u01/app/oracle/product/19.0.0/NTAP2
Oracle OS user	oracle
Oracle OS group	oinstall
Datafile mountpaths	/u02_ntap1dev
Control files	/u02_ntap1dev/ntap1dev/control/control01.ctl /u02_ntap1dev/ntap1dev/control/control02.ctl

Redo groups	RedoGroup =1 TotalSize =200 Path =/u02_ntap1dev/ntap1dev/redolog/redo01_01.log
	RedoGroup =2 TotalSize =200 Path =/u02_ntap1dev/ntap1dev/redolog/redo02_01.log
	RedoGroup =3 TotalSize =200 Path =/u02_ntap1dev/ntap1dev/redolog/redo03_01.log

Recovery scope	Until Cancel
Prescript full path	none
Prescript arguments	
Postscript full path	none
Postscript arguments	
Send email	No

9. Click on running job to open `Job Details` window. The job status can also be opened and viewed from the `Monitor` tab.

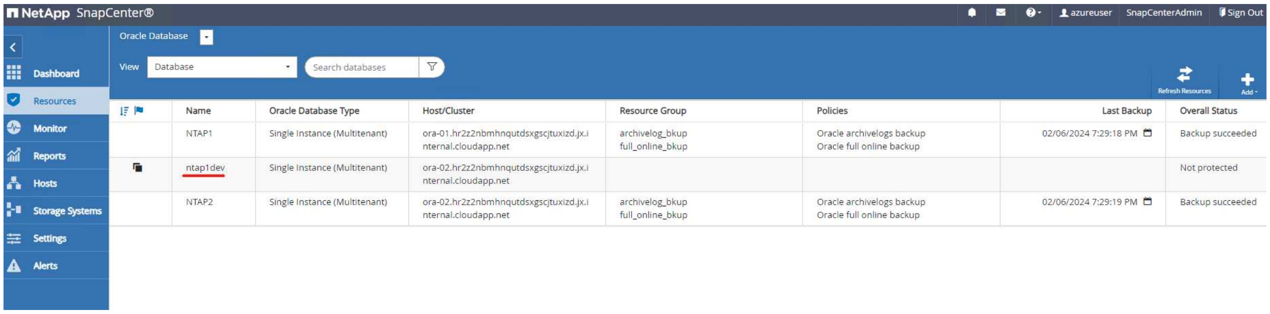


Clone from backup 'ora-01_02-06-2024_18_00_06_0582_0'

- ✓ ▼ Clone from backup 'ora-01_02-06-2024_18_00_06_0582_0'
  - ✓ ▼ ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net
    - ✓ ▶ Prescripts
    - ✓ ▶ Query Host Information
    - ✓ ▶ Prepare for Cloning
    - ✓ ▶ Cloning Resources
    - ✓ ▶ FileSystem Clone
    - ✓ ▶ Application Clone
    - ✓ ▶ Postscripts
    - ✓ ▶ Register Clone
    - ✓ ▶ Unmount Clone
    - ✓ ▶ Data Collection

Task Name: ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net Start Time: 02/06/2024 6:21:59 PM End Time: 02/06/2024 6:28:10 PM

10. Cloned database registers with SnapCenter immediately.



Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status
NTAP1	Single Instance (Multitenant)	ora-01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net	archivelog_bkup full_online_bkup	Oracle archivelogs backup Oracle full online backup	02/06/2024 7:29:18 PM	Backup succeeded
ntap1dev	Single Instance (Multitenant)	ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net				Not protected
NTAP2	Single Instance (Multitenant)	ora-02.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net	archivelog_bkup full_online_bkup	Oracle archivelogs backup Oracle full online backup	02/06/2024 7:29:19 PM	Backup succeeded

11. Validate clone database on DB server host. For a cloned development database, database archive mode should be turned off.

```
[azureuser@ora-02 ~]$ sudo su
[root@ora-02 azureuser]# su - oracle
Last login: Tue Feb  6 16:26:28 UTC 2024 on pts/0

[oracle@ora-02 ~]$ uname -a
Linux ora-02 4.18.0-372.9.1.el8.x86_64 #1 SMP Fri Apr 15 22:12:19
EDT 2022 x86_64 x86_64 x86_64 GNU/Linux
[oracle@ora-02 ~]$ df -h
Filesystem                                       Size  Used Avail
Use% Mounted on
devtmpfs                                         7.7G     0  7.7G
0% /dev
tmpfs                                            7.8G     0  7.8G
0% /dev/shm
tmpfs                                            7.8G   49M  7.7G
1% /run
tmpfs                                            7.8G     0  7.8G
0% /sys/fs/cgroup
/dev/mapper/rootvg-rootlv                         22G   17G  5.6G
75% /
/dev/mapper/rootvg-usrlv                          10G  2.0G  8.1G
20% /usr
/dev/mapper/rootvg-homelv                       1014M   40M  975M
4% /home
/dev/sda1                                        496M  106M  390M
22% /boot
/dev/mapper/rootvg-varlv                         8.0G  958M  7.1G
12% /var
/dev/sda15                                       495M  5.9M  489M
2% /boot/efi
/dev/mapper/rootvg-tmplv                          12G  8.4G  3.7G
70% /tmp
tmpfs                                            1.6G     0  1.6G
0% /run/user/54321
172.30.136.68:/ora-02-u03                        250G  2.1G  248G
1% /u03
172.30.136.68:/ora-02-u01                        100G   10G   91G
10% /u01
172.30.136.68:/ora-02-u02                        250G  7.5G  243G
3% /u02
tmpfs                                            1.6G     0  1.6G
0% /run/user/1000
tmpfs                                            1.6G     0  1.6G
0% /run/user/0
172.30.136.68:/ora-01-u02-Clone-020624161543077  250G  8.2G  242G
```

```
4% /u02_ntap1dev

[oracle@ora-02 ~]$ cat /etc/oratab
#
# This file is used by ORACLE utilities.  It is created by root.sh
# and updated by either Database Configuration Assistant while
creating
# a database or ASM Configuration Assistant while creating ASM
instance.

# A colon, ':', is used as the field terminator.  A new line
terminates
# the entry.  Lines beginning with a pound sign, '#', are comments.
#
# Entries are of the form:
#   $ORACLE_SID:$ORACLE_HOME:<N|Y>:
#
# The first and second fields are the system identifier and home
# directory of the database respectively.  The third field indicates
# to the dbstart utility that the database should , "Y", or should
not,
# "N", be brought up at system boot time.
#
# Multiple entries with the same $ORACLE_SID are not allowed.
#
#
NTAP2:/u01/app/oracle/product/19.0.0/NTAP2:Y
# SnapCenter Plug-in for Oracle Database generated entry (DO NOT
REMOVE THIS LINE)
ntap1dev:/u01/app/oracle/product/19.0.0/NTAP2:N


[oracle@ora-02 ~]$ export ORACLE_SID=ntap1dev
[oracle@ora-02 ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Tue Feb 6 16:29:02 2024
Version 19.18.0.0.0

Copyright (c) 1982, 2022, Oracle.  All rights reserved.


Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 -
Production
Version 19.18.0.0.0
```

```
SQL> select name, open_mode, log_mode from v$database;

NAME      OPEN_MODE            LOG_MODE
--------- -------------------- ------------
NTAP1DEV  READ WRITE           ARCHIVELOG


SQL> shutdown immediate;
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL> startup mount;
ORACLE instance started.

Total System Global Area 3221223168 bytes
Fixed Size                  9168640 bytes
Variable Size             654311424 bytes
Database Buffers         2550136832 bytes
Redo Buffers                7606272 bytes
Database mounted.

SQL> alter database noarchivelog;

Database altered.

SQL> alter database open;

Database altered.

SQL> select name, open_mode, log_mode from v$database;

NAME      OPEN_MODE            LOG_MODE
--------- -------------------- ------------
NTAP1DEV  READ WRITE           NOARCHIVELOG

SQL> show pdbs

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         2 PDB$SEED                       READ ONLY  NO
         3 NTAP1_PDB1                     MOUNTED
         4 NTAP1_PDB2                     MOUNTED
         5 NTAP1_PDB3                     MOUNTED

SQL> alter pluggable database all open;
```

Where to find additional information

To learn more about the information described in this document, review the following documents and/or websites:

- Azure NetApp Files

  https://azure.microsoft.com/en-us/products/netapp

- SnapCenter Software documentation

  https://docs.netapp.com/us-en/snapcenter/index.html

- TR-4987: Simplified, Automated Oracle Deployment on Azure NetApp Files with NFS

  Deployment Procedure

TR-4977: Oracle Database backup, restore and clone with SnapCenter Services - Azure

Allen Cao, Niyaz Mohamed, NetApp

This solution provides overview and details for Oracle database backup, restore, clone using NetApp SnapCenter SaaS using BlueXP console.

Purpose

SnapCenter Services is the SaaS version of the classic SnapCenter database management UI tool that is available through the NetApp BlueXP cloud management console. It is an integral part of the NetApp cloud-backup, data-protection offering for databases such as Oracle and HANA running on Azure NetApp Files. This SaaS-based service simplifies traditional SnapCenter standalone server deployment that generally requires a Windows server operating in a Windows domain environment.

In this documentation, we demonstrate how you can set up SnapCenter Services to backup, restore, and clone Oracle databases deployed on Azure NetApp Files volumes and Azure compute instances. It is very easy to setup data protection for Oracle database deployed on Azure NetApp Files with web based BlueXP user interface.

This solution addresses the following use cases:

- Database backup with snapshots for Oracle databases hosted in Azure NetApp Files and Azure VMs
- Oracle database recovery in the case of a failure
- Fast cloning of primary databases for dev, test environments or other use cases

Audience

This solution is intended for the following audiences:

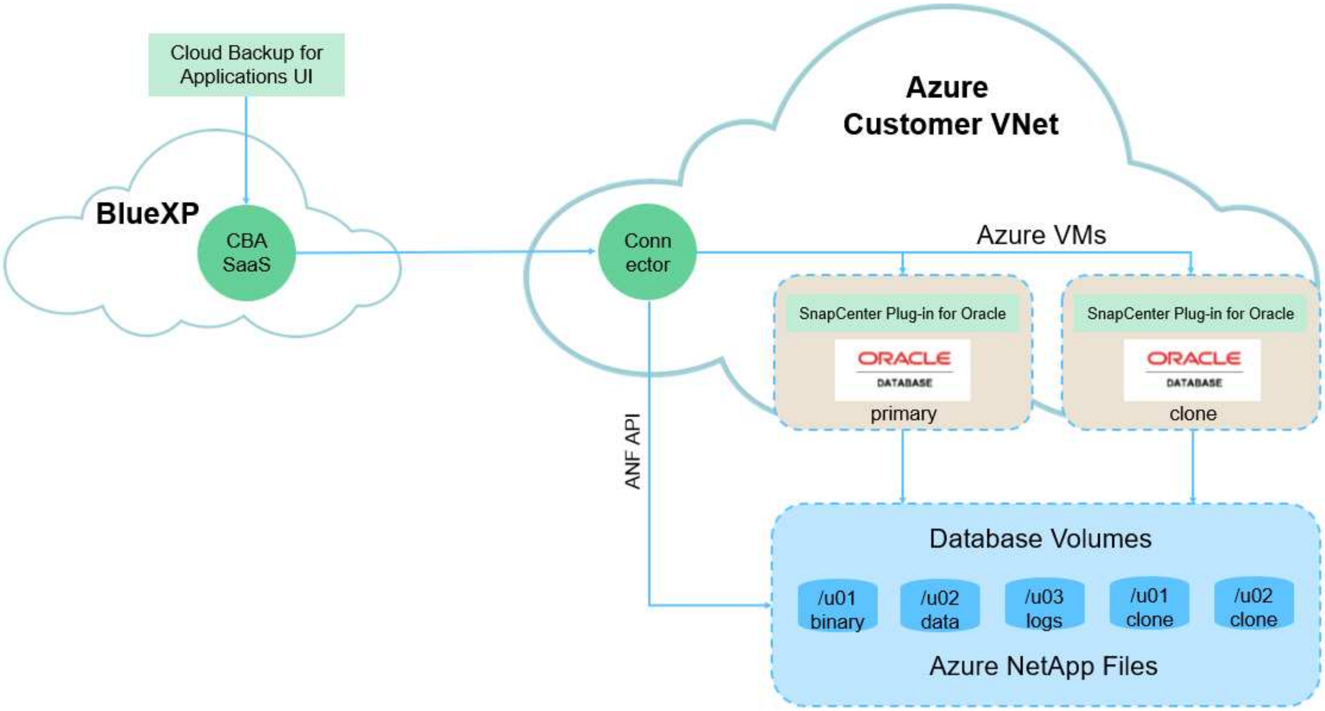
- The DBA who manages Oracle databases running on Azure NetApp Files storage
- The solution architect who is interested in testing Oracle database backup, restore, and clone in Azure
- The storage administrator who supports and manages the Azure NetApp Files storage

- The application owner who owns applications that are deployed to Azure NetApp Files storage and Azure VMs

Solution test and validation environment

The testing and validation of this solution was performed in a lab environment that might not match the final deployment environment. For more information, see the section Key factors for deployment consideration.

Architecture



This image provides a detailed picture of BlueXP backup and recovery for applications within the BlueXP console, including the UI, the connector, and the resources it manages.

Hardware and software components

Hardware

Azure NetApp Files storage	Premium Service level	Auto QoS type, and 4TB in storage capacity in testing
Azure instance for compute	Standard B4ms (4 vcpus, 16 GiB memory)	Two instances deployed, one as primary DB server and the other as clone DB server

Software

RedHat Linux	Red Hat Enterprise Linux 8.7 (LVM) - x64 Gen2	Deployed RedHat subscription for testing
Oracle Database	Version 19.18	Applied RU patch p34765931_190000_Linux-x86-64.zip

Oracle OPatch	Version 12.2.0.1.36	Latest patch p6880880_190000_Linux-x86-64.zip
SnapCenter Service	Version v2.5.0-2822	Agent Version v2.5.0-2822

Key factors for deployment consideration

- **Connector to be deployed in the same virtual network / subnet as databases and Azure NetApp Files.** When possible, the connector should be deployed in the same Azure virtual networks and resource groups, which enables connectivity to the Azure NetApp Files storage and the Azure compute instances.
- **An Azure user account or Active Directory service principle created at Azure portal for SnapCenter connector.** Deploying a BlueXP Connector requires specific permissions to create and configure a virtual machine and other compute resources, to configure networking, and to get access to the Azure subscription. It also requires permissions to later create roles and permissions for the Connector to operate. Create a custom role in Azure with permissions and assign to the user account or service principle. Review the following link for details:Set up Azure permissions.
- **A ssh key pair created in the Azure resource group.** The ssh key pair is assigned to the Azure VM user for logging into the connector host and also the database VM host for deploying and executing a plug-in. BlueXP console UI uses the ssh key to deploy SnapCenter service plugin to database host for one-step plugin installation and application host database discovery.
- **A credential added to the BlueXP console setting.** To add Azure NetApp Files storage to the BlueXP working environment, a credential that grants permissions to access Azure NetApp Files from the BlueXP console needs to be set up in the BlueXP console setting.
- **java-11-openjdk installed on the Azure VM database instance host.** SnapCenter service installation requires java version 11. It needs to be installed on application host before plugin deployment attempt.

Solution deployment

There is extensive NetApp documentation with a broader scope to help you protect your cloud-native application data. The goal of this documentation is to provide step-by-step procedures that cover SnapCenter Service deployment with the BlueXP console to protect your Oracle database deployed on an Azure NetApp Files storage and an Azure compute instance.

To get started, complete the following steps:

- Read the general instructions Protect your cloud native applications data and the sections related to Oracle and Azure NetApp Files.
- Watch the following video walkthrough

  Video of deployment of Oracle and ANF

Prerequisites for SnapCenter service deployment

Deployment requires the following prerequisites.

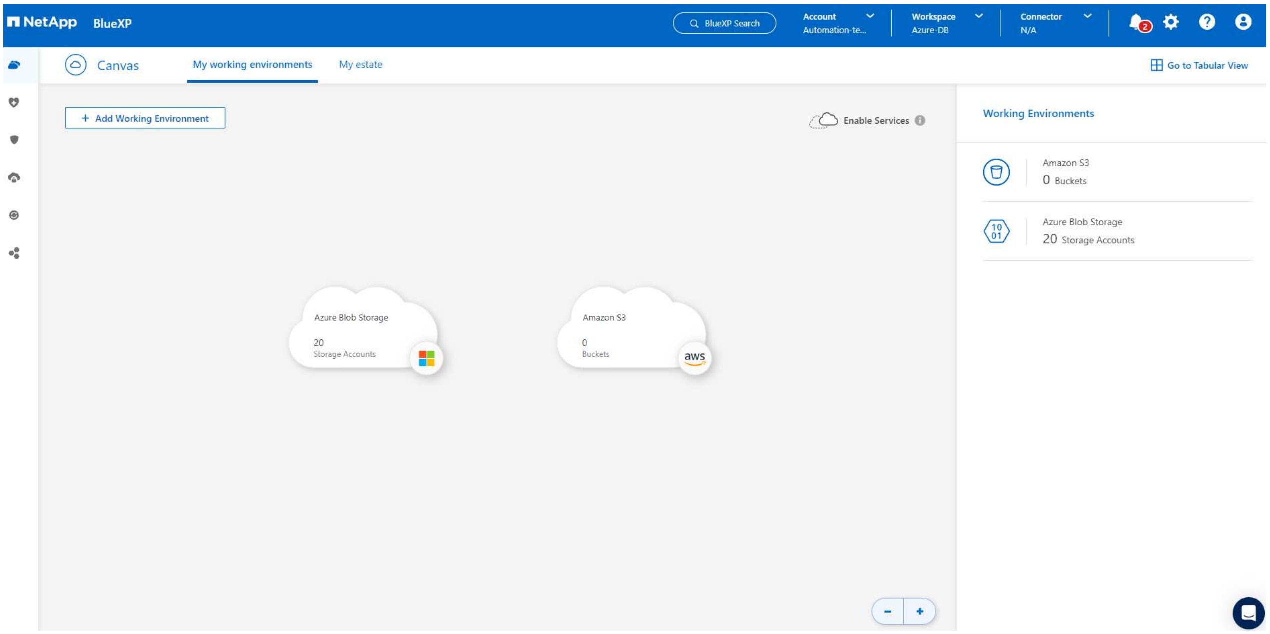
1. A primary Oracle database server on an Azure VM instance with an Oracle database fully deployed and running.
2. An Azure NetApp Files storage service capacity pool deployed in Azure that has capacity to meet the database storage needs listed in hardware component section.
3. A secondary database server on an Azure VM instance that can be used for testing the cloning of an Oracle database to an alternate host for the purpose of supporting a dev/test workload or any use cases that requires a full data set of production Oracle database.
4. For additional information for Oracle database deployment on Azure NetApp Files and Azure compute instance, see Oracle Database Deployment and Protection on Azure NetApp Files.

Onboarding to BlueXP preparation

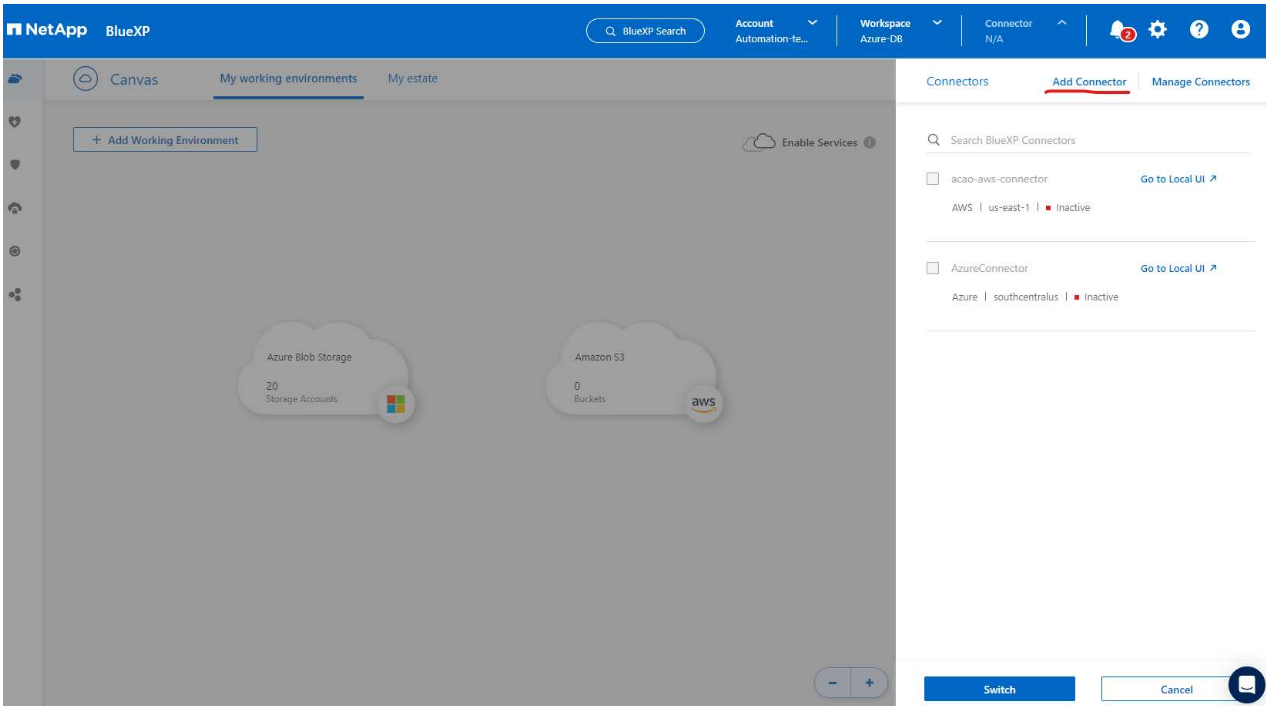
1. Use the link NetApp BlueXP to sign up for BlueXP console access.
2. Create an Azure user account or an Active Directory service principle and grant permissions with role in Azure portal for Azure connector deployment.
3. To set up BlueXP to manage Azure resources, add a BlueXP credential with details of an Active Directory service principal that BlueXP can use to authenticate with Azure Active Directory (App client ID), a client secret for the service principal application (Client Secret), and the Active Directory ID for your organization (Tenant ID).
4. You also need the Azure virtual network, resources group, security group, an SSH key for VM access, etc. ready for connector provisioning and database plugin installation.

Deploy a connector for SnapCenter services

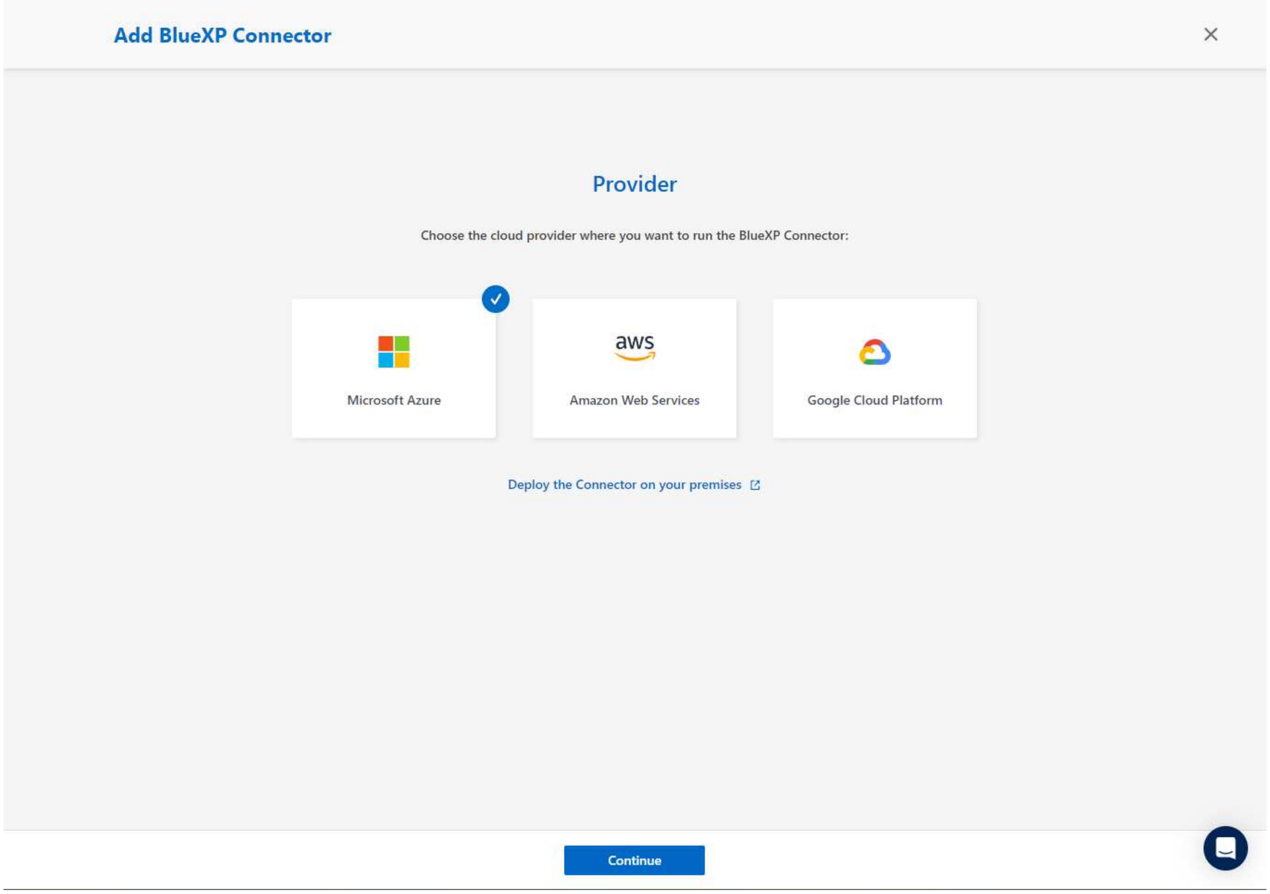
1. Login to the BlueXP console.



2. Click on **Connector** drop down arrow and **Add Connector** to launch the connector provisioning workflow.



3. Choose your cloud provider (in this case, **Microsoft Azure**).

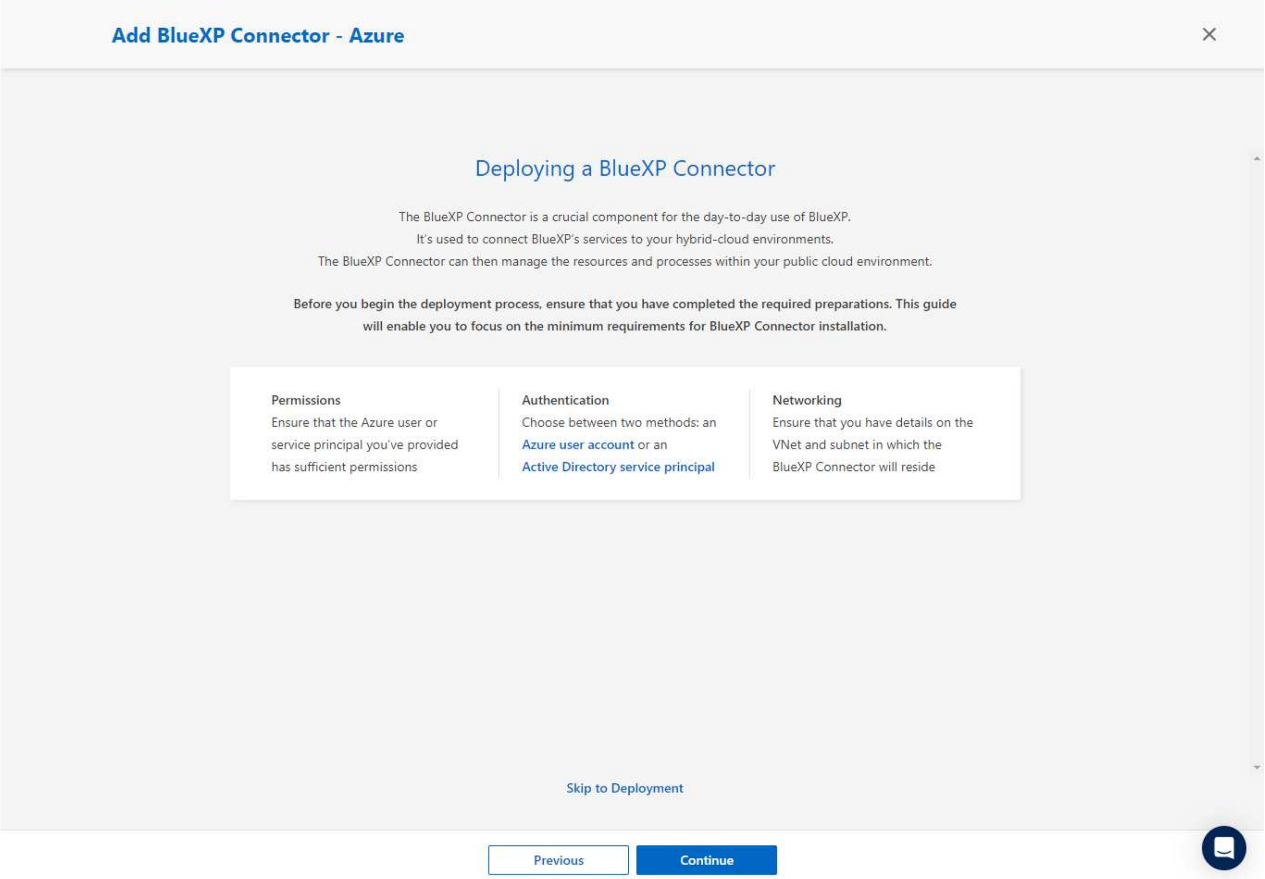


Add BlueXP Connector

Provider

Choose the cloud provider where you want to run the BlueXP Connector:

4. Skip the **Permission**, **Authentication**, and **Networking** steps if you already have them set up in your Azure account. If not, you must configure these before proceeding. From here, you could also retrieve the permissions for the Azure policy that is referenced in the previous section "Onboarding to BlueXP preparation."



Add BlueXP Connector - Azure

Deploying a BlueXP Connector

The BlueXP Connector is a crucial component for the day-to-day use of BlueXP.
It's used to connect BlueXP's services to your hybrid-cloud environments.
The BlueXP Connector can then manage the resources and processes within your public cloud environment.

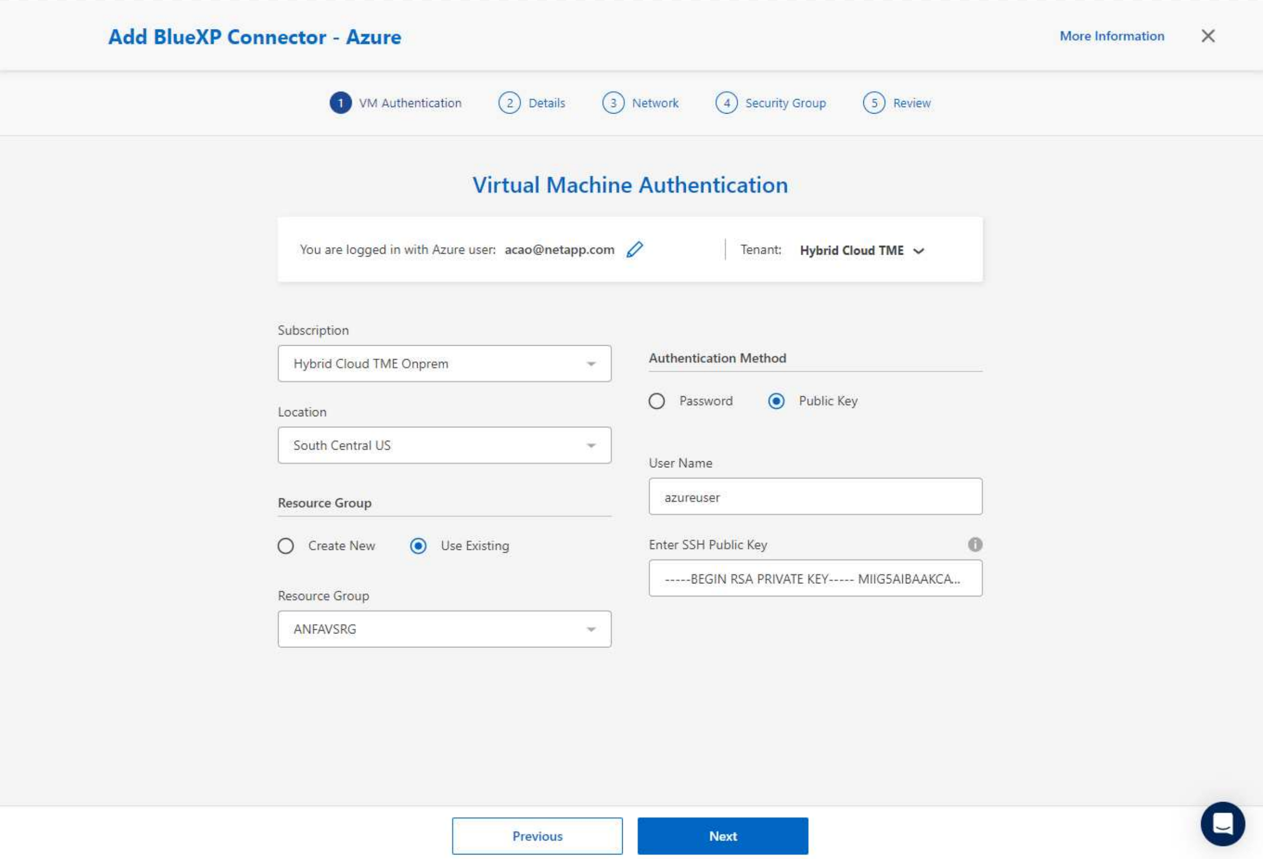
Before you begin the deployment process, ensure that you have completed the required preparations. This guide will enable you to focus on the minimum requirements for BlueXP Connector installation.

Permissions
Ensure that the Azure user or service principal you've provided has sufficient permissions

Authentication
Choose between two methods: an Azure user account or an Active Directory service principal

Networking
Ensure that you have details on the VNet and subnet in which the BlueXP Connector will reside

5. Click on **Skip to Deployment** to configure your connector **Virtual Machine Authentication**. Add the SSH key pair you have created in Azure resource group during onboarding to BlueXP preparation for connector OS authentication.


Add BlueXP Connector - Azure

Virtual Machine Authentication

You are logged in with Azure user: acao@netapp.com | Tenant: Hybrid Cloud TME

Subscription: Hybrid Cloud TME Onprem

Location: South Central US

Resource Group: ○ Create New ● Use Existing

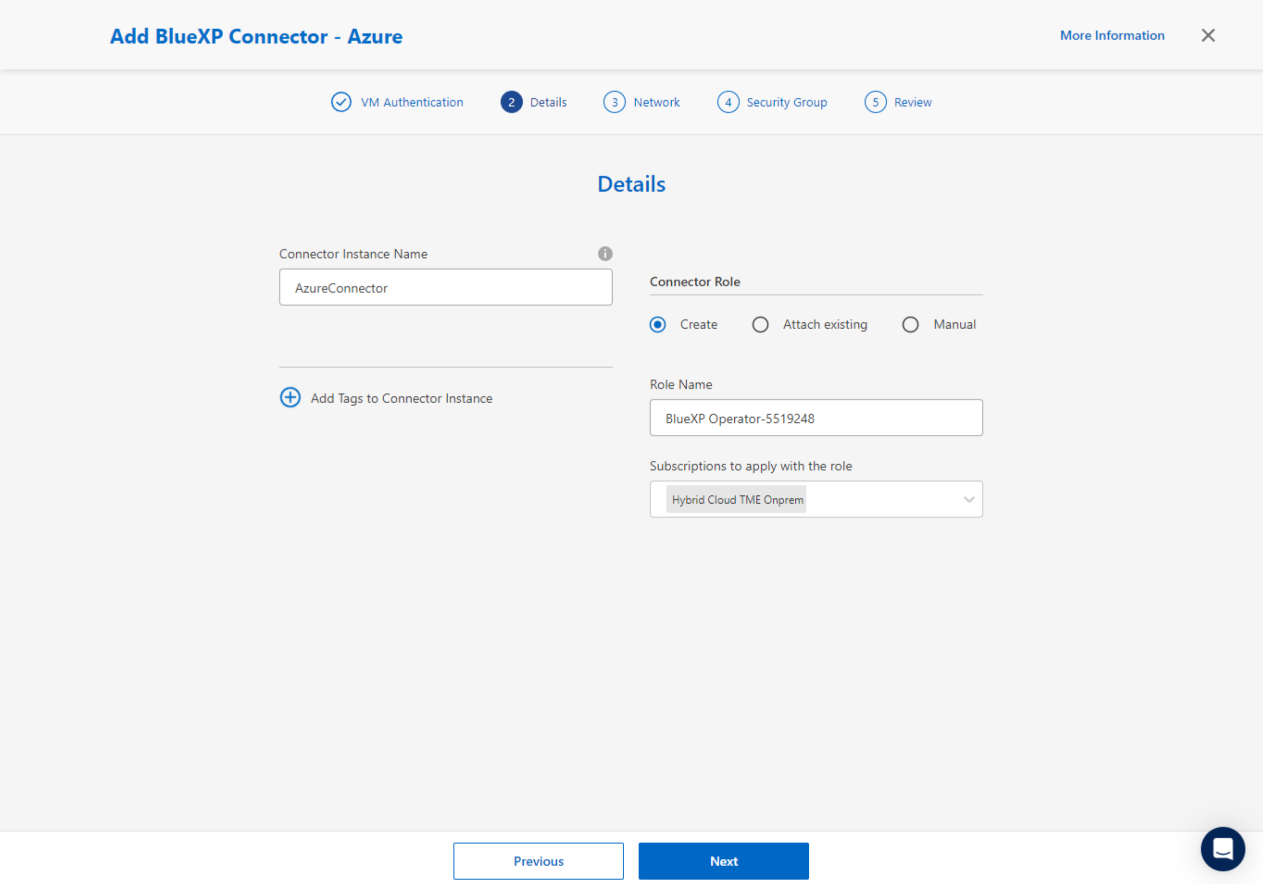
Resource Group: ANFAVSRG

Authentication Method: ○ Password ● Public Key

User Name: azureuser

Enter SSH Public Key: -----BEGIN RSA PRIVATE KEY----- MIIG5AIBAAKCA...

6. Provide a name for the connector instance, select **Create** and accept default **Role Name** under **Details**, and choose the subscription for the Azure account.


Add BlueXP Connector - Azure

Details

Connector Instance Name: AzureConnector

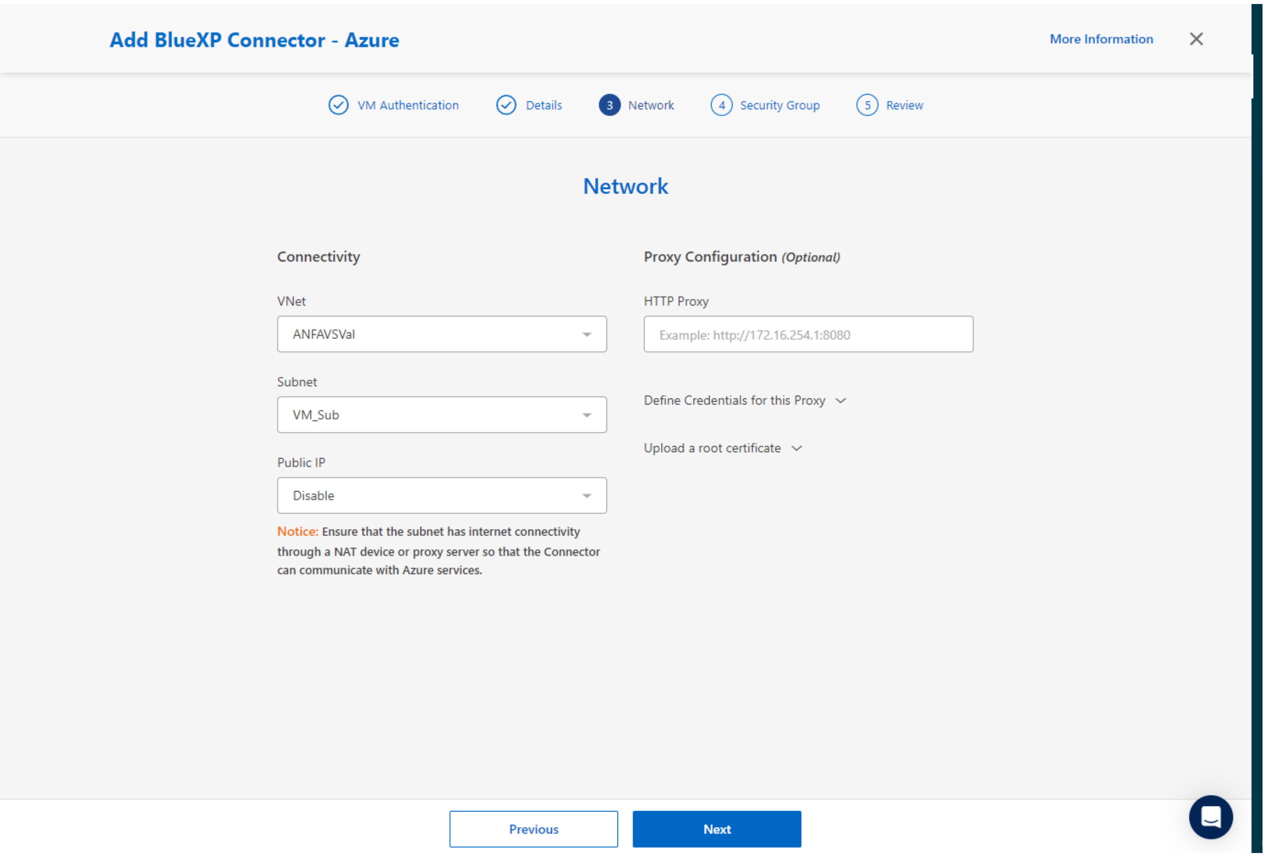
Add Tags to Connector Instance

Connector Role: ● Create ○ Attach existing ○ Manual

Role Name: BlueXP Operator-5519248

Subscriptions to apply with the role: Hybrid Cloud TME Onprem

7. Configure networking with the proper **VNet**, **Subnet**, and disable **Public IP** but ensure that the connector has the internet access in your Azure environment.



Network

Connectivity

VNet: ANFAVSVal

Subnet: VM_Sub

Public IP: Disable

Notice: Ensure that the subnet has internet connectivity through a NAT device or proxy server so that the Connector can communicate with Azure services.

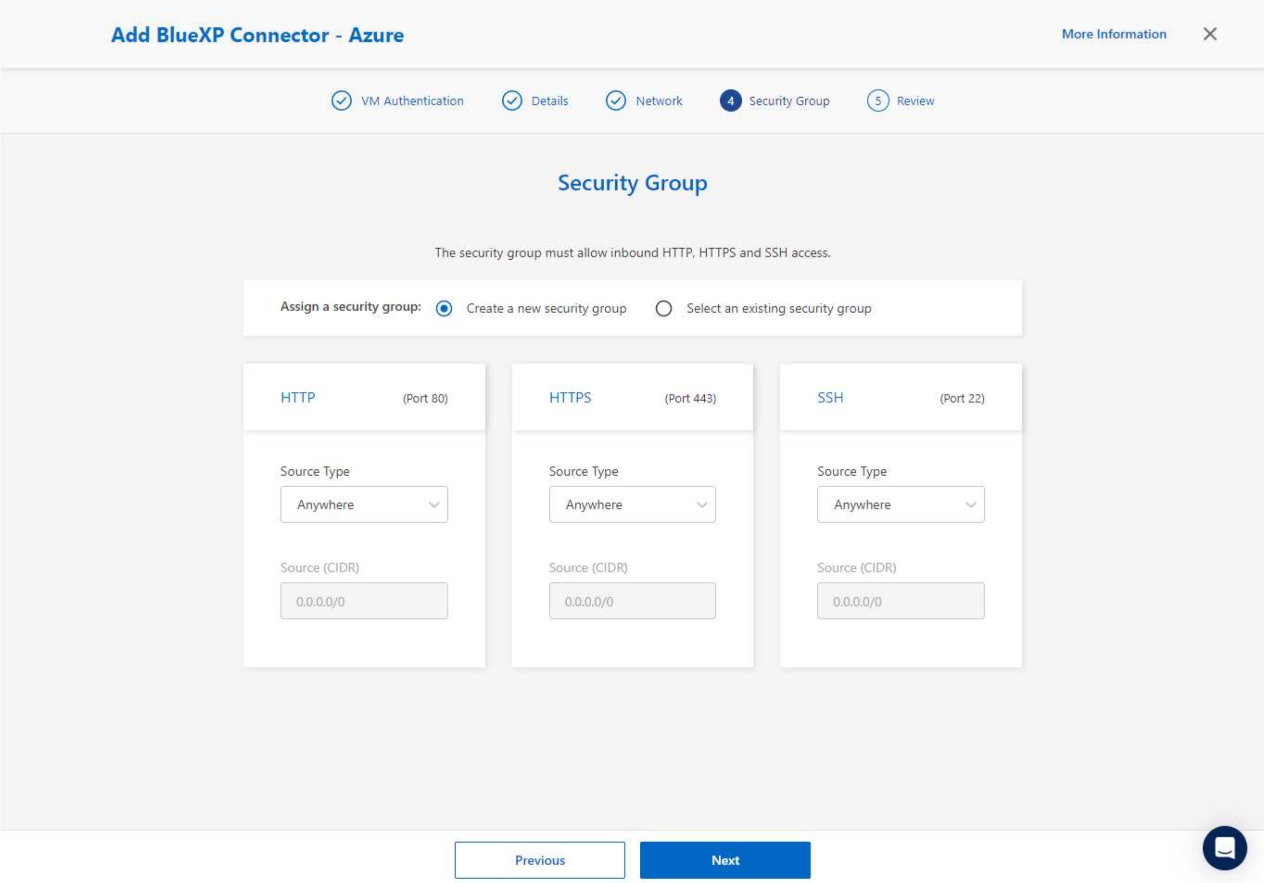
Proxy Configuration *(Optional)*

HTTP Proxy: Example: http://172.16.254.1:8080

Define Credentials for this Proxy

Upload a root certificate

8. Configure the **Security Group** for the connector that allows HTTP, HTTPS, and SSH access.



Add BlueXP Connector - Azure

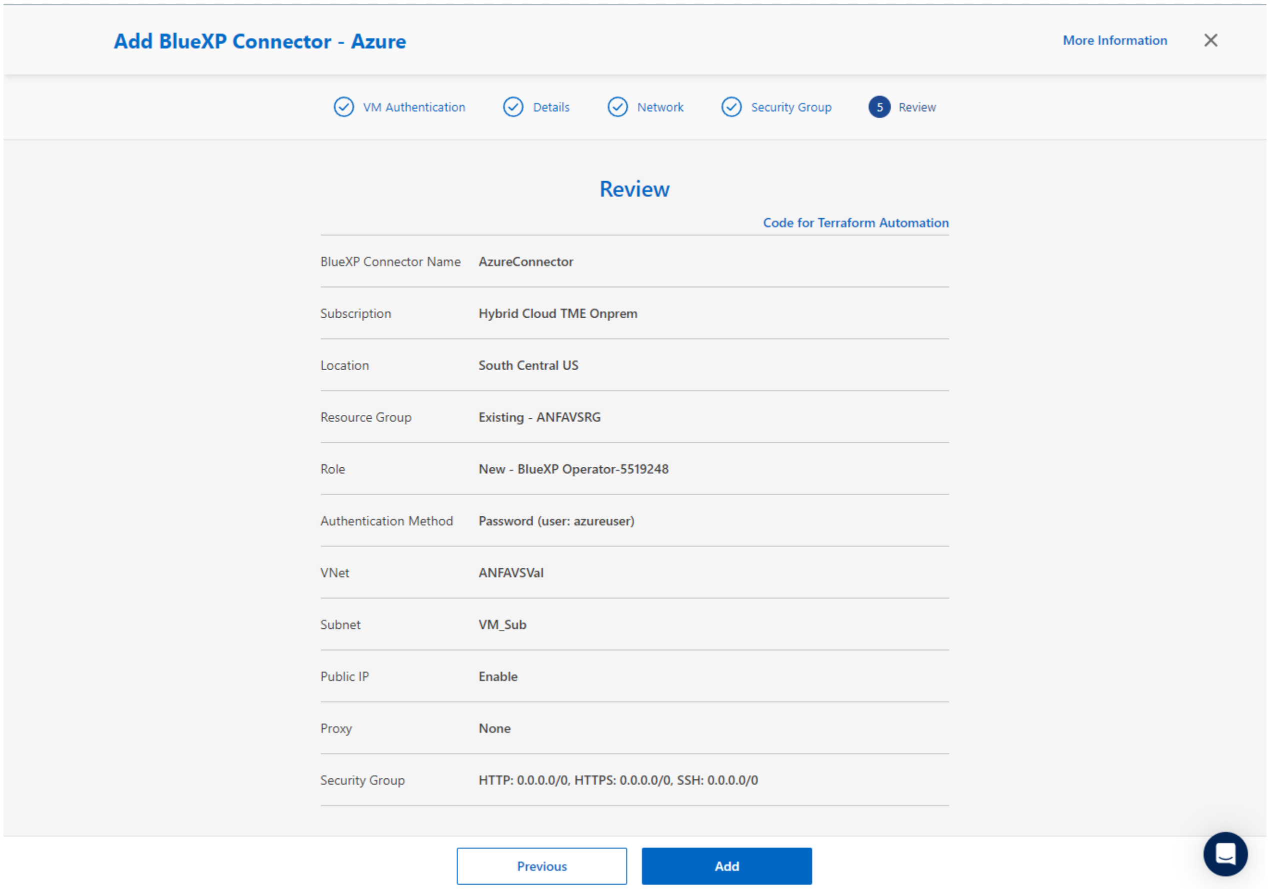
Security Group

The security group must allow inbound HTTP, HTTPS and SSH access.

Assign a security group: ● Create a new security group ○ Select an existing security group

HTTP (Port 80)	HTTPS (Port 443)	SSH (Port 22)
Source Type: Anywhere	Source Type: Anywhere	Source Type: Anywhere
Source (CIDR): 0.0.0.0/0	Source (CIDR): 0.0.0.0/0	Source (CIDR): 0.0.0.0/0

9. Review the summary page and click **Add** to start connector creation. It generally takes about 10 mins to complete deployment. Once completed, the connector instance VM appears in the Azure portal.


Add BlueXP Connector - Azure

More Information

VM Authentication · Details · Network · Security Group · 5 Review

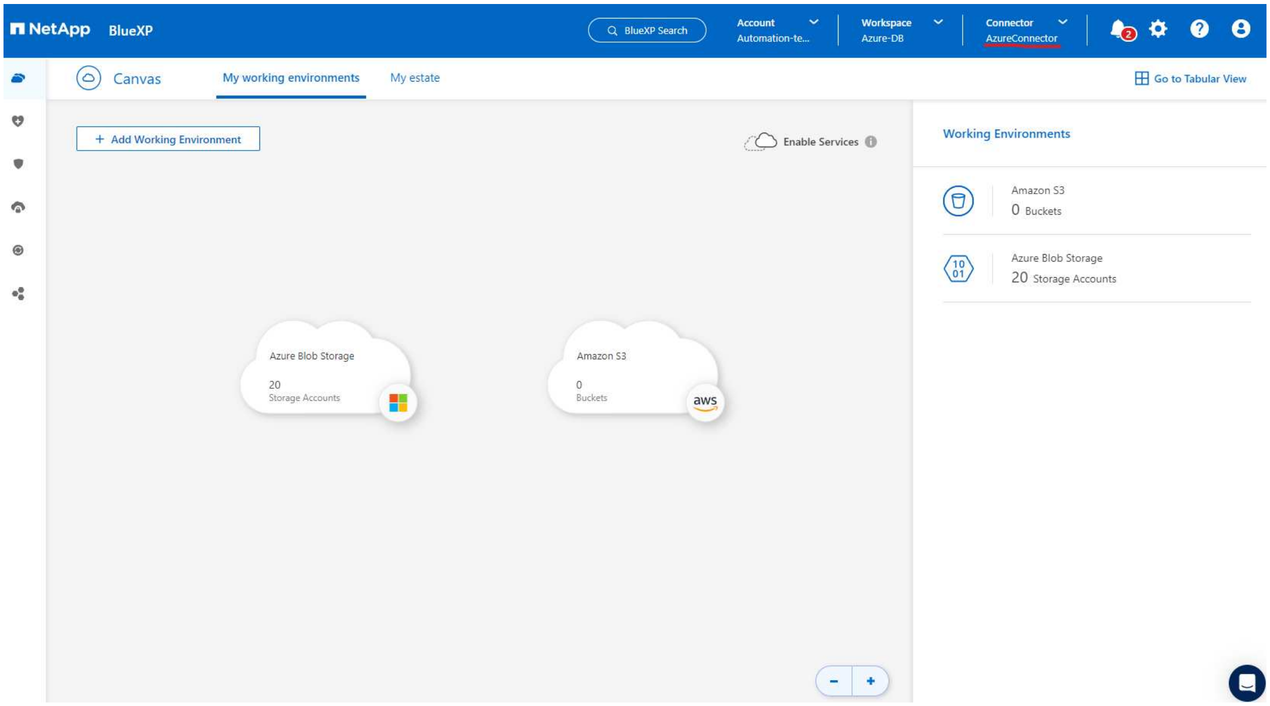
Review

Code for Terraform Automation

BlueXP Connector Name	AzureConnector
Subscription	Hybrid Cloud TME Onprem
Location	South Central US
Resource Group	Existing - ANFAVSRG
Role	New - BlueXP Operator-5519248
Authentication Method	Password (user: azureuser)
VNet	ANFAVSVal
Subnet	VM_Sub
Public IP	Enable
Proxy	None
Security Group	HTTP: 0.0.0.0/0, HTTPS: 0.0.0.0/0, SSH: 0.0.0.0/0

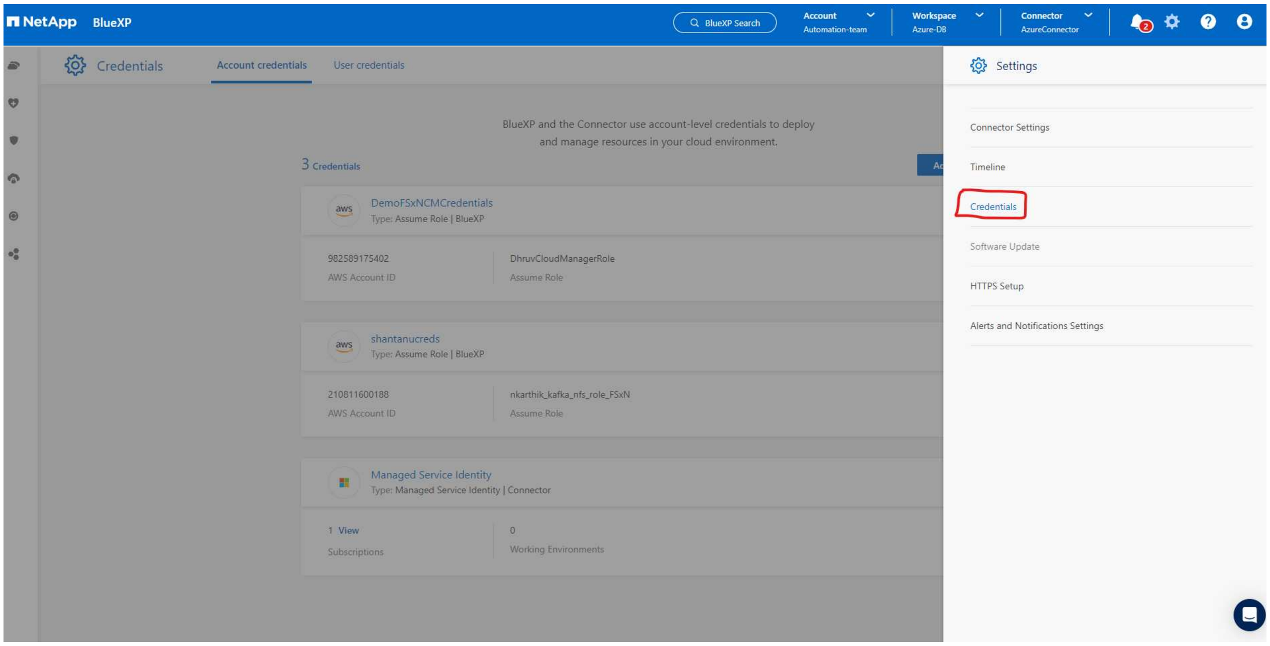
Previous | Add

10. After the connector is deployed, the newly created connector appears under **Connector** drop-down.



Define a credential in BlueXP for Azure resources access

1. Click on setting icon on top right corner of BlueXP console to open **Account credentials** page, click **Add credentials** to start credential configuration workflow.



BlueXP and the Connector use account-level credentials to deploy and manage resources in your cloud environment.

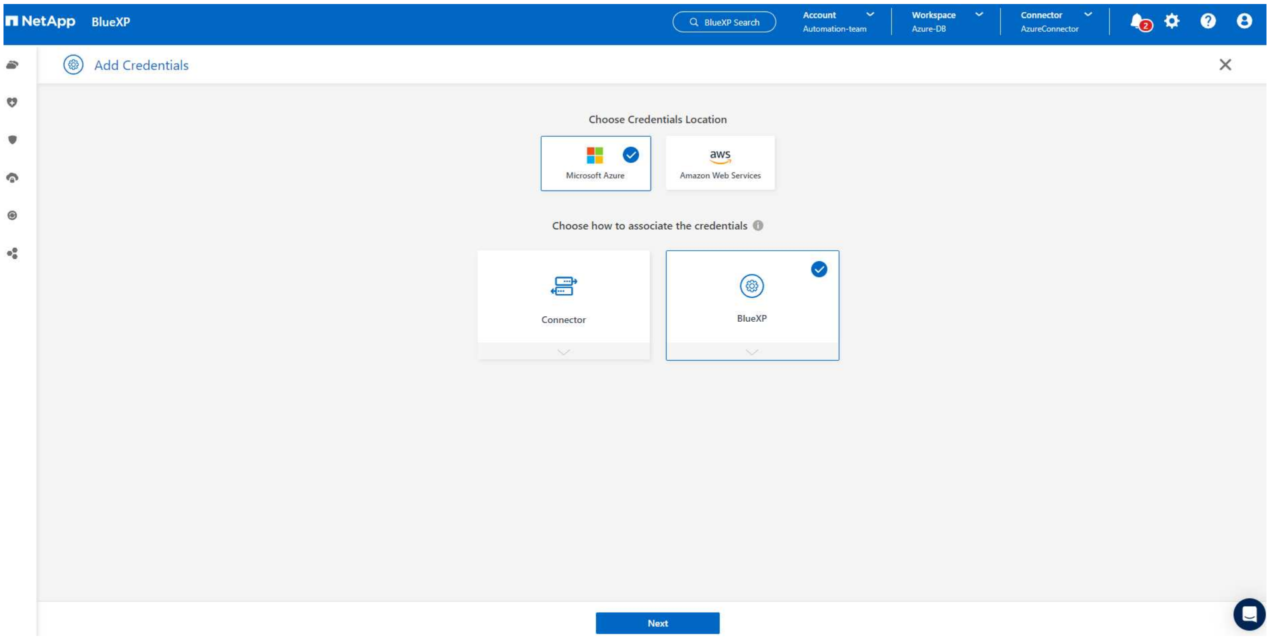
3 Credentials

DemoFSxNCMCredentials
Type: Assume Role | BlueXP
982589175402 AWS Account ID
DhruvCloudManagerRole Assume Role

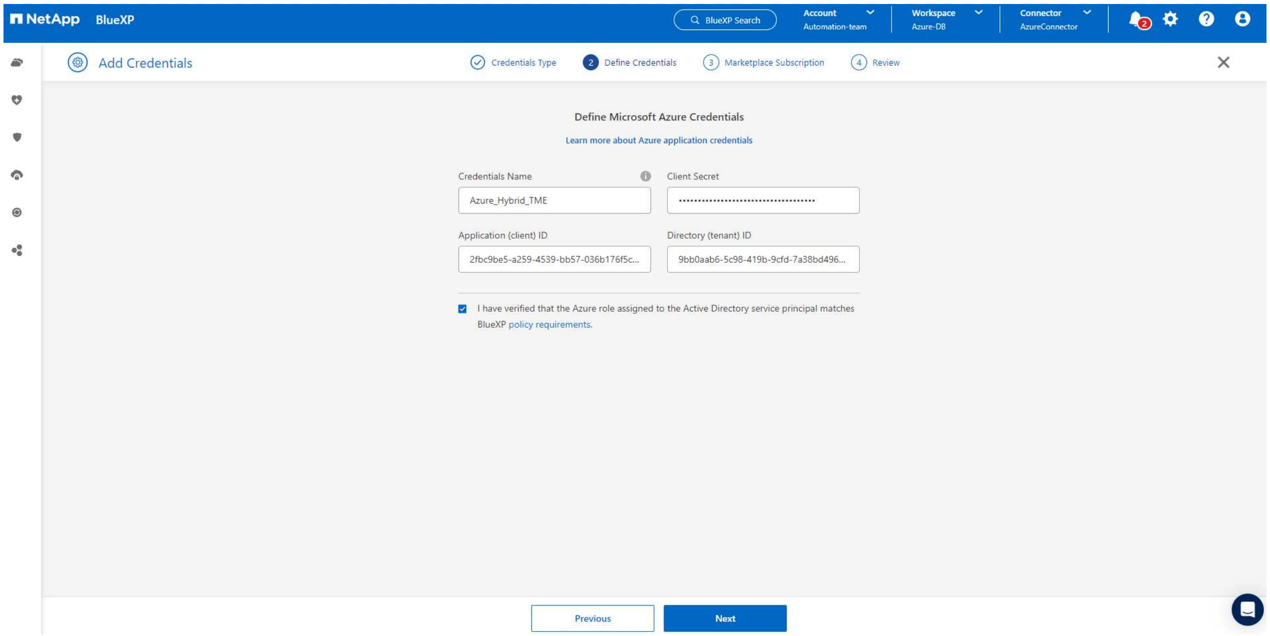
shantanucreds
Type: Assume Role | BlueXP
210811600188 AWS Account ID
nkarthik_kafka_nfs_role_FSxN Assume Role

Managed Service Identity
Type: Managed Service Identity | Connector
1 View Subscriptions
0 Working Environments

2. Choose credential location as - **Microsoft Azure - BlueXP**.



3. Define Azure credentials with proper **Client Secret**, **Client ID**, and **Tenant ID**, which should have been gathered during previous BlueXP onboarding process.



Define Microsoft Azure Credentials

Learn more about Azure application credentials

Credentials Name: Azure_Hybrid_TME

Client Secret: ••••••••••••••••••••••••••••••••••••

Application (client) ID: 2fbc9be5-a259-4539-bb57-036b176f5c...

Directory (tenant) ID: 9bb0aab6-5c98-419b-9cfd-7a38bd496...

☑ I have verified that the Azure role assigned to the Active Directory service principal matches BlueXP policy requirements.

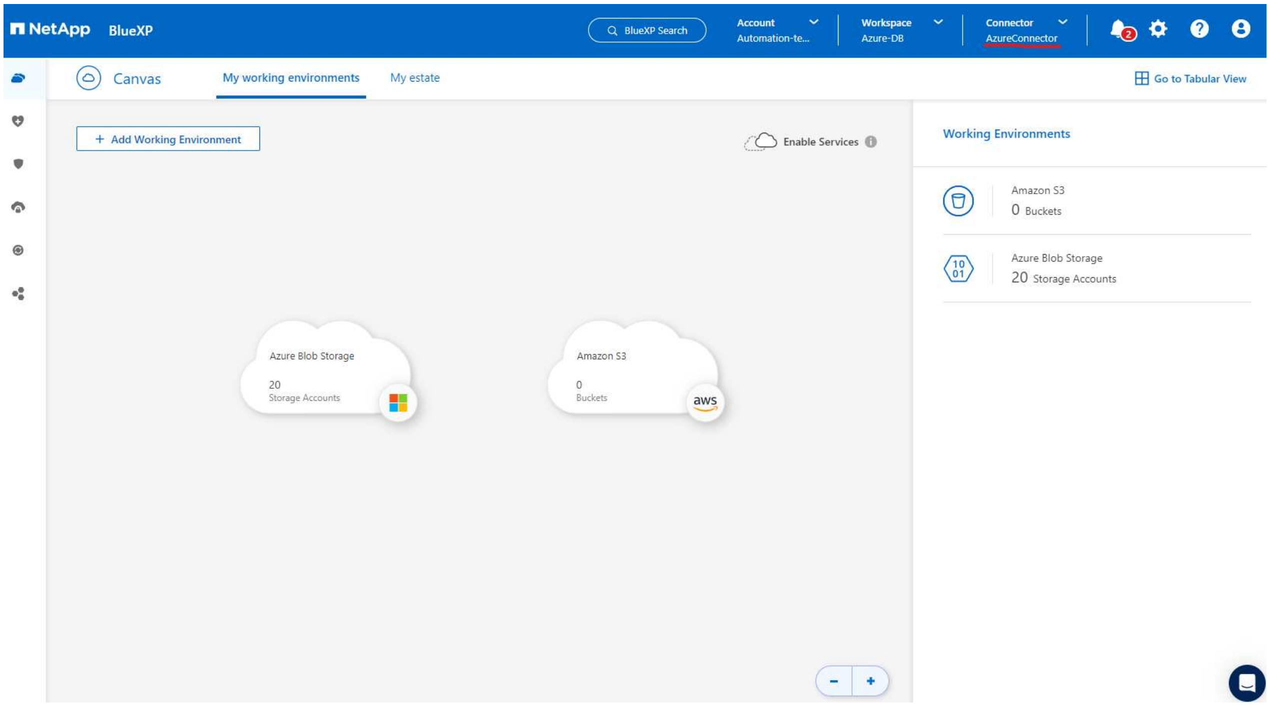
4. Review and **Add**.
   image::snapctr_svcs_credential_04-azure.png["Screenshot showing this step in the GUI."]

5. You may also need to associate a **Marketplace Subscription** with the credential.
   image::snapctr_svcs_credential_05-azure.png["Screenshot showing this step in the GUI."]

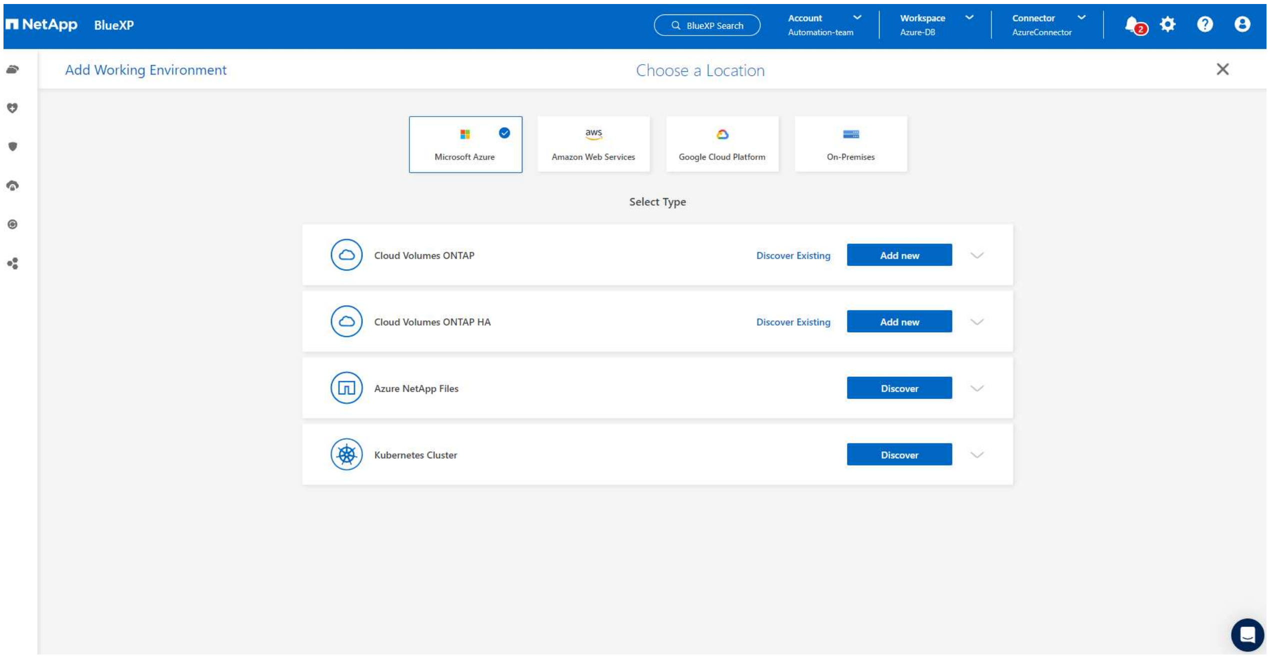
SnapCenter services setup

With the Azure credential configured, SnapCenter services can now be set up with the following procedures:

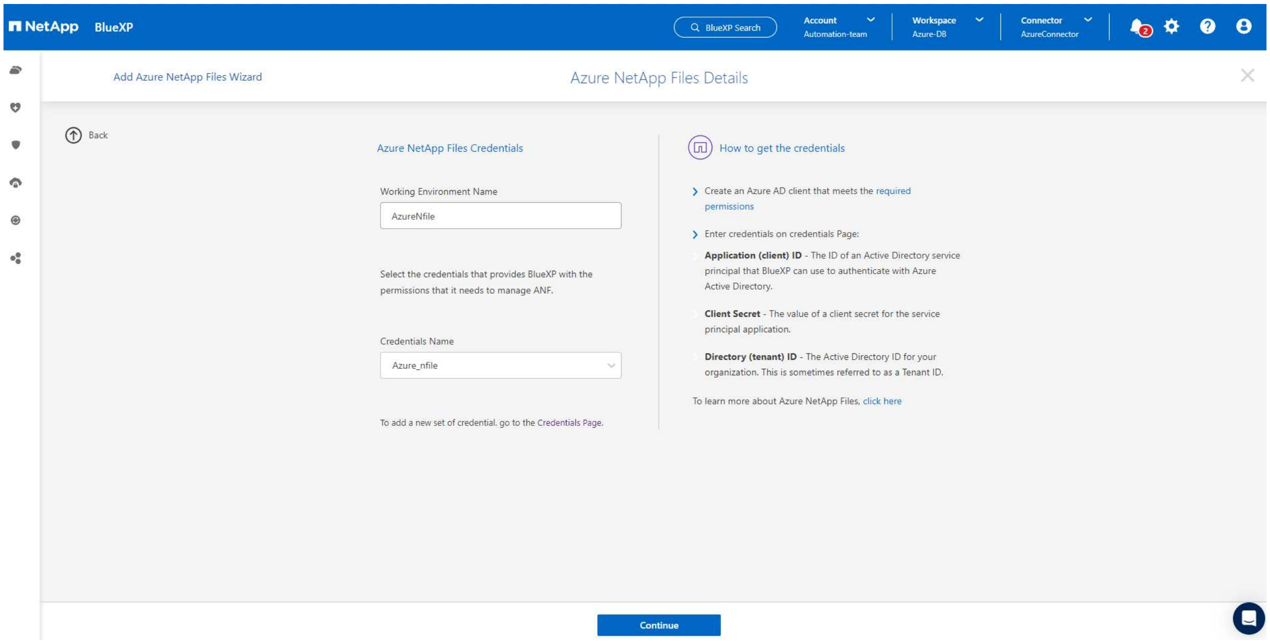
1. Back to Canvas page, from **My Working Environment** click **Add working Environment** to discover Azure NetApp Files deployed in Azure.



2. Choose **Microsoft Azure** as the location and click on **Discover**.



3. Name **Working Environment** and choose **Credential Name** created in previous section, and click **Continue**.



Azure NetApp Files Details

Azure NetApp Files Credentials

Working Environment Name

AzureNfile

Select the credentials that provides BlueXP with the permissions that it needs to manage ANF.

Credentials Name

Azure_nfile

To add a new set of credential. go to the Credentials Page.

How to get the credentials

- Create an Azure AD client that meets the required permissions
- Enter credentials on credentials Page:

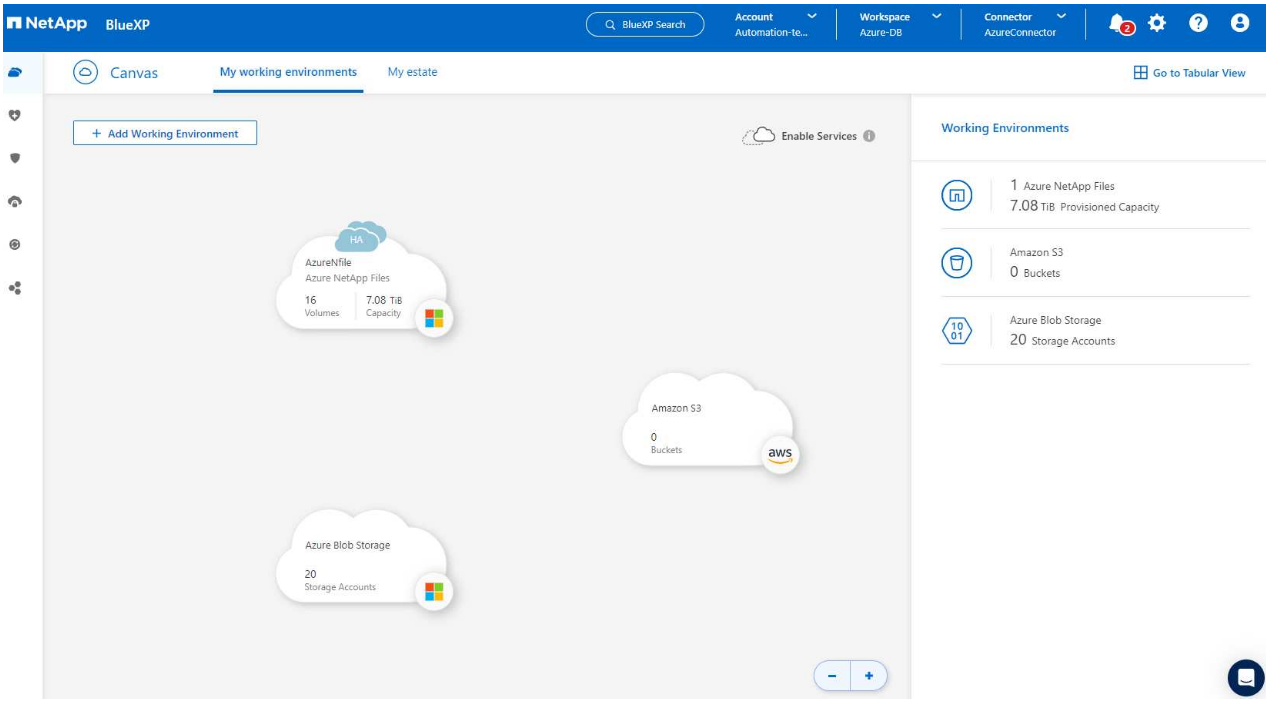
Application (client) ID - The ID of an Active Directory service principal that BlueXP can use to authenticate with Azure Active Directory.

Client Secret - The value of a client secret for the service principal application.

Directory (tenant) ID - The Active Directory ID for your organization. This is sometimes referred to as a Tenant ID.

To learn more about Azure NetApp Files, click here

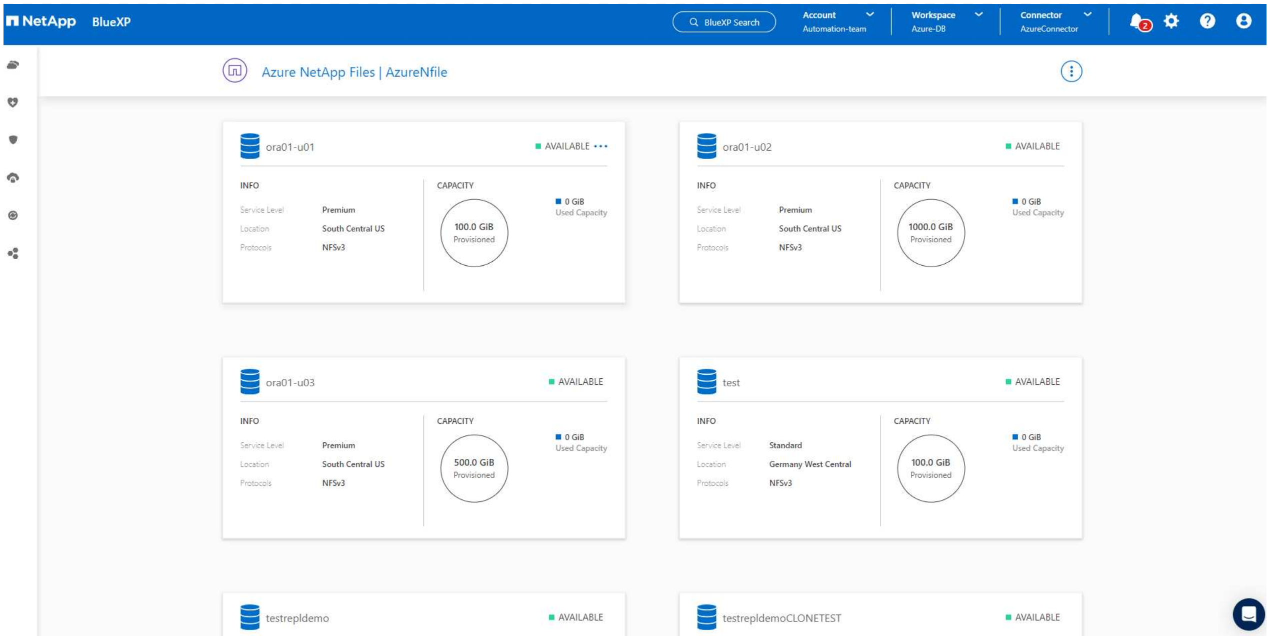
4. BlueXP console returns to **My working environments** and discovered Azure NetApp Files from Azure now appears on **Canvas**.



Working Environments

1 Azure NetApp Files	7.08 TiB Provisioned Capacity
Amazon S3	0 Buckets
Azure Blob Storage	20 Storage Accounts

5. Click on **Azure NetApp Files** icon, then **Enter Working Environment** to view Oracle database volumes deployed in Azure NetApp Files storage.



Azure NetApp Files | AzureNfile

ora01-u01 — AVAILABLE

INFO		CAPACITY
Service Level	Premium	100.0 GiB Provisioned
Location	South Central US	0 GiB Used Capacity
Protocols	NFSv3	

ora01-u02 — AVAILABLE

INFO		CAPACITY
Service Level	Premium	1000.0 GiB Provisioned
Location	South Central US	0 GiB Used Capacity
Protocols	NFSv3	

ora01-u03 — AVAILABLE

INFO		CAPACITY
Service Level	Premium	500.0 GiB Provisioned
Location	South Central US	0 GiB Used Capacity
Protocols	NFSv3	

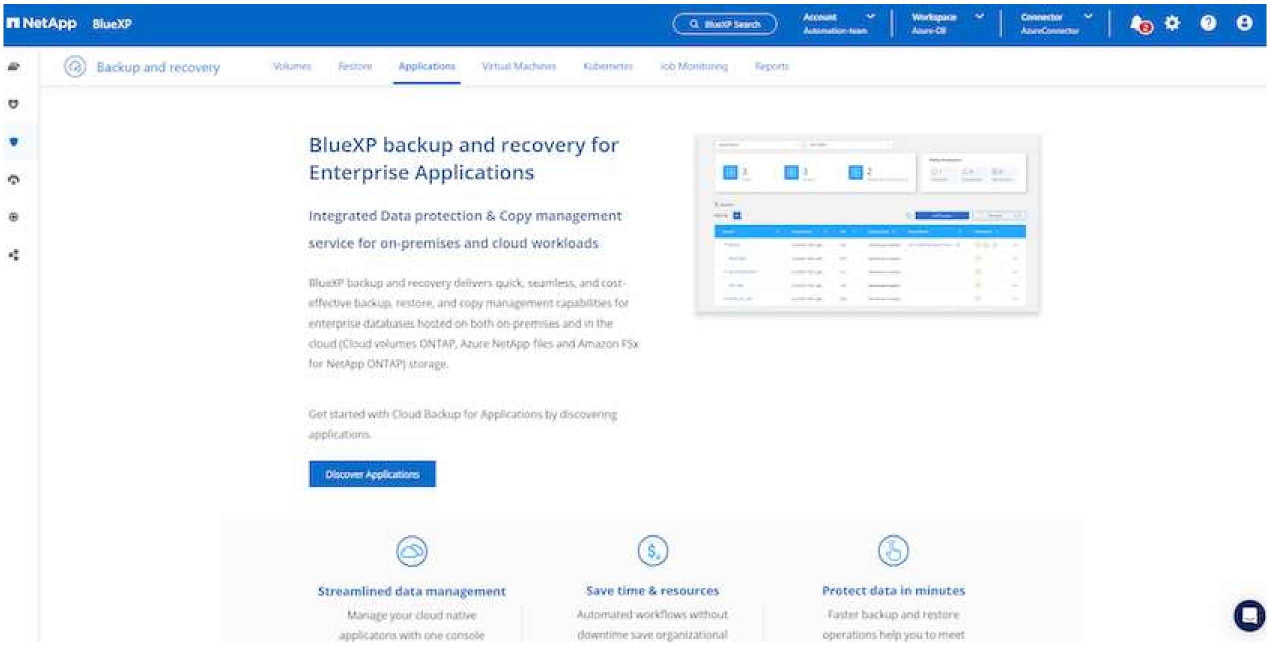
test — AVAILABLE

INFO		CAPACITY
Service Level	Standard	100.0 GiB Provisioned
Location	Germany West Central	0 GiB Used Capacity
Protocols	NFSv3	

testrepldemo — AVAILABLE

testrepldemoCLONETEST — AVAILABLE

6. From the left-hand sidebar of the console, hover your mouse over the protection icon, and then click **Protection** > **Applications** to open the Applications launch page. Click **Discover Applications**.



BlueXP backup and recovery for Enterprise Applications

Integrated Data protection & Copy management service for on-premises and cloud workloads

BlueXP backup and recovery delivers quick, seamless, and cost-effective backup, restore, and copy management capabilities for enterprise databases hosted on both on-premises and in the cloud (Cloud volumes ONTAP, Azure NetApp files and Amazon FSx for NetApp ONTAP) storage.

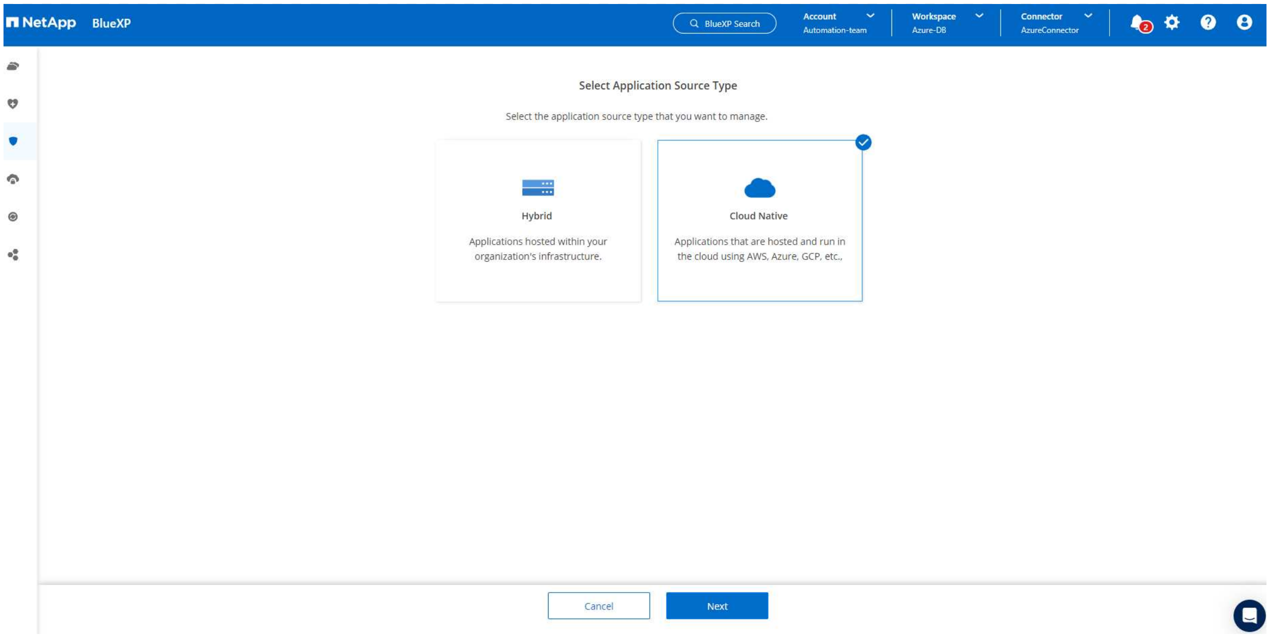
Get started with Cloud Backup for Applications by discovering applications.

Streamlined data management — Manage your cloud native applications with one console

Save time & resources — Automated workflows without downtime save organizational

Protect data in minutes — Faster backup and restore operations help you to meet

7. Select **Cloud Native** as the application source type.



Select Application Source Type

Select the application source type that you want to manage.

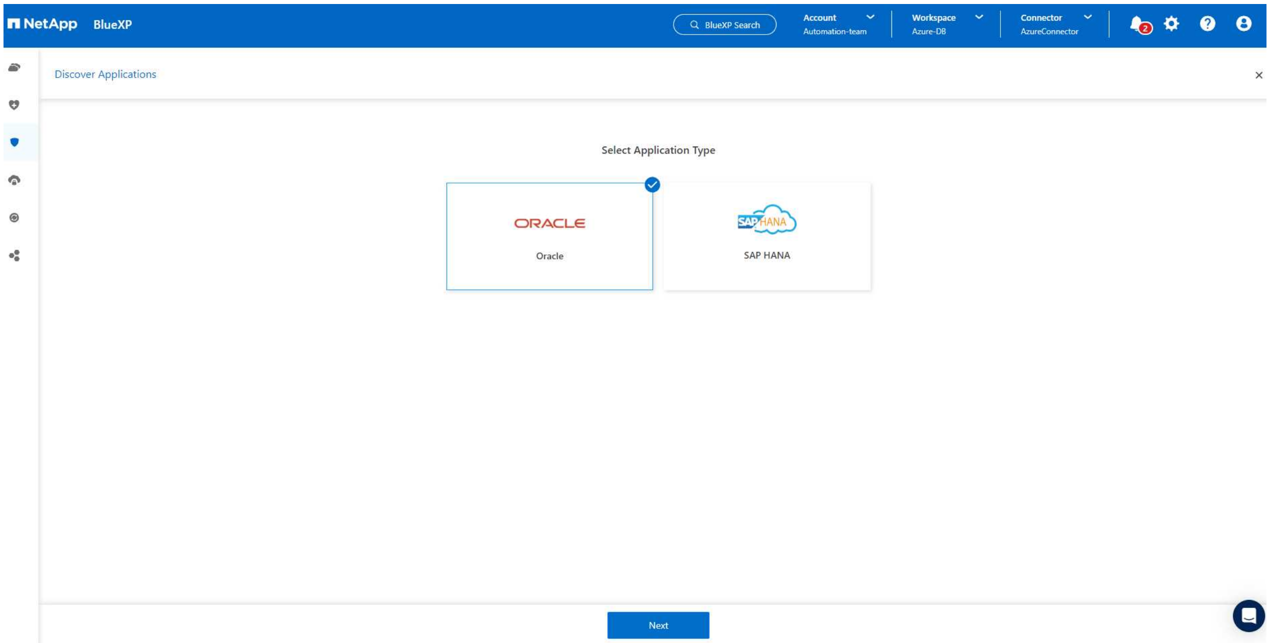
Hybrid

Applications hosted within your organization's infrastructure.

Cloud Native

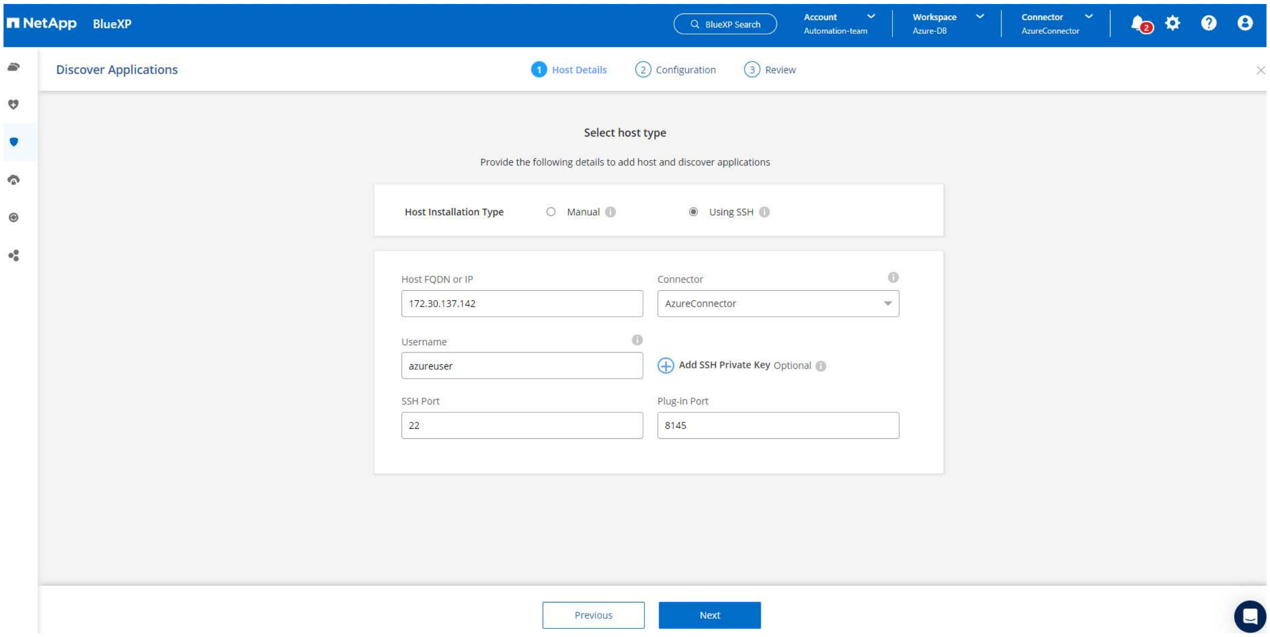
Applications that are hosted and run in the cloud using AWS, Azure, GCP, etc.,

8. Choose **Oracle** for the application type, click on **Next** to open host details page.



Select Application Type

9. Select **Using SSH** and provide the Oracle Azure VM details such as **IP address**, **Connector**, Azure VM management **Username** such as azureuser. Click on **Add SSH Private Key** to paste in the SSH key pair that you used to deploy the Oracle Azure VM. You will also be prompted to confirm the fingerprint.



Discover Applications

1 Host Details 2 Configuration 3 Review

Select host type

Provide the following details to add host and discover applications

Host Installation Type ○ Manual ● Using SSH

Host FQDN or IP: 172.30.137.142

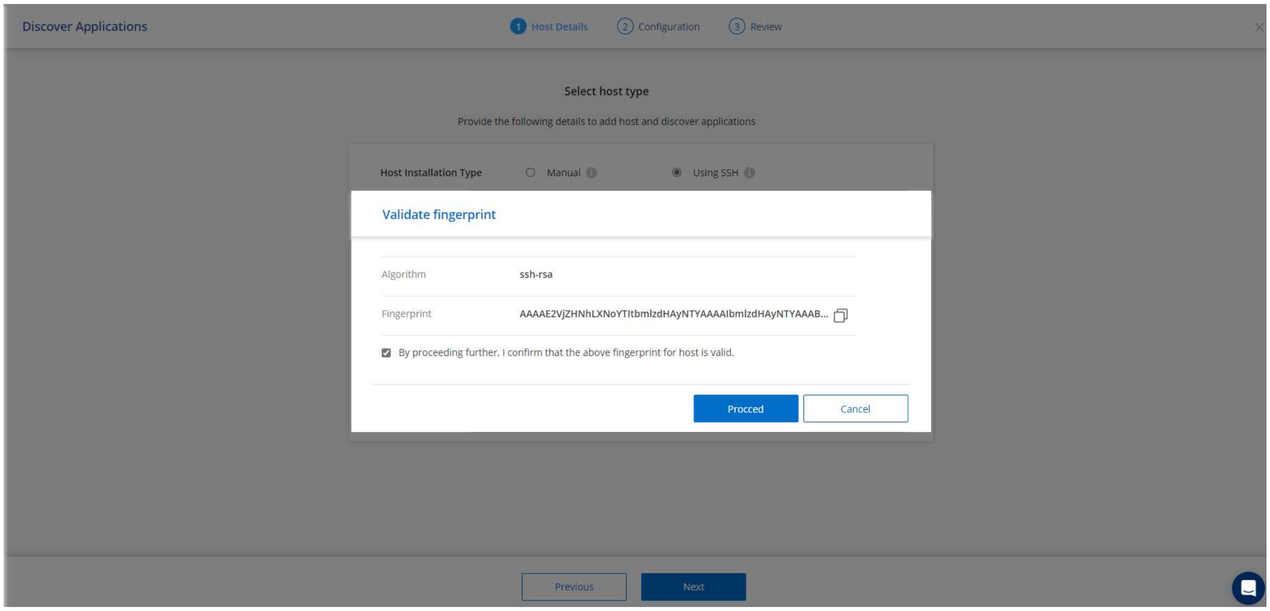
Connector: AzureConnector

Username: azureuser

Add SSH Private Key Optional

SSH Port: 22

Plug-in Port: 8145


Discover Applications

1 Host Details 2 Configuration 3 Review

Select host type

Provide the following details to add host and discover applications

Host Installation Type ○ Manual ● Using SSH

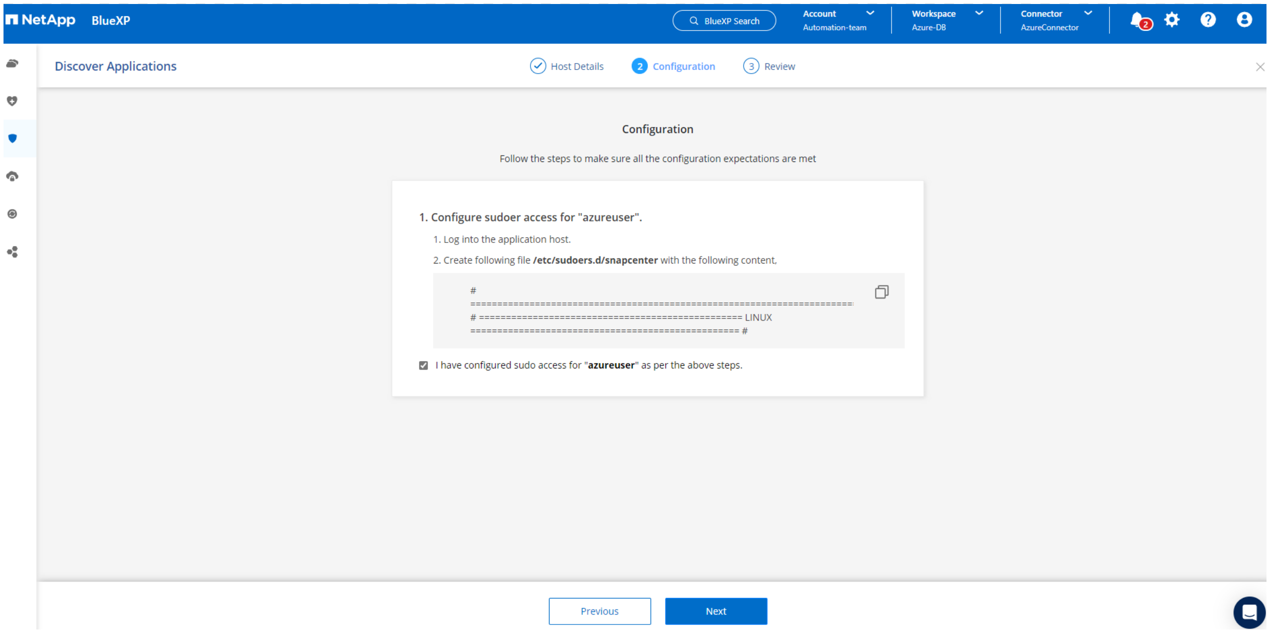
Validate fingerprint

Algorithm: ssh-rsa

Fingerprint: AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbmlzdHAyNTYAAAB...

☑ By proceeding further, I confirm that the above fingerprint for host is valid.

10. Move on to next **Configuration** page to setup sudoer access on Oracle Azure VM.



Configuration

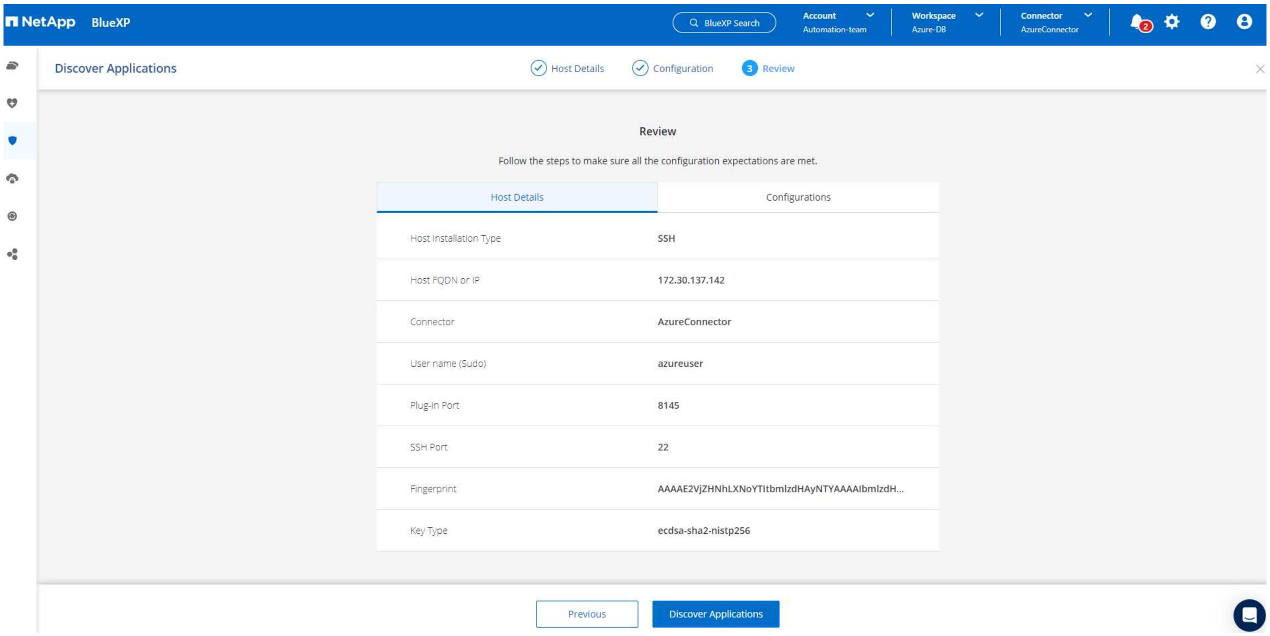
Follow the steps to make sure all the configuration expectations are met

1. Configure sudoer access for "azureuser".
   1. Log into the application host.
   2. Create following file **/etc/sudoers.d/snapcenter** with the following content,

```
#
=======================================================================
# ================================================== LINUX
================================================== #
```

☑ I have configured sudo access for "**azureuser**" as per the above steps.

11. Review and click on **Discover Applications** to install a plugin on the Oracle Azure VM and discover Oracle database on the VM in one step.

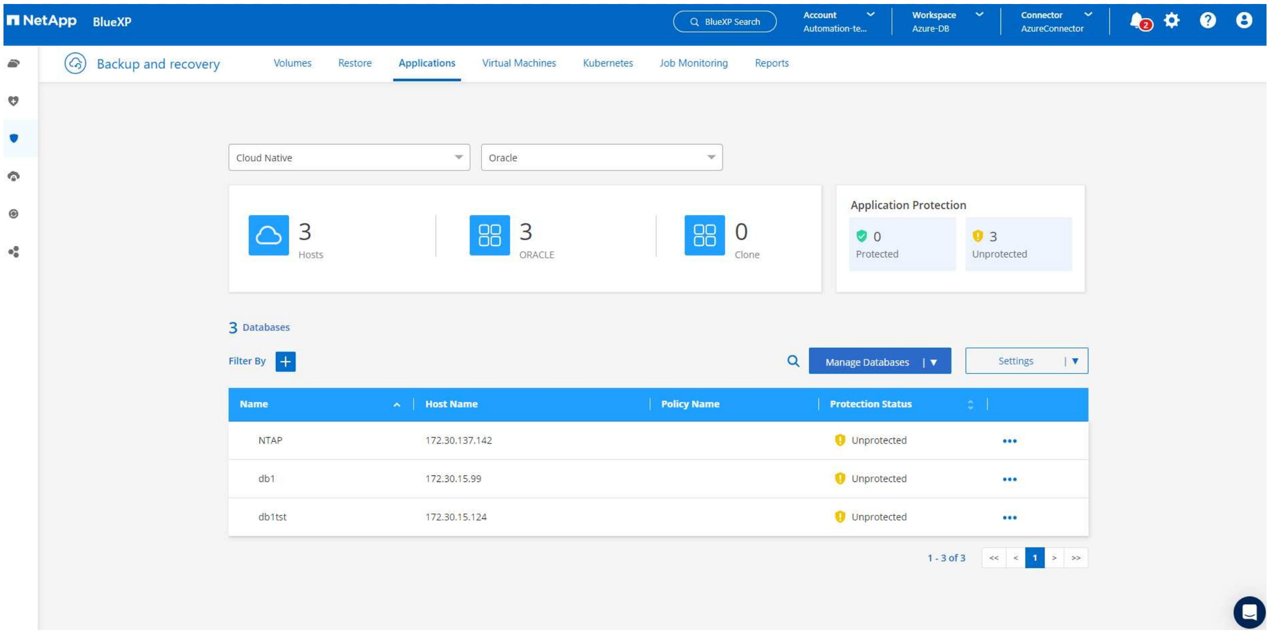


Review

Follow the steps to make sure all the configuration expectations are met.

Host Installation Type	SSH
Host FQDN or IP	172.30.137.142
Connector	AzureConnector
User name (Sudo)	azureuser
Plug-in Port	8145
SSH Port	22
Fingerprint	AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbmlzdH...
Key Type	ecdsa-sha2-nistp256

12. Discovered Oracle databases on Azure VM are added to **Applications**, and the **Applications** page lists the number of hosts and Oracle databases within the environment. The database **Protection Status** initially shows as **Unprotected**.



Name	Host Name	Policy Name	Protection Status
NTAP	172.30.137.142		Unprotected
db1	172.30.15.99		Unprotected
db1tst	172.30.15.124		Unprotected

1 - 3 of 3

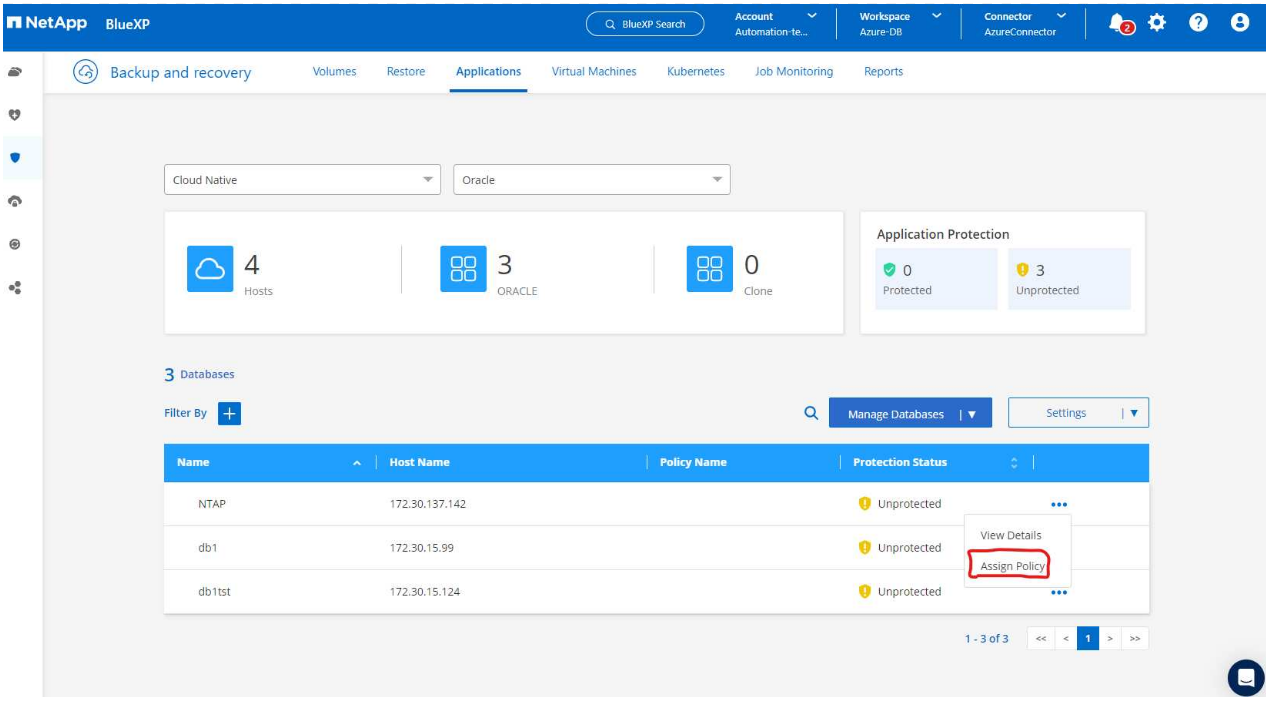
This completes the initial setup of SnapCenter services for Oracle. The next three sections of this document describe Oracle database backup, restore, and clone operations.

Oracle database backup

1. Our test Oracle database in Azure VM is configured with three volumes with an aggregate total storage about 1.6 TiB. This gives context about the timing for the snapshot backup, restore, and clone of a database of this size.

```
[oracle@acao-ora01 ~]$ df -h
Filesystem                  Size  Used Avail Use% Mounted on
devtmpfs                    7.9G     0  7.9G   0% /dev
tmpfs                       7.9G     0  7.9G   0% /dev/shm
tmpfs                       7.9G   17M  7.9G   1% /run
tmpfs                       7.9G     0  7.9G   0% /sys/fs/cgroup
/dev/mapper/rootvg-rootlv   40G   23G   15G  62% /
/dev/mapper/rootvg-usrlv   9.8G  1.6G  7.7G  18% /usr
/dev/sda2                   496M  115M  381M  24% /boot
/dev/mapper/rootvg-varlv   7.9G  787M  6.7G  11% /var
/dev/mapper/rootvg-homelv  976M  323M  586M  36% /home
/dev/mapper/rootvg-optlv   2.0G  9.6M  1.8G   1% /opt
/dev/mapper/rootvg-tmplv   2.0G   22M  1.8G   2% /tmp
/dev/sda1                   500M  6.8M  493M   2% /boot/efi
172.30.136.68:/ora01-u01   100G   23G   78G  23% /u01
172.30.136.68:/ora01-u03   500G  117G  384G  24% /u03
172.30.136.68:/ora01-u02  1000G  804G  197G  81% /u02
tmpfs                       1.6G     0  1.6G   0% /run/user/1000
[oracle@acao-ora01 ~]$
```

1. To protect database, click the three dots next to the database **Protection Status**, and then click **Assign Policy** to view the default preloaded or user defined database protection policies that can be applied to your Oracle databases. Under **Settings** - **Policies**, you have option to create your own policy with a customized backup frequency and backup data-retention window.



Cloud Native | Oracle

4 Hosts | 3 ORACLE | 0 Clone

Application Protection: 0 Protected | 3 Unprotected

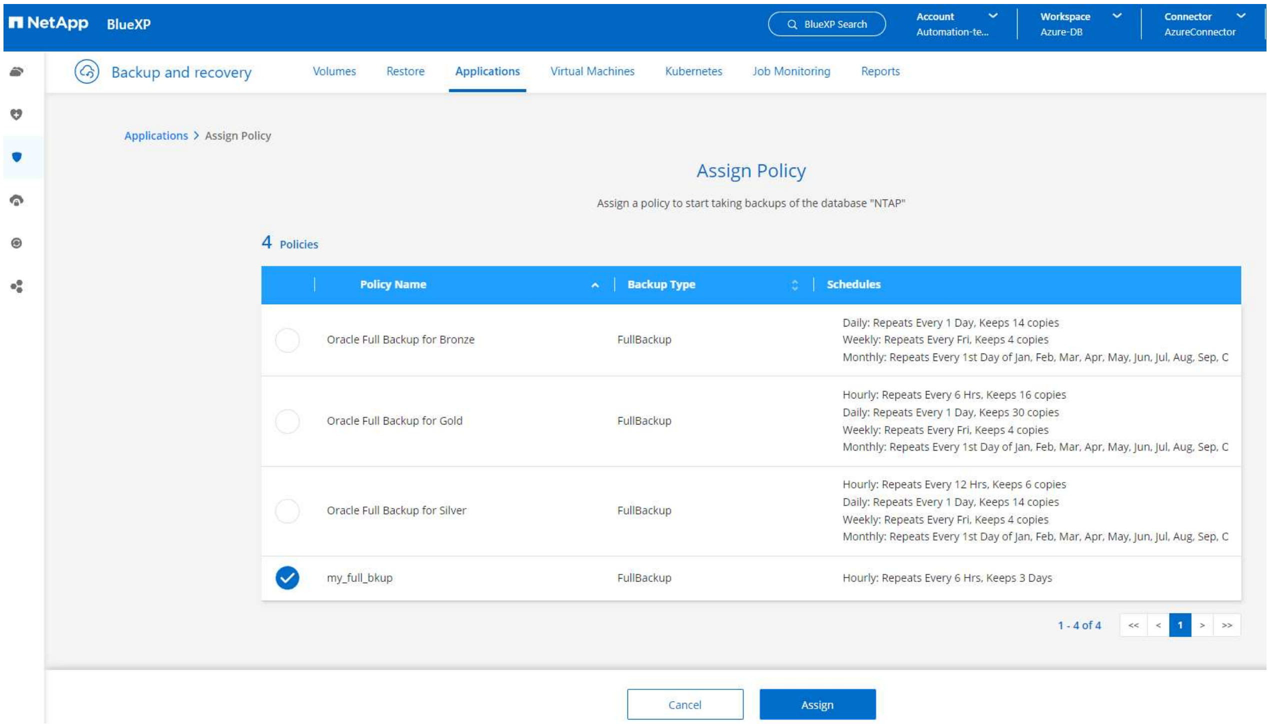
3 Databases

Filter By

Name	Host Name	Policy Name	Protection Status
NTAP	172.30.137.142		Unprotected
db1	172.30.15.99		Unprotected
db1tst	172.30.15.124		Unprotected

1 - 3 of 3

2. When you are happy with the policy configuration, you can then **Assign** your policy of choice to protect the database.



Assign Policy

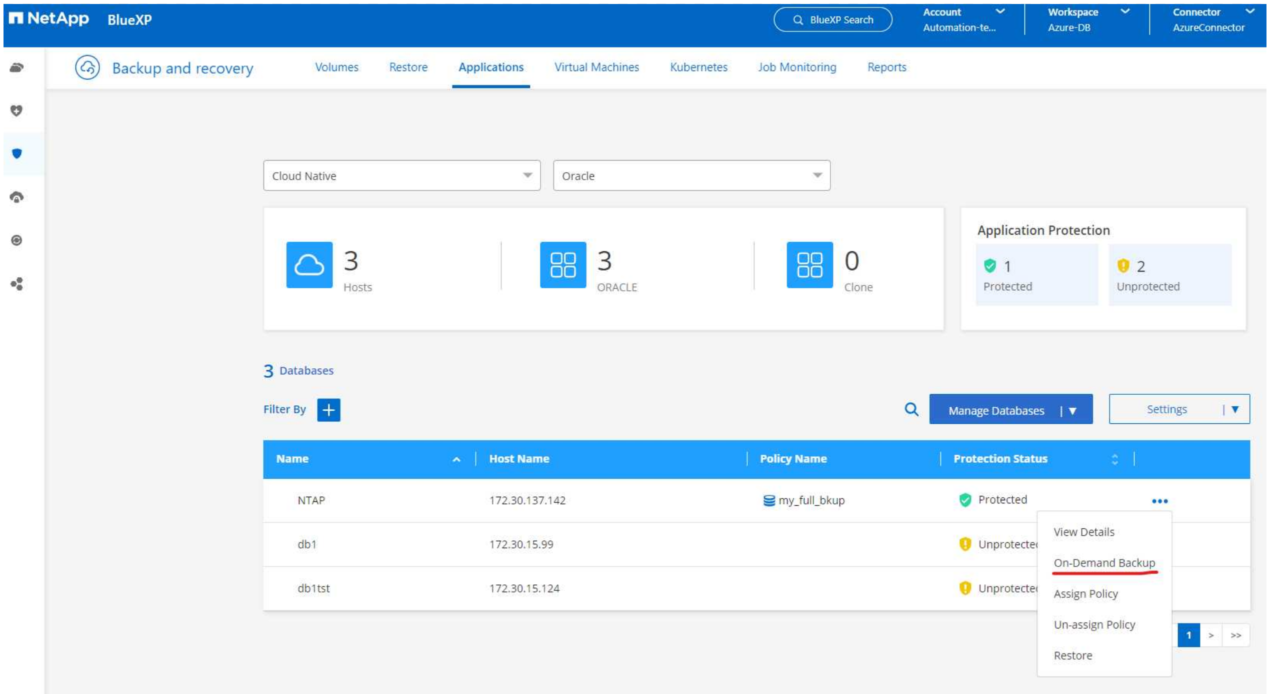
Assign a policy to start taking backups of the database "NTAP"

4 Policies

	Policy Name	Backup Type	Schedules
○	Oracle Full Backup for Bronze	FullBackup	Daily: Repeats Every 1 Day, Keeps 14 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, C
○	Oracle Full Backup for Gold	FullBackup	Hourly: Repeats Every 6 Hrs, Keeps 16 copies Daily: Repeats Every 1 Day, Keeps 30 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, C
○	Oracle Full Backup for Silver	FullBackup	Hourly: Repeats Every 12 Hrs, Keeps 6 copies Daily: Repeats Every 1 Day, Keeps 14 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, C
✓	my_full_bkup	FullBackup	Hourly: Repeats Every 6 Hrs, Keeps 3 Days

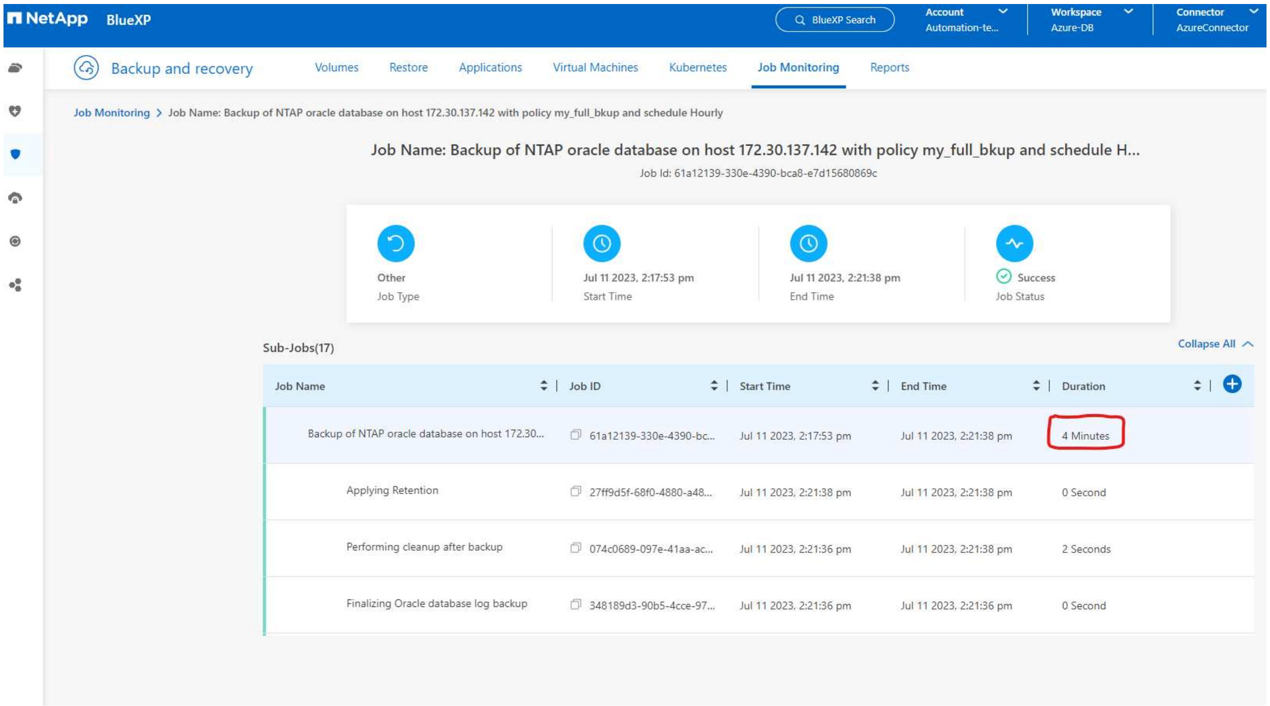
1 - 4 of 4

3. After the policy is applied, the database protection status changed to **Protected** with a green check mark. BlueXP executes the snapshot backup according to the schedule defined. In addition, **ON-Demand Backup** is available from the three-dot drop down menu as shown below.



Name	Host Name	Policy Name	Protection Status
NTAP	172.30.137.142	my_full_bkup	Protected
db1	172.30.15.99		Unprotecte
db1tst	172.30.15.124		Unprotecte

4. From **Job Monitoring** tab, backup job details can be viewed. Our test results showed that it took about 4 minutes to backup an Oracle database about 1.6 TiB.



Job Monitoring > Job Name: Backup of NTAP oracle database on host 172.30.137.142 with policy my_full_bkup and schedule Hourly

Job Name: Backup of NTAP oracle database on host 172.30.137.142 with policy my_full_bkup and schedule H...

Job Id: 61a12139-330e-4390-bca8-e7d15680869c

Job Type: Other

Start Time: Jul 11 2023, 2:17:53 pm

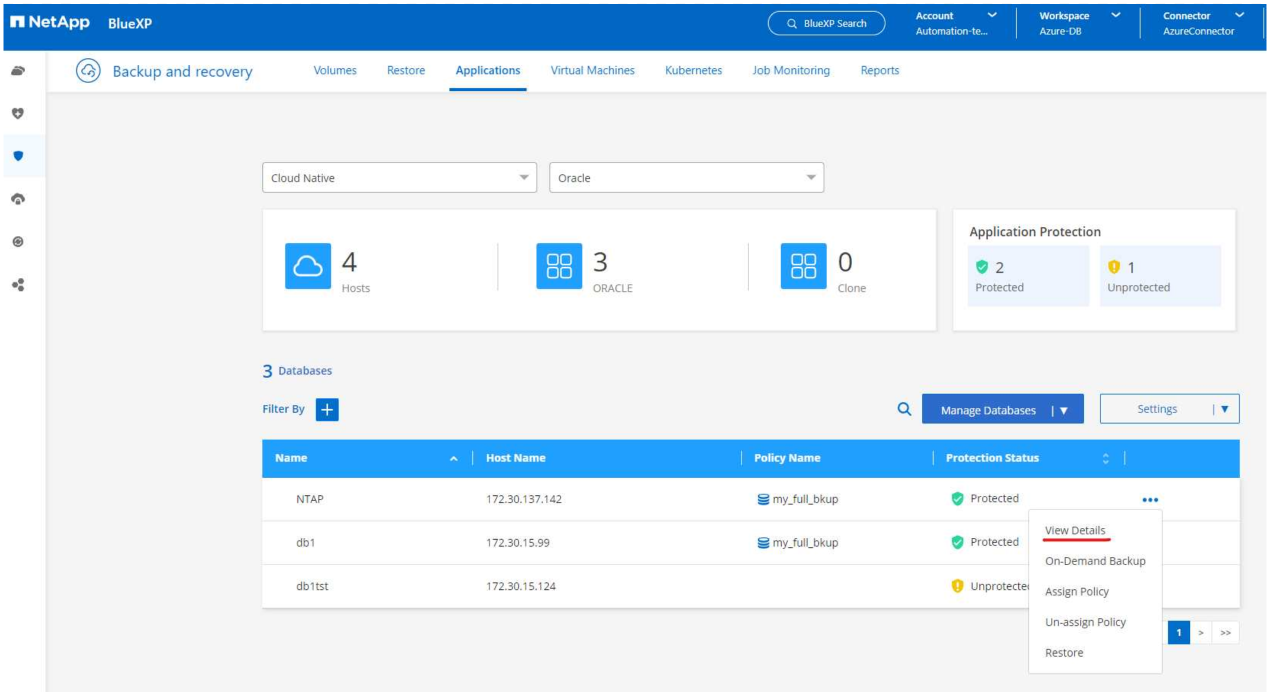
End Time: Jul 11 2023, 2:21:38 pm

Job Status: Success

Sub-Jobs(17)

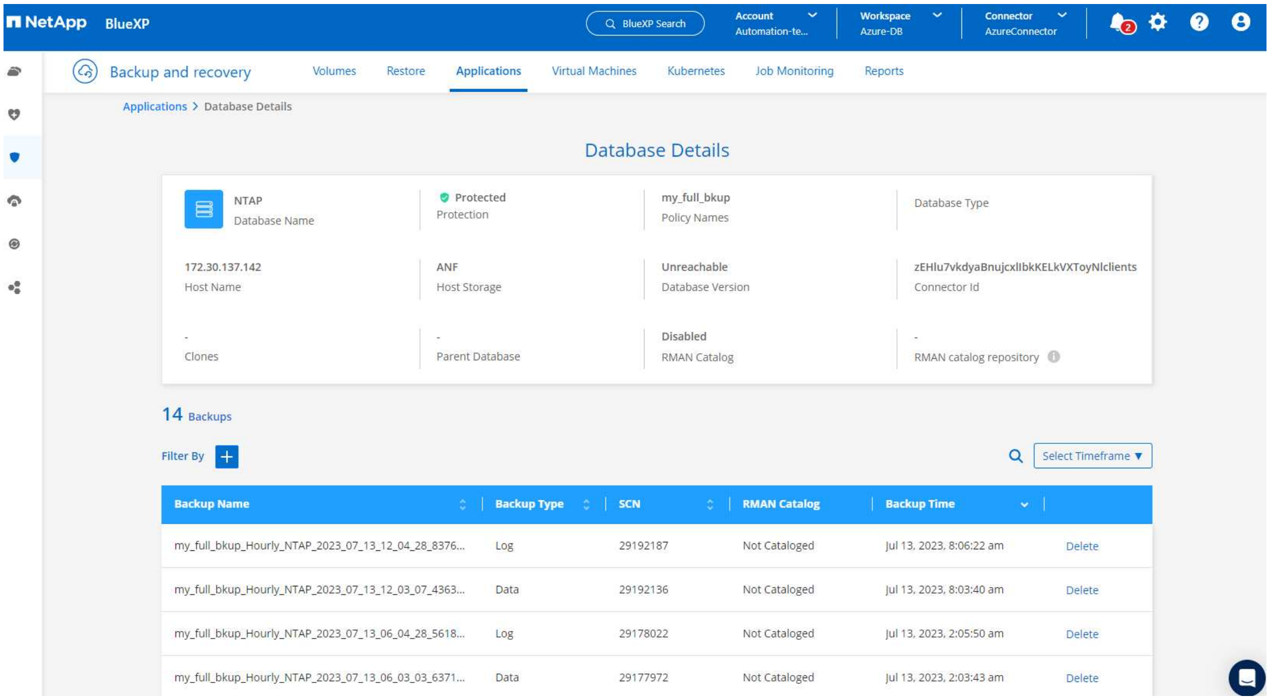
Job Name	Job ID	Start Time	End Time	Duration
Backup of NTAP oracle database on host 172.30...	61a12139-330e-4390-bc...	Jul 11 2023, 2:17:53 pm	Jul 11 2023, 2:21:38 pm	4 Minutes
Applying Retention	27ff9d5f-68f0-4880-a48...	Jul 11 2023, 2:21:38 pm	Jul 11 2023, 2:21:38 pm	0 Second
Performing cleanup after backup	074c0689-097e-41aa-ac...	Jul 11 2023, 2:21:36 pm	Jul 11 2023, 2:21:38 pm	2 Seconds
Finalizing Oracle database log backup	348189d3-90b5-4cce-97...	Jul 11 2023, 2:21:36 pm	Jul 11 2023, 2:21:36 pm	0 Second

5. From three-dot drop down menu **View Details**, you can view the backup sets created from snapshot backup.



Name	Host Name	Policy Name	Protection Status
NTAP	172.30.137.142	my_full_bkup	Protected
db1	172.30.15.99	my_full_bkup	Protected
db1tst	172.30.15.124		Unprotected

6. Database backup details include the **Backup Name**, **Backup Type**, **SCN**, **RMAN Catalog**, and **Backup Time**. A backup set contains application-consistent snapshots for data volume and log volume respectively. A log volume snapshot takes place right after a database data volume snapshot. You could apply a filter if you are looking for a particular backup in the backup list.



NTAP
Database Name

Protected
Protection

my_full_bkup
Policy Names

Database Type

172.30.137.142
Host Name

ANF
Host Storage

Unreachable
Database Version

zEHlu7vkdyaBnujcxlIbkKELkVXToyNlclients
Connector Id

-
Clones

-
Parent Database

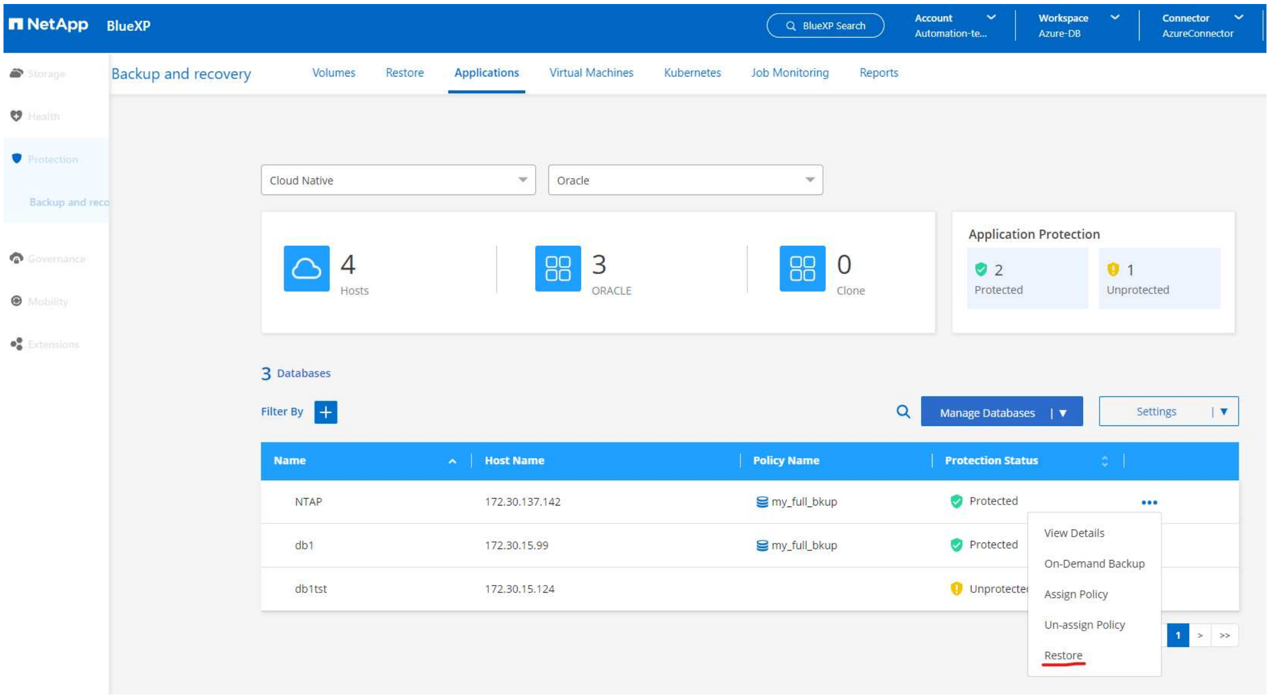
Disabled
RMAN Catalog

-
RMAN catalog repository

Backup Name	Backup Type	SCN	RMAN Catalog	Backup Time	
my_full_bkup_Hourly_NTAP_2023_07_13_12_04_28_8376...	Log	29192187	Not Cataloged	Jul 13, 2023, 8:06:22 am	Delete
my_full_bkup_Hourly_NTAP_2023_07_13_12_03_07_4363...	Data	29192136	Not Cataloged	Jul 13, 2023, 8:03:40 am	Delete
my_full_bkup_Hourly_NTAP_2023_07_13_06_04_28_5618...	Log	29178022	Not Cataloged	Jul 13, 2023, 2:05:50 am	Delete
my_full_bkup_Hourly_NTAP_2023_07_13_06_03_03_6371...	Data	29177972	Not Cataloged	Jul 13, 2023, 2:03:43 am	Delete

Oracle database restore and recovery

1. For a database restore, click the three-dot drop down menu for the particular database to be restored in **Applications**, then click **Restore** to initiate database restore and recovery workflow.



Cloud Native | Oracle

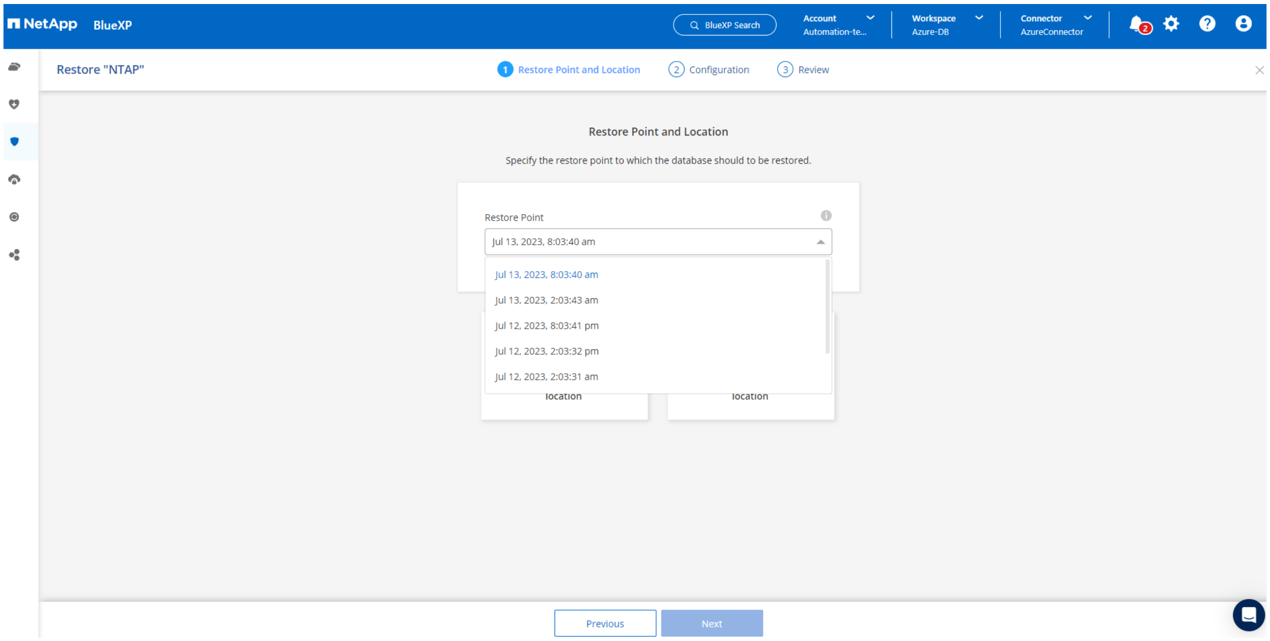
4 Hosts | 3 ORACLE | 0 Clone

Application Protection: 2 Protected | 1 Unprotected

3 Databases

Name	Host Name	Policy Name	Protection Status
NTAP	172.30.137.142	my_full_bkup	Protected
db1	172.30.15.99	my_full_bkup	Protected
db1tst	172.30.15.124		Unprotected

2. Choose your **Restore Point** by time stamp. Each time stamp in the list represents an available database backup set.



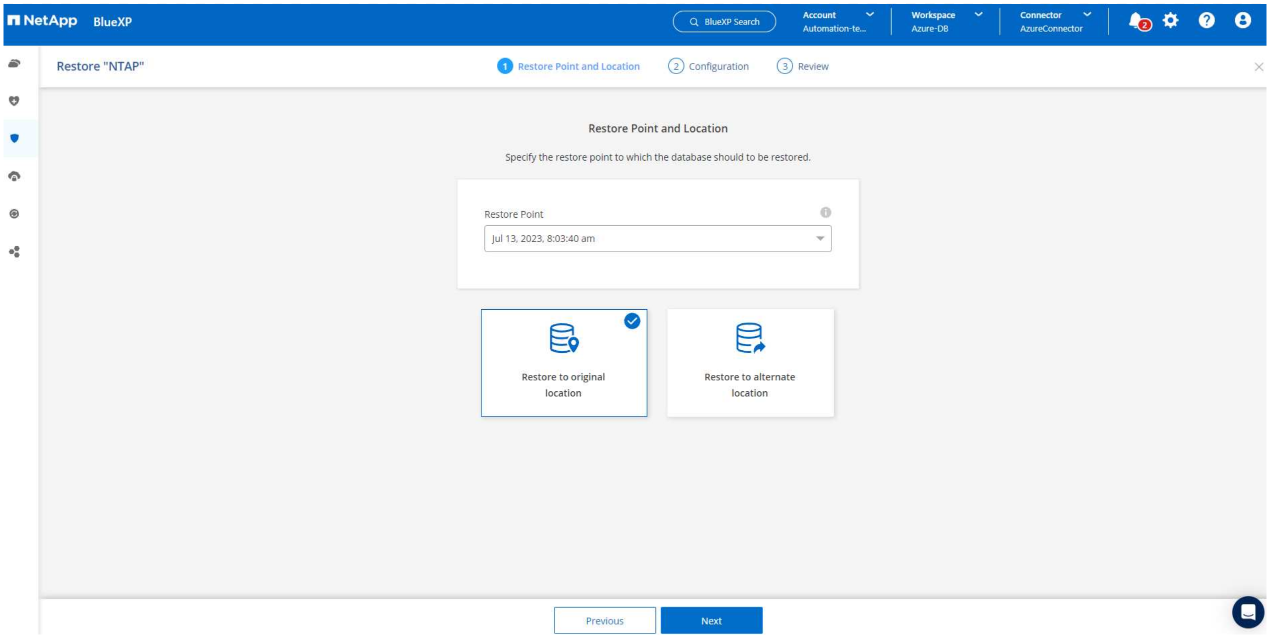
Restore Point and Location

Specify the restore point to which the database should to be restored.

Restore Point: Jul 13, 2023, 8:03:40 am

- Jul 13, 2023, 8:03:40 am
- Jul 13, 2023, 2:03:43 am
- Jul 12, 2023, 8:03:41 pm
- Jul 12, 2023, 2:03:32 pm
- Jul 12, 2023, 2:03:31 am

3. Choose your **Restore Location** to **original location** for an Oracle database in place restore and recovery.



Restore "NTAP"

1 Restore Point and Location   2 Configuration   3 Review

Restore Point and Location

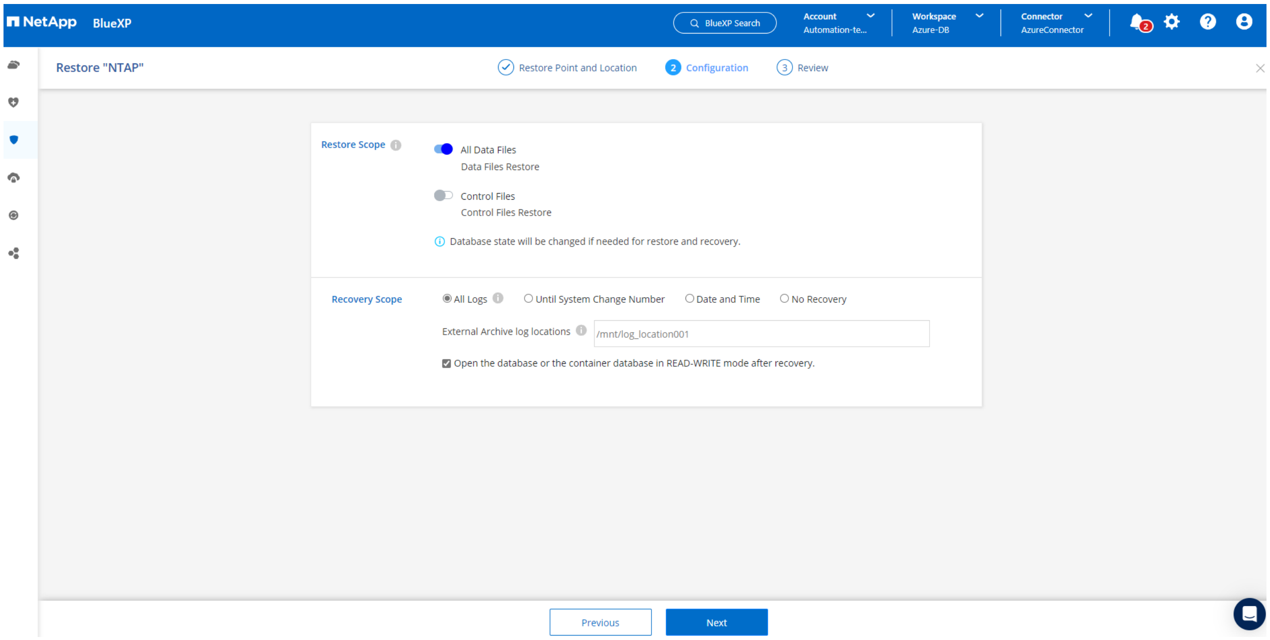
Specify the restore point to which the database should to be restored.

Restore Point: Jul 13, 2023, 8:03:40 am

☑ Restore to original location

Restore to alternate location

4. Define your **Restore Scope**, and **Recovery Scope**. All Logs mean a full recovery up to date including current logs.



Restore "NTAP"

✓ Restore Point and Location   2 Configuration   3 Review

Restore Scope

- ● All Data Files — Data Files Restore
- ○ Control Files — Control Files Restore

Database state will be changed if needed for restore and recovery.

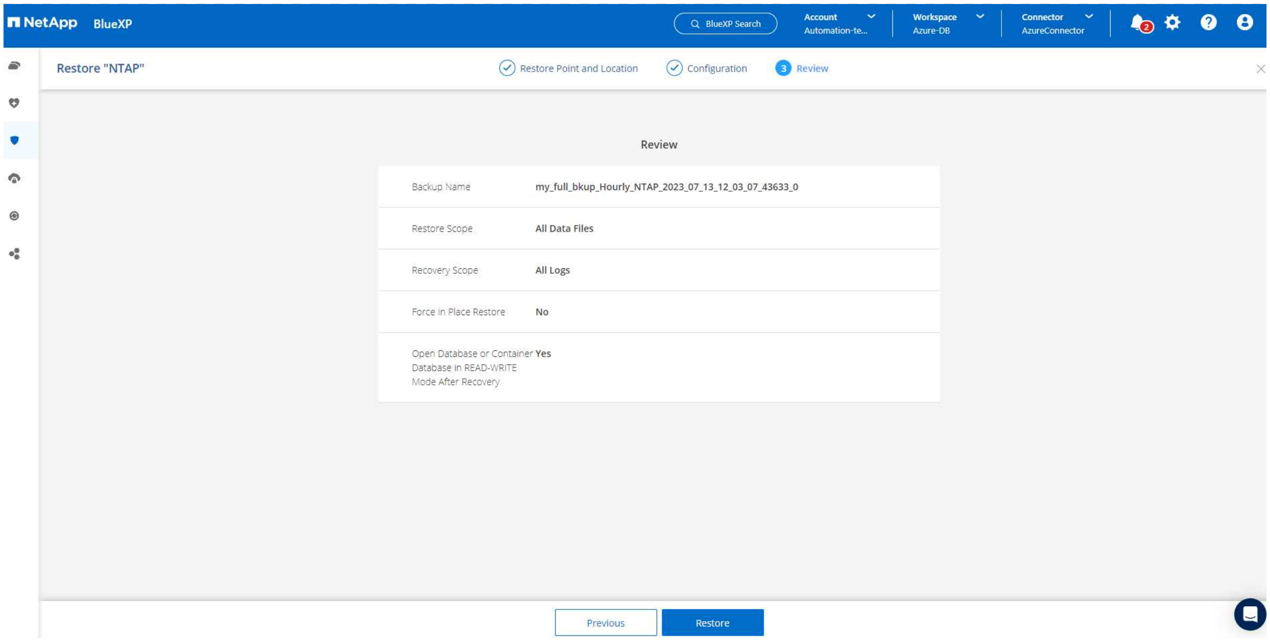
Recovery Scope

● All Logs   ○ Until System Change Number   ○ Date and Time   ○ No Recovery

External Archive log locations: /mnt/log_location001

☑ Open the database or the container database in READ-WRITE mode after recovery.

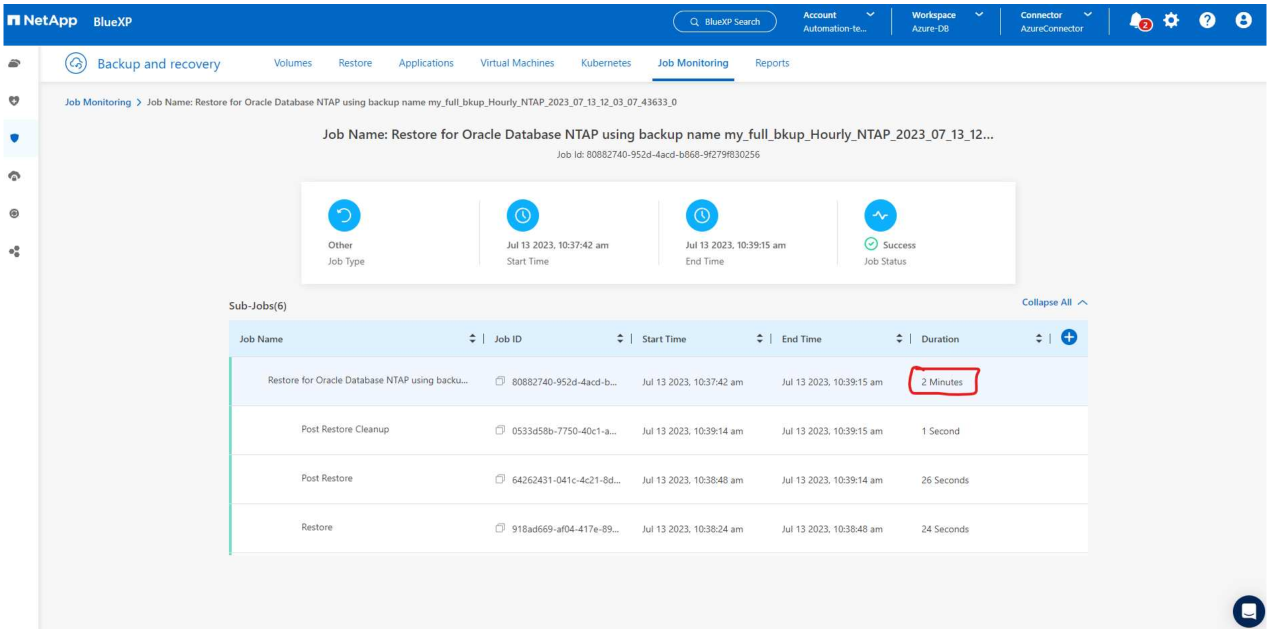
5. Review and **Restore** to start database restore and recovery.



Review

Backup Name	my_full_bkup_Hourly_NTAP_2023_07_13_12_03_07_43633_0
Restore Scope	All Data Files
Recovery Scope	All Logs
Force In Place Restore	No
Open Database or Container Database in READ-WRITE Mode After Recovery	Yes

6. From the **Job Monitoring** tab, we observed that it took 2 minutes to run a full database restore and recovery up to date.



Job Monitoring > Job Name: Restore for Oracle Database NTAP using backup name my_full_bkup_Hourly_NTAP_2023_07_13_12_03_07_43633_0

Job Name: Restore for Oracle Database NTAP using backup name my_full_bkup_Hourly_NTAP_2023_07_13_12...

Job Id: 80882740-952d-4acd-b868-9f279f830256

Job Type	Start Time	End Time	Job Status
Other	Jul 13 2023, 10:37:42 am	Jul 13 2023, 10:39:15 am	Success

Sub-Jobs(6)

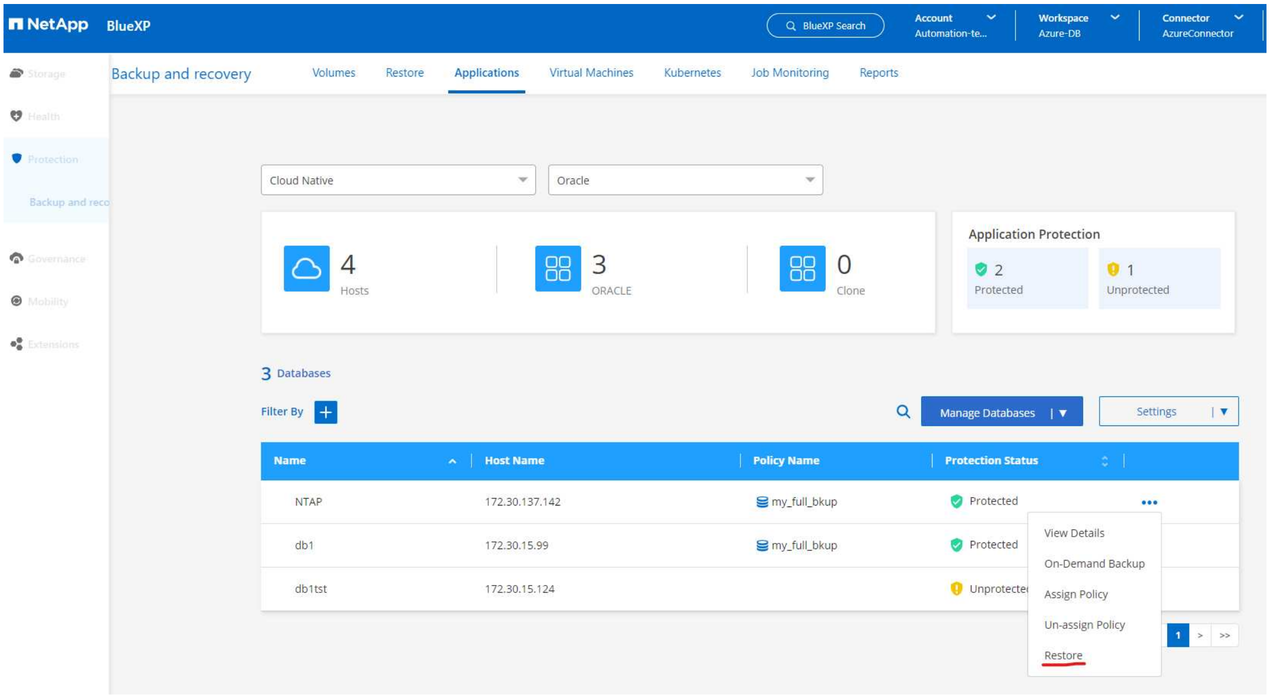
Job Name	Job ID	Start Time	End Time	Duration
Restore for Oracle Database NTAP using backu...	80882740-952d-4acd-b...	Jul 13 2023, 10:37:42 am	Jul 13 2023, 10:39:15 am	2 Minutes
Post Restore Cleanup	0533d58b-7750-40c1-a...	Jul 13 2023, 10:39:14 am	Jul 13 2023, 10:39:15 am	1 Second
Post Restore	64262431-041c-4c21-8d...	Jul 13 2023, 10:38:48 am	Jul 13 2023, 10:39:14 am	26 Seconds
Restore	918ad669-af04-417e-89...	Jul 13 2023, 10:38:24 am	Jul 13 2023, 10:38:48 am	24 Seconds

Oracle database clone

Database clone procedures are similar to restore but to an alternate Azure VM with identical Oracle software stack pre-installed and configured.

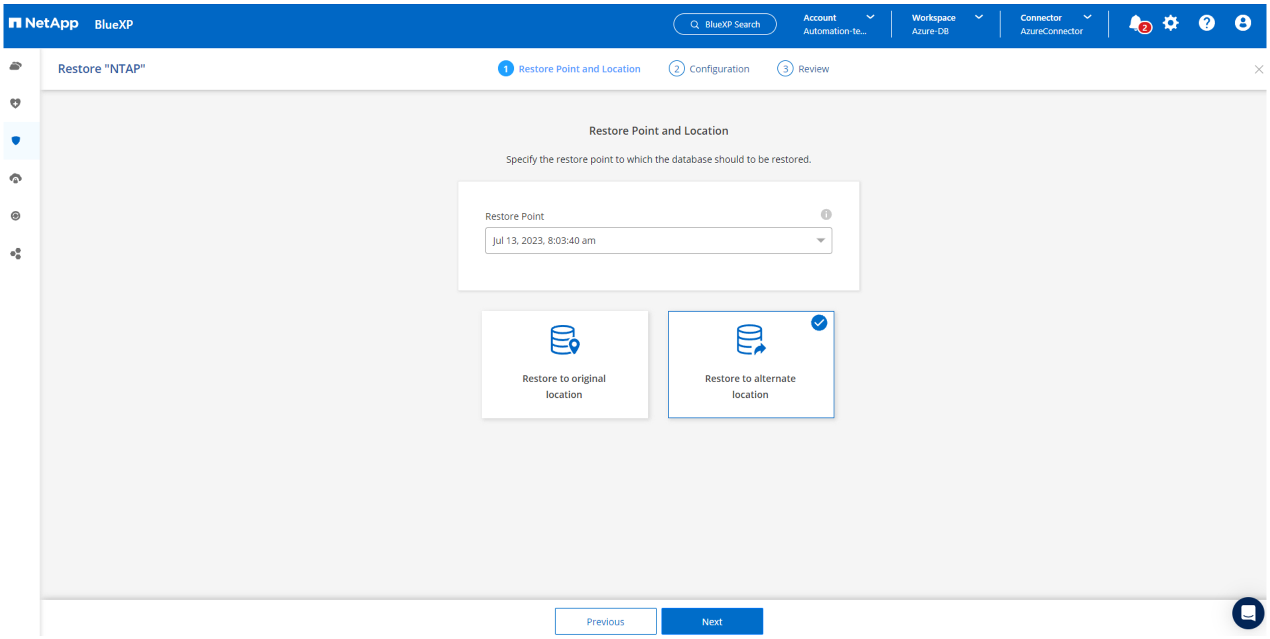
> ⓘ Ensure that your Azure NetApp File storage has sufficient capacity for a cloned database the same size as the primary database to be cloned. The alternate Azure VM has been added to **Applications**.

1. Click the three-dot drop down menu for the particular database to be cloned in **Applications**, then click **Restore** to initiate clone workflow.



Name	Host Name	Policy Name	Protection Status
NTAP	172.30.137.142	my_full_bkup	Protected
db1	172.30.15.99	my_full_bkup	Protected
db1tst	172.30.15.124		Unprotected

2. Select the **Restore Point** and check the **Restore to alternate location**.

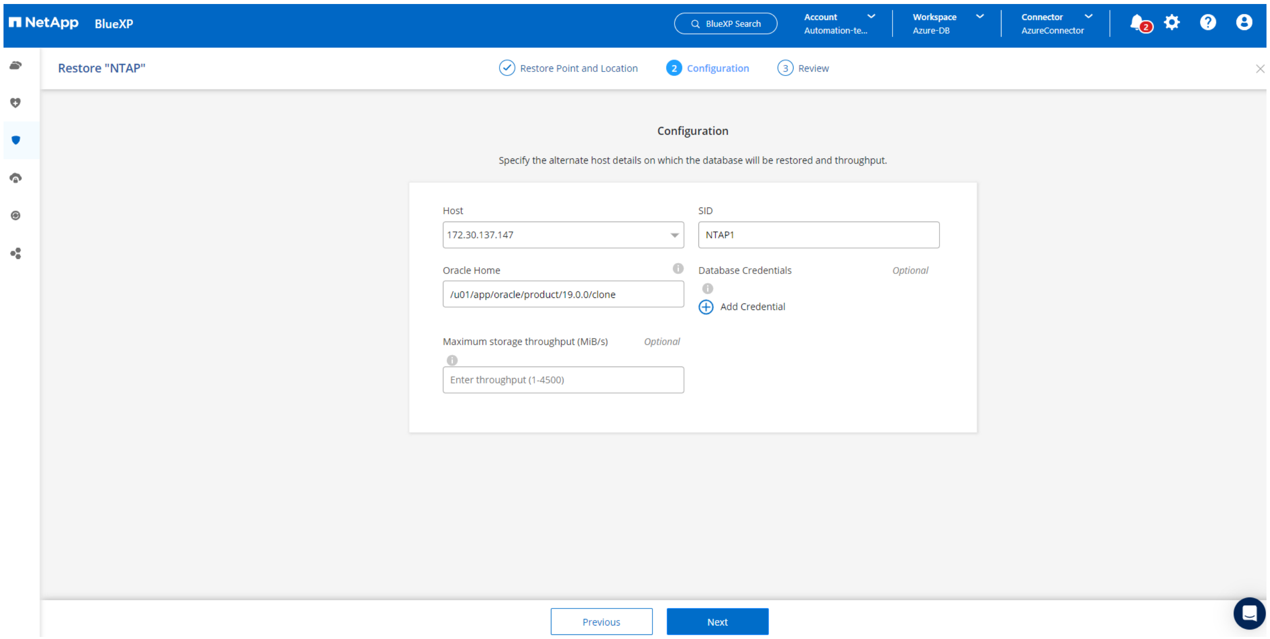


NetApp BlueXP
BlueXP Search
Account Automation-te...
Workspace Azure-DB
Connector AzureConnector
Restore "NTAP"
1 Restore Point and Location
2 Configuration
3 Review
Restore Point and Location
Specify the restore point to which the database should to be restored.
Restore to original location
Restore to alternate location
Previous
Next

Restore Point: Jul 13, 2023, 8:03:40 am

3. In the next **Configuration** page, set alternate **Host**, new database **SID**, and **Oracle Home** as

configured at alternate Azure VM.



Configuration

Specify the alternate host details on which the database will be restored and throughput.

Host: 172.30.137.147

SID: NTAP1

Oracle Home: /u01/app/oracle/product/19.0.0/clone

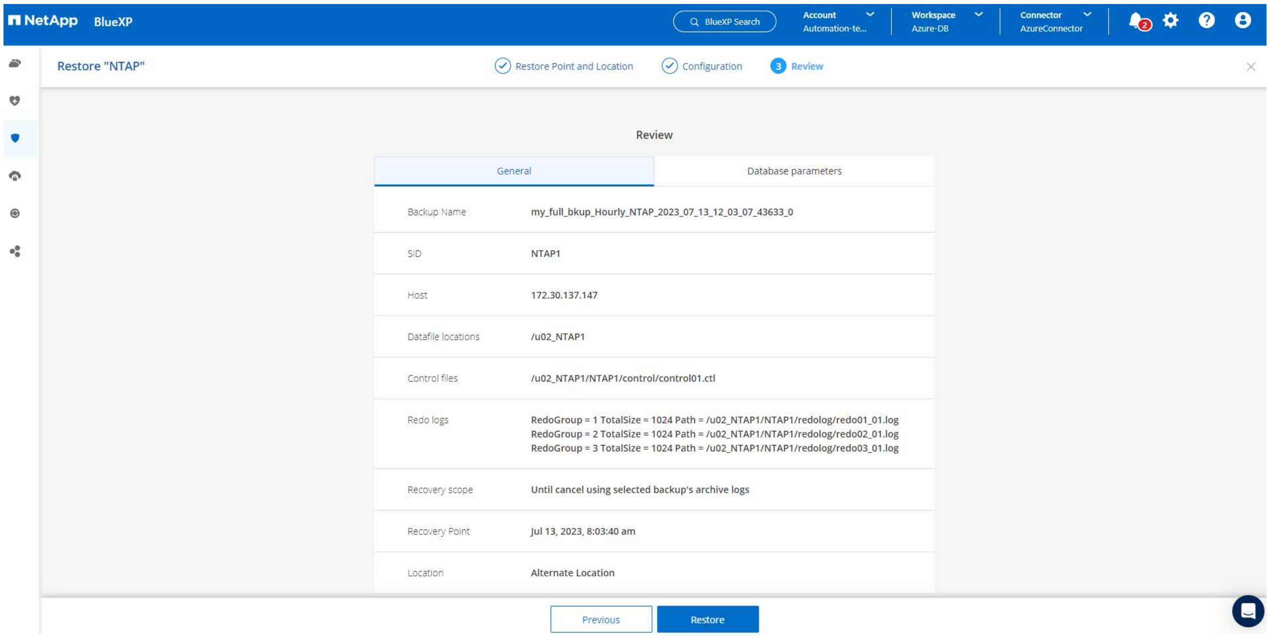
Database Credentials *Optional*

Add Credential

Maximum storage throughput (MiB/s) *Optional*

Enter throughput (1-4500)

4. Review **General** page shows the details of cloned database such as SID, alternate host, data file locations, recovery scope etc.



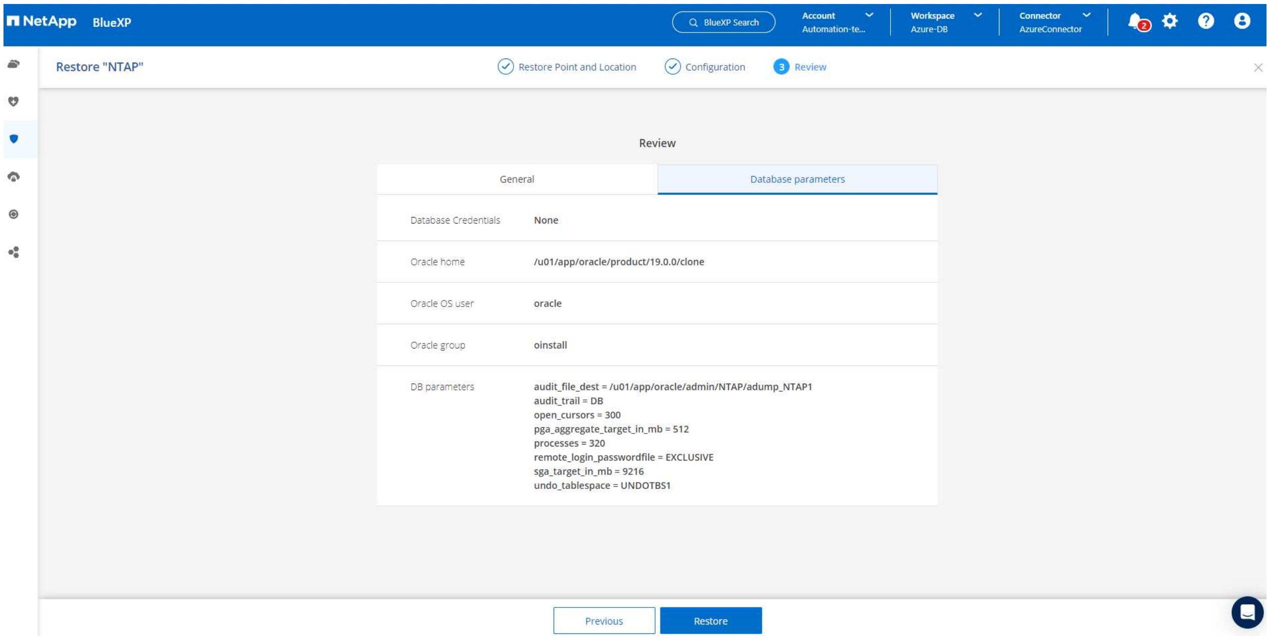
Review

General	Database parameters
Backup Name	my_full_bkup_Hourly_NTAP_2023_07_13_12_03_07_43633_0
SID	NTAP1
Host	172.30.137.147
Datafile locations	/u02_NTAP1
Control files	/u02_NTAP1/NTAP1/control/control01.ctl

Redo logs	RedoGroup = 1 TotalSize = 1024 Path = /u02_NTAP1/NTAP1/redolog/redo01_01.log
	RedoGroup = 2 TotalSize = 1024 Path = /u02_NTAP1/NTAP1/redolog/redo02_01.log
	RedoGroup = 3 TotalSize = 1024 Path = /u02_NTAP1/NTAP1/redolog/redo03_01.log

Recovery scope	Until cancel using selected backup's archive logs
Recovery Point	Jul 13, 2023, 8:03:40 am
Location	Alternate Location

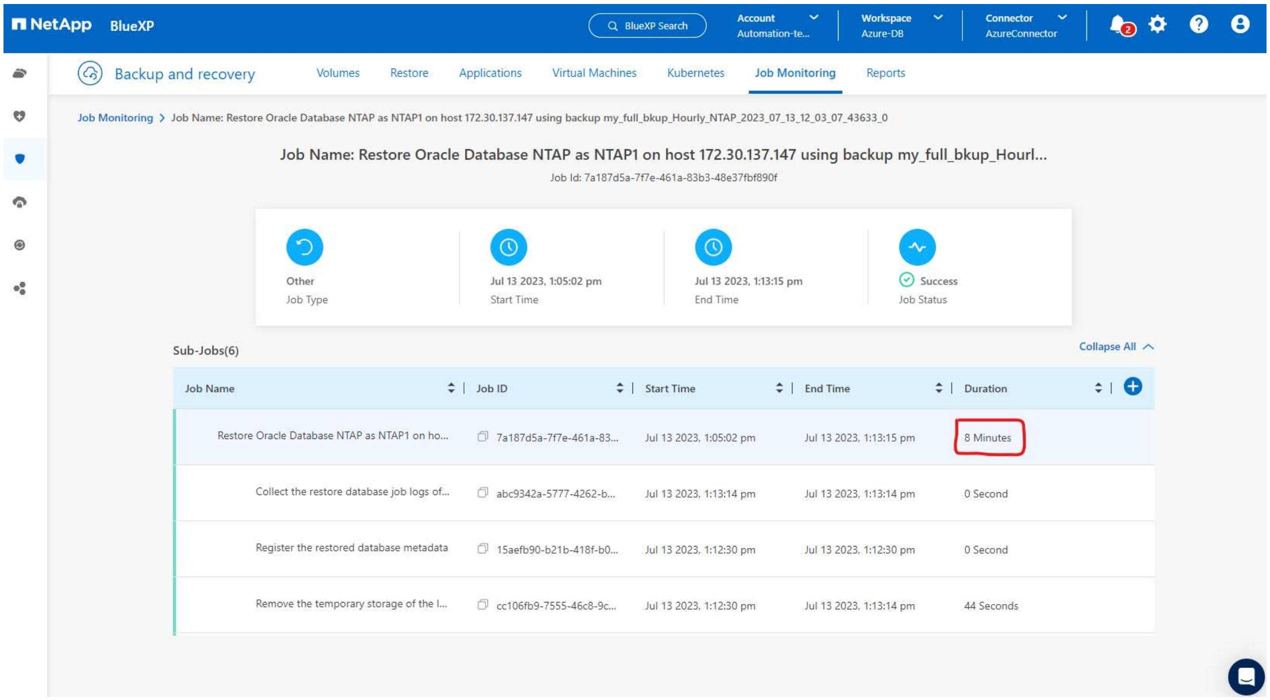
5. Review **Database parameters** page shows the details of cloned database configuration as well as some database parameters setting.



Database Credentials	None
Oracle home	/u01/app/oracle/product/19.0.0/clone
Oracle OS user	oracle
Oracle group	oinstall

DB parameters	audit_file_dest = /u01/app/oracle/admin/NTAP/adump_NTAP1
	audit_trail = DB
	open_cursors = 300
	pga_aggregate_target_in_mb = 512
	processes = 320
	remote_login_passwordfile = EXCLUSIVE
	sga_target_in_mb = 9216
	undo_tablespace = UNDOTBS1

6. Monitor the cloning job status from the **Job Monitoring** tab, we observed that it took 8 minutes to clone a 1.6 TiB Oracle database.



Job Monitoring > Job Name: Restore Oracle Database NTAP as NTAP1 on host 172.30.137.147 using backup my_full_bkup_Hourly_NTAP_2023_07_13_12_03_07_43633_0

Job Name: Restore Oracle Database NTAP as NTAP1 on host 172.30.137.147 using backup my_full_bkup_Hourl...

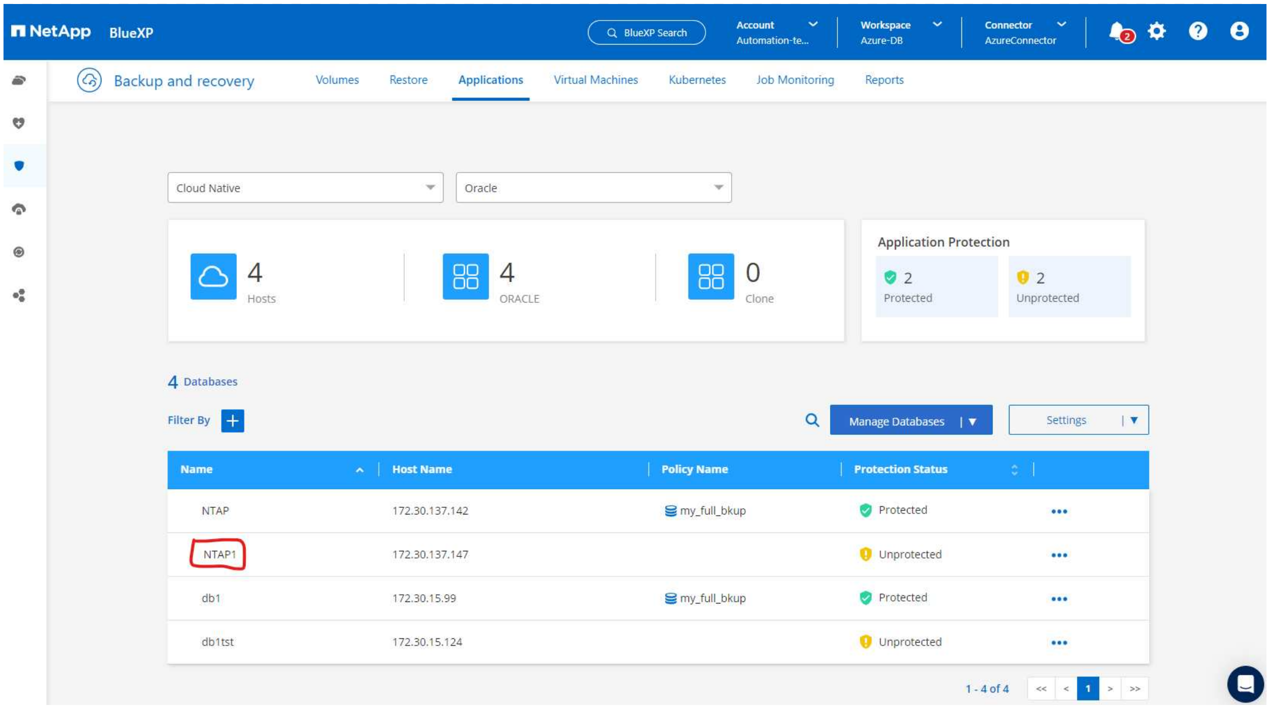
Job Id: 7a187d5a-7f7e-461a-83b3-48e37fbf890f

Job Type	Start Time	End Time	Job Status
Other	Jul 13 2023, 1:05:02 pm	Jul 13 2023, 1:13:15 pm	Success

Sub-Jobs(6)

Job Name	Job ID	Start Time	End Time	Duration
Restore Oracle Database NTAP as NTAP1 on ho...	7a187d5a-7f7e-461a-83...	Jul 13 2023, 1:05:02 pm	Jul 13 2023, 1:13:15 pm	8 Minutes
Collect the restore database job logs of...	abc9342a-5777-4262-b...	Jul 13 2023, 1:13:14 pm	Jul 13 2023, 1:13:14 pm	0 Second
Register the restored database metadata	15aefb90-b21b-418f-b0...	Jul 13 2023, 1:12:30 pm	Jul 13 2023, 1:12:30 pm	0 Second
Remove the temporary storage of the l...	cc106fb9-7555-46c8-9c...	Jul 13 2023, 1:12:30 pm	Jul 13 2023, 1:13:14 pm	44 Seconds

7. Validate the cloned database in BlueXP **Applications** page that showed the cloned database was immediately registered with BlueXP.



Cloud Native

Oracle

4 Hosts

4 ORACLE

0 Clone

Application Protection

2 Protected

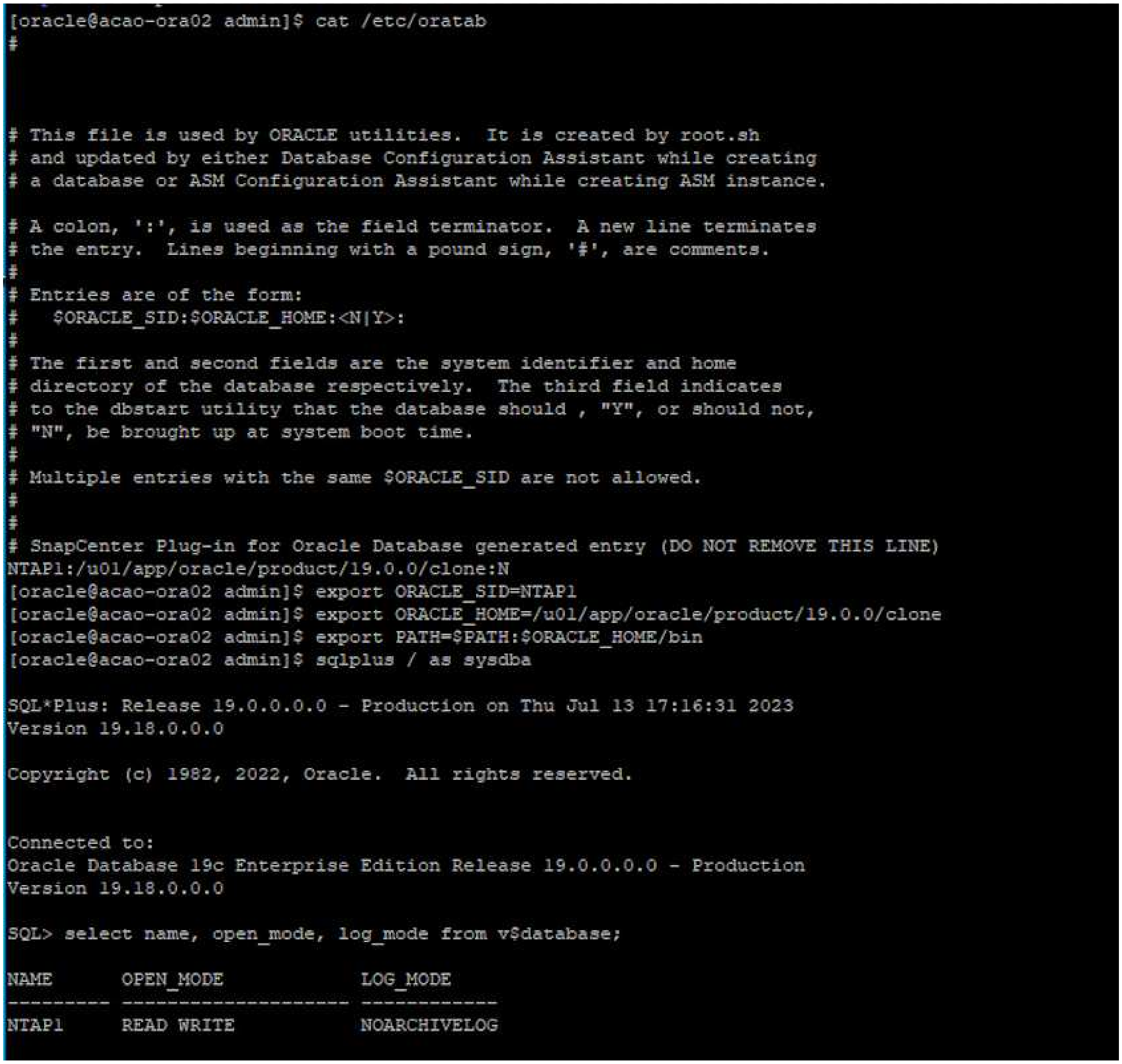
2 Unprotected

4 Databases

Name	Host Name	Policy Name	Protection Status	
NTAP	172.30.137.142	my_full_bkup	Protected	•••
NTAP1	172.30.137.147		Unprotected	•••
db1	172.30.15.99	my_full_bkup	Protected	•••
db1tst	172.30.15.124		Unprotected	•••

1 - 4 of 4

8. Validate the cloned database on the Oracle Azure VM that showed the cloned database was running as expected.



```
[oracle@acao-ora02 admin]$ cat /etc/oratab
#



# This file is used by ORACLE utilities.  It is created by root.sh
# and updated by either Database Configuration Assistant while creating
# a database or ASM Configuration Assistant while creating ASM instance.

# A colon, ':', is used as the field terminator.  A new line terminates
# the entry.  Lines beginning with a pound sign, '#', are comments.
#
# Entries are of the form:
#   $ORACLE_SID:$ORACLE_HOME:<N|Y>:
#
# The first and second fields are the system identifier and home
# directory of the database respectively.  The third field indicates
# to the dbstart utility that the database should , "Y", or should not,
# "N", be brought up at system boot time.
#
# Multiple entries with the same $ORACLE_SID are not allowed.
#
#
# SnapCenter Plug-in for Oracle Database generated entry (DO NOT REMOVE THIS LINE)
NTAP1:/u01/app/oracle/product/19.0.0/clone:N
[oracle@acao-ora02 admin]$ export ORACLE_SID=NTAP1
[oracle@acao-ora02 admin]$ export ORACLE_HOME=/u01/app/oracle/product/19.0.0/clone
[oracle@acao-ora02 admin]$ export PATH=$PATH:$ORACLE_HOME/bin
[oracle@acao-ora02 admin]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Thu Jul 13 17:16:31 2023
Version 19.18.0.0.0

Copyright (c) 1982, 2022, Oracle.  All rights reserved.


Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.18.0.0.0

SQL> select name, open_mode, log_mode from v$database;

NAME      OPEN_MODE            LOG_MODE
--------- -------------------- ------------
NTAP1     READ WRITE           NOARCHIVELOG
```

This completes the demonstration of an Oracle database backup, restore, and clone in Azure with NetApp BlueXP console using SnapCenter Service.

Additional information

To learn more about the information that is described in this document, review the following documents and/or websites:

- Set up and administer BlueXP

  https://docs.netapp.com/us-en/cloud-manager-setup-admin/index.html

- BlueXP backup and recovery documentation

  https://docs.netapp.com/us-en/cloud-manager-backup-restore/index.html

- Azure NetApp Files

https://azure.microsoft.com/en-us/products/netapp

- Get started with Azure

  https://azure.microsoft.com/en-us/get-started/

TR-4964: Oracle Database backup, restore and clone with SnapCenter Services - AWS

This solution provides overview and details for Oracle database backup, restore, clone using NetApp SnapCenter SaaS using BlueXP console in Azure cloud.

Allen Cao, Niyaz Mohamed, NetApp

Purpose

SnapCenter Services is the SaaS version of the classic SnapCenter database management UI tool that is available through the NetApp BlueXP cloud management console. It is an integral part of the NetApp cloud-backup, data-protection offering for databases such as Oracle and HANA running on NetApp cloud storage. This SaaS-based service simplifies traditional SnapCenter standalone server deployment that generally requires a Windows server operating in a Windows domain environment.

In this documentation, we demonstrate how you can set up SnapCenter Services to backup, restore, and clone Oracle databases deployed to Amazon FSx for ONTAP storage and EC2 compute instances. Although it is much easier to set up and use, SnapCenter Services deliver key functionalities that are available in the legacy SnapCenter UI tool.

This solution addresses the following use cases:

- Database backup with snapshots for Oracle databases hosted in Amazon FSx for ONTAP
- Oracle database recovery in the case of a failure
- Fast and storage-efficient cloning of primary databases for a dev/test environment or other use cases

Audience

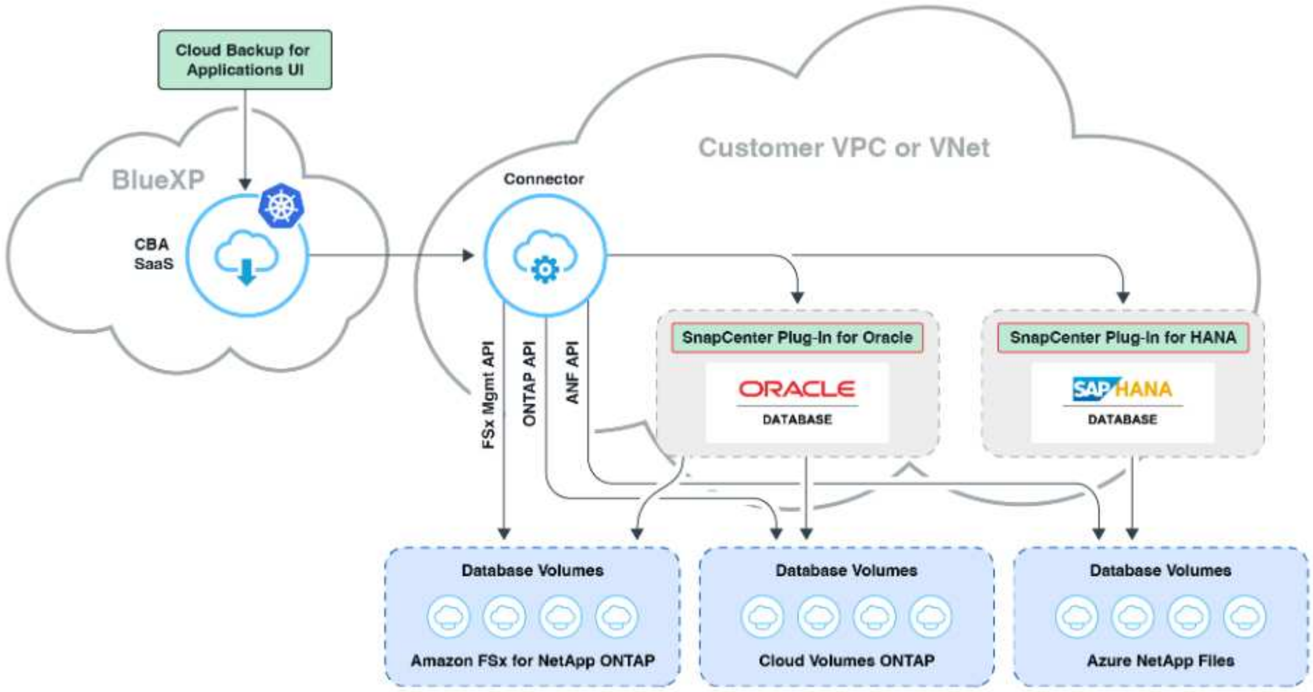
This solution is intended for the following audiences:

- The DBA who manages Oracle databases running on Amazon FSx for ONTAP storage
- The solution architect who is interested in testing Oracle database backup, restore, and clone in the public AWS cloud
- The storage administrator who supports and manages the Amazon FSx for ONTAP storage
- The application owner who owns applications that are deployed to Amazon FSx for ONTAP storage

Solution test and validation environment

The testing and validation of this solution was performed in an AWS FSx and EC2 environment that might not match the final deployment environment. For more information, see the section Key factors for deployment consideration.

Architecture



This image provides a detailed picture of BlueXP backup and recovery for applications within the BlueXP console, including the UI, the connector, and the resources it manages.

Hardware and software components

Hardware

FSx ONTAP storage	Current version offered by AWS	One FSx HA cluster in the same VPC and availability zone
EC2 instance for compute	t2.xlarge/4vCPU/16G	Two EC2 T2 xlarge EC2 instances, one as primary DB server and the other as clone DB server

Software

RedHat Linux	RHEL-8.6.0_HVM-20220503-x86_64-2-Hourly2-GP2	Deployed RedHat subscription for testing
Oracle Grid Infrastructure	Version 19.18	Applied RU patch p34762026_190000_Linux-x86-64.zip
Oracle Database	Version 19.18	Applied RU patch p34765931_190000_Linux-x86-64.zip
Oracle OPatch	Version 12.2.0.1.36	Latest patch p6880880_190000_Linux-x86-64.zip

SnapCenter Service	Version	v2.3.1.2324

Key factors for deployment consideration

- **Connector to be deployed in the same VPC as database and FSx.** When possible, the connector should be deployed in the same AWS VPC, which enables connectivity to the FSx storage and the EC2 compute instance.
- **An AWS IAM policy created for SnapCenter connector.** The policy in JSON format is available in the detailed SnapCenter service documentation. When you launch connector deployment with the BlueXP console, you are also prompted to set up the prerequisites with details of required permission in JSON format. The policy should be assigned to the AWS user account that owns the connector.
- **The AWS account access key and the SSH key pair created in the AWS account.** The SSH key pair is assigned to the ec2-user for logging into the connector host and then deploying a database plug-in to the EC2 DB server host. The access key grants permission for provisioning the required connector with IAM policy above.
- **A credential added to the BlueXP console setting.** To add Amazon FSx for ONTAP to the BlueXP working environment, a credential that grants BlueXP permissions to access Amazon FSx for ONTAP is set up in the BlueXP console setting.
- **java-11-openjdk installed on the EC2 database instance host.** SnapCenter service installation requires java version 11. It needs to be installed on application host before plugin deployment attempt.

Solution deployment

There is extensive NetApp documentation with a broader scope to help you protect your cloud-native application data. The goal of this documentation is to provide step-by-step procedures that cover SnapCenter Service deployment with the BlueXP console to protect your Oracle database deployed to Amazon FSx for ONTAP and an EC2 compute instance. This document fills in certain details that might be missing from more general instructions.

To get started, complete the following steps:

- Read the general instructions Protect your cloud native applications data and the sections related to Oracle and Amazon FSx for ONTAP.
- Watch the following video walkthrough.

Solution Deployment

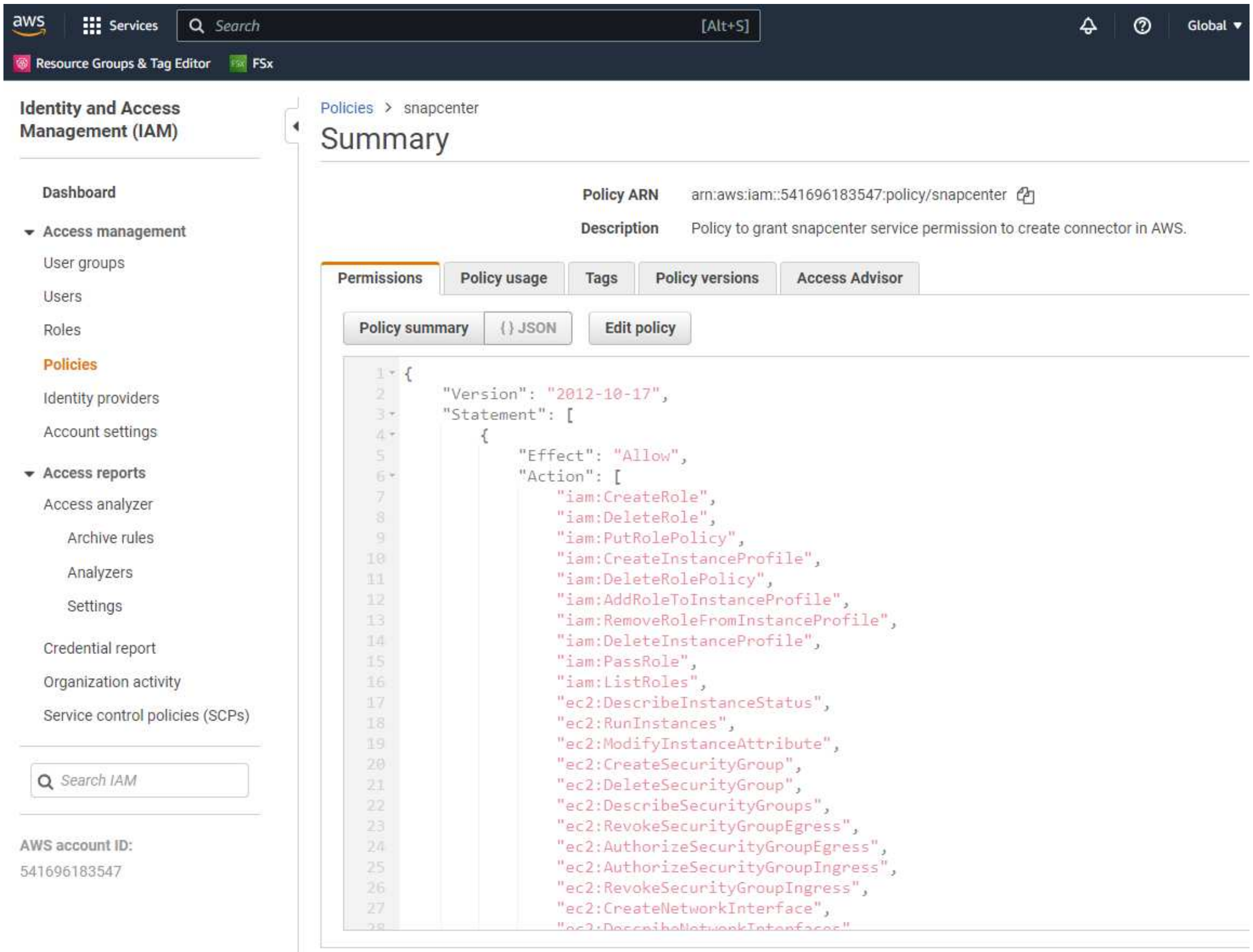
Prerequisites for SnapCenter service deployment

Deployment requires the following prerequisites.

1. A primary Oracle database server on an EC2 instance with an Oracle database fully deployed and running.
2. An Amazon FSx for ONTAP cluster deployed in AWS that is hosting the database volumes above.
3. An optional database server on an EC2 instance that can be used for testing the cloning of an Oracle database to an alternate host for the purpose of supporting a dev/test workload or any use cases that requires a full data set of a production Oracle database.
4. If you need help to meet the above prerequisites for Oracle database deployment on Amazon FSx for ONTAP and EC2 compute instance, see Oracle Database Deployment and Protection in AWS FSx/EC2 with iSCSI/ASM or white paper Oracle Database Deployment on EC2 and FSx Best Practices

Onboarding to BlueXP preparation

1. Use the link NetApp BlueXP to sign up for BlueXP console access.
2. Login to your AWS account to create an IAM policy with proper permissions and assign the policy to the AWS account that will be used for BlueXP connector deployment.



AWS account ID: 541696183547

Policy ARN arn:aws:iam::541696183547:policy/snapcenter

Description Policy to grant snapcenter service permission to create connector in AWS.

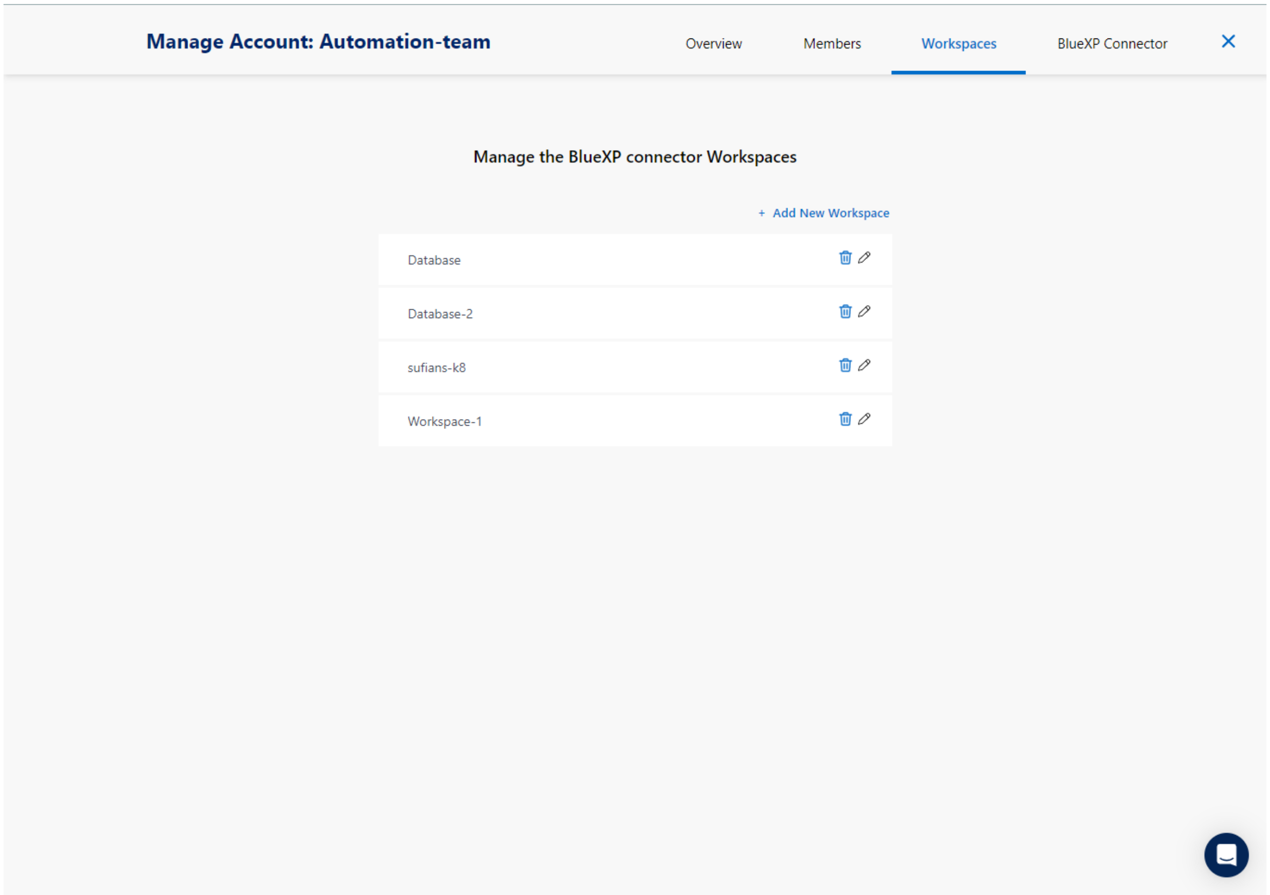
```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "iam:CreateRole",
                "iam:DeleteRole",
                "iam:PutRolePolicy",
                "iam:CreateInstanceProfile",
                "iam:DeleteRolePolicy",
                "iam:AddRoleToInstanceProfile",
                "iam:RemoveRoleFromInstanceProfile",
                "iam:DeleteInstanceProfile",
                "iam:PassRole",
                "iam:ListRoles",
                "ec2:DescribeInstanceStatus",
                "ec2:RunInstances",
                "ec2:ModifyInstanceAttribute",
                "ec2:CreateSecurityGroup",
                "ec2:DeleteSecurityGroup",
                "ec2:DescribeSecurityGroups",
                "ec2:RevokeSecurityGroupEgress",
                "ec2:AuthorizeSecurityGroupEgress",
                "ec2:AuthorizeSecurityGroupIngress",
                "ec2:RevokeSecurityGroupIngress",
                "ec2:CreateNetworkInterface",
                "ec2:DescribeNetworkInterfaces"
```

The policy should be configured with a JSON string that is available in NetApp documentation. The JSON string can also be retrieved from the page when connector provisioning is launched and you are prompted for the prerequisites permissions assignment.

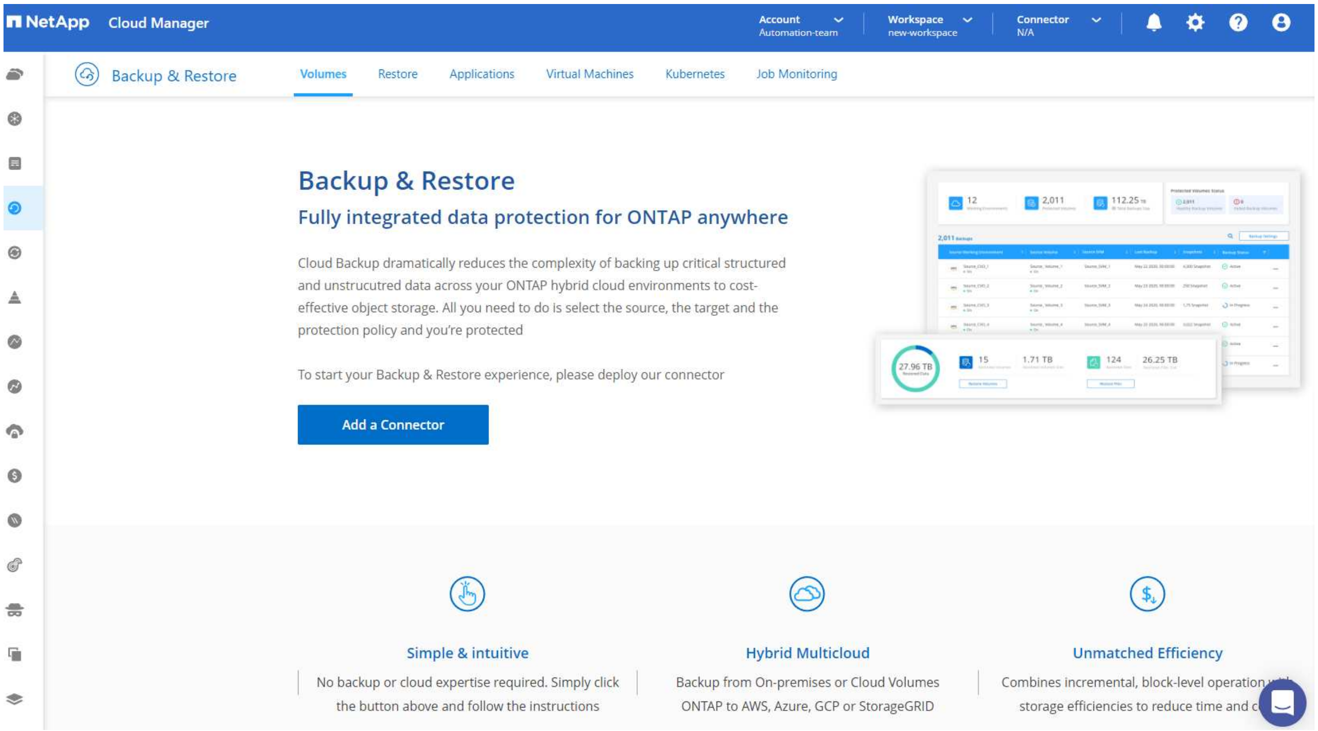
3. You also need the AWS VPC, subnet, security group, an AWS user account access key and secrets, an SSH key for ec2-user, and so on ready for connector provisioning.

Deploy a connector for SnapCenter services

1. Login to the BlueXP console. For a shared account, it is a best practice to create an individual workspace by clicking **Account** > **Manage Account** > **Workspace** to add a new workspace.



2. Click **Add a Connector** to launch the connector provisioning workflow.



Backup & Restore

Fully integrated data protection for ONTAP anywhere

Cloud Backup dramatically reduces the complexity of backing up critical structured and unstrucutred data across your ONTAP hybrid cloud environments to cost-effective object storage. All you need to do is select the source, the target and the protection policy and you're protected

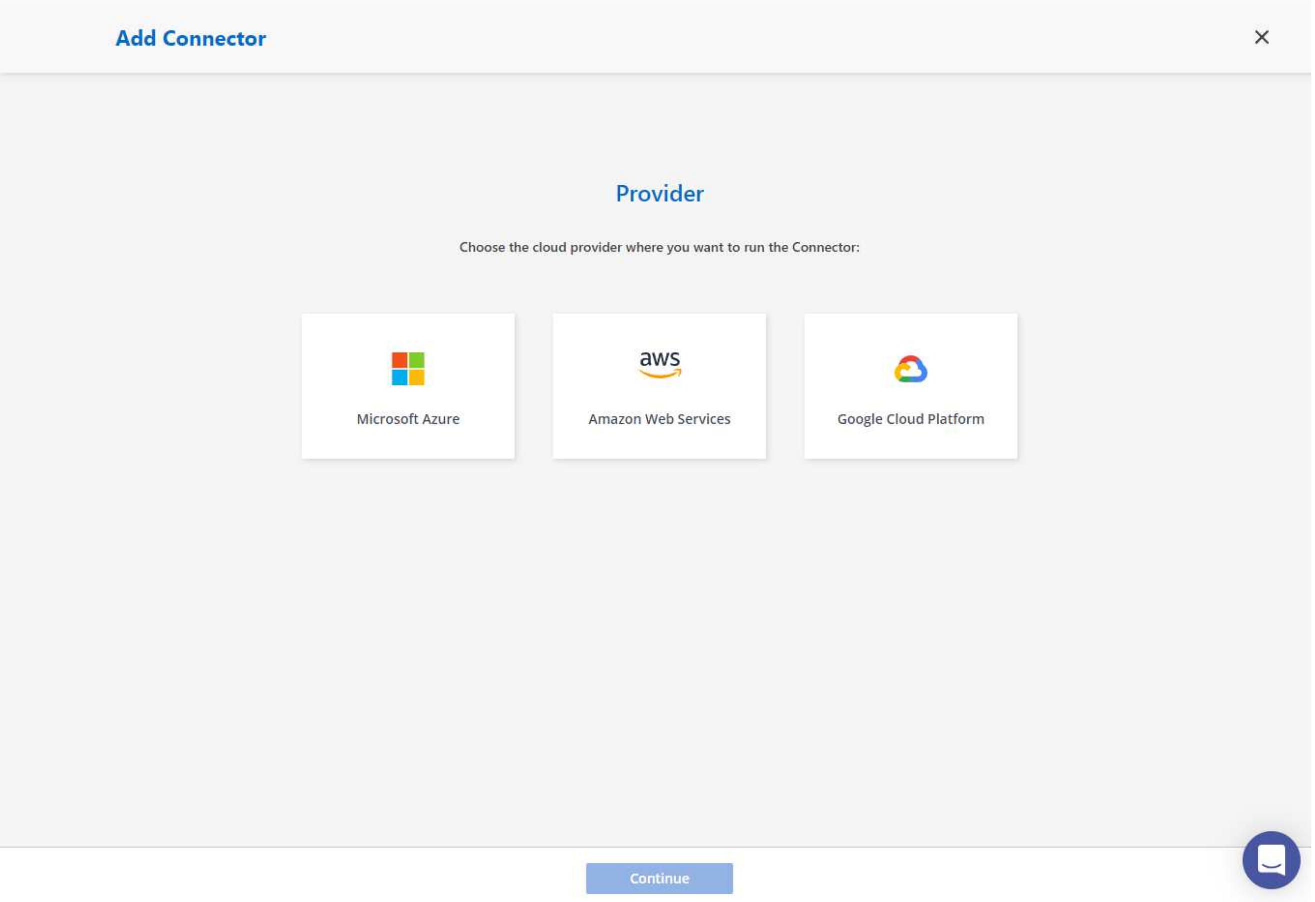
To start your Backup & Restore experience, please deploy our connector

No backup or cloud expertise required. Simply click the button above and follow the instructions

Backup from On-premises or Cloud Volumes ONTAP to AWS, Azure, GCP or StorageGRID

Combines incremental, block-level operation storage efficiencies to reduce time and c

1. Choose your cloud provider (in this case, **Amazon Web Services**).

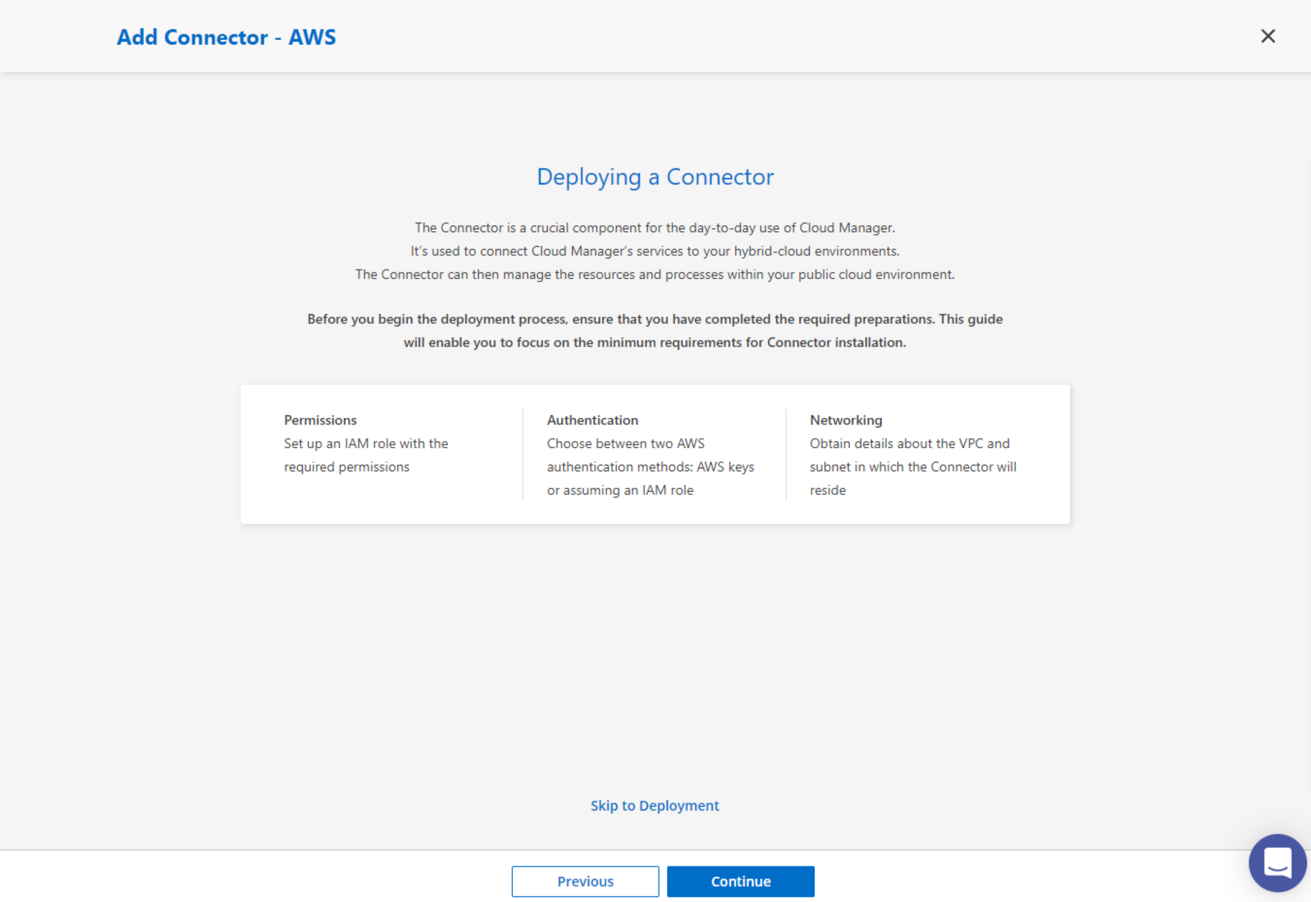


Add Connector

Provider

Choose the cloud provider where you want to run the Connector:

1. Skip the **Permission**, **Authentication**, and **Networking** steps if you already have them set up in your AWS account. If not, you must configure these before proceeding. From here, you could also retrieve the permissions for the AWS policy that is referenced in the previous section "Onboarding to BlueXP preparation."



Add Connector - AWS

Deploying a Connector

The Connector is a crucial component for the day-to-day use of Cloud Manager.
It's used to connect Cloud Manager's services to your hybrid-cloud environments.
The Connector can then manage the resources and processes within your public cloud environment.

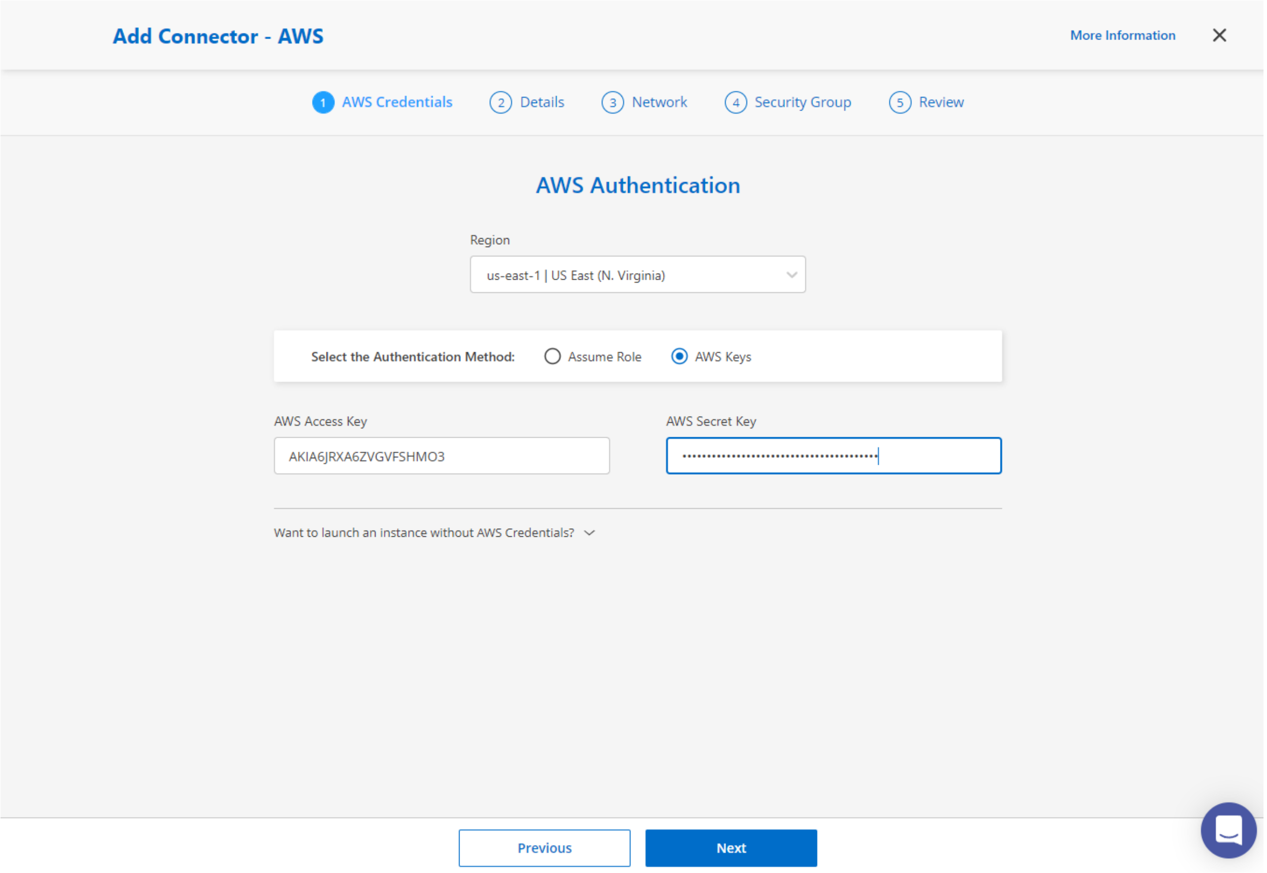
Before you begin the deployment process, ensure that you have completed the required preparations. This guide will enable you to focus on the minimum requirements for Connector installation.

Permissions
Set up an IAM role with the required permissions

Authentication
Choose between two AWS authentication methods: AWS keys or assuming an IAM role

Networking
Obtain details about the VPC and subnet in which the Connector will reside

1. Enter your AWS account authentication with **Access Key** and **Secret Key**.



Add Connector - AWS

AWS Authentication

Region: us-east-1 | US East (N. Virginia)

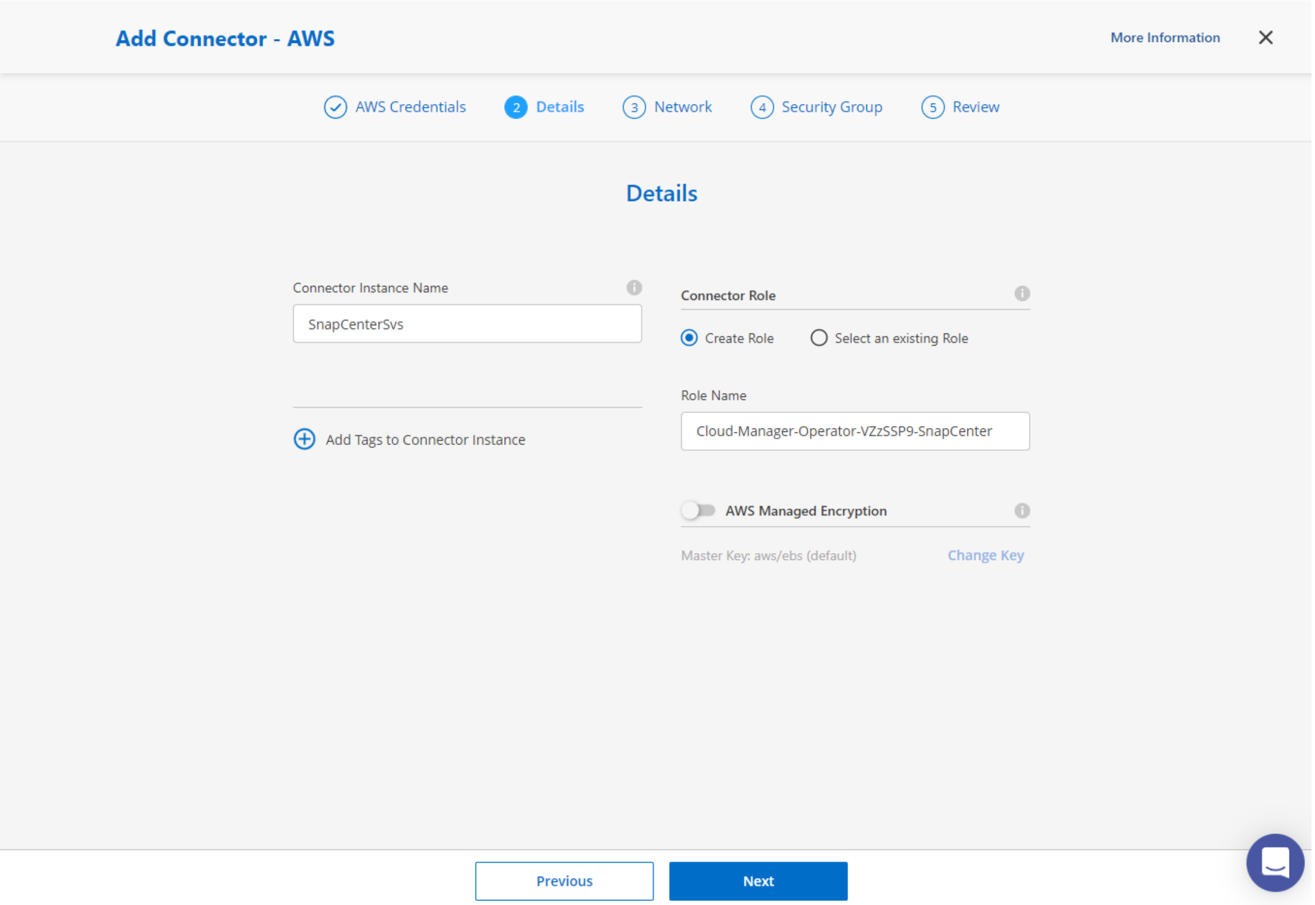
Select the Authentication Method: ○ Assume Role ● AWS Keys

AWS Access Key: AKIA6JRXA6ZVGVFSHMO3

AWS Secret Key: ••

Want to launch an instance without AWS Credentials?

2. Name the connector instance and select **Create Role** under **Details**.



Connector Instance Name: SnapCenterSvs

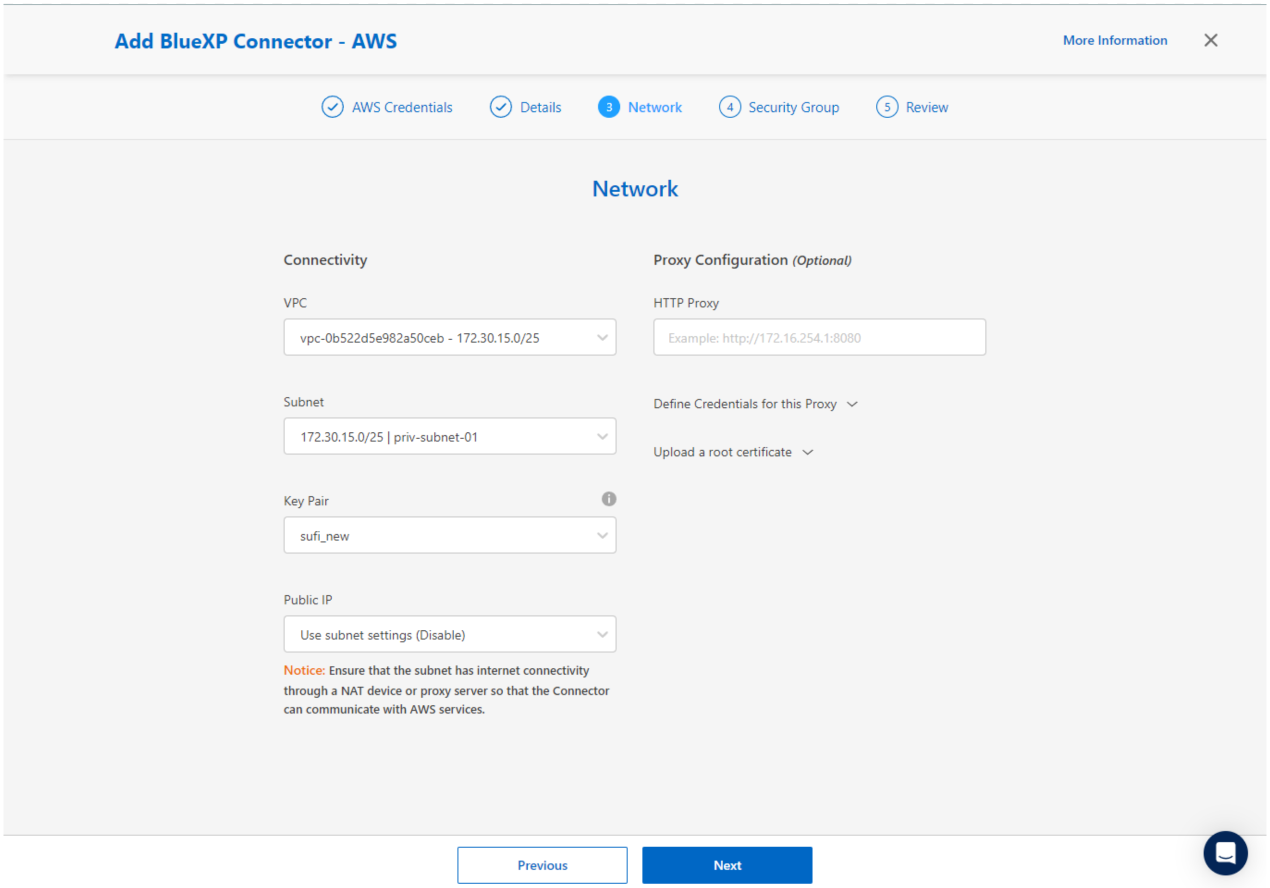
Connector Role: ● Create Role ○ Select an existing Role

Role Name: Cloud-Manager-Operator-VZzSSP9-SnapCenter

AWS Managed Encryption

Master Key: aws/ebs (default)

1. Configure networking with the proper **VPC**, **Subnet**, and SSH **Key Pair** for connector access.



Add BlueXP Connector - AWS

More Information ✕

✓ AWS Credentials ✓ Details 3 Network 4 Security Group 5 Review

Network

Connectivity

VPC: vpc-0b522d5e982a50ceb - 172.30.15.0/25

Subnet: 172.30.15.0/25 | priv-subnet-01

Key Pair: sufi_new

Public IP: Use subnet settings (Disable)

Notice: Ensure that the subnet has internet connectivity through a NAT device or proxy server so that the Connector can communicate with AWS services.

Proxy Configuration *(Optional)*

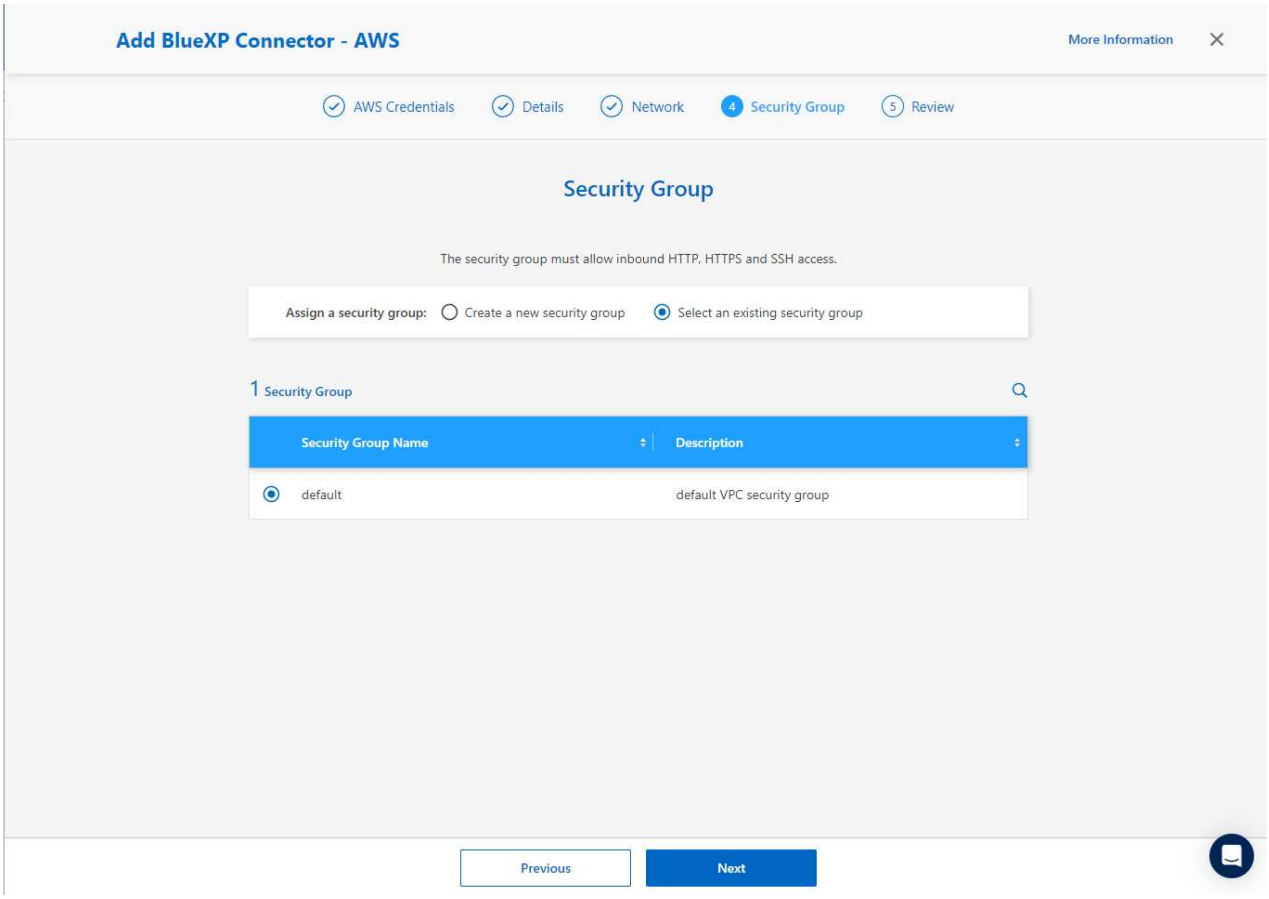
HTTP Proxy: Example: http://172.16.254.1:8080

Define Credentials for this Proxy

Upload a root certificate

Previous Next

2. Set the **Security Group** for the connector.



Add BlueXP Connector - AWS

More Information ✕

✓ AWS Credentials ✓ Details ✓ Network 4 Security Group 5 Review

Security Group

The security group must allow inbound HTTP, HTTPS and SSH access.

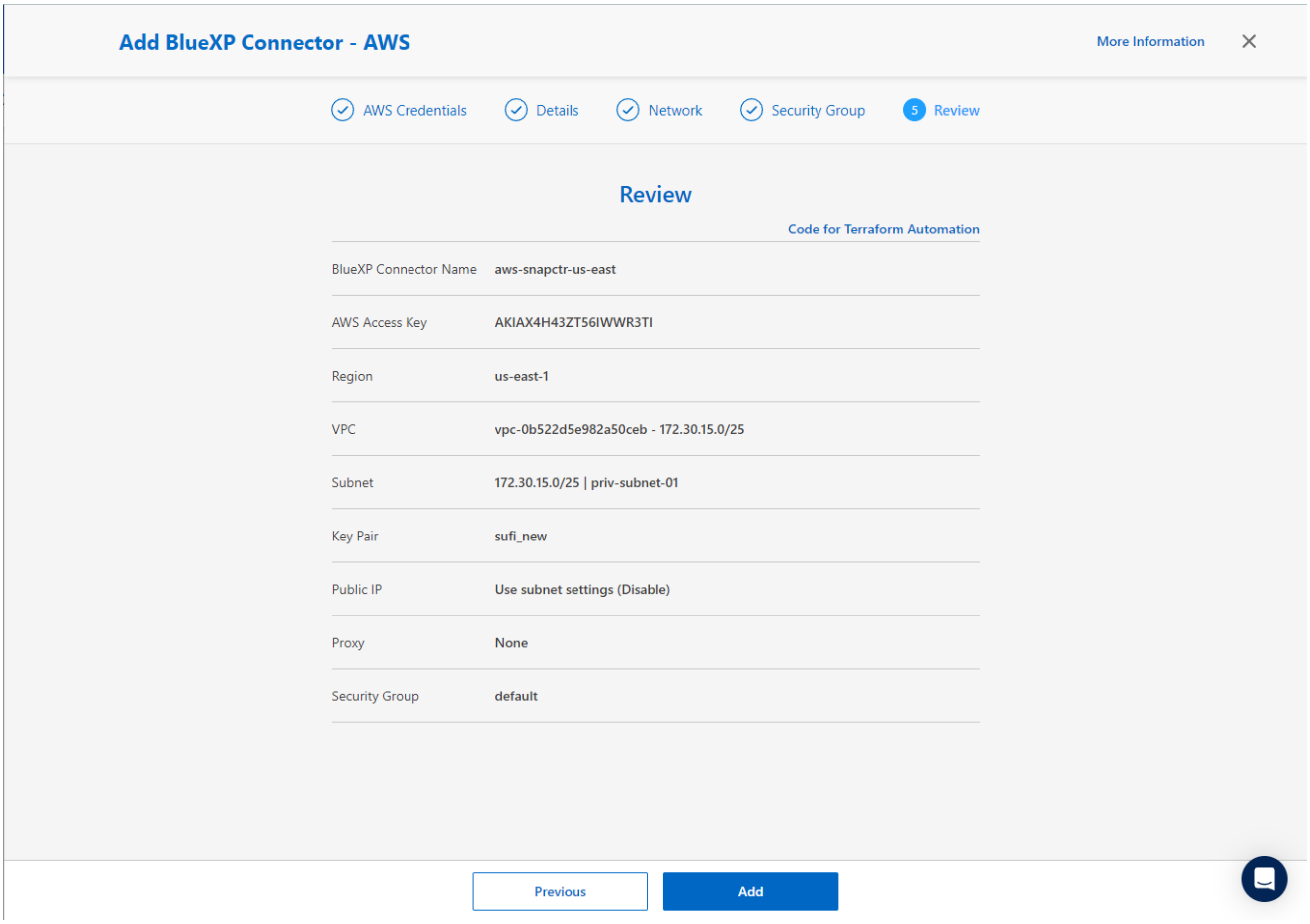
Assign a security group: ○ Create a new security group ● Select an existing security group

1 Security Group

	Security Group Name	Description
●	default	default VPC security group

Previous Next

3. Review the summary page and click **Add** to start connector creation. It generally takes about 10 mins to complete deployment. Once completed, the connector instance appears in the AWS EC2 dashboard.

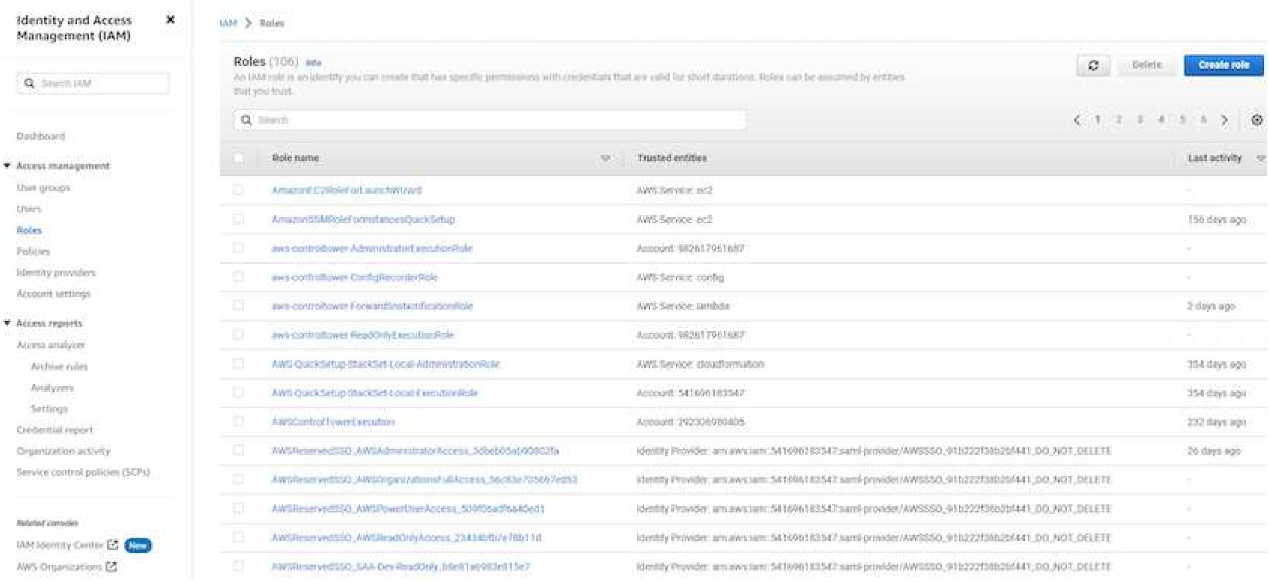


Review

BlueXP Connector Name	aws-snapctr-us-east
AWS Access Key	AKIAX4H43ZT56IWWR3TI
Region	us-east-1
VPC	vpc-0b522d5e982a50ceb - 172.30.15.0/25
Subnet	172.30.15.0/25 | priv-subnet-01
Key Pair	sufi_new
Public IP	Use subnet settings (Disable)
Proxy	None
Security Group	default

Define a credential in BlueXP for AWS resources access

1. First, from AWS EC2 console, create a role in **Identity and Access Management (IAM)** menu **Roles**, **Create role** to start role creation workflow.

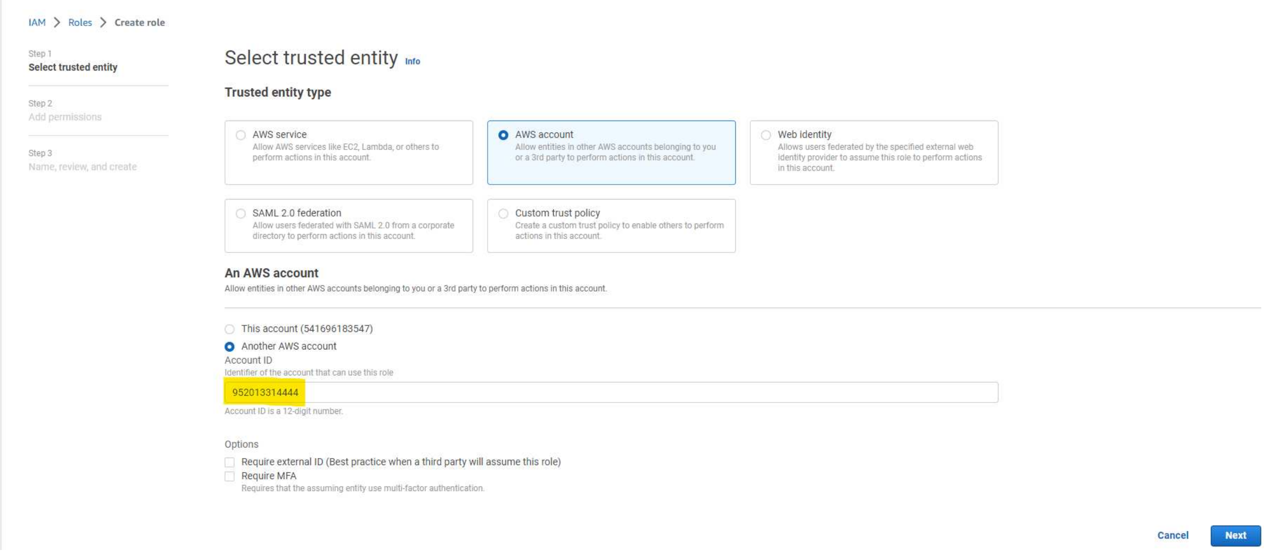


Roles (106) Info

An IAM role is an identity you can create that has specific permissions with credentials that are valid for short durations. Roles can be assumed by entities that you trust.

	Role name	Trusted entities	Last activity
□	AmazonEC2RoleForLaunchWizard	AWS Service: ec2	-
□	AmazonSSMRoleForInstancesQuickSetup	AWS Service: ec2	156 days ago
□	aws-controltower-AdministratorExecutionRole	Account: 982617961687	-
□	aws-controltower-ConfigRecorderRole	AWS Service: config	-
□	aws-controltower-ForwardSnsNotificationRole	AWS Service: lambda	2 days ago
□	aws-controltower-ReadOnlyExecutionRole	Account: 982617961687	-
□	AWS-QuickSetup-StackSet-Local-AdministrationRole	AWS Service: cloudformation	354 days ago
□	AWS-QuickSetup-StackSet-Local-ExecutionRole	Account: 541696183547	354 days ago
□	AWSControlTowerExecution	Account: 292306980405	232 days ago
□	AWSReservedSSO_AWSAdministratorAccess_3dbeb05ab90802fa	Identity Provider: arn:aws:iam::541696183547:saml-provider/AWSSSO_91b222f38b2bf441_DO_NOT_DELETE	26 days ago
□	AWSReservedSSO_AWSOrganizationsFullAccess_56c83e735667ed53	Identity Provider: arn:aws:iam::541696183547:saml-provider/AWSSSO_91b222f38b2bf441_DO_NOT_DELETE	-
□	AWSReservedSSO_AWSPowerUserAccess_509f0badf6a40ed1	Identity Provider: arn:aws:iam::541696183547:saml-provider/AWSSSO_91b222f38b2bf441_DO_NOT_DELETE	-
□	AWSReservedSSO_AWSReadOnlyAccess_23434bf7c7e78b11d	Identity Provider: arn:aws:iam::541696183547:saml-provider/AWSSSO_91b222f38b2bf441_DO_NOT_DELETE	-
□	AWSReservedSSO_SAA-Dev-ReadOnly_b8e81a6983e815e7	Identity Provider: arn:aws:iam::541696183547:saml-provider/AWSSSO_91b222f38b2bf441_DO_NOT_DELETE	-

2. In **Select trusted entity** page, choose **AWS account**, **Another AWS account**, and paste in the BlueXP account ID, which can be retrieved from BlueXP console.



Select trusted entity Info

Trusted entity type

○ AWS service
Allow AWS services like EC2, Lambda, or others to perform actions in this account.

● AWS account
Allow entities in other AWS accounts belonging to you or a 3rd party to perform actions in this account.

○ Web identity
Allows users federated by the specified external web identity provider to assume this role to perform actions in this account.

○ SAML 2.0 federation
Allow users federated with SAML 2.0 from a corporate directory to perform actions in this account.

○ Custom trust policy
Create a custom trust policy to enable others to perform actions in this account.

An AWS account

Allow entities in other AWS accounts belonging to you or a 3rd party to perform actions in this account.

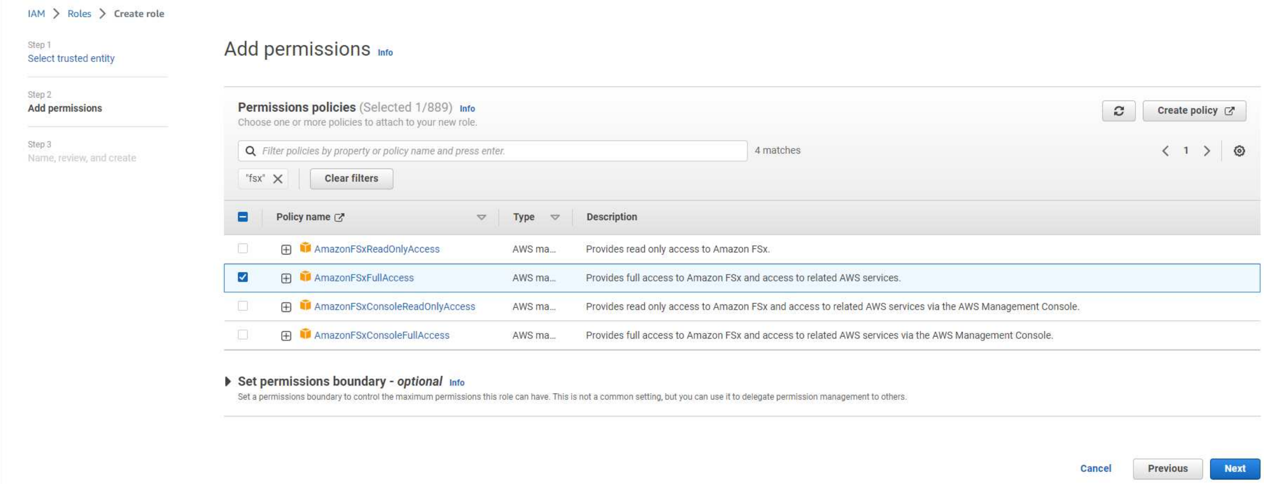
○ This account (541696183547)

● Another AWS account

Account ID
Identifier of the account that can use this role
952013314444
Account ID is a 12-digit number.

Options
□ Require external ID (Best practice when a third party will assume this role)
□ Require MFA
Requires that the assuming entity use multi-factor authentication.

3. Filter permission policies by fsx and add **Permissions policies** to the role.



Add permissions Info

Permissions policies (Selected 1/889) Info

Choose one or more policies to attach to your new role.

Filter policies by property or policy name and press enter. 4 matches

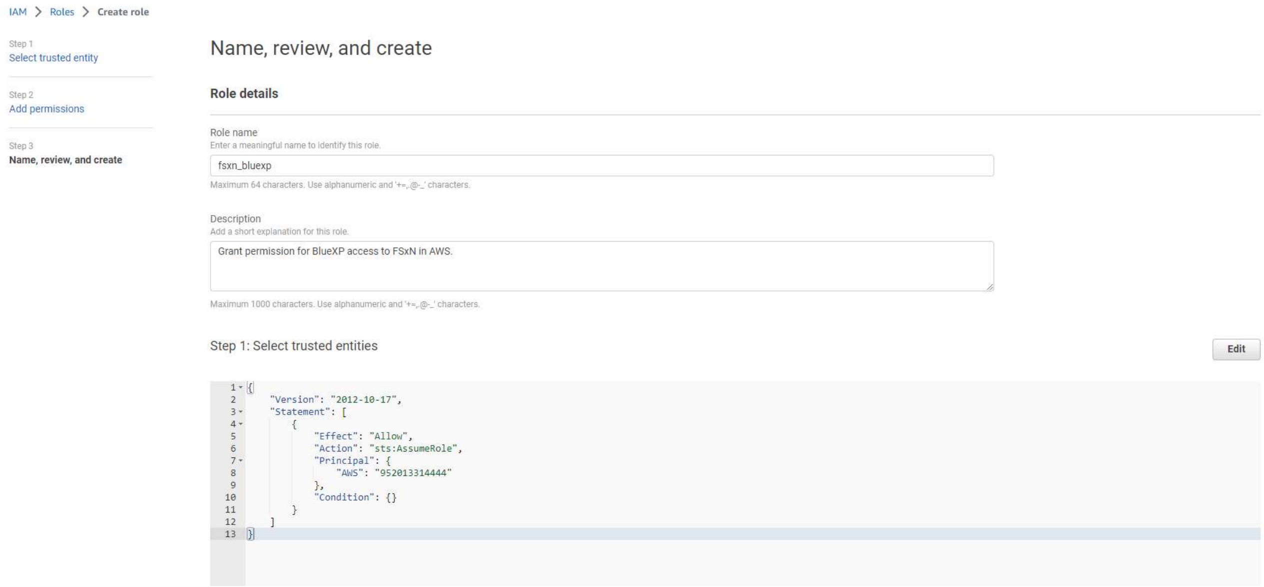
"fsx"

	Policy name	Type	Description
□	AmazonFSxReadOnlyAccess	AWS ma...	Provides read only access to Amazon FSx.
☑	AmazonFSxFullAccess	AWS ma...	Provides full access to Amazon FSx and access to related AWS services.
□	AmazonFSxConsoleReadOnlyAccess	AWS ma...	Provides read only access to Amazon FSx and access to related AWS services via the AWS Management Console.
□	AmazonFSxConsoleFullAccess	AWS ma...	Provides full access to Amazon FSx and access to related AWS services via the AWS Management Console.

Set permissions boundary - *optional* Info

Set a permissions boundary to control the maximum permissions this role can have. This is not a common setting, but you can use it to delegate permission management to others.

4. In **Role details** page, name the role, add a description, then click **Create role**.



Name, review, and create

Role details

Role name

Enter a meaningful name to identify this role.

fsxn_bluexp

Maximum 64 characters. Use alphanumeric and '+=,.@-_' characters.

Description

Add a short explanation for this role.

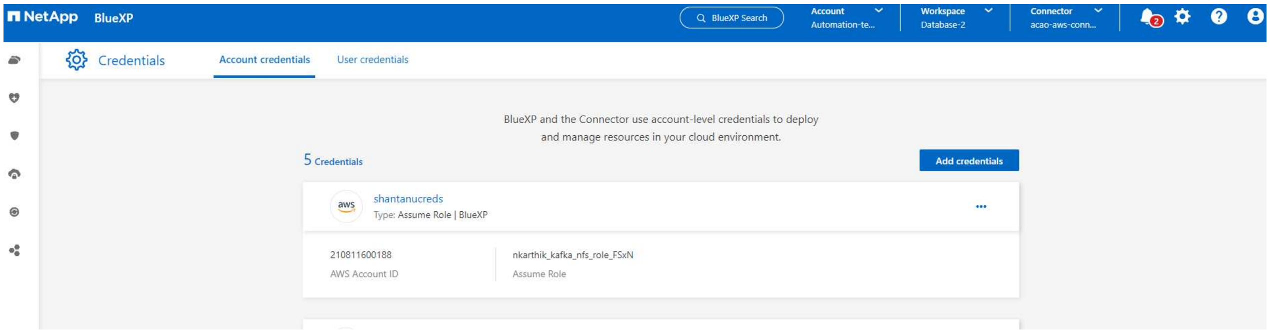
Grant permission for BlueXP access to FSxN in AWS.

Maximum 1000 characters. Use alphanumeric and '+=,.@-_' characters.

Step 1: Select trusted entities

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": "sts:AssumeRole",
            "Principal": {
                "AWS": "952013314444"
            },
            "Condition": {}
        }
    ]
}
```

5. Back to BlueXP console, click on setting icon on top right corner of the console to open **Account credentials** page, click **Add credentials** to start credential configuration workflow.



BlueXP and the Connector use account-level credentials to deploy and manage resources in your cloud environment.

5 Credentials

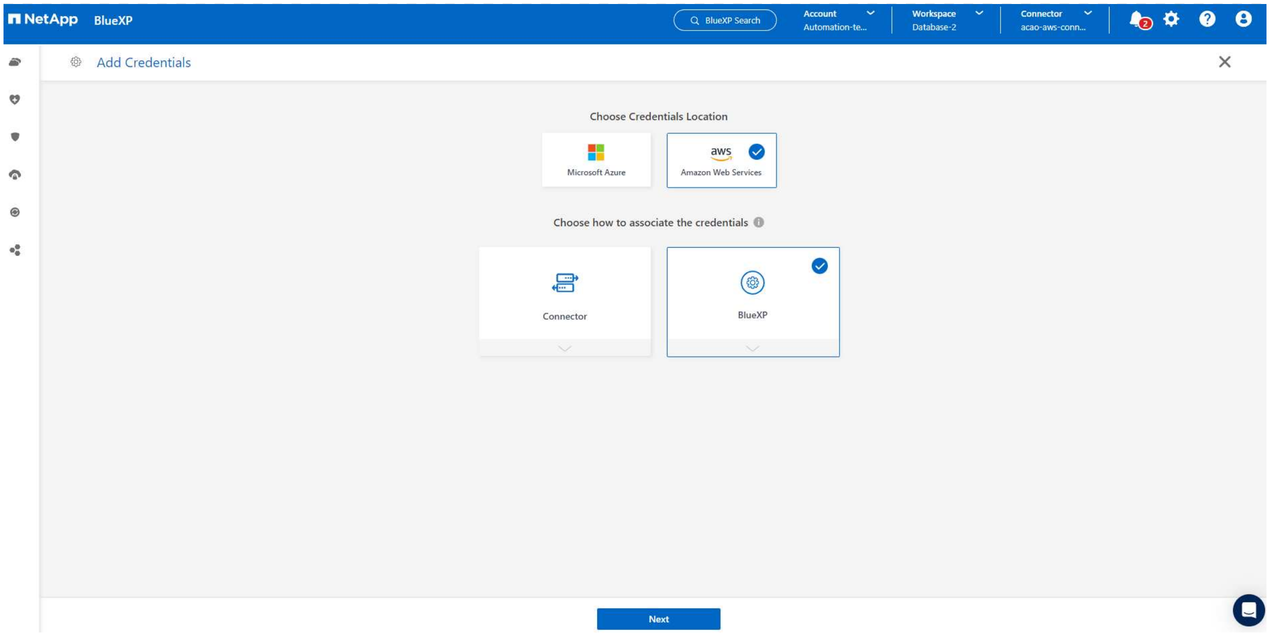
shantanucreds

Type: Assume Role | BlueXP

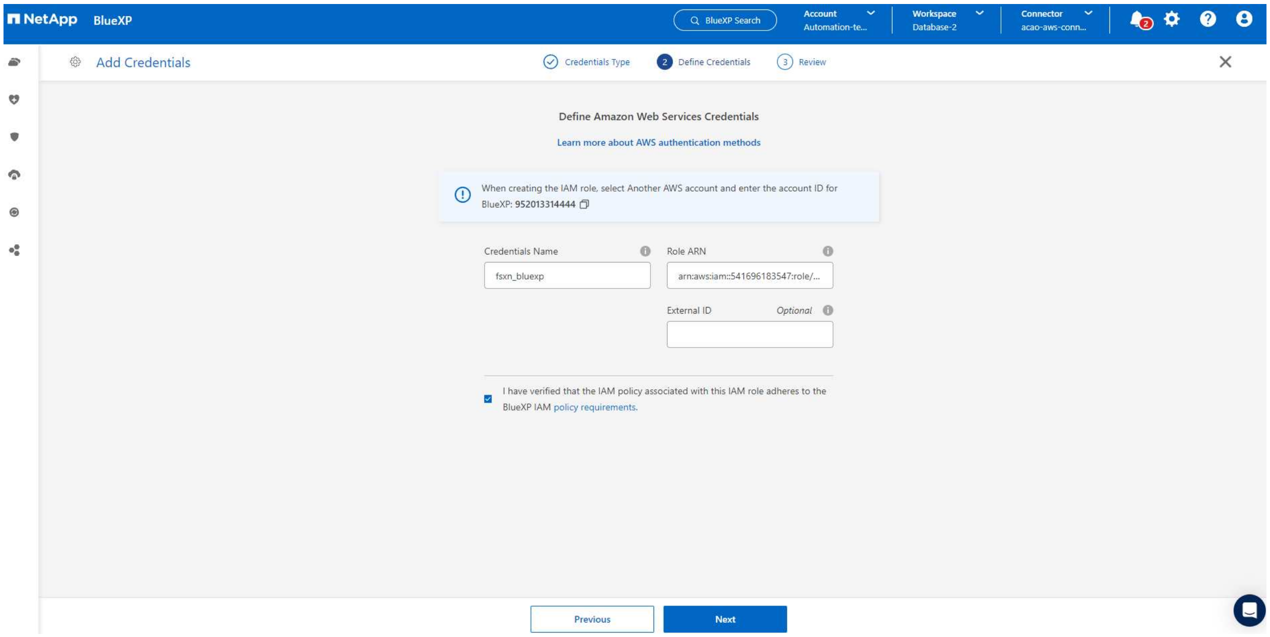
210811600188 — AWS Account ID

nkarthik_kafka_nfs_role_FSxN — Assume Role

6. Choose credential location as - **Amazon Web Services - BlueXP**.



7. Define AWS credentials with proper **Role ARN**, which can be retrieved from AWS IAM role created in step one above. BlueXP **account ID**, which is used for creating AWS IAM role in step one.



When creating the IAM role, select Another AWS account and enter the account ID for BlueXP: **952013314444**

Credentials Name: fsxn_bluexp

Role ARN: arn:aws:iam::541696183547:role/...

External ID *Optional*:

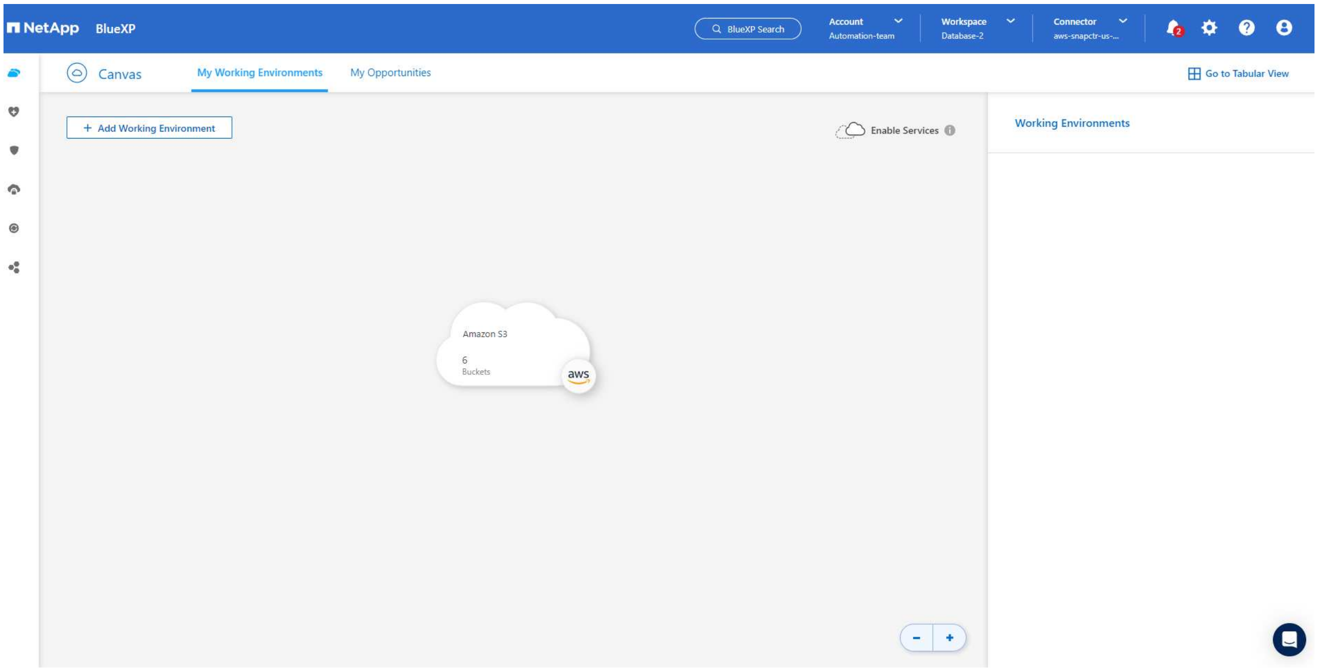
☑ I have verified that the IAM policy associated with this IAM role adheres to the BlueXP IAM policy requirements.

8. Review and **Add**.
image::snapctr_svcs_credential_08-aws.png["Screenshot showing this step in the GUI."]

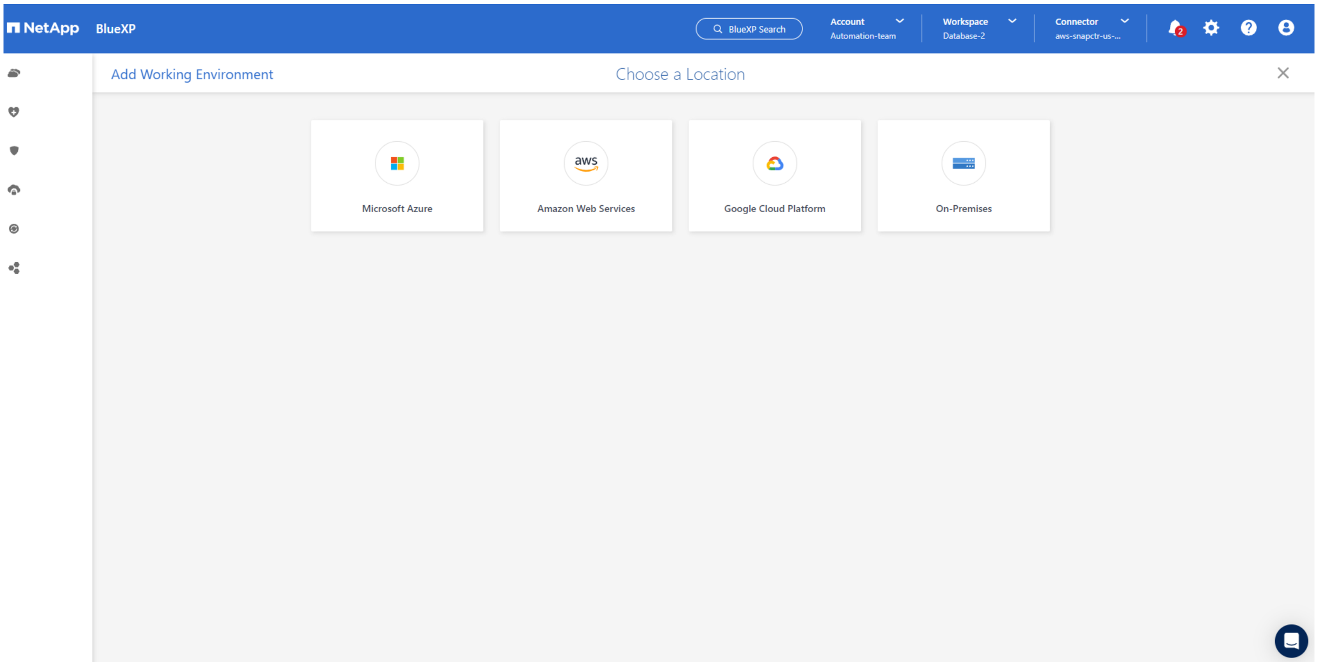
SnapCenter services setup

With the connector deployed and the credential added, SnapCenter services can now be set up with the following procedure:

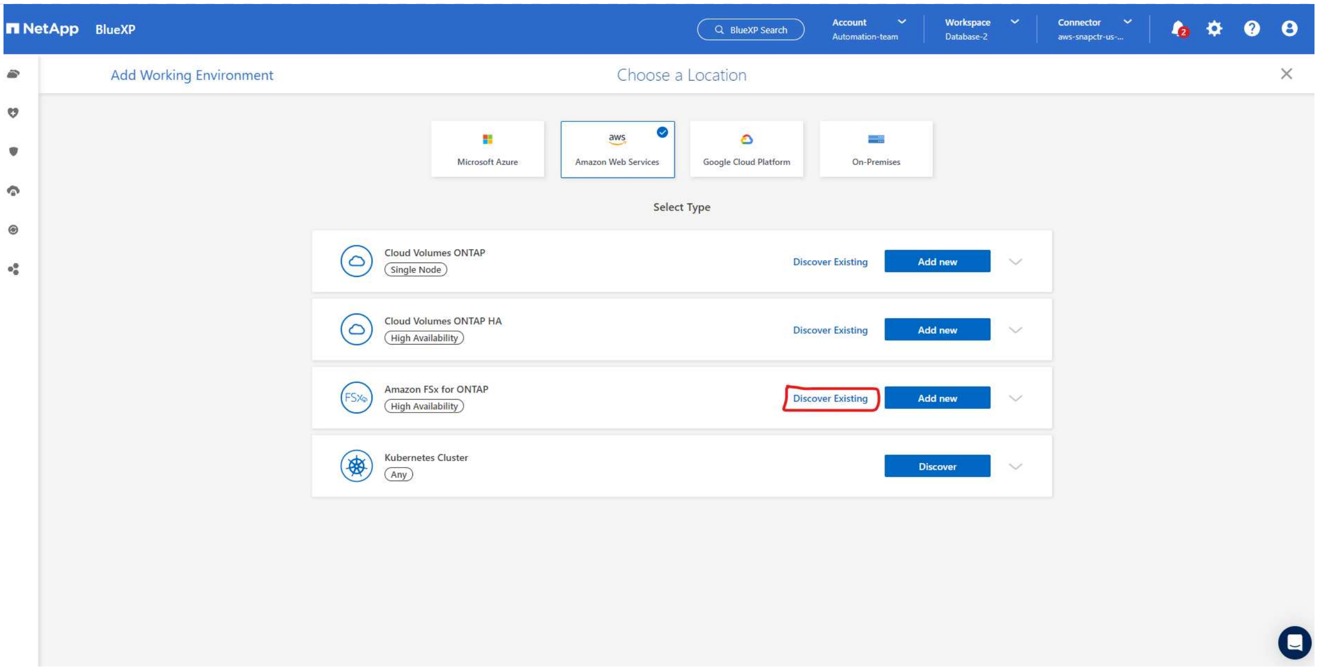
1. From **My Working Environment** click **Add working Environment** to discover FSx deployed in AWS.



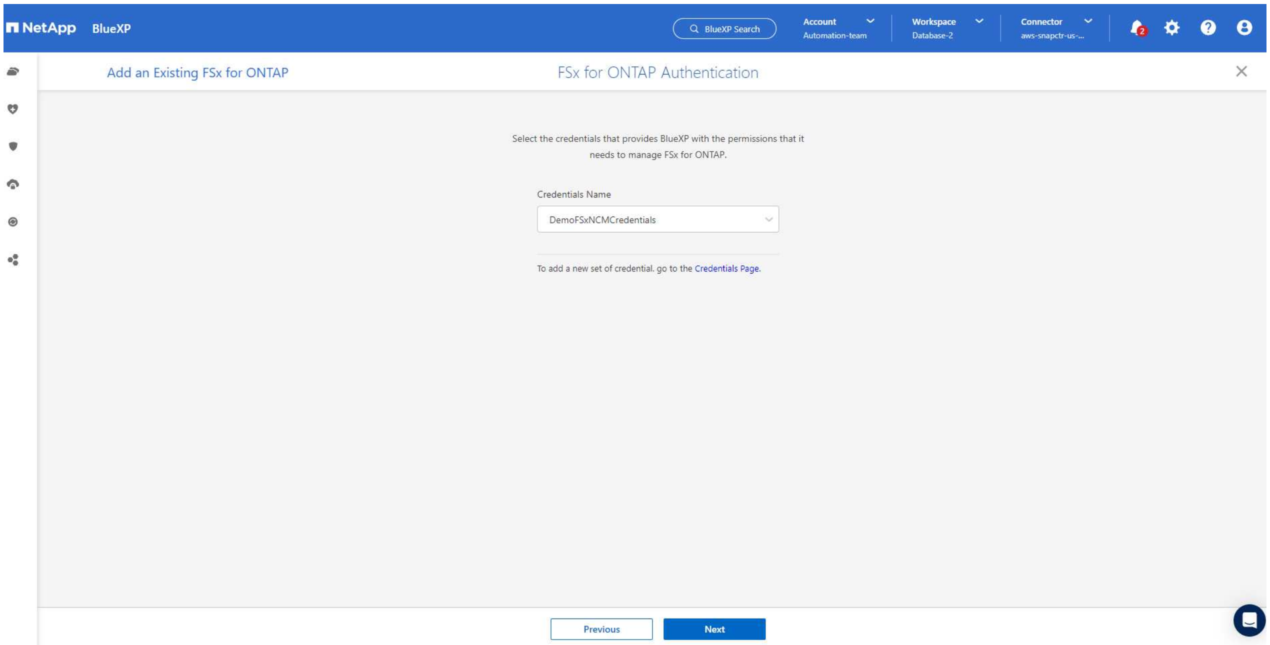
1. Choose **Amazon Web Services** as the location.



1. Click **Discover Existing** next to **Amazon FSx for ONTAP**.



1. Select the **Credentials Name** that you have created in previous section to grant BlueXP with the permissions that it needs to manage FSx for ONTAP. If you have not added credentials, you can add it from the **Settings** menu at the top right corner of the BlueXP console.

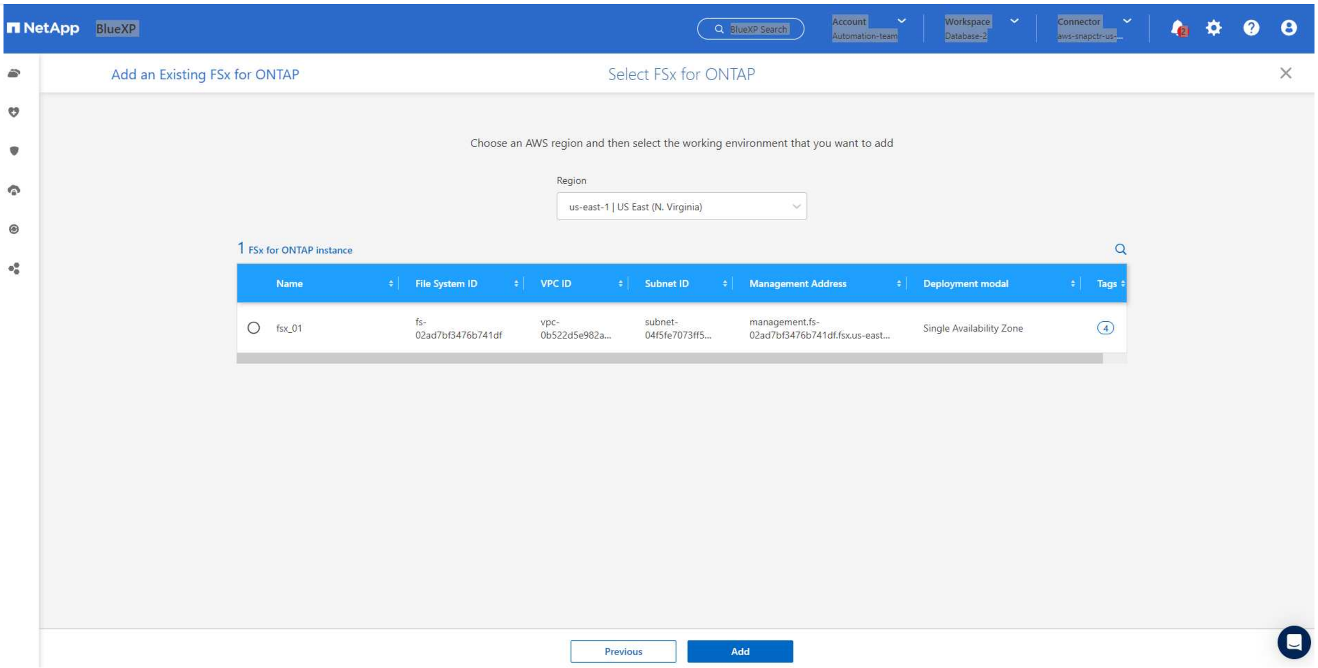

NetApp BlueXP
BlueXP Search
Account Automation-team
Workspace Database-2
Connector aws-snapctr-us-...
Add an Existing FSx for ONTAP
FSx for ONTAP Authentication
Previous
Next

Select the credentials that provides BlueXP with the permissions that it needs to manage FSx for ONTAP.

Credentials Name: DemoFSxNCMCredentials

To add a new set of credential. go to the Credentials Page.

2. Choose the AWS region where Amazon FSx for ONTAP is deployed, select the FSx cluster that is hosting the Oracle database and click Add.



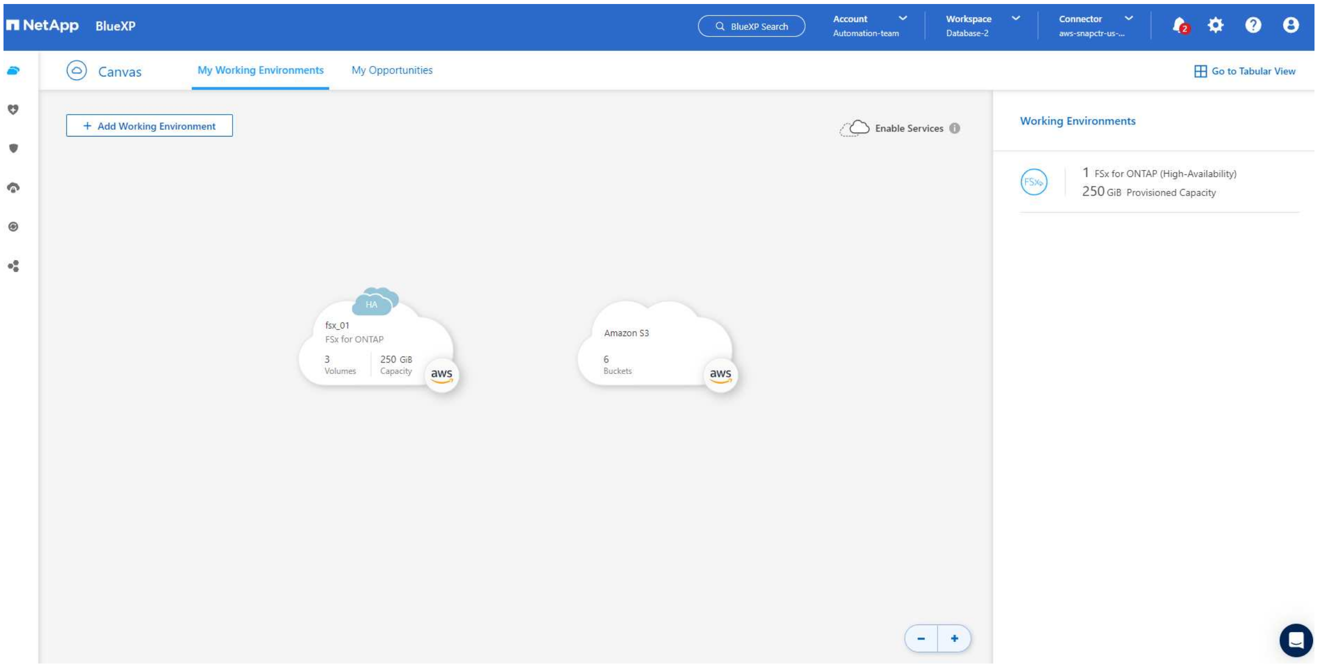
Choose an AWS region and then select the working environment that you want to add

Region: us-east-1 | US East (N. Virginia)

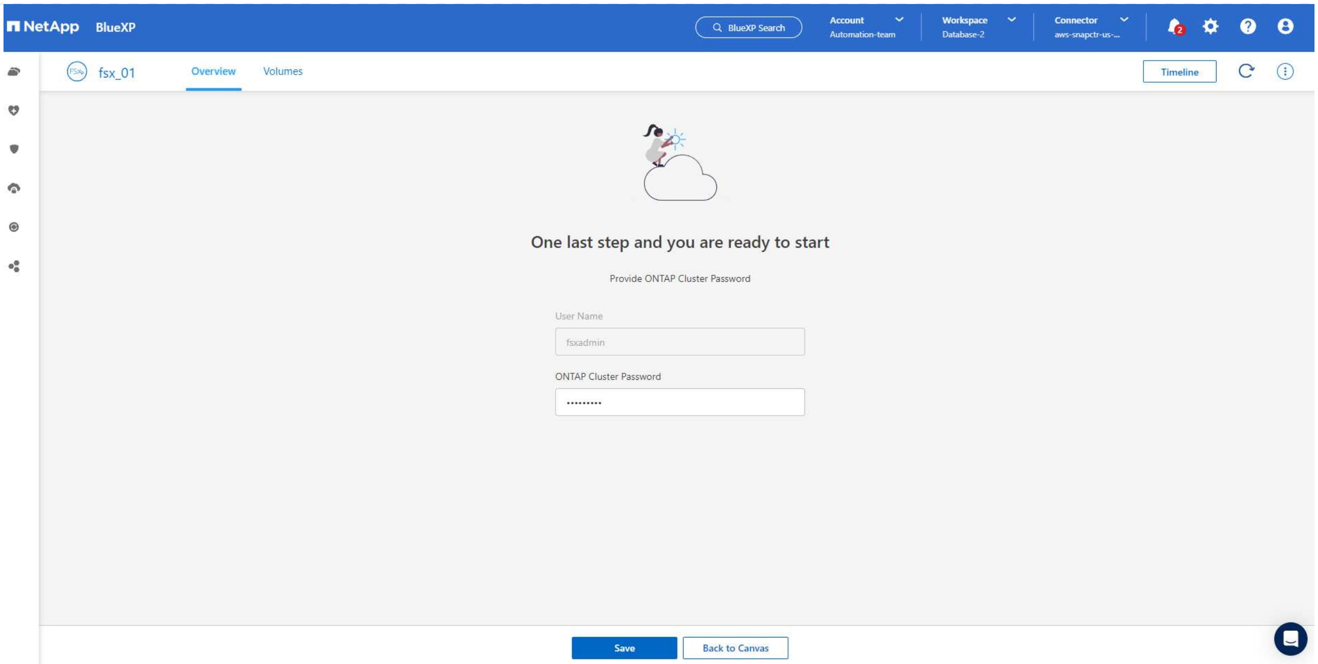
1 FSx for ONTAP instance

	Name	File System ID	VPC ID	Subnet ID	Management Address	Deployment modal	Tags
○	fsx_01	fs-02ad7bf3476b741df	vpc-0b522d5e982a...	subnet-04f5fe7073ff5...	management.fs-02ad7bf3476b741df.fsx.us-east...	Single Availability Zone	4

1. The discovered Amazon FSx for ONTAP instance now appears in the working environment.



1. You can log into the FSx cluster with your fsxadmin account credentials.



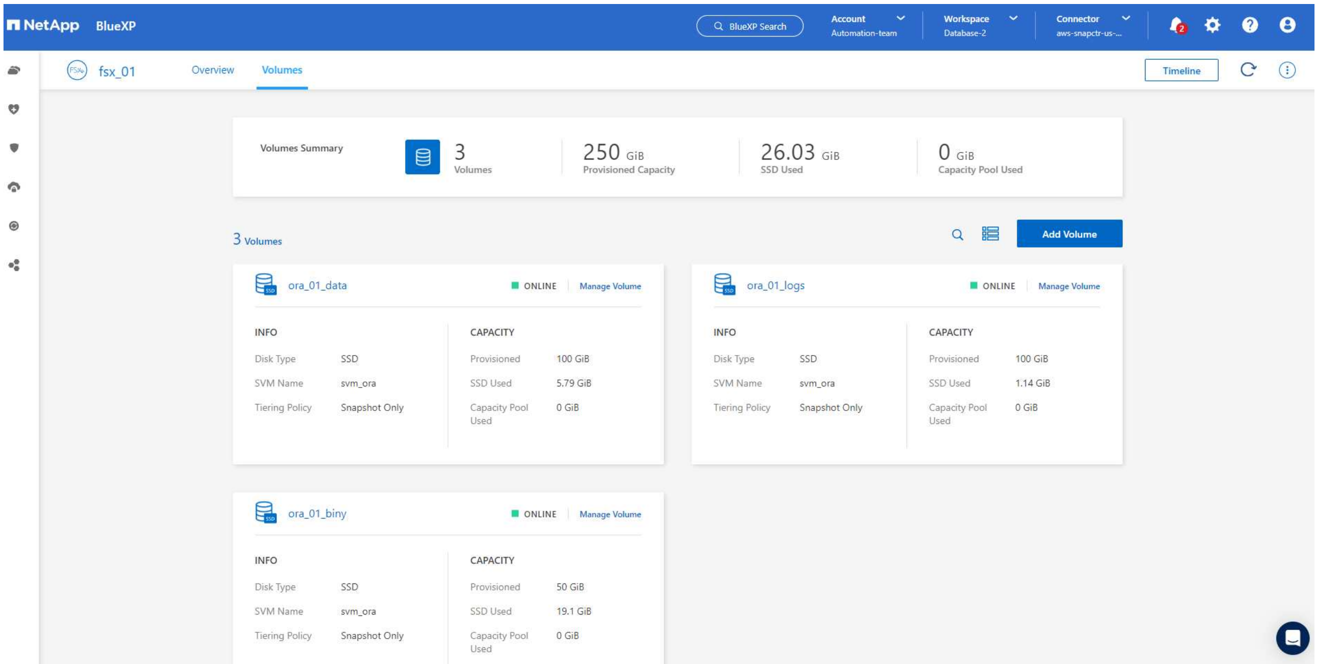
One last step and you are ready to start

Provide ONTAP Cluster Password

User Name: fsxadmin

ONTAP Cluster Password: ••••••••••

1. After you log into Amazon FSx for ONTAP, review your database storage information (such as database volumes).



Volumes Summary

3 Volumes	250 GiB Provisioned Capacity	26.03 GiB SSD Used	0 GiB Capacity Pool Used

3 Volumes

ora_01_data — ONLINE

INFO		CAPACITY	
Disk Type	SSD	Provisioned	100 GiB
SVM Name	svm_ora	SSD Used	5.79 GiB
Tiering Policy	Snapshot Only	Capacity Pool Used	0 GiB

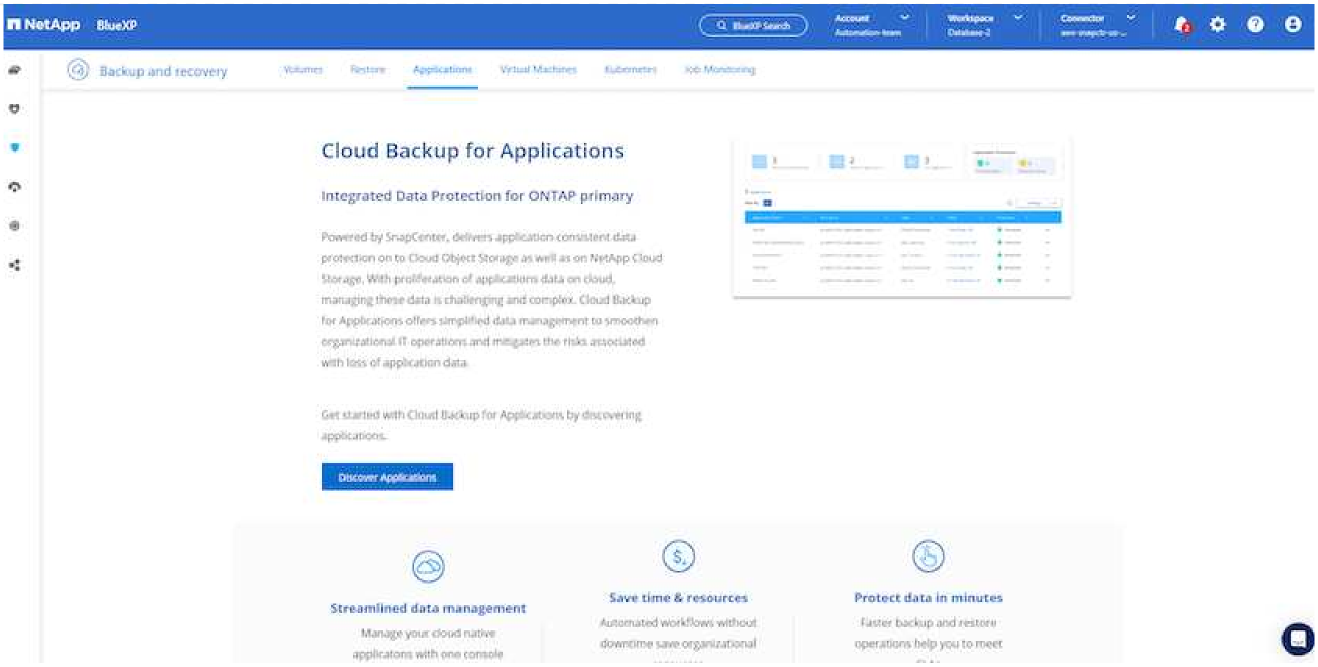
ora_01_logs — ONLINE

INFO		CAPACITY	
Disk Type	SSD	Provisioned	100 GiB
SVM Name	svm_ora	SSD Used	1.14 GiB
Tiering Policy	Snapshot Only	Capacity Pool Used	0 GiB

ora_01_biny — ONLINE

INFO		CAPACITY	
Disk Type	SSD	Provisioned	50 GiB
SVM Name	svm_ora	SSD Used	19.1 GiB
Tiering Policy	Snapshot Only	Capacity Pool Used	0 GiB

1. From the left-hand sidebar of the console, hover your mouse over the protection icon, and then click **Protection** > **Applications** to open the Applications launch page. Click **Discover Applications**.



Cloud Backup for Applications

Integrated Data Protection for ONTAP primary

Powered by SnapCenter, delivers application consistent data protection on to Cloud Object Storage as well as on NetApp Cloud Storage. With proliferation of applications data on cloud, managing these data is challenging and complex. Cloud Backup for Applications offers simplified data management to smoothen organizational IT operations and mitigates the risks associated with loss of application data.

Get started with Cloud Backup for Applications by discovering applications.

Streamlined data management

Manage your cloud native applicatons with one console

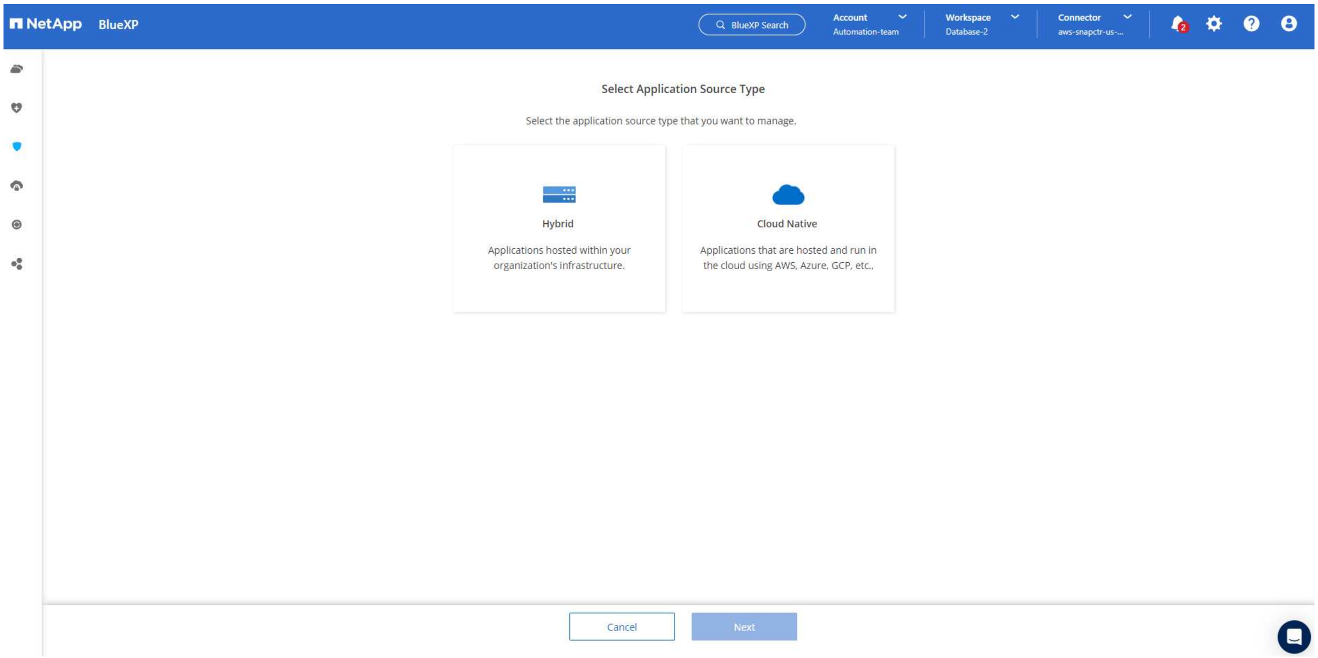
Save time & resources

Automated workflows without downtime save organizational

Protect data in minutes

Faster backup and restore operations help you to meet

1. Select **Cloud Native** as the application source type.



Select Application Source Type

Select the application source type that you want to manage.

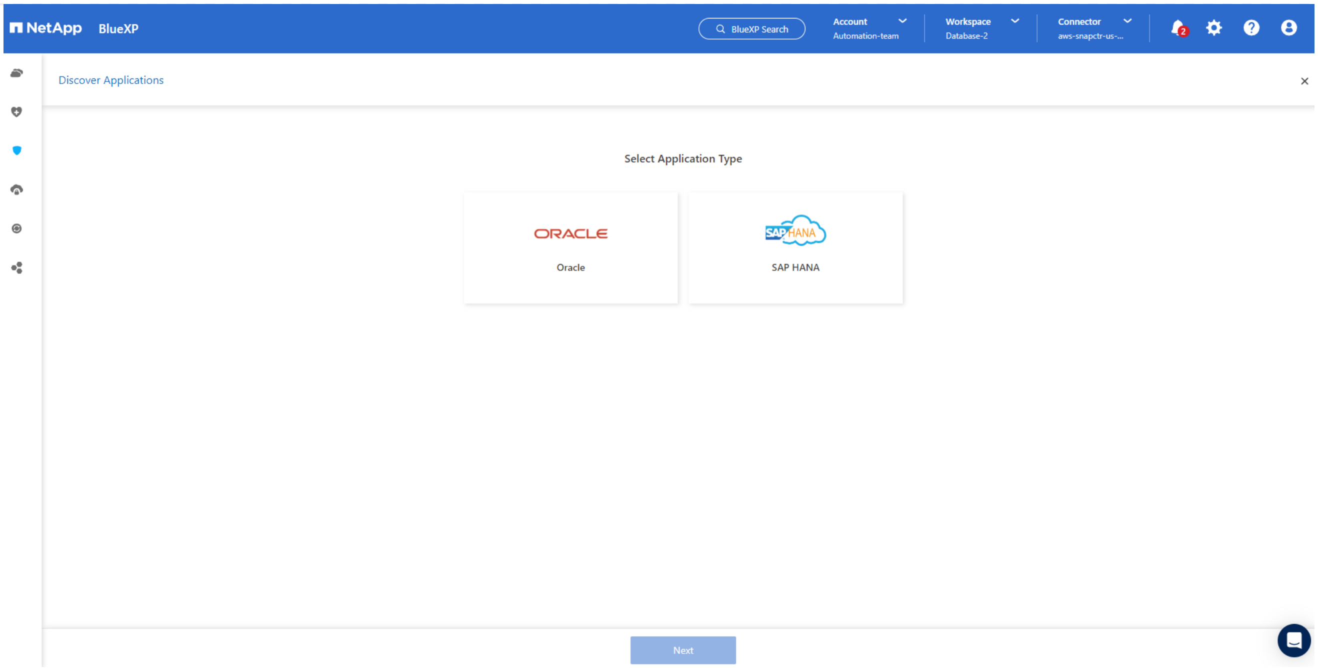
Hybrid

Applications hosted within your organization's infrastructure.

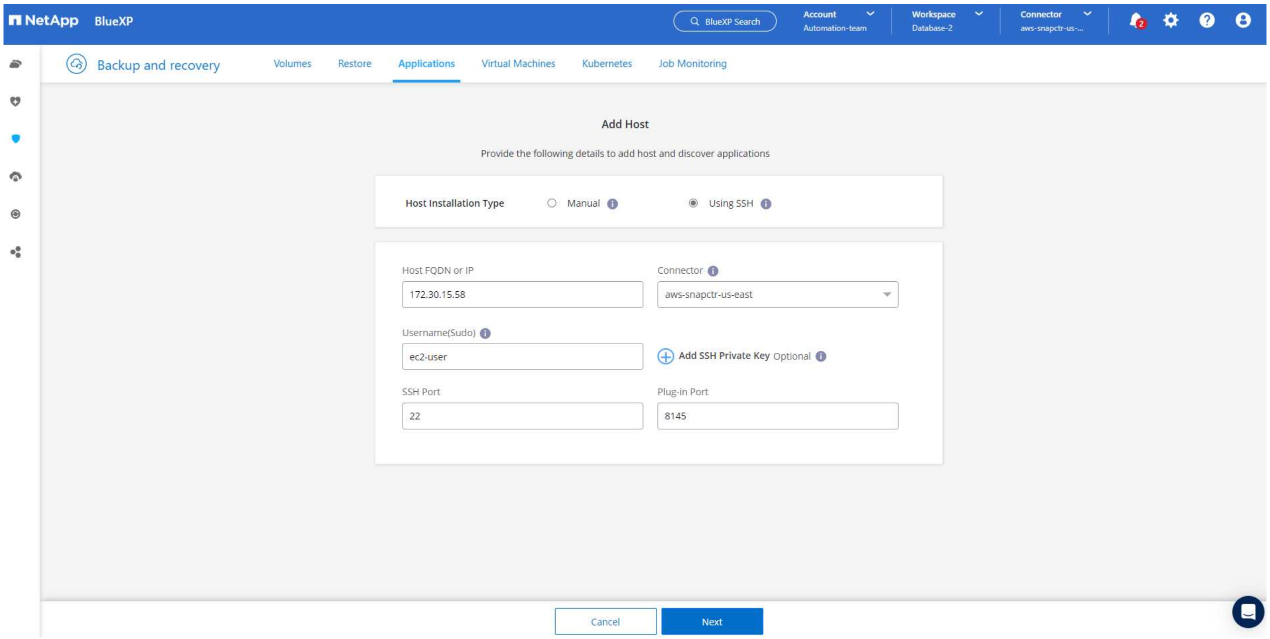
Cloud Native

Applications that are hosted and run in the cloud using AWS, Azure, GCP, etc..

1. Choose **Oracle** for the application type.



1. Fill in the AWS EC2 Oracle application host details. Choose **Using SSH** as **Host Installation Type** for one step plugin installation and database discovery. Then, click on **Add SSH Private Key**.



Add Host

Provide the following details to add host and discover applications

Host Installation Type ○ Manual ● Using SSH

Host FQDN or IP: 172.30.15.58

Connector: aws-snapctr-us-east

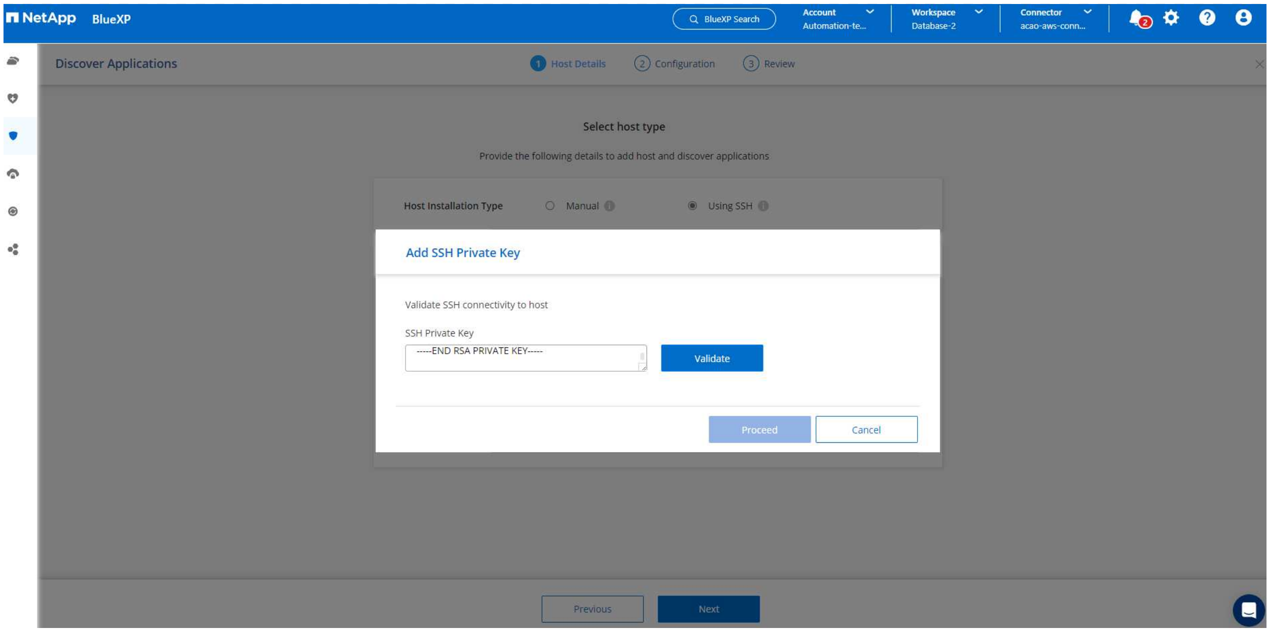
Username(Sudo): ec2-user

Add SSH Private Key Optional

SSH Port: 22

Plug-in Port: 8145

2. Paste in your ec2-user SSH key for the database EC2 host and click on **Validate** to proceed.



Select host type

Provide the following details to add host and discover applications

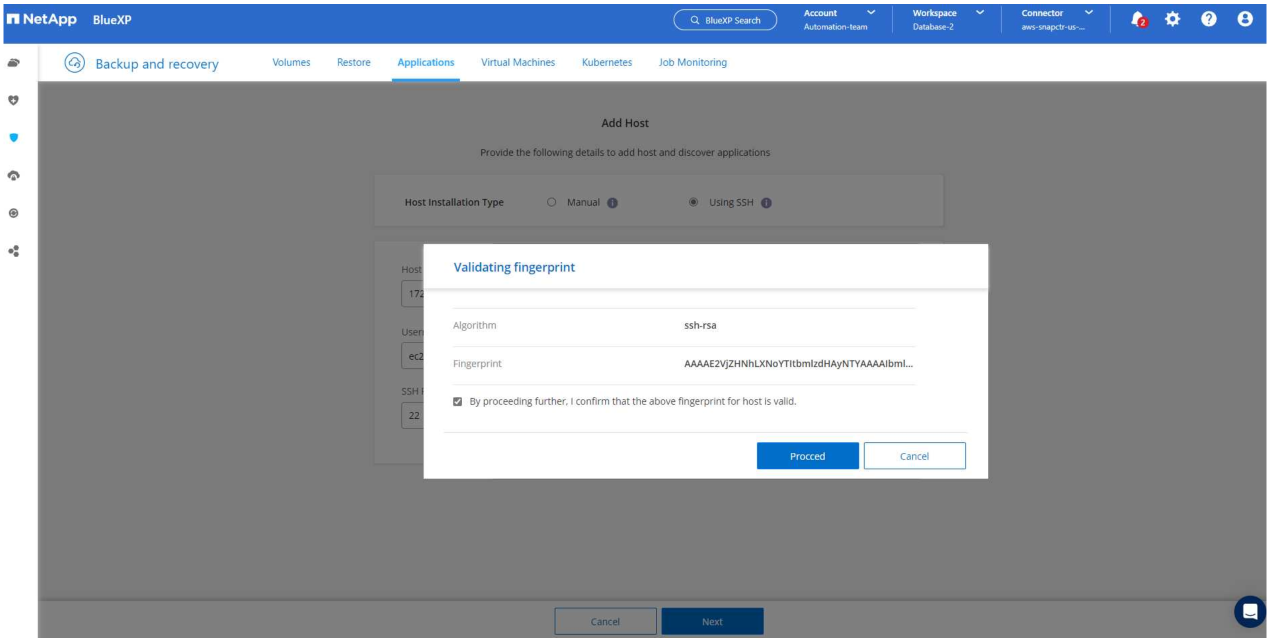
Host Installation Type ○ Manual ● Using SSH

Add SSH Private Key

Validate SSH connectivity to host

SSH Private Key: -----END RSA PRIVATE KEY-----

3. You will be prompted for **Validating fingerprint** to proceed.



Add Host

Provide the following details to add host and discover applications

Host Installation Type ○ Manual ● Using SSH

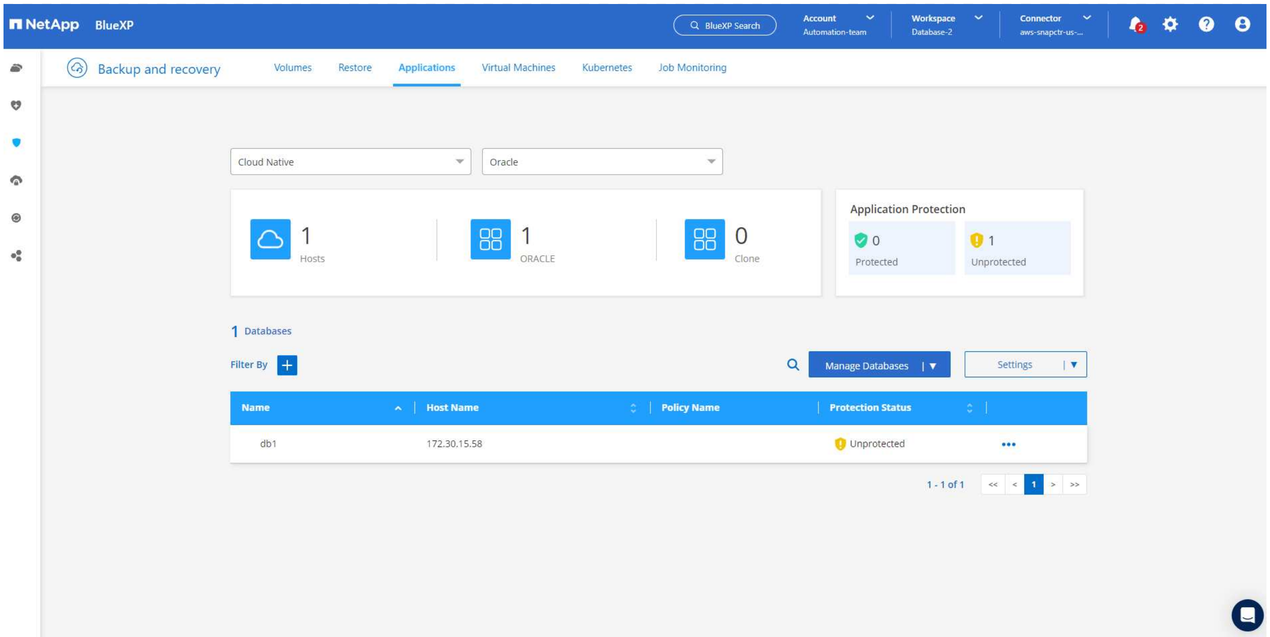
Validating fingerprint

Algorithm: ssh-rsa

Fingerprint: AAAAE2VjZHNhLXNoYTItbmlzdHAyNTYAAAAIbml...

☑ By proceeding further, I confirm that the above fingerprint for host is valid.

4. Click on **Next** to install an Oracle database plugin and discover the Oracle databases on the EC2 host. Discovered databases are added to **Applications**. The database **Protection Status** shows as **Unprotected** when initially discovered.

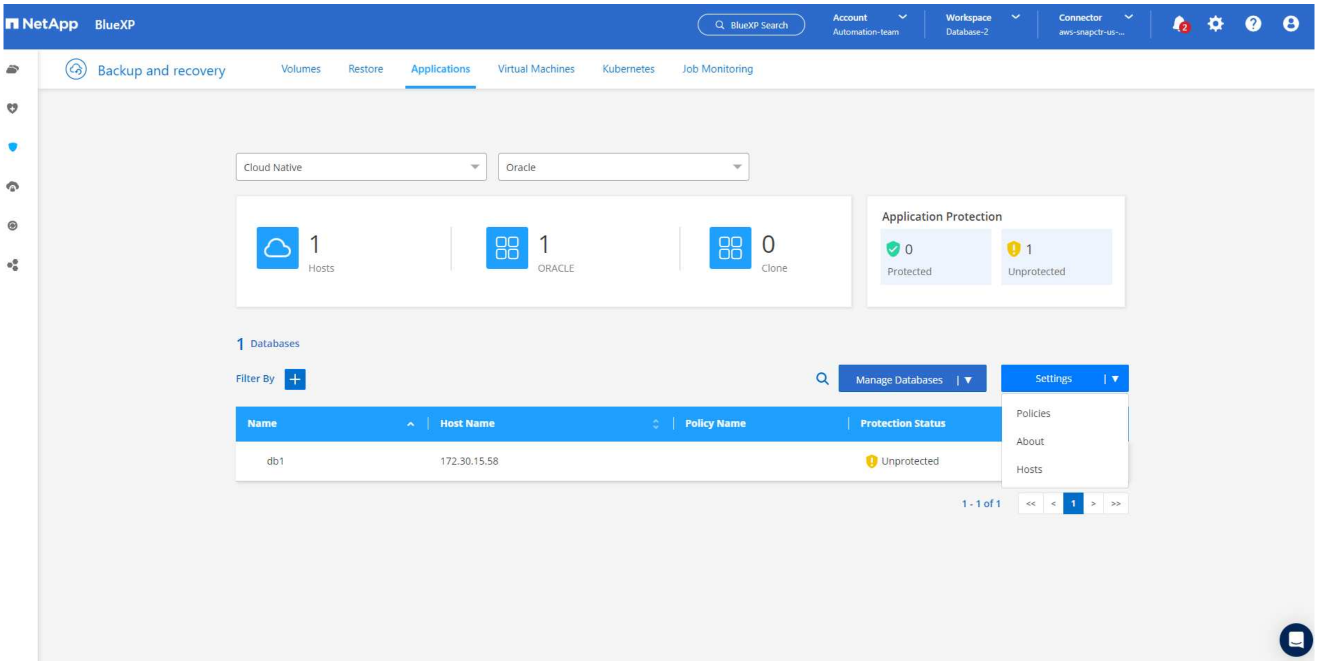


Name	Host Name	Policy Name	Protection Status
db1	172.30.15.58		Unprotected

This completes the initial setup of SnapCenter services for Oracle. The next three sections of this document describe Oracle database backup, restore, and clone operations.

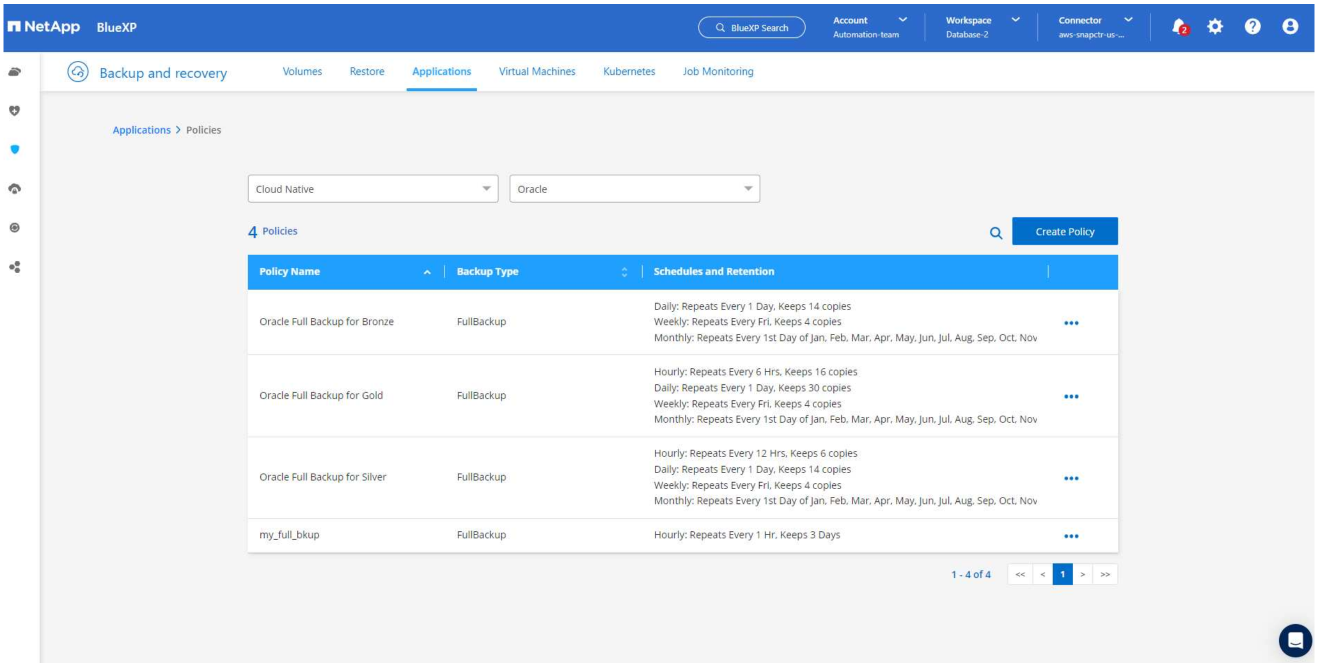
Oracle database backup

1. Click the three dots next to the database **Protection Status**, and then click **Polices** to view the default preloaded database protection policies that can be applied to protect your Oracle databases.



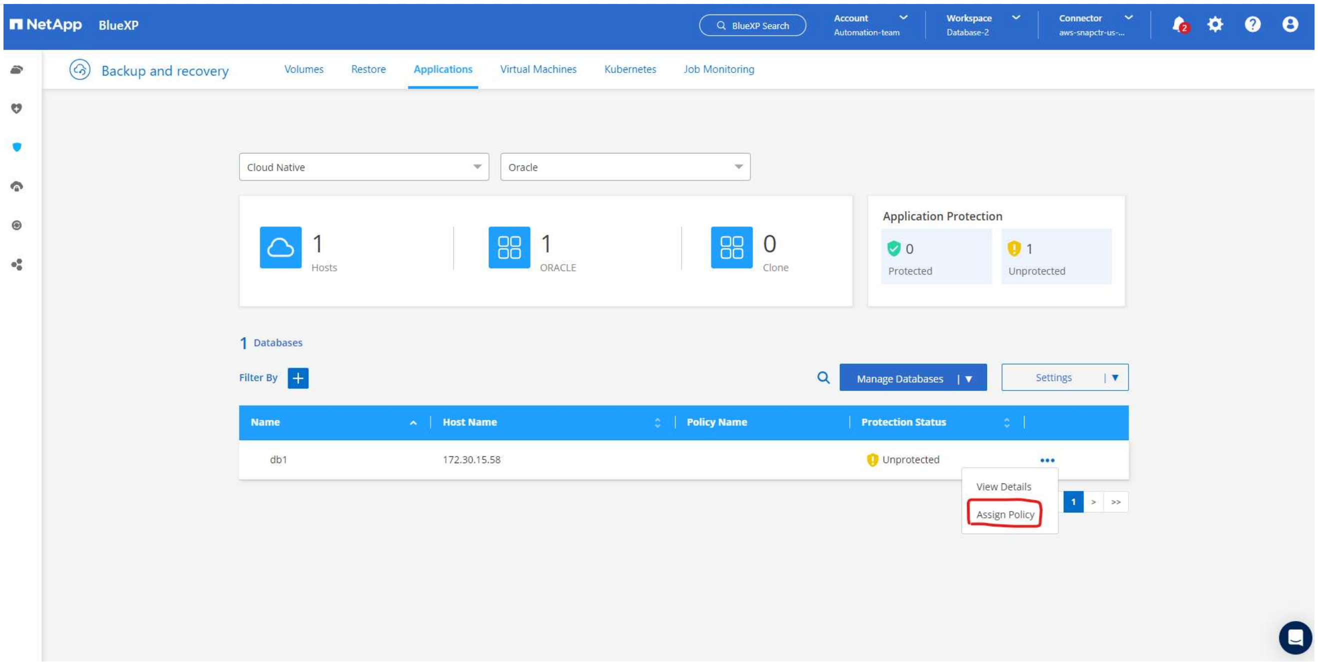
Name	Host Name	Policy Name	Protection Status
db1	172.30.15.58		Unprotected

1. You can also create your own policy with a customized backup frequency and backup data-retention window.



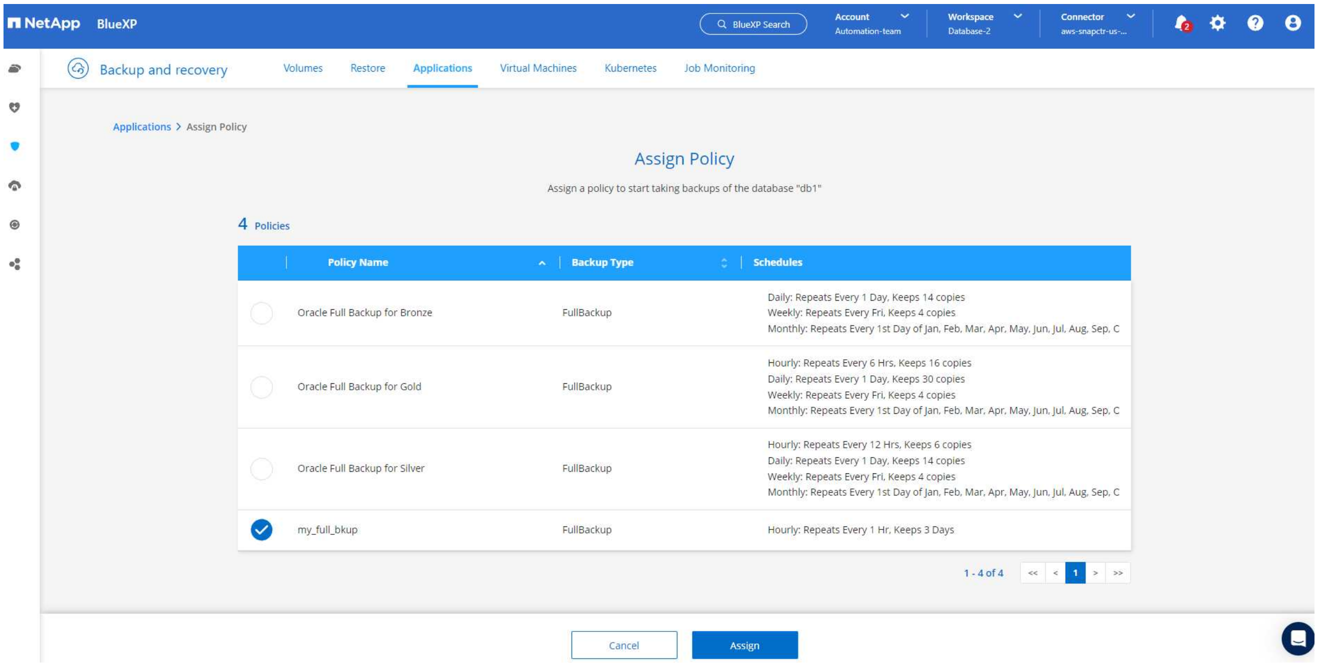
Policy Name	Backup Type	Schedules and Retention
Oracle Full Backup for Bronze	FullBackup	Daily: Repeats Every 1 Day, Keeps 14 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov
Oracle Full Backup for Gold	FullBackup	Hourly: Repeats Every 6 Hrs, Keeps 16 copies Daily: Repeats Every 1 Day, Keeps 30 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov
Oracle Full Backup for Silver	FullBackup	Hourly: Repeats Every 12 Hrs, Keeps 6 copies Daily: Repeats Every 1 Day, Keeps 14 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov
my_full_bkup	FullBackup	Hourly: Repeats Every 1 Hr, Keeps 3 Days

1. When you are happy with the policy configuration, you can then assign your policy of choice to protect the database.



Name	Host Name	Policy Name	Protection Status
db1	172.30.15.58		Unprotected

1. Choose the policy to assign to the database.



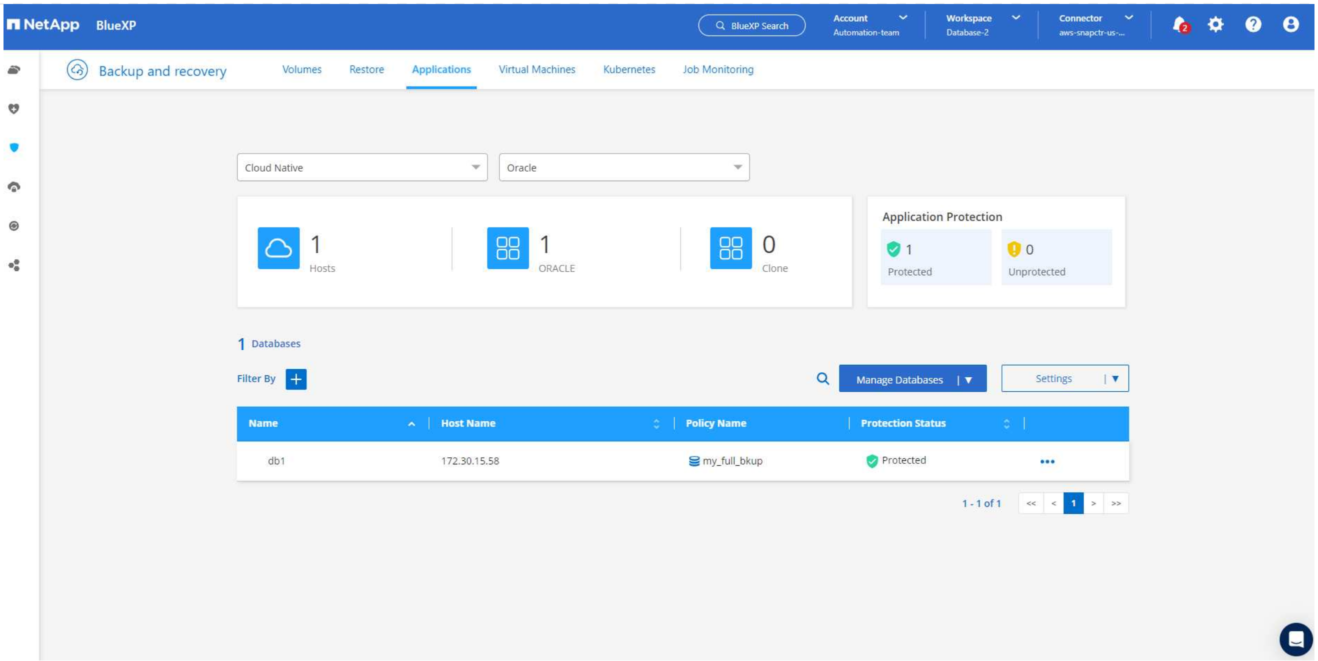
Assign Policy

Assign a policy to start taking backups of the database "db1"

4 Policies

	Policy Name	Backup Type	Schedules
○	Oracle Full Backup for Bronze	FullBackup	Daily: Repeats Every 1 Day, Keeps 14 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, C
○	Oracle Full Backup for Gold	FullBackup	Hourly: Repeats Every 6 Hrs, Keeps 16 copies Daily: Repeats Every 1 Day, Keeps 30 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, C
○	Oracle Full Backup for Silver	FullBackup	Hourly: Repeats Every 12 Hrs, Keeps 6 copies Daily: Repeats Every 1 Day, Keeps 14 copies Weekly: Repeats Every Fri, Keeps 4 copies Monthly: Repeats Every 1st Day of Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, C
✓	my_full_bkup	FullBackup	Hourly: Repeats Every 1 Hr, Keeps 3 Days

1. After the policy is applied, the database protection status changed to **Protected** with a green check mark.



Cloud Native | Oracle

1 Hosts | 1 ORACLE | 0 Clone

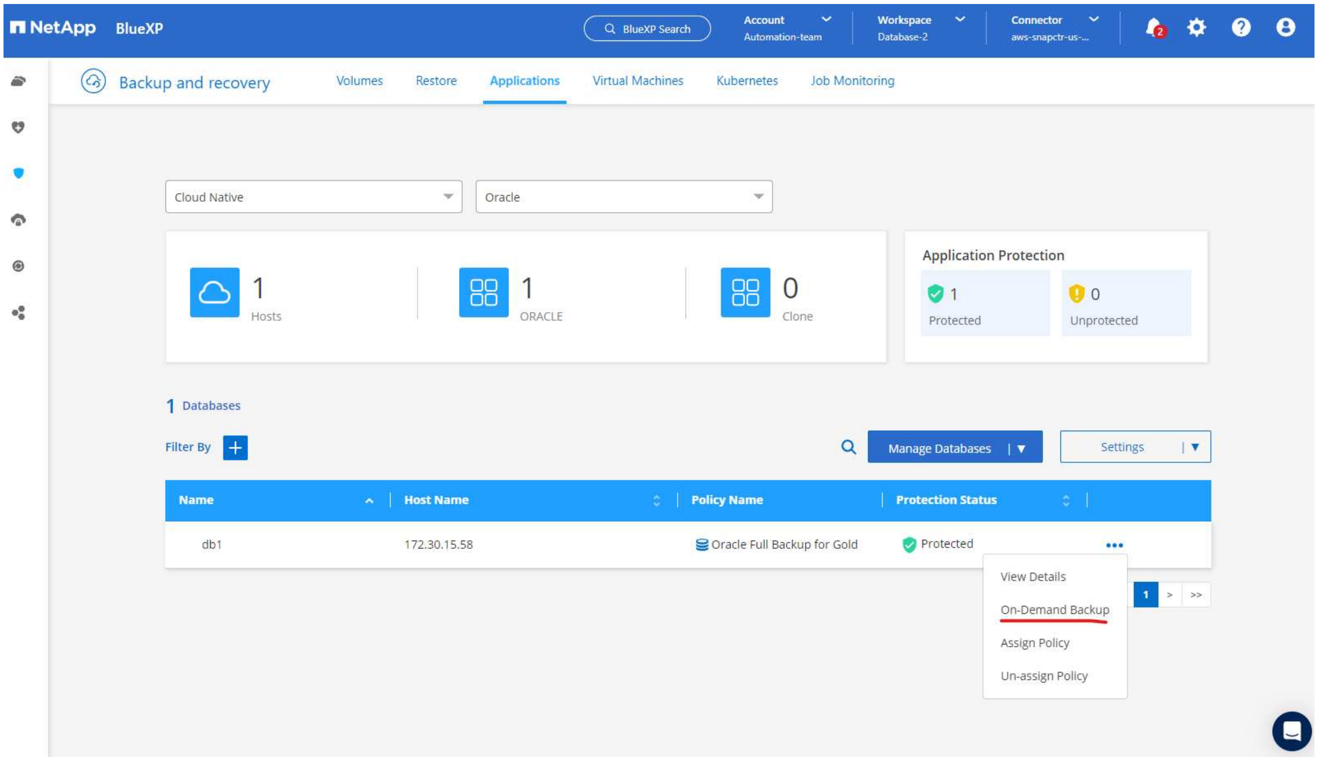
Application Protection: 1 Protected | 0 Unprotected

1 Databases

Name	Host Name	Policy Name	Protection Status
db1	172.30.15.58	my_full_bkup	Protected

1 - 1 of 1

1. The database backup runs on a predefined schedule. You can also run a one-off on-demand backup as shown below.



Cloud Native | Oracle

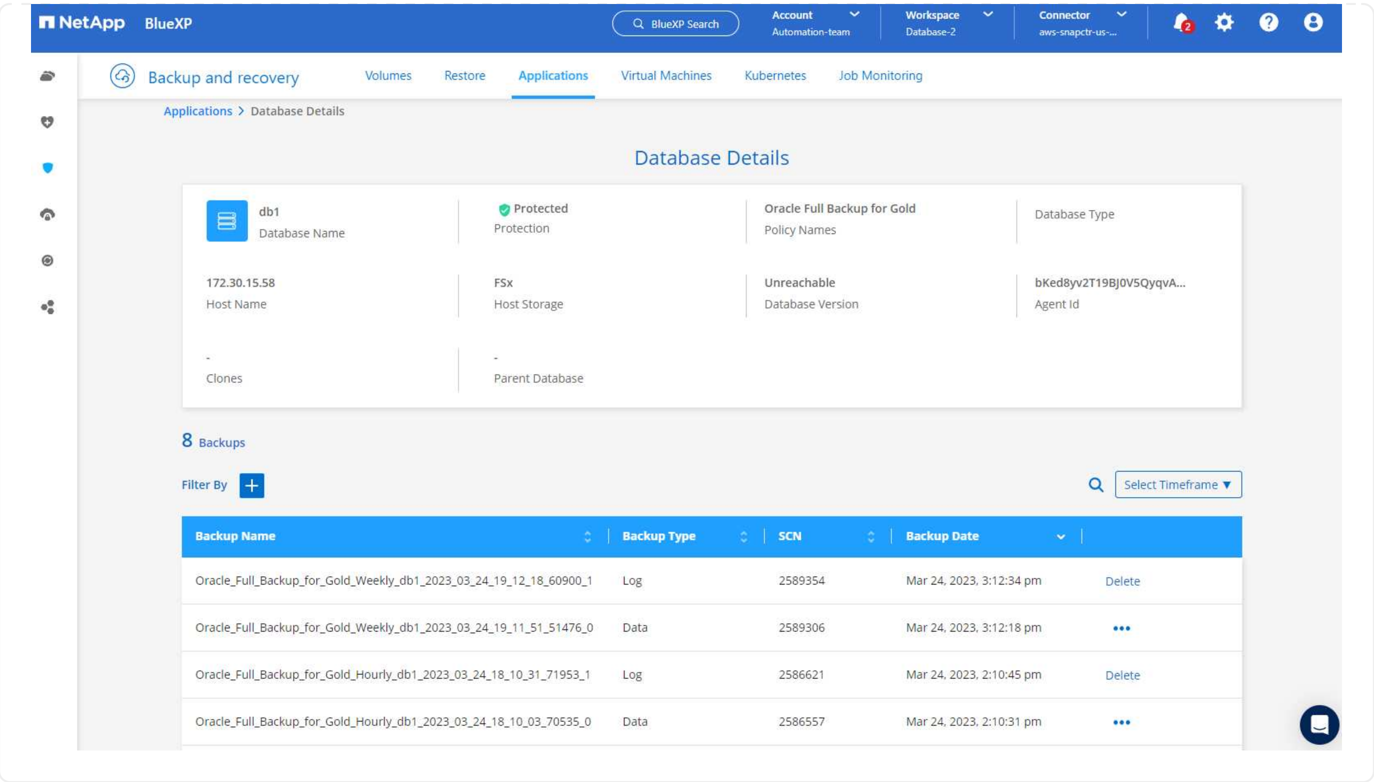
1 Hosts | 1 ORACLE | 0 Clone

Application Protection: 1 Protected | 0 Unprotected

1 Databases

Name	Host Name	Policy Name	Protection Status
db1	172.30.15.58	Oracle Full Backup for Gold	Protected

1. The database backups details can be viewed by clicking **View Details** from the menu list. This includes the backup name, backup type, SCN, and backup date. A backup set covers a snapshot for both data volume and log volume. A log volume snapshot takes place right after a database volume snapshot. You can apply a filter if you are looking for a particular backup in a long list.



Database Details

db1 Database Name	Protected Protection	Oracle Full Backup for Gold Policy Names	Database Type
172.30.15.58 Host Name	FSx Host Storage	Unreachable Database Version	bKed8yv2T19BJ0V5QyqvA... Agent Id
- Clones	- Parent Database		

8 Backups

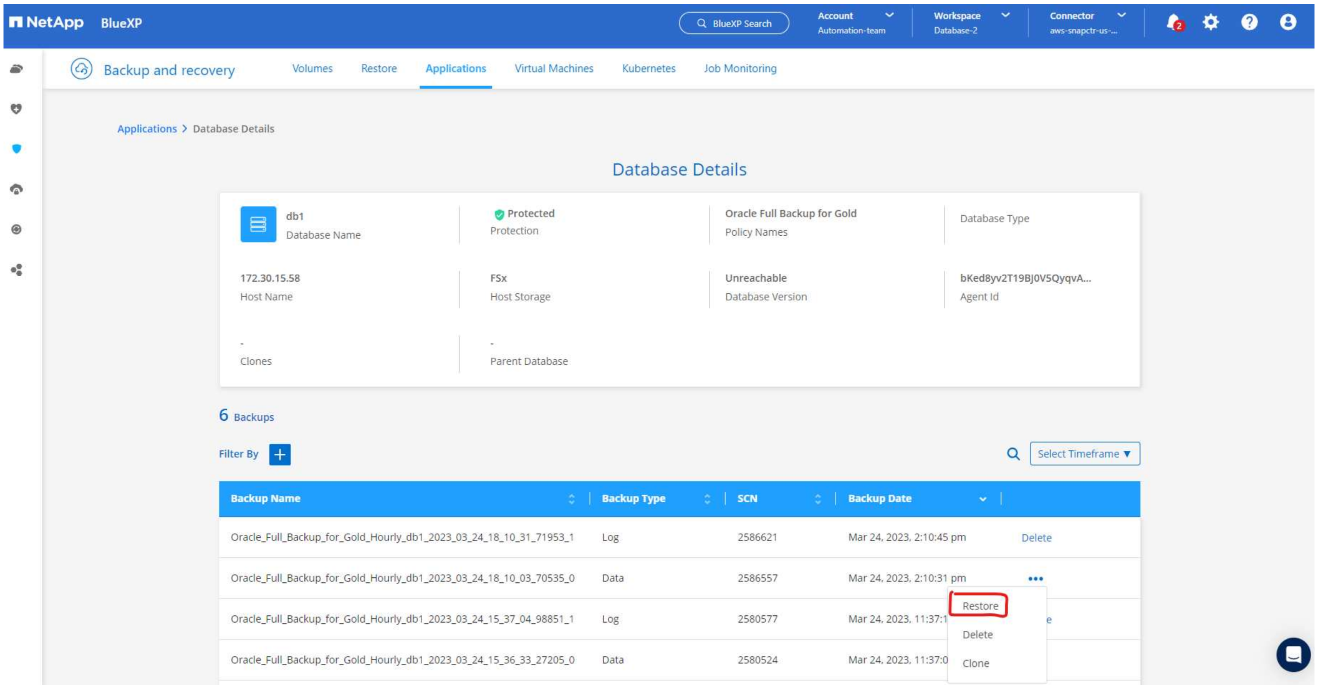
Filter By +

Select Timeframe ▼

Backup Name	Backup Type	SCN	Backup Date	
Oracle_Full_Backup_for_Gold_Weekly_db1_2023_03_24_19_12_18_60900_1	Log	2589354	Mar 24, 2023, 3:12:34 pm	Delete
Oracle_Full_Backup_for_Gold_Weekly_db1_2023_03_24_19_11_51_51476_0	Data	2589306	Mar 24, 2023, 3:12:18 pm	•••
Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_18_10_31_71953_1	Log	2586621	Mar 24, 2023, 2:10:45 pm	Delete
Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_18_10_03_70535_0	Data	2586557	Mar 24, 2023, 2:10:31 pm	•••

Oracle database restore and recovery

1. For a database restore, choose the right backup, either by the SCN or backup time. Click the three dots from the database data backup, and then click **Restore** to initiate database restore and recovery.



Database Details

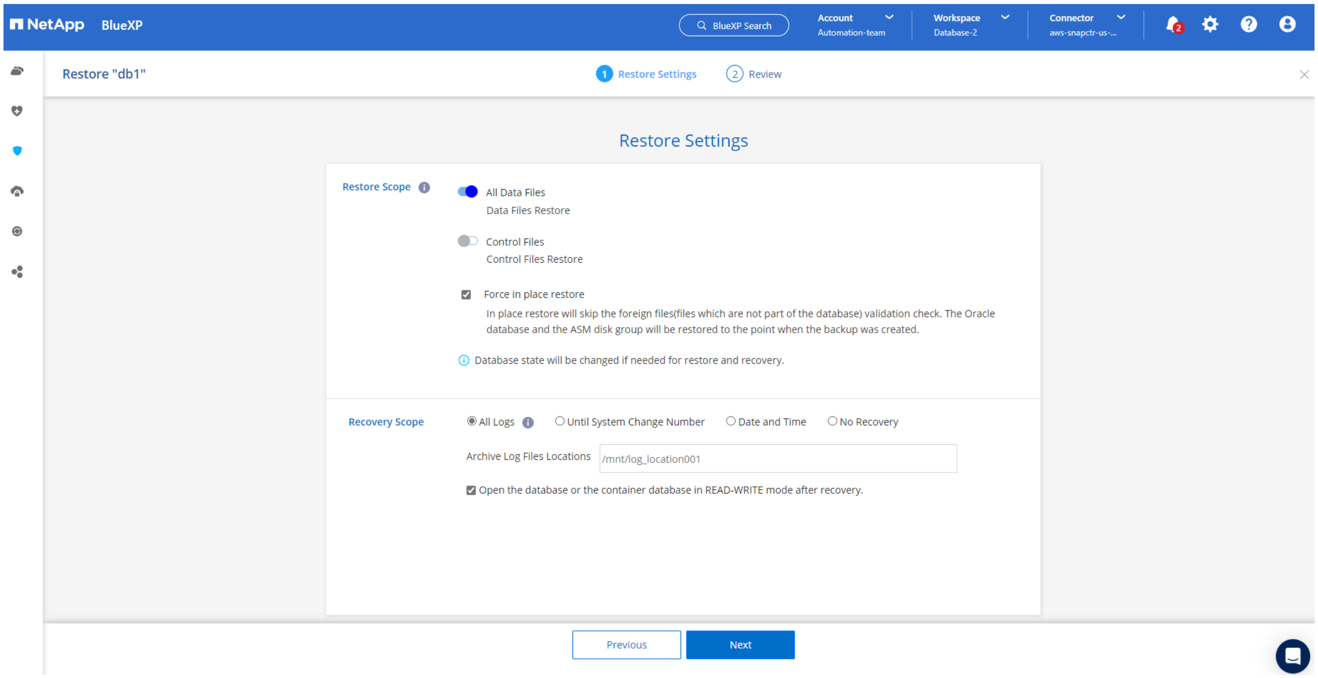
db1 Database Name	Protected Protection	Oracle Full Backup for Gold Policy Names	Database Type
172.30.15.58 Host Name	FSx Host Storage	Unreachable Database Version	bKed8yv2T19BJ0V5QyqvA... Agent Id
- Clones	- Parent Database		

6 Backups

Filter By + Select Timeframe ▼

Backup Name	Backup Type	SCN	Backup Date	
Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_18_10_31_71953_1	Log	2586621	Mar 24, 2023, 2:10:45 pm	Delete
Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_18_10_03_70535_0	Data	2586557	Mar 24, 2023, 2:10:31 pm	•••
Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_15_37_04_98851_1	Log	2580577	Mar 24, 2023, 11:37:1	e
Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_15_36_33_27205_0	Data	2580524	Mar 24, 2023, 11:37:0	

1. Choose your restore setting. If you are sure that nothing has changed in the physical database structure after the backup (such as the addition of a data file or a disk group), you can use the **Force in place restore** option, which is generally faster. Otherwise, do not check this box.



Restore Settings

Restore Scope

● All Data Files
Data Files Restore

○ Control Files
Control Files Restore

☑ Force in place restore
In place restore will skip the foreign files(files which are not part of the database) validation check. The Oracle database and the ASM disk group will be restored to the point when the backup was created.

Database state will be changed if needed for restore and recovery.

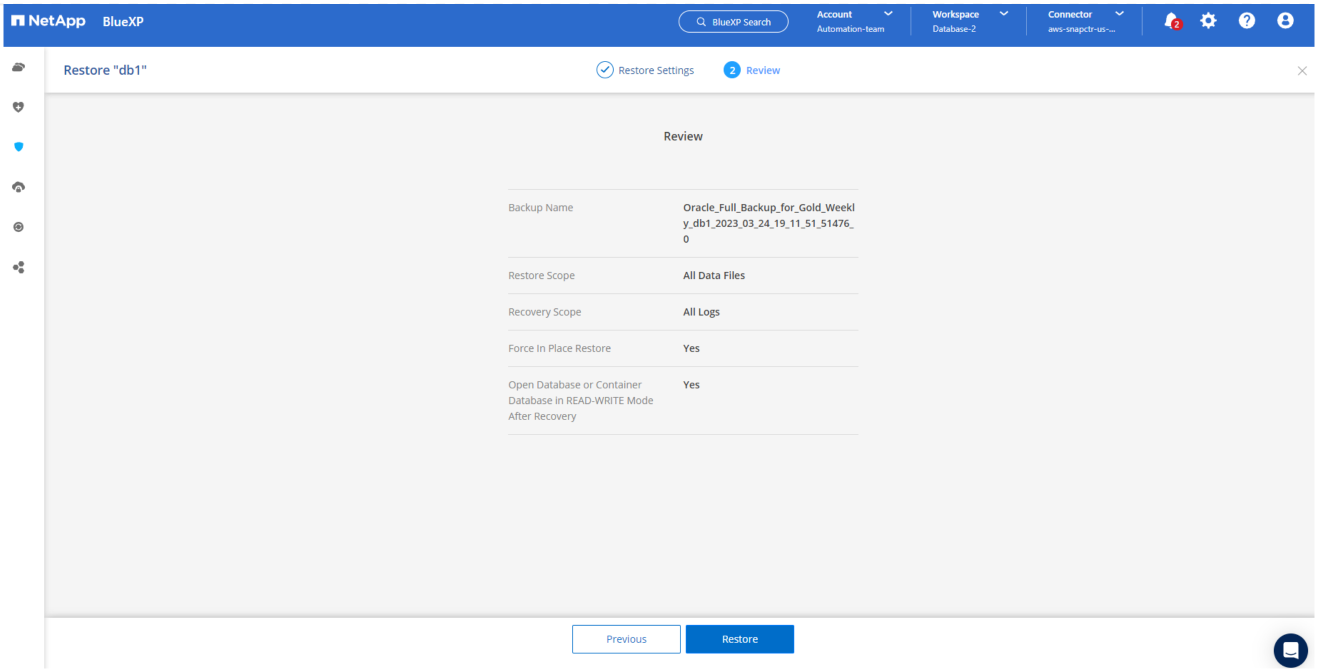
Recovery Scope

● All Logs ○ Until System Change Number ○ Date and Time ○ No Recovery

Archive Log Files Locations /mnt/log_location001

☑ Open the database or the container database in READ-WRITE mode after recovery.

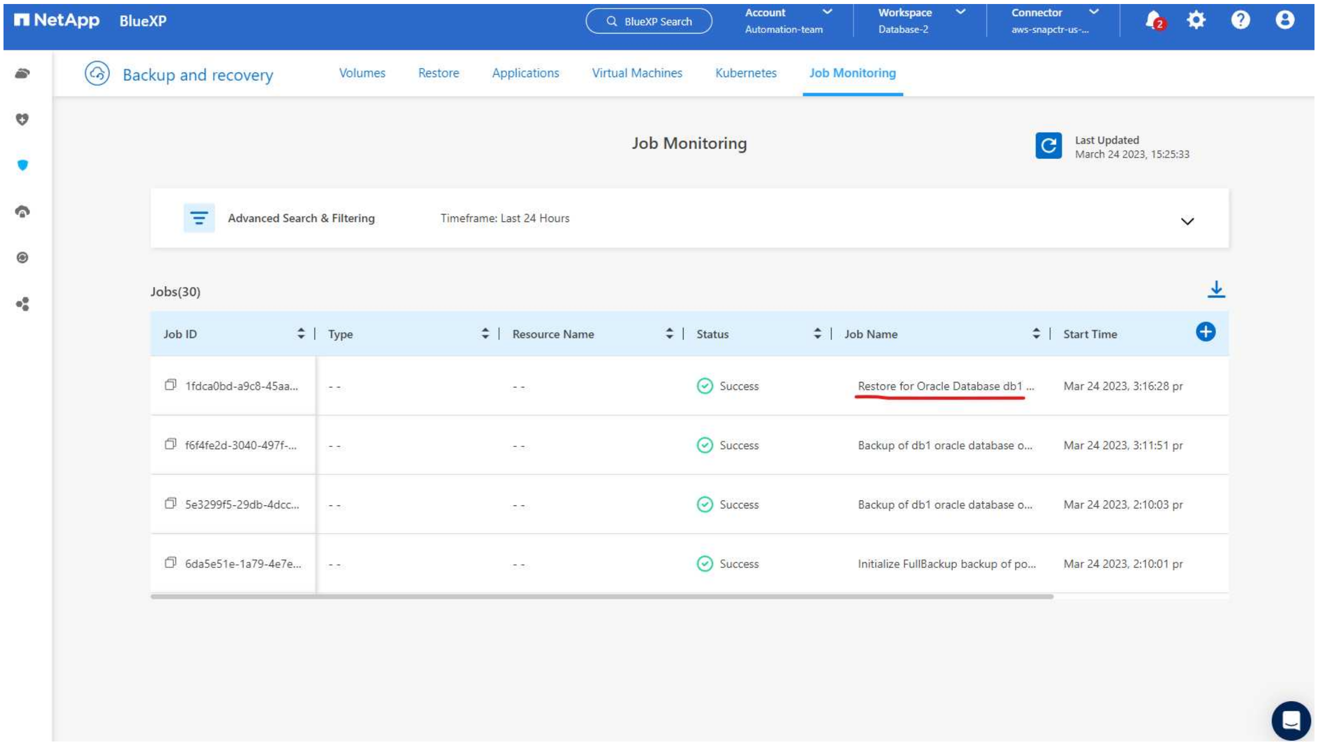
1. Review and start database restore and recovery.



Review

Backup Name	Oracle_Full_Backup_for_Gold_Weekly_db1_2023_03_24_19_11_51_51476_0
Restore Scope	All Data Files
Recovery Scope	All Logs
Force In Place Restore	Yes
Open Database or Container Database in READ-WRITE Mode After Recovery	Yes

1. From the **Job Monitoring** tab, you can view the status of the restore job as well as any details while it is running.



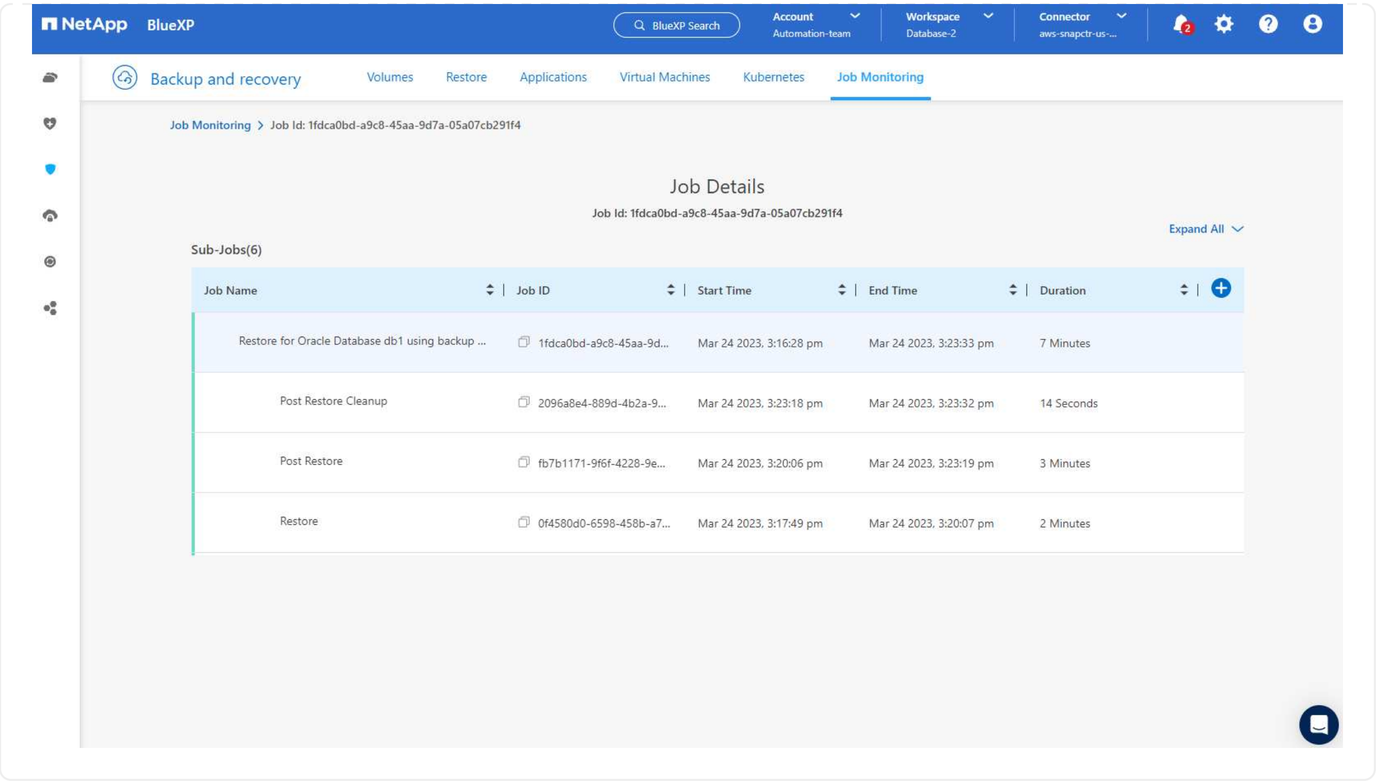
Job Monitoring

Last Updated
March 24 2023, 15:25:33

Advanced Search & Filtering   Timeframe: Last 24 Hours

Jobs(30)

Job ID	Type	Resource Name	Status	Job Name	Start Time
1fdca0bd-a9c8-45aa...	- -	- -	✓ Success	Restore for Oracle Database db1 ...	Mar 24 2023, 3:16:28 pr
f6f4fe2d-3040-497f-...	- -	- -	✓ Success	Backup of db1 oracle database o...	Mar 24 2023, 3:11:51 pr
5e3299f5-29db-4dcc...	- -	- -	✓ Success	Backup of db1 oracle database o...	Mar 24 2023, 2:10:03 pr
6da5e51e-1a79-4e7e...	- -	- -	✓ Success	Initialize FullBackup backup of po...	Mar 24 2023, 2:10:01 pr



Job Monitoring > Job Id: 1fdca0bd-a9c8-45aa-9d7a-05a07cb291f4

Job Details

Job Id: 1fdca0bd-a9c8-45aa-9d7a-05a07cb291f4

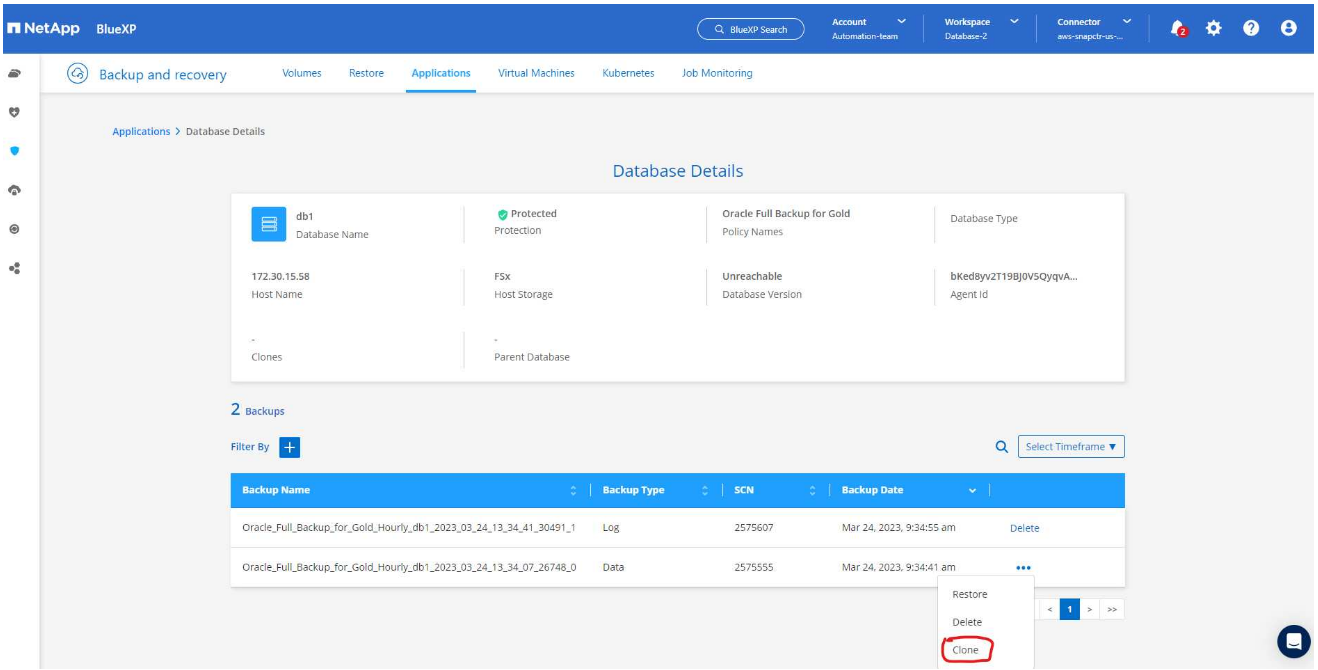
Sub-Jobs(6)

Job Name	Job ID	Start Time	End Time	Duration
Restore for Oracle Database db1 using backup ...	1fdca0bd-a9c8-45aa-9d...	Mar 24 2023, 3:16:28 pm	Mar 24 2023, 3:23:33 pm	7 Minutes
Post Restore Cleanup	2096a8e4-889d-4b2a-9...	Mar 24 2023, 3:23:18 pm	Mar 24 2023, 3:23:32 pm	14 Seconds
Post Restore	fb7b1171-9f6f-4228-9e...	Mar 24 2023, 3:20:06 pm	Mar 24 2023, 3:23:19 pm	3 Minutes
Restore	0f4580d0-6598-458b-a7...	Mar 24 2023, 3:17:49 pm	Mar 24 2023, 3:20:07 pm	2 Minutes

Oracle database clone

To clone a database, launch the clone workflow from the same database backup details page.

1. Select the right database backup copy, click the three dots to view the menu, and choose the **Clone** option.



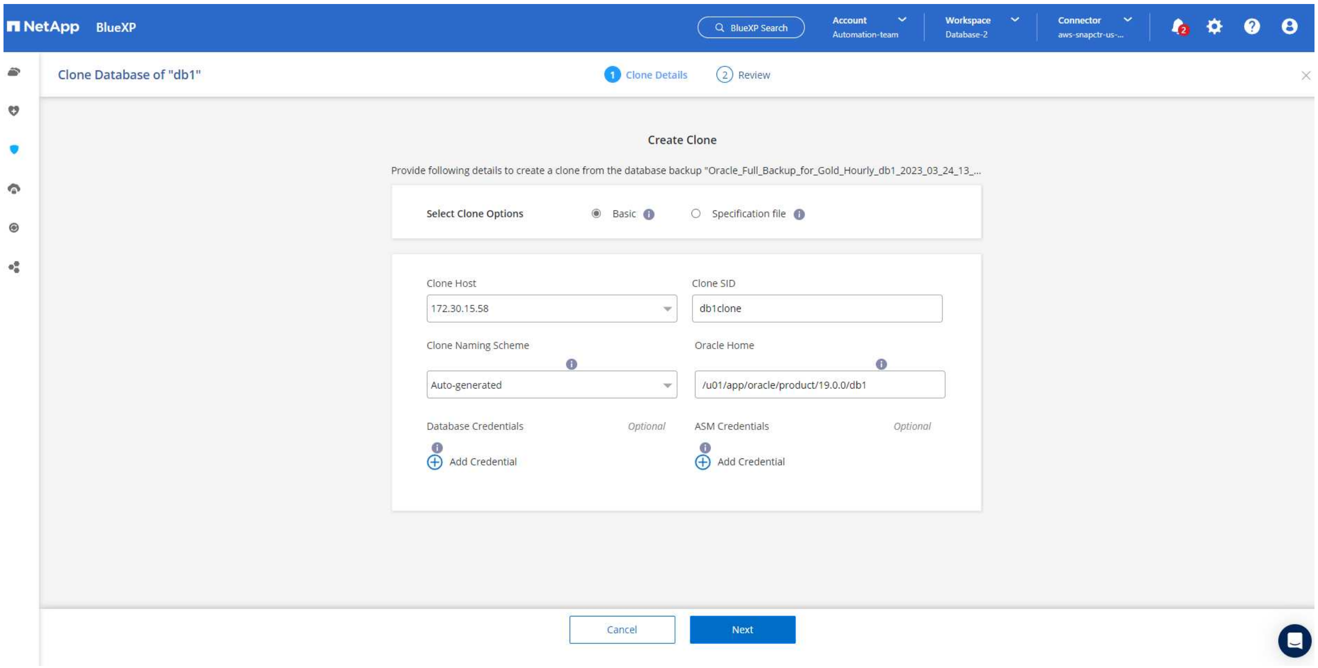
Database Details

db1 Database Name	Protected Protection	Oracle Full Backup for Gold Policy Names	Database Type
172.30.15.58 Host Name	FSx Host Storage	Unreachable Database Version	bKed8yv2T19BJ0V5QyqvA... Agent Id
- Clones	- Parent Database		

2 Backups

Backup Name	Backup Type	SCN	Backup Date	
Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_13_34_41_30491_1	Log	2575607	Mar 24, 2023, 9:34:55 am	Delete
Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_13_34_07_26748_0	Data	2575555	Mar 24, 2023, 9:34:41 am	•••

1. Select the **Basic** option if you don’t need to change any cloned database parameters.



Clone Database of "db1"

Create Clone

Provide following details to create a clone from the database backup "Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_13_...

Select Clone Options ● Basic ○ Specification file

Clone Host: 172.30.15.58

Clone SID: db1clone

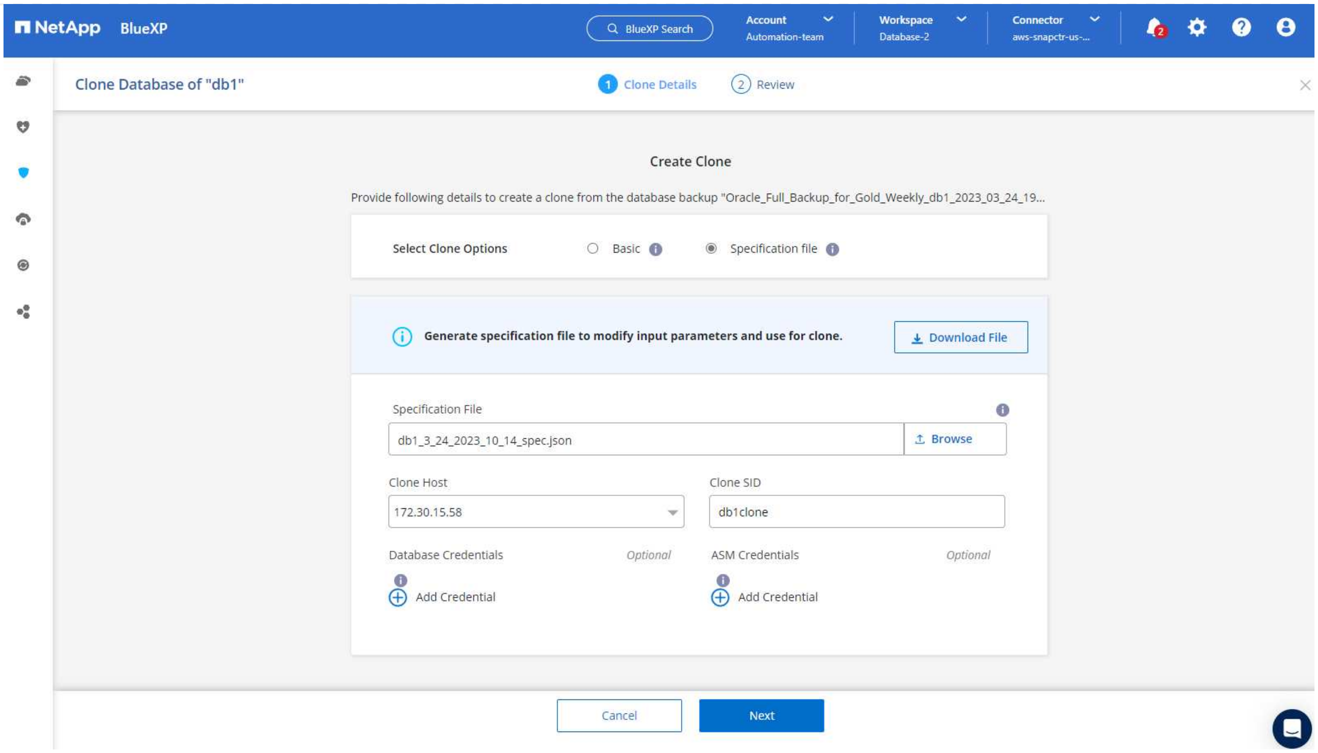
Clone Naming Scheme: Auto-generated

Oracle Home: /u01/app/oracle/product/19.0.0/db1

Database Credentials Optional: Add Credential

ASM Credentials Optional: Add Credential

1. Alternatively, select **Specification file**, which gives you the option of downloading the current init file, making changes, and then uploading it back to the job.



Create Clone

Provide following details to create a clone from the database backup "Oracle_Full_Backup_for_Gold_Weekly_db1_2023_03_24_19...

Select Clone Options ○ Basic ● Specification file

Generate specification file to modify input parameters and use for clone.

Specification File: db1_3_24_2023_10_14_spec.json

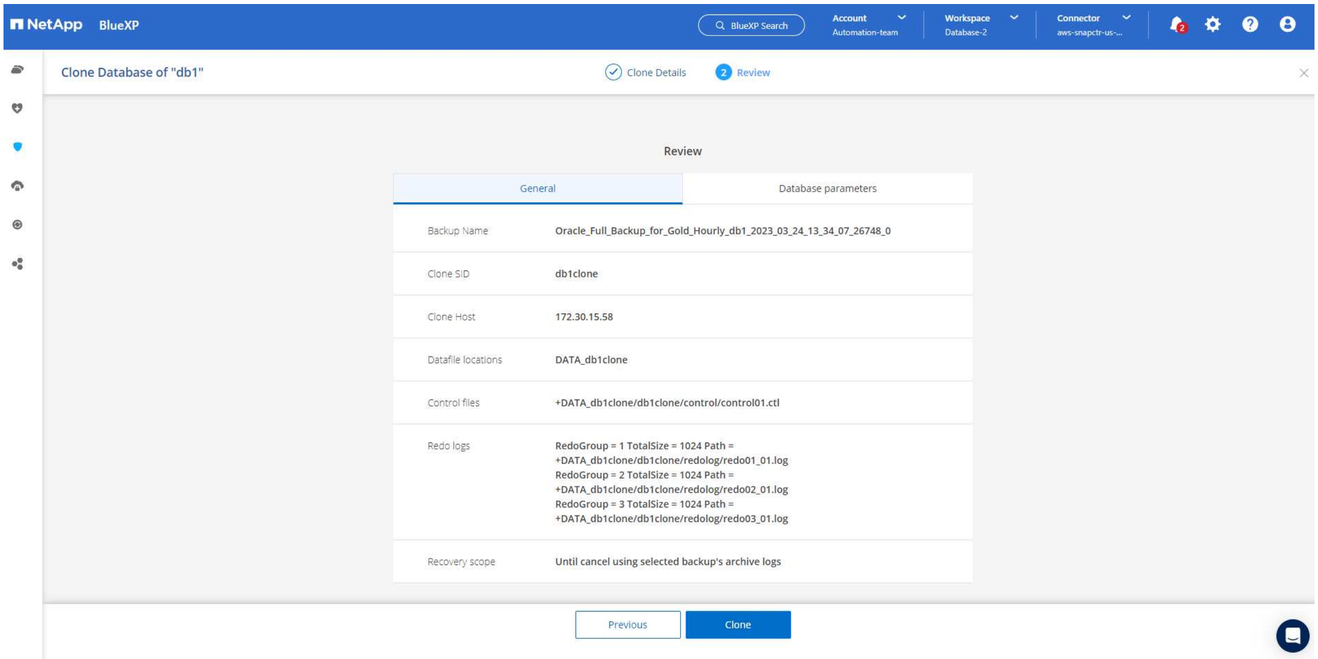
Clone Host: 172.30.15.58

Clone SID: db1clone

Database Credentials *Optional*

ASM Credentials *Optional*

1. Review and launch the job.



Review

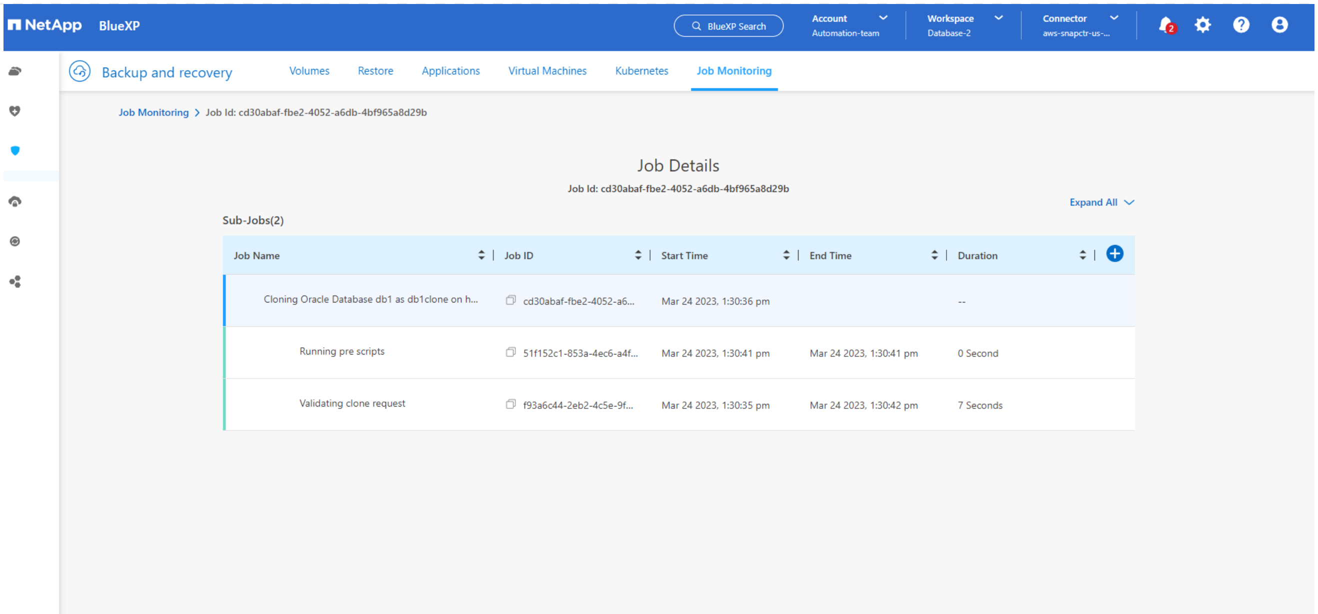
General | Database parameters

Backup Name	Oracle_Full_Backup_for_Gold_Hourly_db1_2023_03_24_13_34_07_26748_0
Clone SID	db1clone
Clone Host	172.30.15.58
Datafile locations	DATA_db1clone
Control files	+DATA_db1clone/db1clone/control/control01.ctl

Redo logs	RedoGroup = 1 TotalSize = 1024 Path =
	+DATA_db1clone/db1clone/redolog/redo01_01.log
	RedoGroup = 2 TotalSize = 1024 Path =
	+DATA_db1clone/db1clone/redolog/redo02_01.log
	RedoGroup = 3 TotalSize = 1024 Path =
	+DATA_db1clone/db1clone/redolog/redo03_01.log

Recovery scope	Until cancel using selected backup's archive logs

1. Monitor the cloning job status from the **Job Monitoring** tab.



Job Monitoring > Job Id: cd30abaf-fbe2-4052-a6db-4bf965a8d29b

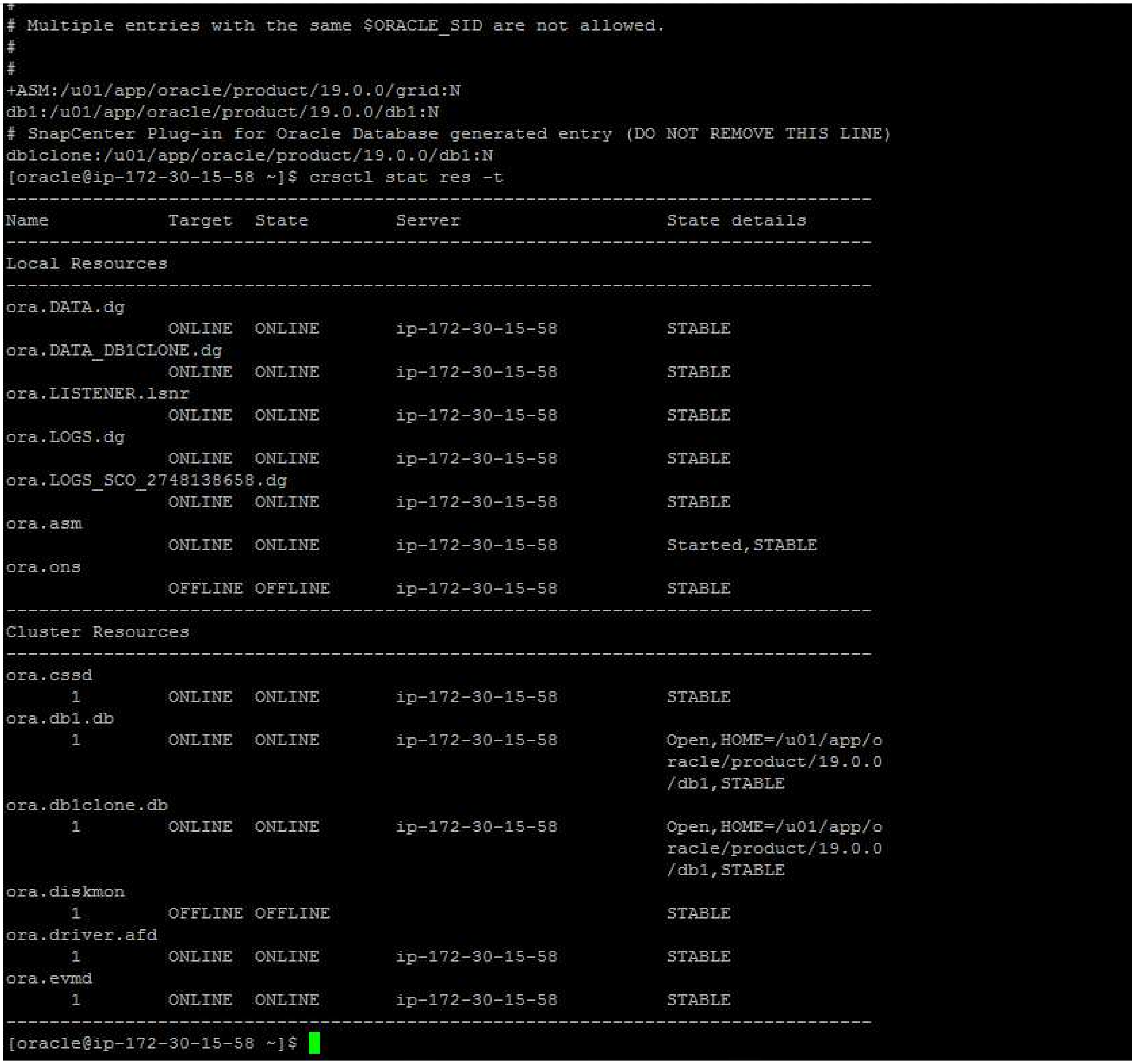
Job Details

Job Id: cd30abaf-fbe2-4052-a6db-4bf965a8d29b

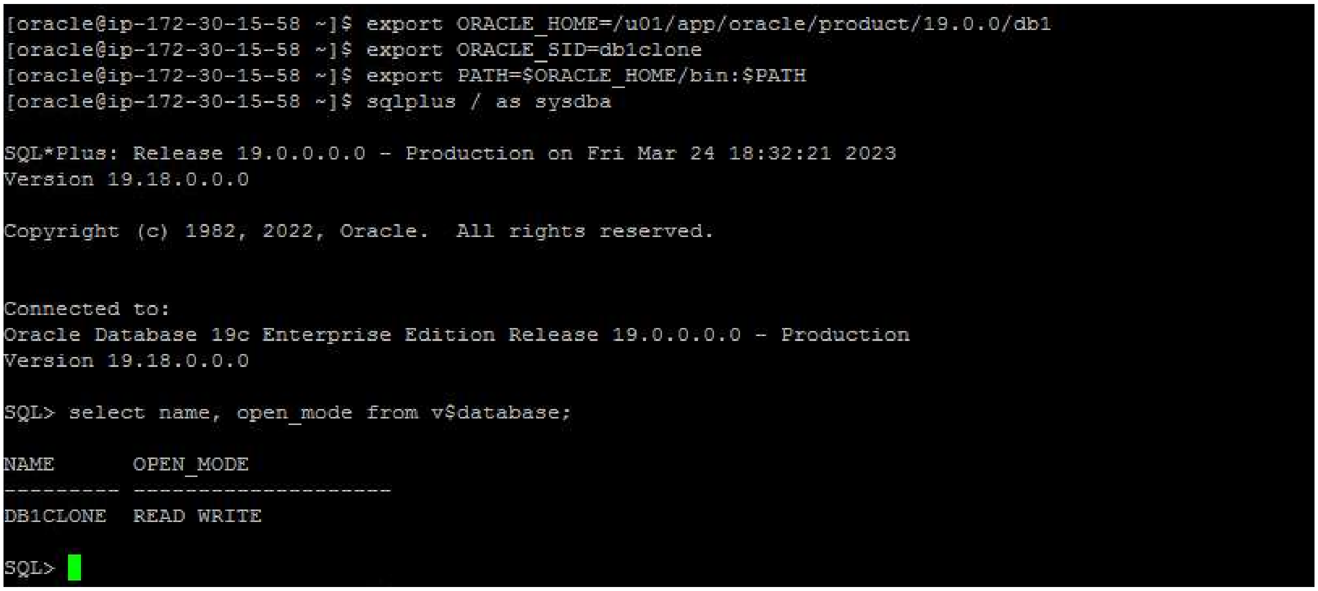
Sub-Jobs(2)

Job Name	Job ID	Start Time	End Time	Duration
Cloning Oracle Database db1 as db1clone on h...	cd30abaf-fbe2-4052-a6...	Mar 24 2023, 1:30:36 pm		--
Running pre scripts	51f152c1-853a-4ec6-a4f...	Mar 24 2023, 1:30:41 pm	Mar 24 2023, 1:30:41 pm	0 Second
Validating clone request	f93a6c44-2eb2-4c5e-9f...	Mar 24 2023, 1:30:35 pm	Mar 24 2023, 1:30:42 pm	7 Seconds

1. Validate the cloned database on the EC2 instance host.



```
#
# Multiple entries with the same $ORACLE_SID are not allowed.
#
#
+ASM:/u01/app/oracle/product/19.0.0/grid:N
db1:/u01/app/oracle/product/19.0.0/db1:N
# SnapCenter Plug-in for Oracle Database generated entry (DO NOT REMOVE THIS LINE)
db1clone:/u01/app/oracle/product/19.0.0/db1:N
[oracle@ip-172-30-15-58 ~]$ crsctl stat res -t
--------------------------------------------------------------------------------
Name           Target  State        Server                   State details
--------------------------------------------------------------------------------
Local Resources
--------------------------------------------------------------------------------
ora.DATA.dg
               ONLINE  ONLINE       ip-172-30-15-58          STABLE
ora.DATA_DB1CLONE.dg
               ONLINE  ONLINE       ip-172-30-15-58          STABLE
ora.LISTENER.lsnr
               ONLINE  ONLINE       ip-172-30-15-58          STABLE
ora.LOGS.dg
               ONLINE  ONLINE       ip-172-30-15-58          STABLE
ora.LOGS_SCO_2748138658.dg
               ONLINE  ONLINE       ip-172-30-15-58          STABLE
ora.asm
               ONLINE  ONLINE       ip-172-30-15-58          Started,STABLE
ora.ons
               OFFLINE OFFLINE      ip-172-30-15-58          STABLE
--------------------------------------------------------------------------------
Cluster Resources
--------------------------------------------------------------------------------
ora.cssd
      1        ONLINE  ONLINE       ip-172-30-15-58          STABLE
ora.db1.db
      1        ONLINE  ONLINE       ip-172-30-15-58          Open,HOME=/u01/app/o
                                                             racle/product/19.0.0
                                                             /db1,STABLE
ora.db1clone.db
      1        ONLINE  ONLINE       ip-172-30-15-58          Open,HOME=/u01/app/o
                                                             racle/product/19.0.0
                                                             /db1,STABLE
ora.diskmon
      1        OFFLINE OFFLINE                               STABLE
ora.driver.afd
      1        ONLINE  ONLINE       ip-172-30-15-58          STABLE
ora.evmd
      1        ONLINE  ONLINE       ip-172-30-15-58          STABLE
--------------------------------------------------------------------------------
[oracle@ip-172-30-15-58 ~]$
```



```
[oracle@ip-172-30-15-58 ~]$ export ORACLE_HOME=/u01/app/oracle/product/19.0.0/db1
[oracle@ip-172-30-15-58 ~]$ export ORACLE_SID=db1clone
[oracle@ip-172-30-15-58 ~]$ export PATH=$ORACLE_HOME/bin:$PATH
[oracle@ip-172-30-15-58 ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Fri Mar 24 18:32:21 2023
Version 19.18.0.0.0

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Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.18.0.0.0

SQL> select name, open_mode from v$database;

NAME      OPEN_MODE
--------- --------------------
DB1CLONE  READ WRITE

SQL>
```

Additional information

To learn more about the information that is described in this document, review the following documents and/or websites:

- Set up and administer BlueXP

https://docs.netapp.com/us-en/cloud-manager-setup-admin/index.html

- BlueXP backup and recovery documentation

https://docs.netapp.com/us-en/cloud-manager-backup-restore/index.html

- Amazon FSx for NetApp ONTAP

https://aws.amazon.com/fsx/netapp-ontap/

- Amazon EC2

https://aws.amazon.com/pm/ec2/?trk=36c6da98-7b20-48fa-8225-4784bced9843&sc_channel=ps&s_kwcid=AL!4422!3!467723097970!e!!g!!aws%20ec2&ef_id=Cj0KCQiA54KfBhCKARIsAJzSrdqwQrghn6I71jiWzSeaT9Uh1-vY-VfhJixF-xnv5rWwn2S7RqZOTQ0aAh7eEALw_wcB:G:s&s_kwcid=AL!4422!3!467723097970!e!!g!!aws%20ec2

Hybrid Cloud Database Solutions with SnapCenter

TR-4908: Hybrid Cloud Database Solutions with SnapCenter Overview

Alan Cao, Felix Melligan, NetApp

This solution provides NetApp field and customers with instructions and guidance for configuring, operating, and migrating databases to a hybrid cloud environment using the NetApp SnapCenter GUI-based tool and the NetApp storage service CVO in public clouds for the following use cases:

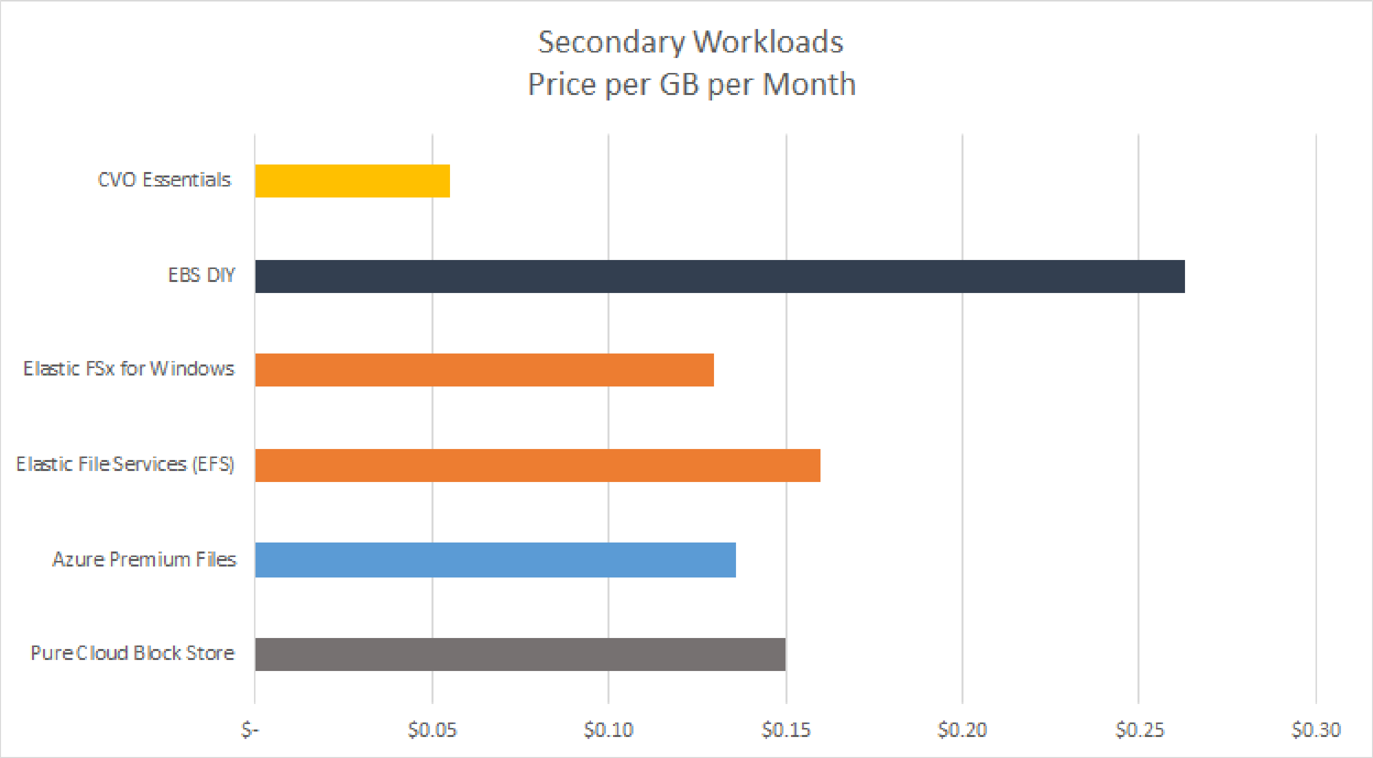
- Database dev/test operations in the hybrid cloud
- Database disaster recovery in the hybrid cloud

Today, many enterprise databases still reside in private corporate data centers for performance, security, and/or other reasons. This hybrid cloud database solution enables enterprises to operate their primary databases on site while using a public cloud for dev/test database operations as well as for disaster recovery to reduce licensing and operational costs.

Many enterprise databases, such as Oracle, SQL Server, SAP HANA, and so on, carry high licensing and operational costs. Many customers pay a one-time license fee as well as annual support costs based on the number of compute cores in their database environment, whether the cores are used for development, testing, production, or disaster recovery. Many of those environments might not be fully utilized throughout the application lifecycle.

The solutions provide an option for customers to potentially reduce their licensable cores count by moving their database environments devoted to development, testing, or disaster recovery to the cloud. By using public-cloud scale, redundancy, high availability, and a consumption-based billing model, the cost saving for licensing and operation can be substantial, while not sacrificing any application usability or availability.

Beyond potential database license-cost savings, the NetApp capacity-based CVO license model allows customers to save storage costs on a per-GB basis while empowering them with high level of database manageability that is not available from competing storage services. The following chart shows a storage cost comparison of popular storage services available in the public cloud.



This solution demonstrates that, by using the SnapCenter GUI-based software tool and NetApp SnapMirror technology, hybrid cloud database operations can be easily setup, implemented, and operated.

The following videos demonstrate SnapCenter in action:

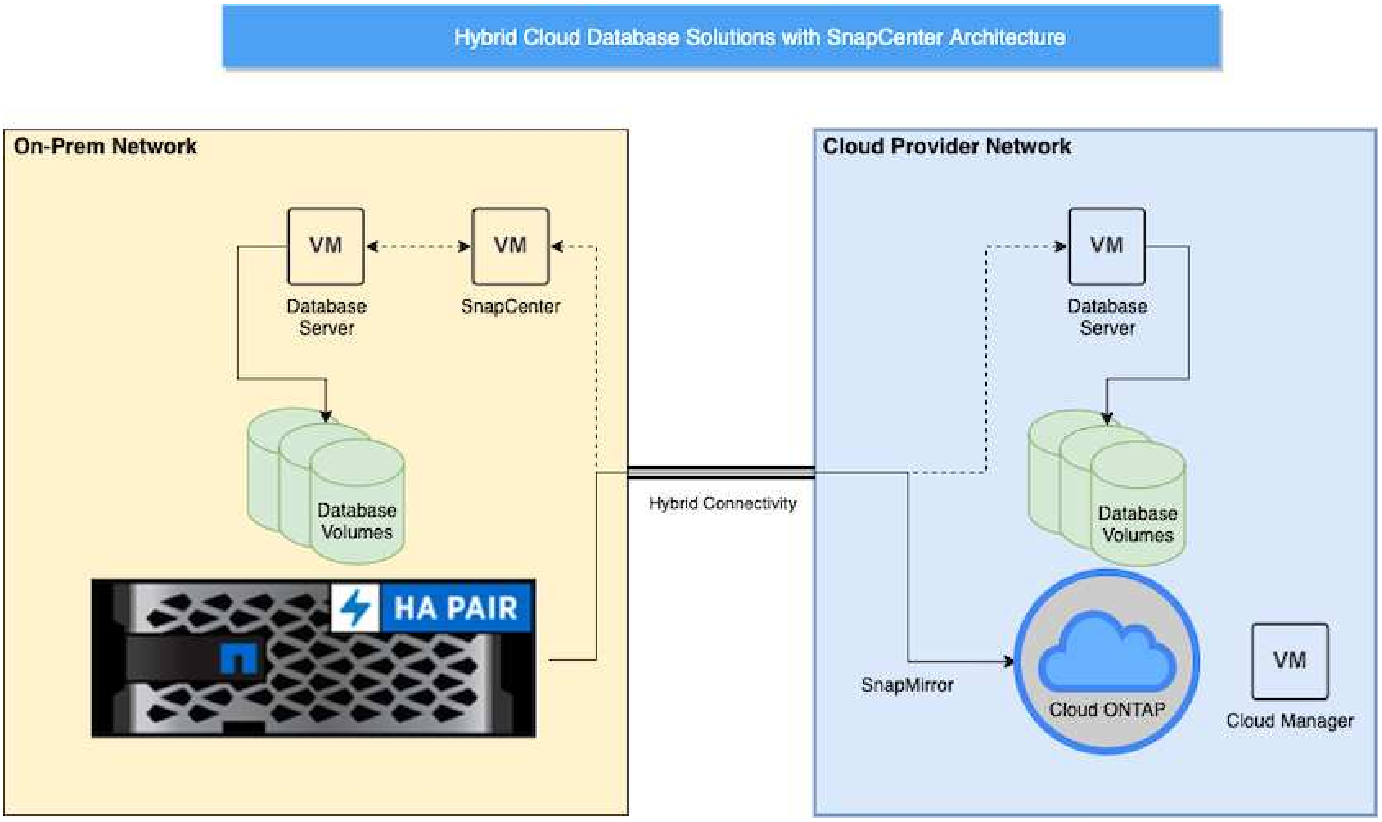
- Backup of an Oracle database across a Hybrid Cloud using SnapCenter
- SnapCenter- Clone DEV/TEST to AWS Cloud for an Oracle database

Notably, although the illustrations throughout this document show CVO as a target storage instance in the public cloud, the solution is also fully validated for the new release of the FSx ONTAP storage engine for AWS.

To test drive the solution and use cases for yourself, a NetApp Lab-on-Demand SL10680 can be requested at following xref:./databases/ TL_AWS_004 HCoD: AWS - NW,SnapCenter(OnPrem).

Solution Architecture

The following architecture diagram illustrates a typical implementation of enterprise database operation in a hybrid cloud for dev/test and disaster recovery operations.



In normal business operations, synchronized database volumes in the cloud can be cloned and mounted to dev/test database instances for applications development or testing. In the event of a failure, the synchronized database volumes in the cloud can then be activated for disaster recovery.

SnapCenter Requirements

This solution is designed in a hybrid cloud setting to support on-premises production databases that can burst to all of the popular public clouds for dev/test and disaster recovery operations.

This solution supports all databases that are currently supported by SnapCenter, although only Oracle and SQL Server databases are demonstrated here. This solution is validated with virtualized database workloads, although bare-metal workloads are also supported.

We assume that production database servers are hosted on-premises with DB volumes presented to DB hosts from a ONTAP storage cluster. SnapCenter software is installed on-premises for database backup and data replication to the cloud. An Ansible controller is recommended but not required for database deployment automation or OS kernel and DB configuration syncing with a standby DR instance or dev/test instances in the public cloud.

Requirements

Environment	Requirements
On-premises	Any databases and versions supported by SnapCenter
	SnapCenter v4.4 or higher
	Ansible v2.09 or higher
	ONTAP cluster 9.x
	Intercluster LIFs configured
	Connectivity from on-premises to a cloud VPC (VPN, interconnect, and so on)
	Networking ports open - ssh 22 - tcp 8145, 8146, 10000, 11104, 11105
Cloud - AWS	Cloud Manager Connector
	Cloud Volumes ONTAP
	Matching DB OS EC2 instances to On-prem
Cloud - Azure	Cloud Manager Connector
	Cloud Volumes ONTAP
	Matching DB OS Azure Virtual Machines to On-prem
Cloud - GCP	Cloud Manager Connector
	Cloud Volumes ONTAP
	Matching DB OS Google Compute Engine instances to on-premises

Prerequisites configuration

Certain prerequisites must be configured both on-premises and in the cloud before the execution of hybrid cloud database workloads. The following section provides a high-level summary of this process, and the following links provide further information about necessary system configuration.

On premises

- SnapCenter installation and configuration
- On-premises database server storage configuration
- Licensing requirements
- Networking and security
- Automation

Public cloud

- A NetApp Cloud Central login
- Network access from a web browser to several endpoints
- A network location for a connector

- Cloud provider permissions
- Networking for individual services

Important considerations:

1. Where to deploy the Cloud Manager Connector?
2. Cloud Volume ONTAP sizing and architecture
3. Single node or high availability?

The following links provide further details:

On Premises

Public Cloud

Prerequisites on-premises

The following tasks must be completed on-premises to prepare the SnapCenter hybrid-cloud database workload environment.

SnapCenter installation and configuration

The NetApp SnapCenter tool is a Windows-based application that typically runs in a Windows domain environment, although workgroup deployment is also possible. It is based on a multitiered architecture that includes a centralized management server (the SnapCenter server) and a SnapCenter plug-in on the database server hosts for database workloads. Here are a few key considerations for hybrid-cloud deployment.

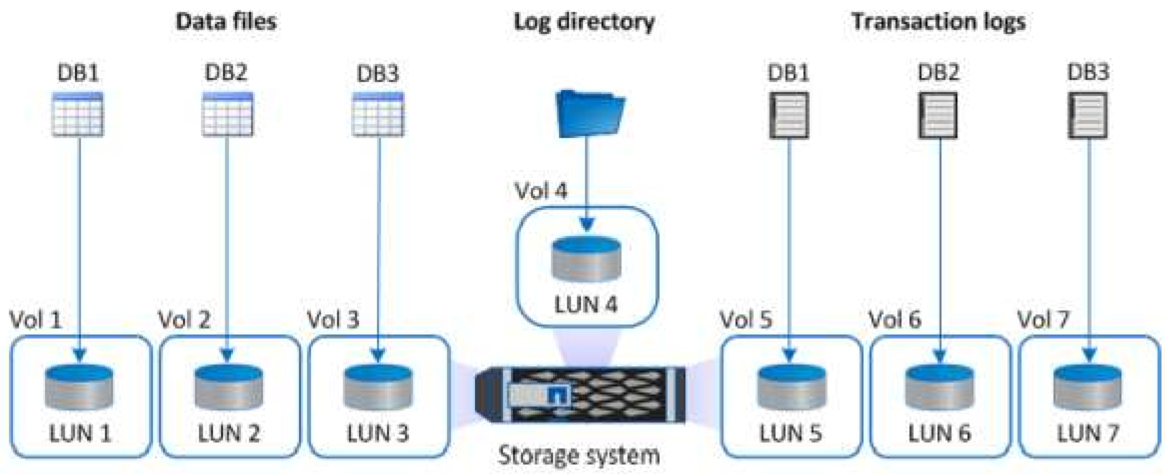
- **Single instance or HA deployment.** HA deployment provides redundancy in the case of a single SnapCenter instance server failure.
- **Name resolution.** DNS must be configured on the SnapCenter server to resolve all database hosts as well as on the storage SVM for forward and reverse lookup. DNS must also be configured on database servers to resolve the SnapCenter server and the storage SVM for both forward and reverse lookup.
- **Role-based access control (RBAC) configuration.** For mixed database workloads, you might want to use RBAC to segregate management responsibility for different DB platform such as an admin for Oracle database or an admin for SQL Server. Necessary permissions must be granted for the DB admin user.
- **Enable policy-based backup strategy.** To enforce backup consistency and reliability.
- **Open necessary network ports on the firewall.** For the on-premises SnapCenter server to communicate with agents installed in the cloud DB host.
- **Ports must be open to allow SnapMirror traffic between on-prem and public cloud.** The SnapCenter server relies on ONTAP SnapMirror to replicate onsite Snapshot backups to cloud CVO storage SVMs.

After careful pre-installation planning and consideration, click this SnapCenter installation workflow for details of SnapCenter installation and configuration.

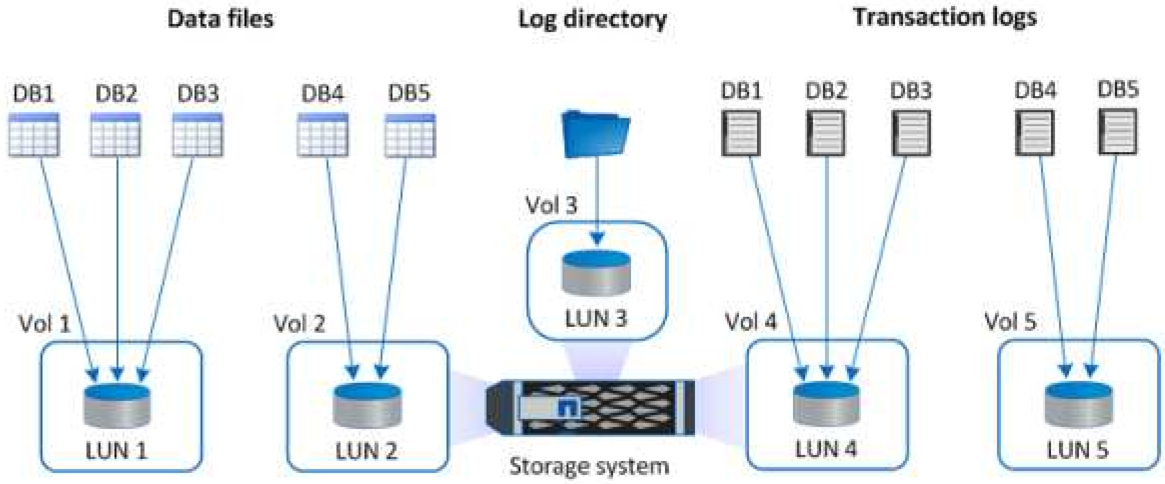
On-premises database server storage configuration

Storage performance plays an important role in the overall performance of databases and applications. A well-designed storage layout can not only improve DB performance but also make it easy to manage database backup and recovery. Several factors should be considered when defining your storage layout, including the size of the database, the rate of expected data change for the database, and the frequency with which you perform backups.

Directly attaching storage LUNs to the guest VM by either NFS or iSCSI for virtualized database workloads generally provides better performance than storage allocated via VMDK. NetApp recommends the storage layout for a large SQL Server database on LUNs depicted in the following figure.

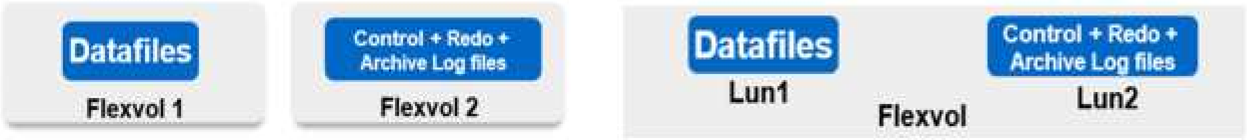


The following figure shows the NetApp recommended storage layout for small or medium SQL Server database on LUNs.

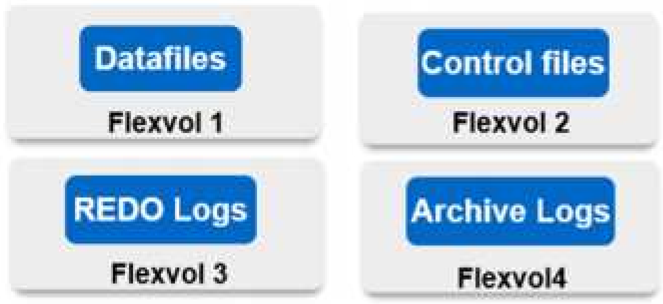


The Log directory is dedicated to SnapCenter to perform transaction log rollup for database recovery. For an extra large database, multiple LUNs can be allocated to a volume for better performance.

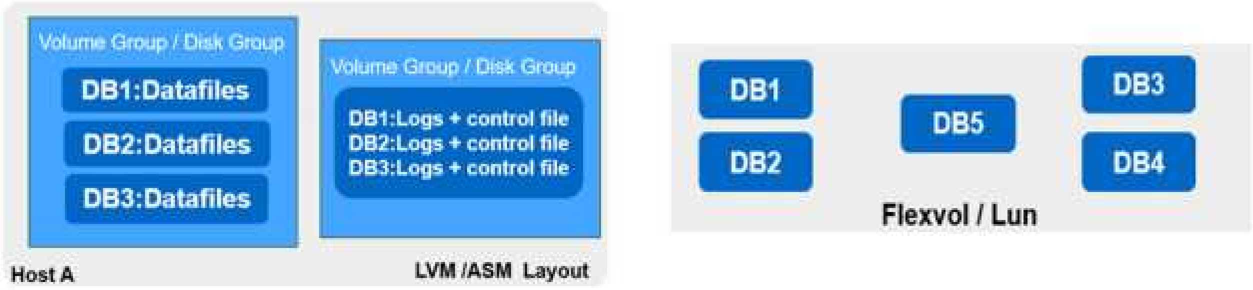
For Oracle database workloads, SnapCenter supports database environments backed by ONTAP storage that are mounted to the host as either physical or virtual devices. You can host the entire database on a single or multiple storage devices based on the criticality of the environment. Typically, customers isolate data files on dedicated storage from all other files such as control files, redo files, and archive log files. This helps administrators to quickly restore (ONTAP single-file SnapRestore) or clone a large critical database (petabyte scale) using Snapshot technology within few seconds to minutes.


Datafiles
Flexvol 1
Control + Redo + Archive Log files
Flexvol 2
Datafiles
Lun1
Flexvol
Control + Redo + Archive Log files
Lun2

For mission critical workloads that are sensitive to latency, a dedicated storage volume should be deployed to different types of Oracle files to achieve the best latency possible. For a large database, multiple LUNs (NetApp recommends up to eight) per volume should be allocated to data files.



For smaller Oracle databases, SnapCenter supports shared storage layouts in which you can host multiple databases or part of a database on the same storage volume or LUN. As an example of this layout, you can host data files for all the databases on a +DATA ASM disk group or a volume group. The remainder of the files (redo, archive log, and control files) can be hosted on another dedicated disk group or volume group (LVM). Such a deployment scenario is illustrated below.



To facilitate the relocation of Oracle databases, the Oracle binary should be installed on a separate LUN that is included in the regular backup policy. This ensures that in the case of database relocation to a new server host, the Oracle stack can be started for recovery without any potential issues due to an out-of-sync Oracle binary.

Licensing requirements

SnapCenter is licensed software from NetApp. It is generally included in an on-premises ONTAP license. However, for hybrid cloud deployment, a cloud license for SnapCenter is also required to add CVO to SnapCenter as a target data replication destination. Please review following links for SnapCenter standard capacity-based license for details:

SnapCenter standard capacity-based licenses

Networking and security

In a hybrid database operation that requires an on-premises production database that is burstable to cloud for dev/test and disaster recovery, networking and security is important factor to consider when setting up the environment and connecting to the public cloud from an on-premises data center.

Public clouds typically use a virtual private cloud (VPC) to isolate different users within a public-cloud platform. Within an individual VPC, security is controlled using measures such as security groups that are configurable based on user needs for the lockdown of a VPC.

The connectivity from the on-premises data center to the VPC can be secured through a VPN tunnel. On the VPN gateway, security can be hardened using NAT and firewall rules that block attempts to establish network connections from hosts on the internet to hosts inside the corporate data center.

For networking and security considerations, review the relevant inbound and outbound CVO rules for your public cloud of choice:

- Security group rules for CVO - AWS
- Security group rules for CVO - Azure
- Firewall rules for CVO - GCP

Using Ansible automation to sync DB instances between on-premises and the cloud - optional

To simplify management of a hybrid-cloud database environment, NetApp highly recommends but does not require that you deploy an Ansible controller to automate some management tasks, such as keeping compute instances on-premises and in the cloud in sync. This is particular important because an out-of-sync compute instance in the cloud might render the recovered database in the cloud error prone because of missing kernel packages and other issues.

The automation capability of an Ansible controller can also be used to augment SnapCenter for certain tasks, such as breaking up the SnapMirror instance to activate the DR data copy for production.

Follow these instruction to set up your Ansible control node for RedHat or CentOS machines: include::_include/automation_rhel_centos_setup.adoc[]

Follow these instruction to set up your Ansible control node for Ubuntu or Debian machines: include::_include/automation_ubuntu_debian_setup.adoc[]

Prerequisites for the public cloud

Before we install the Cloud Manager connector and Cloud Volumes ONTAP and configure SnapMirror, we must perform some preparation for our cloud environment. This page describes the work that needs to be done as well as the considerations when deploying Cloud Volumes ONTAP.

Cloud Manager and Cloud Volumes ONTAP deployment prerequisites checklist

□ A NetApp Cloud Central login

□ Network access from a web browser to several endpoints

□ A network location for a Connector

□ Cloud provider permissions

□ Networking for individual services

For more information about what you need to get started, visit our cloud documentation.

Considerations

1. What is a Cloud Manager connector?

In most cases, a Cloud Central account admin must deploy a connector in your cloud or on-premises network. The connector enables Cloud Manager to manage resources and processes within your public cloud environment.

For more information about Connectors, visit our cloud documentation.

2. Cloud Volumes ONTAP sizing and architecture

When deploying Cloud Volumes ONTAP, you are given the choice of either a predefined package or the creation of your own configuration. Although many of these values can be changed later on nondisruptively, there are some key decisions that need to be made before deployment based on the workloads to be deployed in the cloud.

Each cloud provider has different options for deployment and almost every workload has its own unique properties. NetApp has a CVO sizing tool that can help size deployments correctly based on capacity and performance, but it has been built around some basic concepts which are worth considering:

- Capacity required
- Network capability of the cloud virtual machine
- Performance characteristics of cloud storage

The key is to plan for a configuration that not only satisfies the current capacity and performance requirements, but also looks at future growth. This is generally known as capacity headroom and performance headroom.

If you would like further information, read the documentation about planning correctly for AWS, Azure, and GCP.

3. Single node or high availability?

In all clouds, there is the option to deploy CVO in either a single node or in a clustered high availability pair with two nodes. Depending on the use case, you might wish to deploy a single node to save costs or an HA pair to provide further availability and redundancy.

For a DR use case or spinning up temporary storage for development and testing, single nodes are common since the impact of a sudden zonal or infrastructure outage is lower. However, for any production use case, when the data is in only a single location, or when the dataset must have more redundancy and availability, high availability is recommended.

For further information about the architecture of each cloud's version of high availability, visit the documentation for AWS, Azure and GCP.

Getting started overview

This section provides a summary of the tasks that must be completed to meet the prerequisite requirements as outlined in previous section. The following section provide a high level tasks list for both on-premises and public cloud operations. The detailed processes and procedures can be accessed by clicking on the relevant links.

On-premises

- Setup database admin user in SnapCenter
- SnapCenter plugin installation prerequisites
- SnapCenter host plugin installation
- DB resource discovery
- Setup storage cluster peering and DB volume replication
- Add CVO database storage SVM to SnapCenter

- Setup database backup policy in SnapCenter
- Implement backup policy to protect database
- Validate backup

AWS public cloud

- Pre-flight check
- Steps to deploy Cloud Manager and Cloud Volumes ONTAP in AWS
- Deploy EC2 compute instance for database workload

Click the following links for details:

On Premises, Public Cloud - AWS

Getting started on premises

The NetApp SnapCenter tool uses role based access control (RBAC) to manage user resources access and permission grants, and SnapCenter installation creates prepopulated roles. You can also create custom roles based on your needs or applications.

On Premises

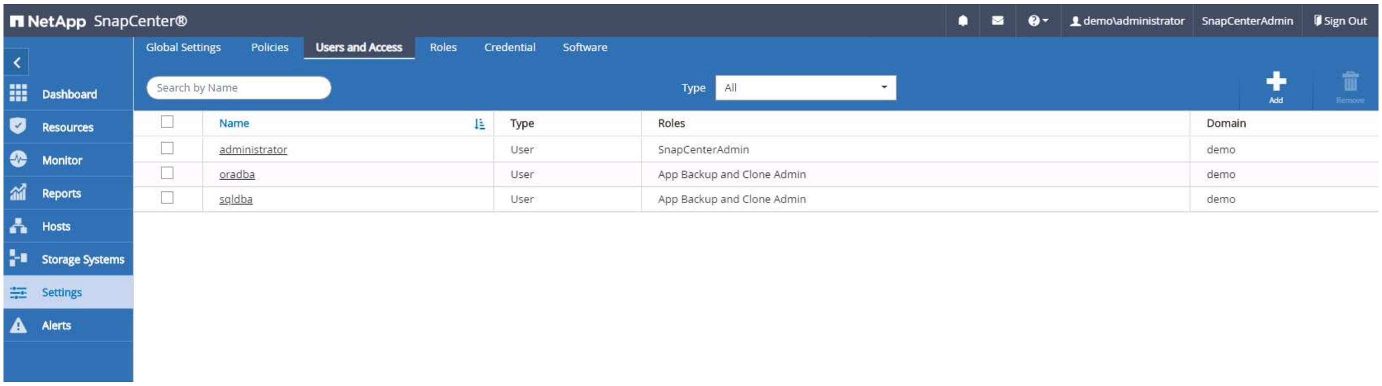
1. Setup database admin user in SnapCenter

It makes sense to have a dedicated admin user ID for each database platform supported by SnapCenter for database backup, restoration, and/or disaster recovery. You can also use a single ID to manage all databases. In our test cases and demonstration, we created a dedicated admin user for both Oracle and SQL Server, respectively.

Certain SnapCenter resources can only be provisioned with the SnapCenterAdmin role. Resources can then be assigned to other user IDs for access.

In a pre-installed and configured on-premises SnapCenter environment, the following tasks might have already have been completed. If not, the following steps create a database admin user:

1. Add the admin user to Windows Active Directory.
2. Log into SnapCenter using an ID granted with the SnapCenterAdmin role.
3. Navigate to the Access tab under Settings and Users, and click Add to add a new user. The new user ID is linked to the admin user created in Windows Active Directory in step 1. . Assign the proper role to the user as needed. Assign resources to the admin user as applicable.



	Name	Type	Roles	Domain
□	administrator	User	SnapCenterAdmin	demo
□	oradba	User	App Backup and Clone Admin	demo
□	sqldba	User	App Backup and Clone Admin	demo

2. SnapCenter plugin installation prerequisites

SnapCenter performs backup, restore, clone, and other functions by using a plugin agent running on the DB hosts. It connects to the database host and database via credentials configured under the Setting and Credentials tab for plugin installation and other management functions. There are specific privilege requirements based on the target host type, such as Linux or Windows, as well as the type of database.

DB hosts credentials must be configured before SnapCenter plugin installation. Generally, you want to use an administrator user accounts on the DB host as your host connection credentials for plugin installation. You can also grant the same user ID for database access using OS-based authentication. On the other hand, you can also employ database authentication with different database user IDs for DB management access. If you decide to use OS-based authentication, the OS admin user ID must be granted DB access. For Windows domain-based SQL Server installation, a domain admin account can be used to manage all SQL Servers within the domain.

Windows host for SQL server:

1. If you are using Windows credentials for authentication, you must set up your credential before installing plugins.
2. If you are using a SQL Server instance for authentication, you must add the credentials after installing plugins.
3. If you have enabled SQL authentication while setting up the credentials, the discovered instance or database is shown with a red lock icon. If the lock icon appears, you must specify the instance or database credentials to successfully add the instance or database to a resource group.
4. You must assign the credential to a RBAC user without sysadmin access when the following conditions are met:
    - The credential is assigned to a SQL instance.
    - The SQL instance or host is assigned to an RBAC user.
    - The RBAC DB admin user must have both the resource group and backup privileges.

Unix host for Oracle:

1. You must have enabled the password-based SSH connection for the root or non-root user by editing sshd.conf and restarting the sshd service. Password-based SSH authentication on AWS instance is turned off by default.
2. Configure the sudo privileges for the non-root user to install and start the plugin process. After installing the plugin, the processes run as an effective root user.
3. Create credentials with the Linux authentication mode for the install user.

4. You must install Java 1.8.x (64-bit) on your Linux host.
5. Installation of the Oracle database plugin also installs the SnapCenter plugin for Unix.

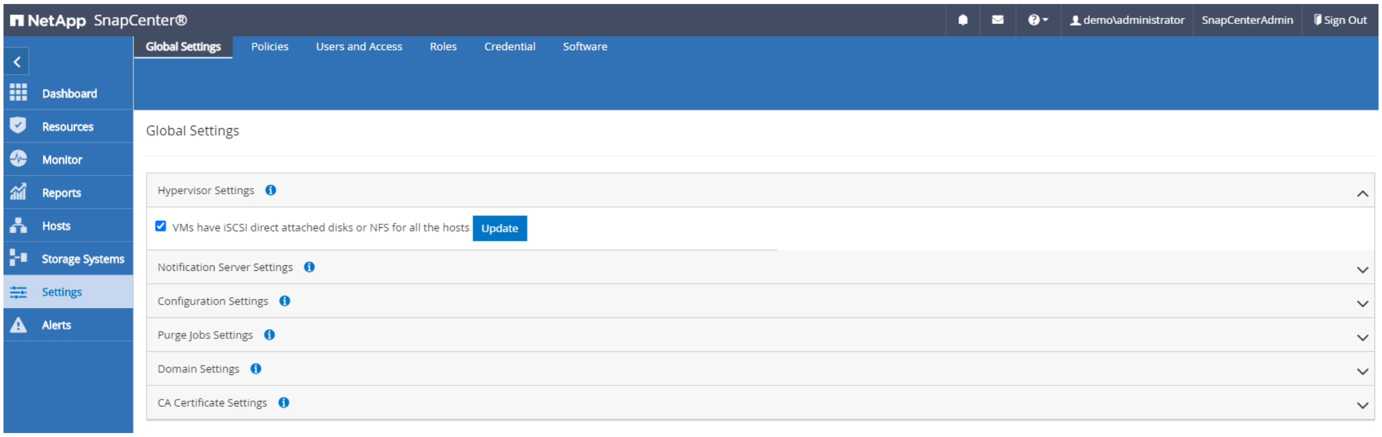
3. SnapCenter host plugin installation

> Before attempting to install SnapCenter plugins on cloud DB server instances, make sure that all configuration steps have been completed as listed in the relevant cloud section for compute instance deployment.

The following steps illustrate how a database host is added to SnapCenter while a SnapCenter plugin is installed on the host. The procedure applies to adding both on-premises hosts and cloud hosts. The following demonstration adds a Windows or a Linux host residing in AWS.

Configure SnapCenter VMware global settings

Navigate to Settings > Global Settings. Select "VMs have iSCSI direct attached disks or NFS for all the hosts" under Hypervisor Settings and click Update.



Global Settings

Hypervisor Settings

☑ VMs have iSCSI direct attached disks or NFS for all the hosts [Update]

Notification Server Settings

Configuration Settings

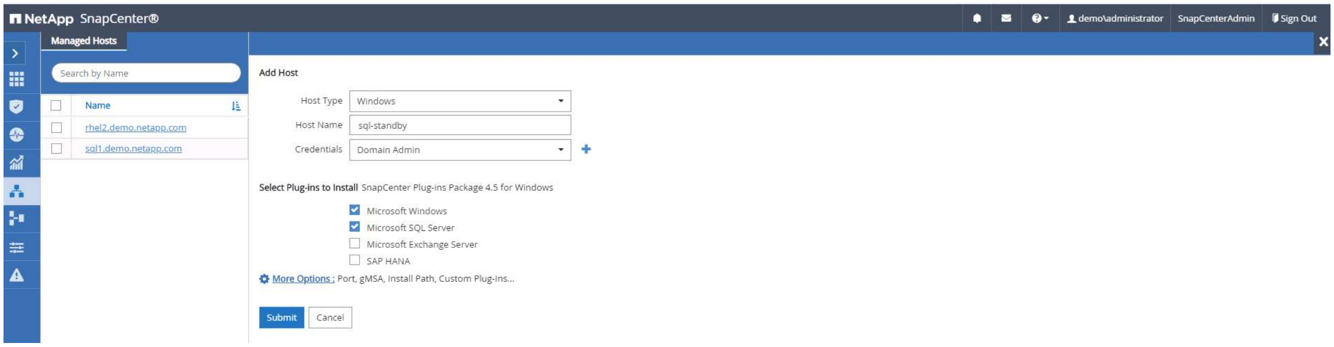
Purge Jobs Settings

Domain Settings

CA Certificate Settings

Add Windows host and installation of plugin on the host

1. Log into SnapCenter with a user ID with SnapCenterAdmin privileges.
2. Click the Hosts tab from the left-hand menu, and then click Add to open the Add Host workflow.
3. Choose Windows for Host Type; the Host Name can be either a host name or an IP address. The host name must be resolved to the correct host IP address from the SnapCenter host. Choose the host credentials created in step 2. Choose Microsoft Windows and Microsoft SQL Server as the plugin packages to be installed.



□	Name
□	rhel2.demo.netapp.com
□	sql1.demo.netapp.com

Add Host

Host Type: Windows

Host Name: sql-standby

Credentials: Domain Admin

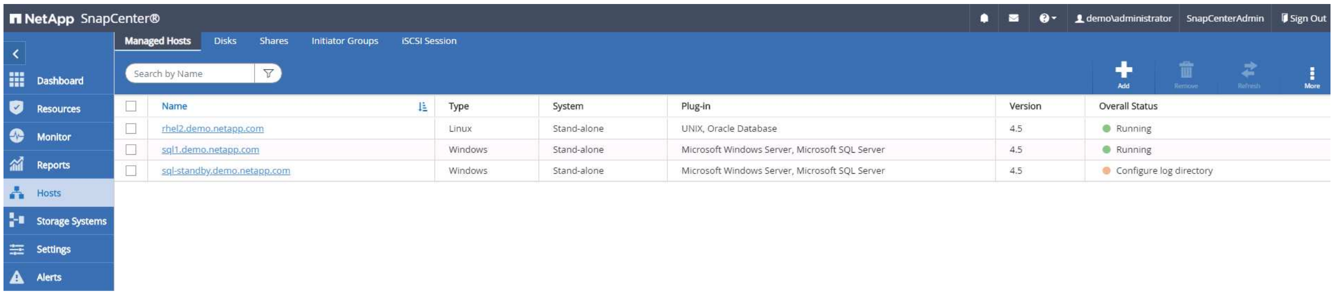
Select Plug-ins to Install SnapCenter Plug-ins Package 4.5 for Windows

☑ Microsoft Windows
☑ Microsoft SQL Server
□ Microsoft Exchange Server
□ SAP HANA

More Options : Port, gMSA, Install Path, Custom Plug-ins...

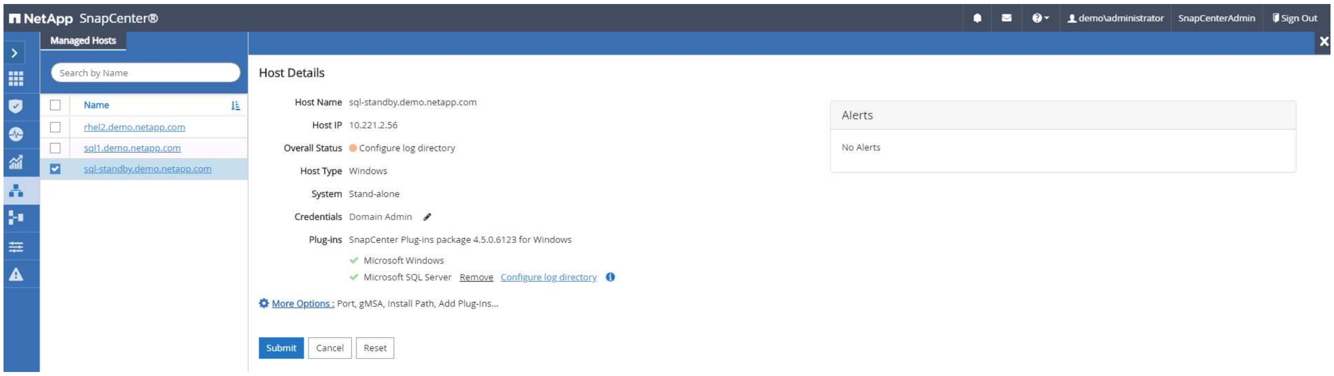
[Submit] [Cancel]

4. After the plugin is installed on a Windows host, its Overall Status is shown as "Configure log directory."



	Name	Type	System	Plug-in	Version	Overall Status
□	rhel2.demo.netapp.com	Linux	Stand-alone	UNIX, Oracle Database	4.5	● Running
□	sql1.demo.netapp.com	Windows	Stand-alone	Microsoft Windows Server, Microsoft SQL Server	4.5	● Running
□	sql-standby.demo.netapp.com	Windows	Stand-alone	Microsoft Windows Server, Microsoft SQL Server	4.5	● Configure log directory

5. Click the Host Name to open the SQL Server log directory configuration.

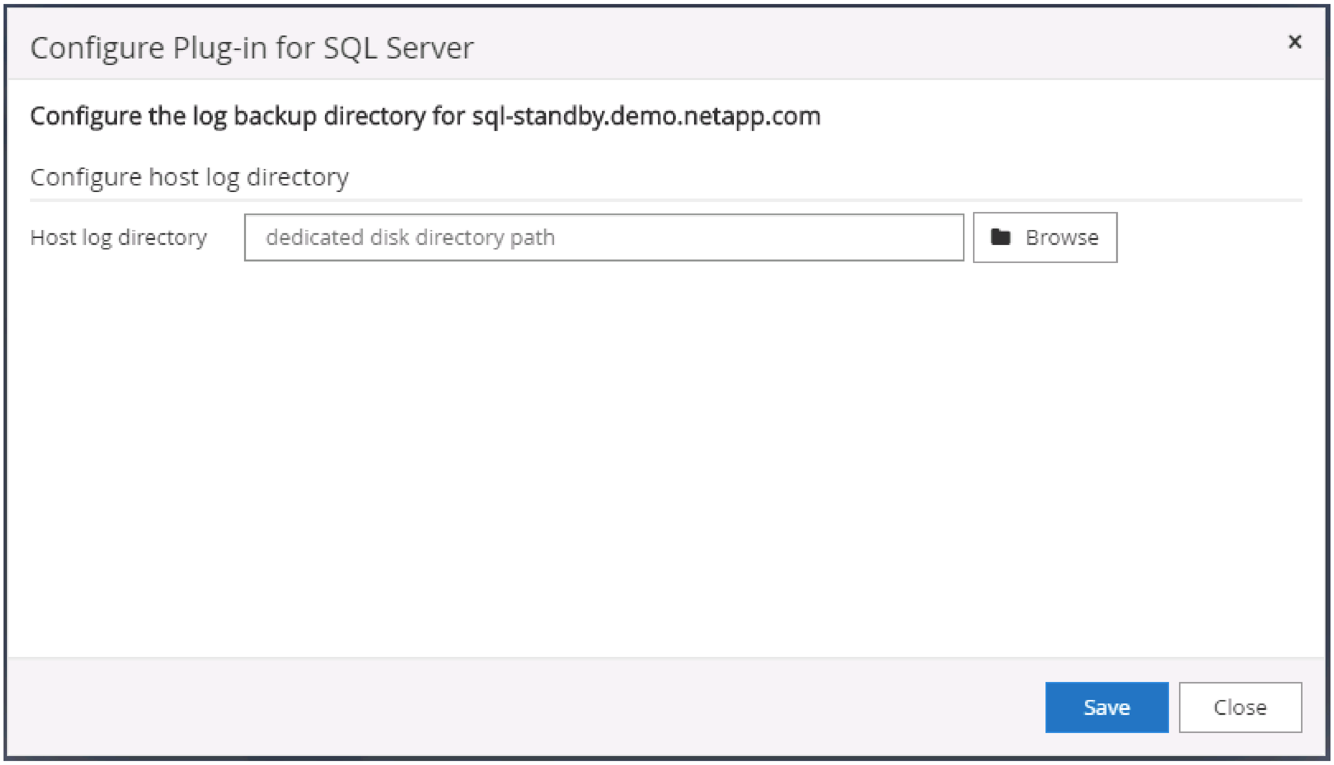


Host Details

Host Name sql-standby.demo.netapp.com
Host IP 10.221.2.56
Overall Status ● Configure log directory
Host Type Windows
System Stand-alone
Credentials Domain Admin
Plug-ins SnapCenter Plug-ins package 4.5.0.6123 for Windows
✓ Microsoft Windows
✓ Microsoft SQL Server Remove Configure log directory

More Options : Port, gMSA, Install Path, Add Plug-Ins...

6. Click "Configure log directory" to open "Configure Plug-in for SQL Server."



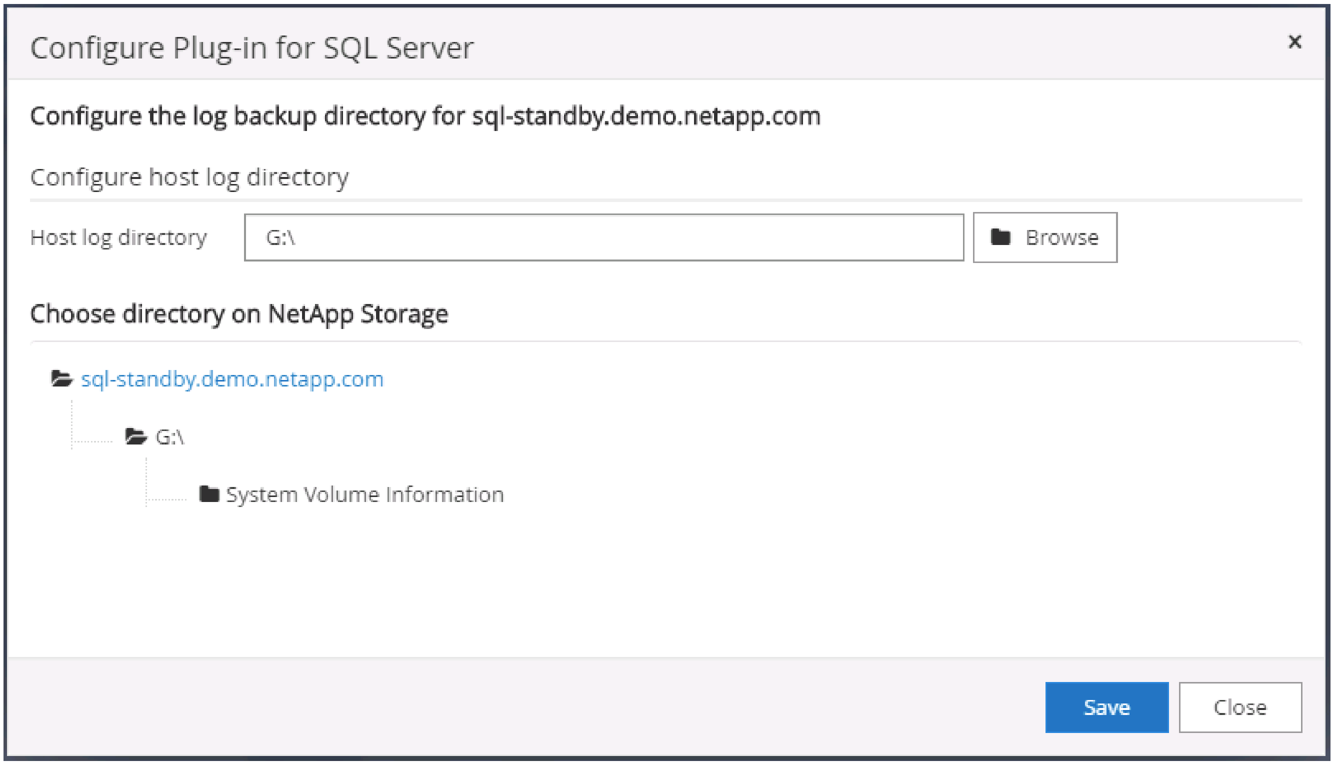
Configure Plug-in for SQL Server

Configure the log backup directory for sql-standby.demo.netapp.com

Configure host log directory

Host log directory: dedicated disk directory path

7. Click Browse to discover NetApp storage so that a log directory can be set; SnapCenter uses this log directory to roll up the SQL server transaction log files. Then click Save.



Configure Plug-in for SQL Server

Configure the log backup directory for sql-standby.demo.netapp.com

Configure host log directory

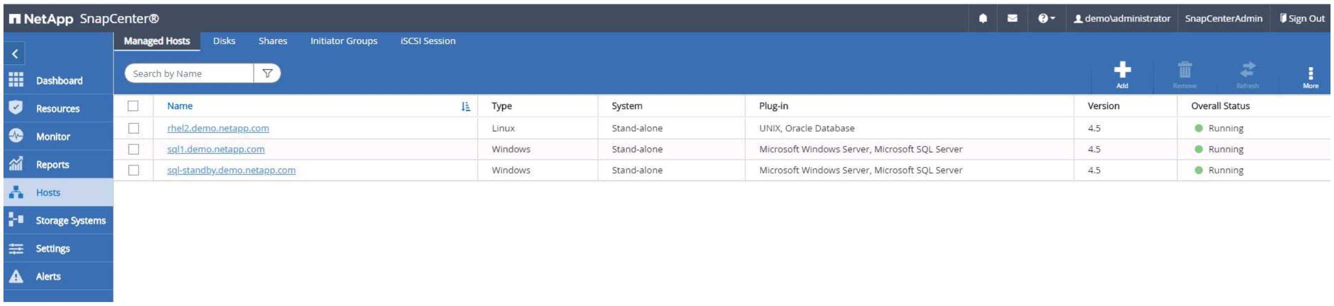
Host log directory: G:\

Choose directory on NetApp Storage

- sql-standby.demo.netapp.com
  - G:\
    - System Volume Information

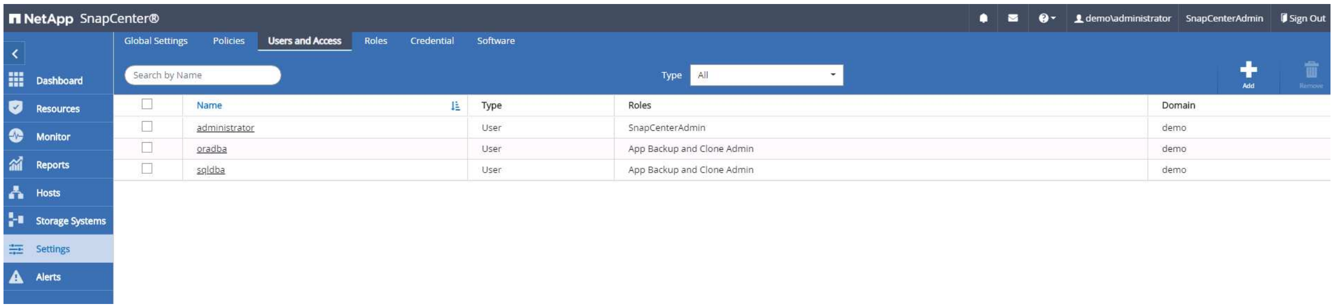
For NetApp storage provisioned to a DB host to be discovered, the storage (on-prem or CVO) must be added to SnapCenter, as illustrated in step 6 for CVO as an example.

8. After the log directory is configured, the Windows host plugin Overall Status is changed to Running.



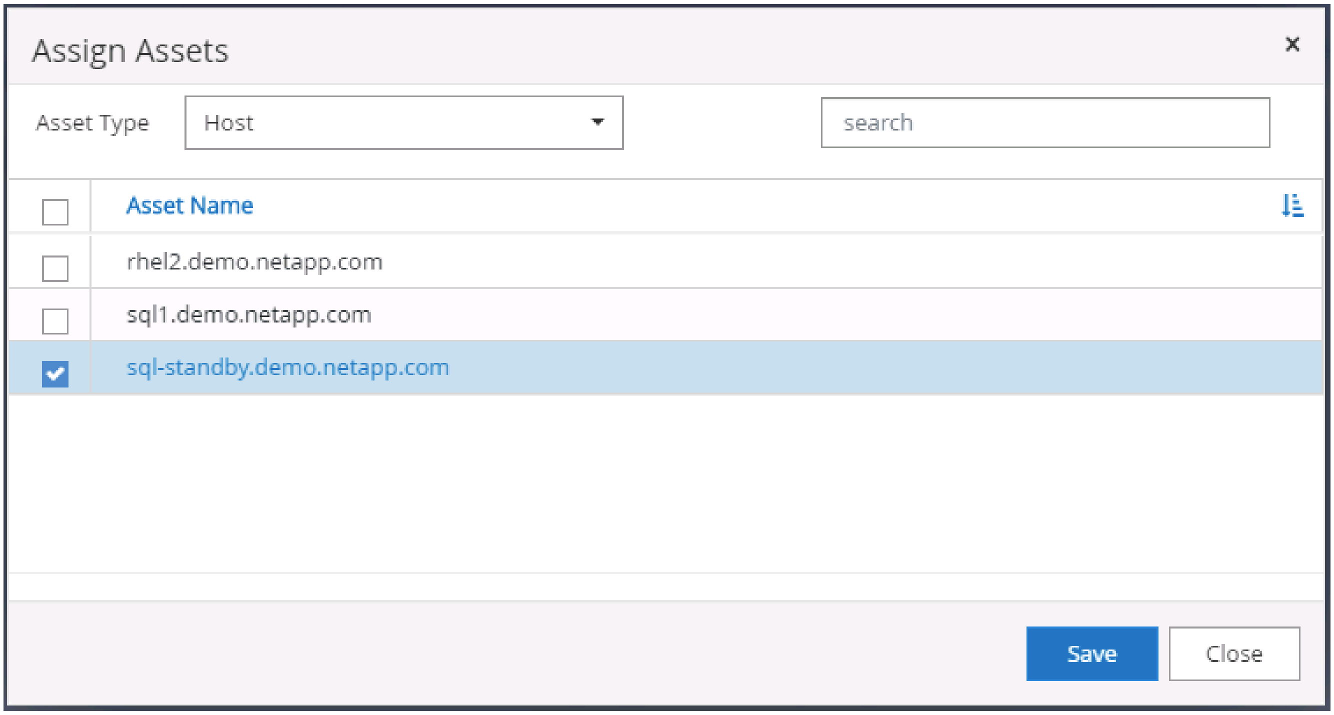
☐	Name	Type	System	Plug-in	Version	Overall Status
☐	rhel2.demo.netapp.com	Linux	Stand-alone	UNIX, Oracle Database	4.5	● Running
☐	sql1.demo.netapp.com	Windows	Stand-alone	Microsoft Windows Server, Microsoft SQL Server	4.5	● Running
☐	sql-standby.demo.netapp.com	Windows	Stand-alone	Microsoft Windows Server, Microsoft SQL Server	4.5	● Running

9. To assign the host to the database management user ID, navigate to the Access tab under Settings and Users, click the database management user ID (in our case the sqldba that the host needs to be assigned to), and click Save to complete host resource assignment.



Type: All

☐	Name	Type	Roles	Domain
☐	administrator	User	SnapCenterAdmin	demo
☐	oradba	User	App Backup and Clone Admin	demo
☐	sqldba	User	App Backup and Clone Admin	demo


Assign Assets

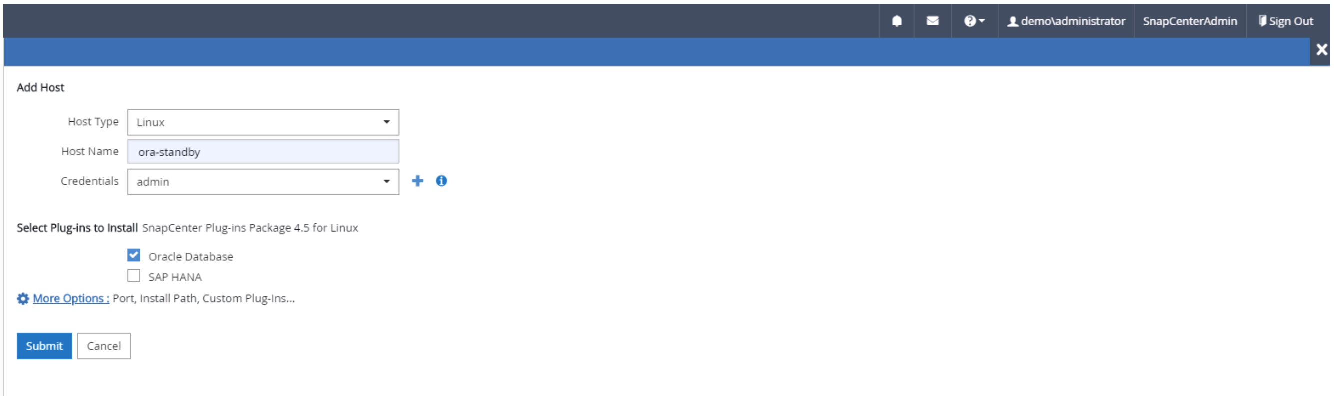
Asset Type: Host

search

□	Asset Name
□	rhel2.demo.netapp.com
□	sql1.demo.netapp.com
☑	sql-standby.demo.netapp.com

Add Unix host and installation of plugin on the host

1. Log into SnapCenter with a user ID with SnapCenterAdmin privileges.
2. Click the Hosts tab from left-hand menu, and click Add to open the Add Host workflow.
3. Choose Linux as the Host Type. The Host Name can be either the host name or an IP address. However, the host name must be resolved to correct host IP address from SnapCenter host. Choose host credentials created in step 2. The host credentials require sudo privileges. Check Oracle Database as the plug-in to be installed, which installs both Oracle and Linux host plugins.



Add Host

Host Type: Linux

Host Name: ora-standby

Credentials: admin

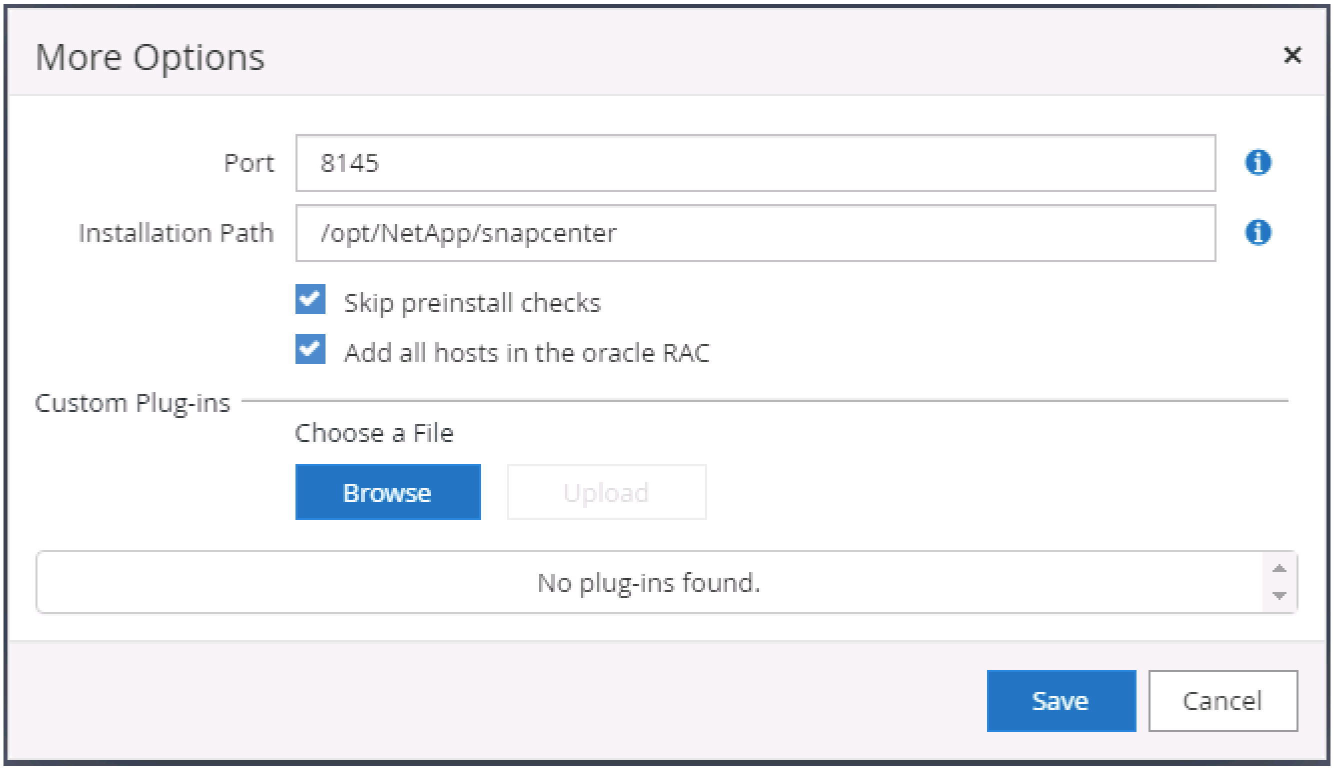
Select Plug-ins to Install SnapCenter Plug-ins Package 4.5 for Linux

☑ Oracle Database

□ SAP HANA

More Options : Port, Install Path, Custom Plug-ins...

4. Click More Options and select "Skip preinstall checks." You are prompted to confirm the skipping of the preinstall check. Click Yes and then Save.



Port: 8145

Installation Path: /opt/NetApp/snapcenter

☑ Skip preinstall checks

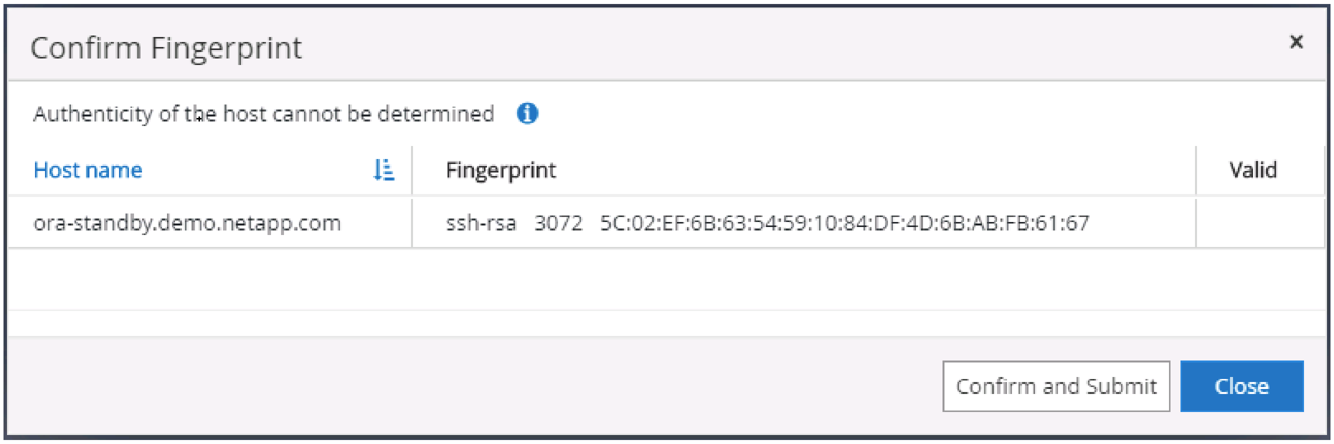
☑ Add all hosts in the oracle RAC

Custom Plug-ins

Choose a File

No plug-ins found.

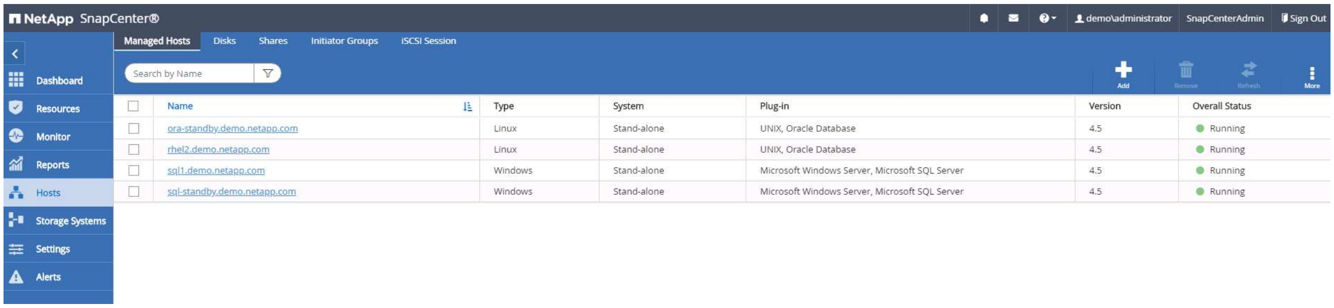
5. Click Submit to start the plugin installation. You are prompted to Confirm Fingerprint as shown below.



Authenticity of the host cannot be determined

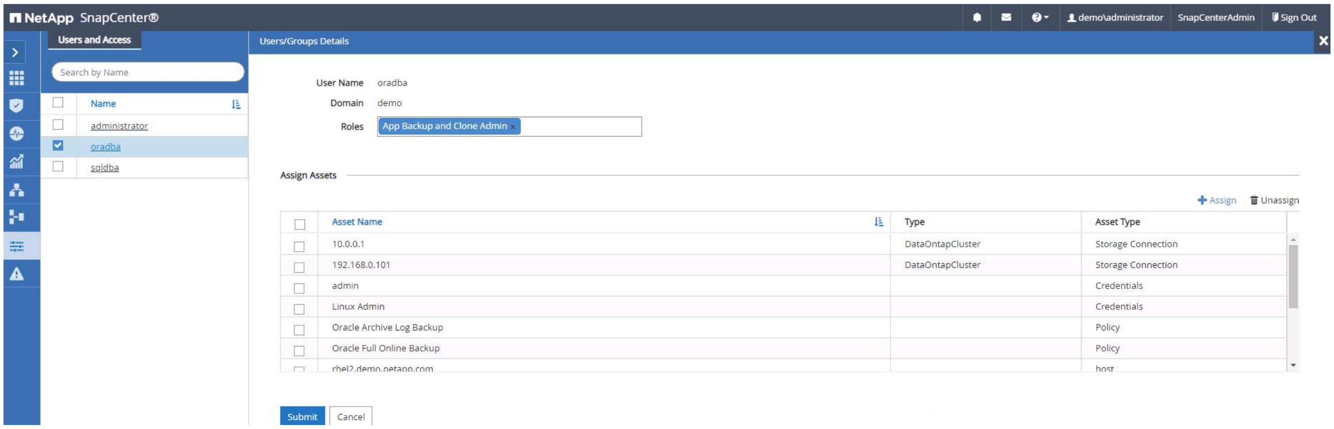
Host name	Fingerprint	Valid
ora-standby.demo.netapp.com	ssh-rsa 3072 5C:02:EF:6B:63:54:59:10:84:DF:4D:6B:AB:FB:61:67	

6. SnapCenter performs host validation and registration, and then the plugin is installed on the Linux host. The status is changed from Installing Plugin to Running.



□	Name	Type	System	Plug-in	Version	Overall Status
□	ora-standby.demo.netapp.com	Linux	Stand-alone	UNIX, Oracle Database	4.5	● Running
□	rhel2.demo.netapp.com	Linux	Stand-alone	UNIX, Oracle Database	4.5	● Running
□	sql1.demo.netapp.com	Windows	Stand-alone	Microsoft Windows Server, Microsoft SQL Server	4.5	● Running
□	sql-standby.demo.netapp.com	Windows	Stand-alone	Microsoft Windows Server, Microsoft SQL Server	4.5	● Running

7. Assign the newly added host to the proper database management user ID (in our case, oradba).



	Name
□	administrator
☑	oradba
□	sqldba

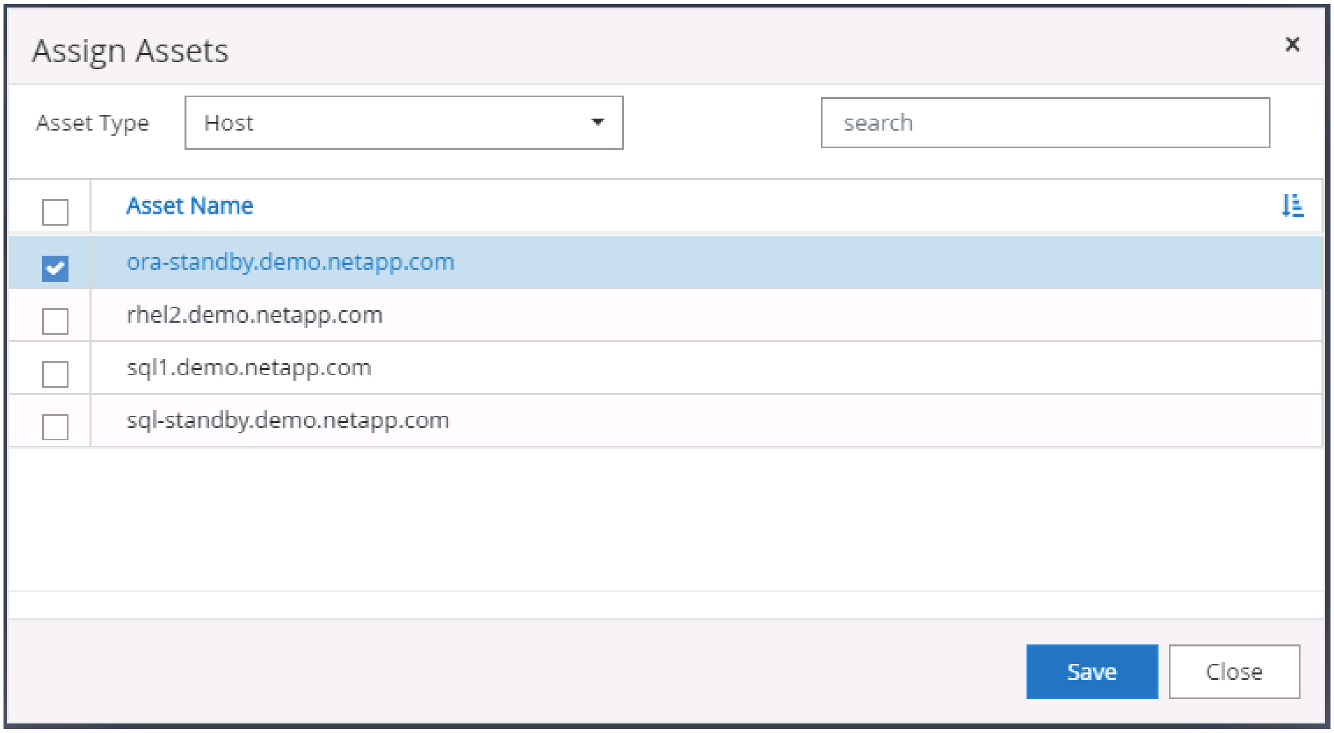
User Name oradba

Domain demo

Roles App Backup and Clone Admin

Assign Assets

□	Asset Name	Type	Asset Type
□	10.0.0.1	DataOntapCluster	Storage Connection
□	192.168.0.101	DataOntapCluster	Storage Connection
□	admin		Credentials
□	Linux Admin		Credentials
□	Oracle Archive Log Backup		Policy
□	Oracle Full Online Backup		Policy
□	rhel2.demo.netapp.com		host



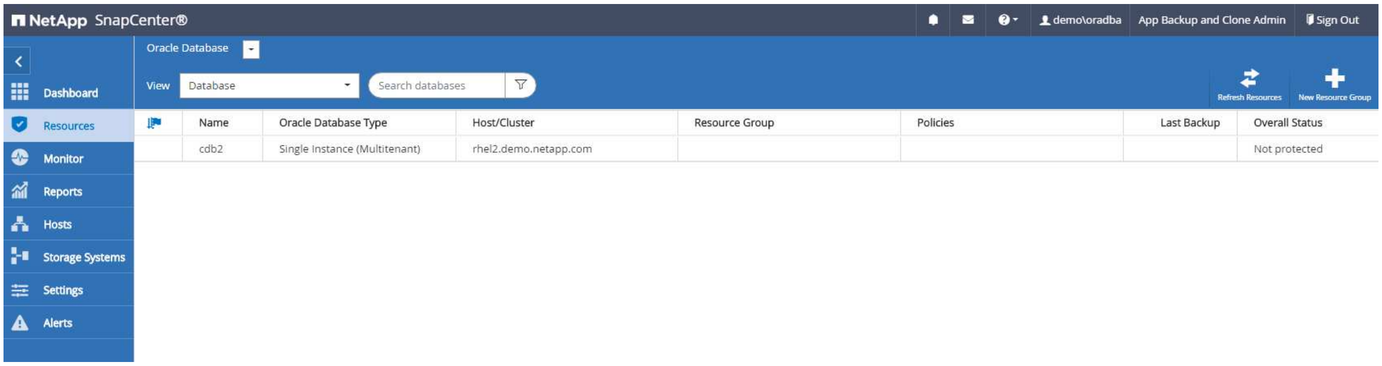
Asset Type Host

search

□	Asset Name
☑	ora-standby.demo.netapp.com
□	rhel2.demo.netapp.com
□	sql1.demo.netapp.com
□	sql-standby.demo.netapp.com

4. Database resource discovery

With successful plugin installation, the database resources on the host can be immediately discovered. Click the Resources tab in the left-hand menu. Depending on the type of database platform, a number of views are available, such as the database, resources group, and so on. You might need to click the Refresh Resources tab if the resources on the host are not discovered and displayed.

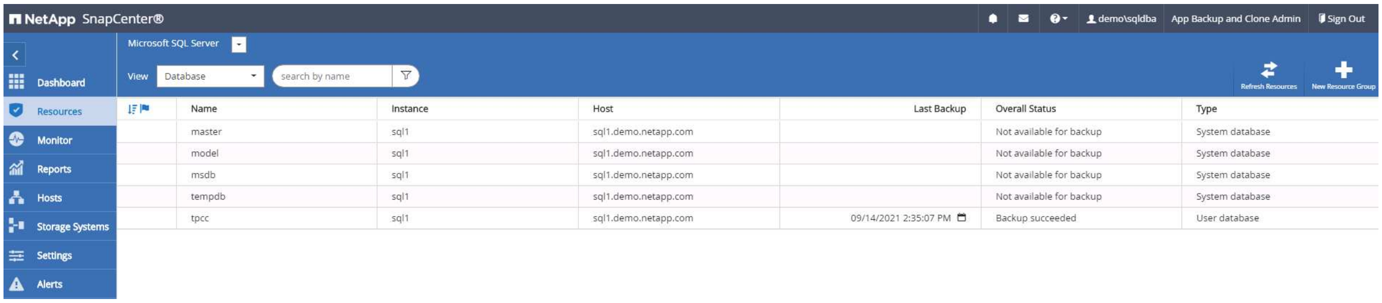


View Database

	Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status
	cdb2	Single Instance (Multitenant)	rhel2.demo.netapp.com				Not protected

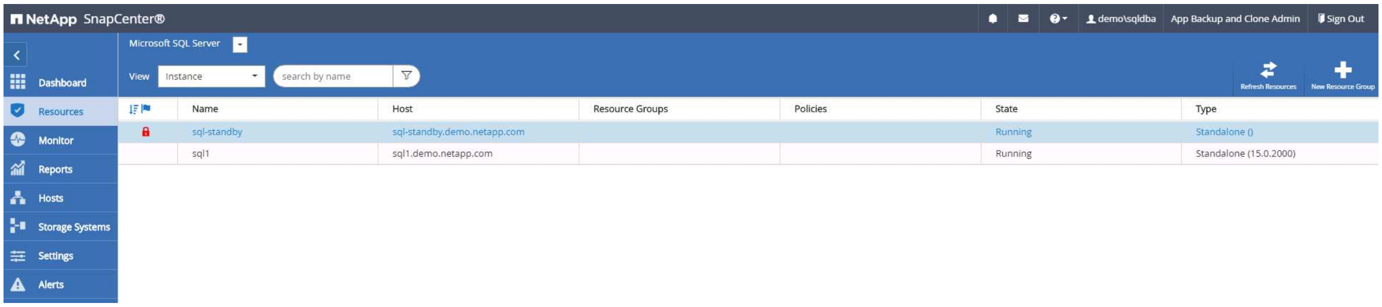
When the database is initially discovered, the Overall Status is shown as "Not protected." The previous screenshot shows an Oracle database not protected yet by a backup policy.

When a backup configuration or policy is set up and a backup has been executed, the Overall Status for the database shows the backup status as "Backup succeeded" and the timestamp of the last backup. The following screenshot shows the backup status of a SQL Server user database.

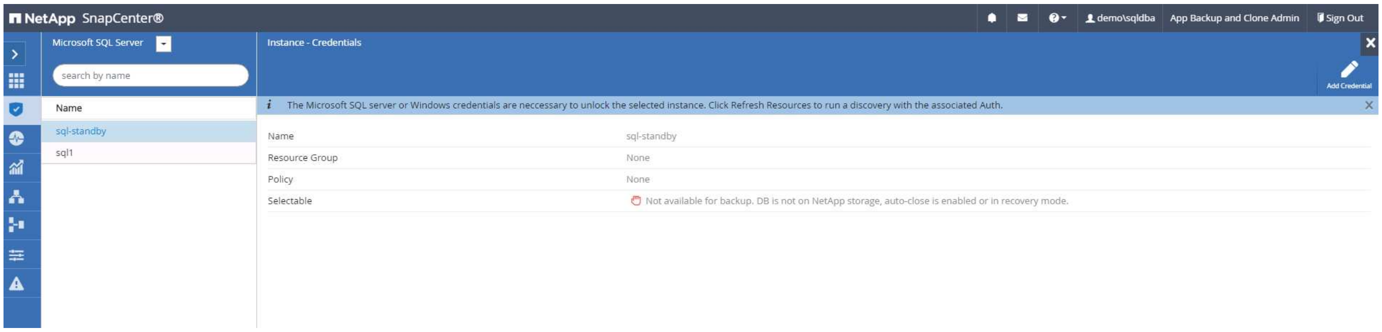


Name	Instance	Host	Last Backup	Overall Status	Type
master	sql1	sql1.demo.netapp.com		Not available for backup	System database
model	sql1	sql1.demo.netapp.com		Not available for backup	System database
msdb	sql1	sql1.demo.netapp.com		Not available for backup	System database
tempdb	sql1	sql1.demo.netapp.com		Not available for backup	System database
tpcc	sql1	sql1.demo.netapp.com	09/14/2021 2:35:07 PM	Backup succeeded	User database

If database access credentials are not properly set up, a red lock button indicates that the database is not accessible. For example, if Windows credentials do not have sysadmin access to a database instance, then database credentials must be reconfigured to unlock the red lock.



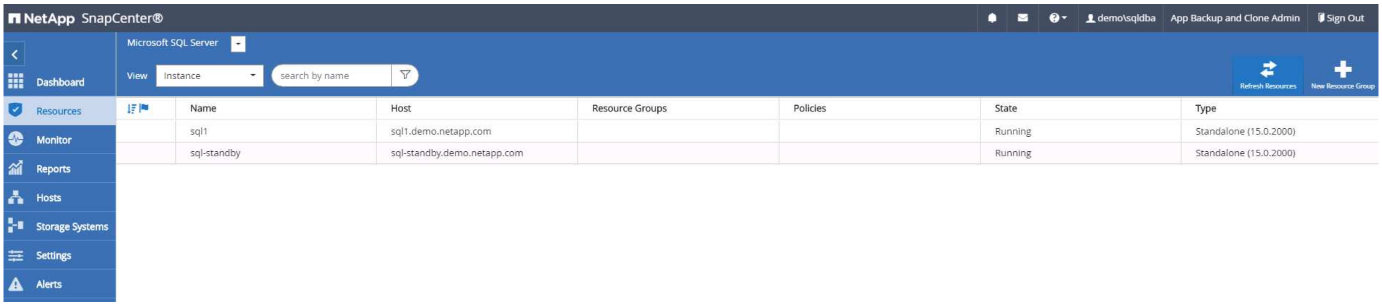
Name	Host	Resource Groups	Policies	State	Type
sql-standby	sql-standby.demo.netapp.com			Running	Standalone ()
sql1	sql1.demo.netapp.com			Running	Standalone (15.0.2000)



The Microsoft SQL server or Windows credentials are neccessary to unlock the selected instance. Click Refresh Resources to run a discovery with the associated Auth.

Name	sql-standby
Resource Group	None
Policy	None
Selectable	Not available for backup. DB is not on NetApp storage, auto-close is enabled or in recovery mode.

After the appropriate credentials are configured either at the Windows level or the database level, the red lock disappears and SQL Server Type information is gathered and reviewed.



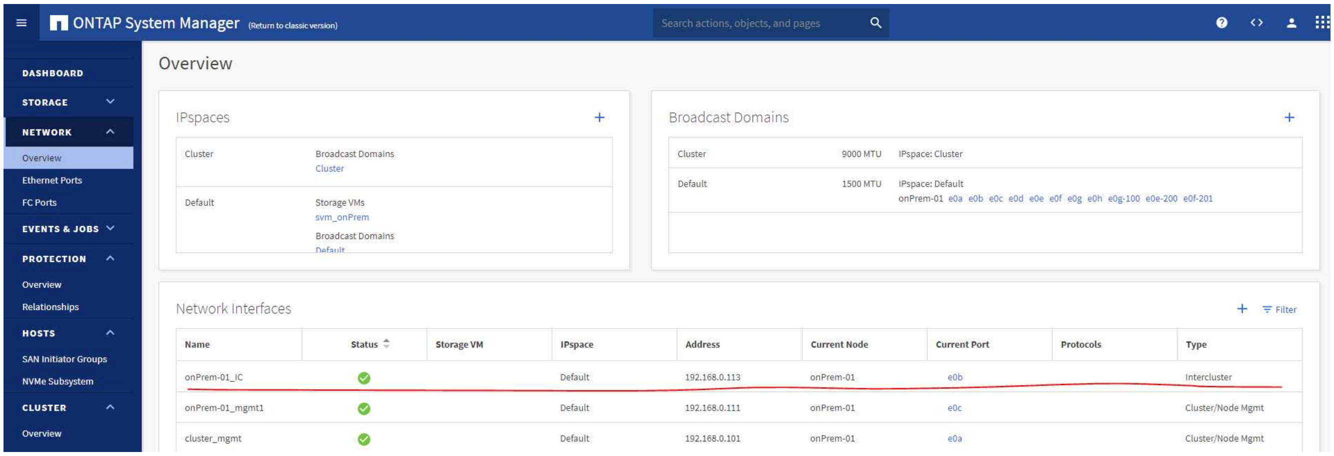
Name	Host	Resource Groups	Policies	State	Type
sql1	sql1.demo.netapp.com			Running	Standalone (15.0.2000)
sql-standby	sql-standby.demo.netapp.com			Running	Standalone (15.0.2000)

5. Setup storage cluster peering and DB volumes replication

To protect your on-premises database data using a public cloud as the target destination, on-premises ONTAP cluster database volumes are replicated to the cloud CVO using NetApp SnapMirror technology. The replicated target volumes can then be cloned for DEV/OPS or disaster recovery. The following high-level steps enable you to set up cluster peering and DB volumes replication.

1. Configure intercluster LIFs for cluster peering on both the on-premises cluster and the CVO cluster instance. This step can be performed with ONTAP System Manger. A default CVO deployment has inter-cluster LIFs configured automatically.

   On-premises cluster:



IPspaces

Cluster	Broadcast Domains Cluster
Default	Storage VMs svm_onPrem Broadcast Domains Default

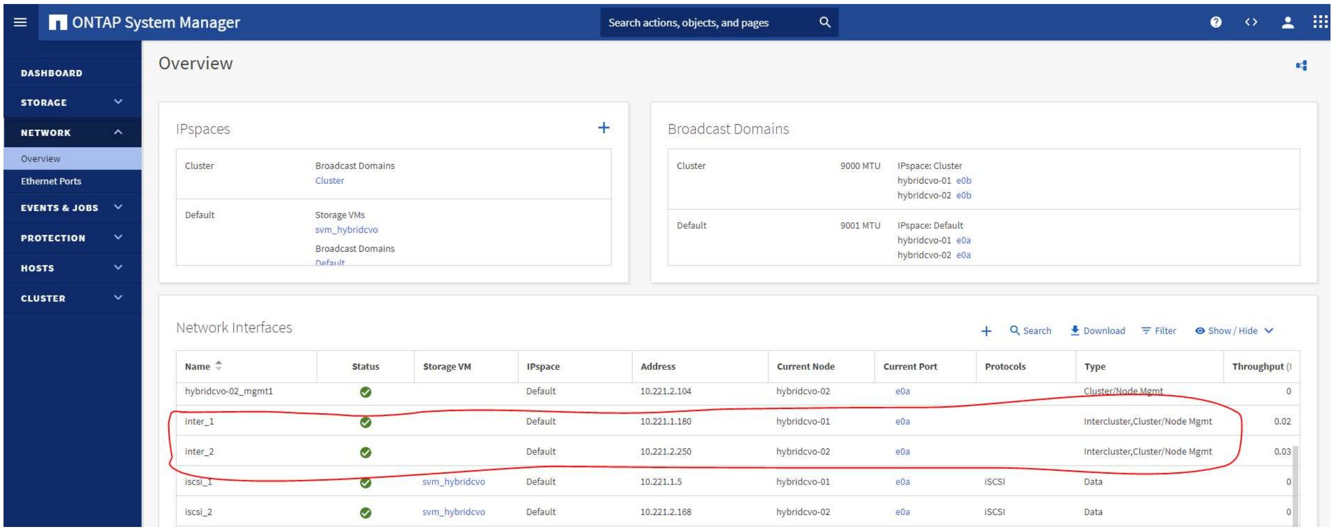
Broadcast Domains

Cluster	9000 MTU	IPspace: Cluster
Default	1500 MTU	IPspace: Default onPrem-01 e0a e0b e0c e0d e0e e0f e0g e0h e0g-100 e0e-200 e0f-201

Network Interfaces

Name	Status	Storage VM	IPspace	Address	Current Node	Current Port	Protocols	Type
onPrem-01_IC	✓		Default	192.168.0.113	onPrem-01	e0b		Intercluster
onPrem-01_mgmt1	✓		Default	192.168.0.111	onPrem-01	e0c		Cluster/Node Mgmt
cluster_mgmt	✓		Default	192.168.0.101	onPrem-01	e0a		Cluster/Node Mgmt

   Target CVO cluster:



IPspaces

Cluster	Broadcast Domains Cluster
Default	Storage VMs svm_hybridcvo Broadcast Domains Default

Broadcast Domains

Cluster	9000 MTU	IPspace: Cluster hybridcvo-01 e0b hybridcvo-02 e0b
Default	9001 MTU	IPspace: Default hybridcvo-01 e0a hybridcvo-02 e0a

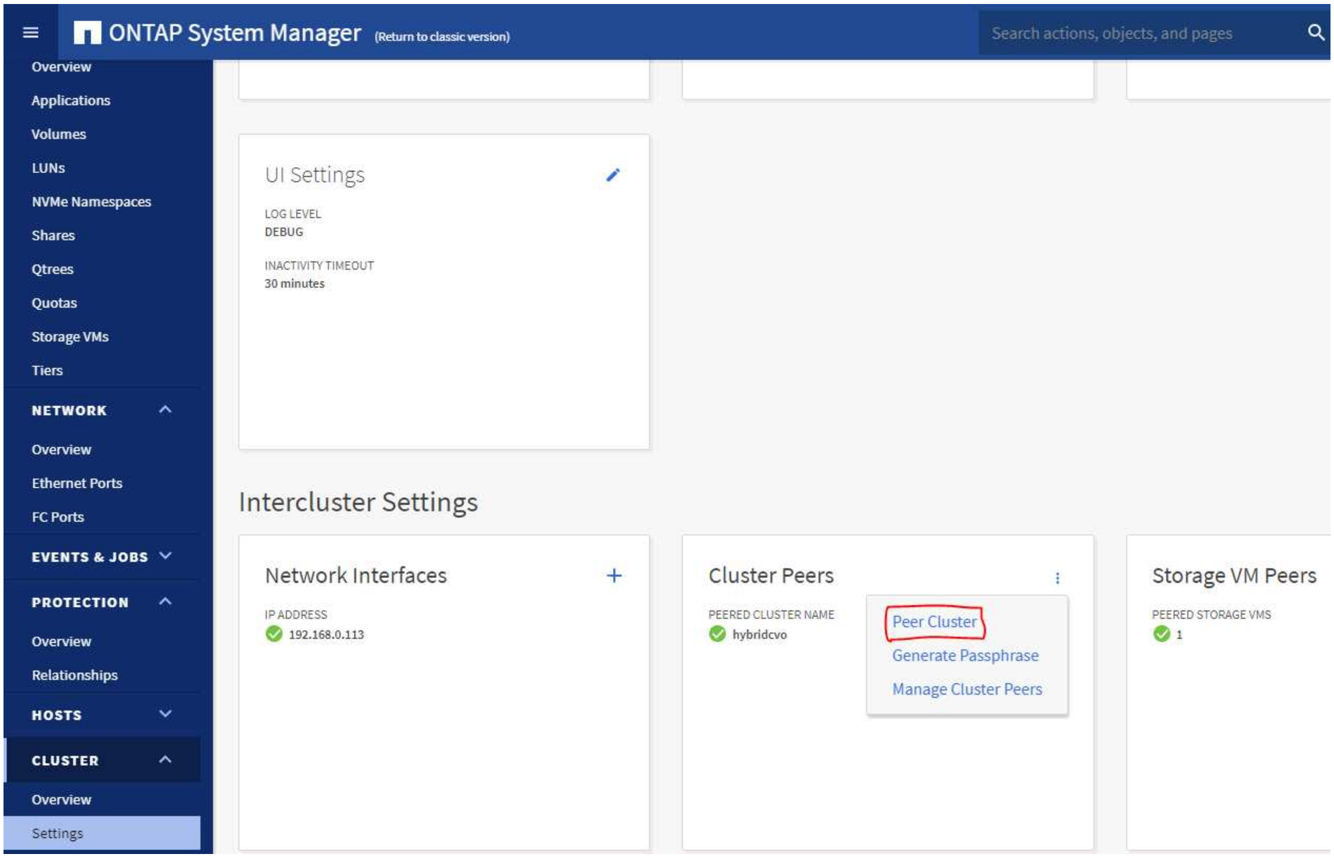
Network Interfaces

Name	Status	Storage VM	IPspace	Address	Current Node	Current Port	Protocols	Type	Throughput (I
hybridcvo-02_mgmt1	✓		Default	10.221.2.104	hybridcvo-02	e0a		Cluster/Node Mgmt	0
inter_1	✓		Default	10.221.1.180	hybridcvo-01	e0a		Intercluster,Cluster/Node Mgmt	0.02
inter_2	✓		Default	10.221.2.250	hybridcvo-02	e0a		Intercluster,Cluster/Node Mgmt	0.03
iscsi_1	✓	svm_hybridcvo	Default	10.221.1.5	hybridcvo-01	e0a	iSCSI	Data	0
iscsi_2	✓	svm_hybridcvo	Default	10.221.2.168	hybridcvo-02	e0a	iSCSI	Data	0

2. With the intercluster LIFs configured, cluster peering and volume replication can be set up by using drag-and-drop in NetApp Cloud Manager. See "Getting Started - AWS Public Cloud" for details.

   Alternatively, cluster peering and DB volume replication can be performed by using ONTAP System Manager as follows:

3. Log into ONTAP System Manager. Navigate to Cluster > Settings and click Peer Cluster to set up cluster peering with the CVO instance in the cloud.



UI Settings

LOG LEVEL
DEBUG

INACTIVITY TIMEOUT
30 minutes

Intercluster Settings

Network Interfaces

IP ADDRESS
✓ 192.168.0.113

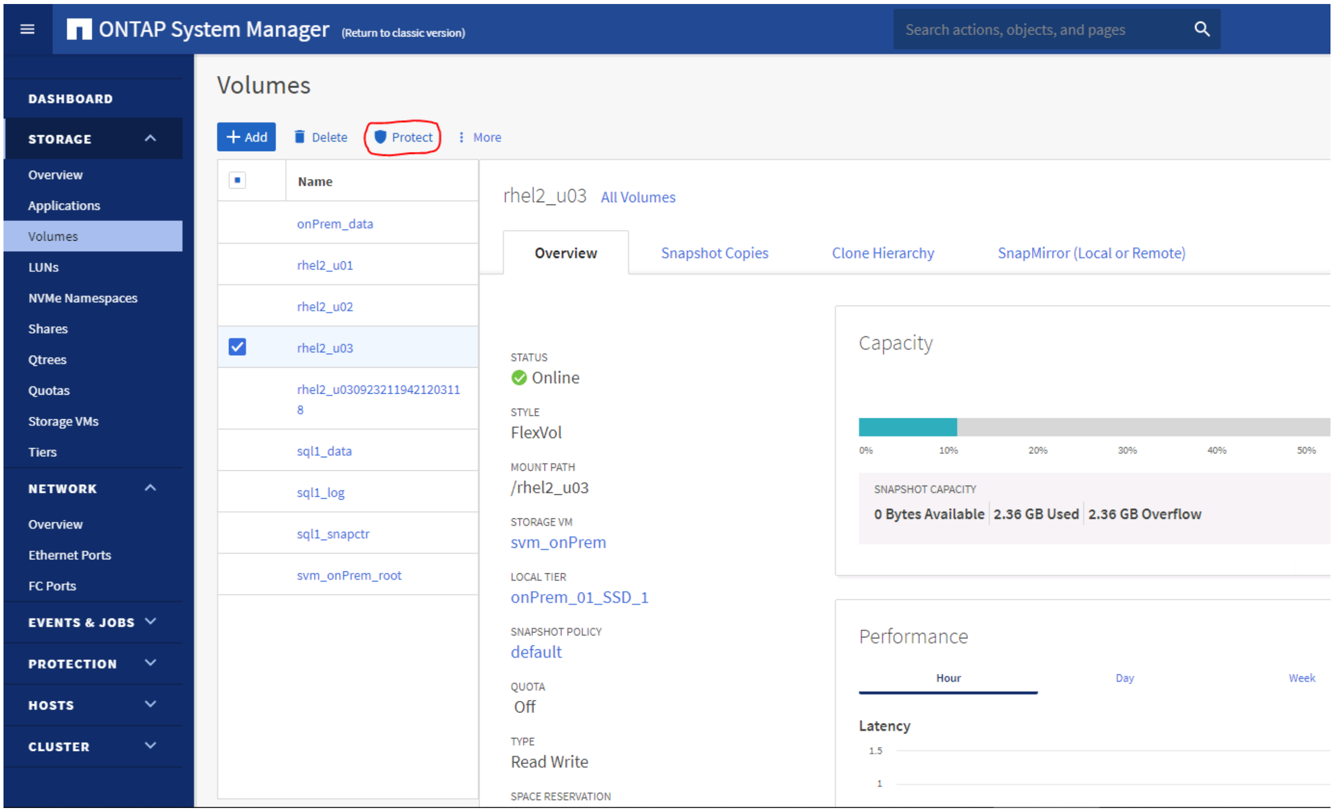
Cluster Peers

PEERED CLUSTER NAME
✓ hybridcvo

Storage VM Peers

PEERED STORAGE VMS
✓ 1

4. Go to the Volumes tab. Select the database volume to be replicated and click Protect.



Volumes

▪	Name
	onPrem_data
	rhel2_u01
	rhel2_u02
☑	rhel2_u03
	rhel2_u0309232119421203118
	sql1_data
	sql1_log
	sql1_snapctr
	svm_onPrem_root

rhel2_u03 All Volumes

STATUS
✓ Online

STYLE
FlexVol

MOUNT PATH
/rhel2_u03

STORAGE VM
svm_onPrem

LOCAL TIER
onPrem_01_SSD_1

SNAPSHOT POLICY
default

QUOTA
Off

TYPE
Read Write

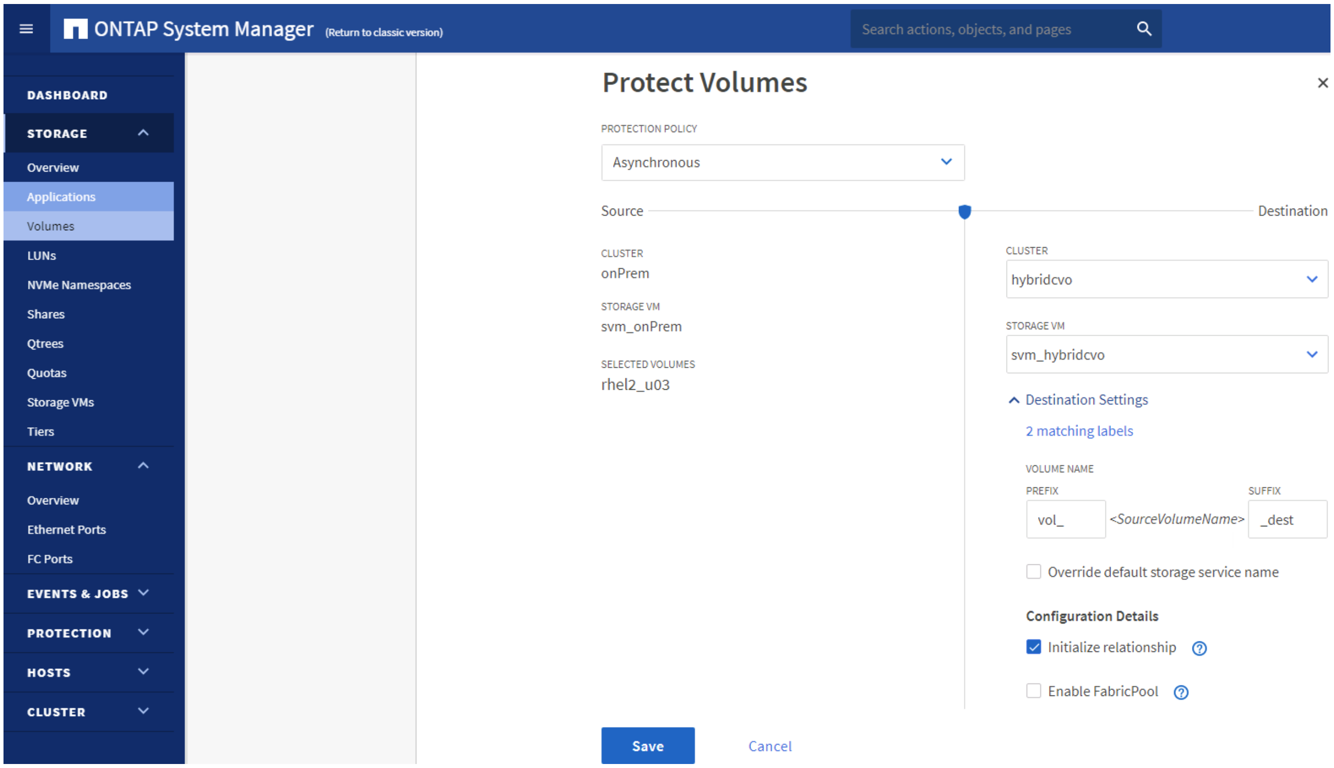
SPACE RESERVATION

Capacity

SNAPSHOT CAPACITY
0 Bytes Available | 2.36 GB Used | 2.36 GB Overflow

Performance

5. Set the protection policy to Asynchronous. Select the destination cluster and storage SVM.



Protect Volumes

PROTECTION POLICY: Asynchronous

Source — Destination

Source:

CLUSTER: onPrem

STORAGE VM: svm_onPrem

SELECTED VOLUMES: rhel2_u03

Destination:

CLUSTER: hybridcvo

STORAGE VM: svm_hybridcvo

Destination Settings

2 matching labels

VOLUME NAME

PREFIX: vol_ <SourceVolumeName> SUFFIX: _dest

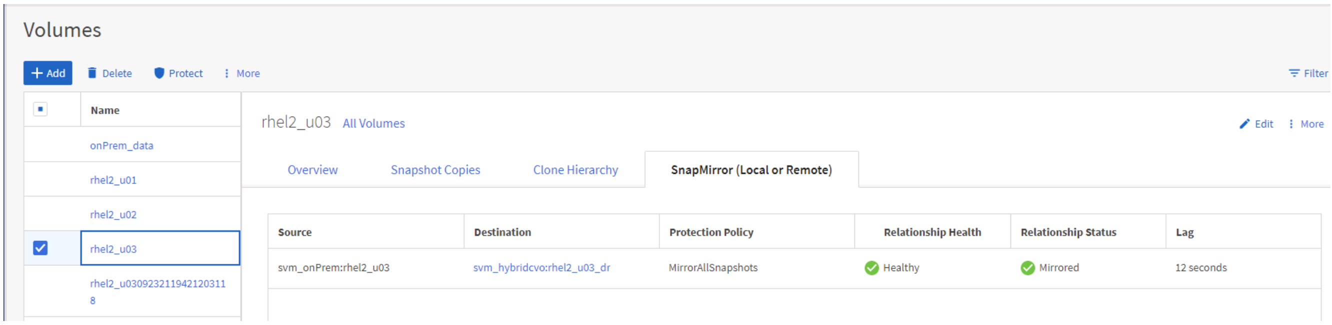
□ Override default storage service name

Configuration Details

☑ Initialize relationship

□ Enable FabricPool

6. Validate that the volume is synced between the source and target and that the replication relationship is healthy.



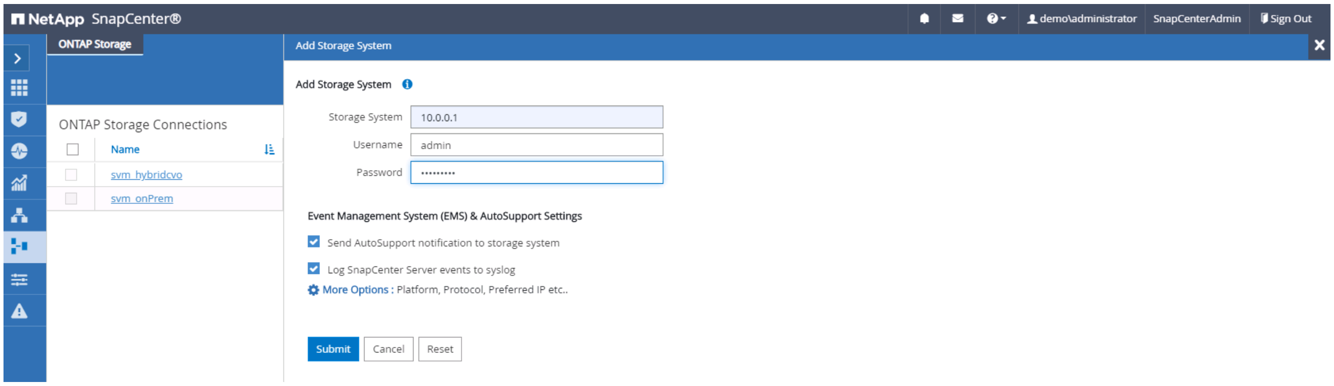
	Name
	onPrem_data
	rhel2_u01
	rhel2_u02
☑	rhel2_u03
	rhel2_u030923211942120311 8

rhel2_u03 All Volumes

Source	Destination	Protection Policy	Relationship Health	Relationship Status	Lag
svm_onPrem:rhel2_u03	svm_hybridcvo:rhel2_u03_dr	MirrorAllSnapshots	✓ Healthy	✓ Mirrored	12 seconds

6. Add CVO database storage SVM to SnapCenter

1. Log into SnapCenter with a user ID with SnapCenterAdmin privileges.
2. Click the Storage System tab from the menu, and then click New to add a CVO storage SVM that hosts replicated target database volumes to SnapCenter. Enter the cluster management IP in the Storage System field, and enter the appropriate username and password.



ONTAP Storage Connections

☐	Name
☐	svm_hybridcvo
☐	svm_onPrem

Add Storage System

Storage System: 10.0.0.1

Username: admin

Password: ••••••••••

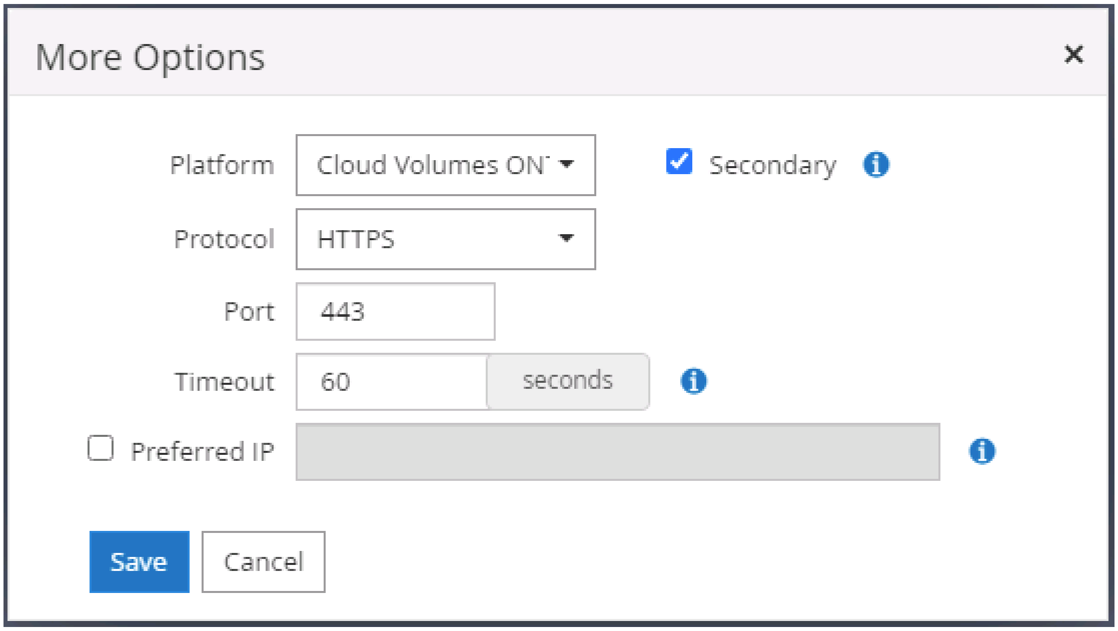
Event Management System (EMS) & AutoSupport Settings

☑ Send AutoSupport notification to storage system

☑ Log SnapCenter Server events to syslog

More Options : Platform, Protocol, Preferred IP etc..

3. Click More Options to open additional storage configuration options. In the Platform field, select Cloud Volumes ONTAP, check Secondary, and then click Save.



More Options

Platform: Cloud Volumes ON˙ ☑ Secondary

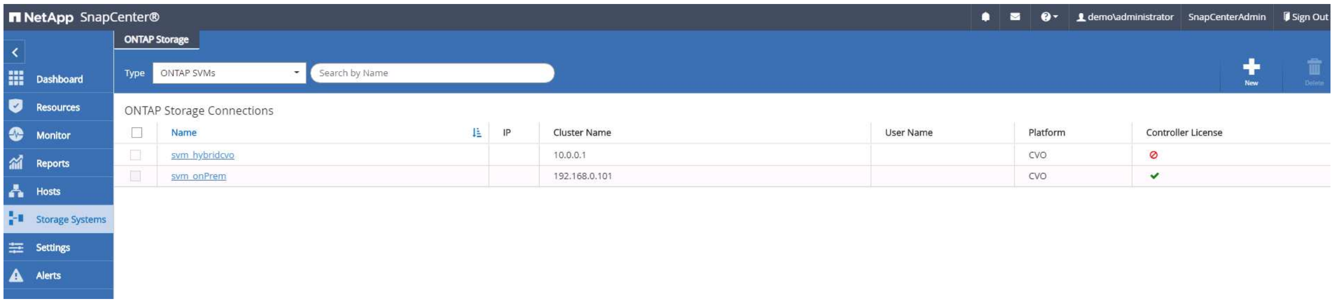
Protocol: HTTPS

Port: 443

Timeout: 60 seconds

☐ Preferred IP

4. Assign the storage systems to SnapCenter database management user IDs as shown in 3. SnapCenter host plugin installation.



Type: ONTAP SVMs Search by Name

ONTAP Storage Connections

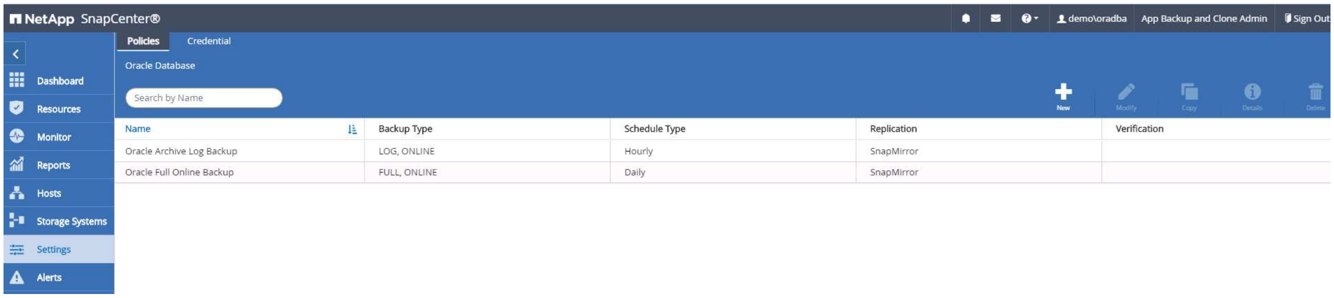
☐	Name	IP	Cluster Name	User Name	Platform	Controller License
☐	svm_hybridcvo		10.0.0.1		CVO	⊘
☐	svm_onPrem		192.168.0.101		CVO	✓

7. Setup database backup policy in SnapCenter

The following procedures demonstrates how to create a full database or log file backup policy. The policy can then be implemented to protect databases resources. The recovery point objective (RPO) or recovery time objective (RTO) dictates the frequency of database and/or log backups.

Create a full database backup policy for Oracle

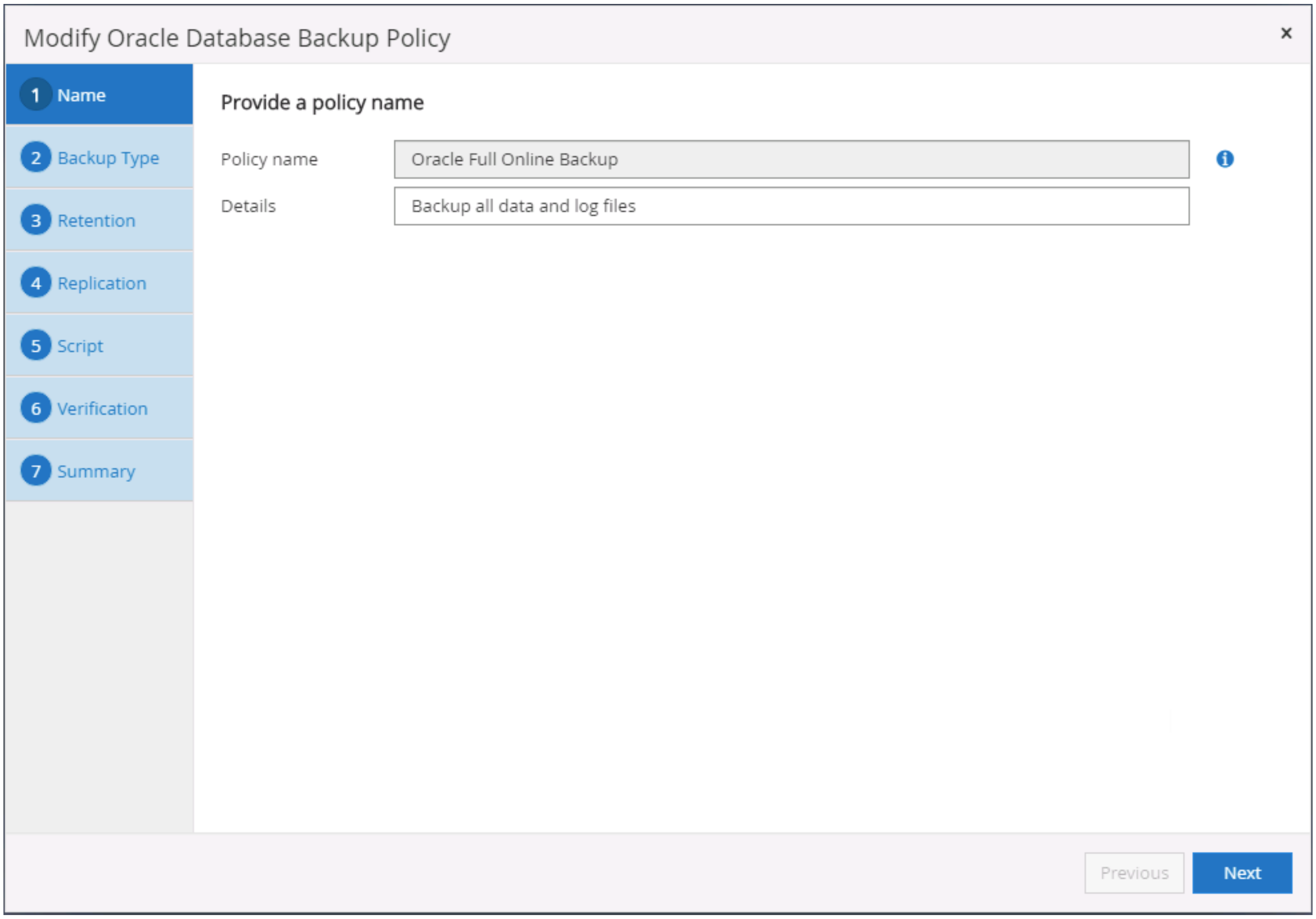
1. Log into SnapCenter as a database management user ID, click Settings, and then click Polices.



Oracle Database

Name	Backup Type	Schedule Type	Replication	Verification
Oracle Archive Log Backup	LOG, ONLINE	Hourly	SnapMirror	
Oracle Full Online Backup	FULL, ONLINE	Daily	SnapMirror	

2. Click New to launch a new backup policy creation workflow or choose an existing policy for modification.



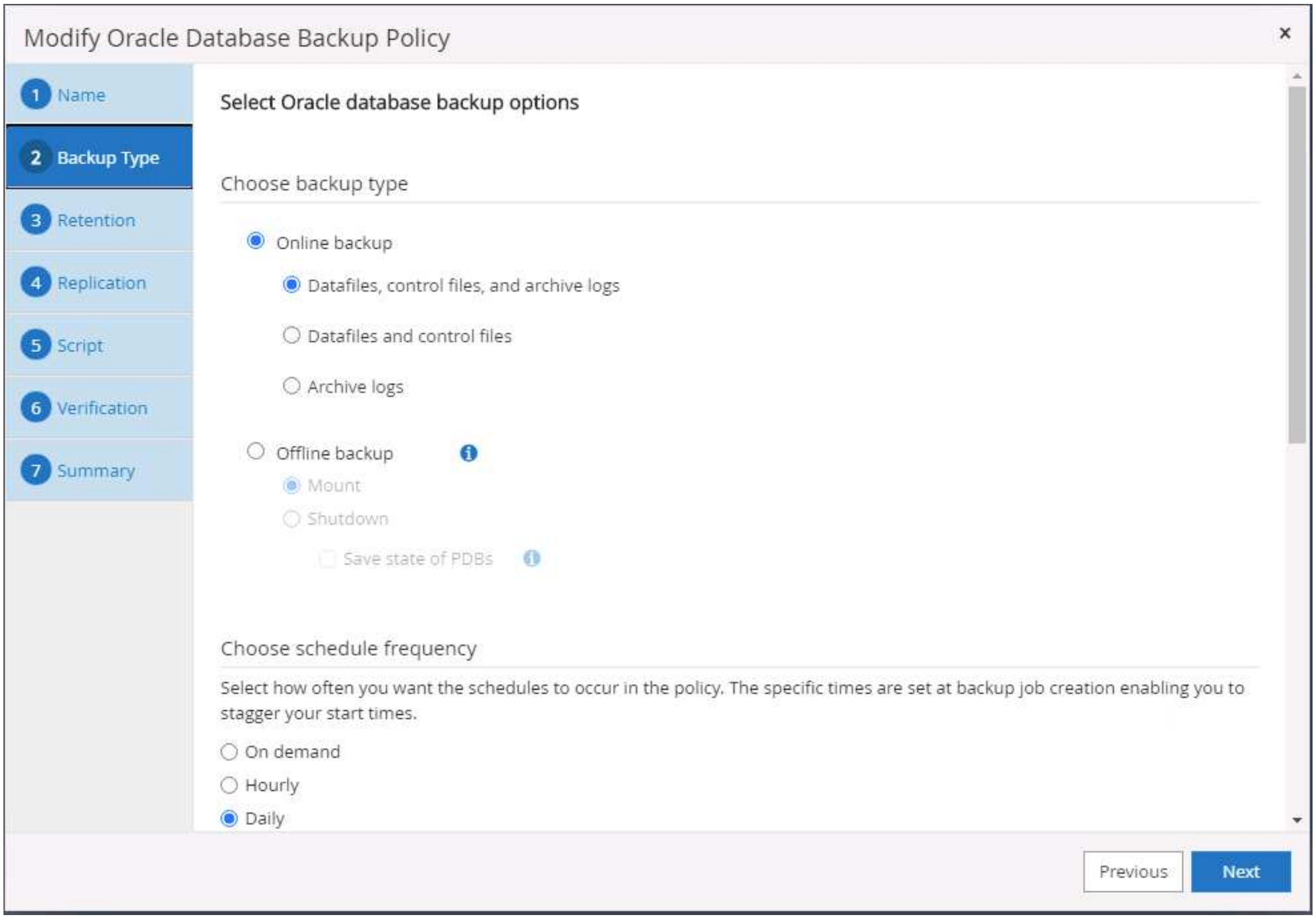
Modify Oracle Database Backup Policy

Provide a policy name

Policy name: Oracle Full Online Backup

Details: Backup all data and log files

3. Select the backup type and schedule frequency.



Modify Oracle Database Backup Policy

Select Oracle database backup options

Choose backup type

● Online backup

● Datafiles, control files, and archive logs

○ Datafiles and control files

○ Archive logs

○ Offline backup

● Mount

○ Shutdown

□ Save state of PDBs

Choose schedule frequency

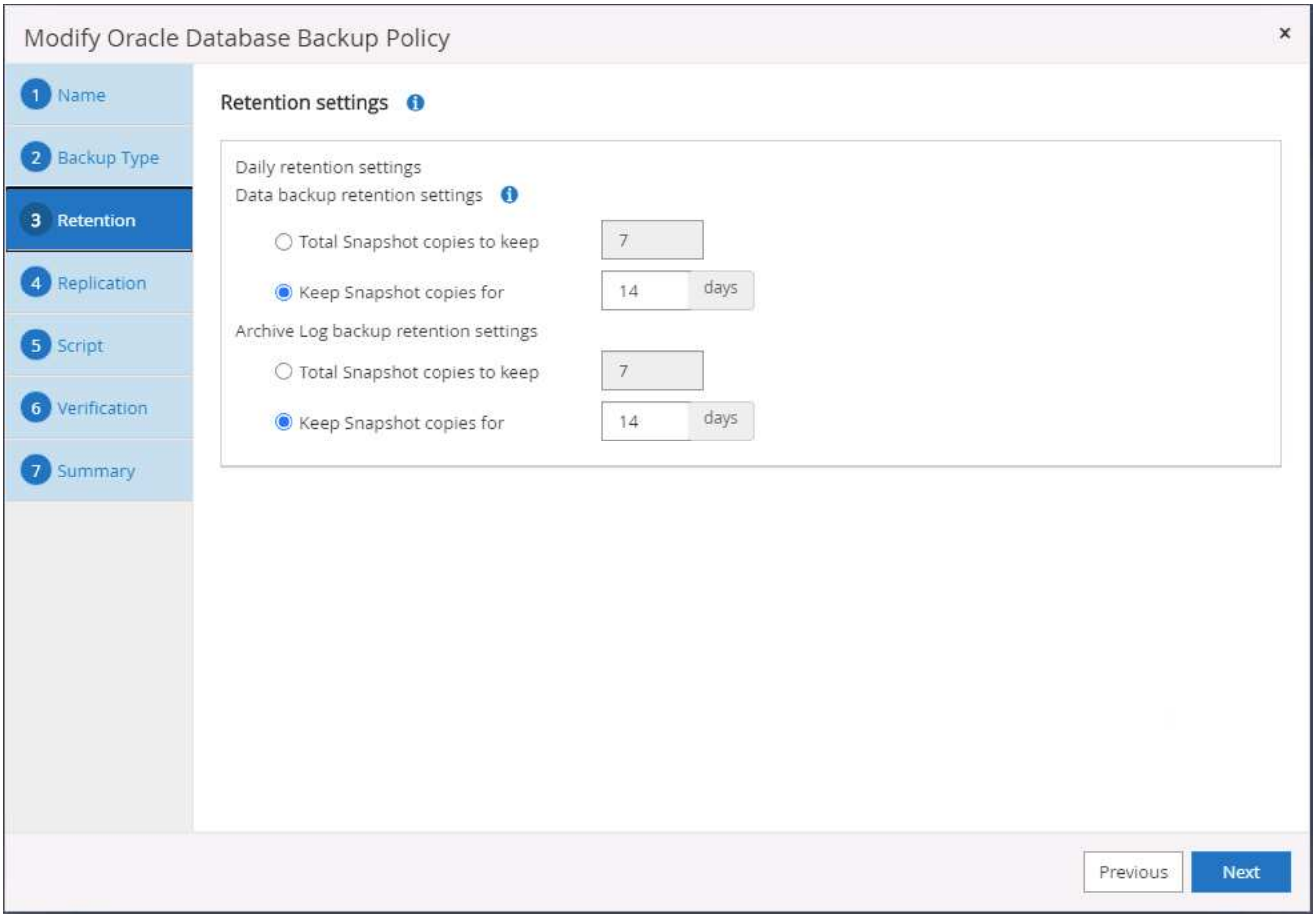
Select how often you want the schedules to occur in the policy. The specific times are set at backup job creation enabling you to stagger your start times.

○ On demand

○ Hourly

● Daily

4. Set the backup retention setting. This defines how many full database backup copies to keep.



Retention settings

Daily retention settings

Data backup retention settings

○ Total Snapshot copies to keep 7

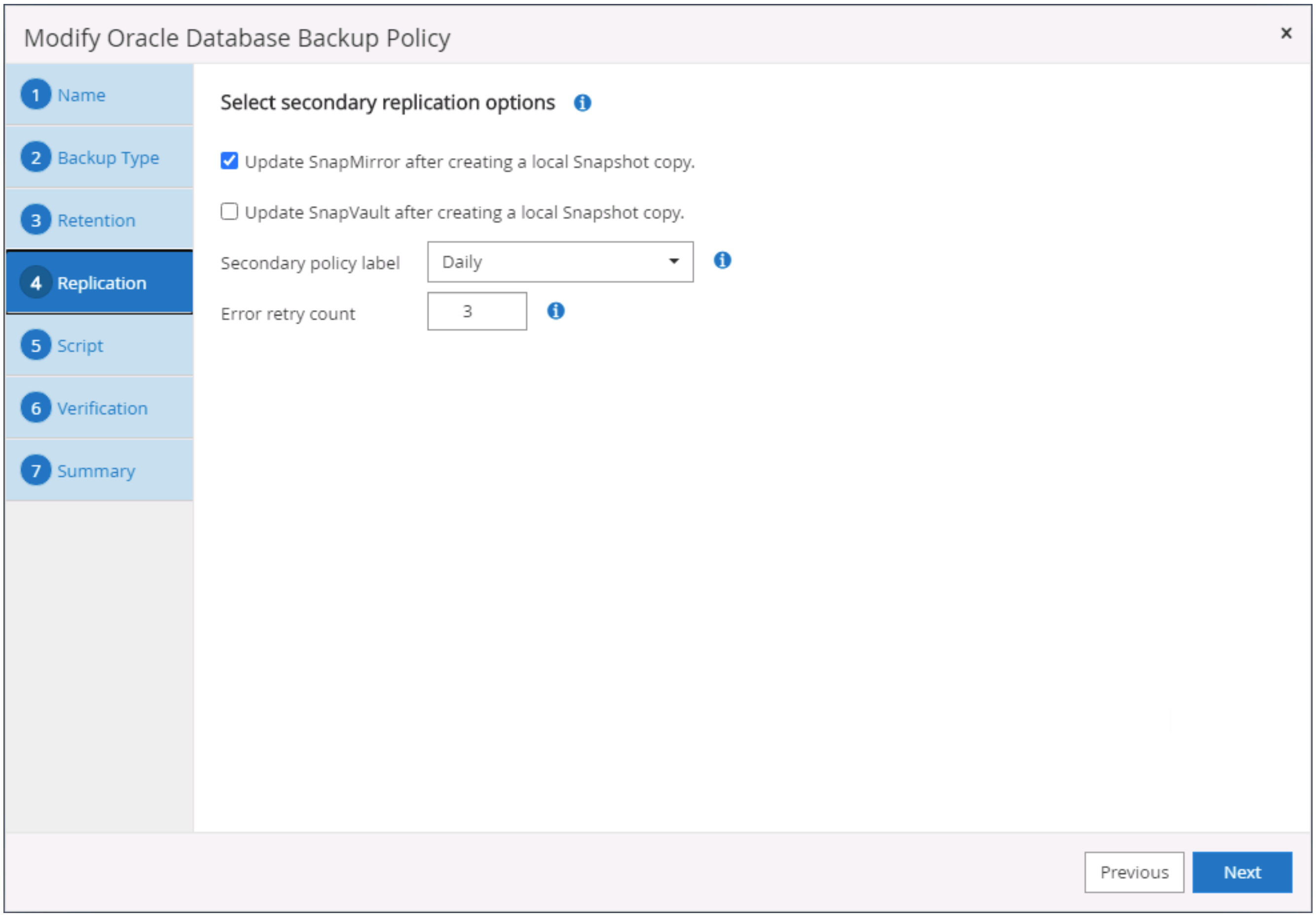
● Keep Snapshot copies for 14 days

Archive Log backup retention settings

○ Total Snapshot copies to keep 7

● Keep Snapshot copies for 14 days

5. Select the secondary replication options to push local primary snapshots backups to be replicated to a secondary location in cloud.



Modify Oracle Database Backup Policy

Select secondary replication options

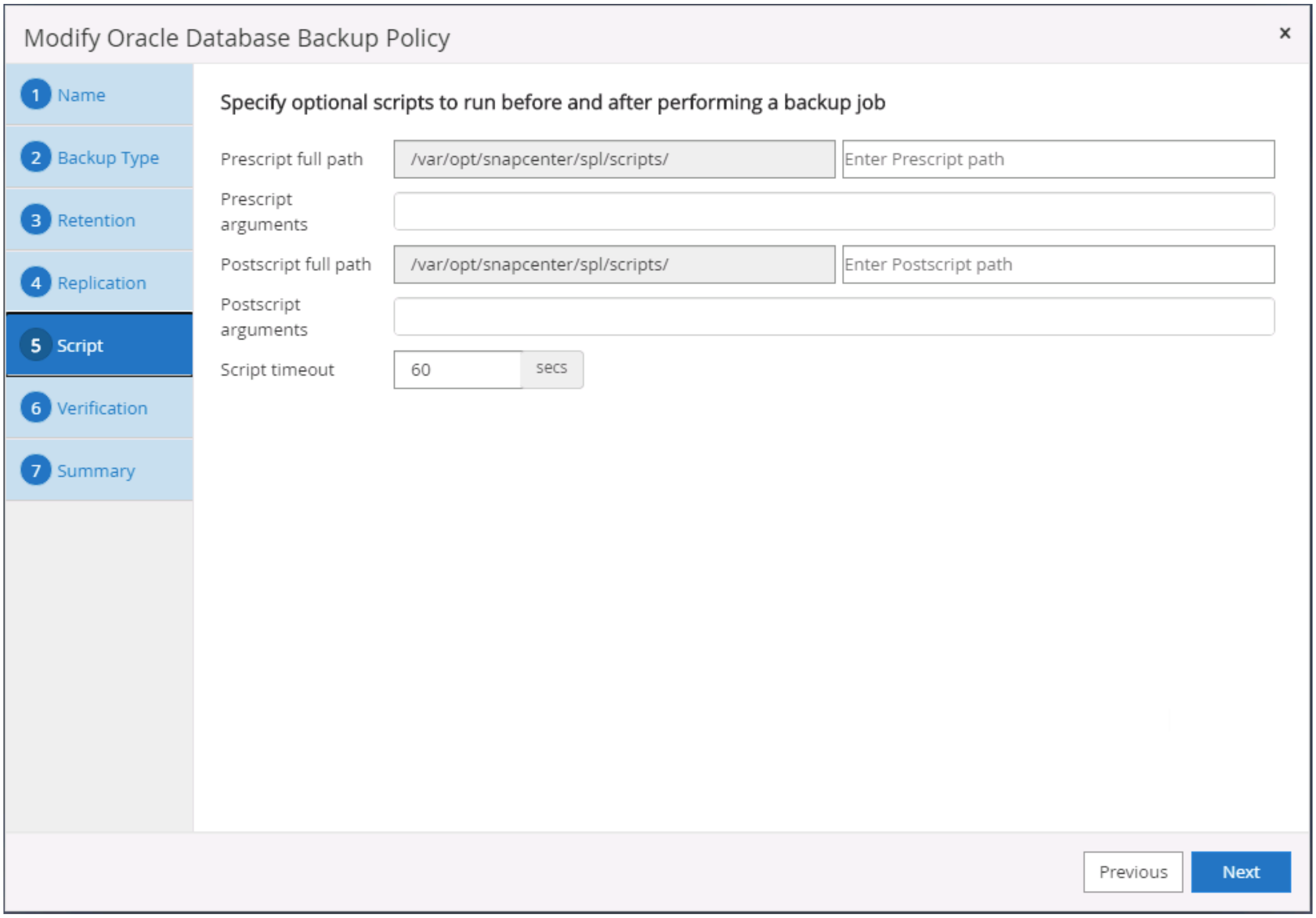
☑ Update SnapMirror after creating a local Snapshot copy.

☐ Update SnapVault after creating a local Snapshot copy.

Secondary policy label: Daily

Error retry count: 3

6. Specify any optional script to run before and after a backup run.


Modify Oracle Database Backup Policy

Specify optional scripts to run before and after performing a backup job

Prescript full path: /var/opt/snapcenter/spl/scripts/

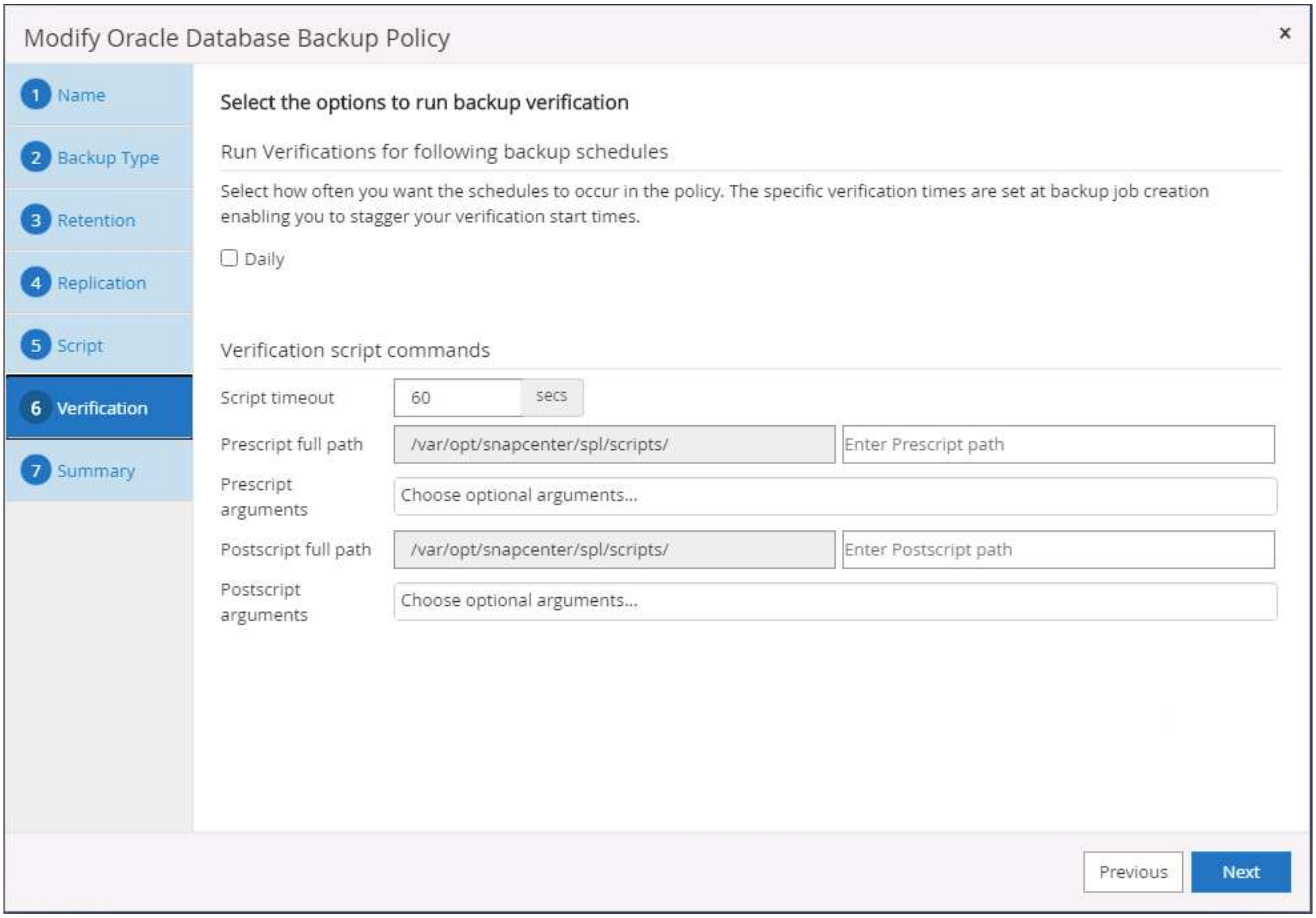
Prescript arguments:

Postscript full path: /var/opt/snapcenter/spl/scripts/

Postscript arguments:

Script timeout: 60 secs

7. Run backup verification if desired.



Select the options to run backup verification

Run Verifications for following backup schedules

Select how often you want the schedules to occur in the policy. The specific verification times are set at backup job creation enabling you to stagger your verification start times.

□ Daily

Verification script commands

Script timeout: 60 secs

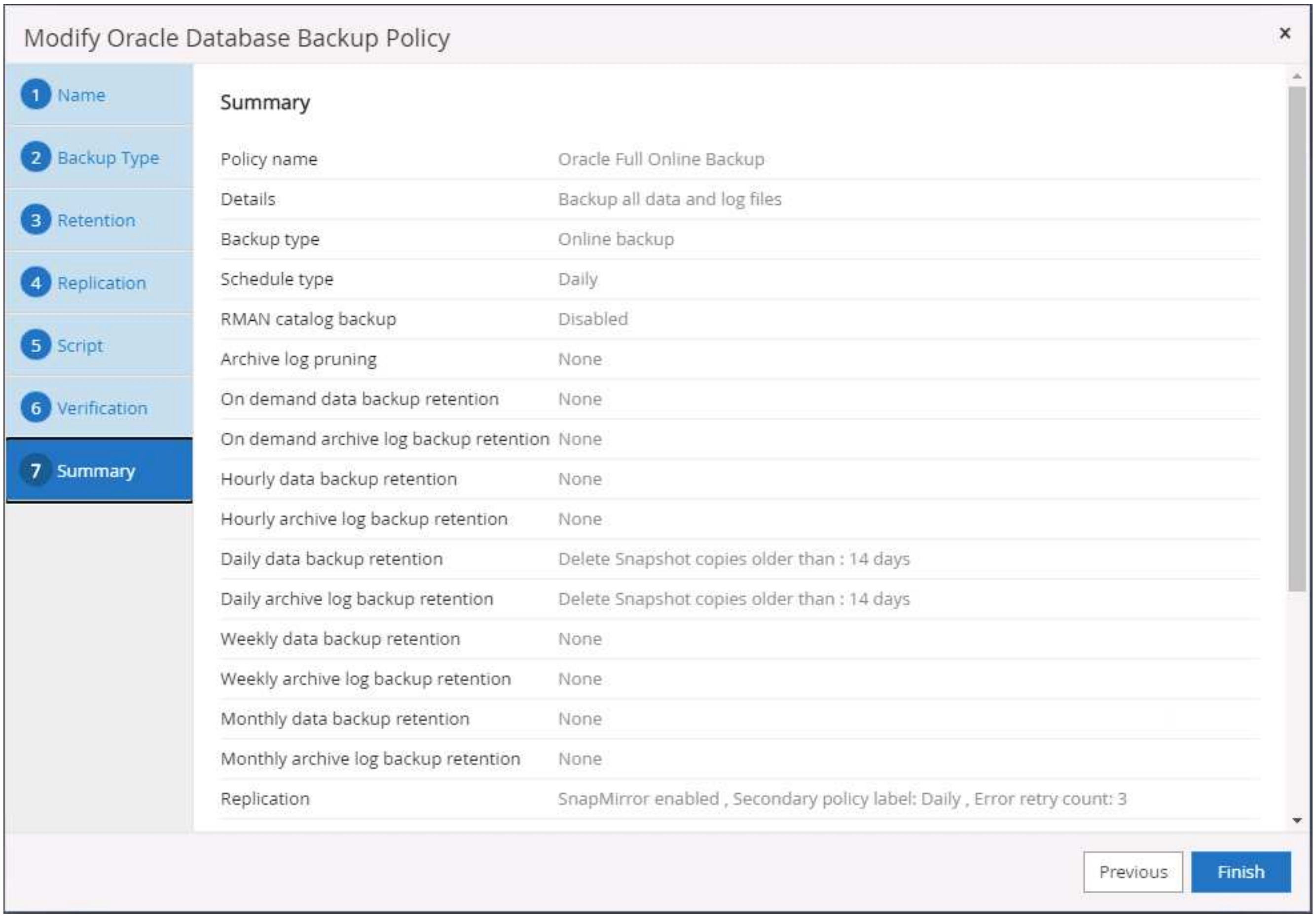
Prescript full path: /var/opt/snapcenter/spl/scripts/ | Enter Prescript path

Prescript arguments: Choose optional arguments...

Postscript full path: /var/opt/snapcenter/spl/scripts/ | Enter Postscript path

Postscript arguments: Choose optional arguments...

8. Summary.



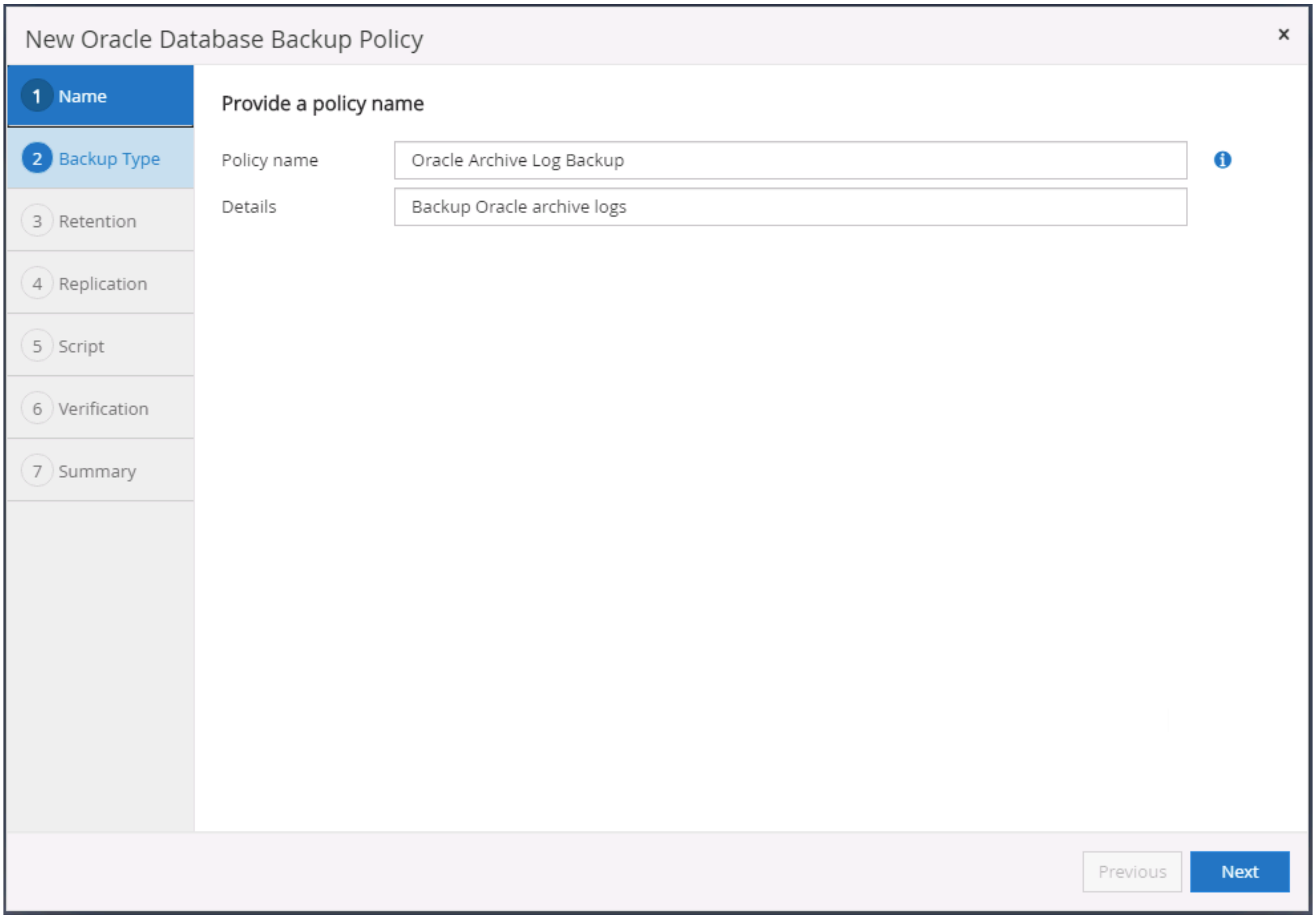
Modify Oracle Database Backup Policy

Summary

Policy name	Oracle Full Online Backup
Details	Backup all data and log files
Backup type	Online backup
Schedule type	Daily
RMAN catalog backup	Disabled
Archive log pruning	None
On demand data backup retention	None
On demand archive log backup retention	None
Hourly data backup retention	None
Hourly archive log backup retention	None
Daily data backup retention	Delete Snapshot copies older than : 14 days
Daily archive log backup retention	Delete Snapshot copies older than : 14 days
Weekly data backup retention	None
Weekly archive log backup retention	None
Monthly data backup retention	None
Monthly archive log backup retention	None
Replication	SnapMirror enabled , Secondary policy label: Daily , Error retry count: 3

Create a database log backup policy for Oracle

1. Log into SnapCenter with a database management user ID, click Settings, and then click Polices.
2. Click New to launch a new backup policy creation workflow, or choose an existing policy for modification.

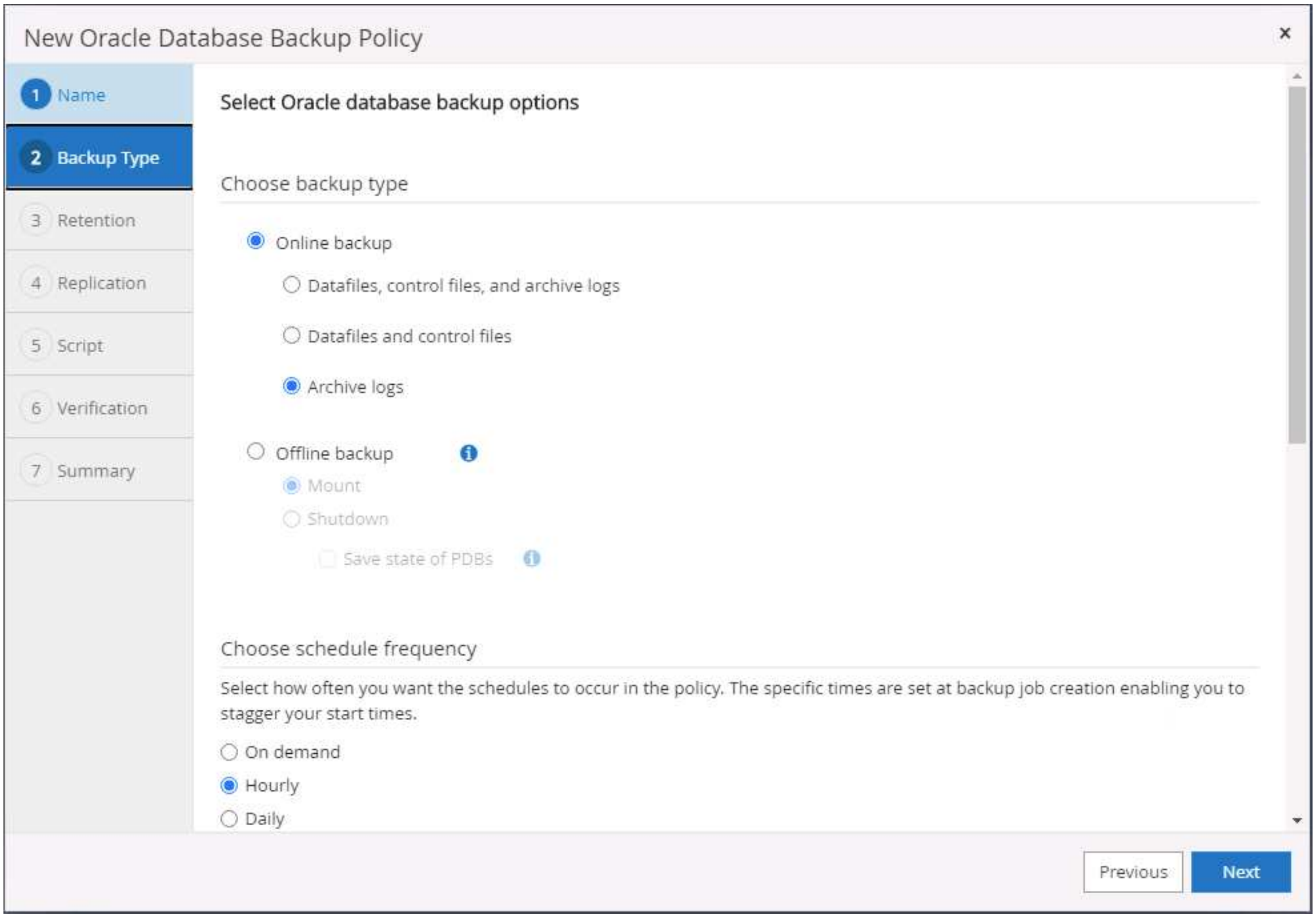


Provide a policy name

Policy name: Oracle Archive Log Backup

Details: Backup Oracle archive logs

3. Select the backup type and schedule frequency.



New Oracle Database Backup Policy

Select Oracle database backup options

Choose backup type

● Online backup

○ Datafiles, control files, and archive logs

○ Datafiles and control files

● Archive logs

○ Offline backup

● Mount

○ Shutdown

□ Save state of PDBs

Choose schedule frequency

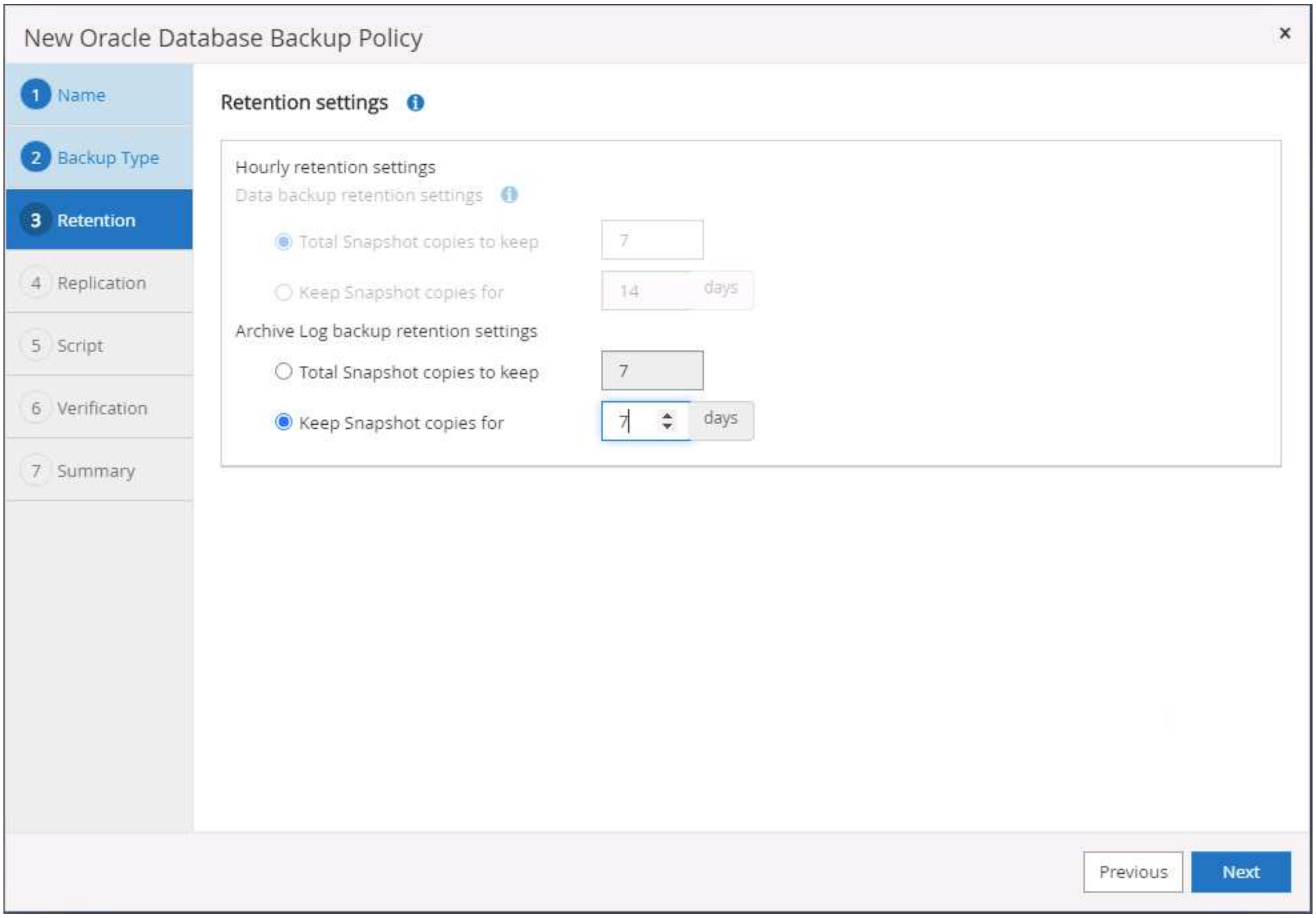
Select how often you want the schedules to occur in the policy. The specific times are set at backup job creation enabling you to stagger your start times.

○ On demand

● Hourly

○ Daily

4. Set the log retention period.



New Oracle Database Backup Policy

Retention settings

Hourly retention settings

Data backup retention settings

● Total Snapshot copies to keep 7

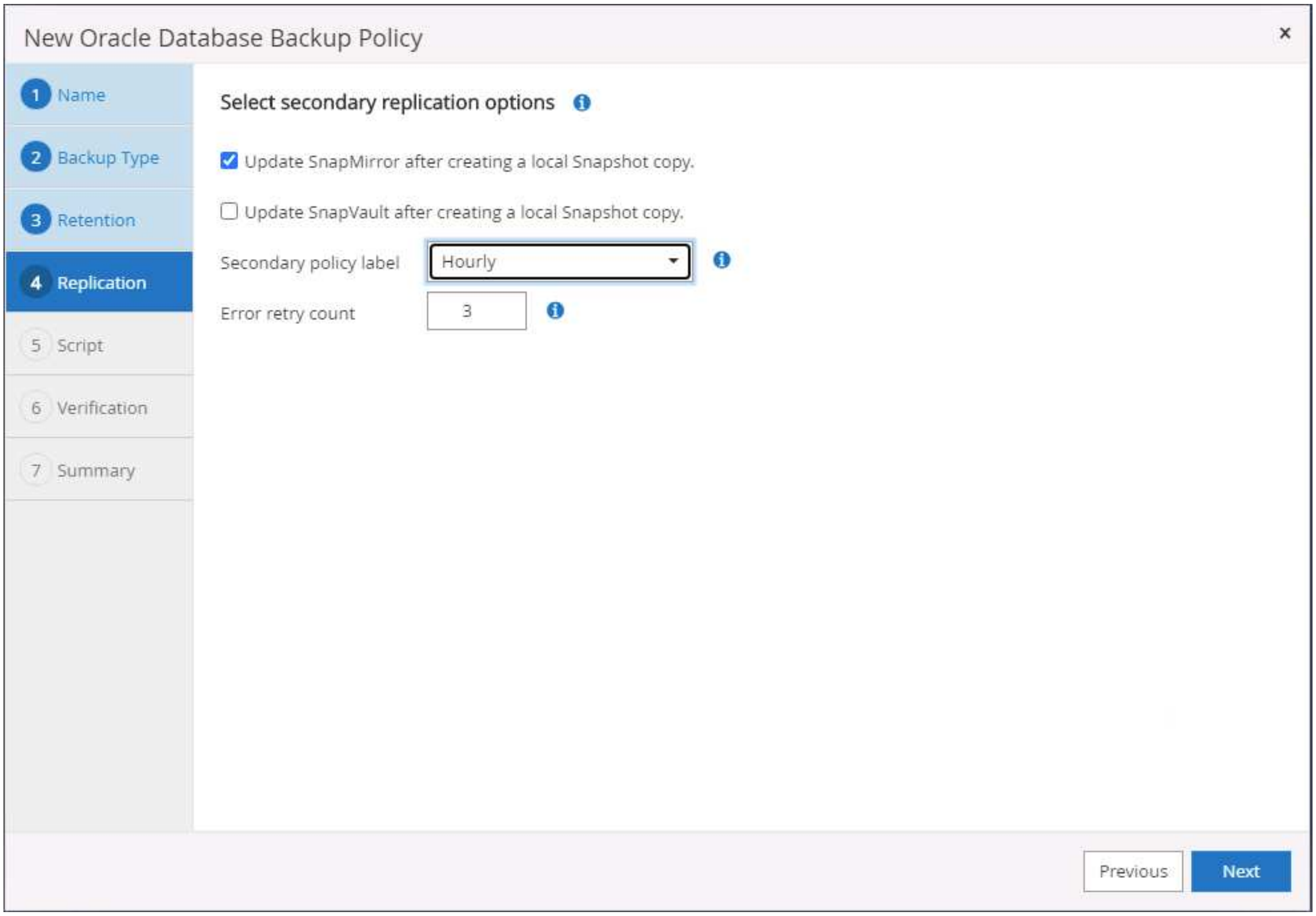
○ Keep Snapshot copies for 14 days

Archive Log backup retention settings

○ Total Snapshot copies to keep 7

● Keep Snapshot copies for 7 days

5. Enable replication to a secondary location in the public cloud.



New Oracle Database Backup Policy

Select secondary replication options

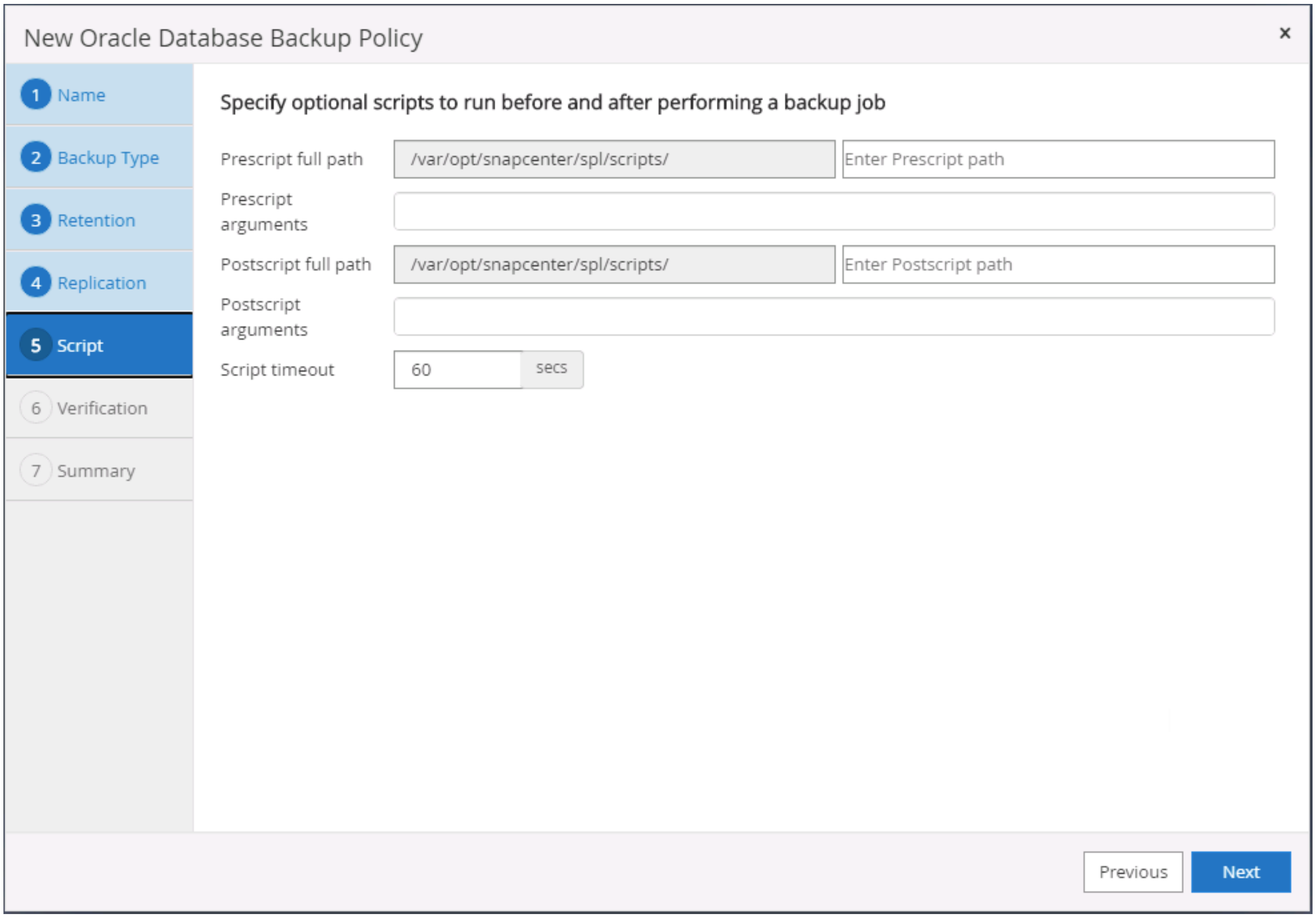
☑ Update SnapMirror after creating a local Snapshot copy.

□ Update SnapVault after creating a local Snapshot copy.

Secondary policy label: Hourly

Error retry count: 3

6. Specify any optional scripts to run before and after log backup.

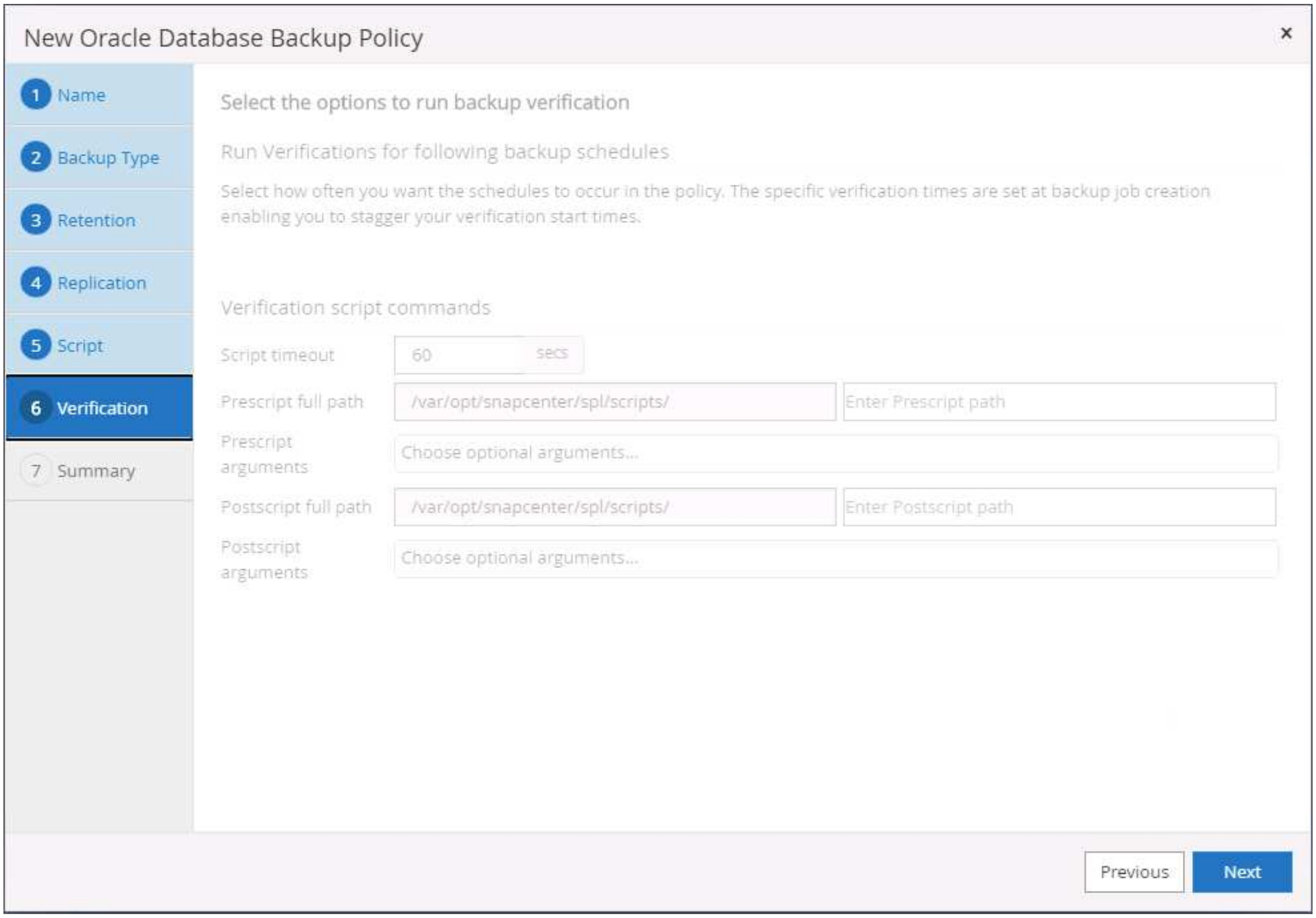


New Oracle Database Backup Policy

Specify optional scripts to run before and after performing a backup job

Prescript full path	/var/opt/snapcenter/spl/scripts/	Enter Prescript path
Prescript arguments		
Postscript full path	/var/opt/snapcenter/spl/scripts/	Enter Postscript path
Postscript arguments		
Script timeout	60 secs	

7. Specify any backup verification scripts.



Select the options to run backup verification

Run Verifications for following backup schedules

Select how often you want the schedules to occur in the policy. The specific verification times are set at backup job creation enabling you to stagger your verification start times.

Verification script commands

Script timeout: 60 secs

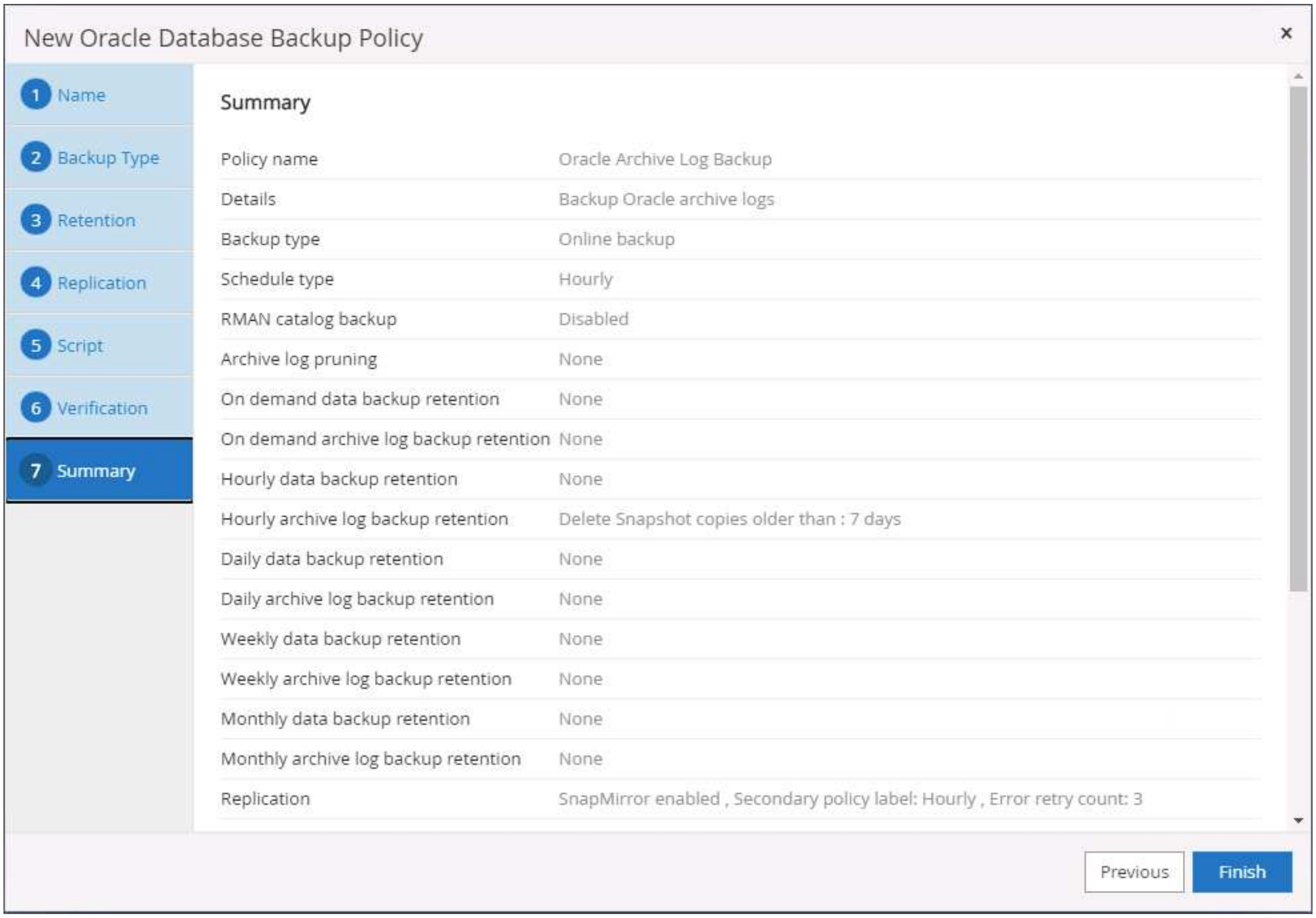
Prescript full path: /var/opt/snapcenter/spl/scripts/ Enter Prescript path

Prescript arguments: Choose optional arguments...

Postscript full path: /var/opt/snapcenter/spl/scripts/ Enter Postscript path

Postscript arguments: Choose optional arguments...

8. Summary.

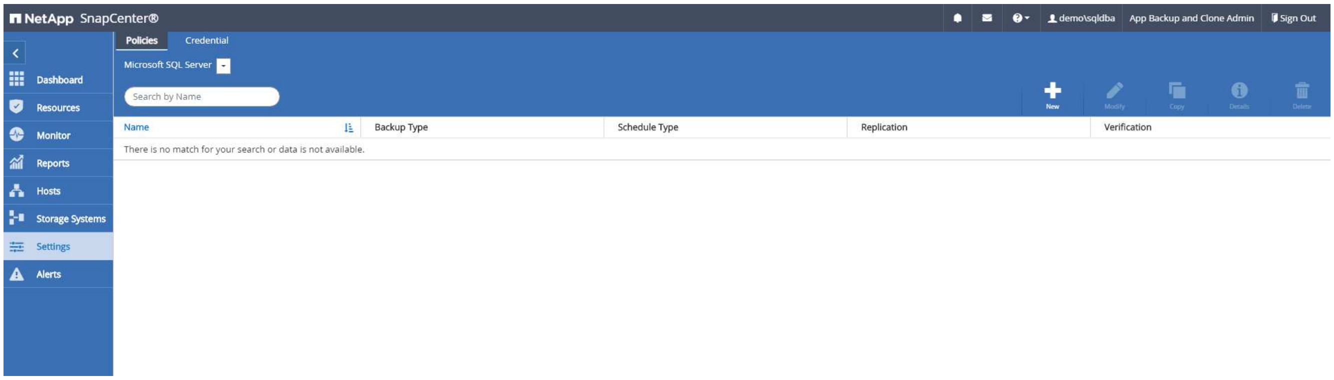


Summary

Policy name	Oracle Archive Log Backup
Details	Backup Oracle archive logs
Backup type	Online backup
Schedule type	Hourly
RMAN catalog backup	Disabled
Archive log pruning	None
On demand data backup retention	None
On demand archive log backup retention	None
Hourly data backup retention	None
Hourly archive log backup retention	Delete Snapshot copies older than : 7 days
Daily data backup retention	None
Daily archive log backup retention	None
Weekly data backup retention	None
Weekly archive log backup retention	None
Monthly data backup retention	None
Monthly archive log backup retention	None
Replication	SnapMirror enabled , Secondary policy label: Hourly , Error retry count: 3

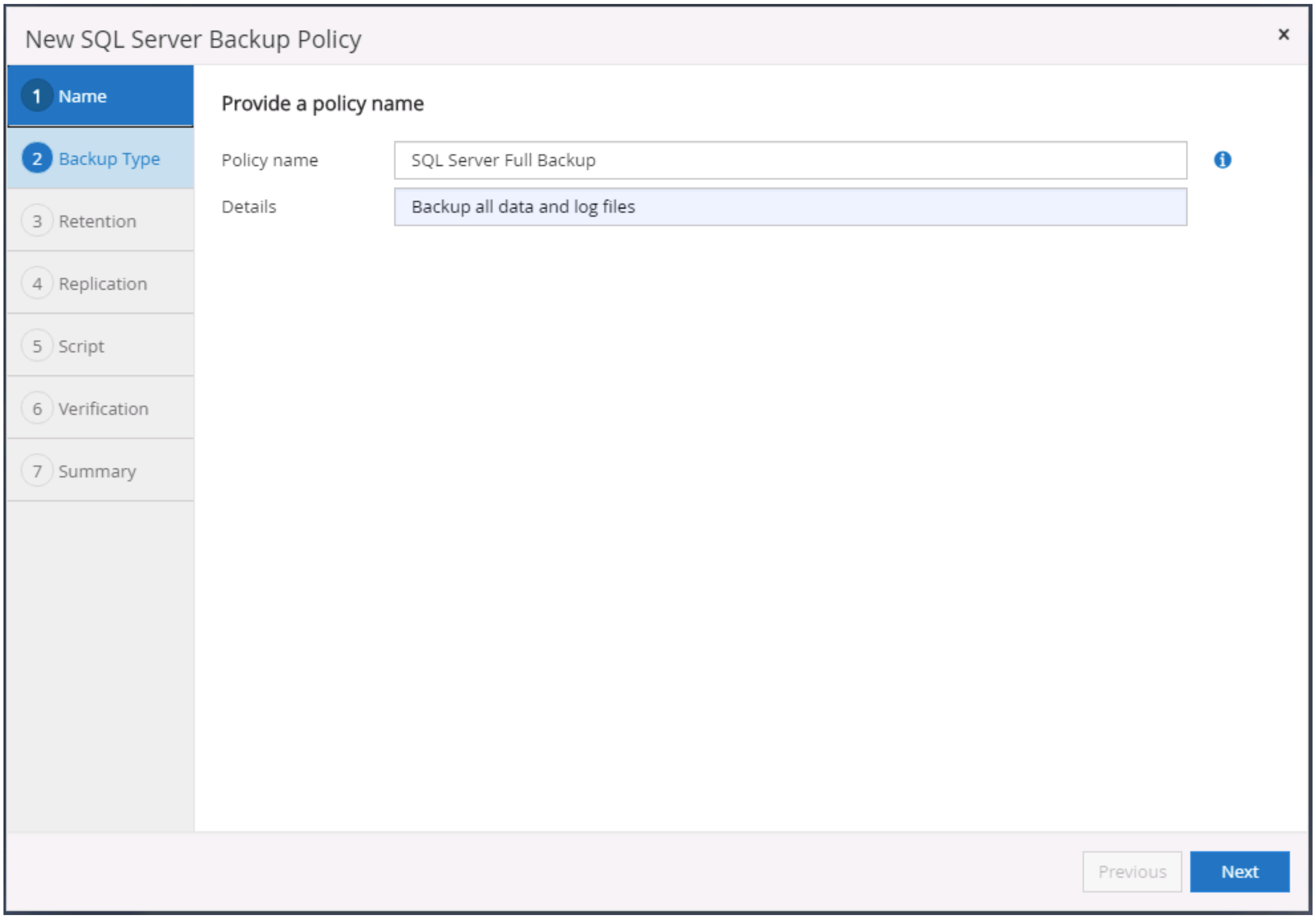
Create a full database backup policy for SQL

1. Log into SnapCenter with a database management user ID, click Settings, and then click Polices.



Name	Backup Type	Schedule Type	Replication	Verification
There is no match for your search or data is not available.				

2. Click New to launch a new backup policy creation workflow, or choose an existing policy for modification.

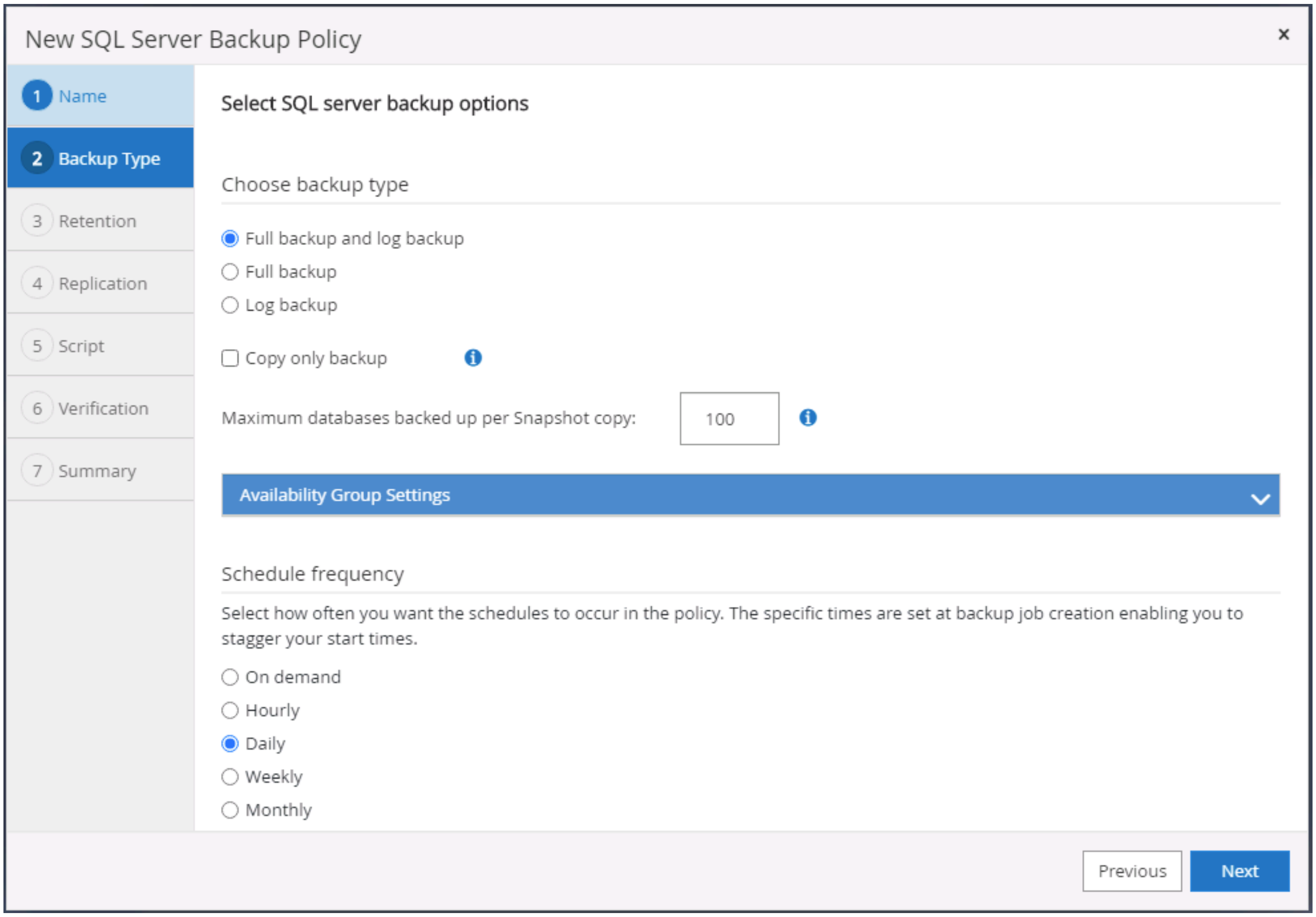


Provide a policy name

Policy name: SQL Server Full Backup

Details: Backup all data and log files

3. Define the backup option and schedule frequency. For SQL Server configured with an availability group, a preferred backup replica can be set.



New SQL Server Backup Policy

Select SQL server backup options

Choose backup type

● Full backup and log backup
○ Full backup
○ Log backup

□ Copy only backup

Maximum databases backed up per Snapshot copy: 100

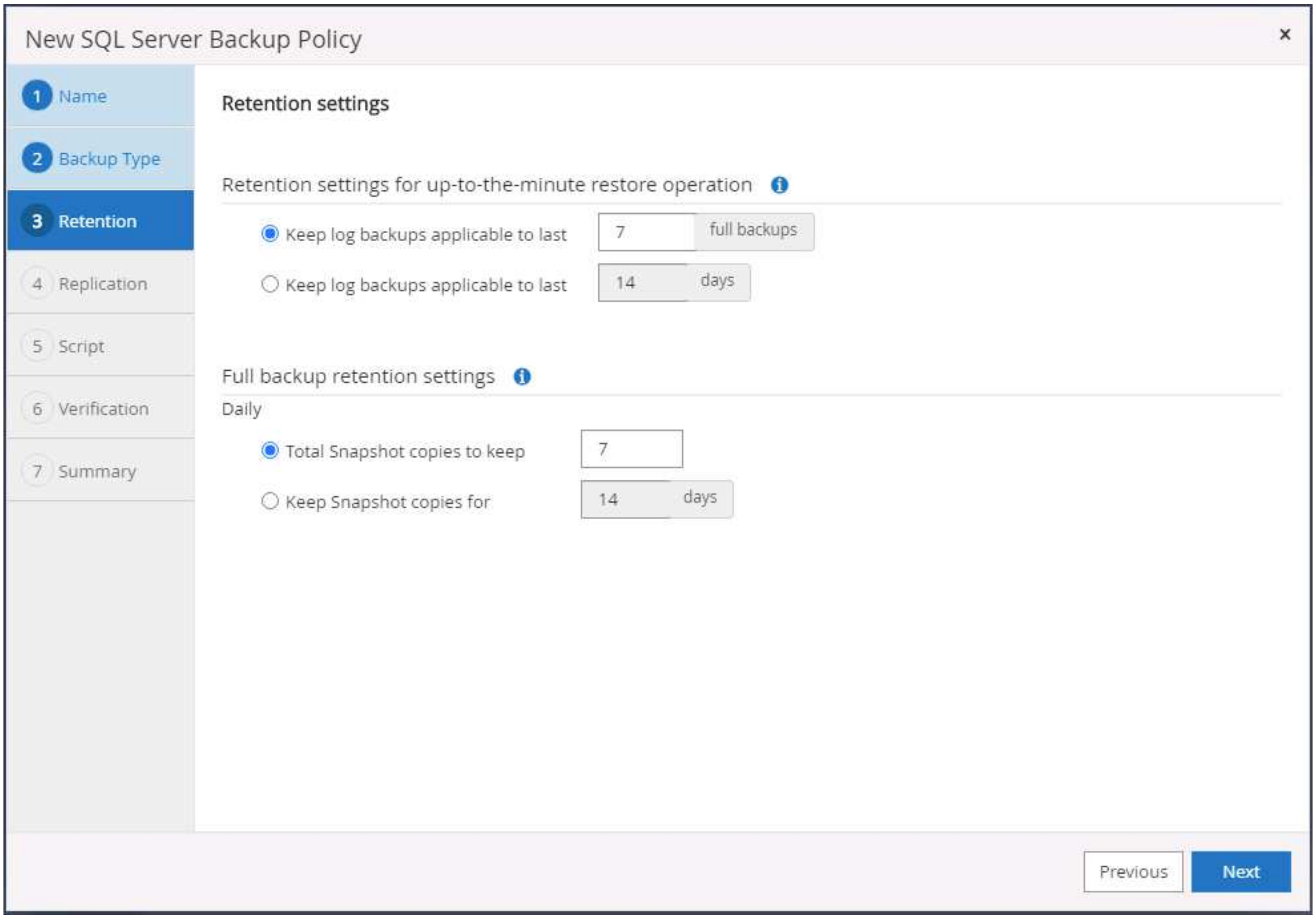
Availability Group Settings

Schedule frequency

Select how often you want the schedules to occur in the policy. The specific times are set at backup job creation enabling you to stagger your start times.

○ On demand
○ Hourly
● Daily
○ Weekly
○ Monthly

4. Set the backup retention period.



New SQL Server Backup Policy

Retention settings

Retention settings for up-to-the-minute restore operation

● Keep log backups applicable to last 7 full backups

○ Keep log backups applicable to last 14 days

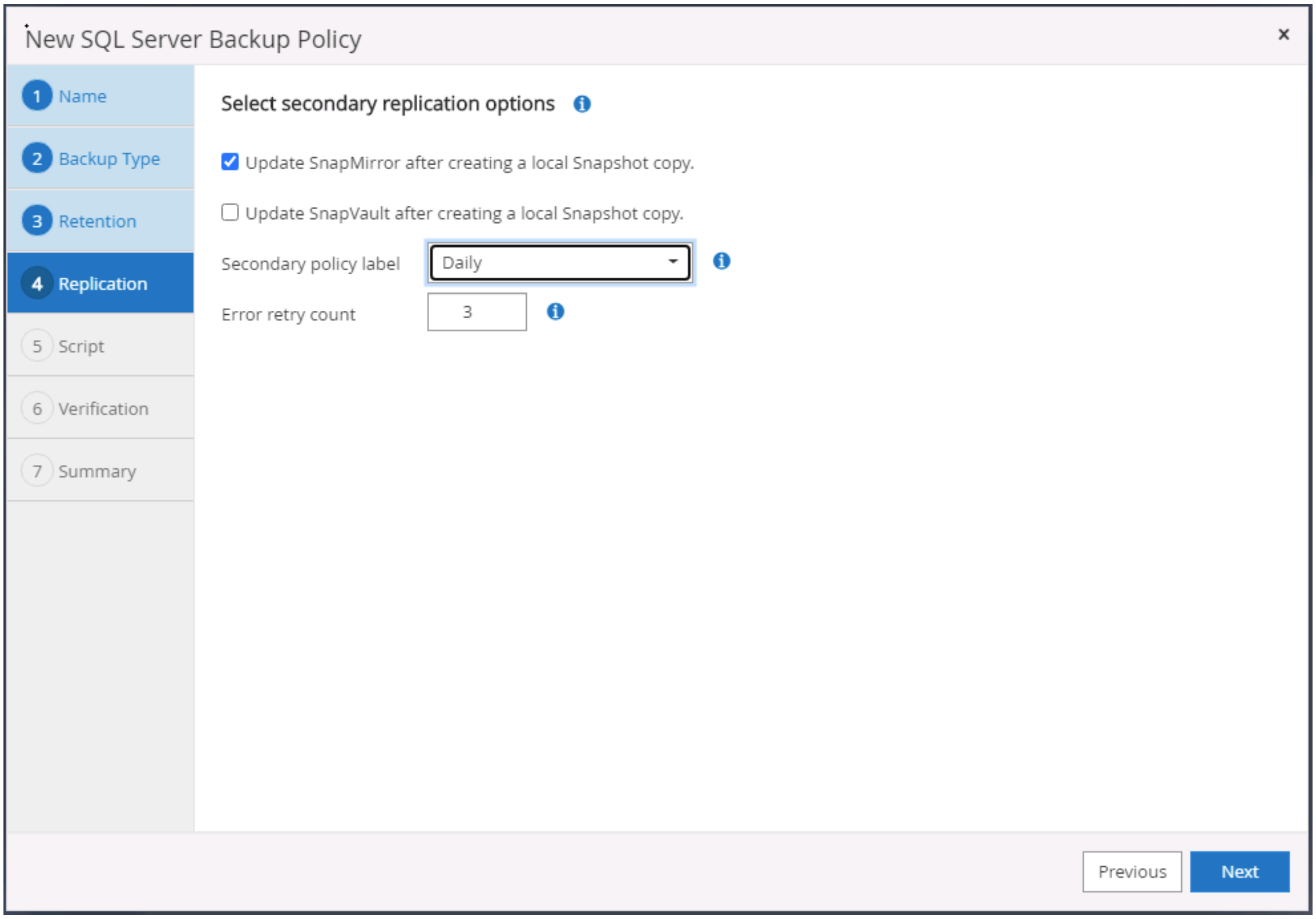
Full backup retention settings

Daily

● Total Snapshot copies to keep 7

○ Keep Snapshot copies for 14 days

5. Enable backup copy replication to a secondary location in cloud.



New SQL Server Backup Policy

Select secondary replication options

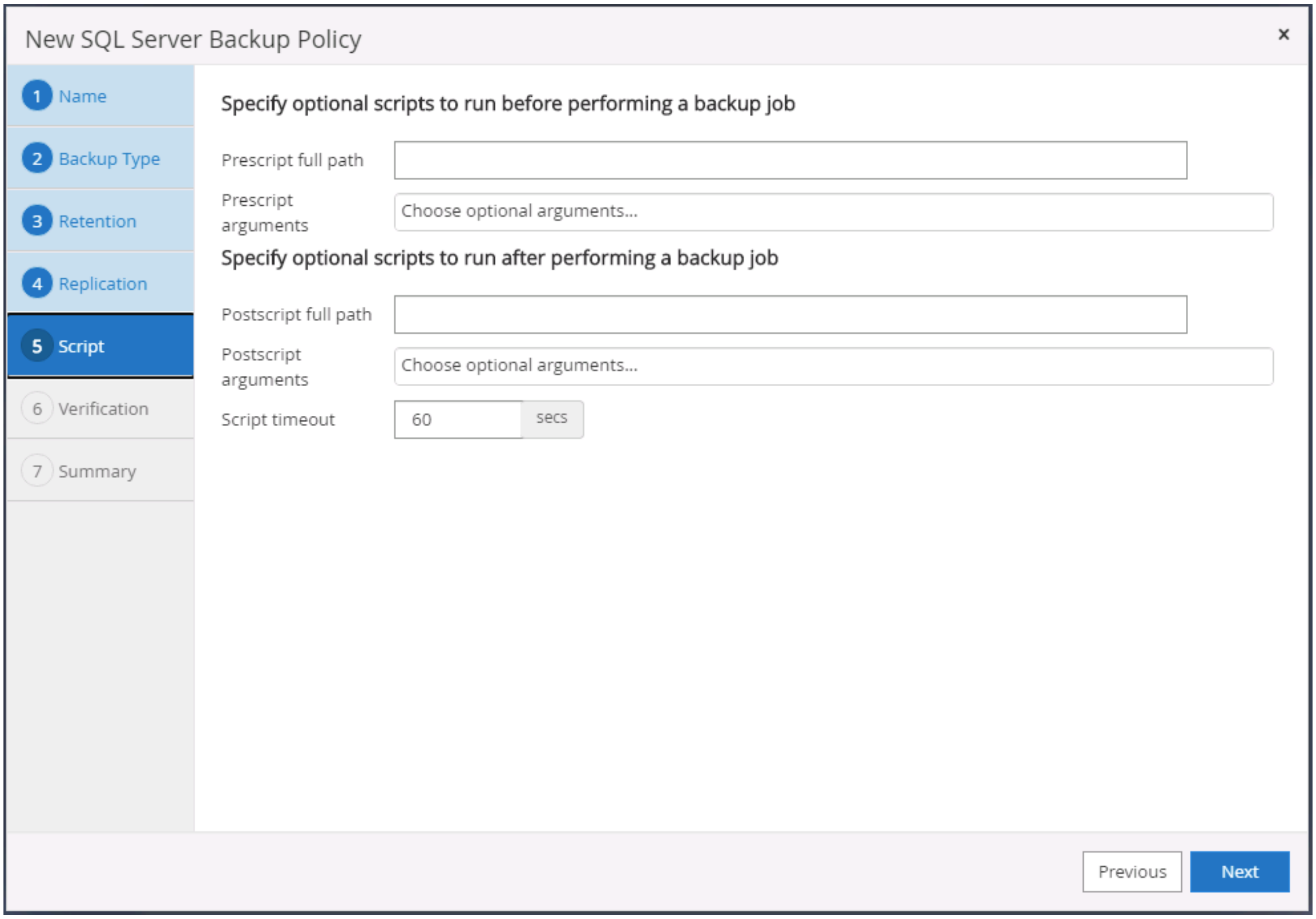
☑ Update SnapMirror after creating a local Snapshot copy.

□ Update SnapVault after creating a local Snapshot copy.

Secondary policy label: Daily

Error retry count: 3

6. Specify any optional scripts to run before or after a backup job.



New SQL Server Backup Policy

Specify optional scripts to run before performing a backup job

Prescript full path:

Prescript arguments: Choose optional arguments...

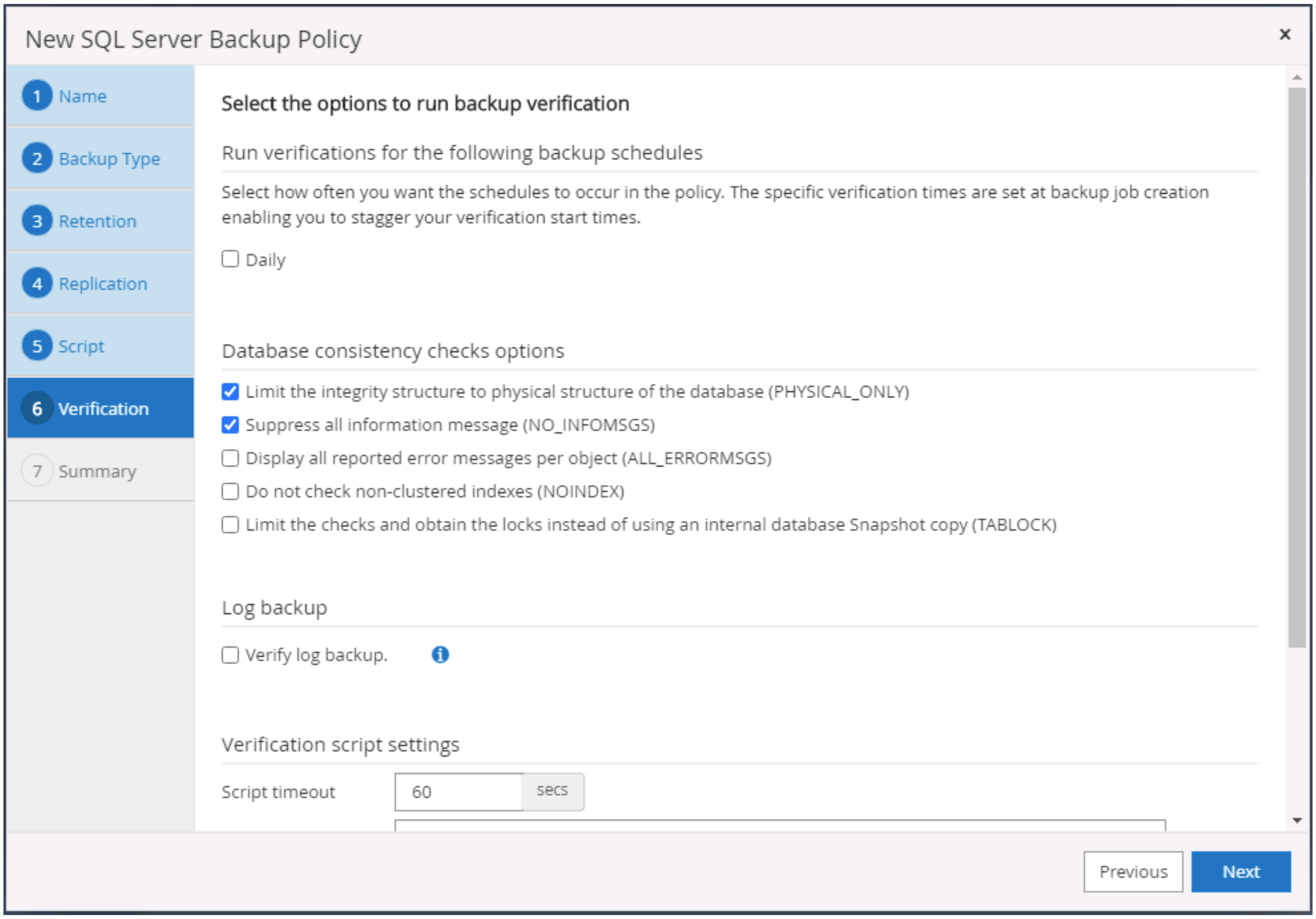
Specify optional scripts to run after performing a backup job

Postscript full path:

Postscript arguments: Choose optional arguments...

Script timeout: 60 secs

7. Specify the options to run backup verification.



Select the options to run backup verification

Run verifications for the following backup schedules

Select how often you want the schedules to occur in the policy. The specific verification times are set at backup job creation enabling you to stagger your verification start times.

☐ Daily

Database consistency checks options

☑ Limit the integrity structure to physical structure of the database (PHYSICAL_ONLY)
☑ Suppress all information message (NO_INFOMSGS)
☐ Display all reported error messages per object (ALL_ERRORMSGS)
☐ Do not check non-clustered indexes (NOINDEX)
☐ Limit the checks and obtain the locks instead of using an internal database Snapshot copy (TABLOCK)

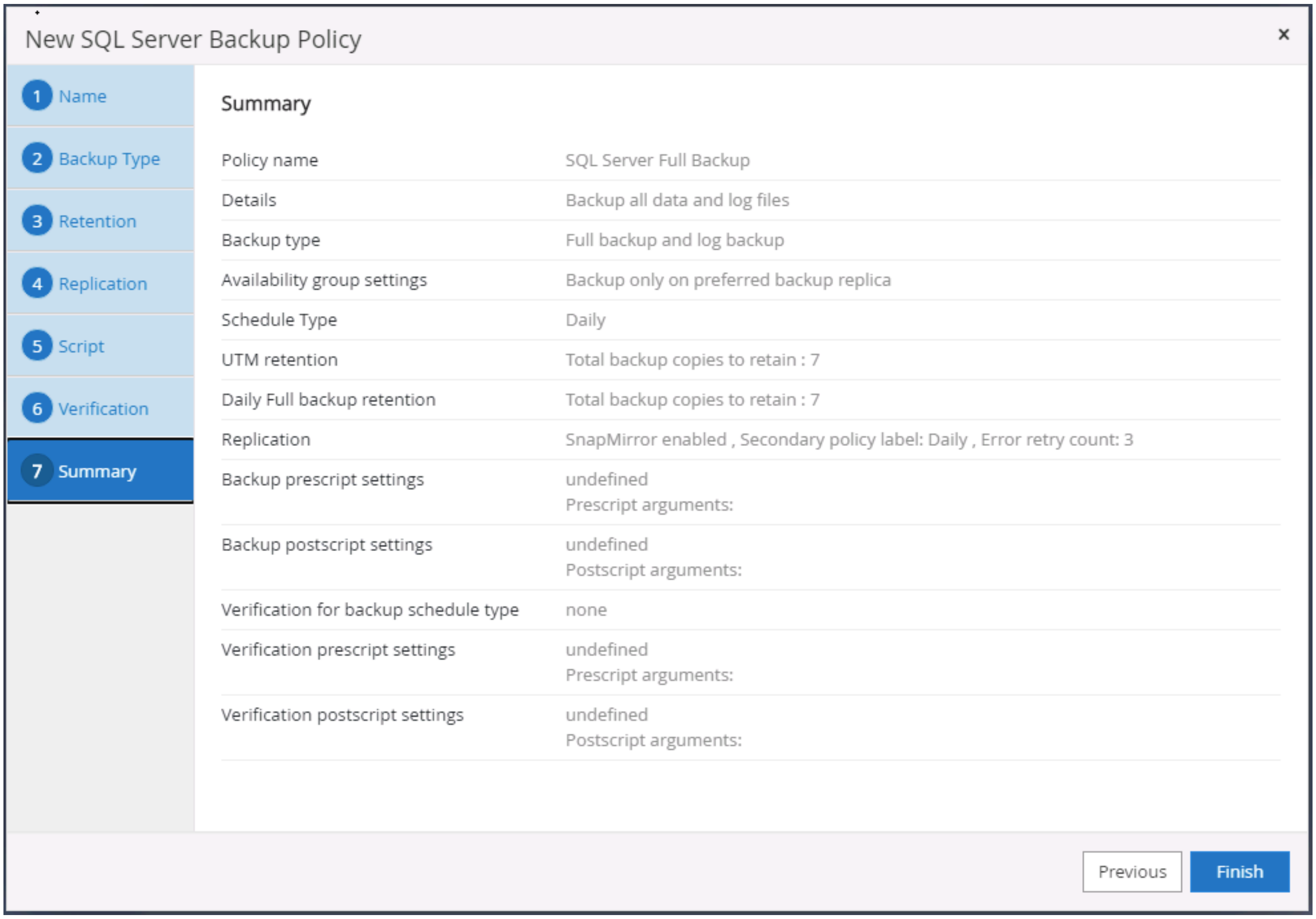
Log backup

☐ Verify log backup.

Verification script settings

Script timeout 60 secs

8. Summary.

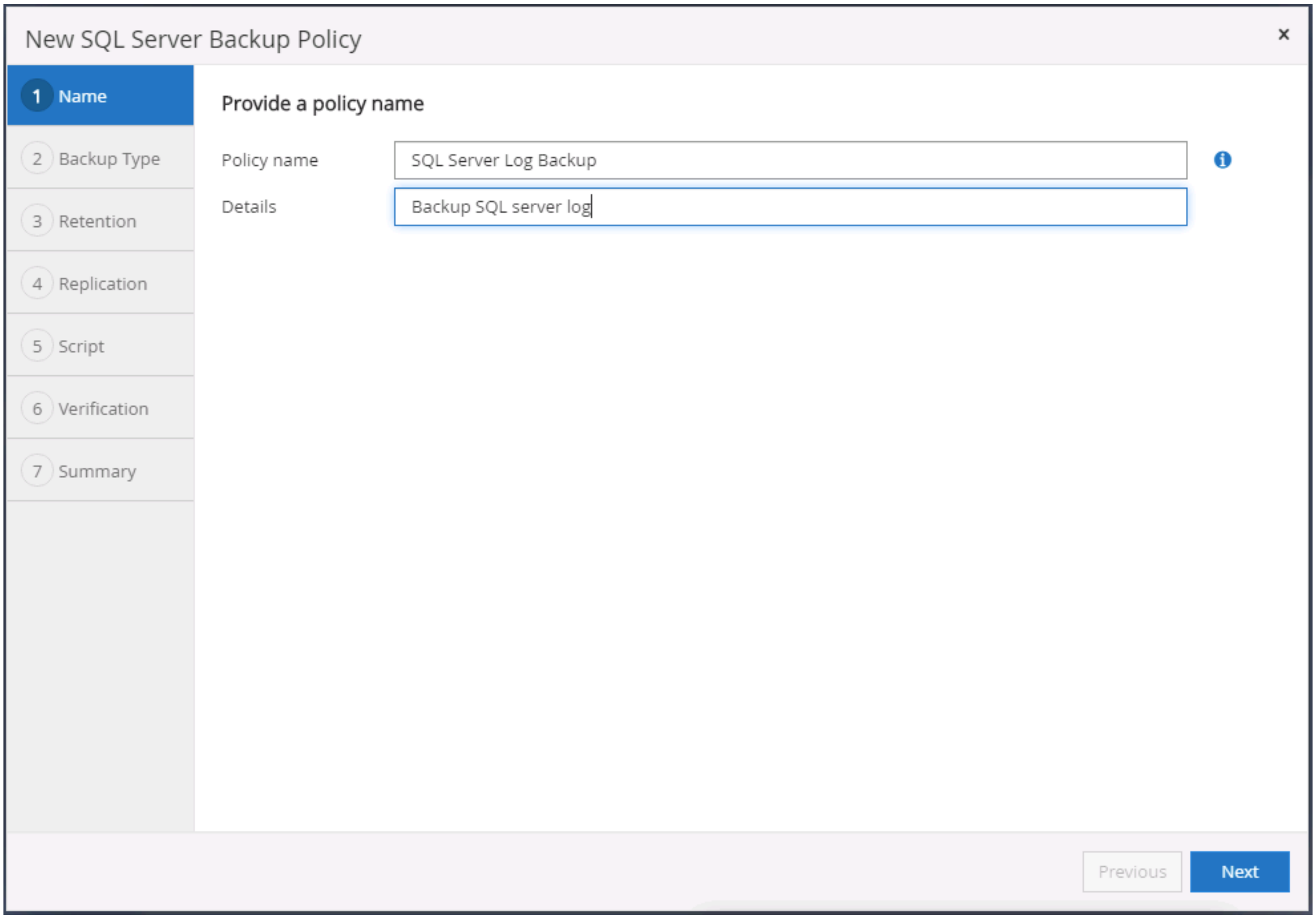


Summary

Policy name	SQL Server Full Backup
Details	Backup all data and log files
Backup type	Full backup and log backup
Availability group settings	Backup only on preferred backup replica
Schedule Type	Daily
UTM retention	Total backup copies to retain : 7
Daily Full backup retention	Total backup copies to retain : 7
Replication	SnapMirror enabled , Secondary policy label: Daily , Error retry count: 3
Backup prescript settings	undefined Prescript arguments:
Backup postscript settings	undefined Postscript arguments:
Verification for backup schedule type	none
Verification prescript settings	undefined Prescript arguments:
Verification postscript settings	undefined Postscript arguments:

Create a database log backup policy for SQL.

1. Log into SnapCenter with a database management user ID, click Settings > Polices, and then New to launch a new policy creation workflow.



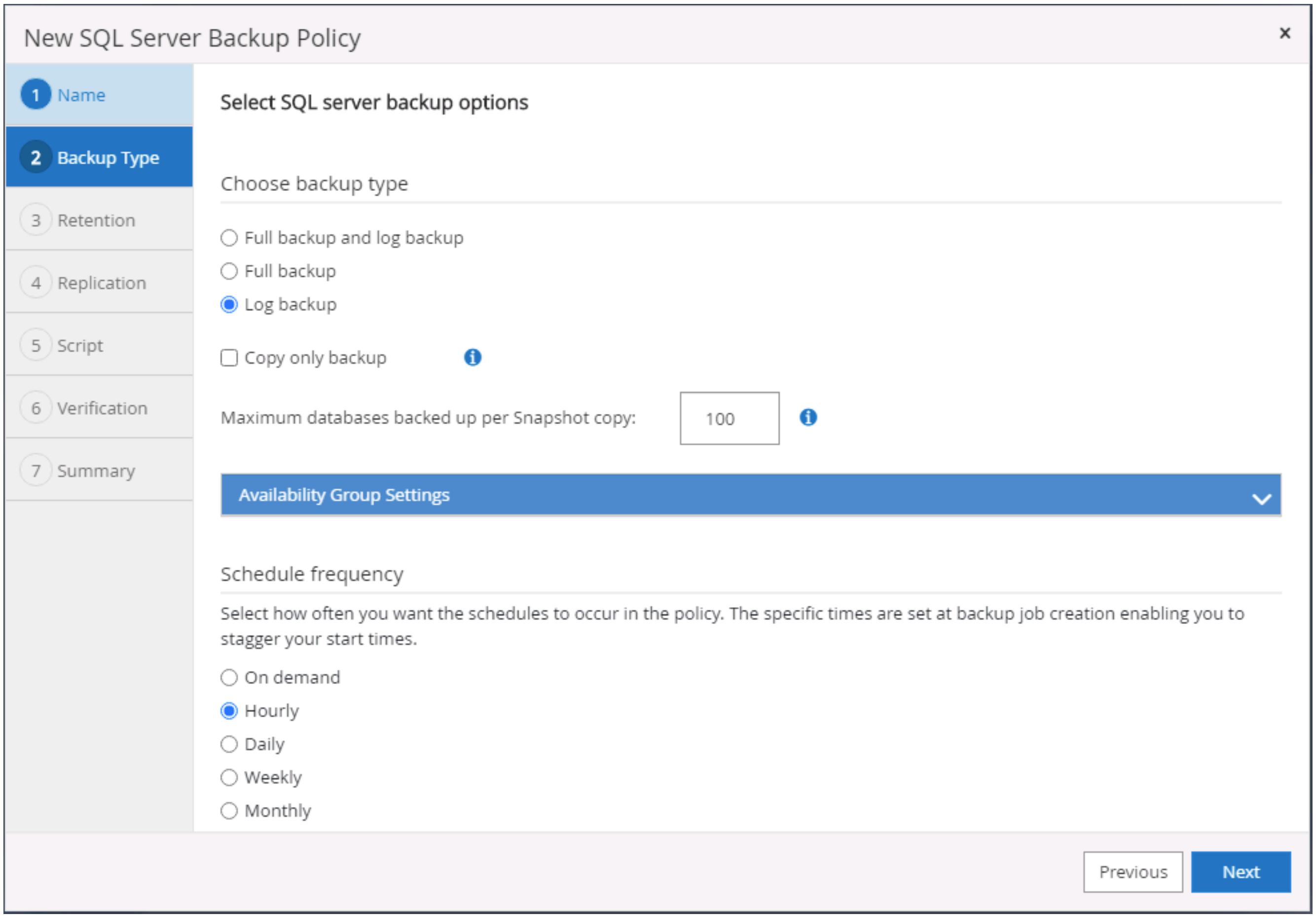
New SQL Server Backup Policy

Provide a policy name

Policy name: SQL Server Log Backup

Details: Backup SQL server log

2. Define the log backup option and schedule frequency. For SQL Server configured with a availability group, a preferred backup replica can be set.



New SQL Server Backup Policy

Select SQL server backup options

Choose backup type

○ Full backup and log backup
○ Full backup
● Log backup

□ Copy only backup

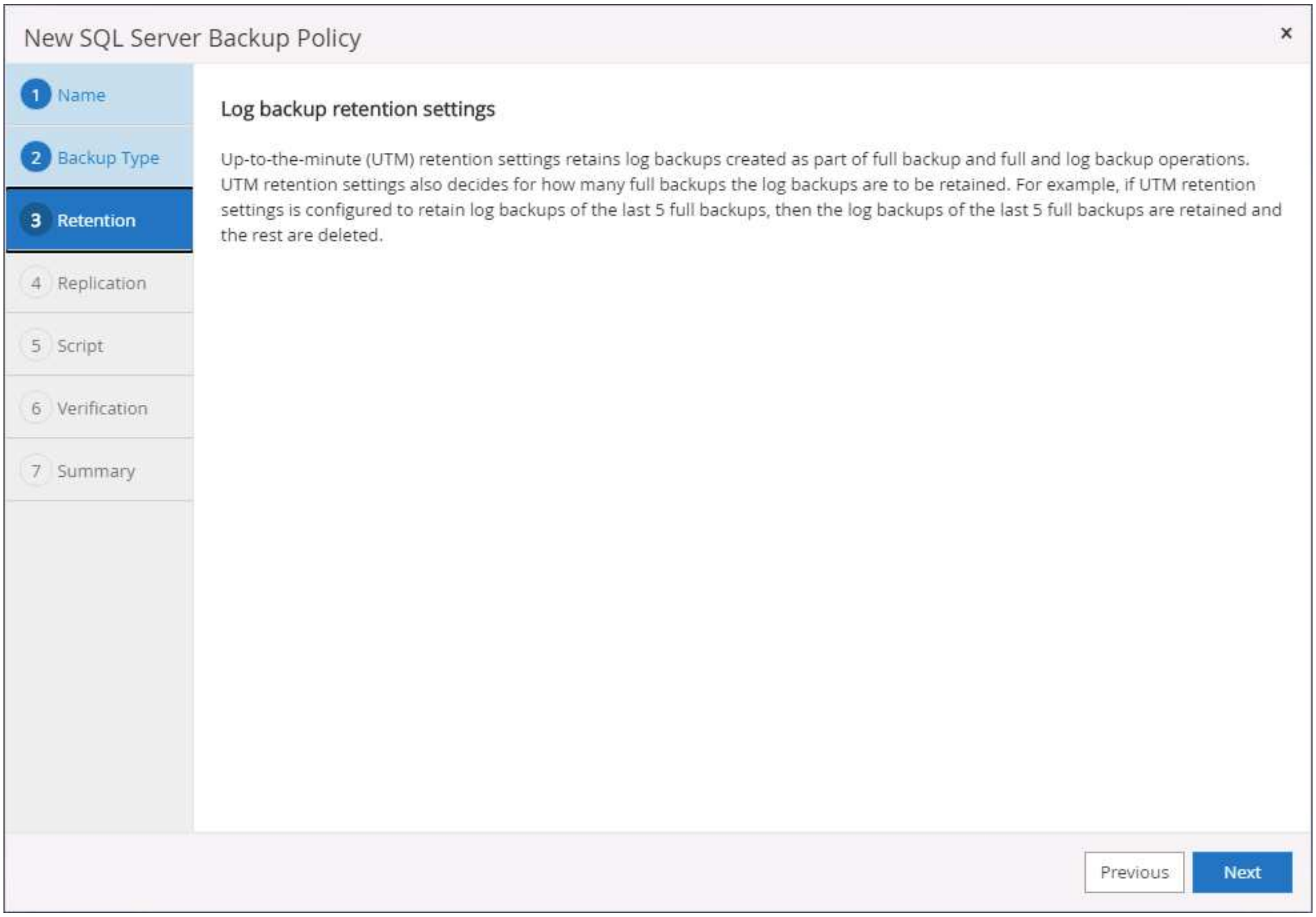
Maximum databases backed up per Snapshot copy: 100

Schedule frequency

Select how often you want the schedules to occur in the policy. The specific times are set at backup job creation enabling you to stagger your start times.

○ On demand
● Hourly
○ Daily
○ Weekly
○ Monthly

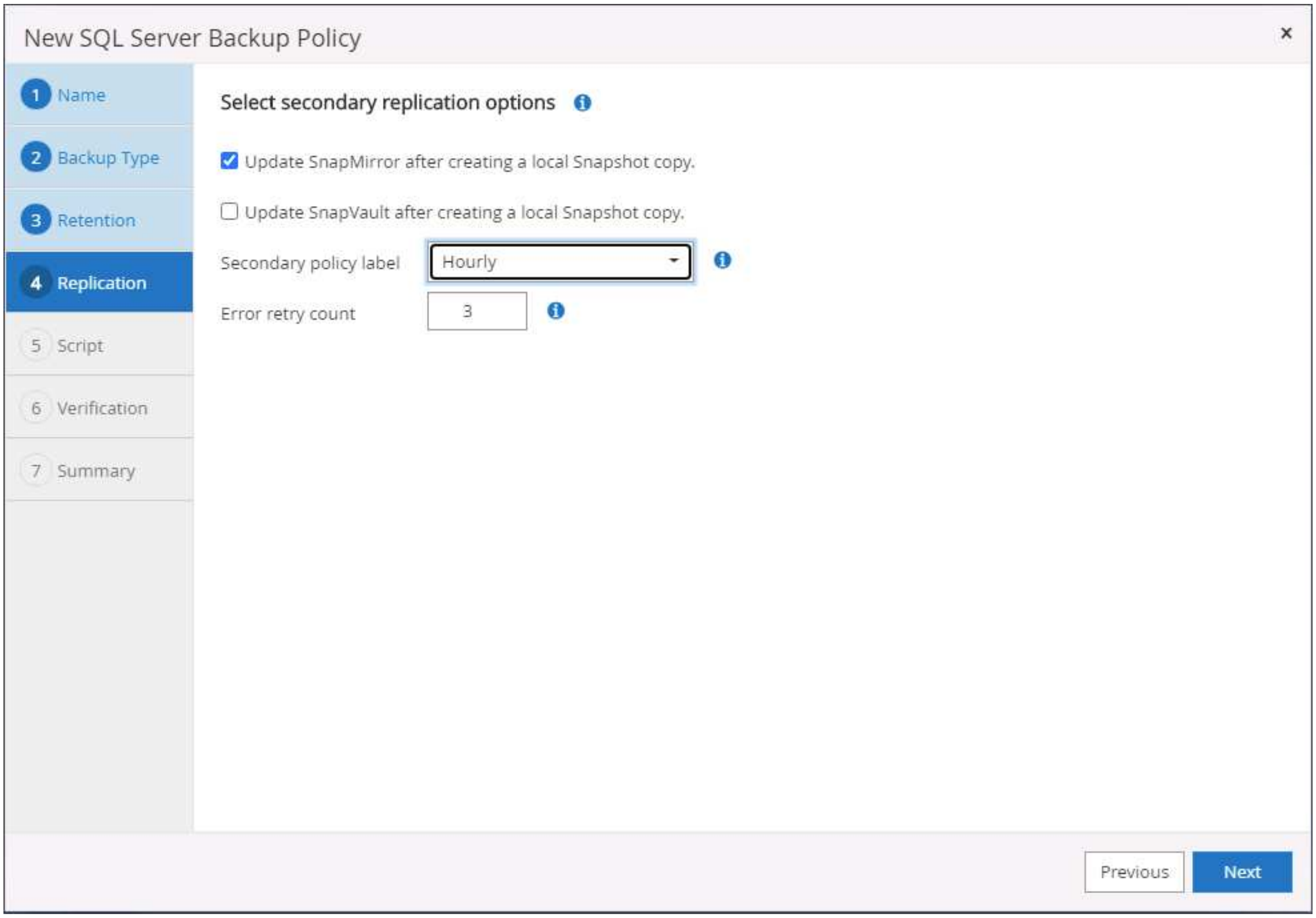
3. SQL server data backup policy defines the log backup retention; accept the defaults here.



Log backup retention settings

Up-to-the-minute (UTM) retention settings retains log backups created as part of full backup and full and log backup operations. UTM retention settings also decides for how many full backups the log backups are to be retained. For example, if UTM retention settings is configured to retain log backups of the last 5 full backups, then the log backups of the last 5 full backups are retained and the rest are deleted.

4. Enable log backup replication to secondary in the cloud.



New SQL Server Backup Policy

Select secondary replication options

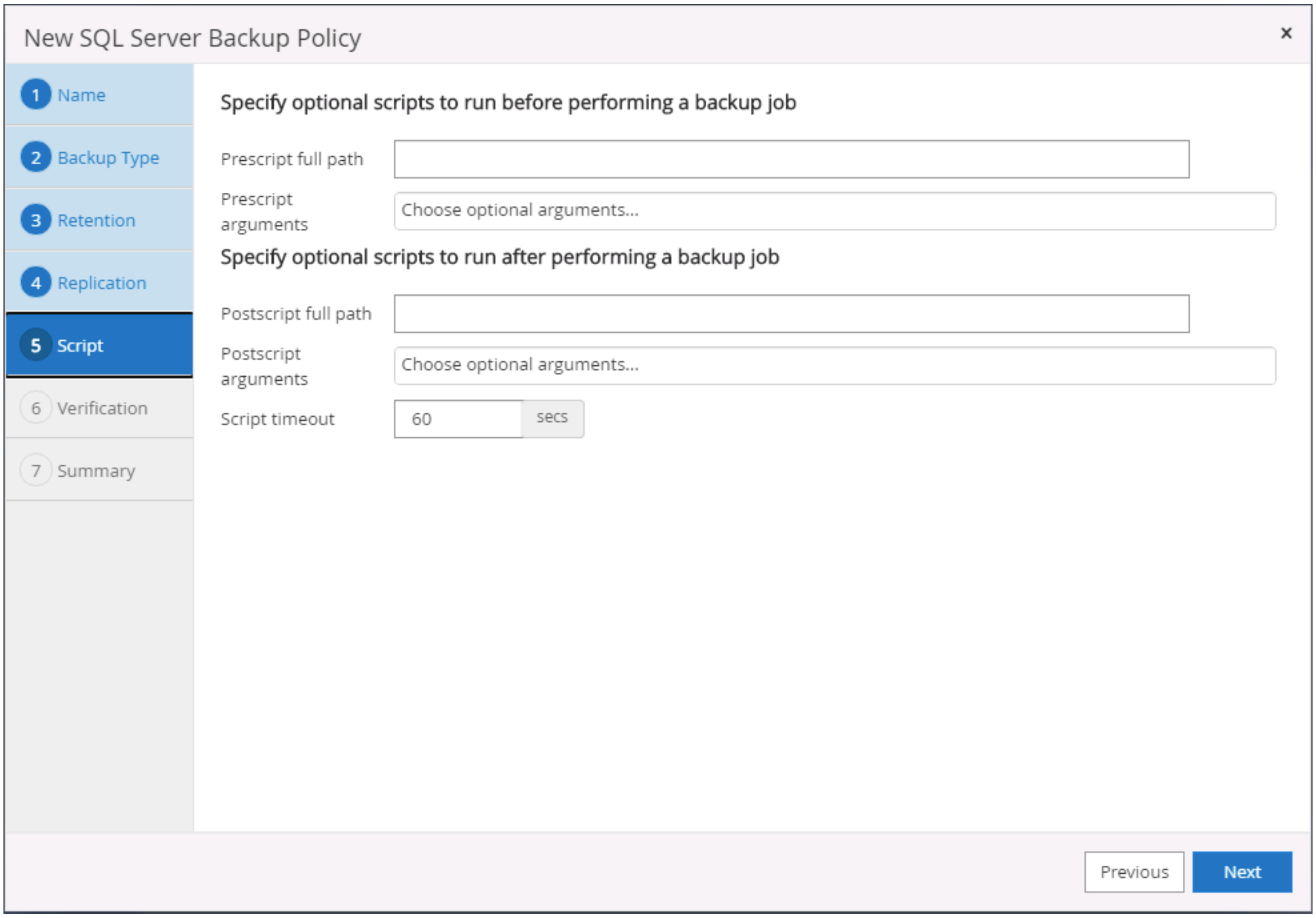
☑ Update SnapMirror after creating a local Snapshot copy.

□ Update SnapVault after creating a local Snapshot copy.

Secondary policy label: Hourly

Error retry count: 3

5. Specify any optional scripts to run before or after a backup job.



Specify optional scripts to run before performing a backup job

Prescript full path

Prescript arguments: Choose optional arguments...

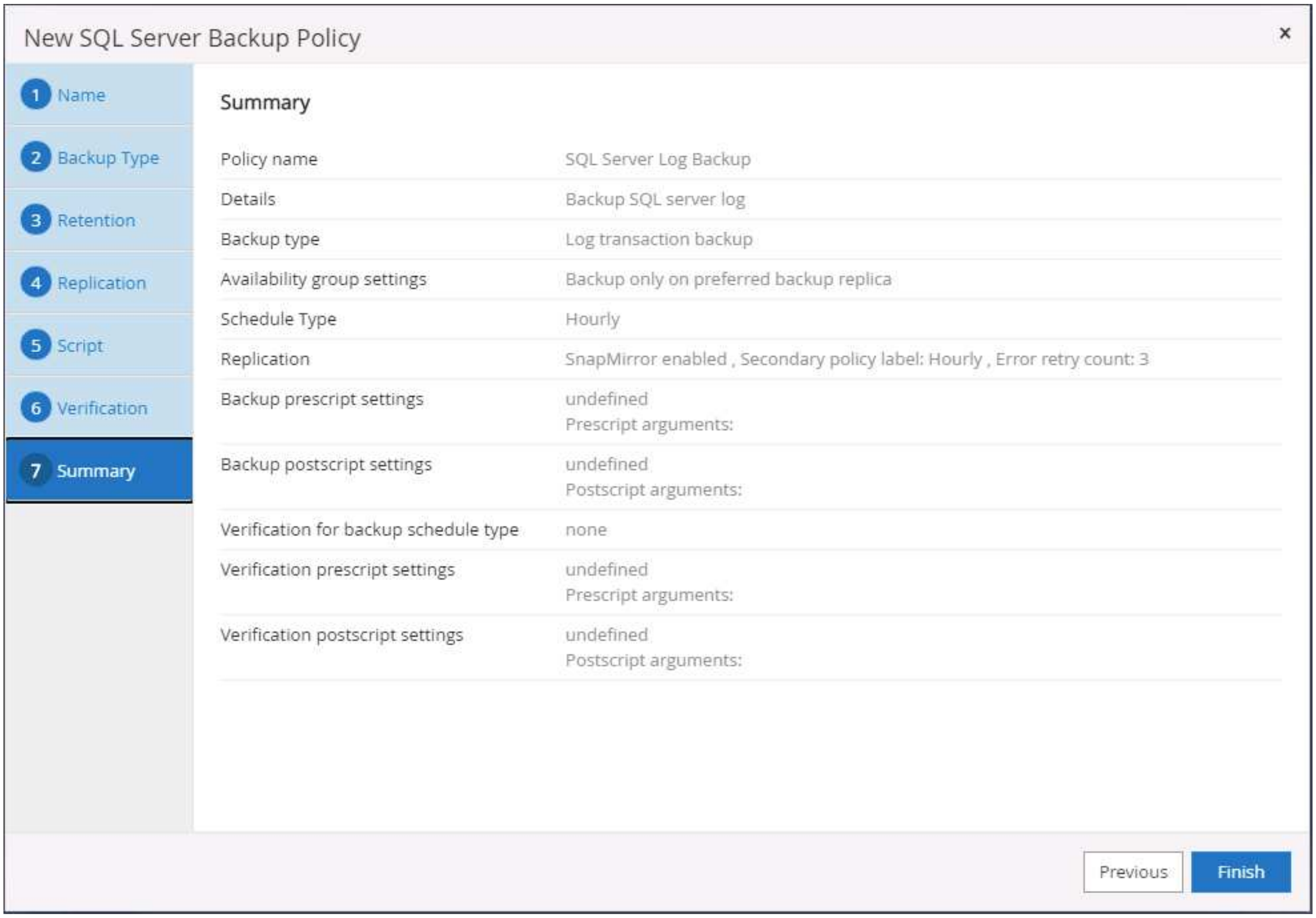
Specify optional scripts to run after performing a backup job

Postscript full path

Postscript arguments: Choose optional arguments...

Script timeout: 60 secs

6. Summary.



Summary

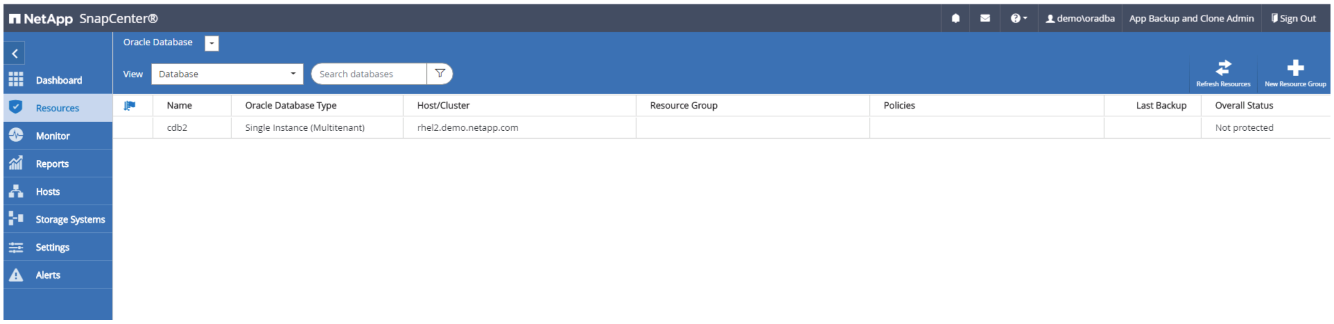
Policy name	SQL Server Log Backup
Details	Backup SQL server log
Backup type	Log transaction backup
Availability group settings	Backup only on preferred backup replica
Schedule Type	Hourly
Replication	SnapMirror enabled , Secondary policy label: Hourly , Error retry count: 3
Backup prescript settings	undefined Prescript arguments:
Backup postscript settings	undefined Postscript arguments:
Verification for backup schedule type	none
Verification prescript settings	undefined Prescript arguments:
Verification postscript settings	undefined Postscript arguments:

8. Implement backup policy to protect database

SnapCenter uses a resource group to backup a database in a logical grouping of database resources, such as multiple databases hosted on a server, a database sharing the same storage volumes, multiple databases supporting a business application, and so on. Protecting a single database creates a resource group of its own. The following procedures demonstrate how to implement a backup policy created in section 7 to protect Oracle and SQL Server databases.

Create a resource group for full backup of Oracle

1. Log into SnapCenter with a database management user ID, and navigate to the Resources tab. In the View drop-down list, choose either Database or Resource Group to launch the resource group creation workflow.

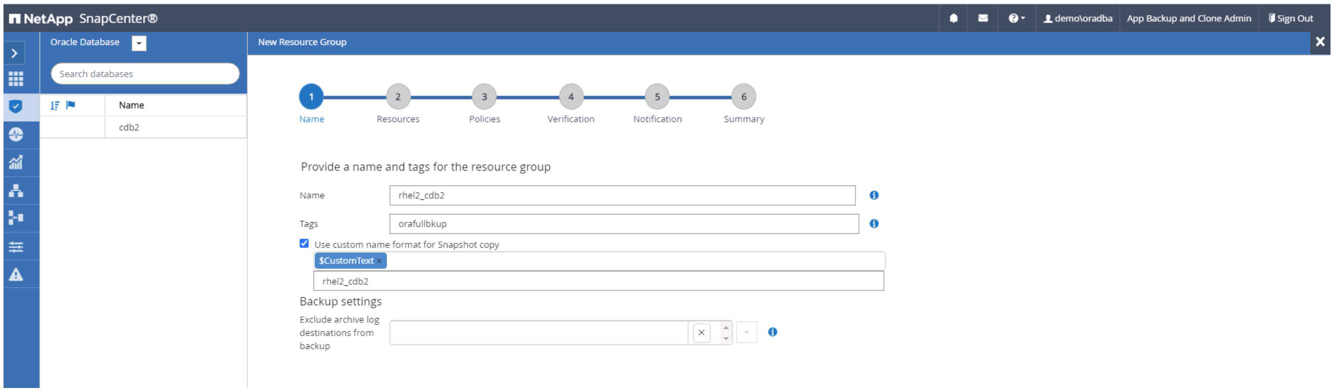


View: Database

Search databases

	Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status
	cdb2	Single Instance (Multitenant)	rhel2.demo.netapp.com				Not protected

2. Provide a name and tags for the resource group. You can define a naming format for the Snapshot copy and bypass the redundant archive log destination if configured.



Provide a name and tags for the resource group

Name: rhel2_cdb2

Tags: orafullbkup

☑ Use custom name format for Snapshot copy

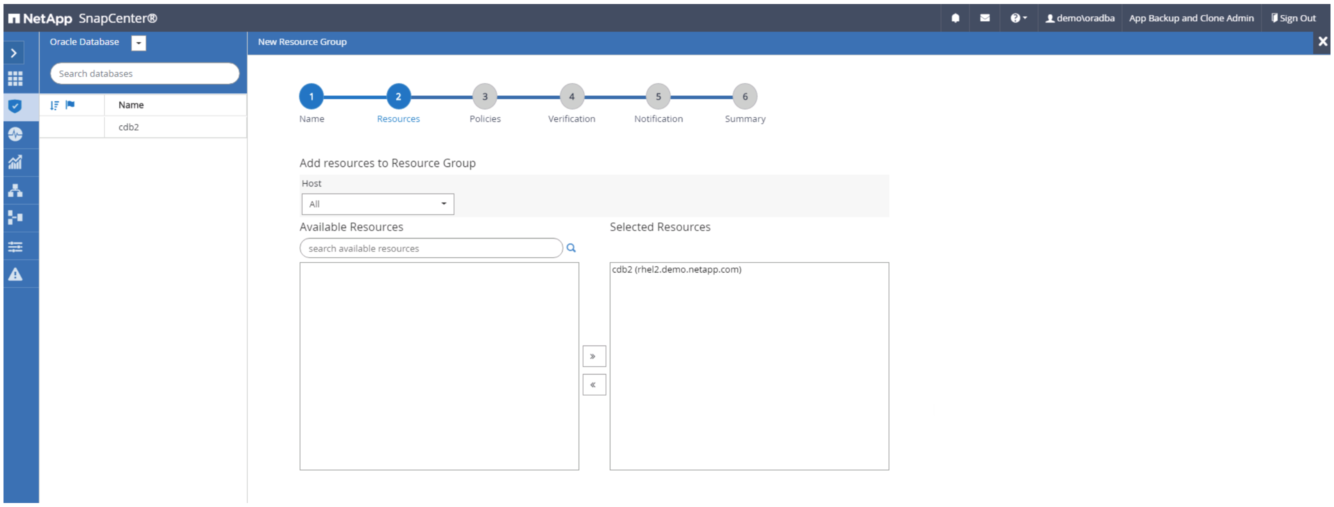
$CustomText

rhel2_cdb2

Backup settings

Exclude archive log destinations from backup

3. Add database resources to the resource group.



Add resources to Resource Group

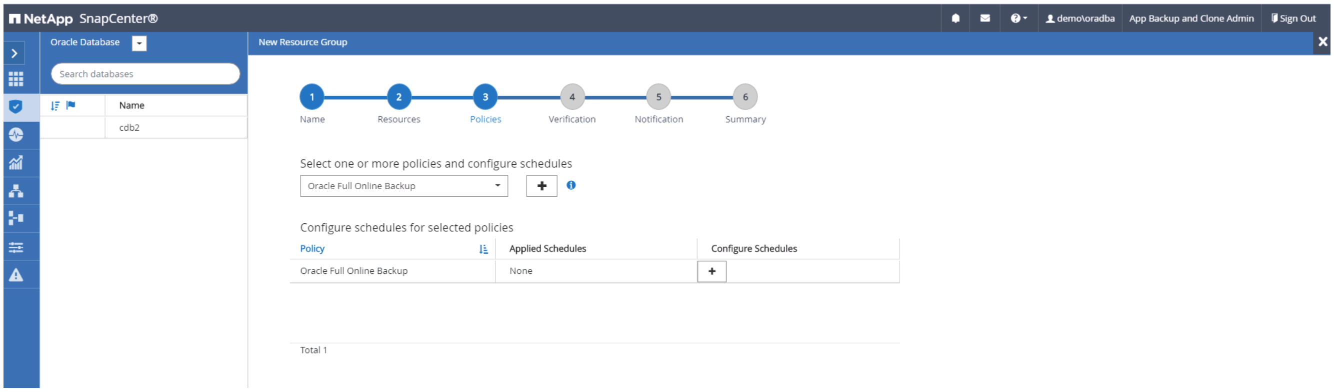
Host: All

Available Resources

Selected Resources

cdb2 (rhel2.demo.netapp.com)

4. Select a full backup policy created in section 7 from the drop-down list.



Select one or more policies and configure schedules

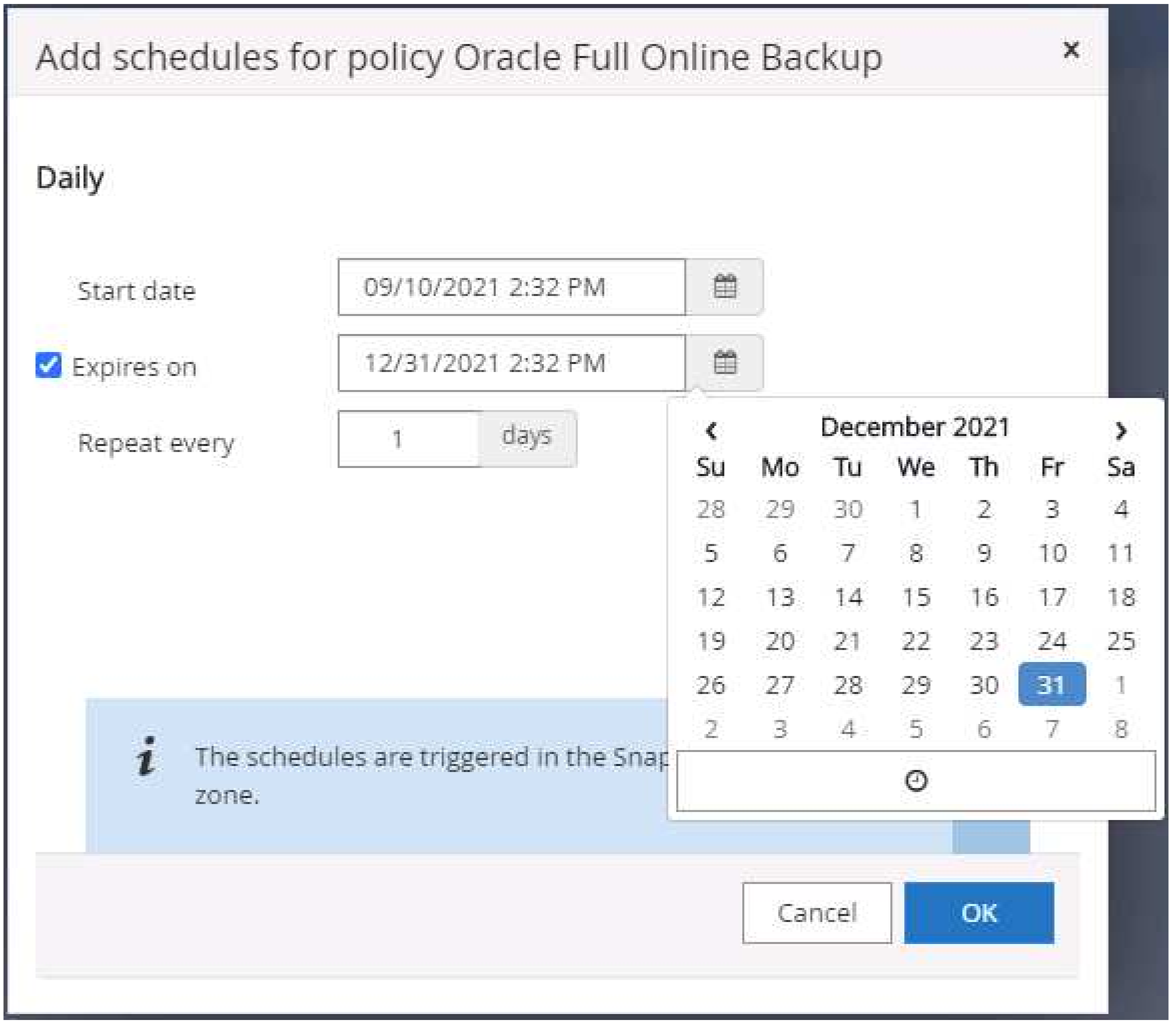
Oracle Full Online Backup

Configure schedules for selected policies

Policy	Applied Schedules	Configure Schedules
Oracle Full Online Backup	None	+

Total 1

5. Click the (+) sign to configure the desired backup schedule.



Add schedules for policy Oracle Full Online Backup

Daily

Start date: 09/10/2021 2:32 PM

☑ Expires on: 12/31/2021 2:32 PM

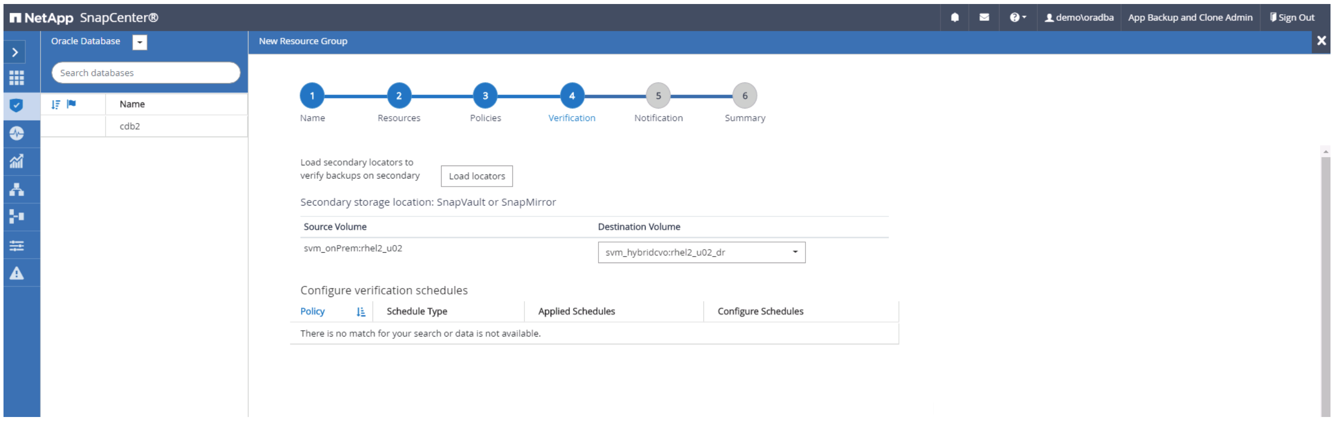
Repeat every: 1 days

December 2021

Su	Mo	Tu	We	Th	Fr	Sa
28	29	30	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

The schedules are triggered in the Snap
zone.

6. Click Load Locators to load the source and destination volume.



Load secondary locators to verify backups on secondary [Load locators]

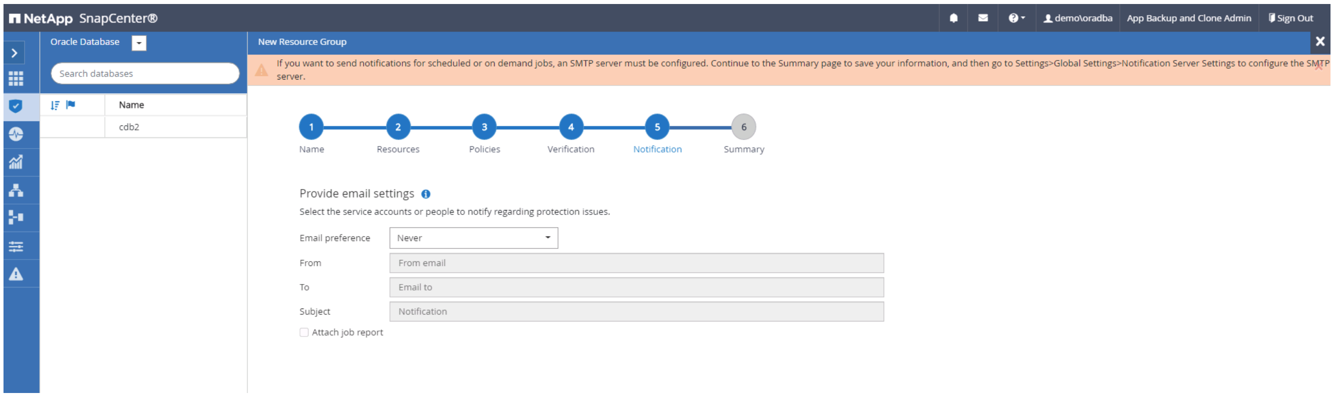
Secondary storage location: SnapVault or SnapMirror

Source Volume	Destination Volume
svm_onPrem:rhel2_u02	svm_hybridcvo:rhel2_u02_dr

Configure verification schedules

Policy	Schedule Type	Applied Schedules	Configure Schedules
There is no match for your search or data is not available.			

7. Configure the SMTP server for email notification if desired.



If you want to send notifications for scheduled or on demand jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTP server.

Provide email settings

Select the service accounts or people to notify regarding protection issues.

Email preference: Never

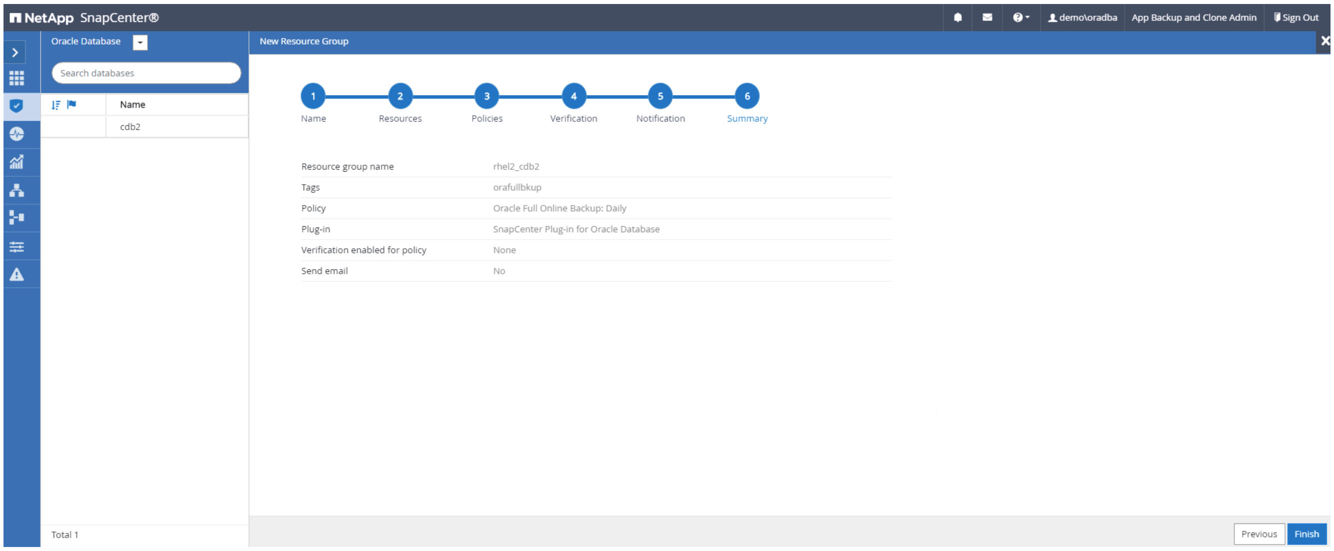
From: From email

To: Email to

Subject: Notification

□ Attach job report

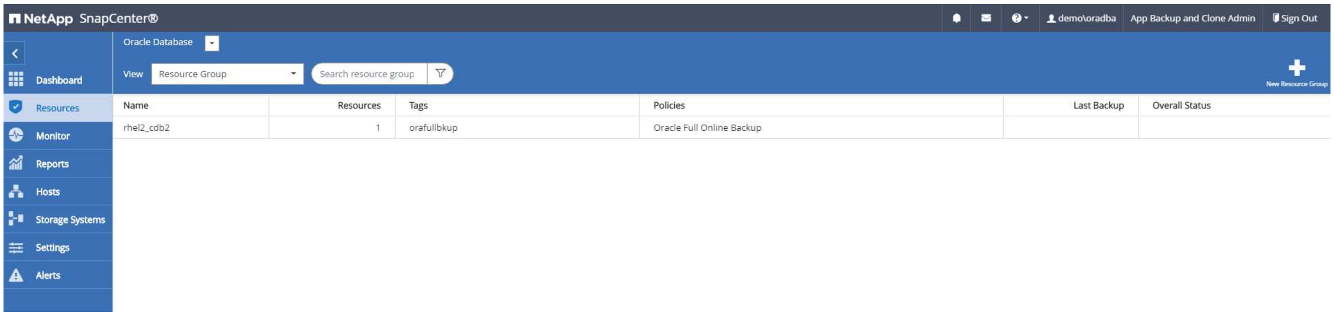
8. Summary.



Resource group name	rhel2_cdb2
Tags	orafullbkup
Policy	Oracle Full Online Backup: Daily
Plug-in	SnapCenter Plug-in for Oracle Database
Verification enabled for policy	None
Send email	No

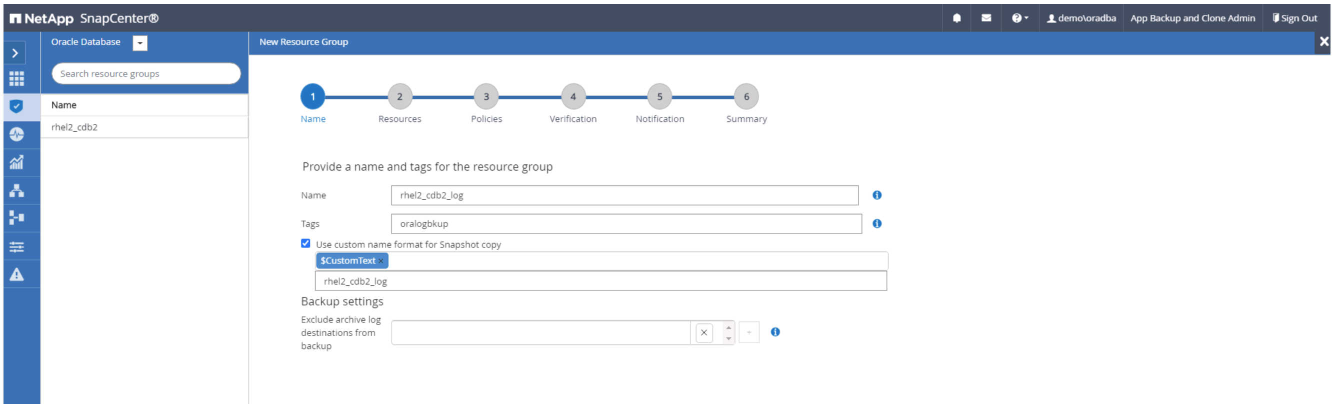
Create a resource group for log backup of Oracle

1. Log into SnapCenter with a database management user ID, and navigate to the Resources tab. In the View drop-down list, choose either Database or Resource Group to launch the resource group creation workflow.



Name	Resources	Tags	Policies	Last Backup	Overall Status
rhel2_cdb2	1	orafullbkup	Oracle Full Online Backup		

2. Provide a name and tags for the resource group. You can define a naming format for the Snapshot copy and bypass the redundant archive log destination if configured.



Provide a name and tags for the resource group

Name: rhel2_cdb2_log

Tags: oralogbkup

☑ Use custom name format for Snapshot copy

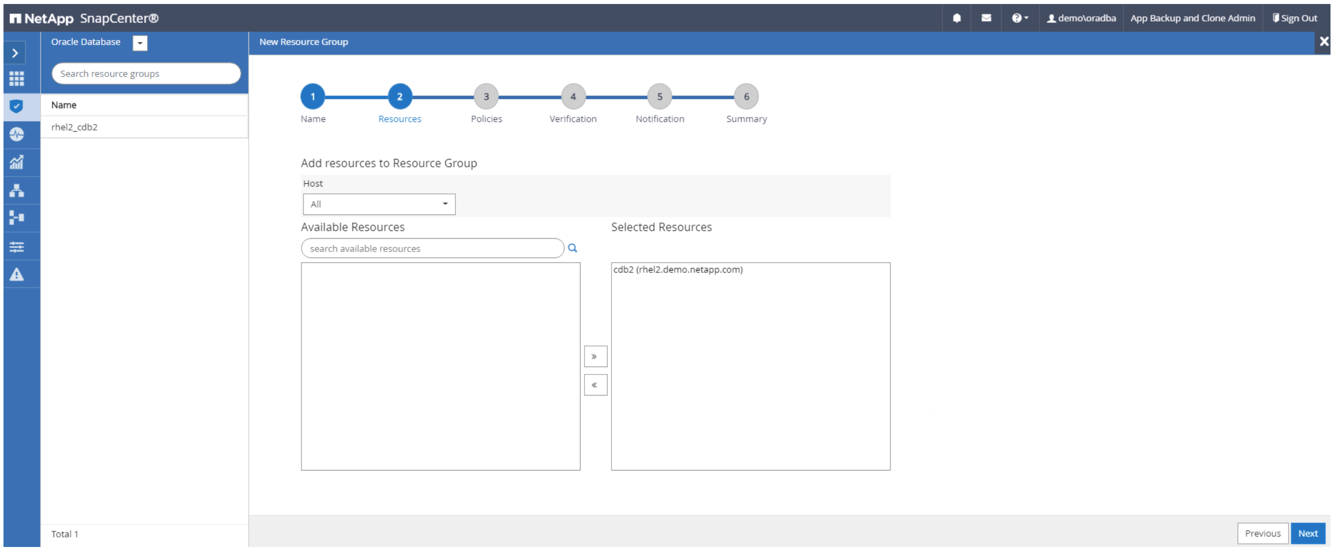
$CustomText

rhel2_cdb2_log

Backup settings

Exclude archive log destinations from backup

3. Add database resources to the resource group.



Add resources to Resource Group

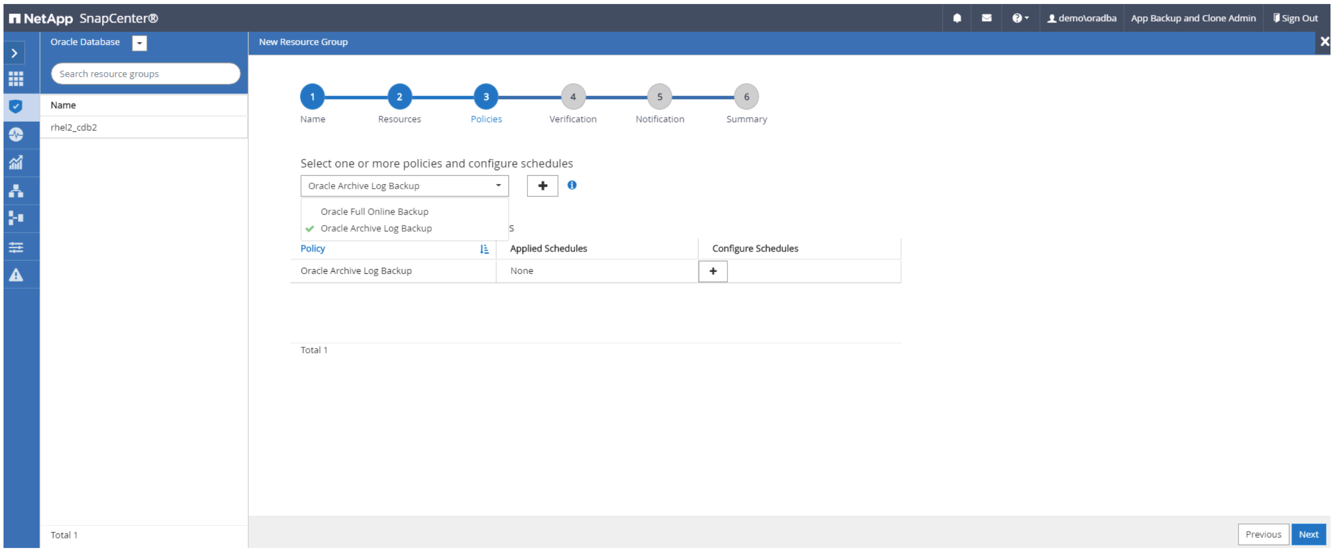
Host: All

Available Resources

Selected Resources

cdb2 (rhel2.demo.netapp.com)

4. Select a log backup policy created in section 7 from the drop-down list.



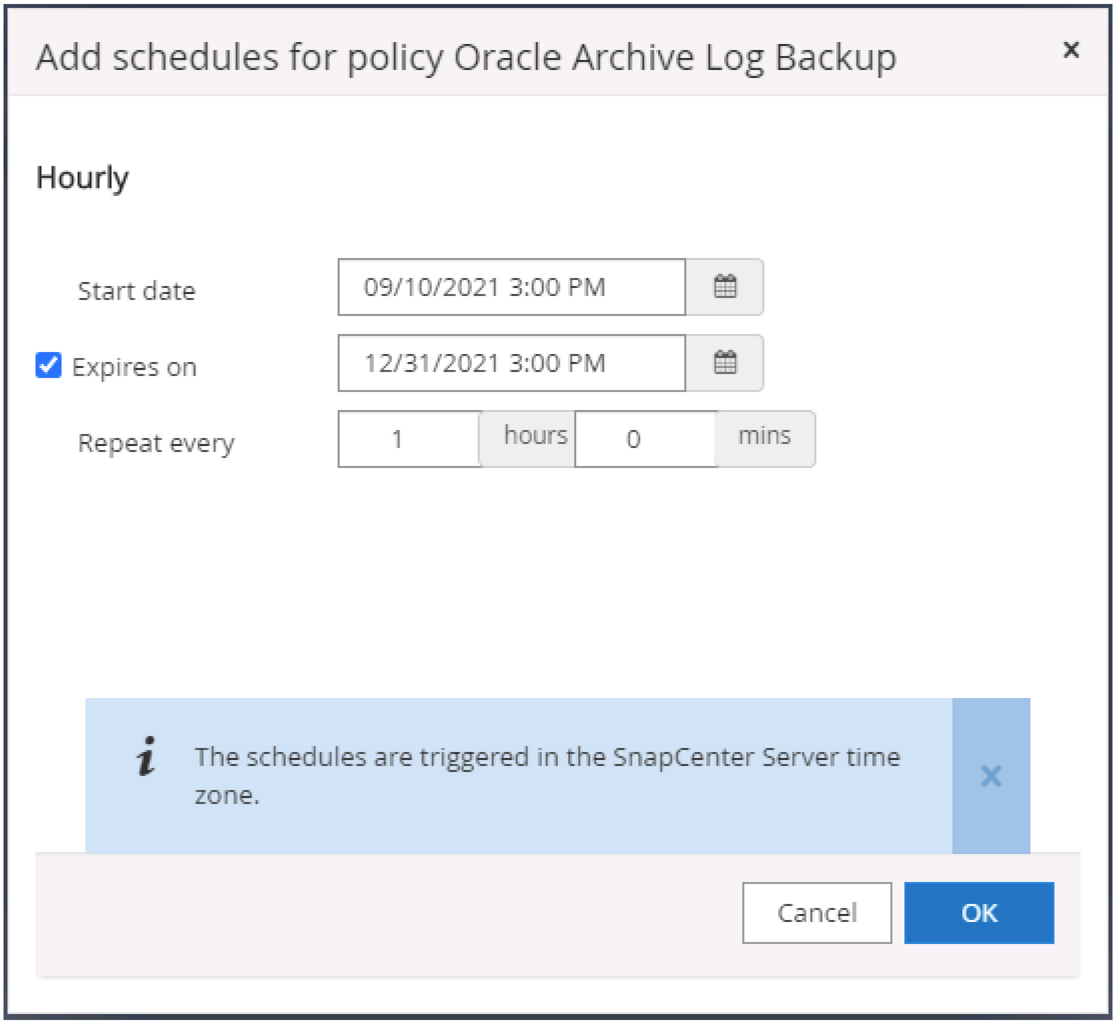
Select one or more policies and configure schedules

Oracle Archive Log Backup

Policy	Applied Schedules	Configure Schedules
Oracle Archive Log Backup	None	+

Total 1

5. Click on the (+) sign to configure the desired backup schedule.



Add schedules for policy Oracle Archive Log Backup

Hourly

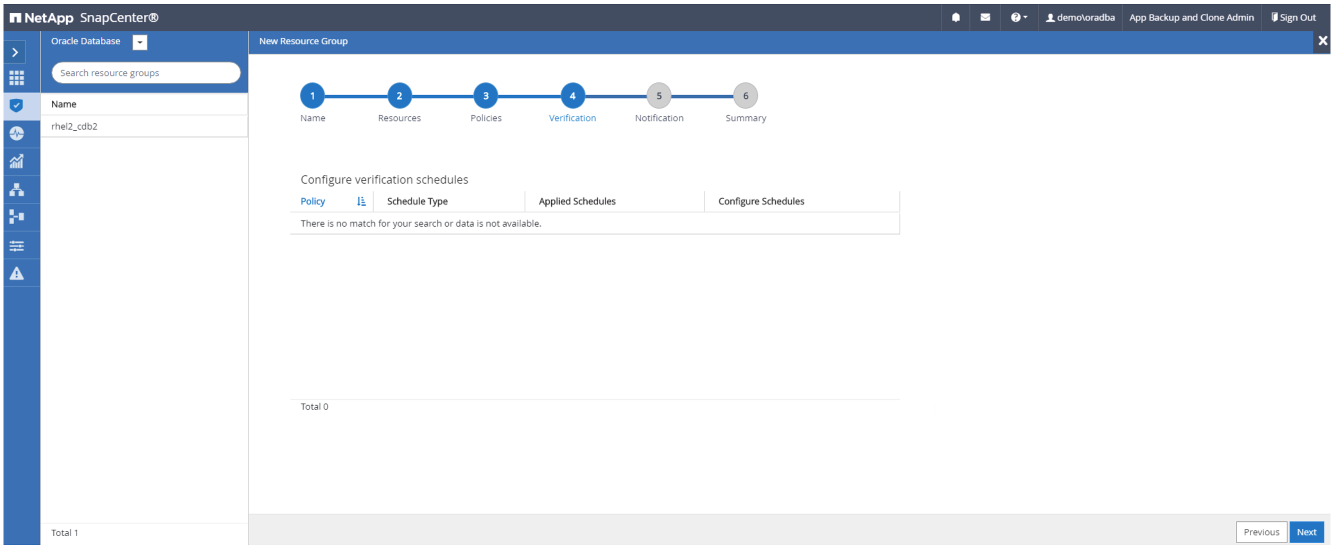
Start date 09/10/2021 3:00 PM

☑ Expires on 12/31/2021 3:00 PM

Repeat every 1 hours 0 mins

The schedules are triggered in the SnapCenter Server time zone.

6. If backup verification is configured, it displays here.



Name
rhel2_cdb2

Total 1

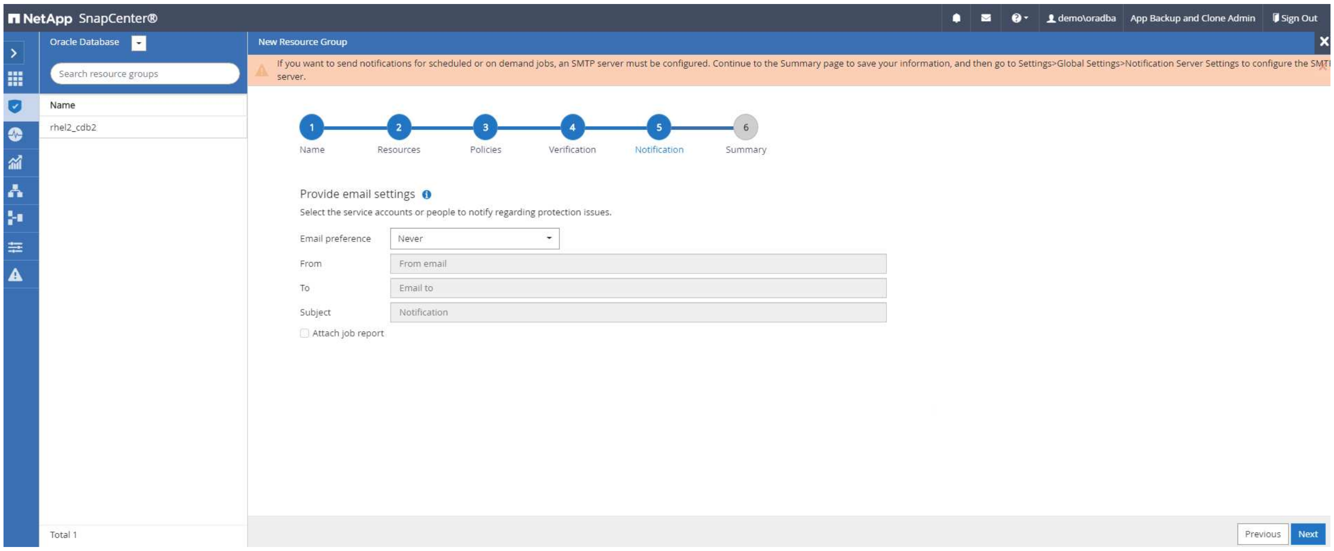
New Resource Group

Configure verification schedules

Policy	Schedule Type	Applied Schedules	Configure Schedules
There is no match for your search or data is not available.			

Total 0

7. Configure an SMTP server for email notification if desired.



If you want to send notifications for scheduled or on demand jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTI server.

Provide email settings

Select the service accounts or people to notify regarding protection issues.

Email preference: Never

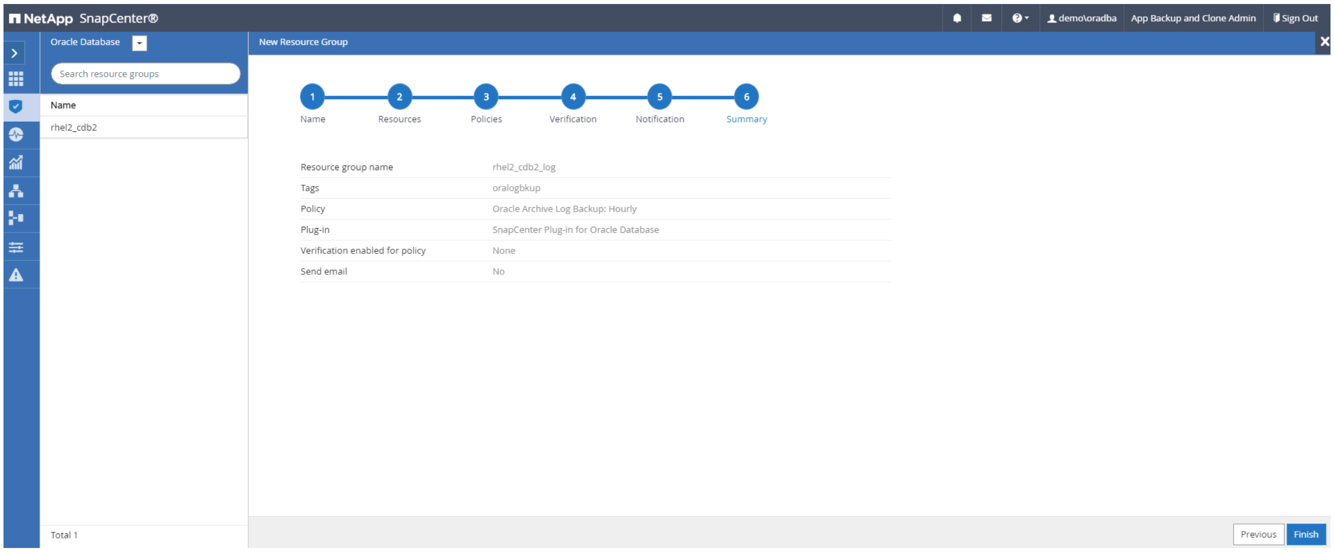
From: From email

To: Email to

Subject: Notification

□ Attach job report

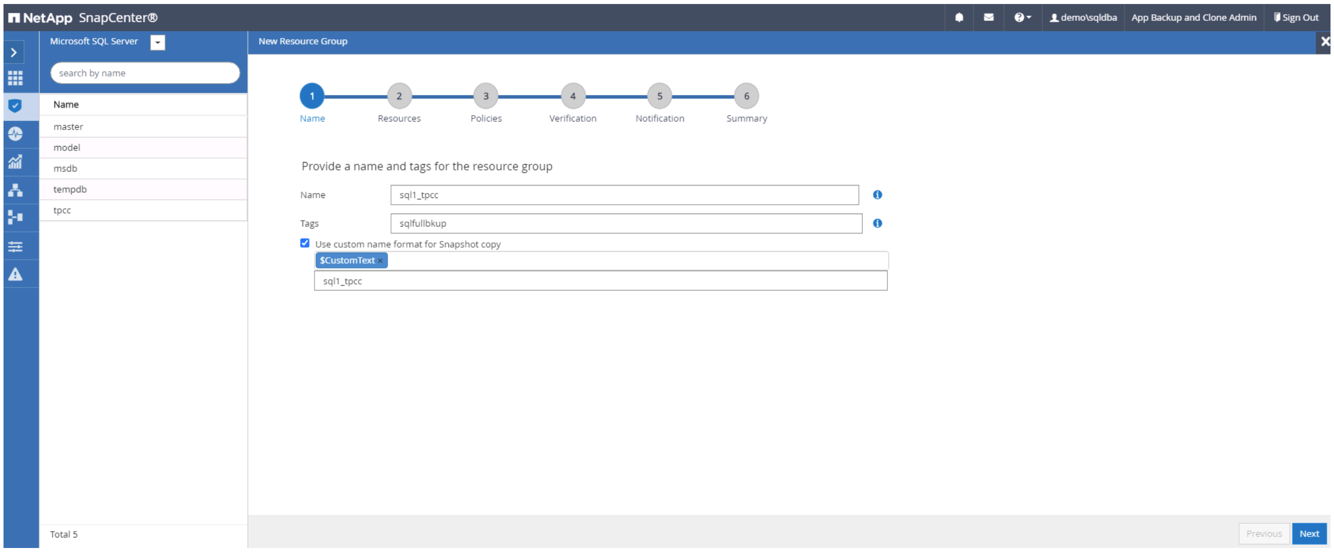
8. Summary.



Resource group name	rhel2_cdb2_log
Tags	oralogbkup
Policy	Oracle Archive Log Backup: Hourly
Plug-in	SnapCenter Plug-in for Oracle Database
Verification enabled for policy	None
Send email	No

Create a resource group for full backup of SQL Server

1. Log into SnapCenter with a database management user ID, and navigate to the Resources tab. In the View drop-down list, choose either a Database or Resource Group to launch the resource group creation workflow. Provide a name and tags for the resource group. You can define a naming format for the Snapshot copy.



Name
master
model
msdb
tempdb
tpcc

Total 5

Provide a name and tags for the resource group

Name: sql1_tpcc

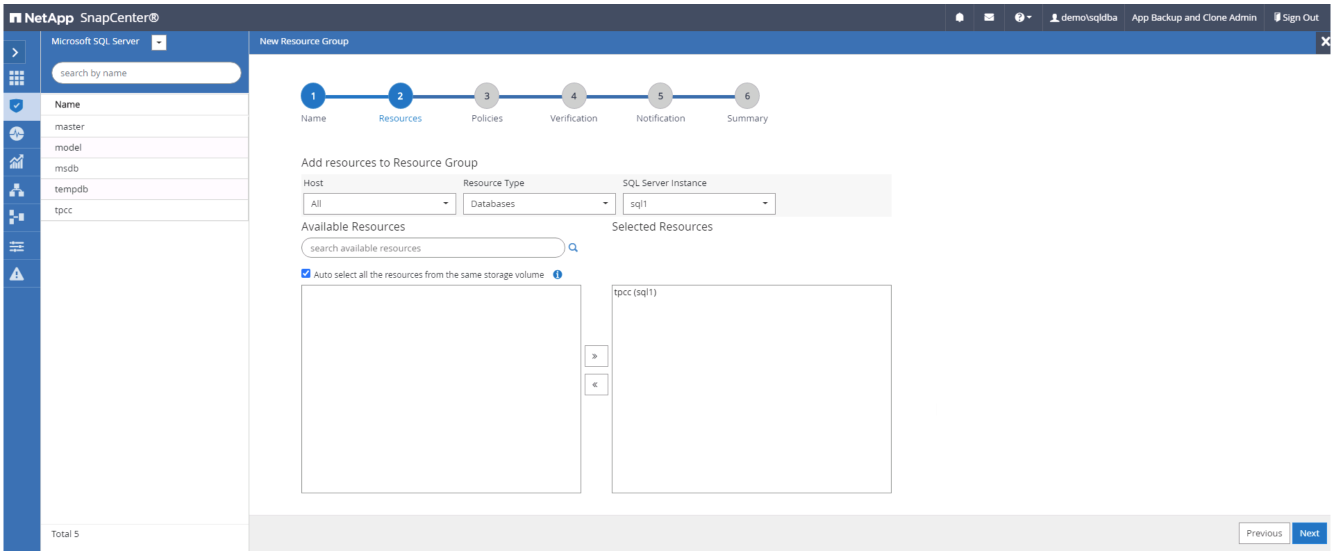
Tags: sqlfullbkup

☑ Use custom name format for Snapshot copy

$CustomText

sql1_tpcc

2. Select the database resources to be backed up.



Name
master
model
msdb
tempdb
tpcc

Total 5

Add resources to Resource Group

Host: All

Resource Type: Databases

SQL Server Instance: sql1

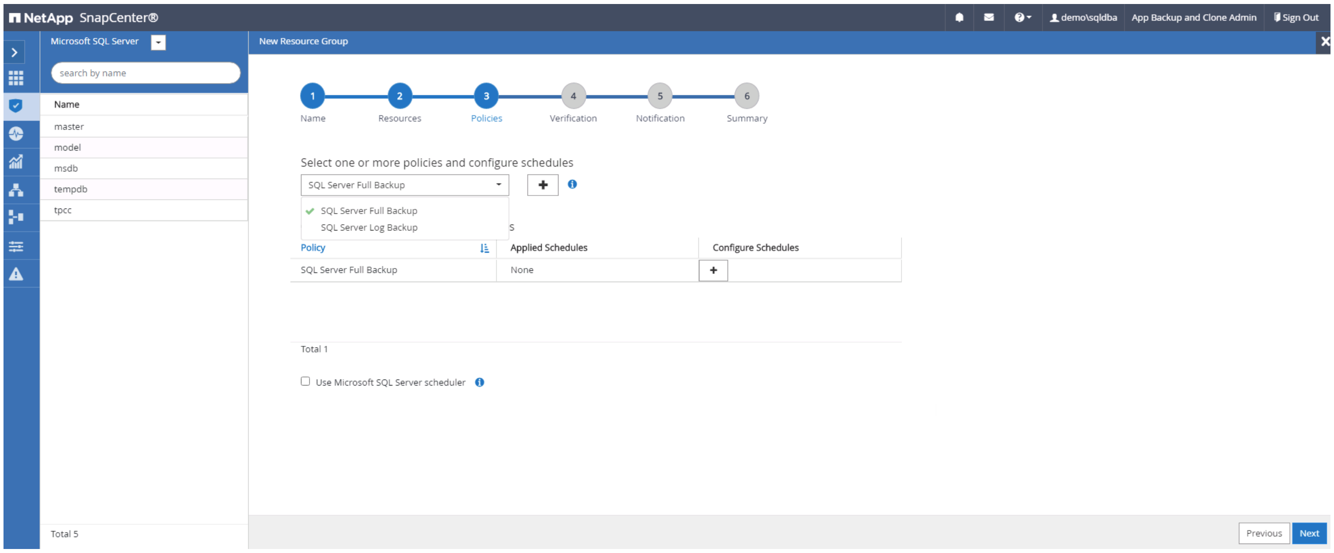
Available Resources

Selected Resources

☑ Auto select all the resources from the same storage volume

tpcc (sql1)

3. Select a full SQL backup policy created in section 7.



Name
master
model
msdb
tempdb
tpcc

Total 5

Select one or more policies and configure schedules

SQL Server Full Backup

✓ SQL Server Full Backup

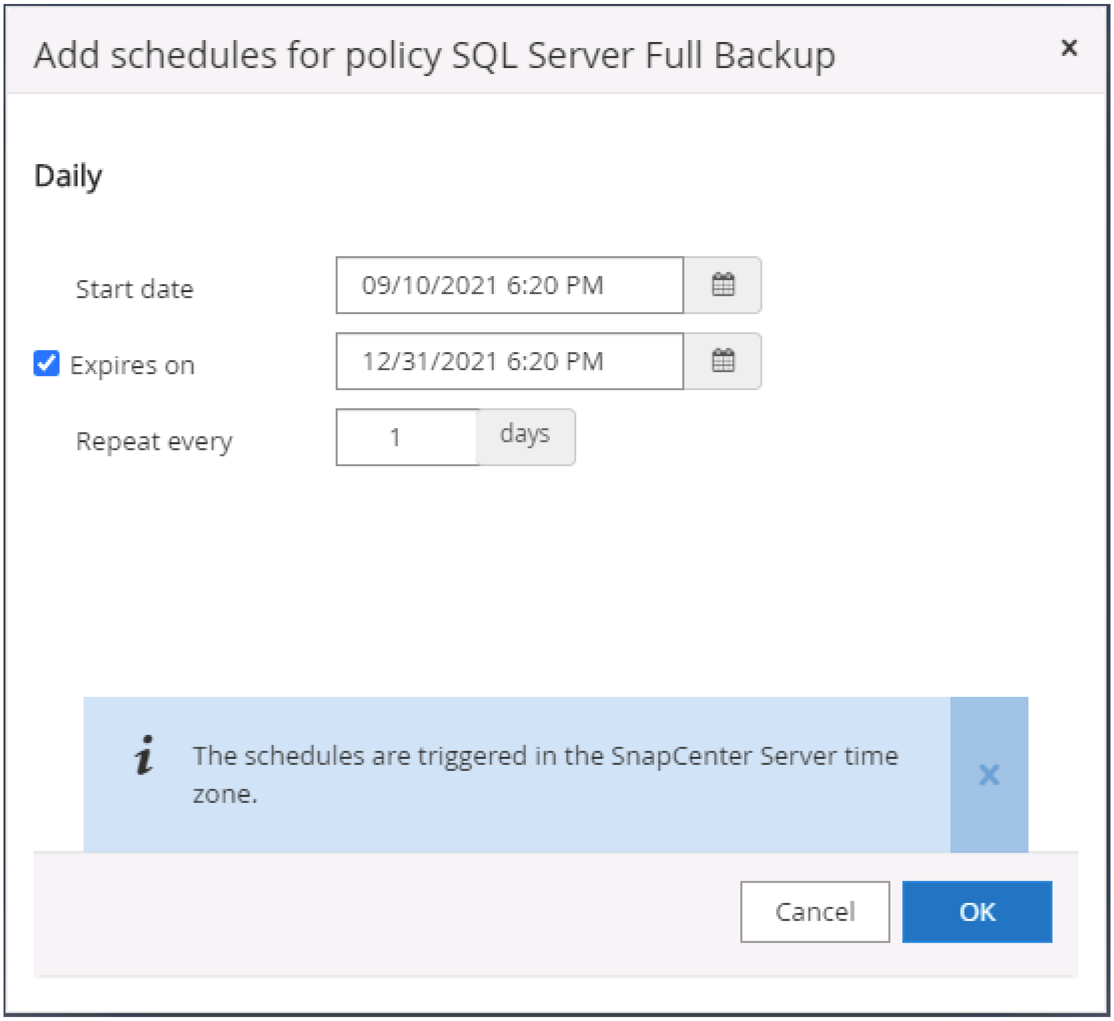
SQL Server Log Backup

Policy	Applied Schedules	Configure Schedules
SQL Server Full Backup	None	+

Total 1

☐ Use Microsoft SQL Server scheduler

4. Add exact timing for backups as well as the frequency.



Add schedules for policy SQL Server Full Backup

Daily

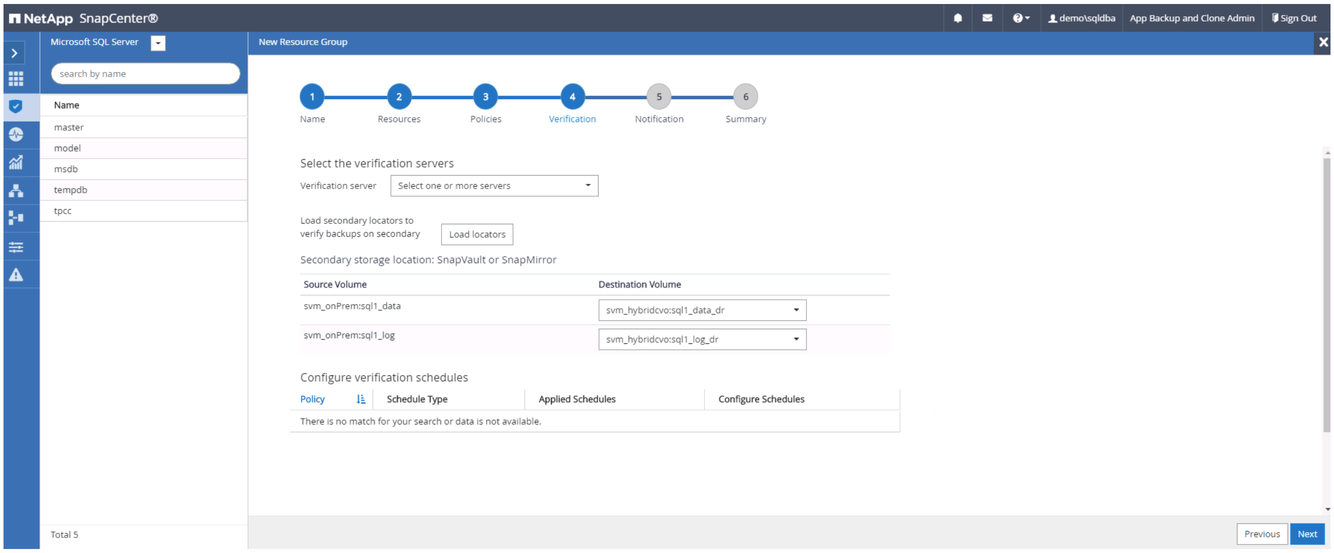
Start date: 09/10/2021 6:20 PM

☑ Expires on: 12/31/2021 6:20 PM

Repeat every: 1 days

The schedules are triggered in the SnapCenter Server time zone.

5. Choose the verification server for the backup on secondary if backup verification is to be performed. Click Load Locator to populate the secondary storage location.



New Resource Group

Name
master
model
msdb
tempdb
tpcc

Total 5

Select the verification servers

Verification server: Select one or more servers

Load secondary locators to verify backups on secondary: Load locators

Secondary storage location: SnapVault or SnapMirror

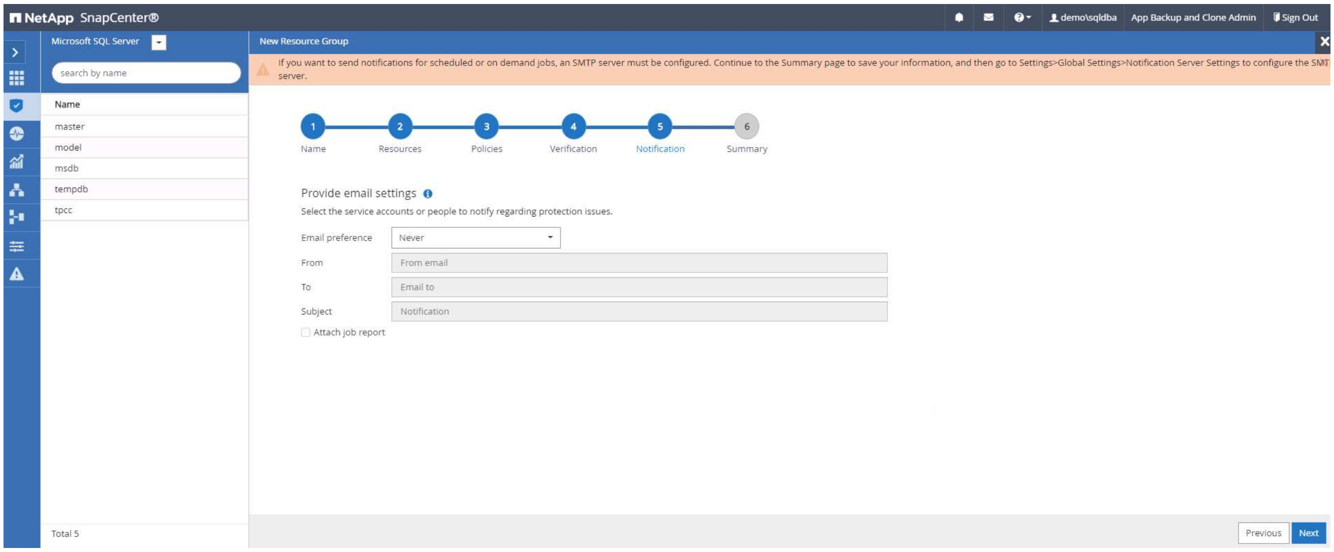
Source Volume	Destination Volume
svm_onPrem:sql1_data	svm_hybridcvo:sql1_data_dr
svm_onPrem:sql1_log	svm_hybridcvo:sql1_log_dr

Configure verification schedules

Policy	Schedule Type	Applied Schedules	Configure Schedules

There is no match for your search or data is not available.

6. Configure the SMTP server for email notification if desired.



If you want to send notifications for scheduled or on demand jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMT server.

Provide email settings

Select the service accounts or people to notify regarding protection issues.

Email preference: Never

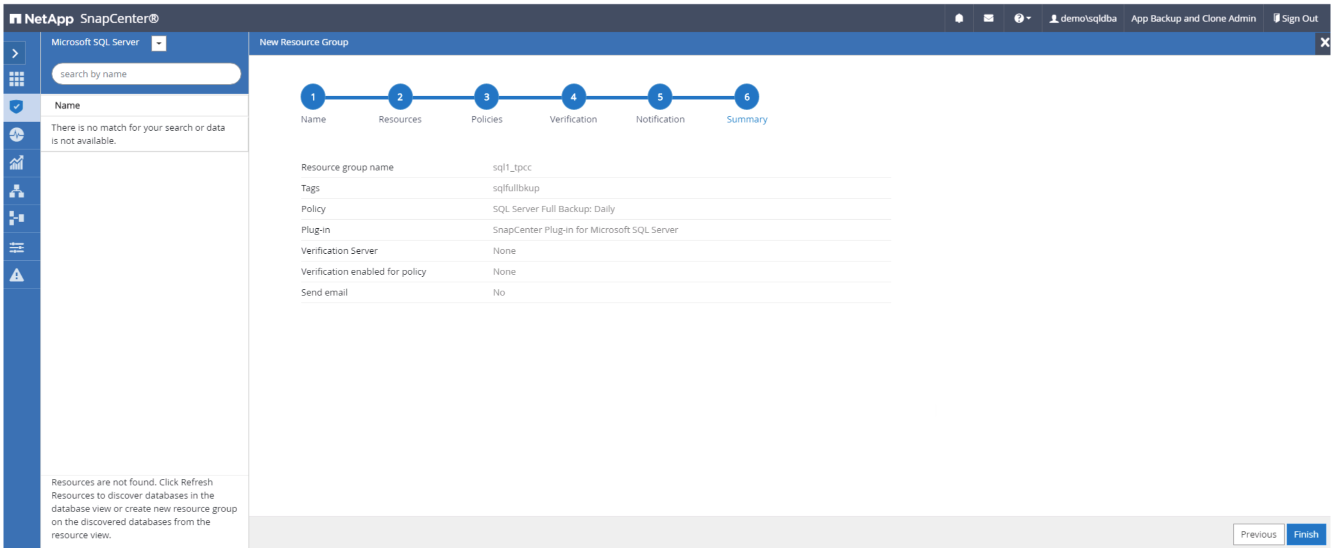
From: From email

To: Email to

Subject: Notification

□ Attach job report

7. Summary.



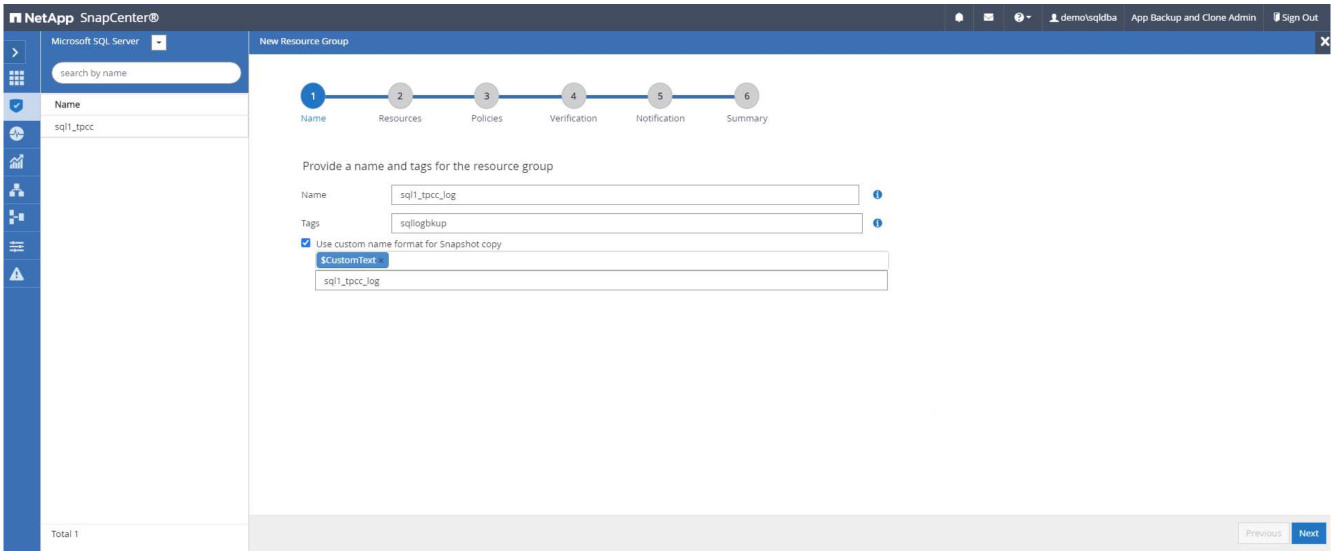
There is no match for your search or data is not available.

Resource group name	sql1_tpcc
Tags	sqlfullbkup
Policy	SQL Server Full Backup: Daily
Plug-in	SnapCenter Plug-in for Microsoft SQL Server
Verification Server	None
Verification enabled for policy	None
Send email	No

Resources are not found. Click Refresh Resources to discover databases in the database view or create new resource group on the discovered databases from the resource view.

Create a resource group for log backup of SQL Server

1. Log into SnapCenter with a database management user ID, and navigate to the Resources tab. In the View drop-down list, choose either a Database or Resource Group to launch the resource group creation workflow. Provide the name and tags for the resource group. You can define a naming format for the Snapshot copy.



Provide a name and tags for the resource group

Name: sql1_tpcc_log

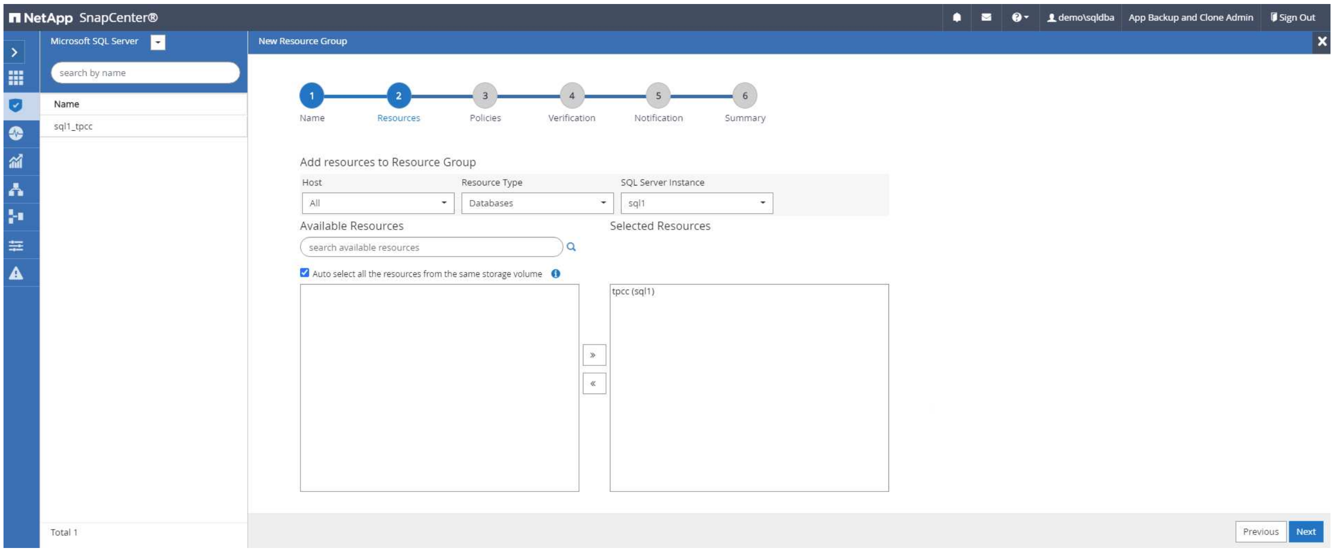
Tags: sqllogbkup

☑ Use custom name format for Snapshot copy

$CustomText

sql1_tpcc_log

2. Select the database resources to be backed up.



Add resources to Resource Group

Host: All

Resource Type: Databases

SQL Server Instance: sql1

Available Resources

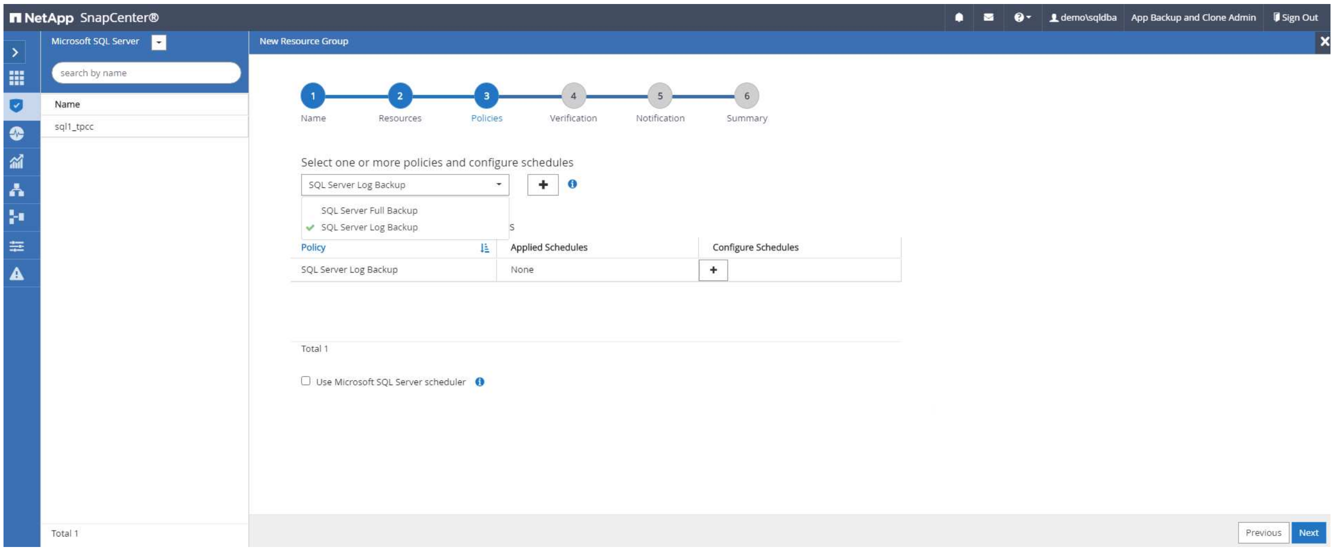
search available resources

☑ Auto select all the resources from the same storage volume

Selected Resources

tpcc (sql1)

3. Select a SQL log backup policy created in section 7.



Select one or more policies and configure schedules

SQL Server Log Backup

SQL Server Full Backup

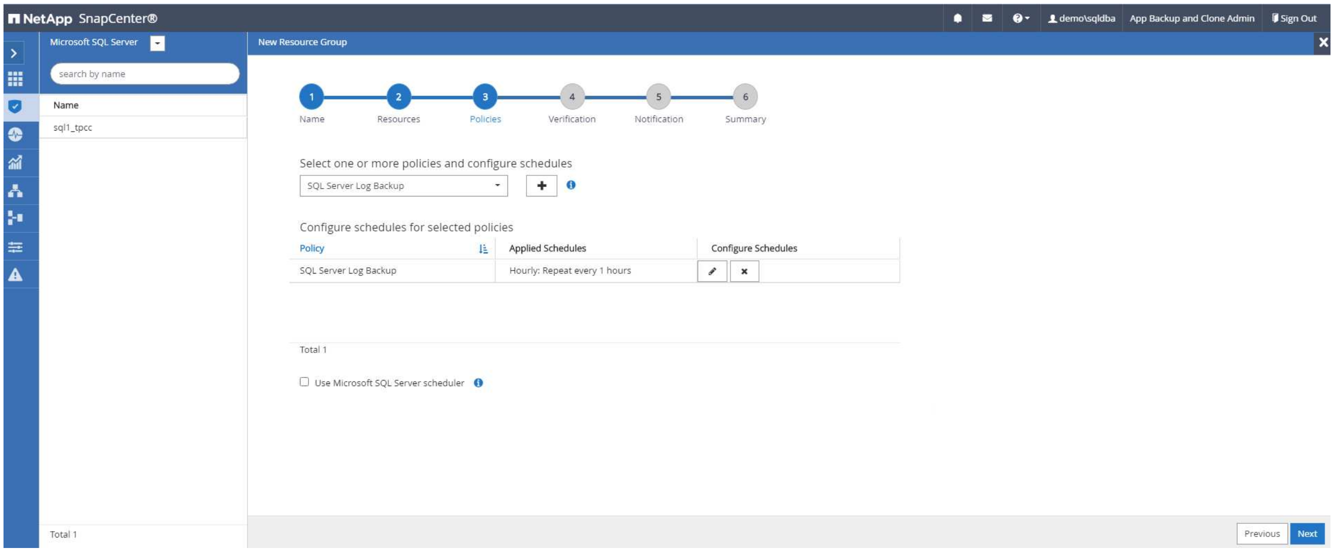
✓ SQL Server Log Backup

Policy	Applied Schedules	Configure Schedules
SQL Server Log Backup	None	+

Total 1

☐ Use Microsoft SQL Server scheduler

4. Add exact timing for the backup as well as the frequency.



NetApp SnapCenter® | demo\sqldba | App Backup and Clone Admin | Sign Out

Microsoft SQL Server | New Resource Group

search by name

Name
sql1_tpcc

Total 1

1 Name — 2 Resources — 3 Policies — 4 Verification — 5 Notification — 6 Summary

Select one or more policies and configure schedules

SQL Server Log Backup

Configure schedules for selected policies

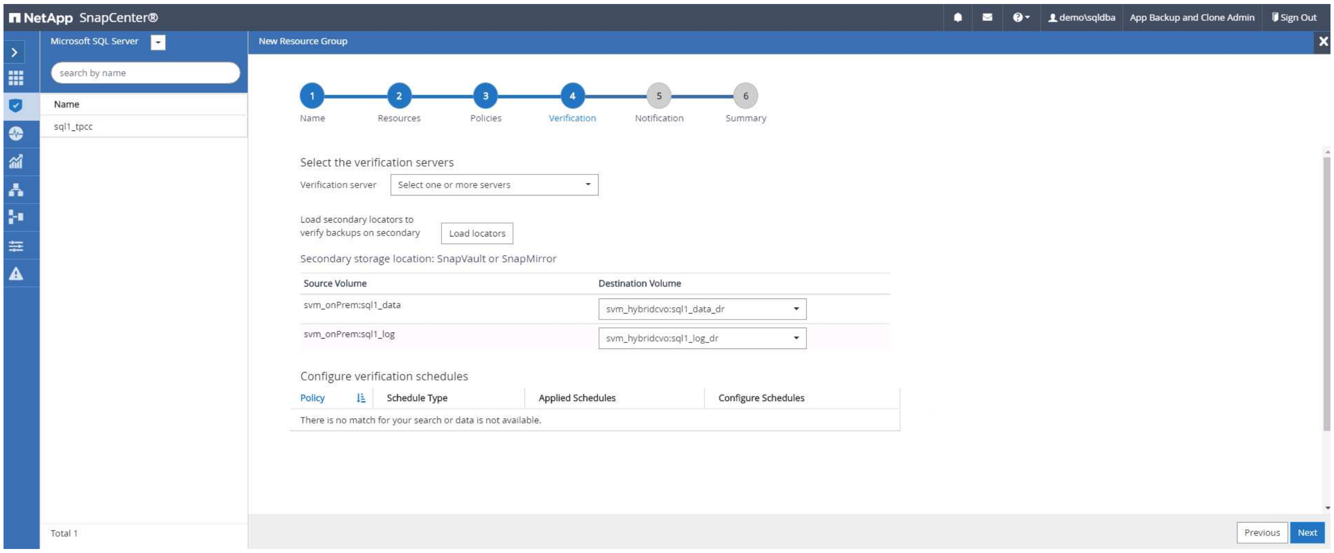
Policy	Applied Schedules	Configure Schedules
SQL Server Log Backup	Hourly: Repeat every 1 hours	

Total 1

□ Use Microsoft SQL Server scheduler

Previous | Next

5. Choose the verification server for the backup on secondary if backup verification is to be performed. Click the Load Locator to populate the secondary storage location.



NetApp SnapCenter® | demo\sqldba | App Backup and Clone Admin | Sign Out

Microsoft SQL Server | New Resource Group

search by name

Name
sql1_tpcc

Total 1

1 Name — 2 Resources — 3 Policies — 4 Verification — 5 Notification — 6 Summary

Select the verification servers

Verification server: Select one or more servers

Load secondary locators to verify backups on secondary: Load locators

Secondary storage location: SnapVault or SnapMirror

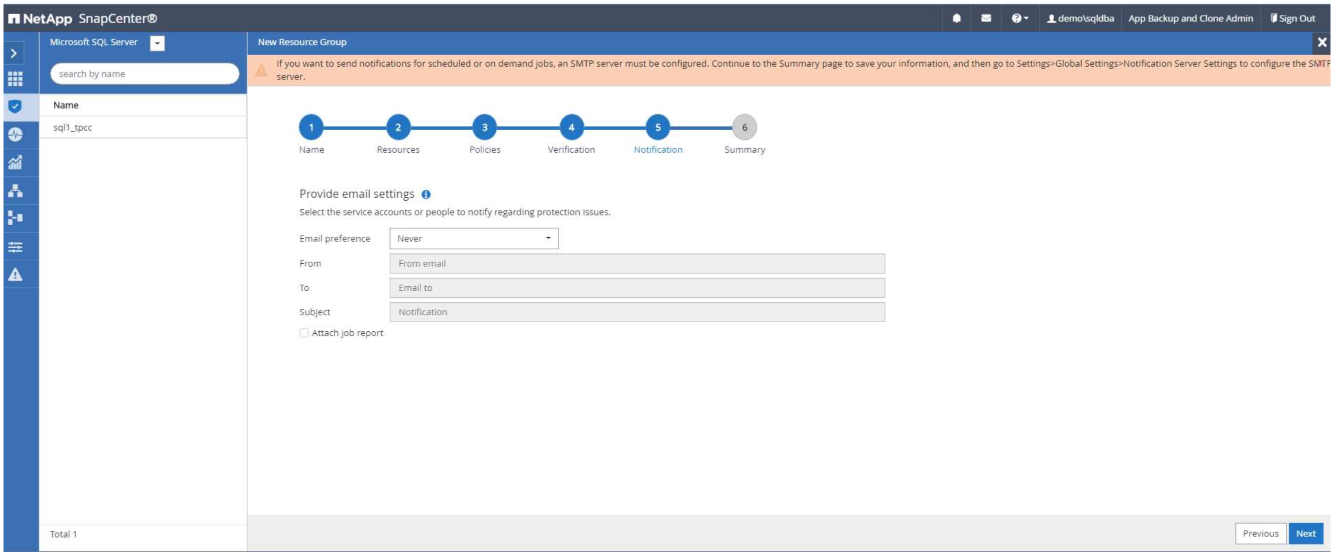
Source Volume	Destination Volume
svm_onPrem:sql1_data	svm_hybridcvo:sql1_data_dr
svm_onPrem:sql1_log	svm_hybridcvo:sql1_log_dr

Configure verification schedules

Policy	Schedule Type	Applied Schedules	Configure Schedules
There is no match for your search or data is not available.			

Previous | Next

6. Configure the SMTP server for email notification if desired.



If you want to send notifications for scheduled or on demand jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTP server.

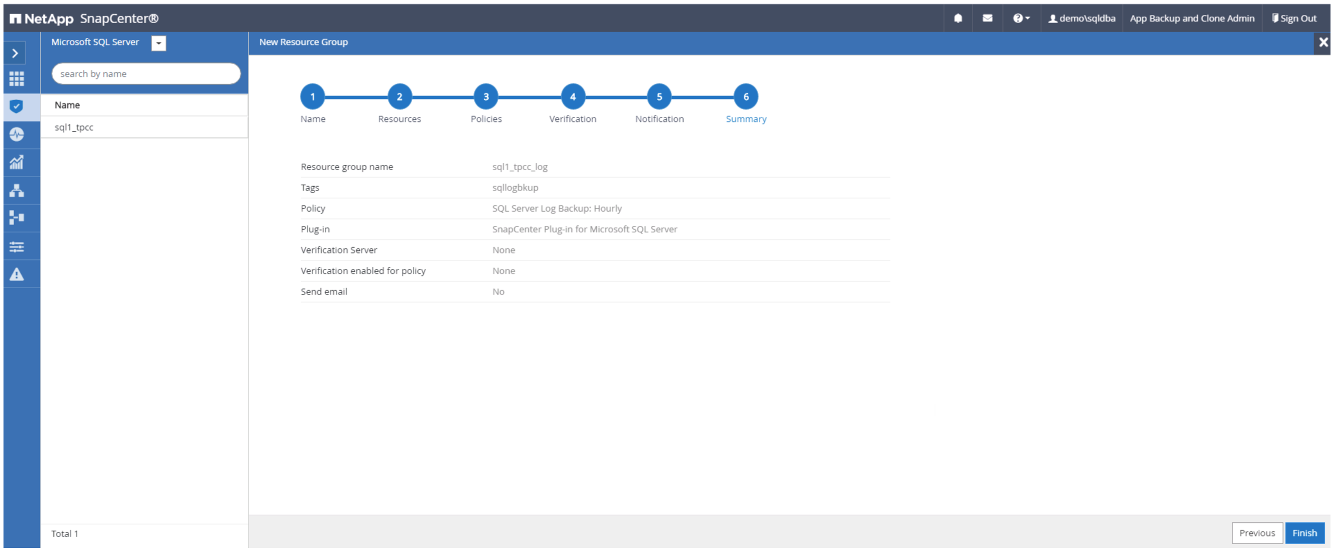
Provide email settings

Select the service accounts or people to notify regarding protection issues.

Email preference	Never
From	From email
To	Email to
Subject	Notification

□ Attach job report

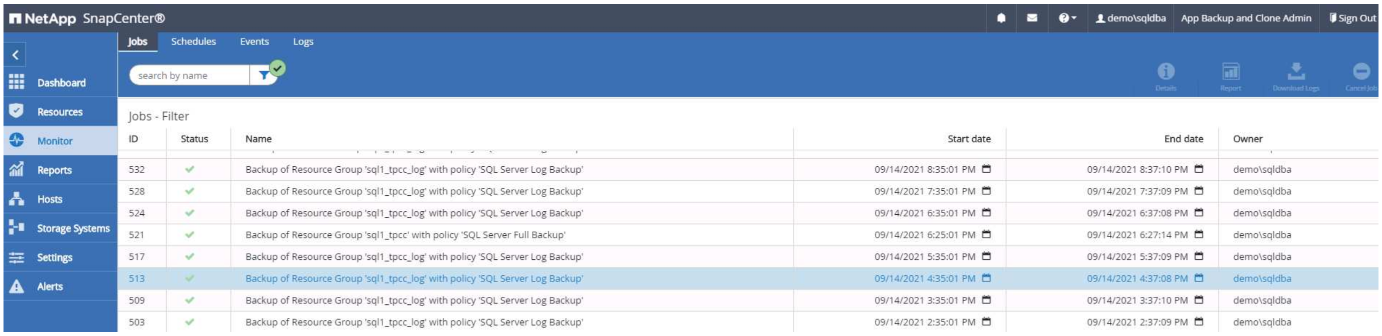
7. Summary.



Resource group name	sql1_tpcc_log
Tags	sqllogbkup
Policy	SQL Server Log Backup: Hourly
Plug-in	SnapCenter Plug-in for Microsoft SQL Server
Verification Server	None
Verification enabled for policy	None
Send email	No

9. Validate backup

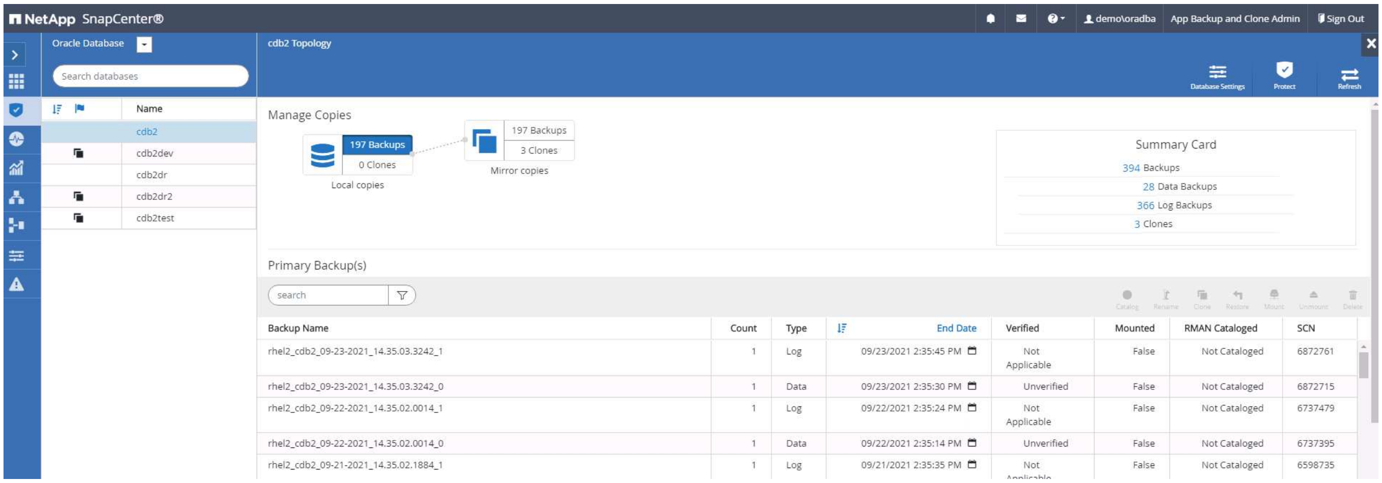
After database backup resource groups are created to protect database resources, the backup jobs runs according to the predefined schedule. Check the job execution status under the Monitor tab.



Jobs - Filter

ID	Status	Name	Start date	End date	Owner
532	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/14/2021 8:35:01 PM	09/14/2021 8:37:10 PM	demo\sqldba
528	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/14/2021 7:35:01 PM	09/14/2021 7:37:09 PM	demo\sqldba
524	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/14/2021 6:35:01 PM	09/14/2021 6:37:08 PM	demo\sqldba
521	✓	Backup of Resource Group 'sql1_tpcc' with policy 'SQL Server Full Backup'	09/14/2021 6:25:01 PM	09/14/2021 6:27:14 PM	demo\sqldba
517	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/14/2021 5:35:01 PM	09/14/2021 5:37:09 PM	demo\sqldba
513	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/14/2021 4:35:01 PM	09/14/2021 4:37:08 PM	demo\sqldba
509	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/14/2021 3:35:01 PM	09/14/2021 3:37:10 PM	demo\sqldba
503	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/14/2021 2:35:01 PM	09/14/2021 2:37:09 PM	demo\sqldba

Go to the Resources tab, click the database name to view details of database backup, and toggle between Local copies and mirror copies to verify that Snapshot backups are replicated to a secondary location in the public cloud.



Backup Name	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_09-23-2021_14.35.03.3242_1	1	Log	09/23/2021 2:35:45 PM	Not Applicable	False	Not Cataloged	6872761
rhel2_cdb2_09-23-2021_14.35.03.3242_0	1	Data	09/23/2021 2:35:30 PM	Unverified	False	Not Cataloged	6872715
rhel2_cdb2_09-22-2021_14.35.02.0014_1	1	Log	09/22/2021 2:35:24 PM	Not Applicable	False	Not Cataloged	6737479
rhel2_cdb2_09-22-2021_14.35.02.0014_0	1	Data	09/22/2021 2:35:14 PM	Unverified	False	Not Cataloged	6737395
rhel2_cdb2_09-21-2021_14.35.02.1884_1	1	Log	09/21/2021 2:35:35 PM	Not	False	Not Cataloged	6598735

At this point, database backup copies in the cloud are ready to clone to run dev/test processes or for disaster recovery in the event of a primary failure.

Getting Started with AWS public cloud

This section describes the process of deploying Cloud Manager and Cloud Volumes ONTAP in AWS.

AWS public cloud

> To make things easier to follow, we have created this document based on a deployment in AWS. However, the process is very similar for Azure and GCP.

1. Pre-flight check

Before deployment, make sure that the infrastructure is in place to allow for the deployment in the next stage. This includes the following:

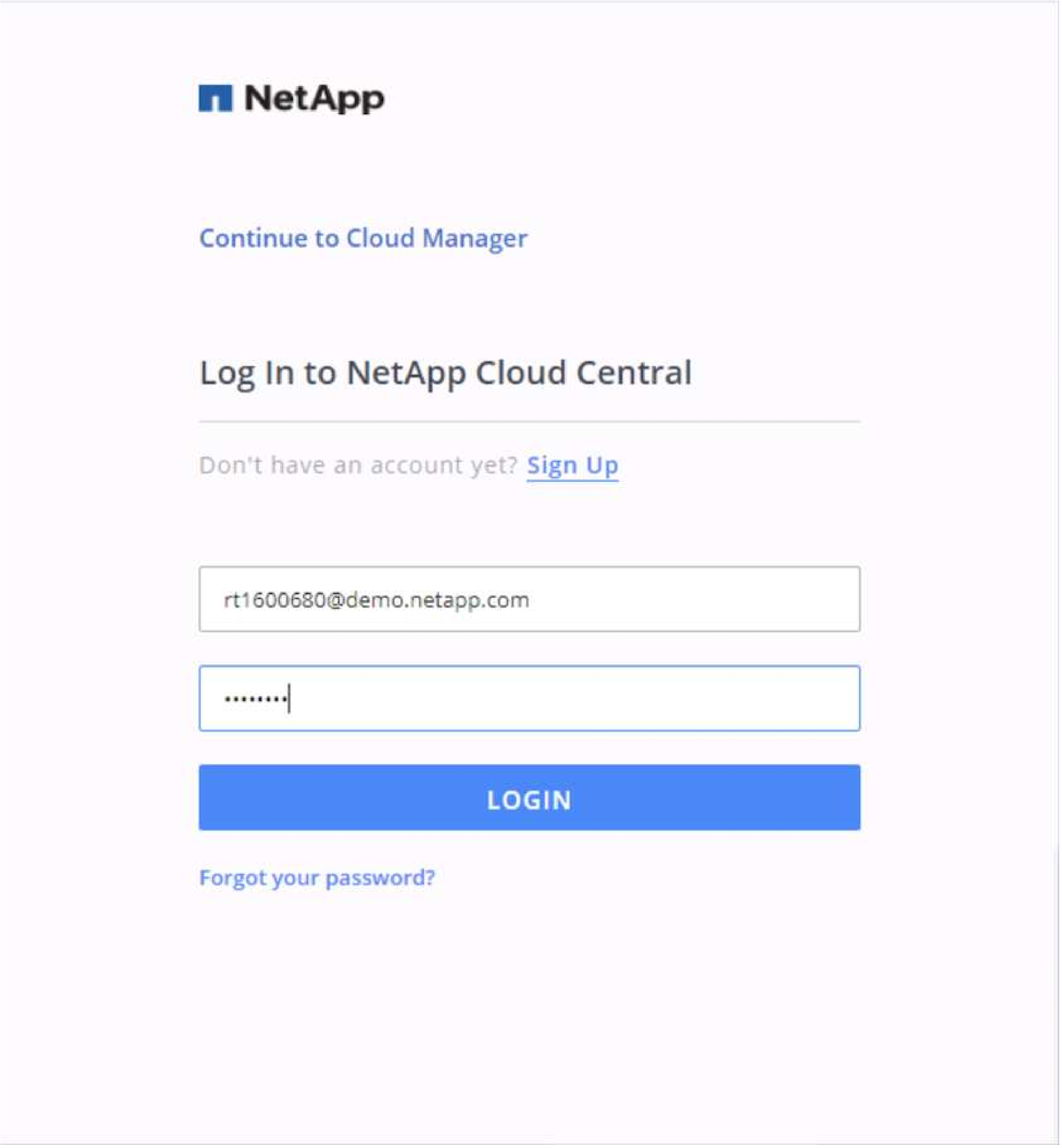
- □ AWS account
- □ VPC in your region of choice
- □ Subnet with access to the public internet
- □ Permissions to add IAM roles into your AWS account
- □ A secret key and access key for your AWS user

2. Steps to deploy Cloud Manager and Cloud Volumes ONTAP in AWS

> There are many methods for deploying Cloud Manager and Cloud Volumes ONTAP; this method is the simplest but requires the most permissions. If this method is not appropriate for your AWS environment, please consult the NetApp Cloud Documentation.

Deploy the Cloud Manager connector

1. Navigate to NetApp Cloud Central and log in or sign up.



NetApp

Continue to Cloud Manager

Log In to NetApp Cloud Central

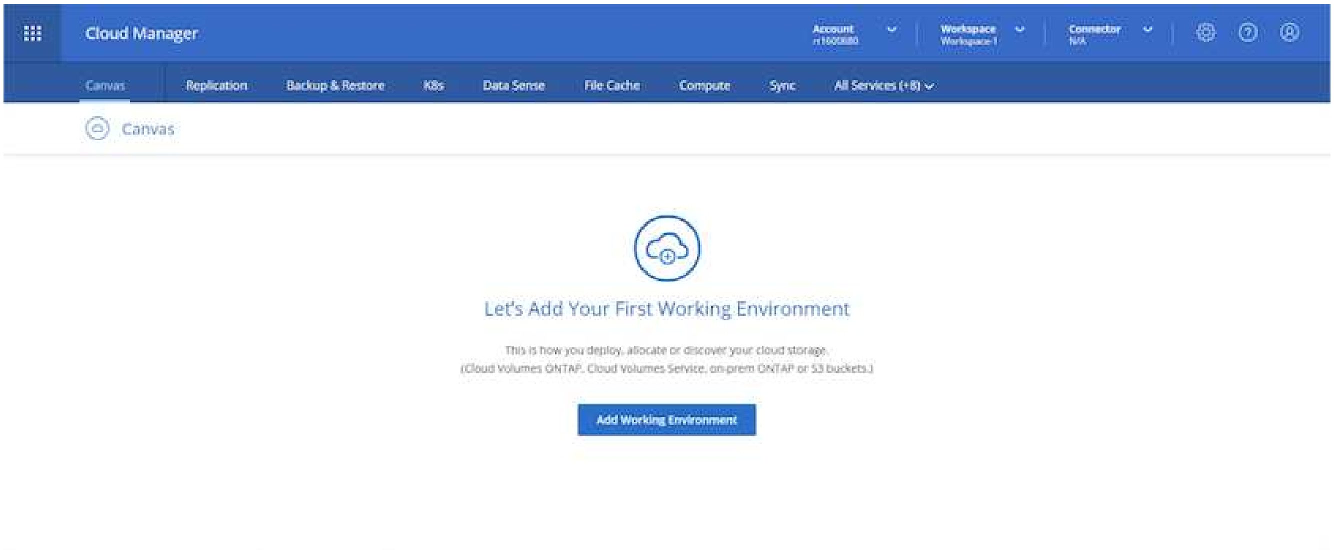
Don't have an account yet? Sign Up

rt1600680@demo.netapp.com

••••••••

Forgot your password?

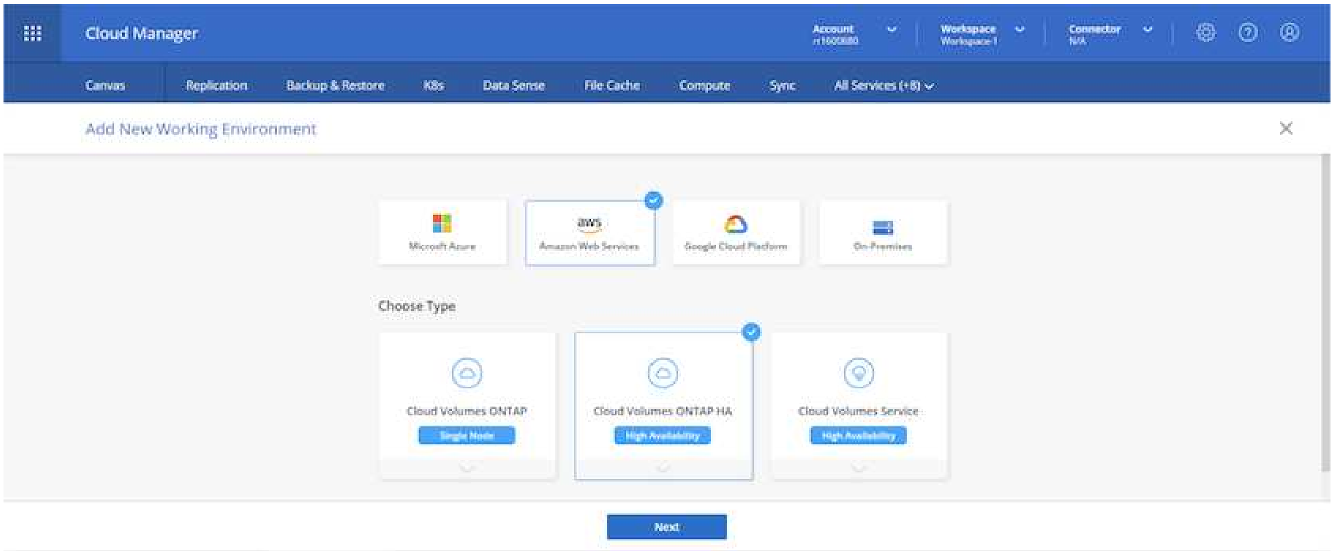
2. After you log in, you should be taken to the Canvas.



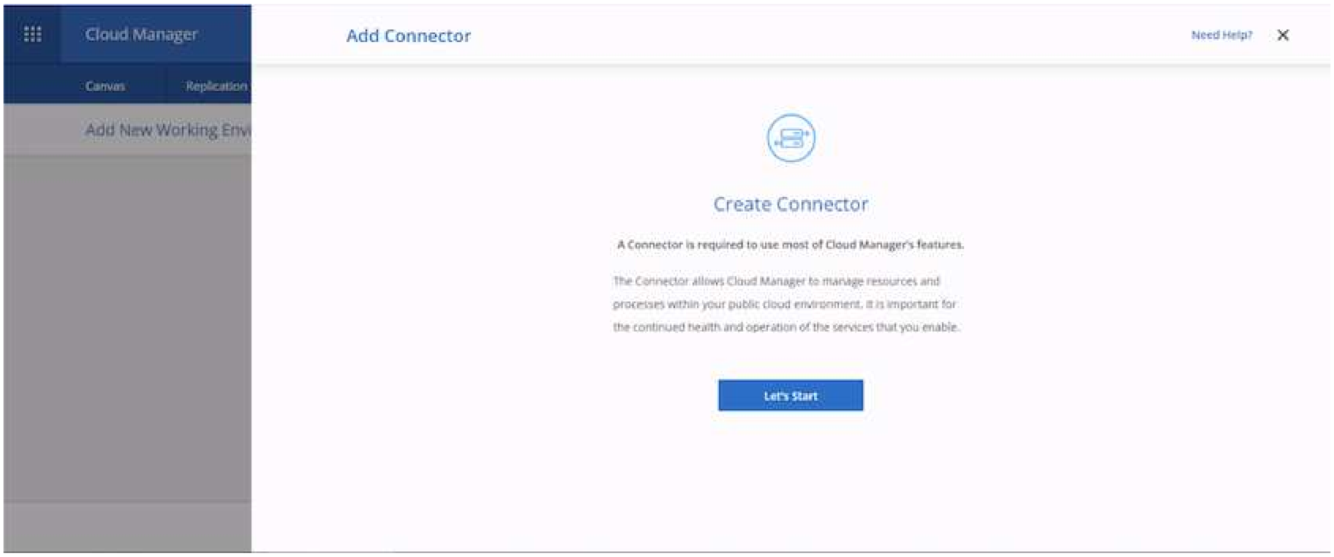
Let's Add Your First Working Environment

This is how you deploy, allocate or discover your cloud storage.
(Cloud Volumes ONTAP, Cloud Volumes Service, on-prem ONTAP or S3 buckets.)

3. Click "Add Working Environment" and choose Cloud Volumes ONTAP in AWS. Here, you also choose whether you want to deploy a single node system or a high availability pair. I have chosen to deploy a high availability pair.



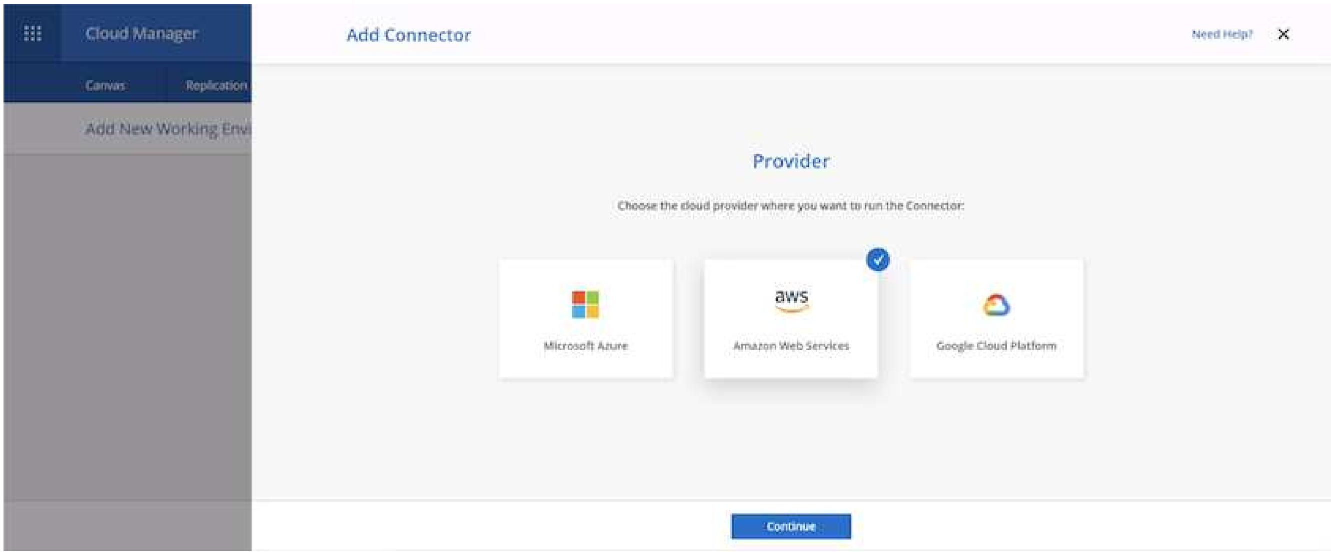
4. If no connector has been created, a pop-up appears asking you to create a connector.



A Connector is required to use most of Cloud Manager's features.

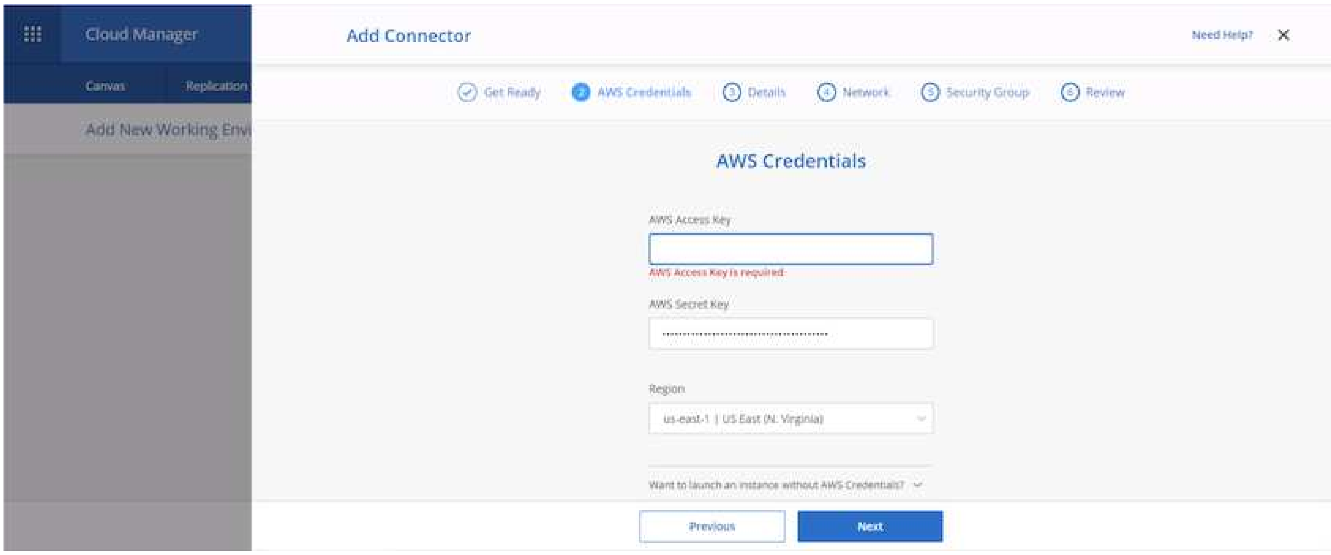
The Connector allows Cloud Manager to manage resources and processes within your public cloud environment. It is important for the continued health and operation of the services that you enable.

5. Click Lets Start, and then choose AWS.



Choose the cloud provider where you want to run the Connector:

6. Enter your secret key and access key. Make sure that your user has the correct permissions outlined on the NetApp policies page.



AWS Access Key

AWS Access Key is required

AWS Secret Key

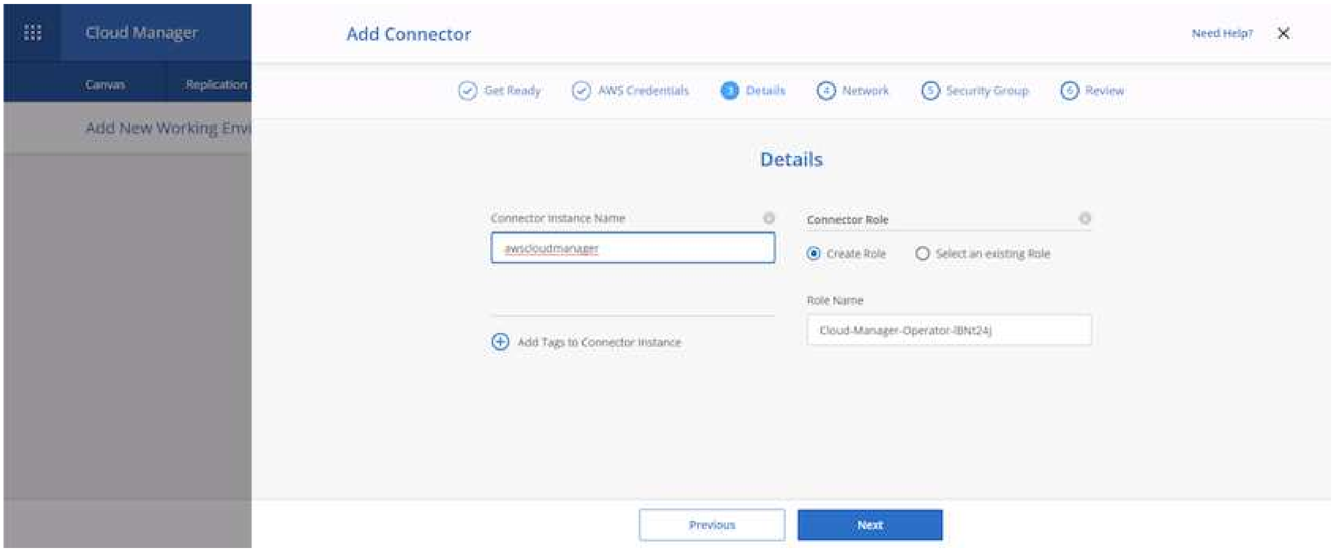
••

Region

us-east-1 | US East (N. Virginia)

Want to launch an instance without AWS Credentials?

7. Give the connector a name and either use a predefined role as described on the NetApp policies page or ask Cloud Manager to create the role for you.



Add Connector

Details

Connector Instance Name: awscloudmanager

Connector Role: ● Create Role ○ Select an existing Role

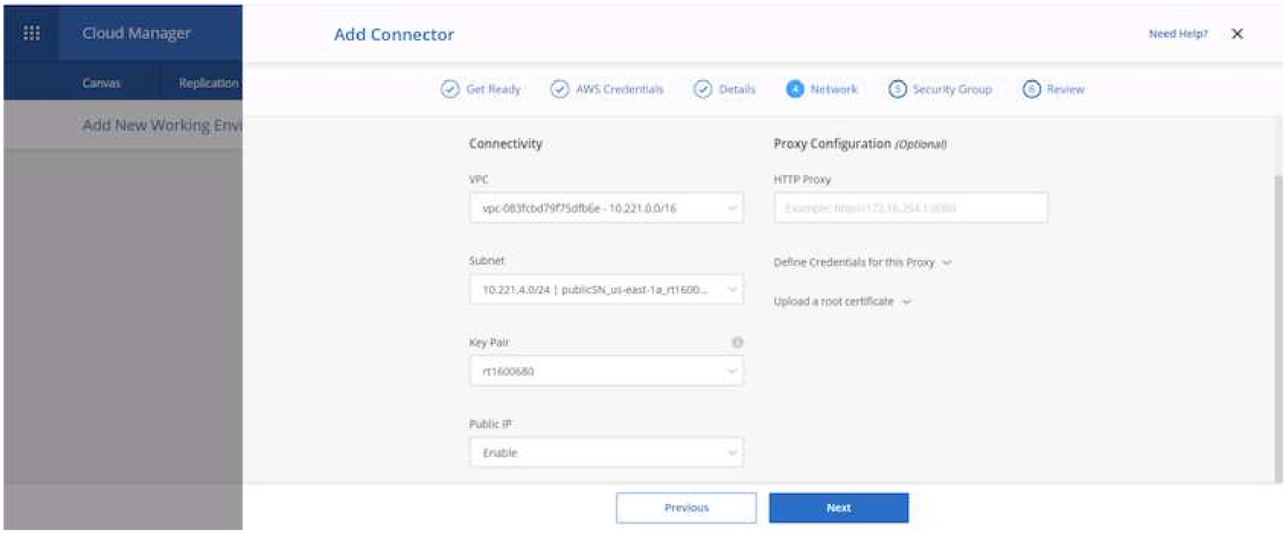
Role Name: Cloud-Manager-Operator-IBNt24j

8. Give the networking information needed to deploy the connector. Verify that outbound internet access is enabled by:

   a. Giving the connector a public IP address

   b. Giving the connector a proxy to work through

   c. Giving the connector a route to the public internet through an Internet Gateway



Add Connector

Connectivity

VPC: vpc-083fcbd79f75dfb6e - 10.221.0.0/16

Subnet: 10.221.4.0/24 | publicSN_us-east-1a_rt1600...

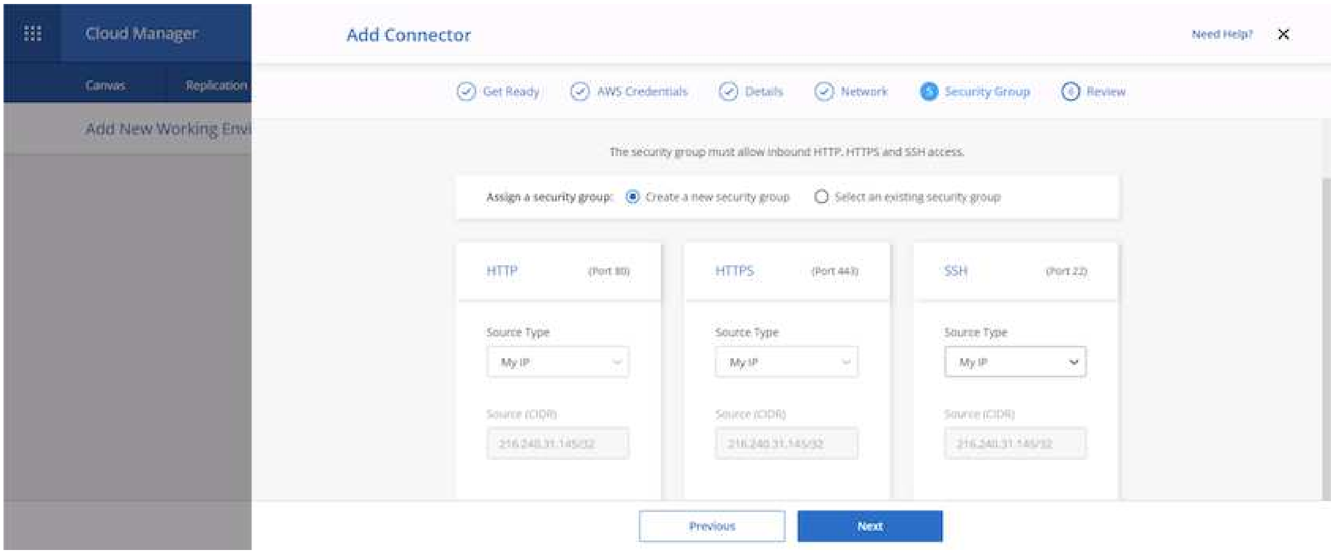
Key Pair: rt1600680

Public IP: Enable

Proxy Configuration *(Optional)*

HTTP Proxy: Example: http://172.16.254.1:8080

9. Provide communication with the connector via SSH, HTTP, and HTTPs by either providing a security group or creating a new security group. I have enabled access to the connector from my IP address only.

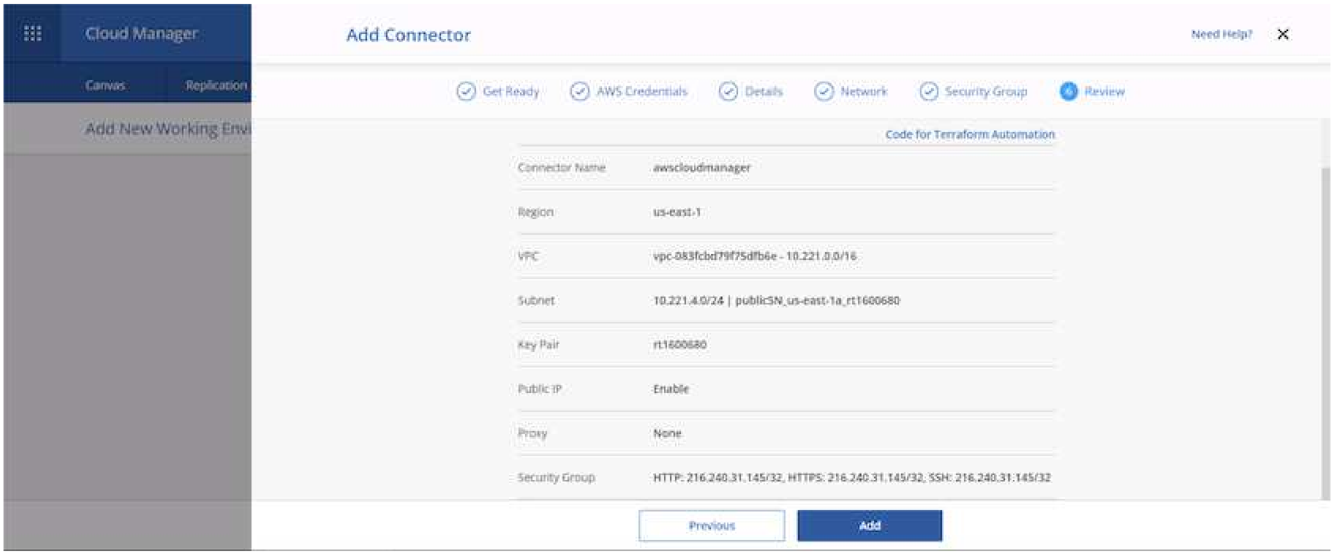


The security group must allow inbound HTTP, HTTPS and SSH access.

Assign a security group: ● Create a new security group ○ Select an existing security group

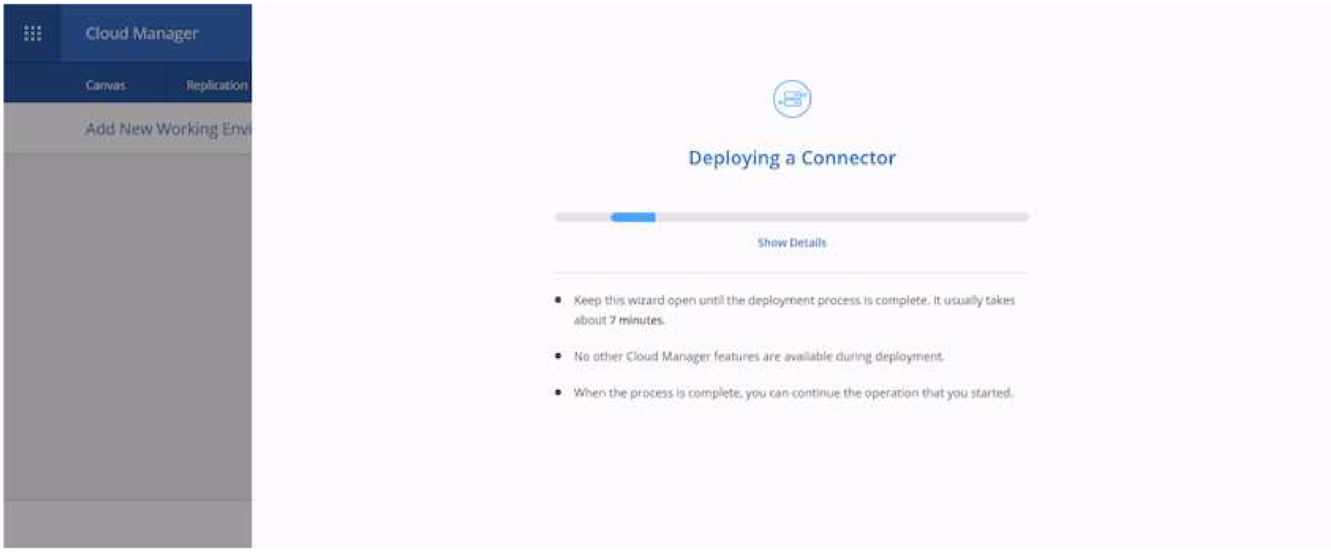
HTTP (Port 80)	HTTPS (Port 443)	SSH (Port 22)
Source Type: My IP	Source Type: My IP	Source Type: My IP
Source (CIDR): 216.240.31.145/32	Source (CIDR): 216.240.31.145/32	Source (CIDR): 216.240.31.145/32

10. Review the information on the summary page and click Add to deploy the connector.



Connector Name	awscloudmanager
Region	us-east-1
VPC	vpc-083fcbd79f75dfb6e - 10.221.0.0/16
Subnet	10.221.4.0/24 | publicSN_us-east-1a_rt1600680
Key Pair	rt1600680
Public IP	Enable
Proxy	None
Security Group	HTTP: 216.240.31.145/32, HTTPS: 216.240.31.145/32, SSH: 216.240.31.145/32

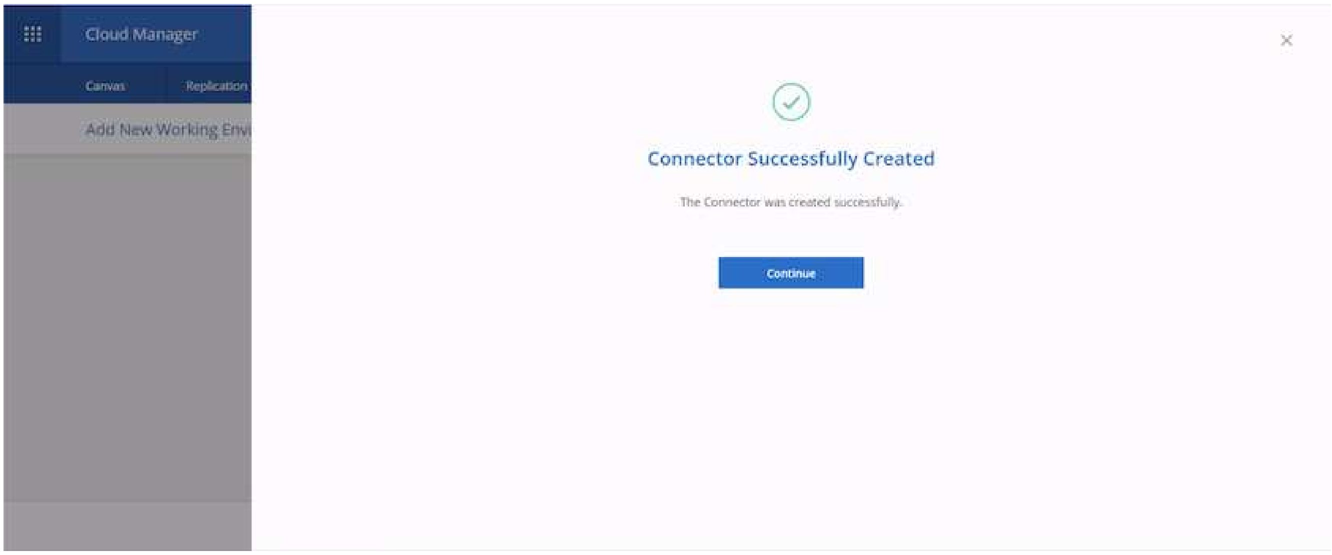
11. The connector now deploys using a cloud formation stack. You can monitor its progress from Cloud Manager or through AWS.



Deploying a Connector

- Keep this wizard open until the deployment process is complete. It usually takes about 7 minutes.
- No other Cloud Manager features are available during deployment.
- When the process is complete, you can continue the operation that you started.

12. When the deployment is complete, a success page appears.

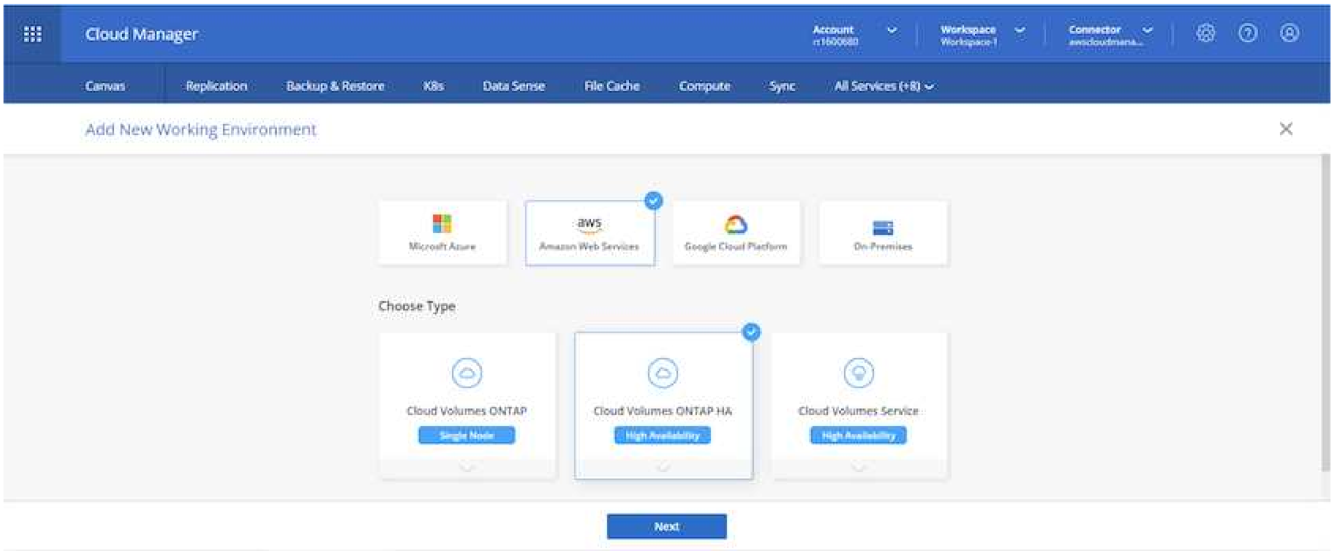


Connector Successfully Created

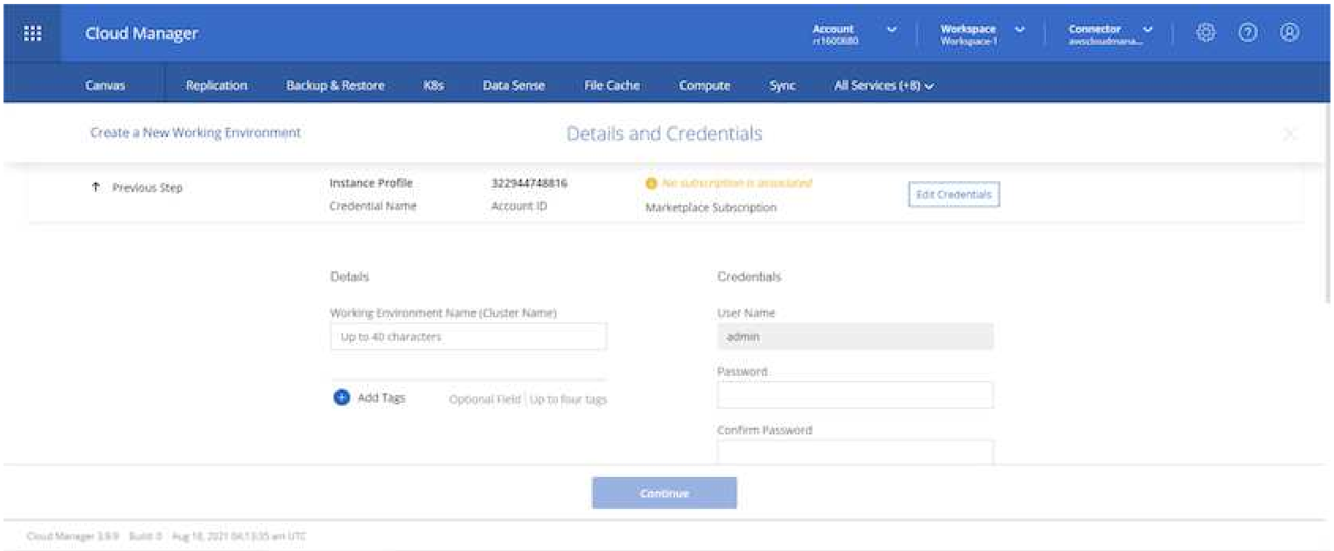
The Connector was created successfully.

Deploy Cloud Volumes ONTAP

1. Select AWS and the type of deployment based on your requirements.



2. If no subscription has been assigned and you wish to purchase with PAYGO, choose Edit Credentials.



Details and Credentials

Instance Profile
Credential Name

322944748816
Account ID

No subscription is associated
Marketplace Subscription

Details

Working Environment Name (Cluster Name)
Up to 40 characters

Optional Field | Up to four tags

Credentials

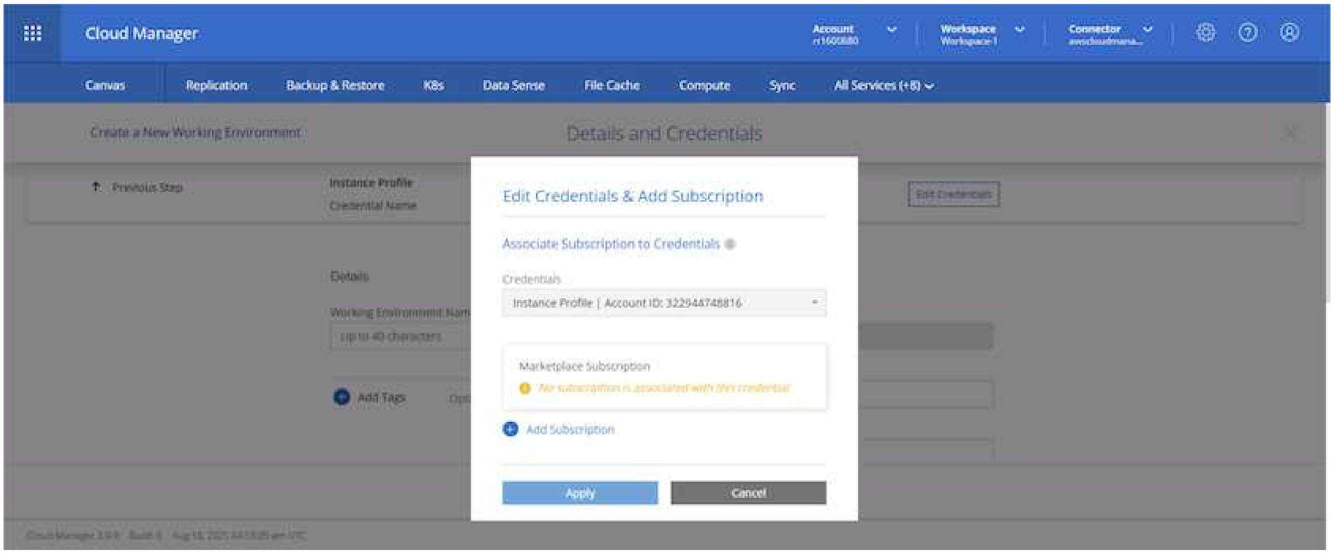
User Name
admin

Password

Confirm Password

Cloud Manager 3.9.9 Build: 0 Aug 18, 2021 04:13:35 am UTC

3. Choose Add Subscription.



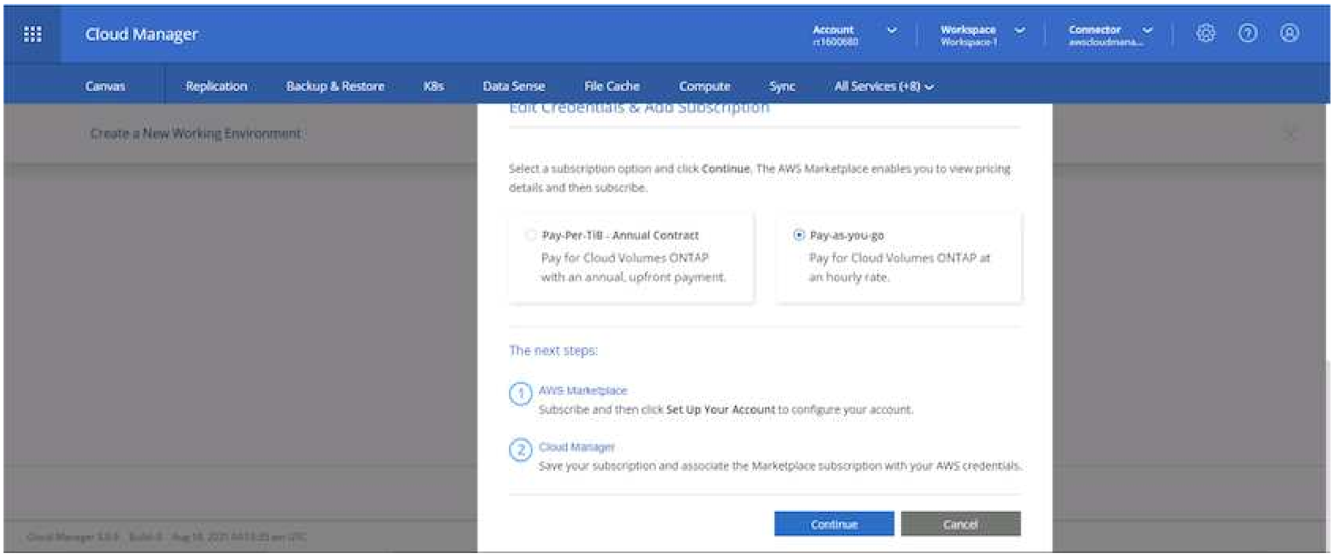
Edit Credentials & Add Subscription

Associate Subscription to Credentials

Credentials
Instance Profile | Account ID: 322944748816

Marketplace Subscription
No subscription is associated with this credential

4. Choose the type of contract that you wish to subscribe to. I chose Pay-as-you-go.



Edit Credentials & Add Subscription

Select a subscription option and click **Continue**. The AWS Marketplace enables you to view pricing details and then subscribe.

○ Pay-Per-TiB - Annual Contract
Pay for Cloud Volumes ONTAP with an annual, upfront payment.

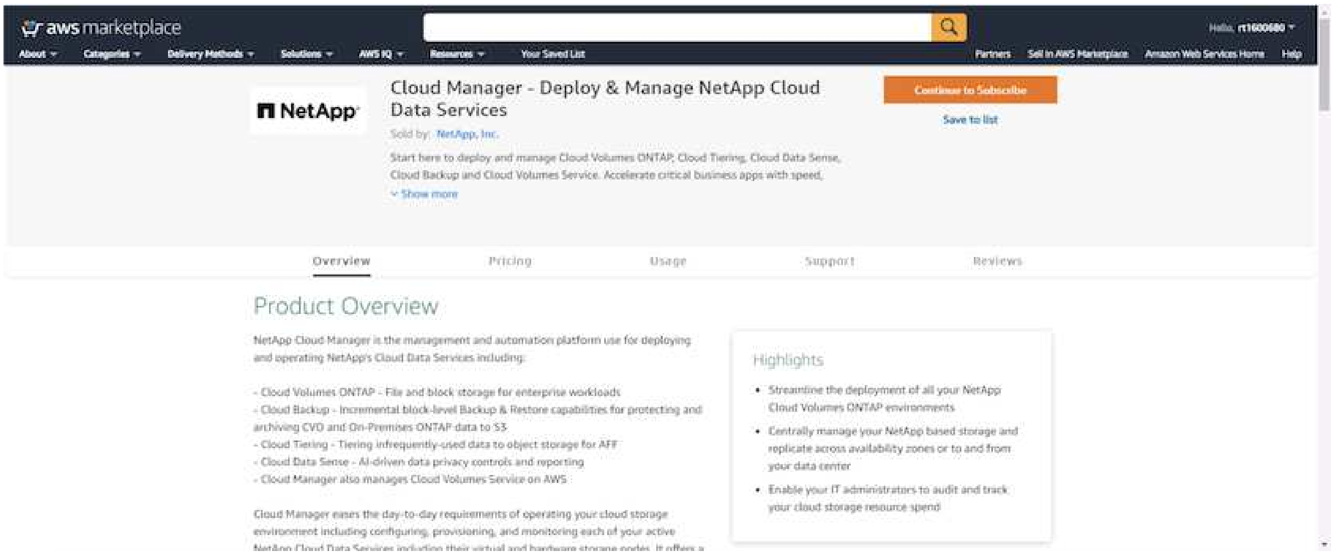
● Pay-as-you-go
Pay for Cloud Volumes ONTAP at an hourly rate.

The next steps:

1. AWS Marketplace
Subscribe and then click **Set Up Your Account** to configure your account.

2. Cloud Manager
Save your subscription and associate the Marketplace subscription with your AWS credentials.

5. You are redirected to AWS; choose Continue to Subscribe.



Cloud Manager - Deploy & Manage NetApp Cloud Data Services

Sold by: NetApp, Inc.

Start here to deploy and manage Cloud Volumes ONTAP, Cloud Tiering, Cloud Data Sense, Cloud Backup and Cloud Volumes Service. Accelerate critical business apps with speed,

Product Overview

NetApp Cloud Manager is the management and automation platform use for deploying and operating NetApp's Cloud Data Services including:

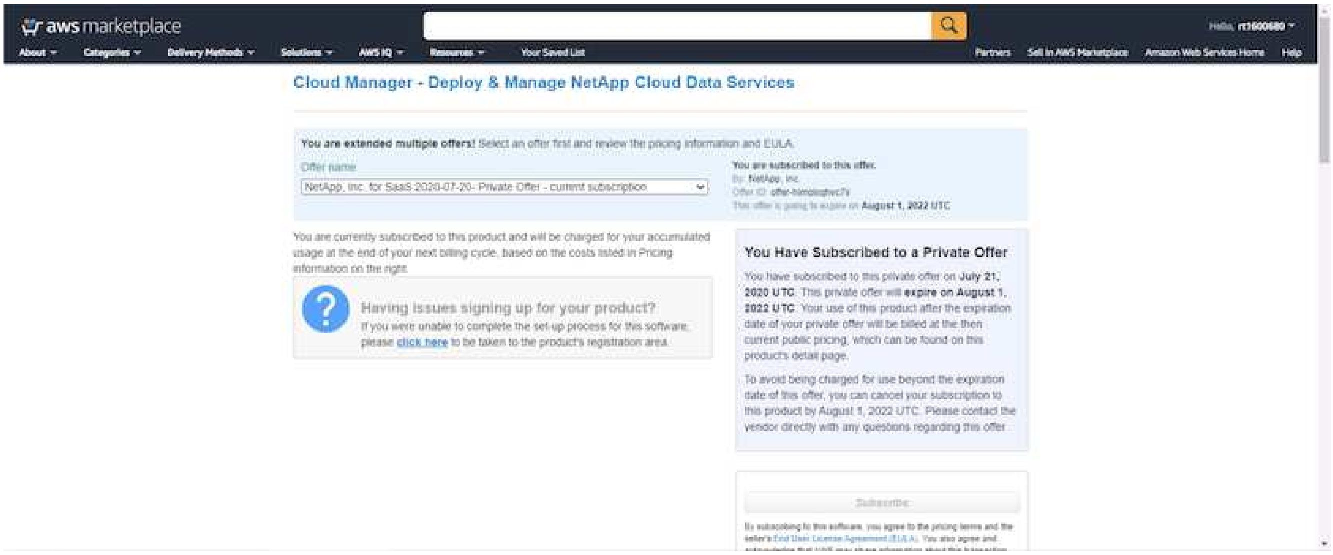
- Cloud Volumes ONTAP - File and block storage for enterprise workloads
- Cloud Backup - Incremental block-level Backup & Restore capabilities for protecting and archiving CVO and On-Premises ONTAP data to S3
- Cloud Tiering - Tiering infrequently-used data to object storage for AFF
- Cloud Data Sense - AI-driven data privacy controls and reporting
- Cloud Manager also manages Cloud Volumes Service on AWS

Cloud Manager eases the day-to-day requirements of operating your cloud storage environment including configuring, provisioning, and monitoring each of your active NetApp Cloud Data Services including their virtual and hardware storage nodes. It offers a

Highlights

- Streamline the deployment of all your NetApp Cloud Volumes ONTAP environments
- Centrally manage your NetApp based storage and replicate across availability zones or to and from your data center
- Enable your IT administrators to audit and track your cloud storage resource spend

6. Subscribe and you are redirected back to NetApp Cloud Central. If you have already subscribed and don’t get redirected, choose the "Click here" link.



Cloud Manager - Deploy & Manage NetApp Cloud Data Services

You are extended multiple offers! Select an offer first and review the pricing information and EULA.

Offer name: NetApp, Inc. for SaaS 2020-07-20- Private Offer - current subscription

You are subscribed to this offer.
By: NetApp, Inc
Offer ID: offer-bimolqhvc7s
This offer is going to expire on **August 1, 2022 UTC**

You are currently subscribed to this product and will be charged for your accumulated usage at the end of your next billing cycle, based on the costs listed in Pricing information on the right.

Having issues signing up for your product?
If you were unable to complete the set-up process for this software, please click here to be taken to the product's registration area.

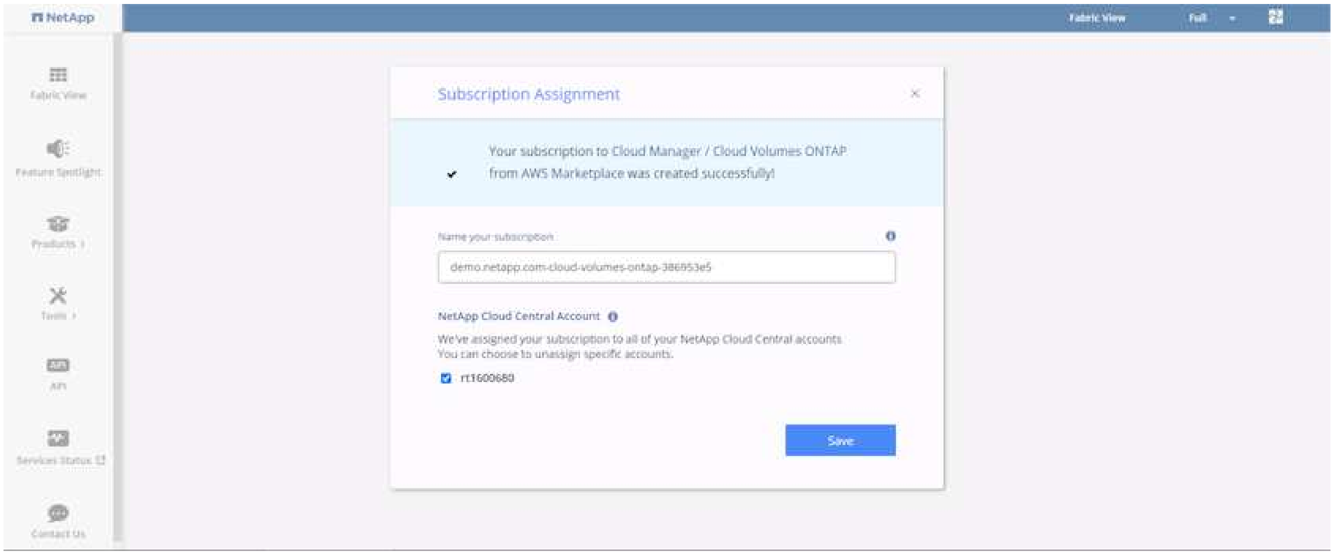
You Have Subscribed to a Private Offer

You have subscribed to this private offer on **July 21, 2020 UTC**. This private offer will **expire on August 1, 2022 UTC**. Your use of this product after the expiration date of your private offer will be billed at the then current public pricing, which can be found on this product's detail page.

To avoid being charged for use beyond the expiration date of this offer, you can cancel your subscription to this product by August 1, 2022 UTC. Please contact the vendor directly with any questions regarding this offer.

By subscribing to this software, you agree to the pricing terms and the seller's End User License Agreement (EULA). You also agree and

7. You are redirected to Cloud Central where you must name your subscription and assign it to your Cloud Central account.



Subscription Assignment

✔ Your subscription to Cloud Manager / Cloud Volumes ONTAP from AWS Marketplace was created successfully!

Name your subscription

demo.netapp.com-cloud-volumes-ontap-386953e5

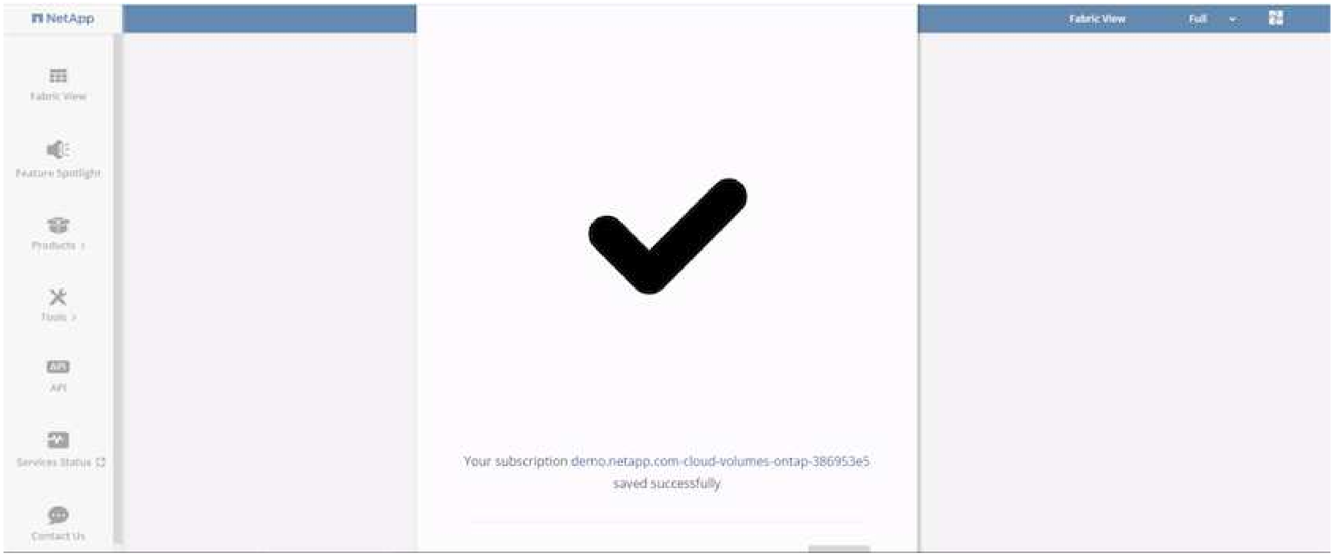
NetApp Cloud Central Account

We've assigned your subscription to all of your NetApp Cloud Central accounts. You can choose to unassign specific accounts.

☑ rt1600680

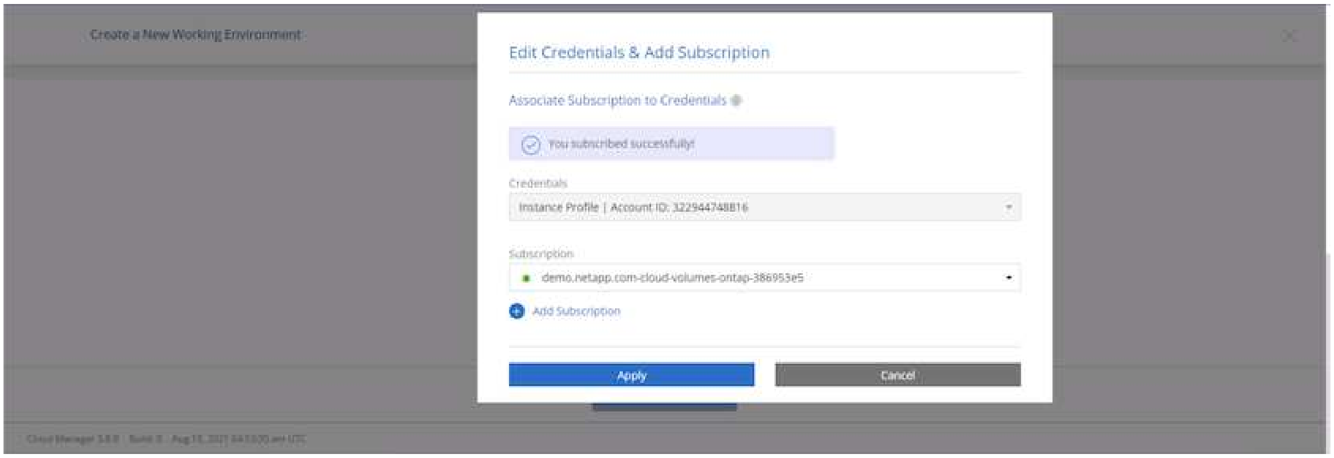
Save

8. When successful, a check mark page appears. Navigate back to your Cloud Manager tab.



Your subscription demo.netapp.com-cloud-volumes-ontap-386953e5 saved successfully

9. The subscription now appears in Cloud Central. Click Apply to continue.



Edit Credentials & Add Subscription

Associate Subscription to Credentials

You subscribed successfully!

Credentials

Instance Profile | Account ID: 322944748816

Subscription

● demo.netapp.com-cloud-volumes-ontap-386953e5

Add Subscription

Apply

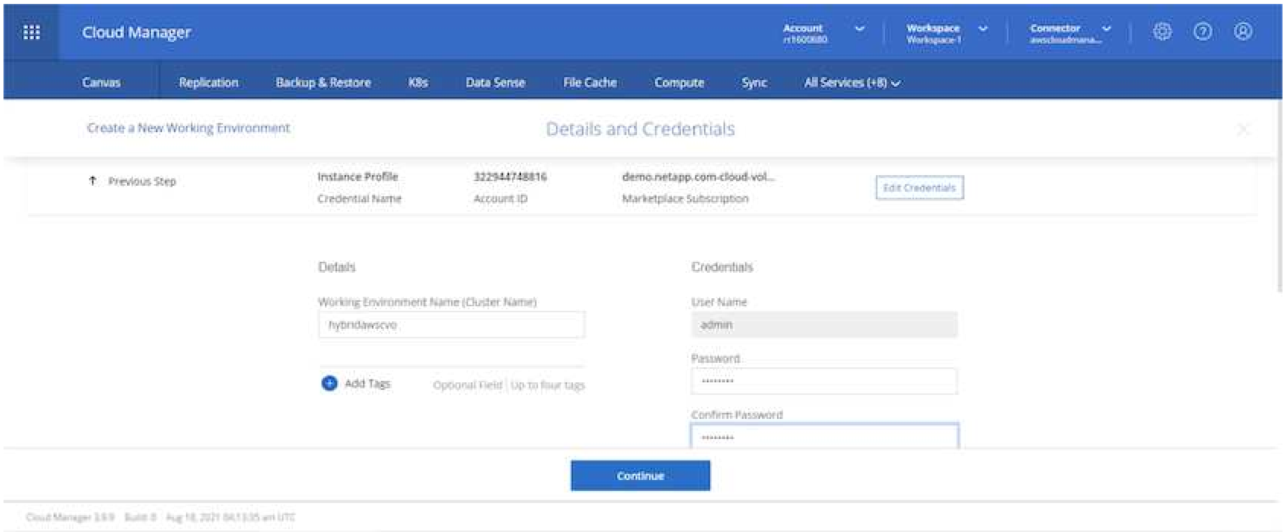
Cancel

10. Enter the working environment details such as:

    a. Cluster name

b. Cluster password

c. AWS tags (Optional)



Details and Credentials

Instance Profile | 322944748816 | demo.netapp.com-cloud-vol...
Credential Name | Account ID | Marketplace Subscription

Details

Working Environment Name (Cluster Name): hybridawscvo

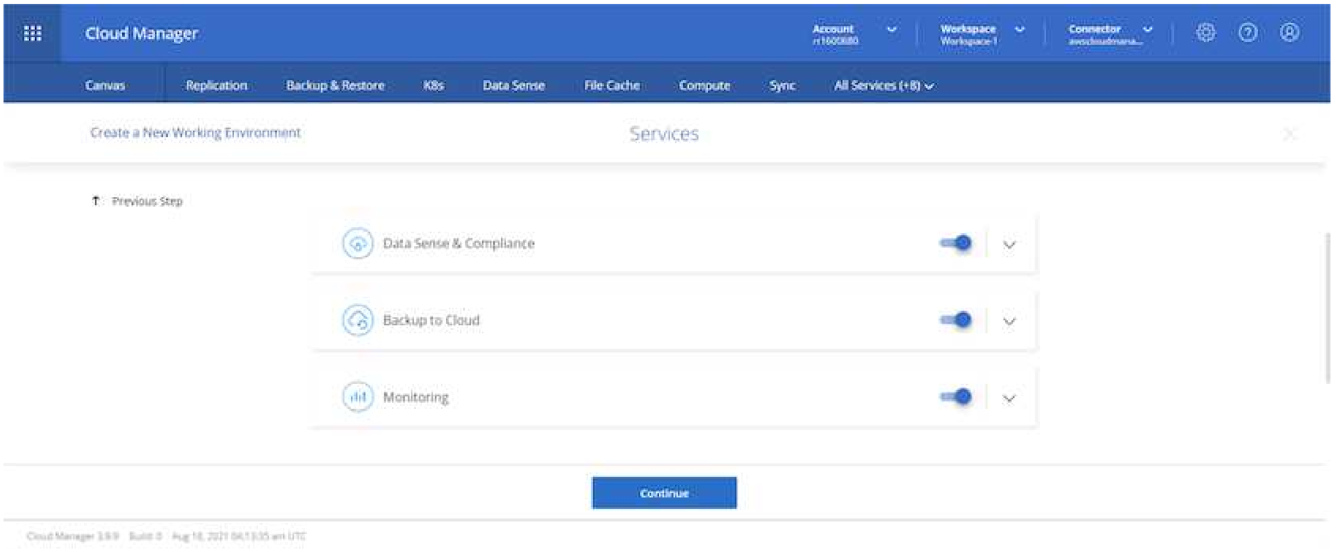
Credentials

User Name: admin

Password: ••••••••

Confirm Password: ••••••••

11. Choose which additional services you would like to deploy. To discover more about these services, visit the NetApp Cloud Homepage.



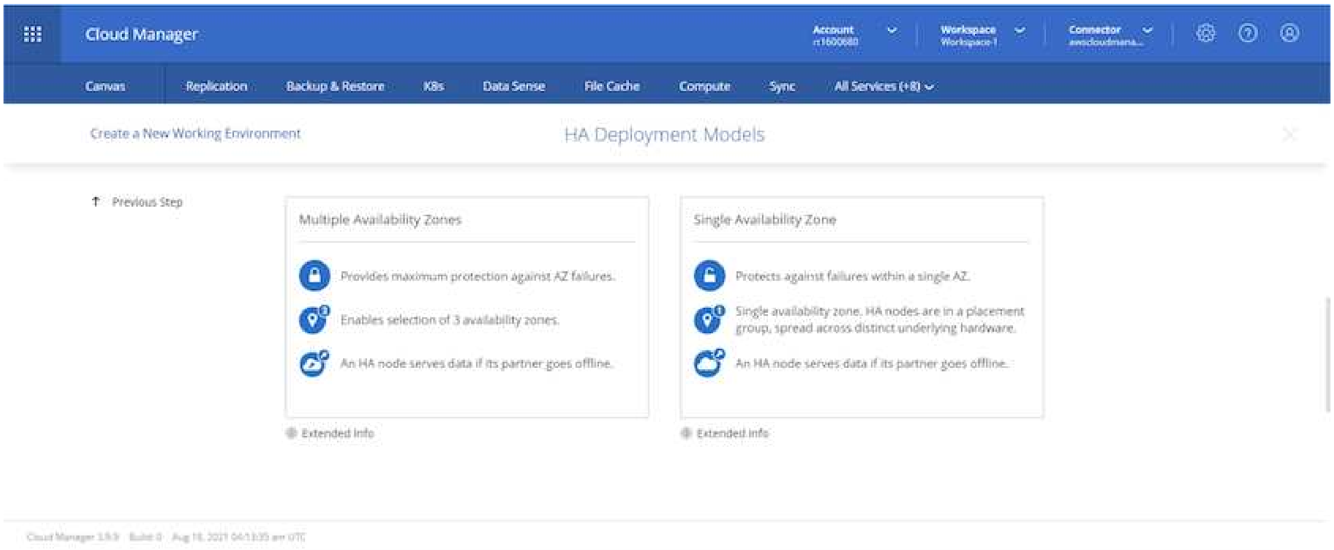
Services

Data Sense & Compliance: ●

Backup to Cloud: ●

Monitoring: ●

12. Choose whether to deploy in multiple availability zones (reguires three subnets, each in a different AZ), or a single availability zone. I chose multiple AZs.



HA Deployment Models

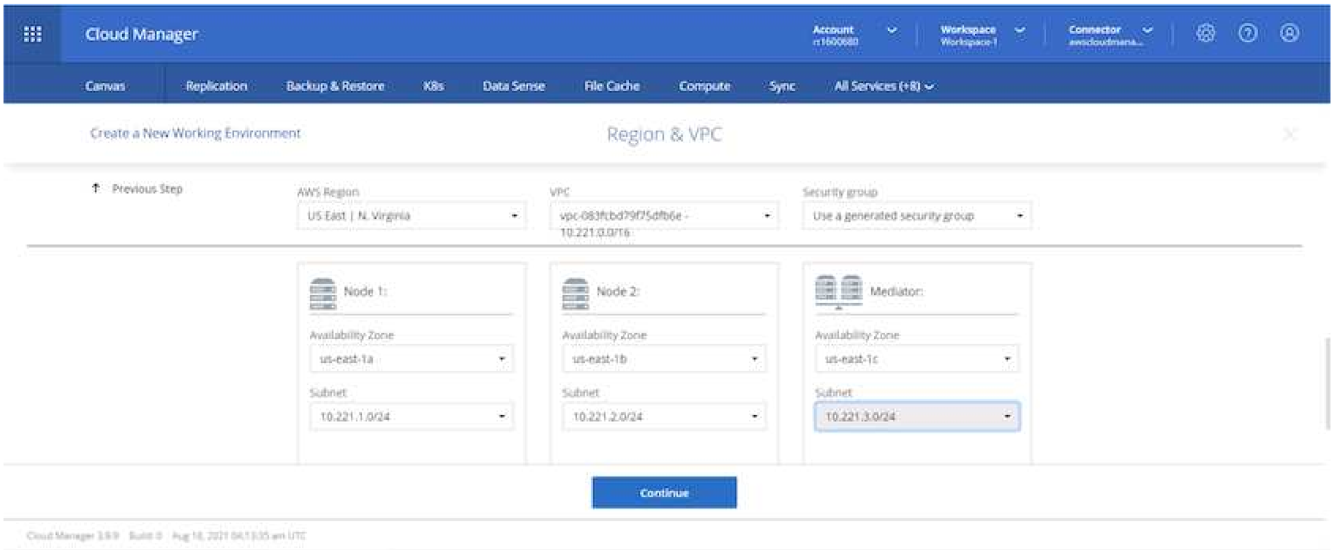
Multiple Availability Zones

- Provides maximum protection against AZ failures.
- Enables selection of 3 availability zones.
- An HA node serves data if its partner goes offline.

Single Availability Zone

- Protects against failures within a single AZ.
- Single availability zone. HA nodes are in a placement group, spread across distinct underlying hardware.
- An HA node serves data if its partner goes offline.

13. Choose the region, VPC, and security group for the cluster to be deployed into. In this section, you also assign the availability zones per node (and mediator) as well as the subnets that they occupy.



Region & VPC

AWS Region: US East | N. Virginia

VPC: vpc-083fcbd79f75dfb6e - 10.221.0.0/16

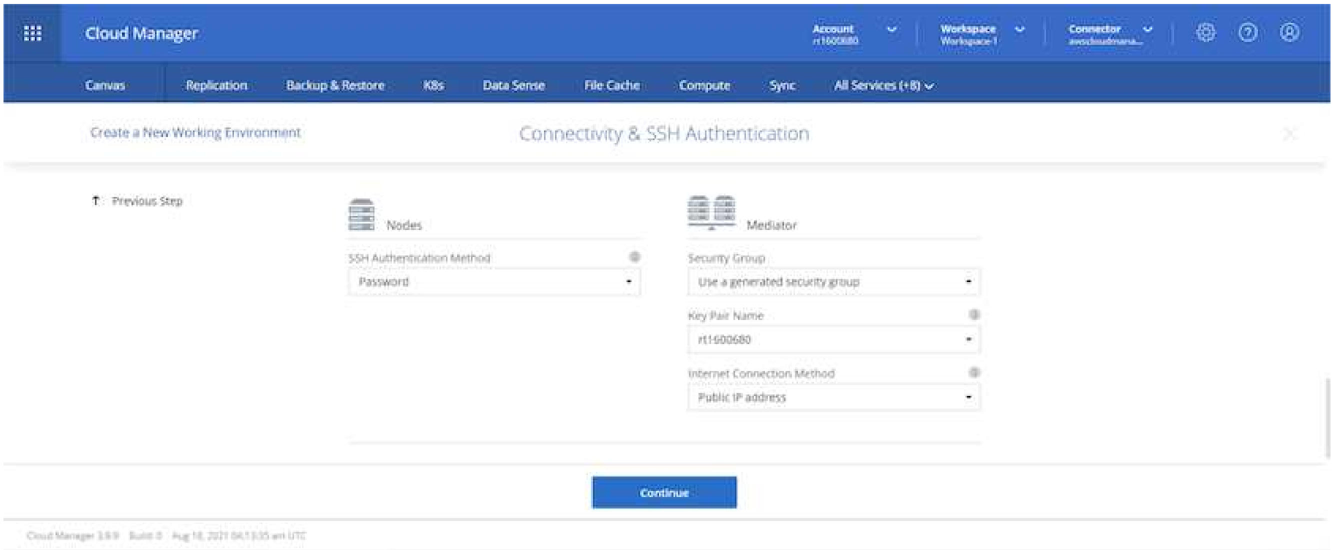
Security group: Use a generated security group

Node 1:
Availability Zone: us-east-1a
Subnet: 10.221.1.0/24

Node 2:
Availability Zone: us-east-1b
Subnet: 10.221.2.0/24

Mediator:
Availability Zone: us-east-1c
Subnet: 10.221.3.0/24

14. Choose the connection methods for the nodes as well as the mediator.



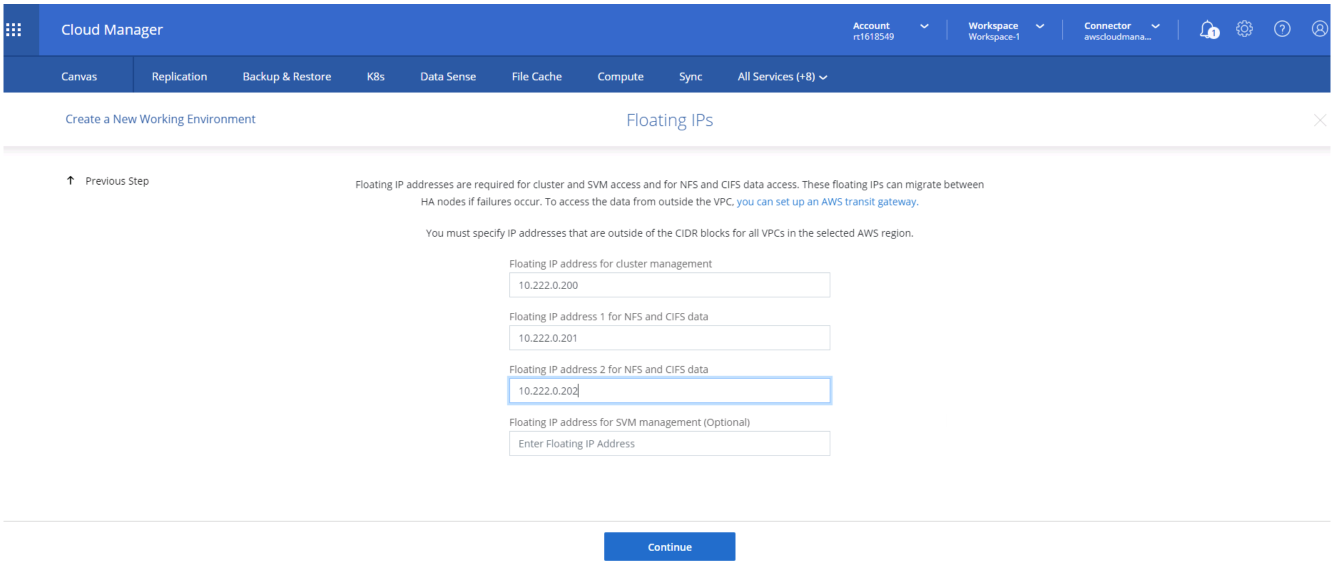
Connectivity & SSH Authentication

Nodes
SSH Authentication Method: Password

Mediator
Security Group: Use a generated security group
Key Pair Name: rt1600680
Internet Connection Method: Public IP address

The mediator requires communication with the AWS APIs. A public IP address is not required so long as the APIs are reachable after the mediator EC2 instance has been deployed.

1. Floating IP addresses are used to allow access to the various IP addresses that Cloud Volumes ONTAP uses, including cluster management and data serving IPs. These must be addresses that are not already routable within your network and are added to route tables in your AWS environment. These are required to enable consistent IP addresses for an HA pair during failover. More information about floating IP addresses can be found in the NetApp Cloud Documenation.



Floating IPs

Floating IP addresses are required for cluster and SVM access and for NFS and CIFS data access. These floating IPs can migrate between HA nodes if failures occur. To access the data from outside the VPC, you can set up an AWS transit gateway.

You must specify IP addresses that are outside of the CIDR blocks for all VPCs in the selected AWS region.

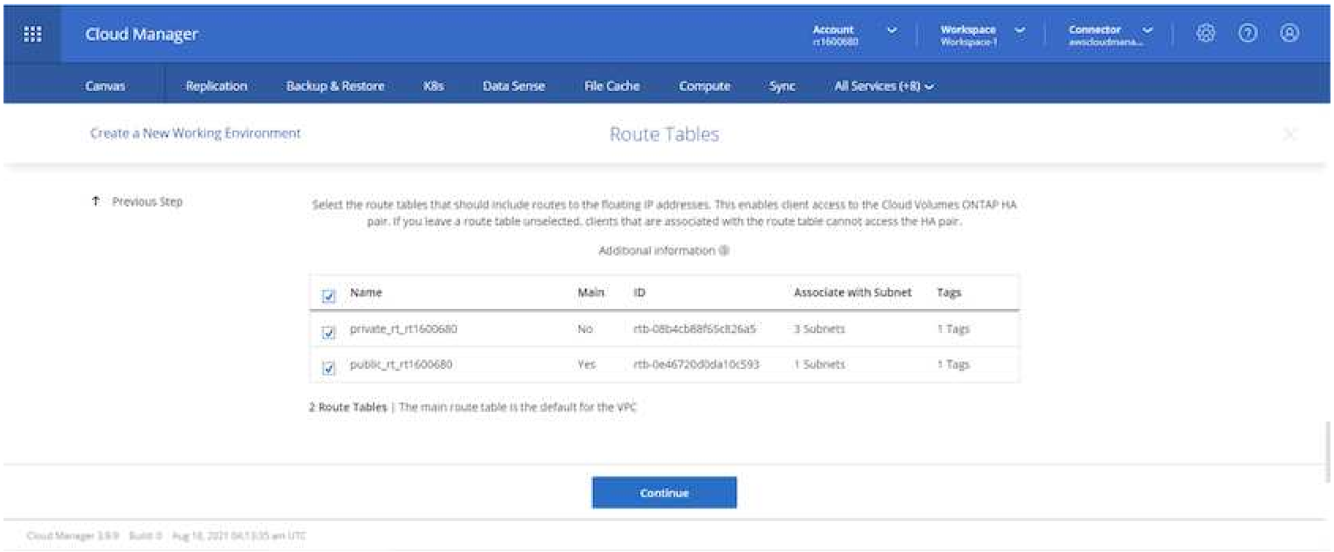
Floating IP address for cluster management: 10.222.0.200

Floating IP address 1 for NFS and CIFS data: 10.222.0.201

Floating IP address 2 for NFS and CIFS data: 10.222.0.202

Floating IP address for SVM management (Optional): Enter Floating IP Address

2. Select which route tables the floating IP addresses are added to. These route tables are used by clients to communicate with Cloud Volumes ONTAP.



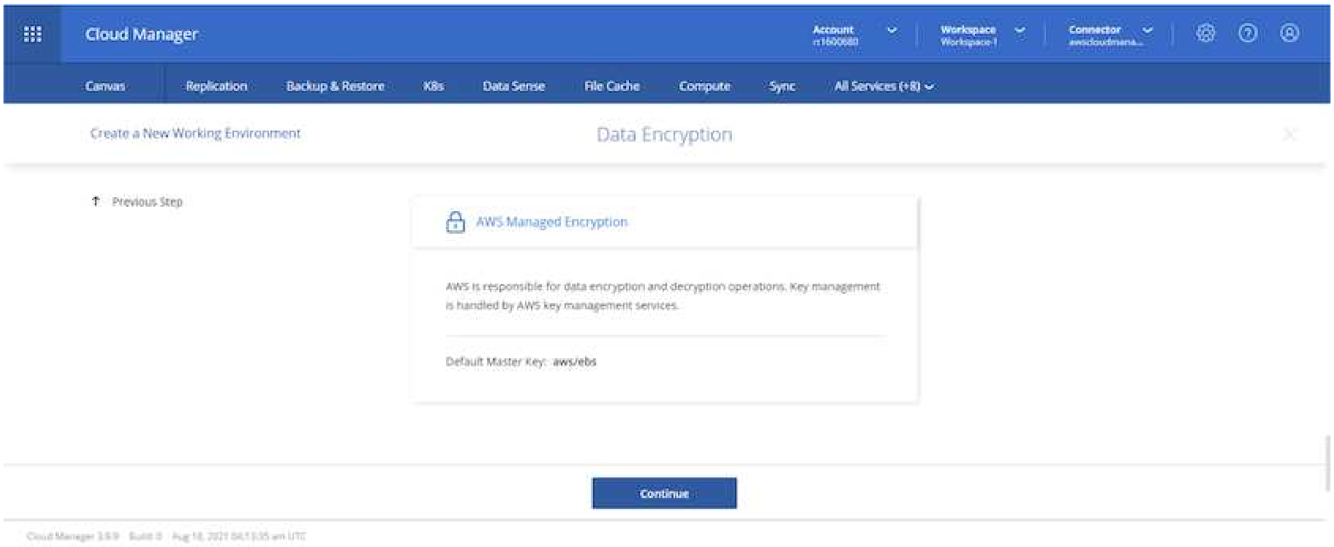
Route Tables

Select the route tables that should include routes to the floating IP addresses. This enables client access to the Cloud Volumes ONTAP HA pair. If you leave a route table unselected, clients that are associated with the route table cannot access the HA pair.

☑	Name	Main	ID	Associate with Subnet	Tags
☑	private_rt_rt1600680	No	rtb-08b4cb88f65c826a5	3 Subnets	1 Tags
☑	public_rt_rt1600680	Yes	rtb-0e46720d0da10c593	1 Subnets	1 Tags

2 Route Tables | The main route table is the default for the VPC

3. Choose whether to enable AWS managed encryption or AWS KMS to encrypt the ONTAP root, boot, and data disks.



AWS is responsible for data encryption and decryption operations. Key management is handled by AWS key management services.

Default Master Key: aws/ebs

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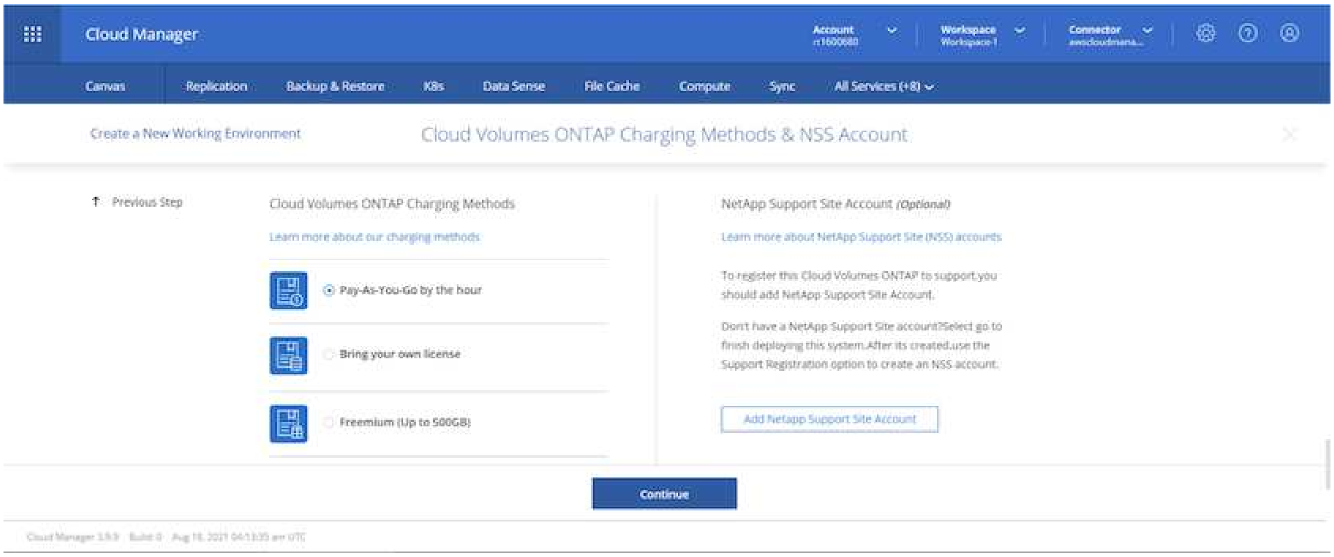
4. Choose your licensing model. If you don’t know which to choose, contact your NetApp representative.


Cloud Manager
Account
Workspace
Workspace-1
Connector
Canvas
Replication
Backup & Restore
K8s
Data Sense
File Cache
Compute
Sync
All Services (+8)
Create a New Working Environment
Cloud Volumes ONTAP Charging Methods & NSS Account
Previous Step
Cloud Volumes ONTAP Charging Methods
Learn more about our charging methods
NetApp Support Site Account (Optional)
Learn more about NetApp Support Site (NSS) accounts
Add Netapp Support Site Account
Continue

● Pay-As-You-Go by the hour

○ Bring your own license

○ Freemium (Up to 500GB)

To register this Cloud Volumes ONTAP to support,you should add NetApp Support Site Account.

Don't have a NetApp Support Site account?Select go to finish deploying this system.After its created,use the Support Registration option to create an NSS account.

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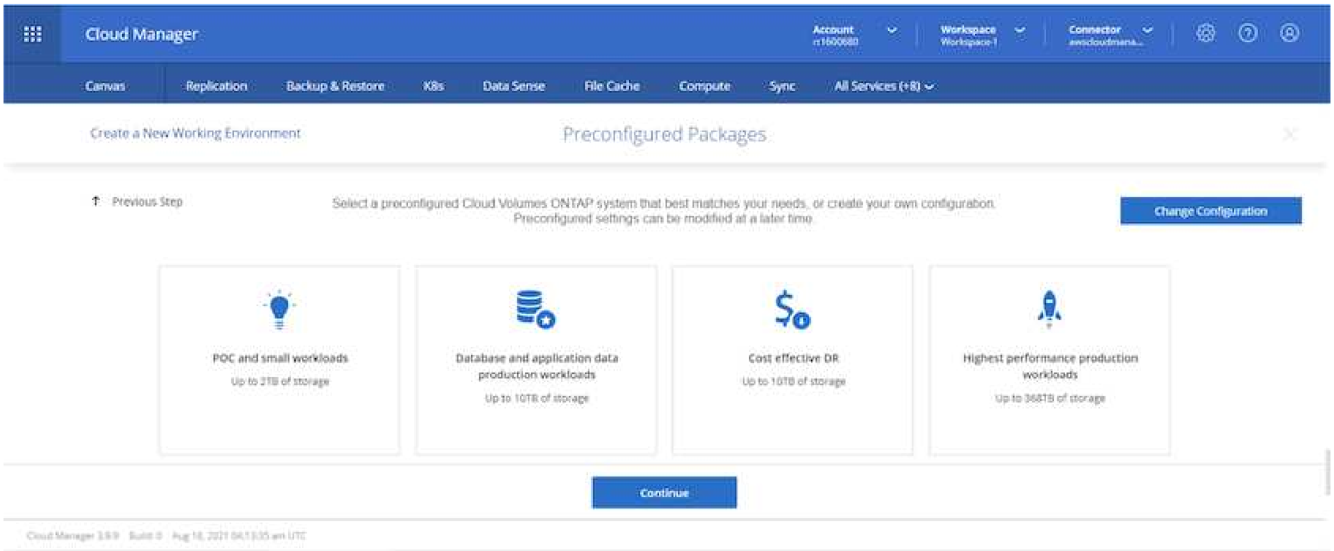
5. Select which configuration best suits your use case. This is related to the sizing considerations covered in the prerequisites page.



Select a preconfigured Cloud Volumes ONTAP system that best matches your needs, or create your own configuration. Preconfigured settings can be modified at a later time.

POC and small workloads
Up to 2TB of storage

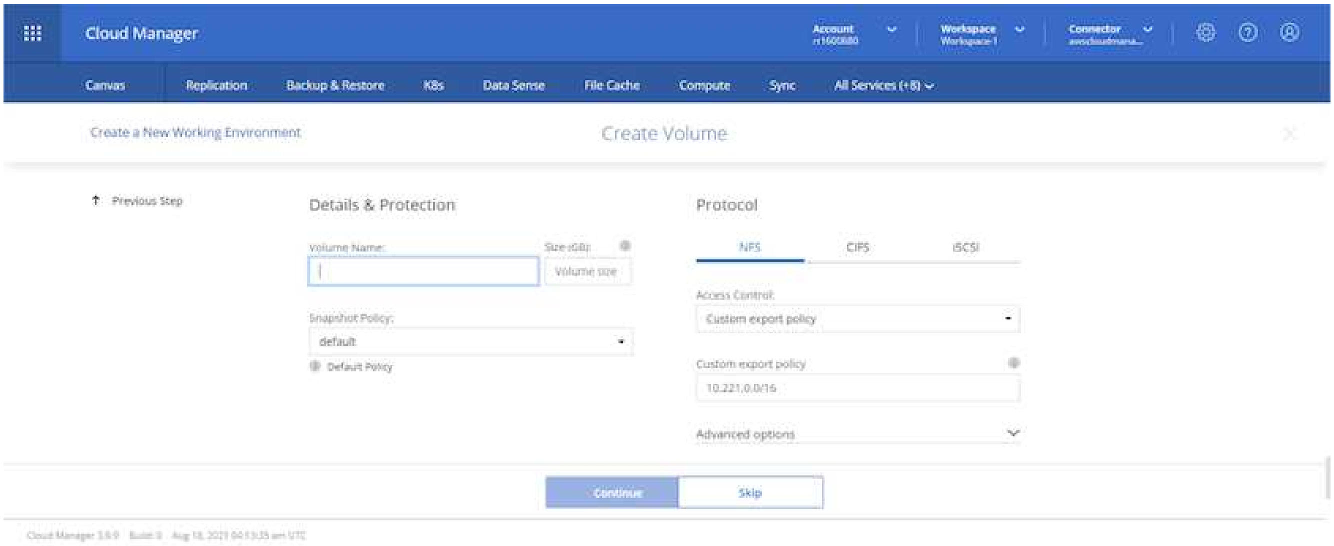
Database and application data production workloads
Up to 10TB of storage

Cost effective DR
Up to 10TB of storage

Highest performance production workloads
Up to 368TB of storage

Cloud Manager 3.9.9 · Build 0 · Aug 18, 2021 04:13:35 am UTC

6. Optionally, create a volume. This is not required, because the next steps use SnapMirror, which creates the volumes for us.



Create Volume

Details & Protection

Volume Name:

Size (GB): Volume size

Snapshot Policy: default

Default Policy

Protocol

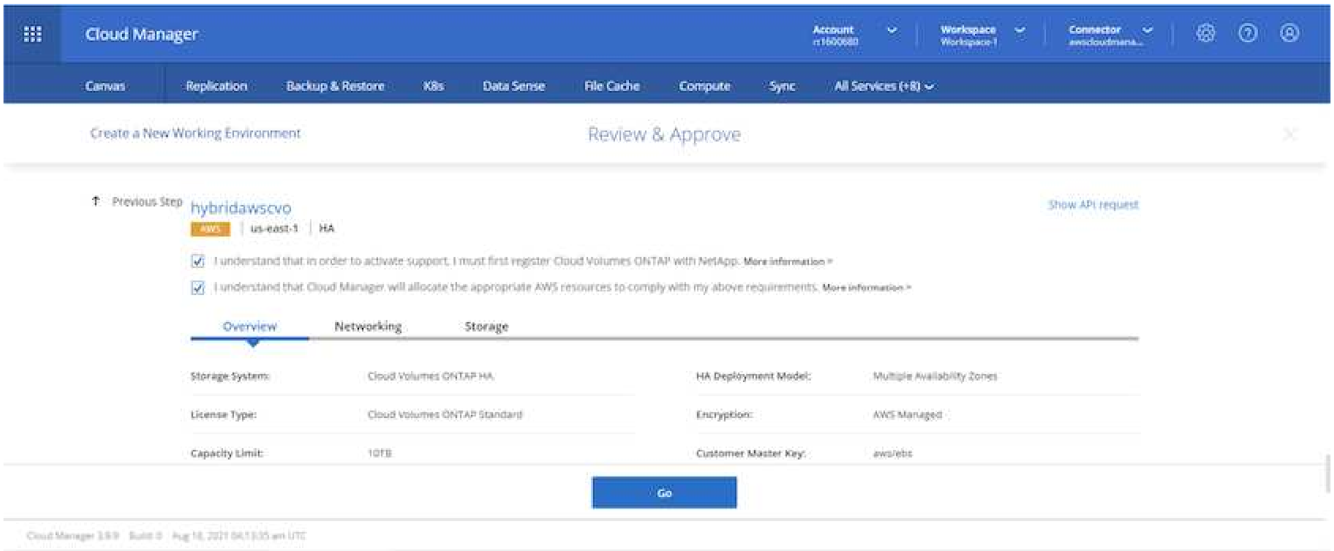
NFS CIFS iSCSI

Access Control: Custom export policy

Custom export policy: 10.221.0.0/16

Advanced options

7. Review the selections made and tick the boxes to verify that you understand that Cloud Manager deploys resources into your AWS environment. When ready, click Go.



Review & Approve

hybridawscvo

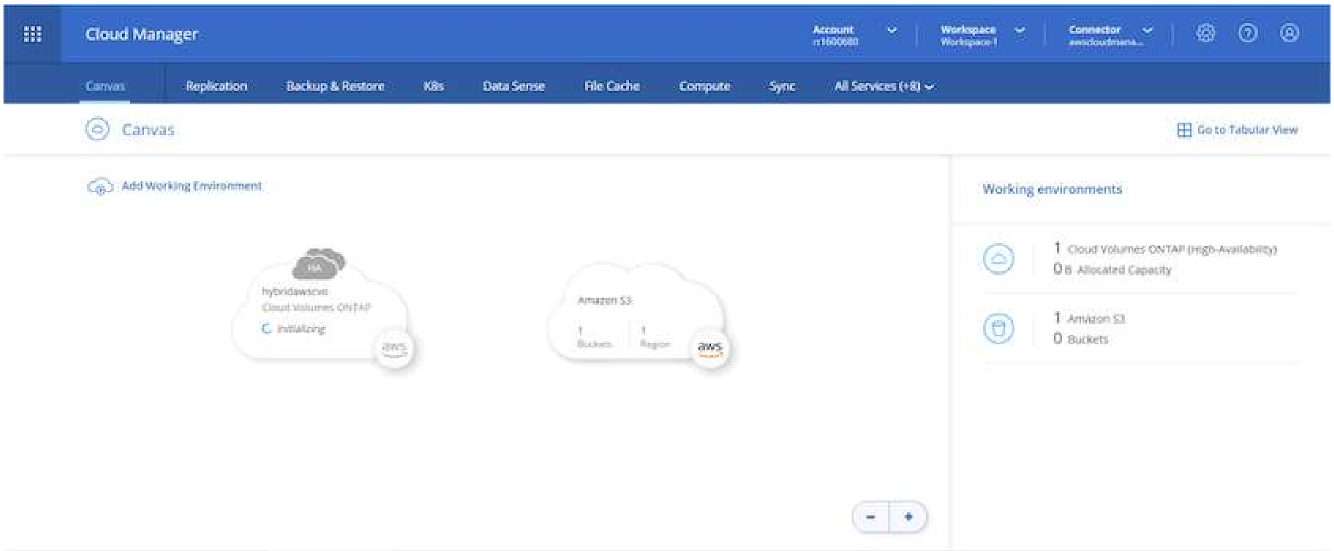
AWS | us-east-1 | HA

☑ I understand that in order to activate support, I must first register Cloud Volumes ONTAP with NetApp. More information »

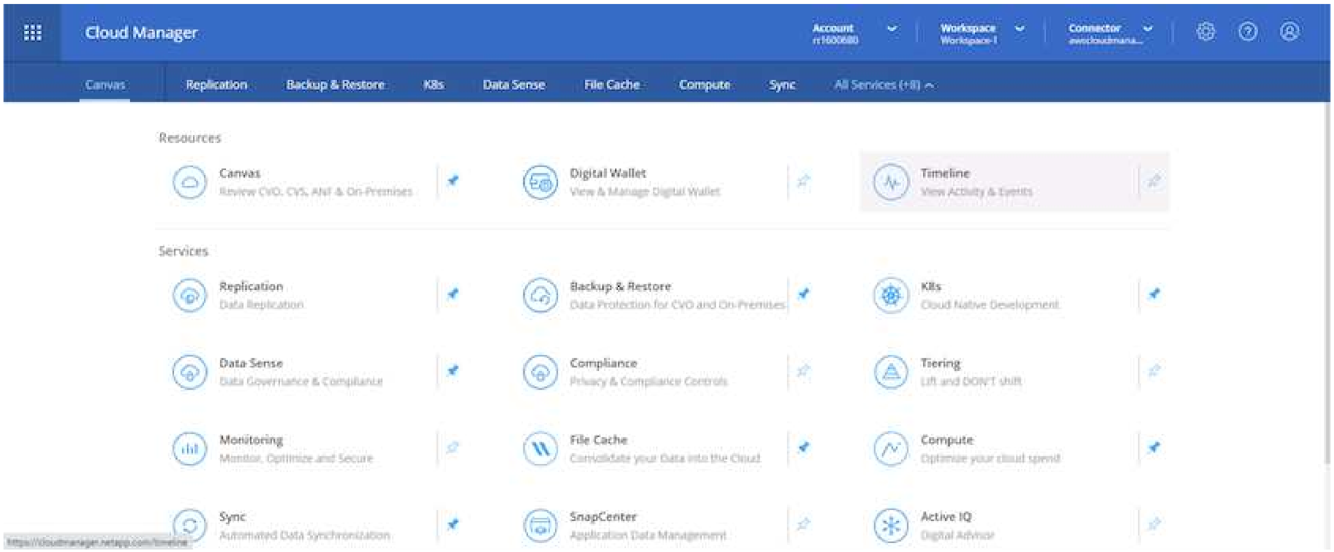
☑ I understand that Cloud Manager will allocate the appropriate AWS resources to comply with my above requirements. More information »

Storage System:	Cloud Volumes ONTAP HA	HA Deployment Model:	Multiple Availability Zones
License Type:	Cloud Volumes ONTAP Standard	Encryption:	AWS Managed
Capacity Limit:	10TB	Customer Master Key:	aws/ebs

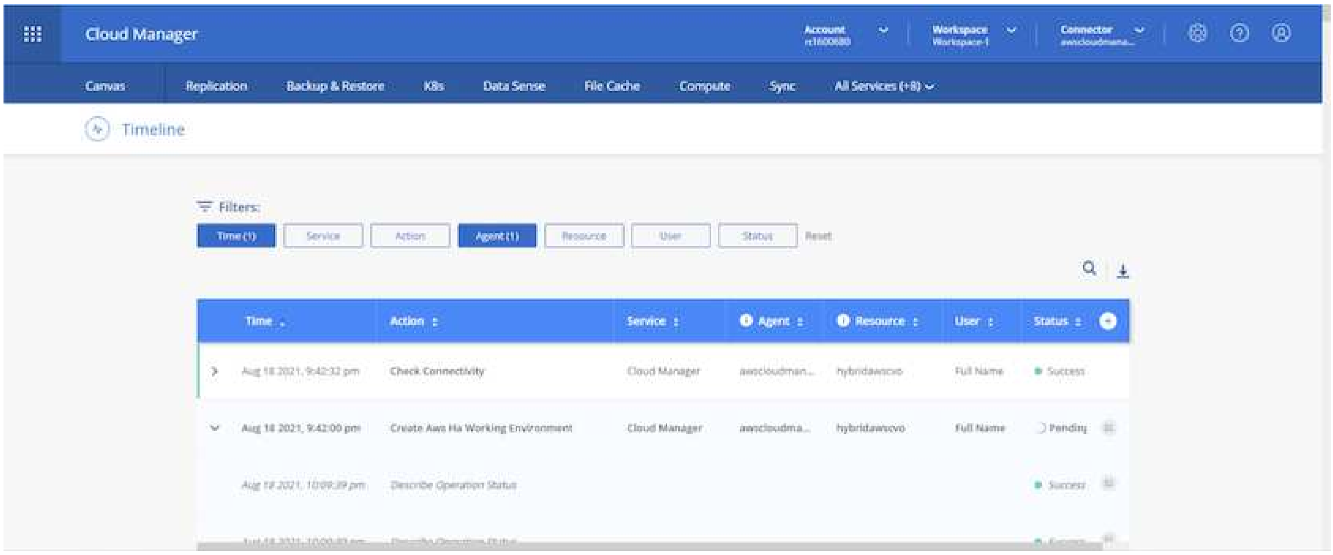
8. Cloud Volumes ONTAP now starts its deployment process. Cloud Manager uses AWS APIs and cloud formation stacks to deploy Cloud Volumes ONTAP. It then configures the system to your specifications, giving you a ready-to-go system that can be instantly utilized. The timing for this process varies depending on the selections made.



9. You can monitor the progress by navigating to the Timeline.

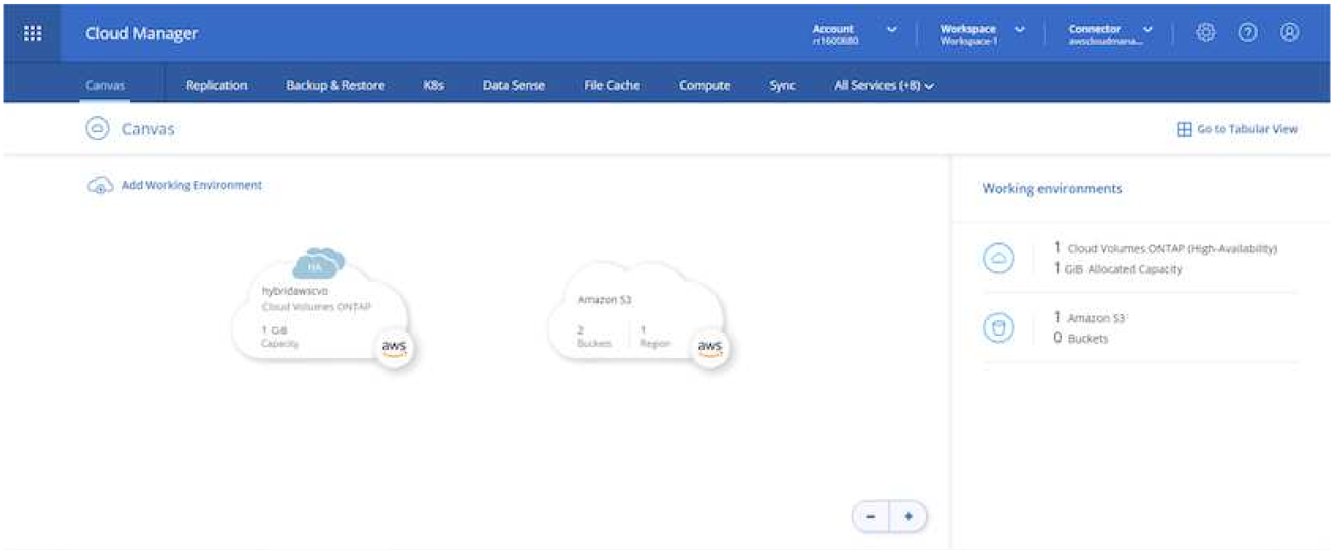


10. The Timeline acts as an audit of all actions performed in Cloud Manager. You can view all of the API calls that are made by Cloud Manager during setup to both AWS as well as the ONTAP cluster. This can also be effectively used to troubleshoot any issues that you face.



	Time	Action	Service	Agent	Resource	User	Status
>	Aug 18 2021, 9:42:32 pm	Check Connectivity	Cloud Manager	awscloudman...	hybridawscvo	Full Name	Success
⌄	Aug 18 2021, 9:42:00 pm	Create Aws Ha Working Environment	Cloud Manager	awscloudma...	hybridawscvo	Full Name	Pending
	Aug 18 2021, 10:09:39 pm	Describe Operation Status					Success

11. After deployment is complete, the CVO cluster appears on the Canvas, which the current capacity. The ONTAP cluster in its current state is fully configured to allow a true, out-of-the-box experience.

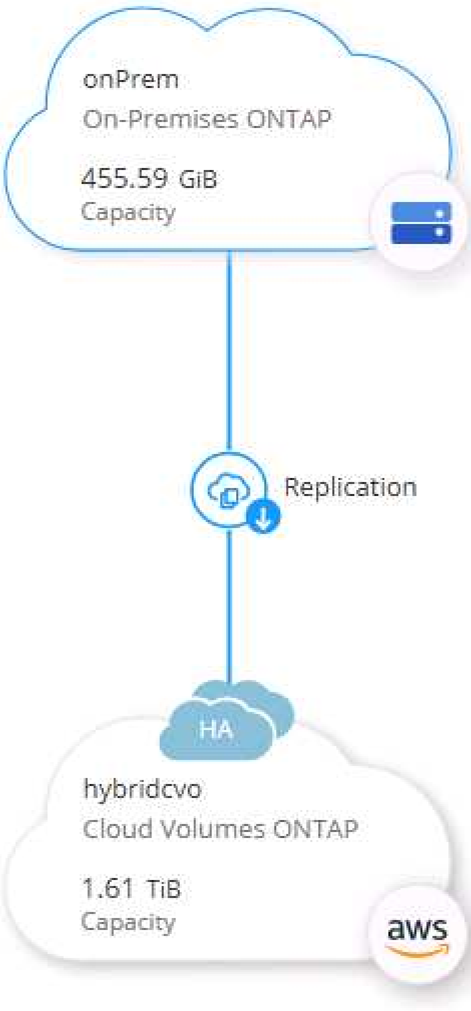


Configure SnapMirror from on-premises to cloud

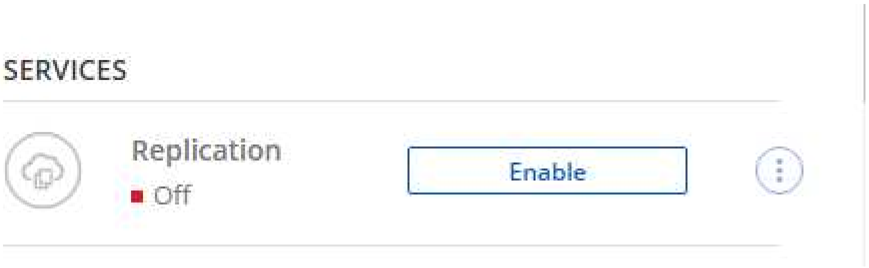
Now that you have a source ONTAP system and a destination ONTAP system deployed, you can replicate volumes containing database data into the cloud.

For a guide on compatible ONTAP versions for SnapMirror, see the SnapMirror Compatibility Matrix.

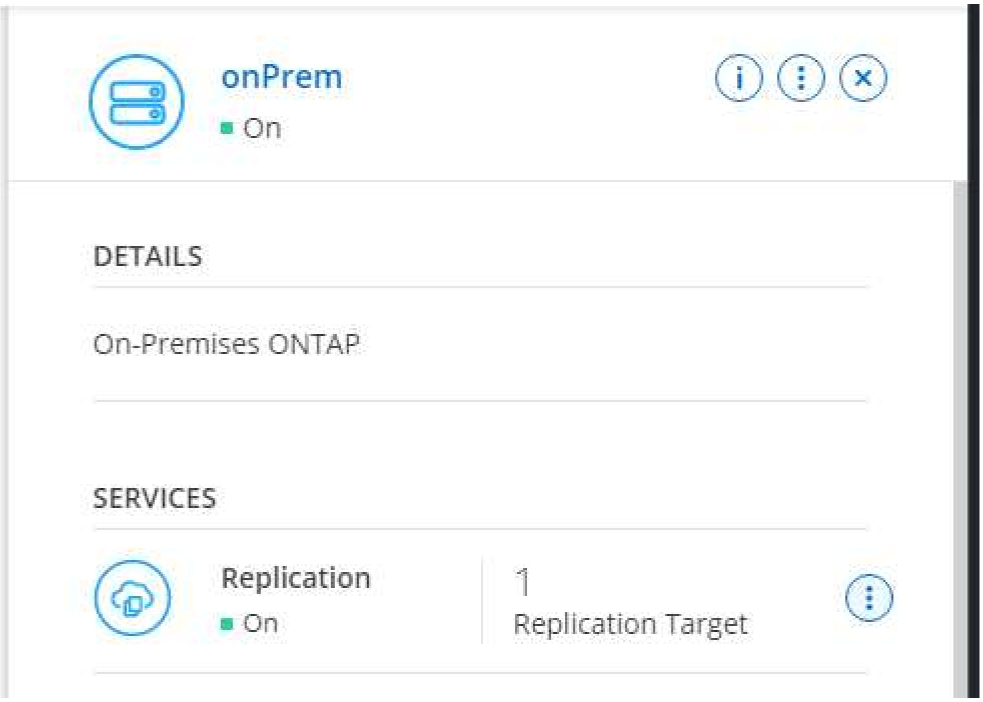
1. Click the source ONTAP system (on-premises) and either drag and drop it to the destination, select Replication > Enable, or select Replication > Menu > Replicate.



Select Enable.



Or Options.



onPrem

🟩 On

DETAILS

On-Premises ONTAP

SERVICES

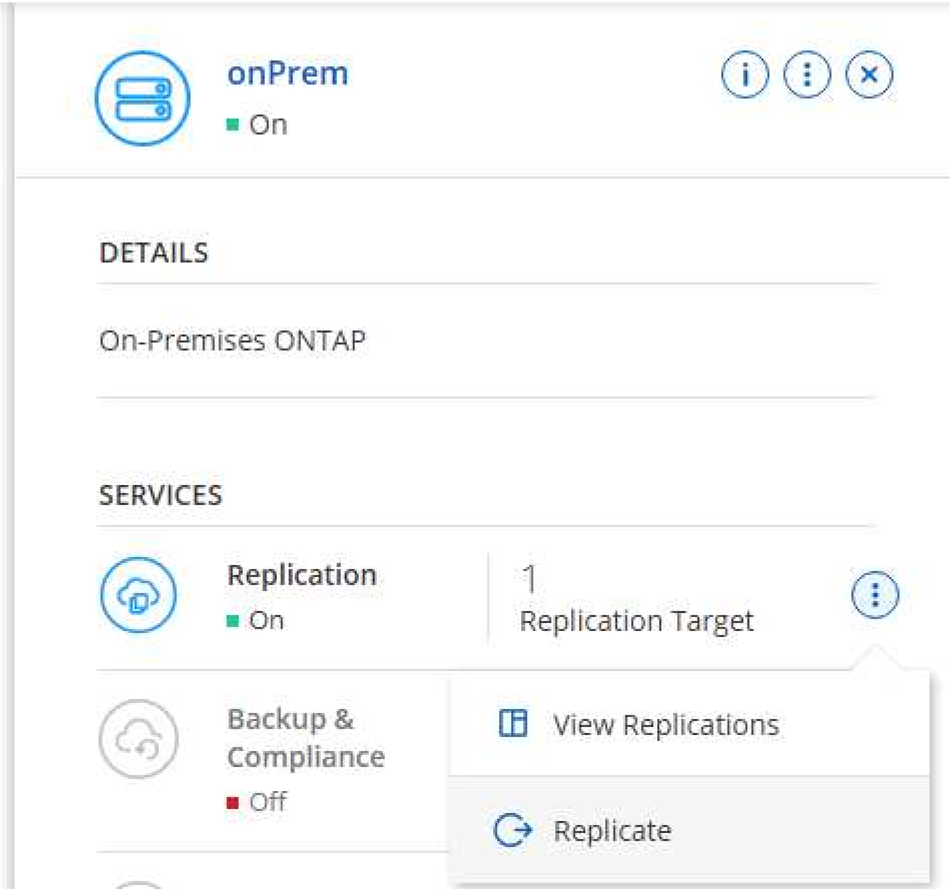
Replication

🟩 On

1

Replication Target

Replicate.



onPrem

🟩 On

DETAILS

On-Premises ONTAP

SERVICES

Replication

🟩 On

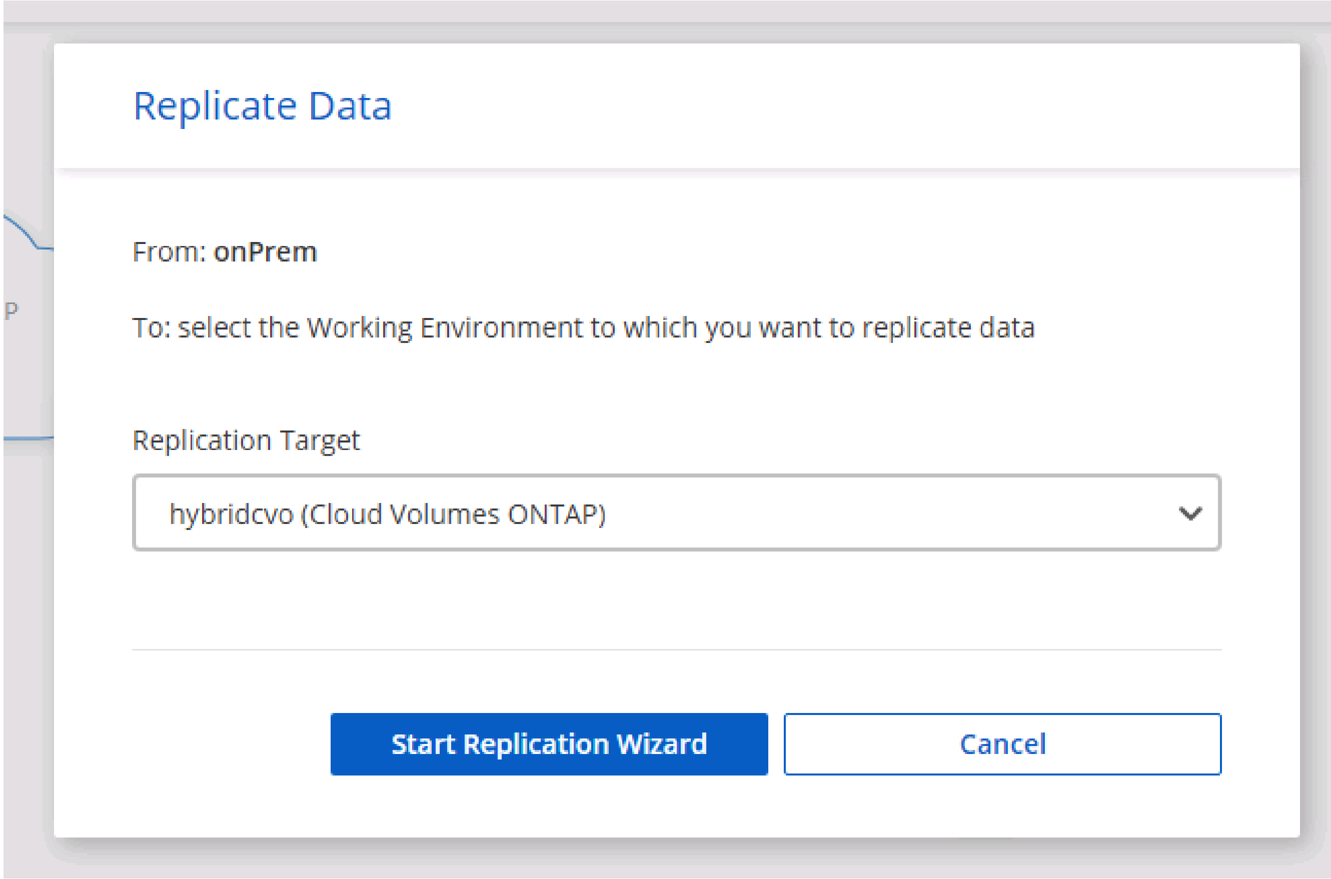
1

Replication Target

Backup & Compliance

🟥 Off

2. If you did not drag and drop, choose the destination cluster to replicate to.

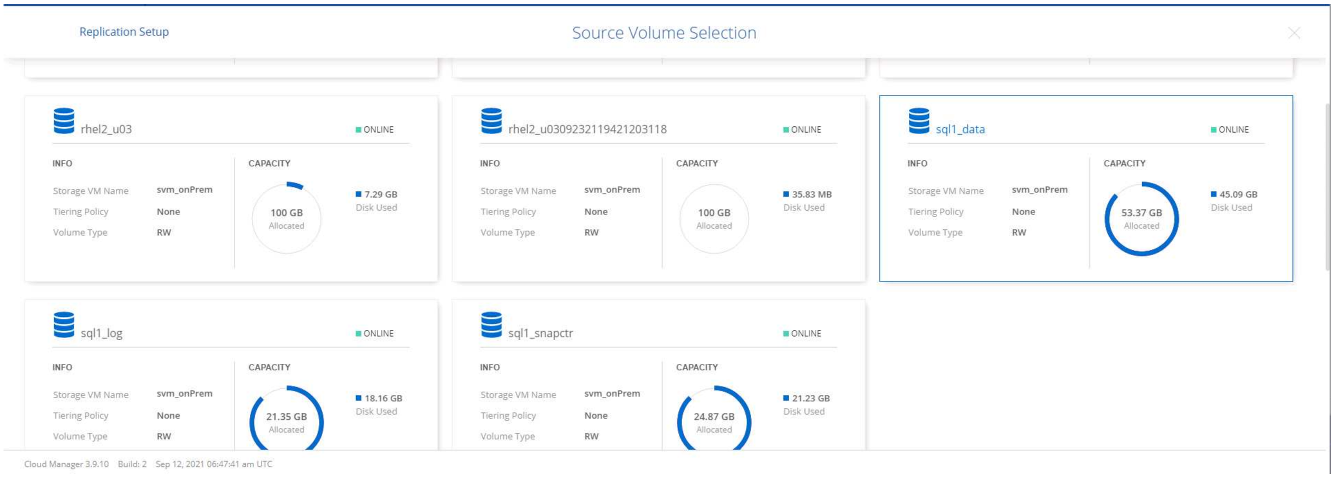

Replicate Data

From: onPrem

To: select the Working Environment to which you want to replicate data

Replication Target: hybridcvo (Cloud Volumes ONTAP)

3. Choose the volume that you'd like to replicate. We replicated the data and all log volumes.



rhel2_u03 — ONLINE
INFO: Storage VM Name svm_onPrem; Tiering Policy None; Volume Type RW
CAPACITY: 100 GB Allocated; 7.29 GB Disk Used

rhel2_u0309232119421203118 — ONLINE
INFO: Storage VM Name svm_onPrem; Tiering Policy None; Volume Type RW
CAPACITY: 100 GB Allocated; 35.83 MB Disk Used

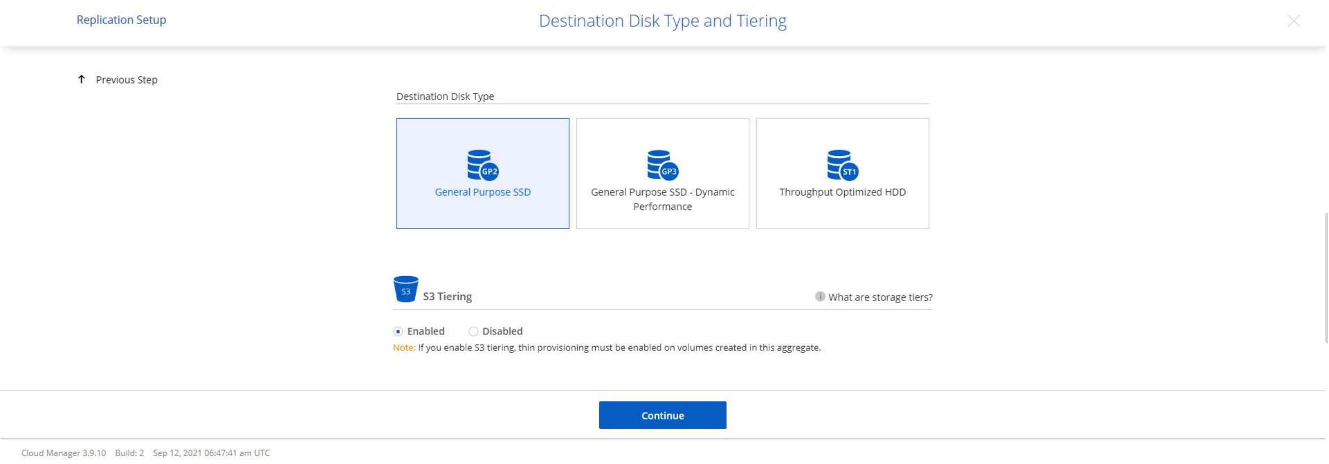
sql1_data — ONLINE
INFO: Storage VM Name svm_onPrem; Tiering Policy None; Volume Type RW
CAPACITY: 53.37 GB Allocated; 45.09 GB Disk Used

sql1_log — ONLINE
INFO: Storage VM Name svm_onPrem; Tiering Policy None; Volume Type RW
CAPACITY: 21.35 GB Allocated; 18.16 GB Disk Used

sql1_snapctr — ONLINE
INFO: Storage VM Name svm_onPrem; Tiering Policy None; Volume Type RW
CAPACITY: 24.87 GB Allocated; 21.23 GB Disk Used

Cloud Manager 3.9.10 Build: 2 Sep 12, 2021 06:47:41 am UTC

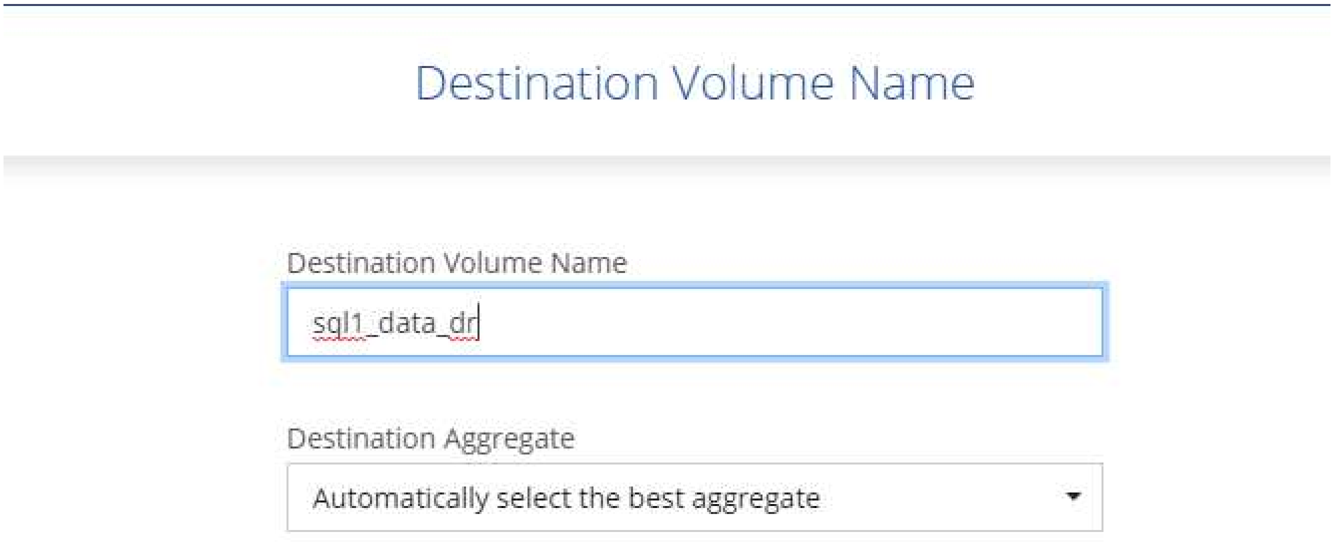
4. Choose the destination disk type and tiering policy. For disaster recovery, we recommend an SSD as the disk type and to maintain data tiering. Data tiering tiers the mirrored data into low-cost object storage and saves you money on local disks. When you break the relationship or clone the volume, the data uses the fast, local storage.



● Enabled ○ Disabled

Note: If you enable S3 tiering, thin provisioning must be enabled on volumes created in this aggregate.

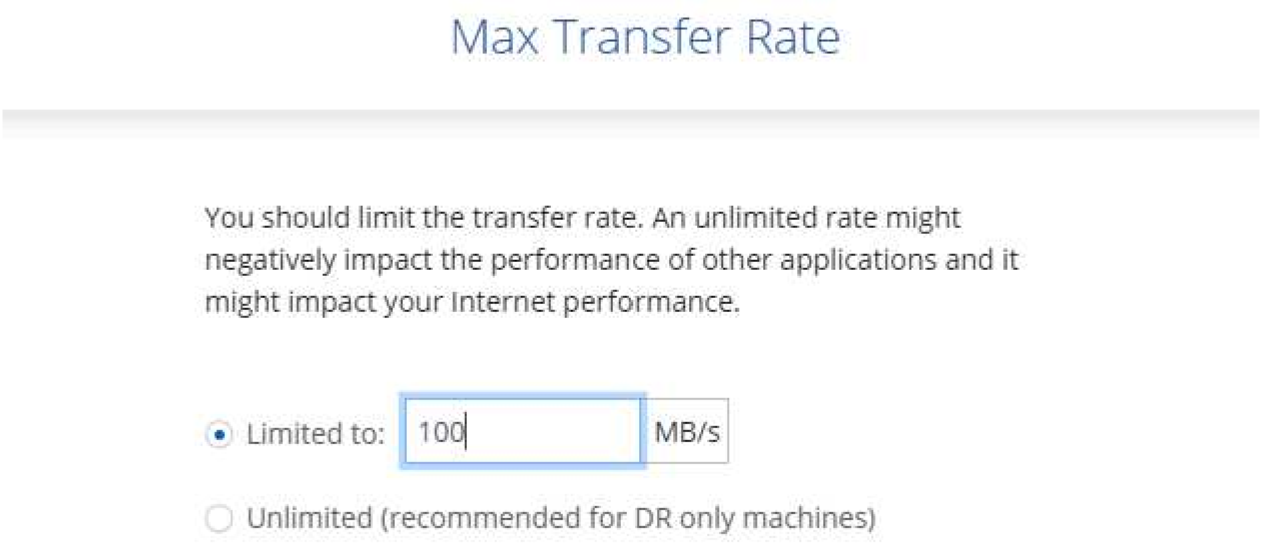
5. Select the destination volume name: we chose `[source_volume_name]_dr`.



Destination Volume Name: sql1_data_dr

Destination Aggregate: Automatically select the best aggregate

6. Select the maximum transfer rate for the replication. This enables you to save bandwidth if you have a low bandwidth connection to the cloud such as a VPN.



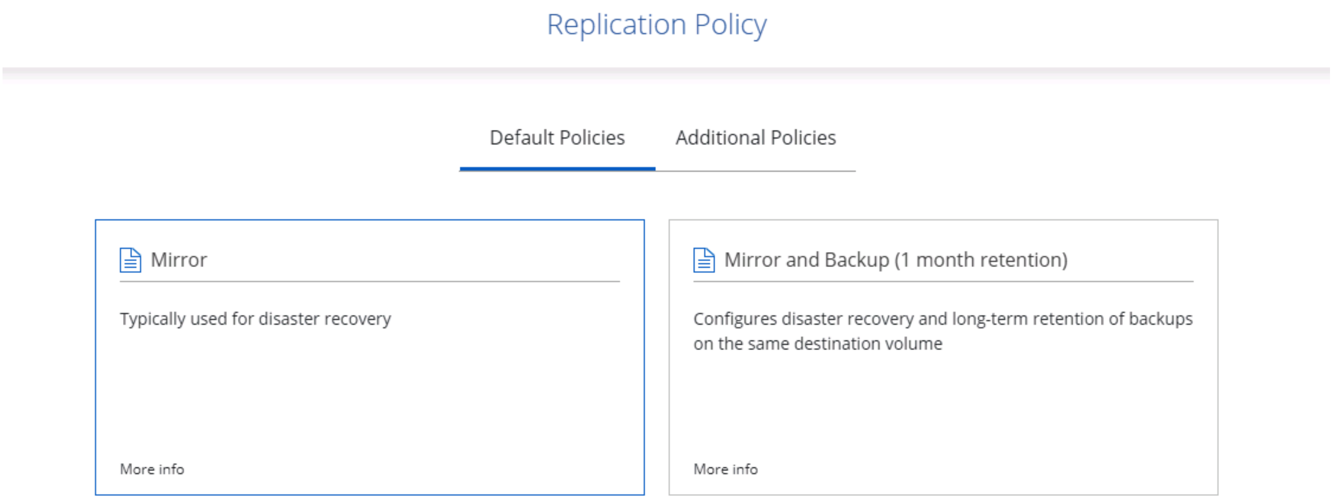
Max Transfer Rate

You should limit the transfer rate. An unlimited rate might negatively impact the performance of other applications and it might impact your Internet performance.

● Limited to: 100 MB/s

○ Unlimited (recommended for DR only machines)

7. Define the replication policy. We chose a Mirror, which takes the most recent dataset and replicates that into the destination volume. You could also choose a different policy based on your requirements.



Replication Policy

Default Policies | Additional Policies

Mirror

Typically used for disaster recovery

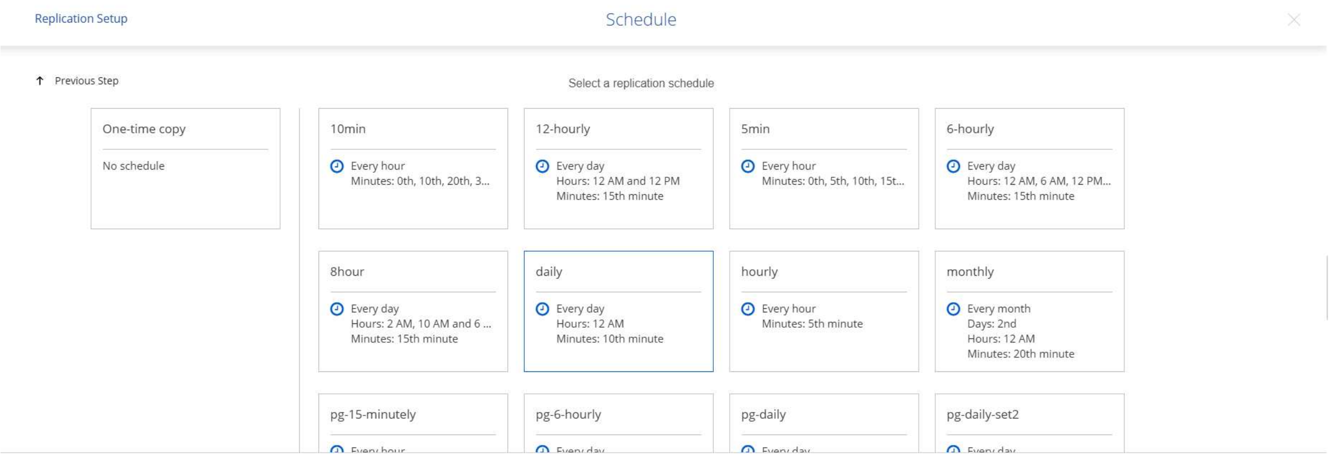
More info

Mirror and Backup (1 month retention)

Configures disaster recovery and long-term retention of backups on the same destination volume

More info

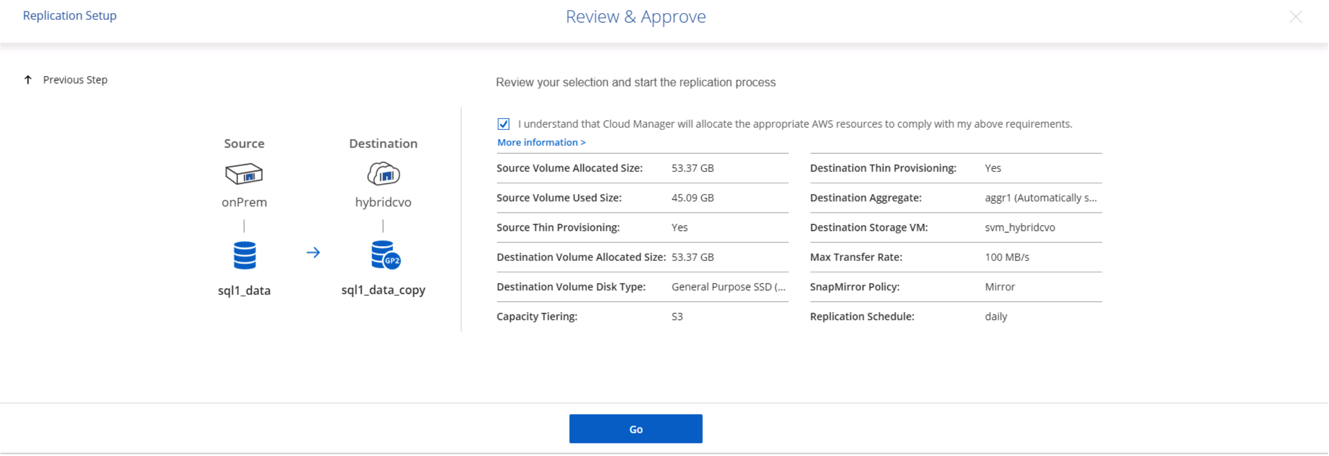
8. Choose the schedule for triggering replication. NetApp recommends setting a "daily" schedule of for the data volume and an "hourly" schedule for the log volumes, although this can be changed based on requirements.



Select a replication schedule

One-time copy	10min	12-hourly	5min	6-hourly
No schedule	Every hour Minutes: 0th, 10th, 20th, 3...	Every day Hours: 12 AM and 12 PM Minutes: 15th minute	Every hour Minutes: 0th, 5th, 10th, 15t...	Every day Hours: 12 AM, 6 AM, 12 PM... Minutes: 15th minute
	8hour	**daily**	**hourly**	**monthly**
	Every day Hours: 2 AM, 10 AM and 6 ... Minutes: 15th minute	Every day Hours: 12 AM Minutes: 10th minute	Every hour Minutes: 5th minute	Every month Days: 2nd Hours: 12 AM Minutes: 20th minute
	pg-15-minutely	**pg-6-hourly**	**pg-daily**	**pg-daily-set2**
	Every hour	Every day	Every day	Every day

9. Review the information entered, click Go to trigger the cluster peer and SVM peer (if this is your first time replicating between the two clusters), and then implement and initialize the SnapMirror relationship.

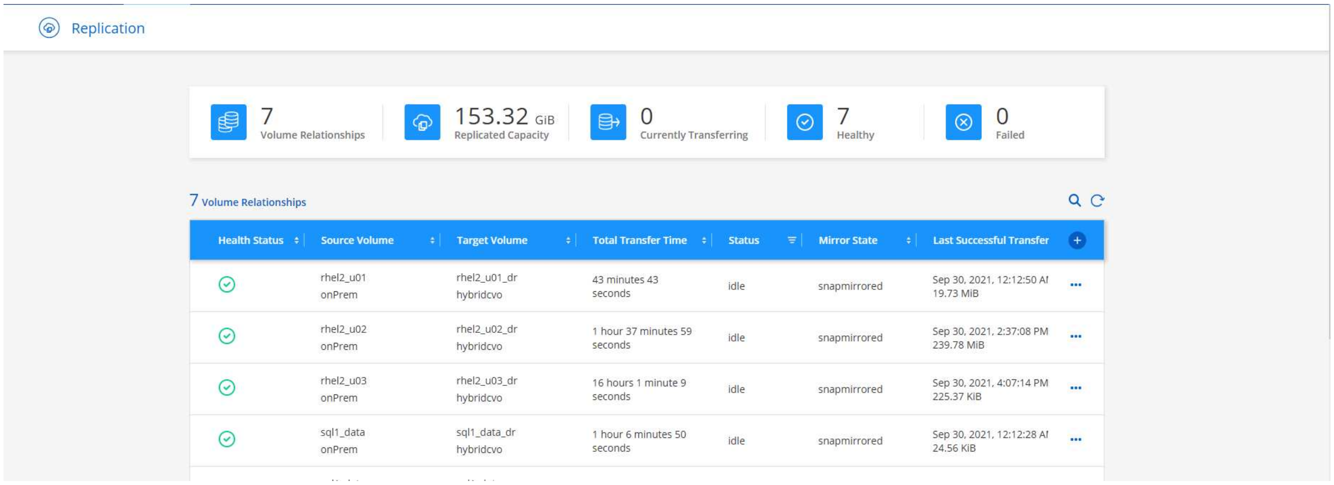


Review your selection and start the replication process

☑ I understand that Cloud Manager will allocate the appropriate AWS resources to comply with my above requirements.
More information >

Source Volume Allocated Size:	53.37 GB	Destination Thin Provisioning:	Yes
Source Volume Used Size:	45.09 GB	Destination Aggregate:	aggr1 (Automatically s...
Source Thin Provisioning:	Yes	Destination Storage VM:	svm_hybridcvo
Destination Volume Allocated Size:	53.37 GB	Max Transfer Rate:	100 MB/s
Destination Volume Disk Type:	General Purpose SSD (...	SnapMirror Policy:	Mirror
Capacity Tiering:	S3	Replication Schedule:	daily

10. Continue this process for data volumes and log volumes.
11. To check all of your relationships, navigate to the Replication tab inside Cloud Manager. Here you can manage your relationships and check on their status.



7 Volume Relationships | 153.32 GiB Replicated Capacity | 0 Currently Transferring | 7 Healthy | 0 Failed

7 Volume Relationships

Health Status	Source Volume	Target Volume	Total Transfer Time	Status	Mirror State	Last Successful Transfer
✓	rhel2_u01 onPrem	rhel2_u01_dr hybridcvo	43 minutes 43 seconds	idle	snapmirrored	Sep 30, 2021, 12:12:50 AI 19.73 MiB
✓	rhel2_u02 onPrem	rhel2_u02_dr hybridcvo	1 hour 37 minutes 59 seconds	idle	snapmirrored	Sep 30, 2021, 2:37:08 PM 239.78 MiB
✓	rhel2_u03 onPrem	rhel2_u03_dr hybridcvo	16 hours 1 minute 9 seconds	idle	snapmirrored	Sep 30, 2021, 4:07:14 PM 225.37 KiB
✓	sql1_data onPrem	sql1_data_dr hybridcvo	1 hour 6 minutes 50 seconds	idle	snapmirrored	Sep 30, 2021, 12:12:28 AI 24.56 KiB

12. After all the volumes have been replicated, you are in a steady state and ready to move on to the disaster recovery and dev/test workflows.

3. Deploy EC2 compute instance for database workload

AWS has preconfigured EC2 compute instances for various workloads. The choice of instance type determines the number of CPU cores, memory capacity, storage type and capacity, and network performance. For the use cases, with the exception of the OS partition, the main storage to run database workload is allocated from CVO or the FSx ONTAP storage engine. Therefore, the main factors to consider are the choice of CPU cores, memory, and network performance level. Typical AWS EC2 instance types can be found here: EC2 Instance Type.

Sizing the compute instance

1. Select the right instance type based on the required workload. Factors to consider include the number of business transactions to be supported, the number of concurrent users, data set sizing, and so on.
2. EC2 instance deployment can be launched through the EC2 Dashboard. The exact deployment procedures are beyond the scope of this solution. See Amazon EC2 for details.

Linux instance configuration for Oracle workload

This section contain additional configuration steps after an EC2 Linux instance is deployed.

1. Add an Oracle standby instance to the DNS server for name resolution within the SnapCenter management domain.
2. Add a Linux management user ID as the SnapCenter OS credentials with sudo permissions without a password. Enable the ID with SSH password authentication on the EC2 instance. (By default, SSH password authentication and passwordless sudo is turned off on EC2 instances.)
3. Configure Oracle installation to match with on-premises Oracle installation such as OS patches, Oracle versions and patches, and so on.
4. NetApp Ansible DB automation roles can be leveraged to configure EC2 instances for database dev/test and disaster recovery use cases. The automation code can be download from the NetApp public GitHub site: Oracle 19c Automated Deployment. The goal is to install and configure a database software stack on an EC2 instance to match on-premises OS and database configurations.

Windows instance configuration for SQL Server workload

This section lists additional configuration steps after an EC2 Windows instance is initially deployed.

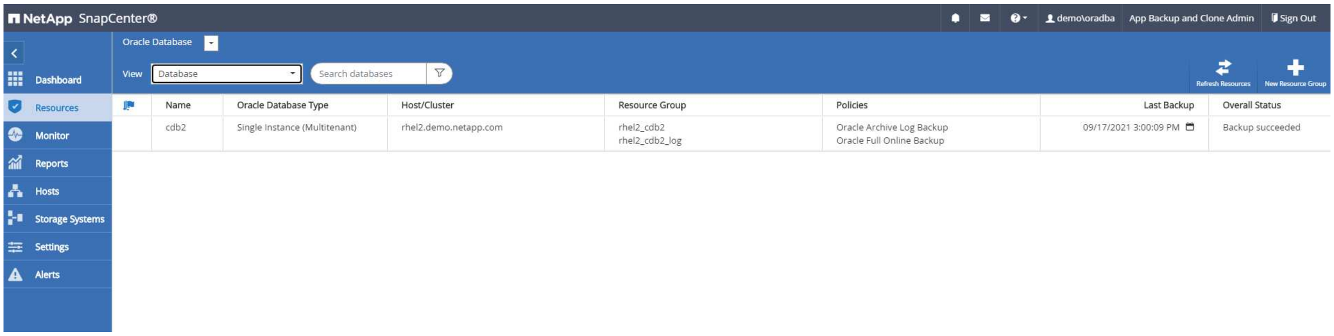
1. Retrieve the Windows administrator password to log in to an instance via RDP.
2. Disable the Windows firewall, join the host to Windows SnapCenter domain, and add the instance to the DNS server for name resolution.
3. Provision a SnapCenter log volume to store SQL Server log files.
4. Configure iSCSI on the Windows host to mount the volume and format the disk drive.
5. Again, many of the previous tasks can be automated with the NetApp automation solution for SQL Server. Check the NetApp automation public GitHub site for newly published roles and solutions: NetApp Automation.

Workflow for dev/test bursting to cloud

The agility of the public cloud, the time to value, and the cost savings are all meaningful value propositions for enterprises adopting the public cloud for database application development and testing effort. There is no better tool than SnapCenter to make this a reality. SnapCenter can not only protect your production database on-premises, but can also it quickly clone a copy for application development or code testing in the public cloud while consuming very little extra storage. Following are details of the step-by-step processes for using this tool.

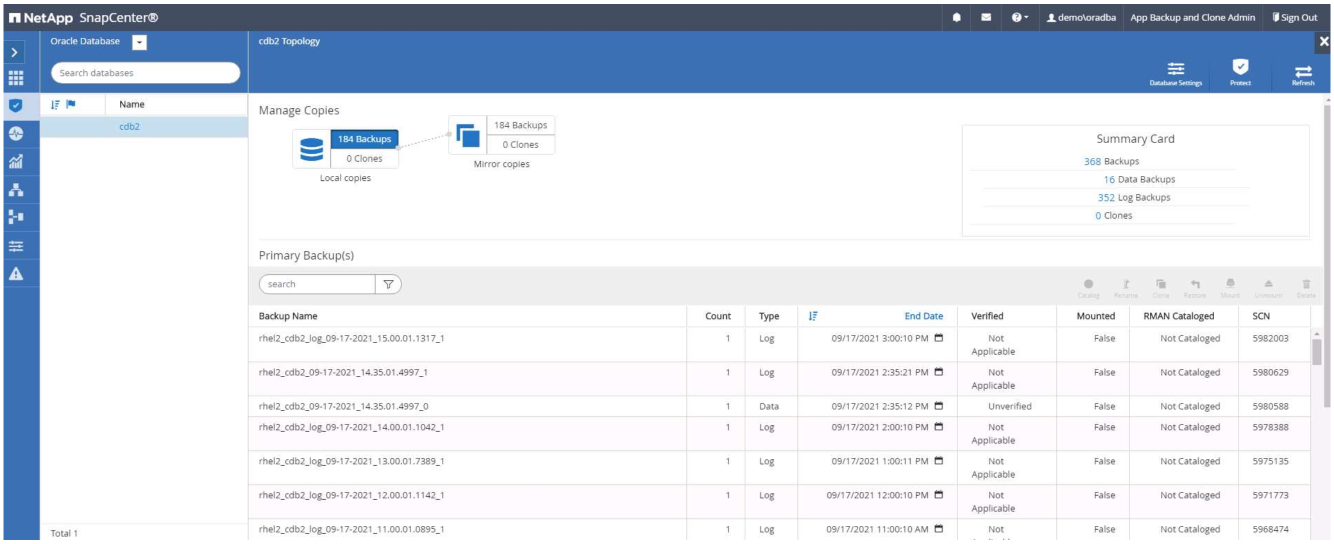
Clone an Oracle Database for dev/test from a replicated snapshot backup

1. Log into SnapCenter with a database management user ID for Oracle. Navigate to the Resources tab, which shows the Oracle databases being protected by SnapCenter.



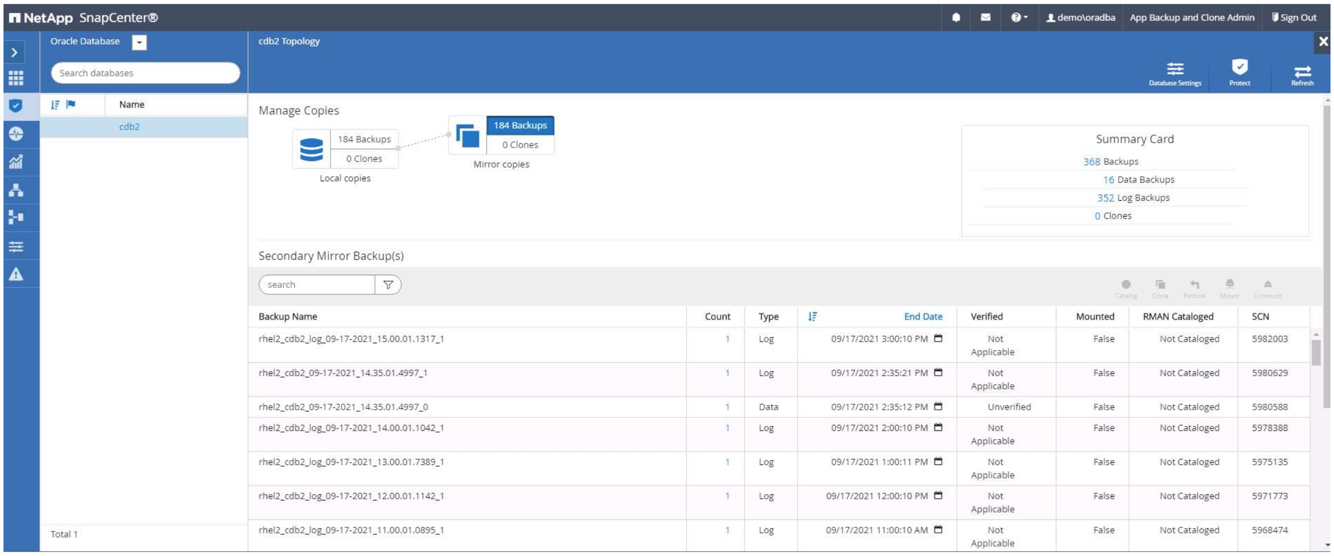
Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status
cdb2	Single Instance (Multitenant)	rhel2.demo.netapp.com	rhel2_cdb2 rhel2_cdb2_log	Oracle Archive Log Backup Oracle Full Online Backup	09/17/2021 3:00:09 PM	Backup succeeded

2. Click the intended on-premises database name for the backup topology and the detailed view. If a secondary replicated location is enabled, it shows linked mirror backups.



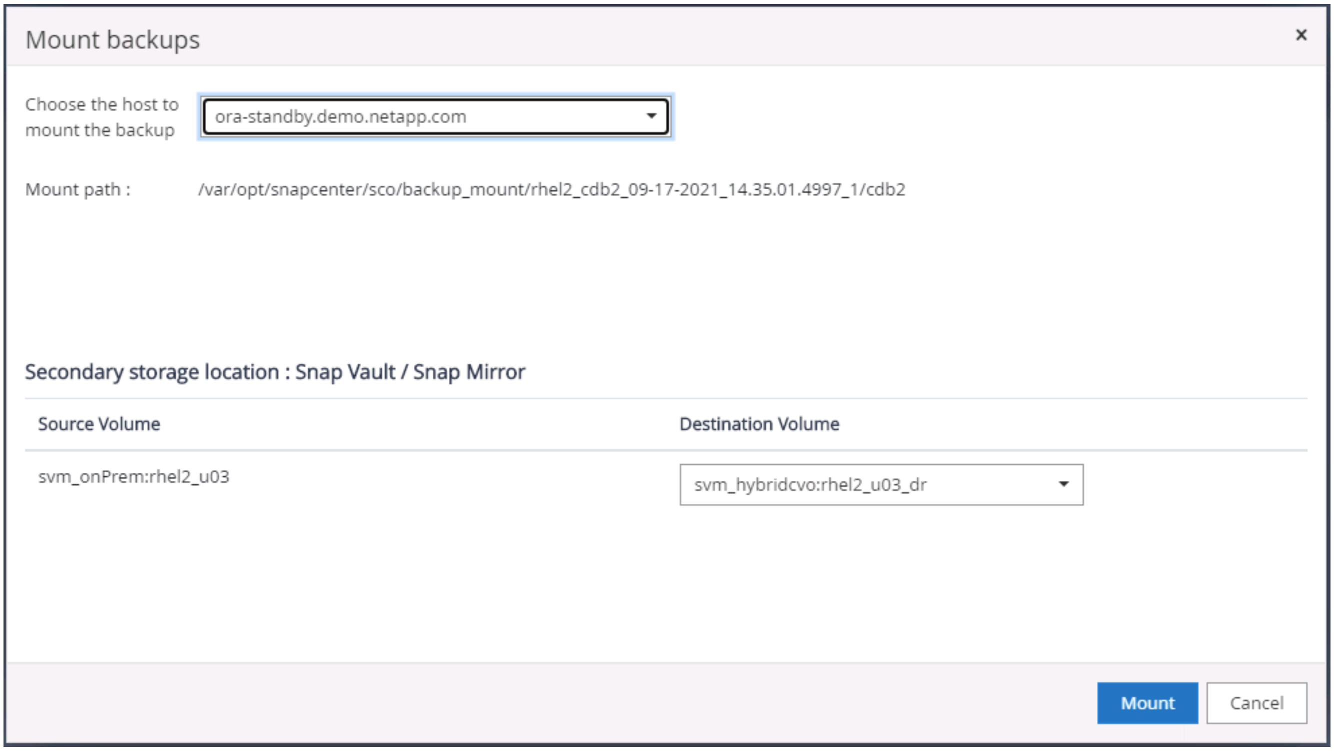
Backup Name	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_log_09-17-2021_15.00.01.1317_1	1	Log	09/17/2021 3:00:10 PM	Not Applicable	False	Not Cataloged	5982003
rhel2_cdb2_09-17-2021_14.35.01.4997_1	1	Log	09/17/2021 2:35:21 PM	Not Applicable	False	Not Cataloged	5980629
rhel2_cdb2_09-17-2021_14.35.01.4997_0	1	Data	09/17/2021 2:35:12 PM	Unverified	False	Not Cataloged	5980588
rhel2_cdb2_log_09-17-2021_14.00.01.1042_1	1	Log	09/17/2021 2:00:10 PM	Not Applicable	False	Not Cataloged	5978388
rhel2_cdb2_log_09-17-2021_13.00.01.7389_1	1	Log	09/17/2021 1:00:11 PM	Not Applicable	False	Not Cataloged	5975135
rhel2_cdb2_log_09-17-2021_12.00.01.1142_1	1	Log	09/17/2021 12:00:10 PM	Not Applicable	False	Not Cataloged	5971773
rhel2_cdb2_log_09-17-2021_11.00.01.0895_1	1	Log	09/17/2021 11:00:10 AM	Not	False	Not Cataloged	5968474

3. Toggled to the mirrored backups view by clicking mirrored backups. The secondary mirror backup(s) is then displayed.



Backup Name	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_log_09-17-2021_15.00.01.1317_1	1	Log	09/17/2021 3:00:10 PM	Not Applicable	False	Not Cataloged	5982003
rhel2_cdb2_09-17-2021_14.35.01.4997_1	1	Log	09/17/2021 2:35:21 PM	Not Applicable	False	Not Cataloged	5980629
rhel2_cdb2_09-17-2021_14.35.01.4997_0	1	Data	09/17/2021 2:35:12 PM	Unverified	False	Not Cataloged	5980588
rhel2_cdb2_log_09-17-2021_14.00.01.1042_1	1	Log	09/17/2021 2:00:10 PM	Not Applicable	False	Not Cataloged	5978388
rhel2_cdb2_log_09-17-2021_13.00.01.7389_1	1	Log	09/17/2021 1:00:11 PM	Not Applicable	False	Not Cataloged	5975135
rhel2_cdb2_log_09-17-2021_12.00.01.1142_1	1	Log	09/17/2021 12:00:10 PM	Not Applicable	False	Not Cataloged	5971773
rhel2_cdb2_log_09-17-2021_11.00.01.0895_1	1	Log	09/17/2021 11:00:10 AM	Not Applicable	False	Not Cataloged	5968474

4. Choose a mirrored secondary database backup copy to be cloned and determine a recovery point either by time and system change number or by SCN. Generally, the recovery point should be trailing the full database backup time or SCN to be cloned. After a recovery point is decided, the required log file backup must be mounted for recovery. The log file backup should be mounted to target DB server where the clone database is to be hosted.

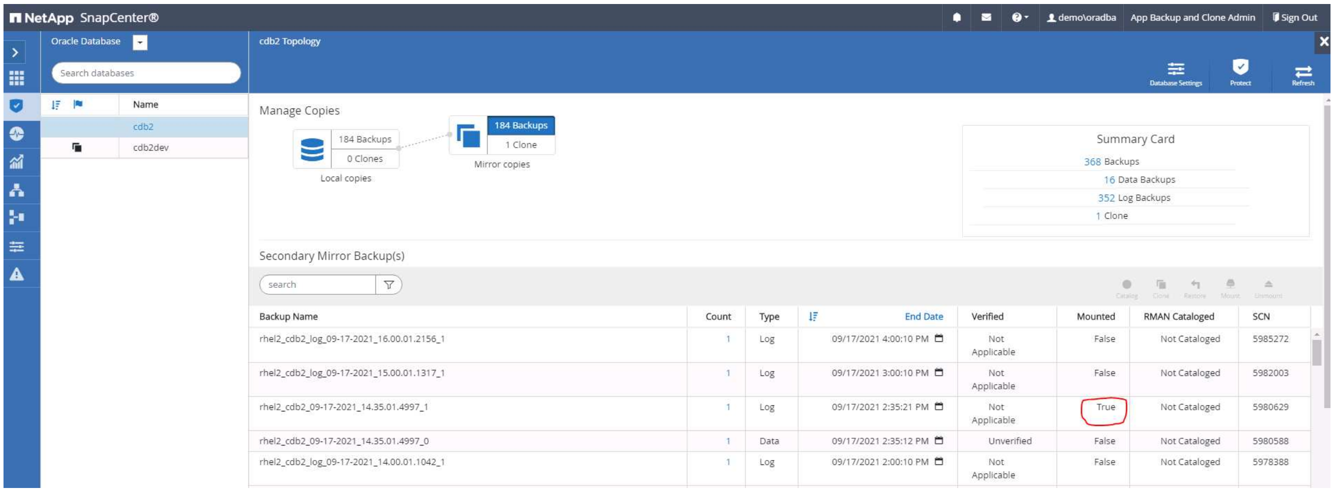


Choose the host to mount the backup: ora-standby.demo.netapp.com

Mount path : /var/opt/snapcenter/sco/backup_mount/rhel2_cdb2_09-17-2021_14.35.01.4997_1/cdb2

Secondary storage location : Snap Vault / Snap Mirror

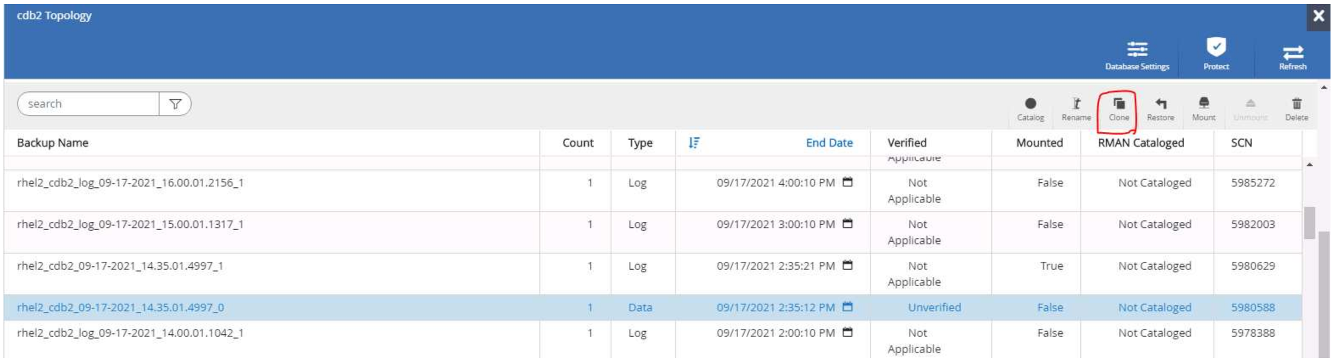
Source Volume	Destination Volume
svm_onPrem:rhel2_u03	svm_hybridcvo:rhel2_u03_dr



Backup Name	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_log_09-17-2021_16.00.01.2156_1	1	Log	09/17/2021 4:00:10 PM	Not Applicable	False	Not Cataloged	5985272
rhel2_cdb2_log_09-17-2021_15.00.01.1317_1	1	Log	09/17/2021 3:00:10 PM	Not Applicable	False	Not Cataloged	5982003
rhel2_cdb2_09-17-2021_14.35.01.4997_1	1	Log	09/17/2021 2:35:21 PM	Not Applicable	True	Not Cataloged	5980629
rhel2_cdb2_09-17-2021_14.35.01.4997_0	1	Data	09/17/2021 2:35:12 PM	Unverified	False	Not Cataloged	5980588
rhel2_cdb2_log_09-17-2021_14.00.01.1042_1	1	Log	09/17/2021 2:00:10 PM	Not Applicable	False	Not Cataloged	5978388

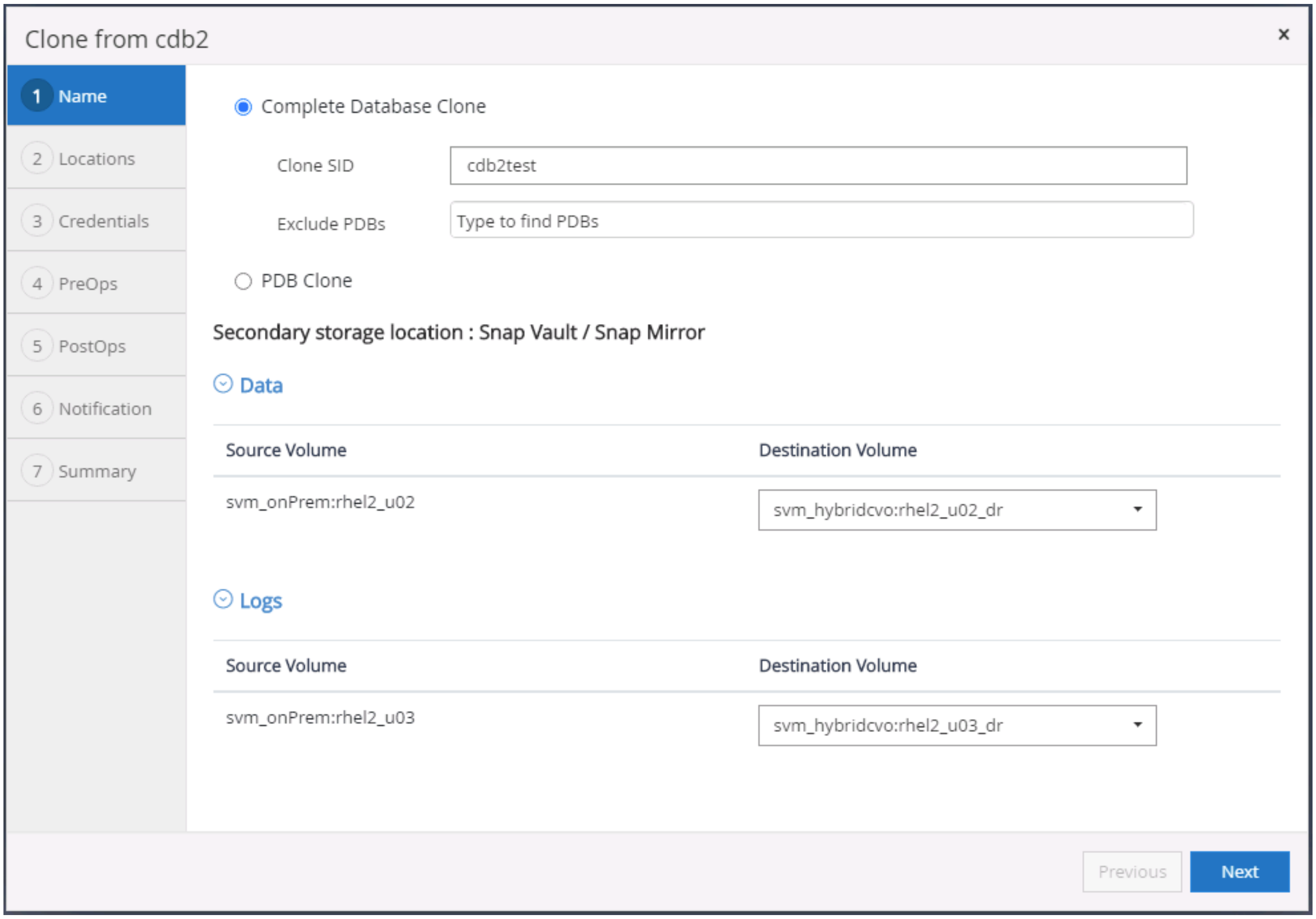
> If log pruning is enabled and the recovery point is extended beyond the last log pruning, multiple archive log backups might need to be mounted.

5. Highlight the full database backup copy to be cloned, and then click the clone button to start the DB clone Workflow.



Backup Name	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_log_09-17-2021_16.00.01.2156_1	1	Log	09/17/2021 4:00:10 PM	Not Applicable	False	Not Cataloged	5985272
rhel2_cdb2_log_09-17-2021_15.00.01.1317_1	1	Log	09/17/2021 3:00:10 PM	Not Applicable	False	Not Cataloged	5982003
rhel2_cdb2_09-17-2021_14.35.01.4997_1	1	Log	09/17/2021 2:35:21 PM	Not Applicable	True	Not Cataloged	5980629
rhel2_cdb2_09-17-2021_14.35.01.4997_0	1	Data	09/17/2021 2:35:12 PM	Unverified	False	Not Cataloged	5980588
rhel2_cdb2_log_09-17-2021_14.00.01.1042_1	1	Log	09/17/2021 2:00:10 PM	Not Applicable	False	Not Cataloged	5978388

6. Choose a proper clone DB SID for a complete container database or CDB clone.


Clone from cdb2

● Complete Database Clone

Clone SID: cdb2test

Exclude PDBs: Type to find PDBs

○ PDB Clone

Secondary storage location : Snap Vault / Snap Mirror

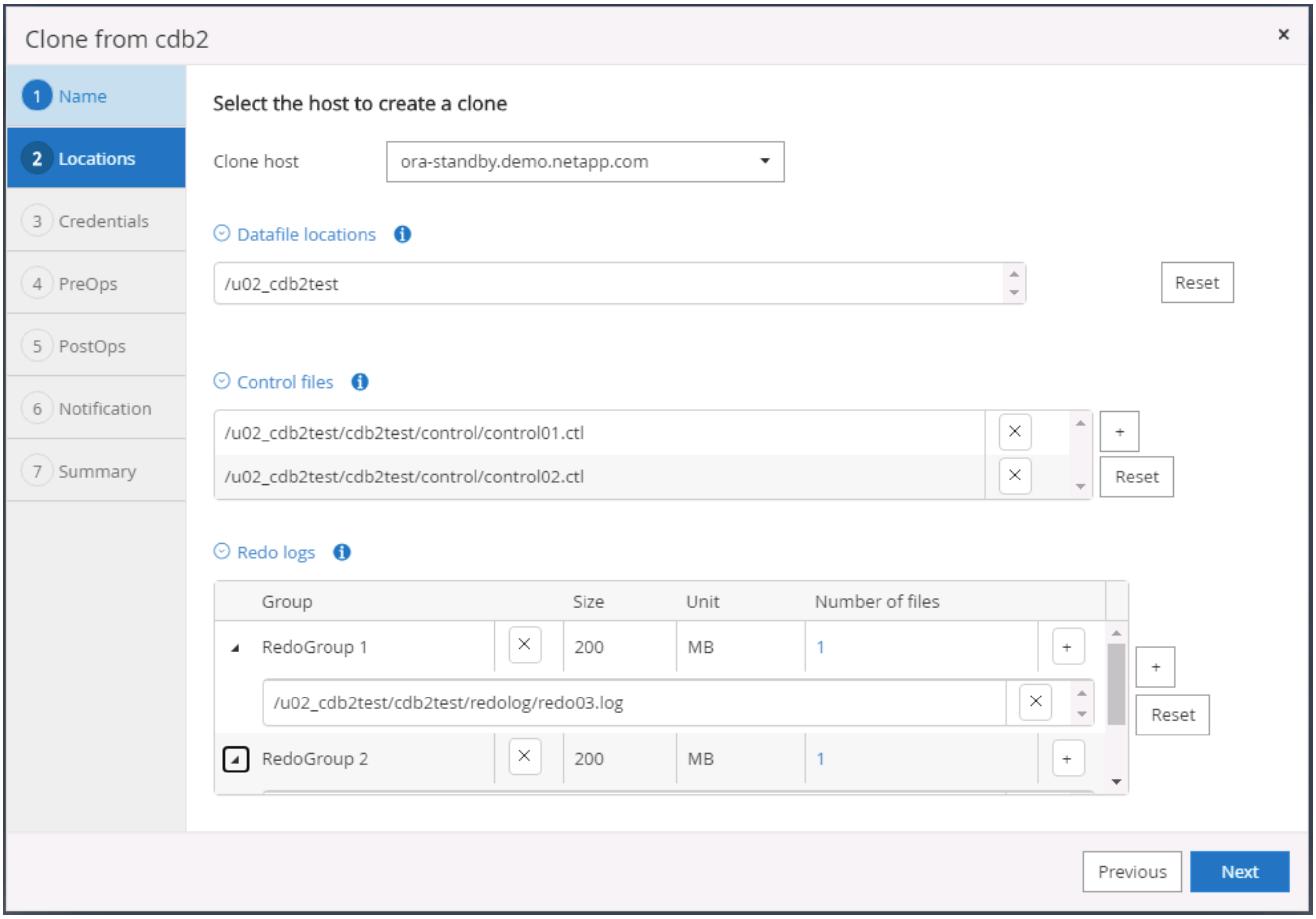
Data

Source Volume	Destination Volume
svm_onPrem:rhel2_u02	svm_hybridcvo:rhel2_u02_dr

Logs

Source Volume	Destination Volume
svm_onPrem:rhel2_u03	svm_hybridcvo:rhel2_u03_dr

7. Select the target clone host in the cloud, and datafile, control file, and redo log directories are created by the clone workflow.



Select the host to create a clone

Clone host: ora-standby.demo.netapp.com

Datafile locations

/u02_cdb2test

Control files

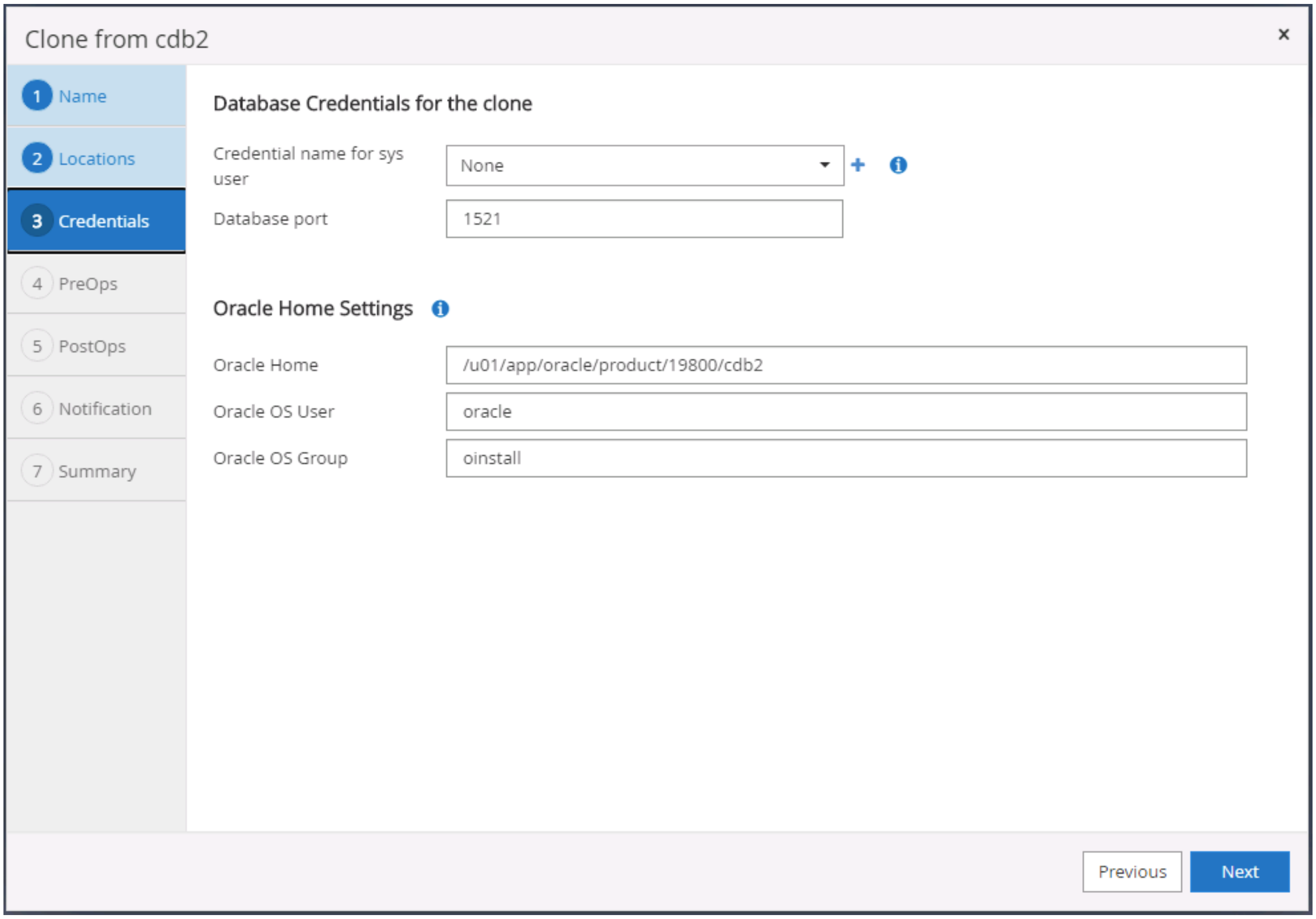
/u02_cdb2test/cdb2test/control/control01.ctl

/u02_cdb2test/cdb2test/control/control02.ctl

Redo logs

Group	Size	Unit	Number of files
RedoGroup 1	200	MB	1
/u02_cdb2test/cdb2test/redolog/redo03.log			
RedoGroup 2	200	MB	1

8. The None credential name is used for OS-based authentication, which renders the database port irrelevant. Fill in the proper Oracle Home, Oracle OS User, and Oracle OS Group as configured in the target clone DB server.



Database Credentials for the clone

Credential name for sys user: None

Database port: 1521

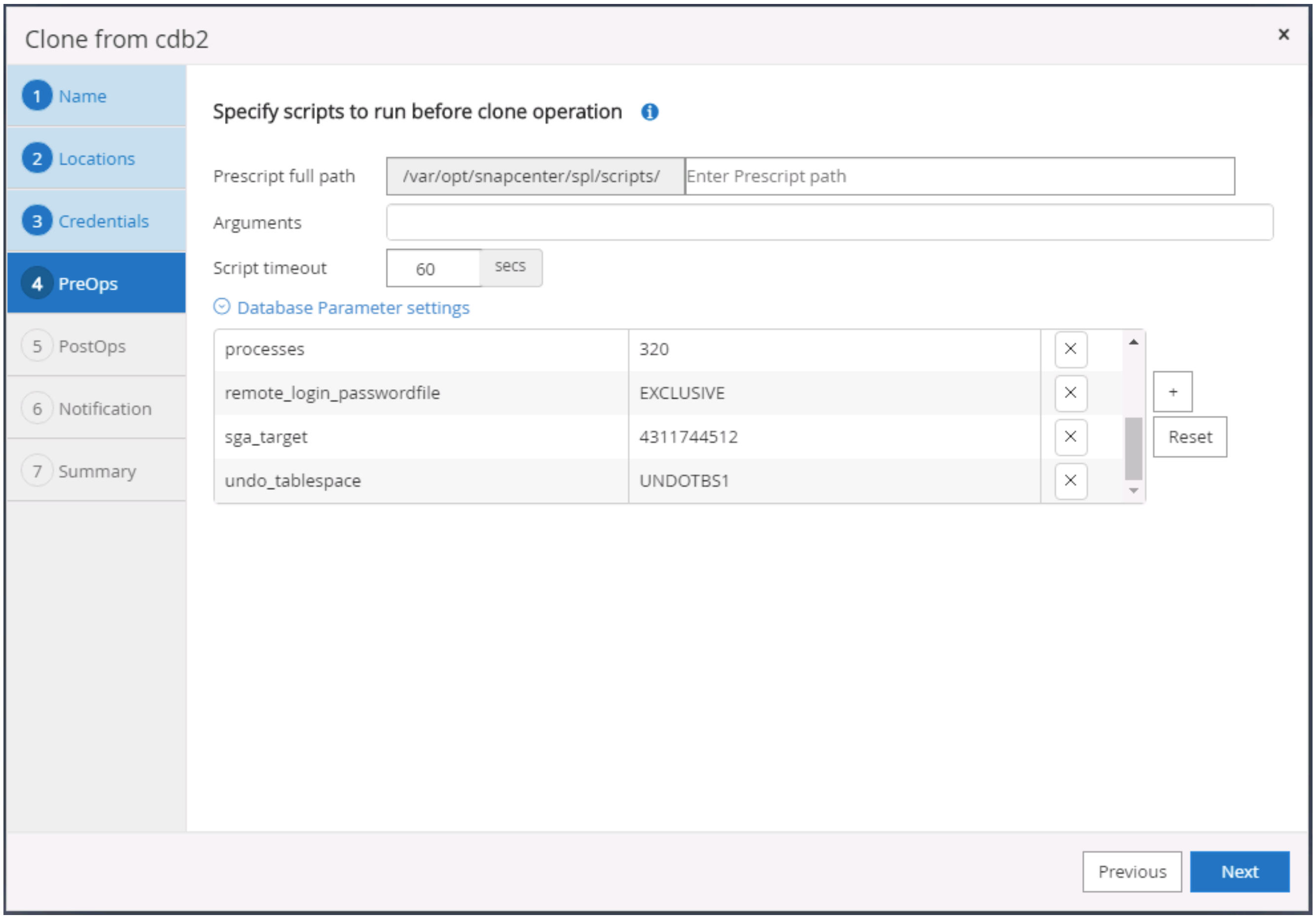
Oracle Home Settings

Oracle Home: /u01/app/oracle/product/19800/cdb2

Oracle OS User: oracle

Oracle OS Group: oinstall

9. Specify the scripts to run before clone operation. More importantly, the database instance parameter can be adjusted or defined here.



Specify scripts to run before clone operation

Prescript full path: /var/opt/snapcenter/spl/scripts/ Enter Prescript path

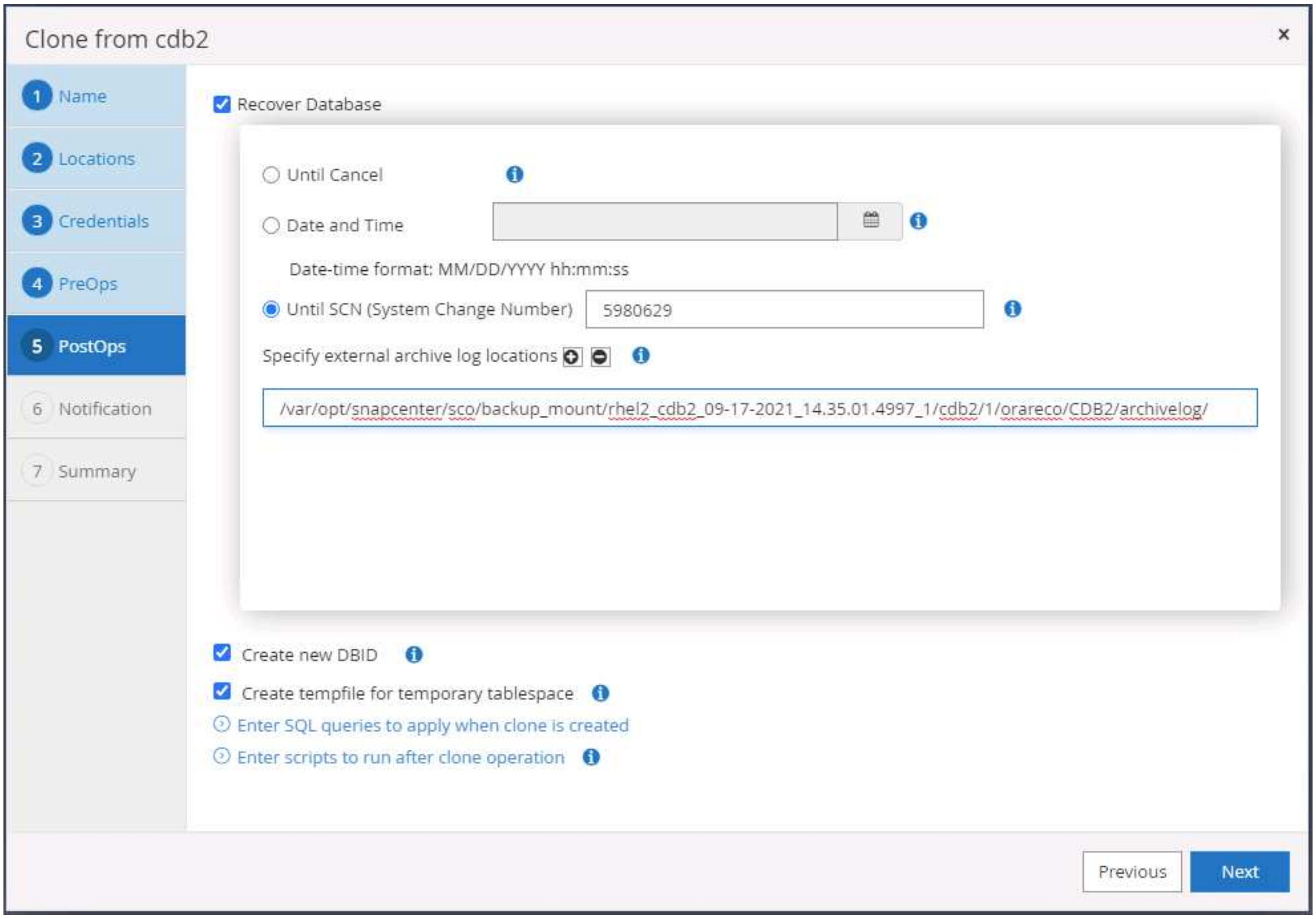
Arguments:

Script timeout: 60 secs

Database Parameter settings

processes	320
remote_login_passwordfile	EXCLUSIVE
sga_target	4311744512
undo_tablespace	UNDOTBS1

10. Specify the recovery point either by the date and time or SCN. Until Cancel recovers the database up to the available archive logs. Specify the external archive log location from the target host where the archive log volume is mounted. If target server Oracle owner is different from the on-premises production server, verify that the archive log directory is readable by the target server Oracle owner.



☑ Recover Database

○ Until Cancel

○ Date and Time

Date-time format: MM/DD/YYYY hh:mm:ss

● Until SCN (System Change Number) 5980629

Specify external archive log locations

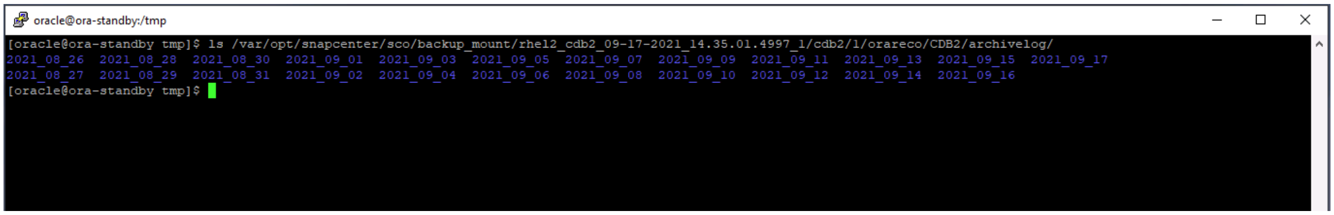
/var/opt/snapcenter/sco/backup_mount/rhel2_cdb2_09-17-2021_14.35.01.4997_1/cdb2/1/orareco/CDB2/archivelog/

☑ Create new DBID

☑ Create tempfile for temporary tablespace

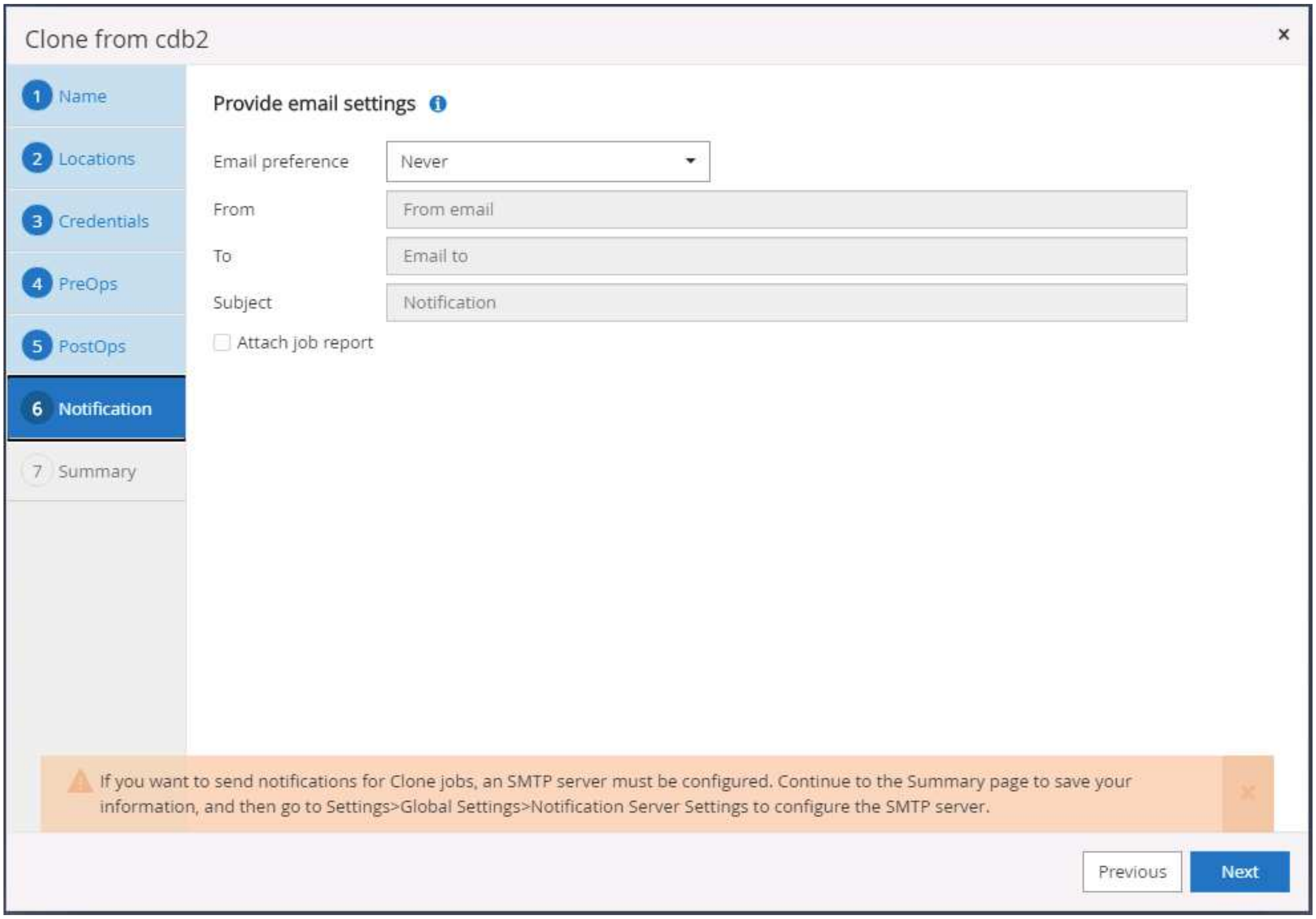
Enter SQL queries to apply when clone is created

Enter scripts to run after clone operation



```
[oracle@ora-standby tmp]$ ls /var/opt/snapcenter/sco/backup_mount/rhel2_cdb2_09-17-2021_14.35.01.4997_1/cdb2/1/orareco/CDB2/archivelog/
2021_08_26  2021_08_28  2021_08_30  2021_09_01  2021_09_03  2021_09_05  2021_09_07  2021_09_09  2021_09_11  2021_09_13  2021_09_15  2021_09_17
2021_08_27  2021_08_29  2021_08_31  2021_09_02  2021_09_04  2021_09_06  2021_09_08  2021_09_10  2021_09_12  2021_09_14  2021_09_16
[oracle@ora-standby tmp]$
```

11. Configure the SMTP server for email notification if desired.



Clone from cdb2

Provide email settings

Email preference: Never

From: From email

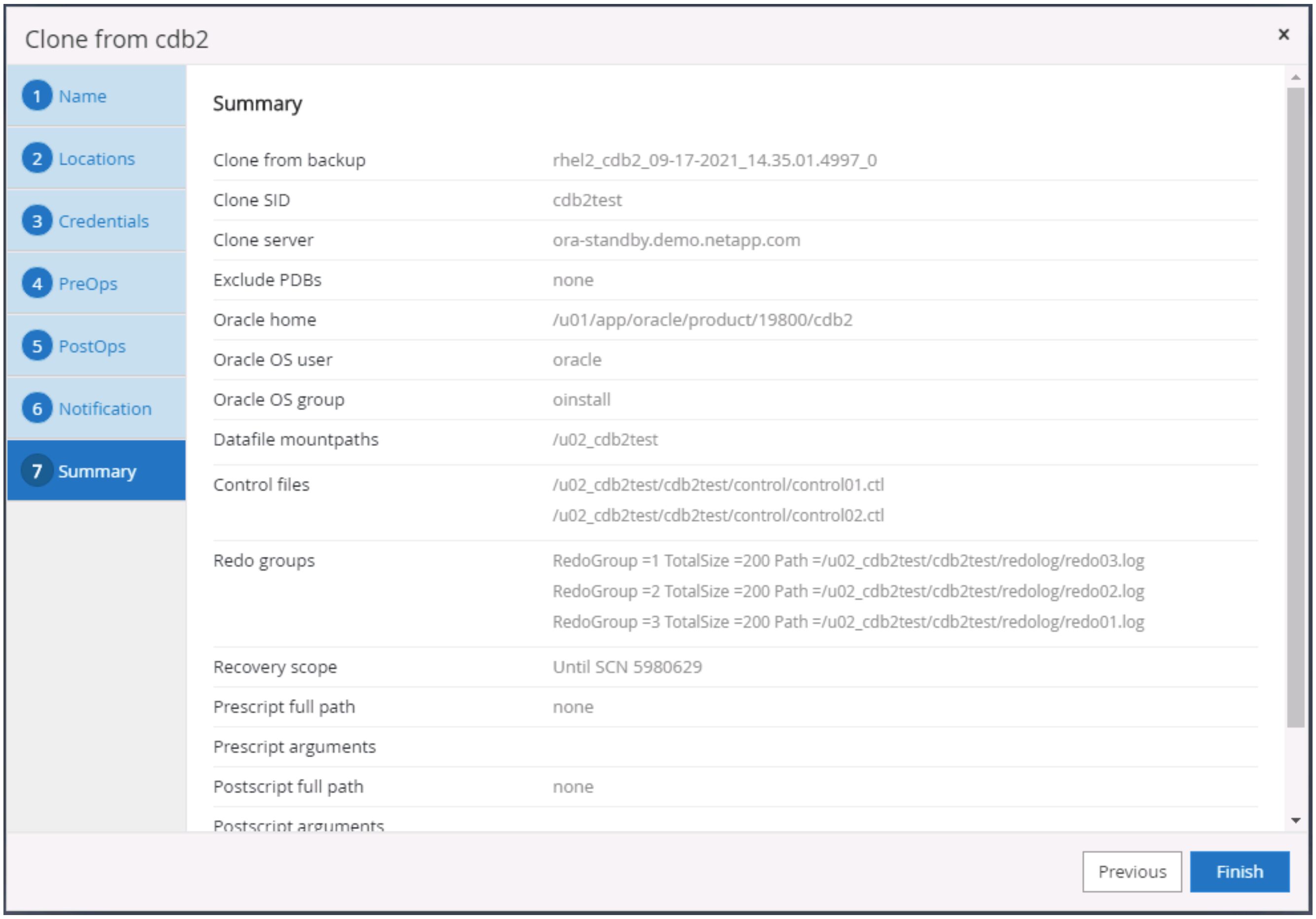
To: Email to

Subject: Notification

□ Attach job report

If you want to send notifications for Clone jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTP server.

12. Clone summary.



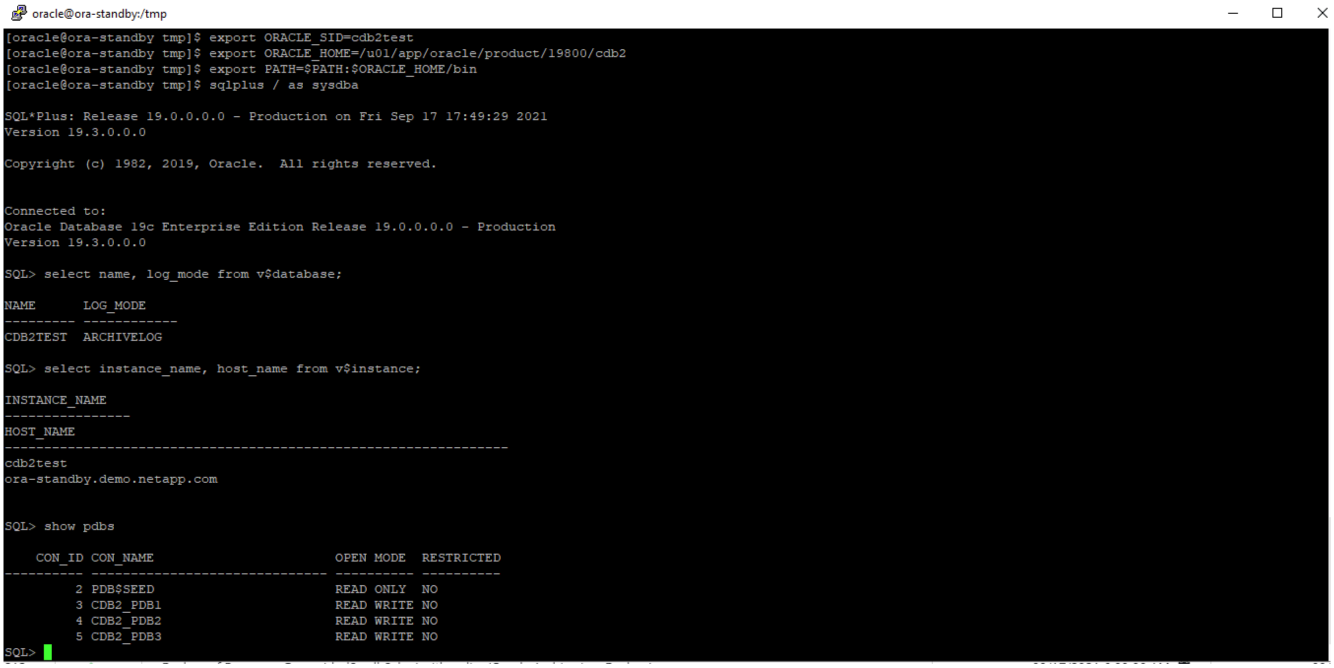
Summary

Clone from backup	rhel2_cdb2_09-17-2021_14.35.01.4997_0
Clone SID	cdb2test
Clone server	ora-standby.demo.netapp.com
Exclude PDBs	none
Oracle home	/u01/app/oracle/product/19800/cdb2
Oracle OS user	oracle
Oracle OS group	oinstall
Datafile mountpaths	/u02_cdb2test
Control files	/u02_cdb2test/cdb2test/control/control01.ctl /u02_cdb2test/cdb2test/control/control02.ctl

Redo groups	RedoGroup =1 TotalSize =200 Path =/u02_cdb2test/cdb2test/redolog/redo03.log
	RedoGroup =2 TotalSize =200 Path =/u02_cdb2test/cdb2test/redolog/redo02.log
	RedoGroup =3 TotalSize =200 Path =/u02_cdb2test/cdb2test/redolog/redo01.log

Recovery scope	Until SCN 5980629
Prescript full path	none
Prescript arguments	
Postscript full path	none
Postscript arguments	

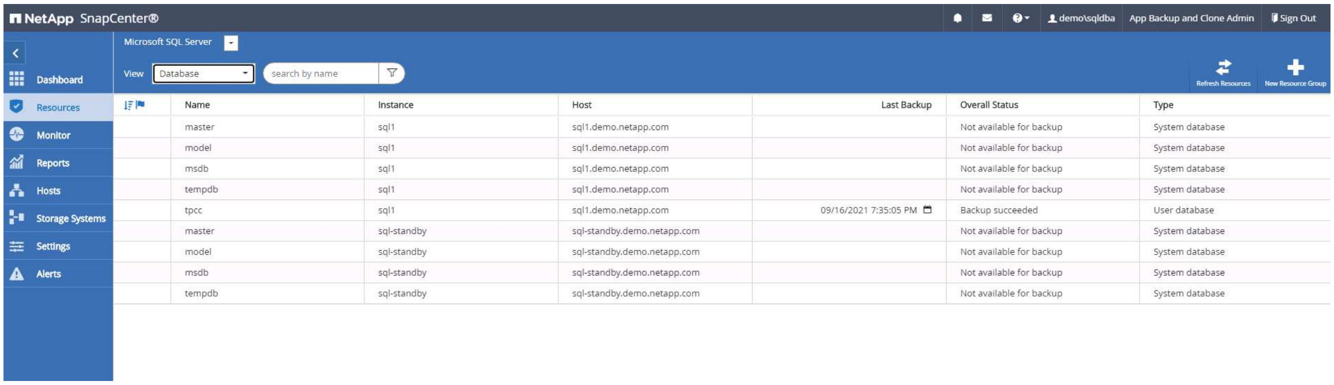
13. You should validate after cloning to make sure that the cloned database is operational. Some additional tasks, such as starting up the listener or turning off the DB log archive mode, can be performed on the dev/test database.



```
[oracle@ora-standby tmp]$ export ORACLE_SID=cdb2test
[oracle@ora-standby tmp]$ export ORACLE_HOME=/u01/app/oracle/product/19800/cdb2
[oracle@ora-standby tmp]$ export PATH=$PATH:$ORACLE_HOME/bin
[oracle@ora-standby tmp]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Fri Sep 17 17:49:29 2021
Version 19.3.0.0.0

Copyright (c) 1982, 2019, Oracle.  All rights reserved.


Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.3.0.0.0

SQL> select name, log_mode from v$database;

NAME      LOG_MODE
--------- ------------
CDB2TEST  ARCHIVELOG

SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME
----------------
HOST_NAME
----------------------------------------------------------------
cdb2test
ora-standby.demo.netapp.com


SQL> show pdbs

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         2 PDB$SEED                       READ ONLY  NO
         3 CDB2_PDB1                      READ WRITE NO
         4 CDB2_PDB2                      READ WRITE NO
         5 CDB2_PDB3                      READ WRITE NO
SQL>
```

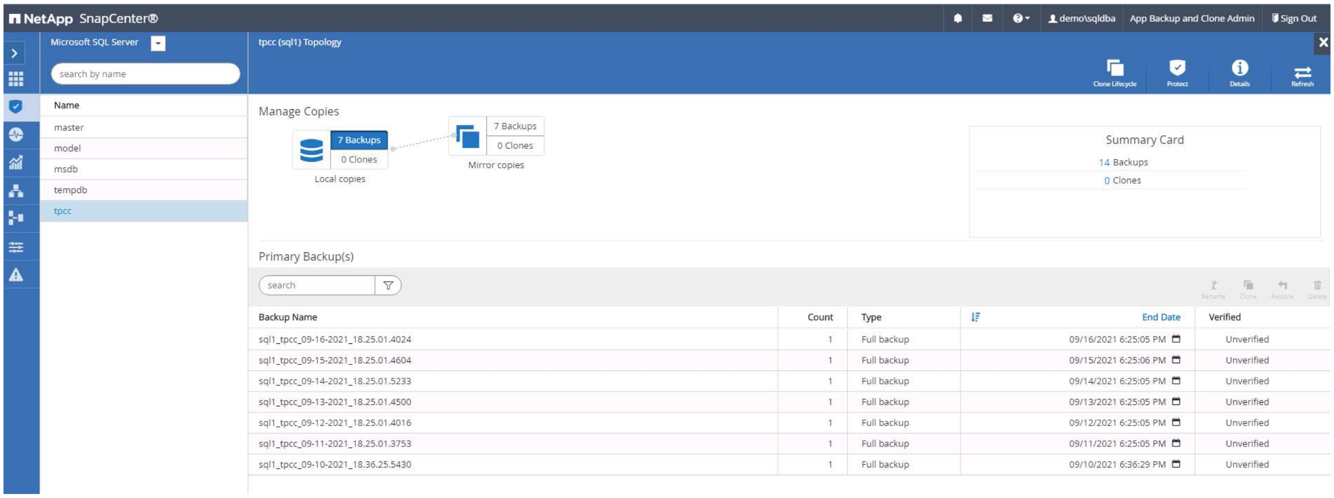
Clone a SQL database for dev/test from a replicated Snapshot backup

1. Log into SnapCenter with a database management user ID for SQL Server. Navigate to the Resources tab, which shows the SQL Sever user databases being protected by SnapCenter and a target standby SQL instance in the public cloud.



Name	Instance	Host	Last Backup	Overall Status	Type
master	sql1	sql1.demo.netapp.com		Not available for backup	System database
model	sql1	sql1.demo.netapp.com		Not available for backup	System database
msdb	sql1	sql1.demo.netapp.com		Not available for backup	System database
tempdb	sql1	sql1.demo.netapp.com		Not available for backup	System database
tpcc	sql1	sql1.demo.netapp.com	09/16/2021 7:35:05 PM	Backup succeeded	User database
master	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database
model	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database
msdb	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database
tempdb	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database

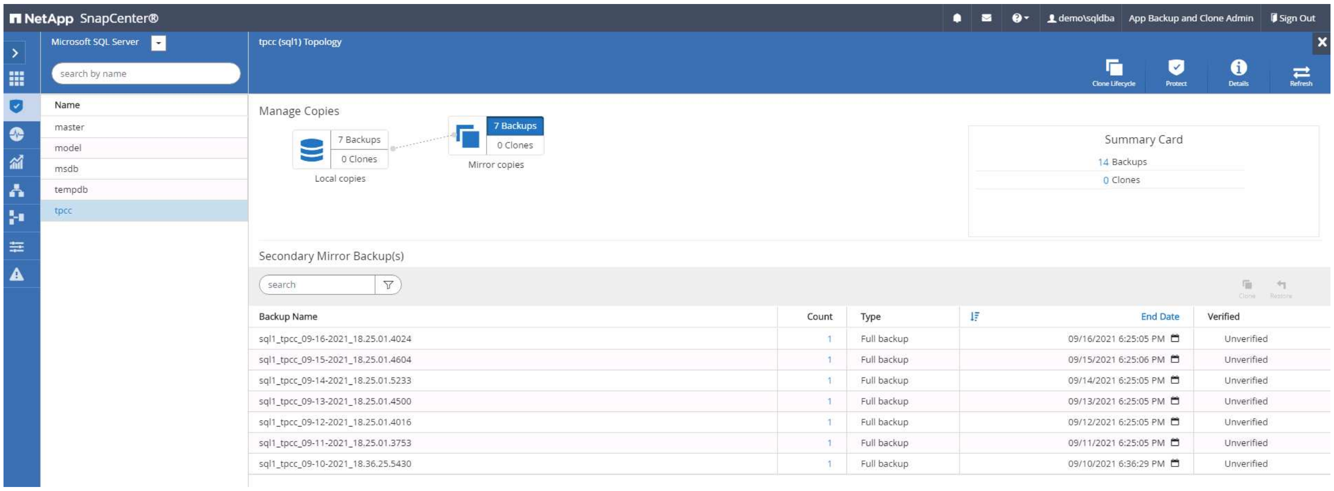
2. Click on the intended on-premises SQL Server user database name for the backups topology and detailed view. If a secondary replicated location is enabled, it shows linked mirror backups.



Name
master
model
msdb
tempdb
tpcc

Backup Name	Count	Type	End Date	Verified
sql1_tpcc_09-16-2021_18.25.01.4024	1	Full backup	09/16/2021 6:25:05 PM	Unverified
sql1_tpcc_09-15-2021_18.25.01.4604	1	Full backup	09/15/2021 6:25:06 PM	Unverified
sql1_tpcc_09-14-2021_18.25.01.5233	1	Full backup	09/14/2021 6:25:05 PM	Unverified
sql1_tpcc_09-13-2021_18.25.01.4500	1	Full backup	09/13/2021 6:25:05 PM	Unverified
sql1_tpcc_09-12-2021_18.25.01.4016	1	Full backup	09/12/2021 6:25:05 PM	Unverified
sql1_tpcc_09-11-2021_18.25.01.3753	1	Full backup	09/11/2021 6:25:05 PM	Unverified
sql1_tpcc_09-10-2021_18.36.25.5430	1	Full backup	09/10/2021 6:36:29 PM	Unverified

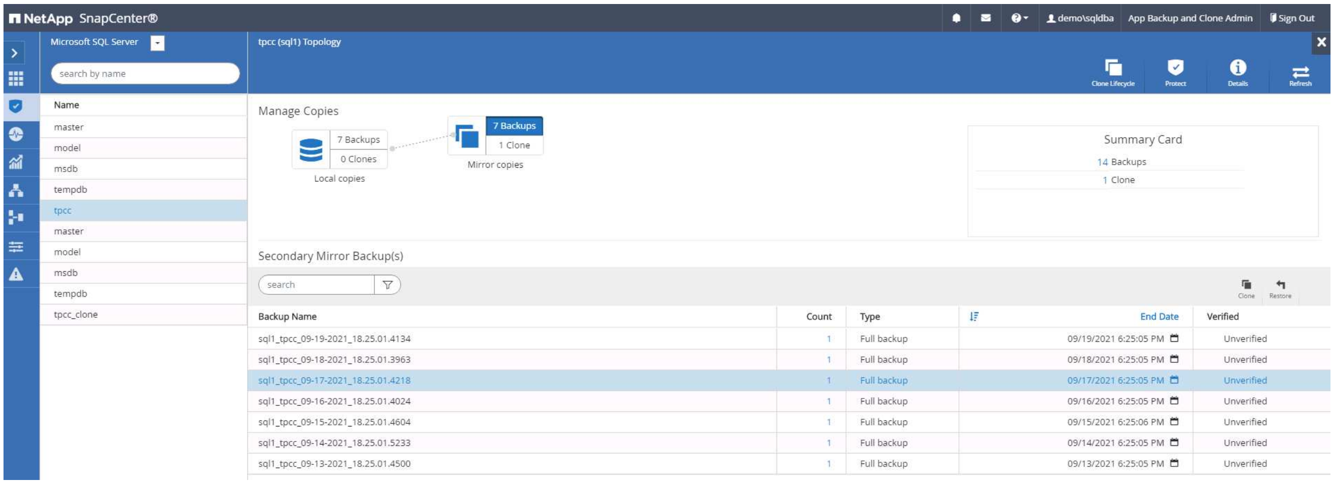
3. Toggle to the Mirrored Backups view by clicking Mirrored Backups. Secondary Mirror Backup(s) are then displayed. Because SnapCenter backs up the SQL Server transaction log to a dedicated drive for recovery, only full database backups are displayed here.



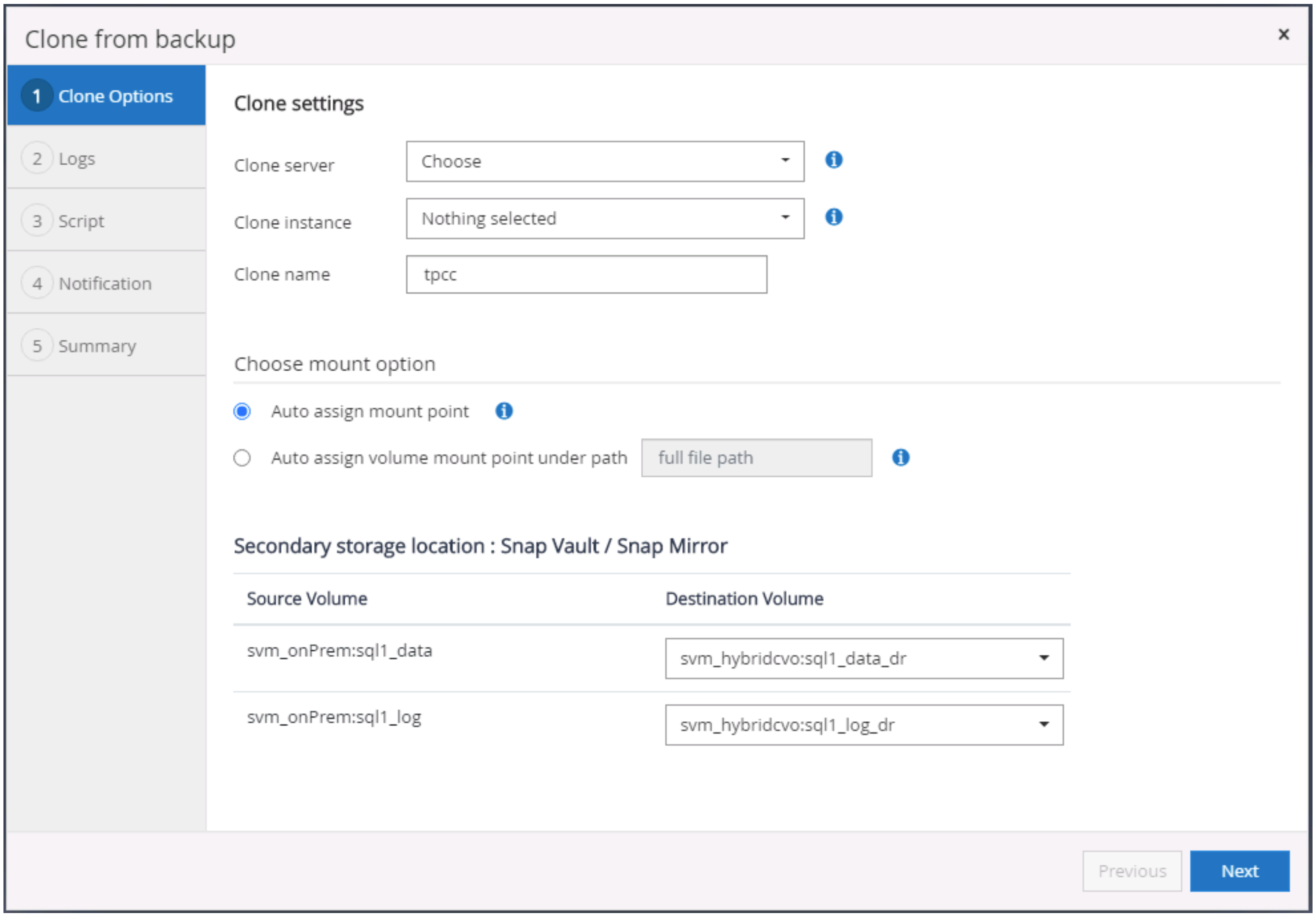
Name
master
model
msdb
tempdb
tpcc

Backup Name	Count	Type	End Date	Verified
sql1_tpcc_09-16-2021_18.25.01.4024	1	Full backup	09/16/2021 6:25:05 PM	Unverified
sql1_tpcc_09-15-2021_18.25.01.4604	1	Full backup	09/15/2021 6:25:06 PM	Unverified
sql1_tpcc_09-14-2021_18.25.01.5233	1	Full backup	09/14/2021 6:25:05 PM	Unverified
sql1_tpcc_09-13-2021_18.25.01.4500	1	Full backup	09/13/2021 6:25:05 PM	Unverified
sql1_tpcc_09-12-2021_18.25.01.4016	1	Full backup	09/12/2021 6:25:05 PM	Unverified
sql1_tpcc_09-11-2021_18.25.01.3753	1	Full backup	09/11/2021 6:25:05 PM	Unverified
sql1_tpcc_09-10-2021_18.36.25.5430	1	Full backup	09/10/2021 6:36:29 PM	Unverified

4. Choose a backup copy, and then click the Clone button to launch the Clone from Backup workflow.



Backup Name	Count	Type	End Date	Verified
sql1_tpcc_09-19-2021_18.25.01.4134	1	Full backup	09/19/2021 6:25:05 PM	Unverified
sql1_tpcc_09-18-2021_18.25.01.3963	1	Full backup	09/18/2021 6:25:05 PM	Unverified
sql1_tpcc_09-17-2021_18.25.01.4218	1	Full backup	09/17/2021 6:25:05 PM	Unverified
sql1_tpcc_09-16-2021_18.25.01.4024	1	Full backup	09/16/2021 6:25:05 PM	Unverified
sql1_tpcc_09-15-2021_18.25.01.4604	1	Full backup	09/15/2021 6:25:06 PM	Unverified
sql1_tpcc_09-14-2021_18.25.01.5233	1	Full backup	09/14/2021 6:25:05 PM	Unverified
sql1_tpcc_09-13-2021_18.25.01.4500	1	Full backup	09/13/2021 6:25:05 PM	Unverified



Clone settings

Clone server: Choose

Clone instance: Nothing selected

Clone name: tpcc

Choose mount option

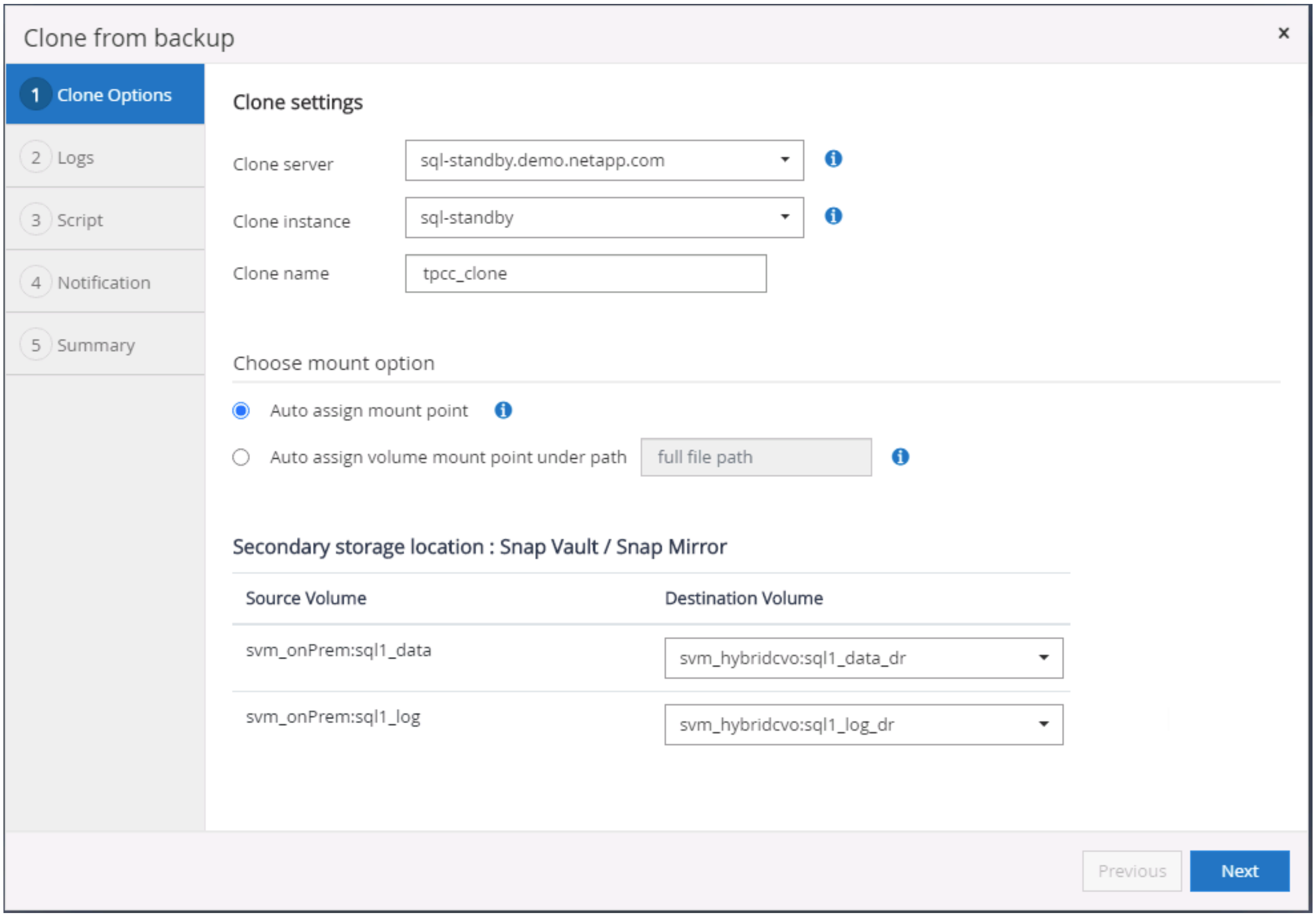
● Auto assign mount point

○ Auto assign volume mount point under path: full file path

Secondary storage location : Snap Vault / Snap Mirror

Source Volume	Destination Volume
svm_onPrem:sql1_data	svm_hybridcvo:sql1_data_dr
svm_onPrem:sql1_log	svm_hybridcvo:sql1_log_dr

5. Select a cloud server as the target clone server, clone instance name, and clone database name. Choose either an auto-assign mount point or a user-defined mount point path.



Clone from backup

Clone settings

Clone server	sql-standby.demo.netapp.com
Clone instance	sql-standby
Clone name	tpcc_clone

Choose mount option

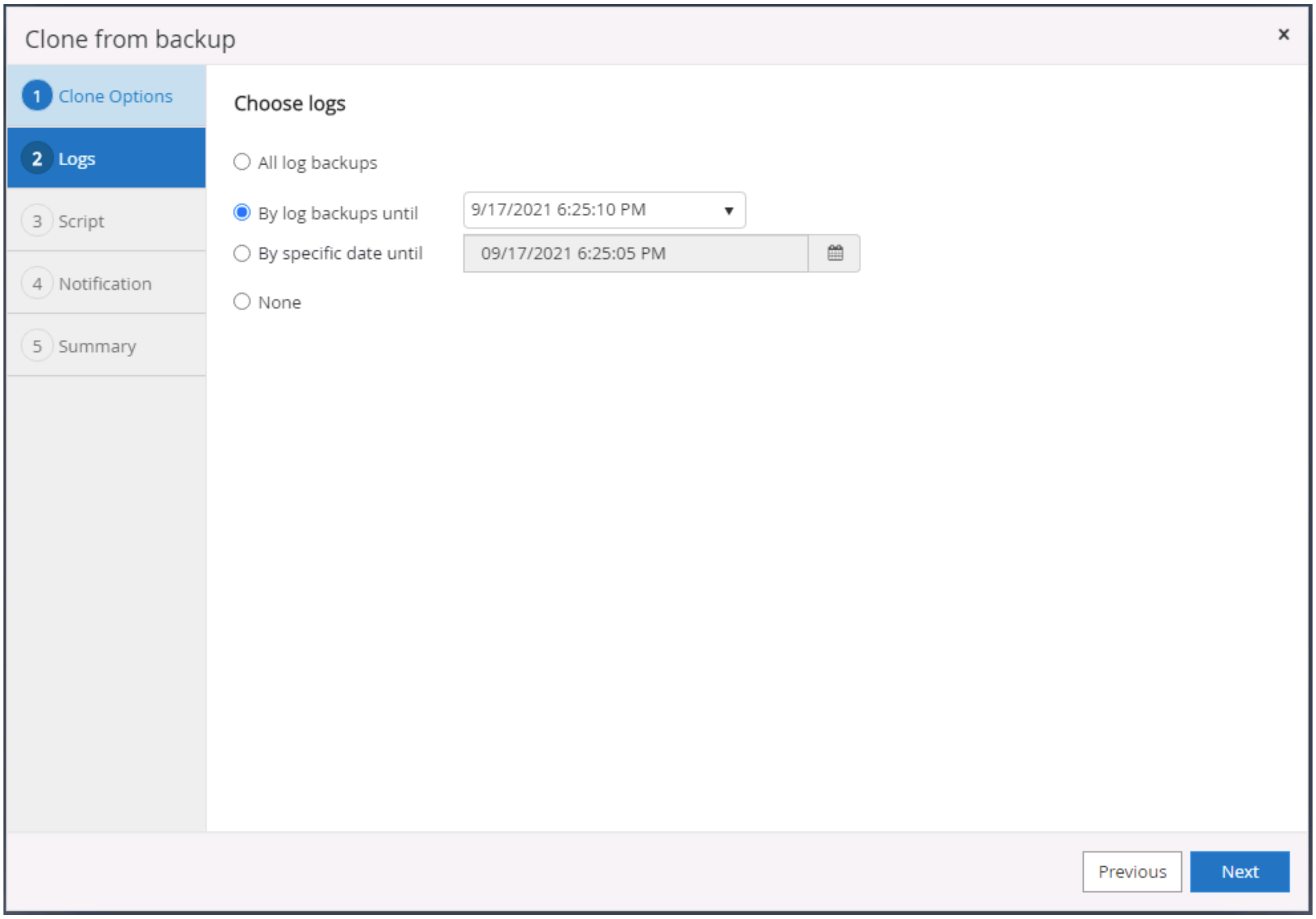
● Auto assign mount point

○ Auto assign volume mount point under path full file path

Secondary storage location : Snap Vault / Snap Mirror

Source Volume	Destination Volume
svm_onPrem:sql1_data	svm_hybridcvo:sql1_data_dr
svm_onPrem:sql1_log	svm_hybridcvo:sql1_log_dr

6. Determine a recovery point either by a log backup time or by a specific date and time.



Clone from backup

Choose logs

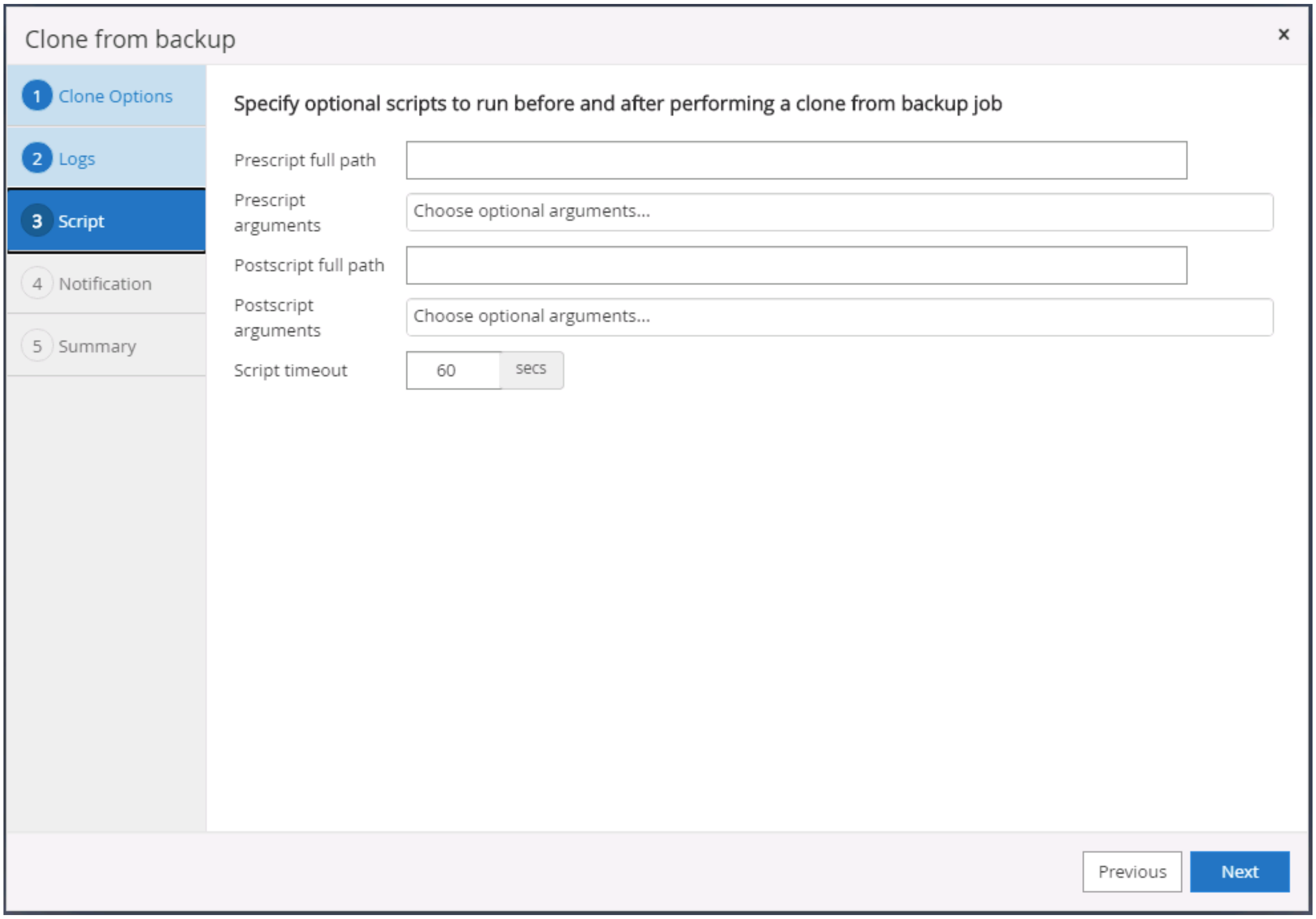
○ All log backups

● By log backups until 9/17/2021 6:25:10 PM

○ By specific date until 09/17/2021 6:25:05 PM

○ None

7. Specify optional scripts to run before and after the cloning operation.



Clone from backup

Specify optional scripts to run before and after performing a clone from backup job

Prescript full path

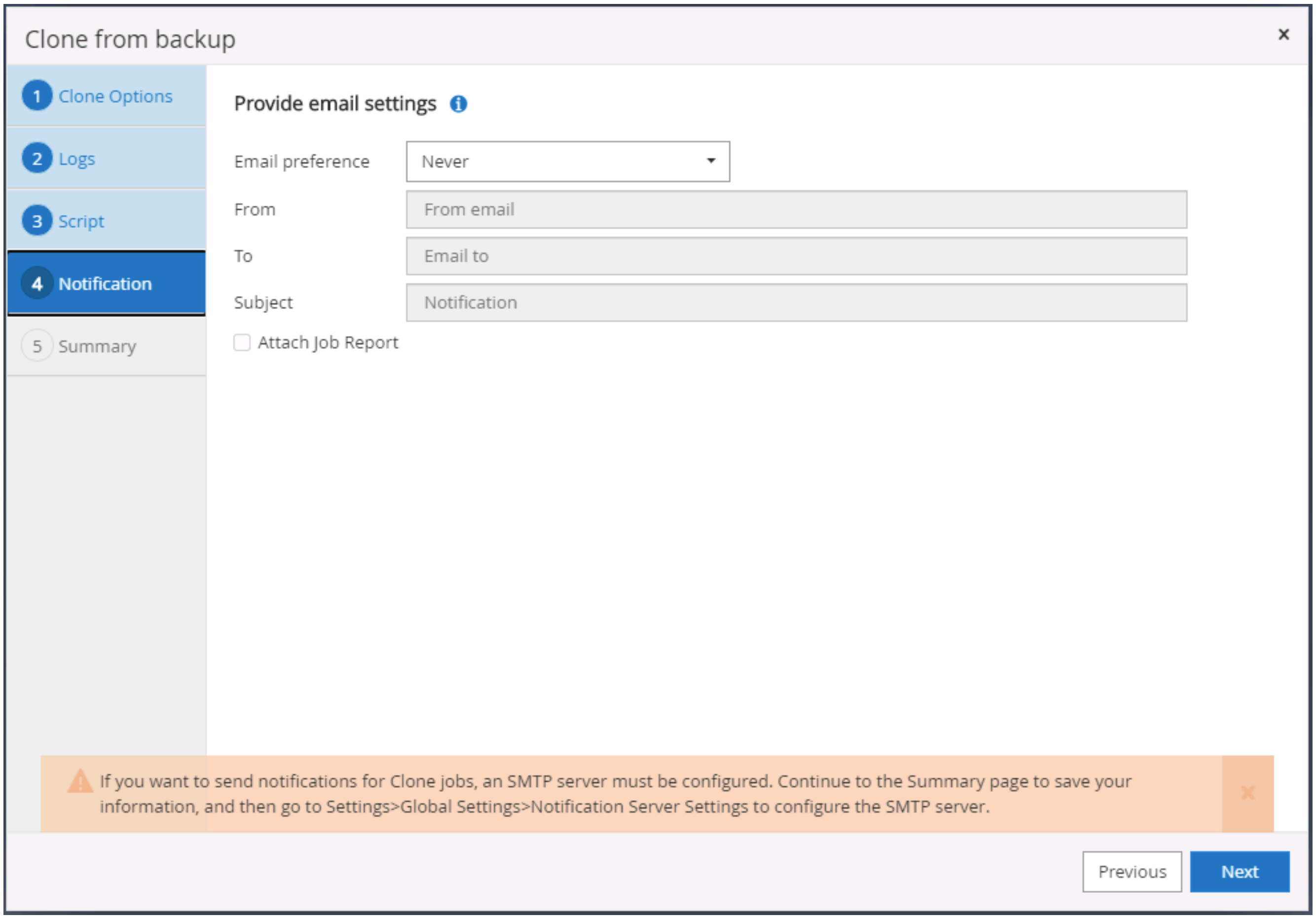
Prescript arguments: Choose optional arguments...

Postscript full path

Postscript arguments: Choose optional arguments...

Script timeout: 60 secs

8. Configure an SMTP server if email notification is desired.



Provide email settings

Email preference: Never

From: From email

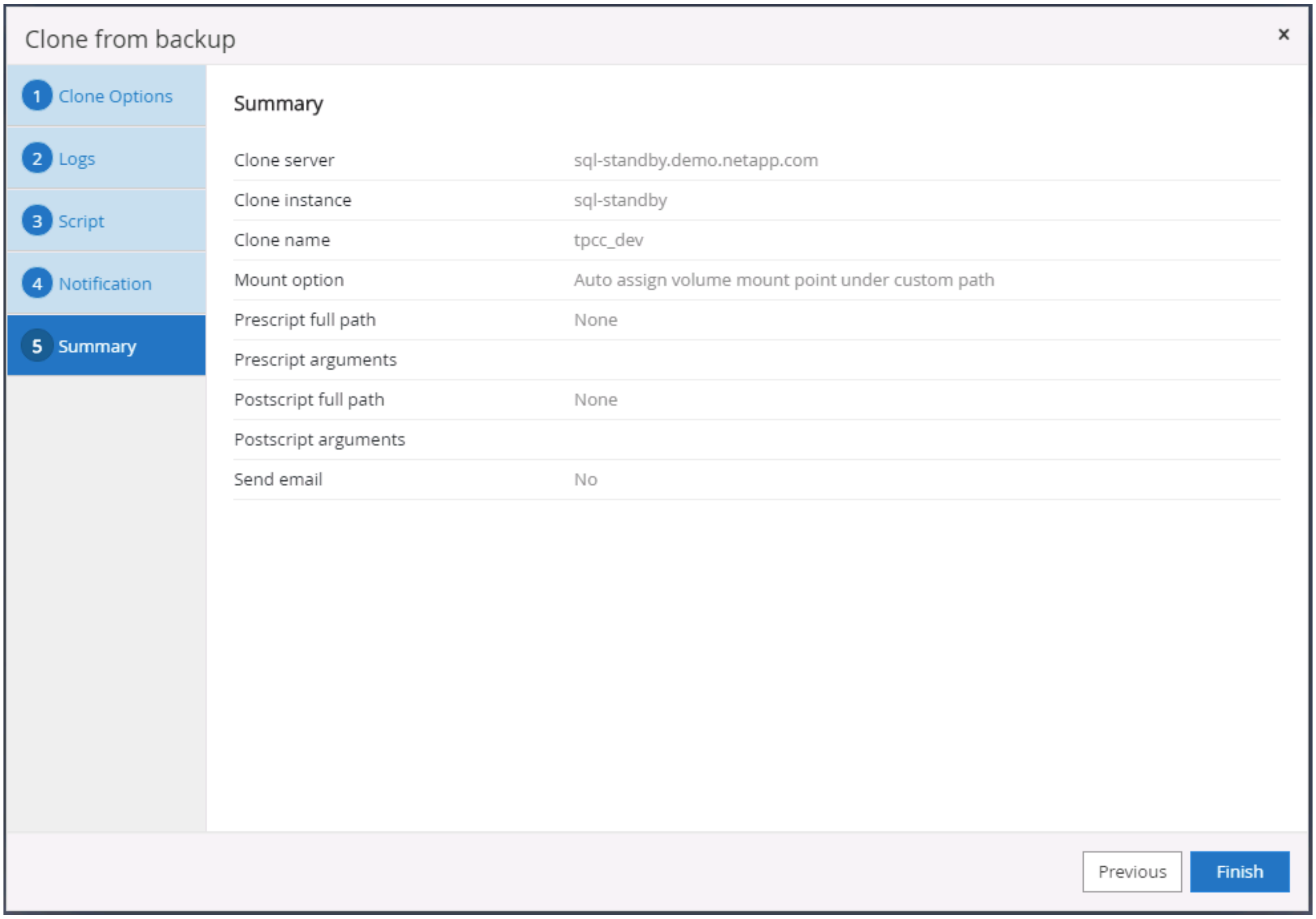
To: Email to

Subject: Notification

□ Attach Job Report

If you want to send notifications for Clone jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTP server.

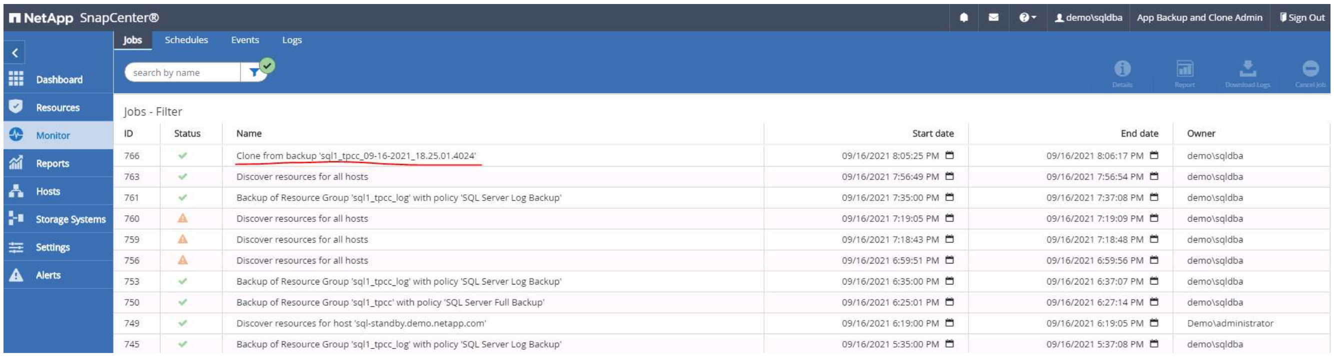
9. Clone Summary.



Summary

Clone server	sql-standby.demo.netapp.com
Clone instance	sql-standby
Clone name	tpcc_dev
Mount option	Auto assign volume mount point under custom path
Prescript full path	None
Prescript arguments	
Postscript full path	None
Postscript arguments	
Send email	No

10. Monitor the job status and validate that the intended user database has been attached to a target SQL instance in the cloud clone server.



Jobs - Filter

ID	Status	Name	Start date	End date	Owner
766	✓	Clone from backup 'sql1_tpcc_09-16-2021_18.25.01.4024'	09/16/2021 8:05:25 PM	09/16/2021 8:06:17 PM	demo\sqldba
763	✓	Discover resources for all hosts	09/16/2021 7:56:49 PM	09/16/2021 7:56:54 PM	demo\sqldba
761	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/16/2021 7:35:00 PM	09/16/2021 7:37:08 PM	demo\sqldba
760	⚠	Discover resources for all hosts	09/16/2021 7:19:05 PM	09/16/2021 7:19:09 PM	demo\sqldba
759	⚠	Discover resources for all hosts	09/16/2021 7:18:43 PM	09/16/2021 7:18:48 PM	demo\sqldba
756	⚠	Discover resources for all hosts	09/16/2021 6:59:51 PM	09/16/2021 6:59:56 PM	demo\sqldba
753	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/16/2021 6:35:00 PM	09/16/2021 6:37:07 PM	demo\sqldba
750	✓	Backup of Resource Group 'sql1_tpcc' with policy 'SQL Server Full Backup'	09/16/2021 6:25:01 PM	09/16/2021 6:27:14 PM	demo\sqldba
749	✓	Discover resources for host 'sql-standby.demo.netapp.com'	09/16/2021 6:19:00 PM	09/16/2021 6:19:05 PM	Demo\administrator
745	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/16/2021 5:35:00 PM	09/16/2021 5:37:08 PM	demo\sqldba

Post-clone configuration

1. An Oracle production database on-premises is usually running in log archive mode. This mode is not necessary for a development or test database. To turn off log archive mode, log into the Oracle DB as sysdba, execute a log mode change command, and start the database for access.
2. Configure an Oracle listener, or register the newly cloned DB with an existing listener for user access.
3. For SQL Server, change the log mode from Full to Easy so that the SQL Server dev/test log file can be readily shrunk when it is filling up the log volume.

Refresh clone database

1. Drop cloned databases and clean up the cloud DB server environment. Then follow the previous procedures to clone a new DB with fresh data. It only takes few minutes to clone a new database.
2. Shutdown the clone database, run a clone refresh command by using the CLI. See the following SnapCenter documentation for details: Refresh a clone.

Where to go for help?

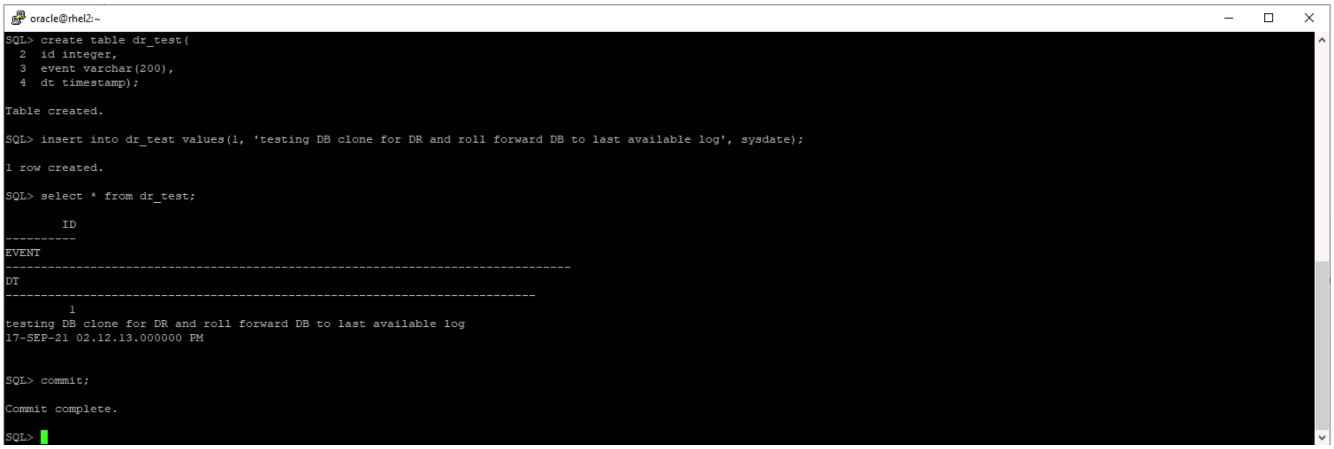
If you need help with this solution and use cases, join the NetApp Solution Automation community support Slack channel and look for the solution-automation channel to post your questions or inquires.

Disaster recovery workflow

Enterprises have embraced the public cloud as a viable resource and destination for disaster recovery. SnapCenter makes this process as seamless as possible. This disaster recovery workflow is very similar to the clone workflow, but database recovery runs through the last available log that was replicated to cloud to recover all the business transactions possible. However, there are additional pre-configuration and post-configuration steps specific to disaster recovery.

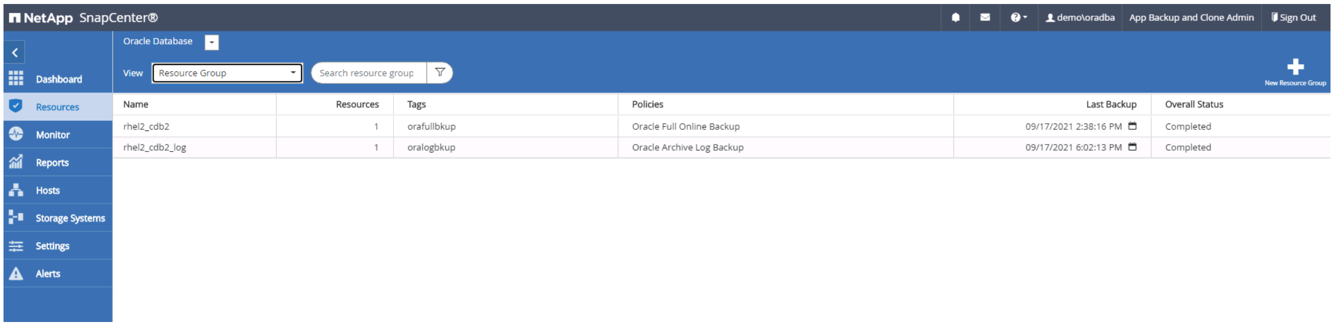
Clone an on-premises Oracle production DB to cloud for DR

1. To validate that the clone recovery runs through last available log, we created a small test table and inserted a row. The test data would be recovered after a full recovery to last available log.



```
SQL> create table dr_test(
  2  id integer,
  3  event varchar(200),
  4  dt timestamp);

Table created.

SQL> insert into dr_test values(1, 'testing DB clone for DR and roll forward DB to last available log', sysdate);

1 row created.

SQL> select * from dr_test;

        ID
----------
EVENT
--------------------------------------------------------------------------------
DT
---------------------------------------------------------------------------
         1
testing DB clone for DR and roll forward DB to last available log
17-SEP-21 02.12.13.000000 PM


SQL> commit;

Commit complete.

SQL>
```

2. Log into SnapCenter as a database management user ID for Oracle. Navigate to the Resources tab, which shows the Oracle databases being protected by SnapCenter.



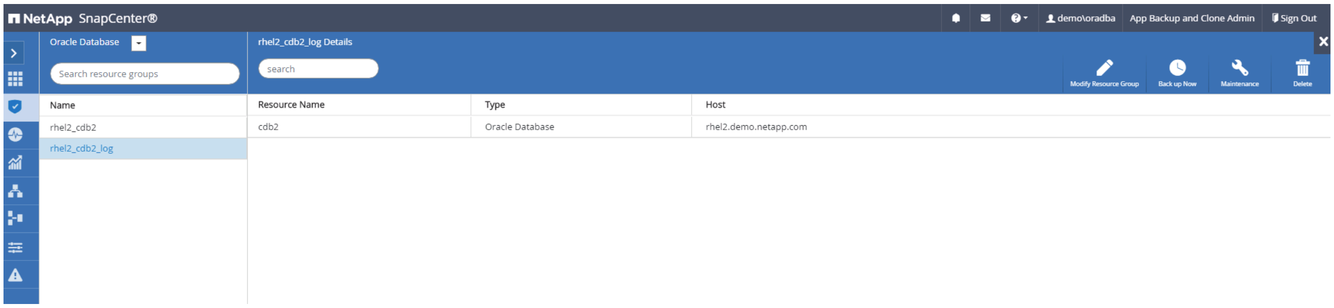
Oracle Database

View: Resource Group

Search resource group

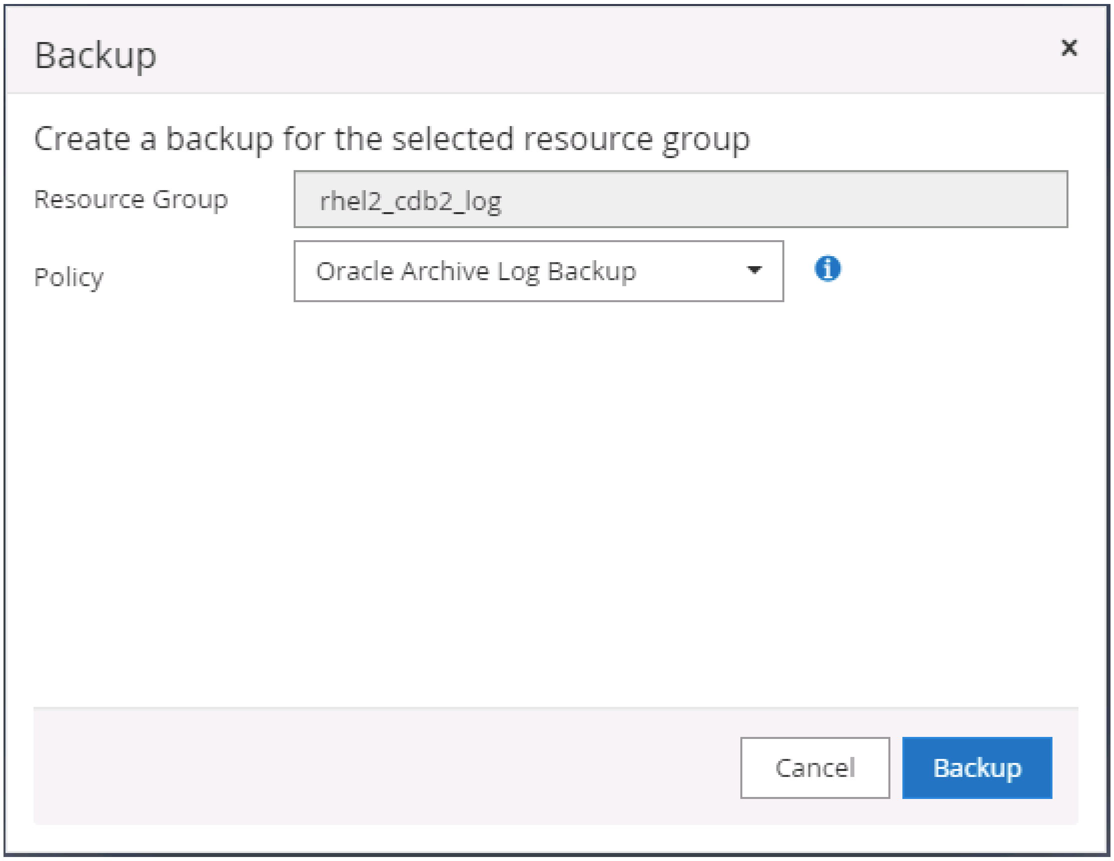
Name	Resources	Tags	Policies	Last Backup	Overall Status
rhel2_cdb2	1	orafullbkup	Oracle Full Online Backup	09/17/2021 2:38:16 PM	Completed
rhel2_cdb2_log	1	oralogbkup	Oracle Archive Log Backup	09/17/2021 6:02:13 PM	Completed

3. Select the Oracle log resource group and click Backup Now to manually run an Oracle log backup to flush the latest transaction to the destination in the cloud. In a real DR scenario, the last transaction recoverable depends on the database log volume replication frequency to the cloud, which in turn depends on the RTO or RPO policy of the company.



Name
rhel2_cdb2
rhel2_cdb2_log

Resource Name	Type	Host
cdb2	Oracle Database	rhel2.demo.netapp.com



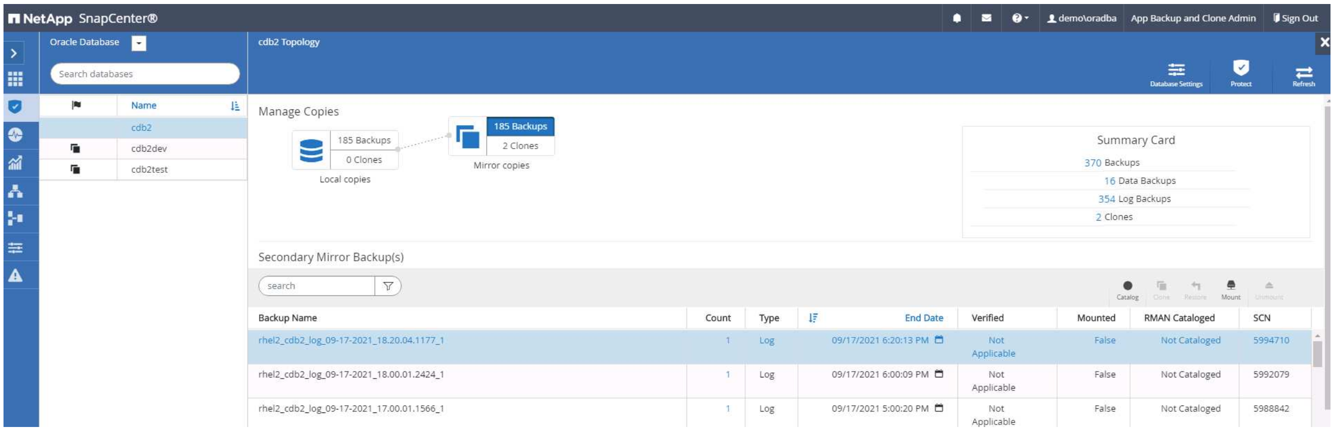
Create a backup for the selected resource group

Resource Group: rhel2_cdb2_log

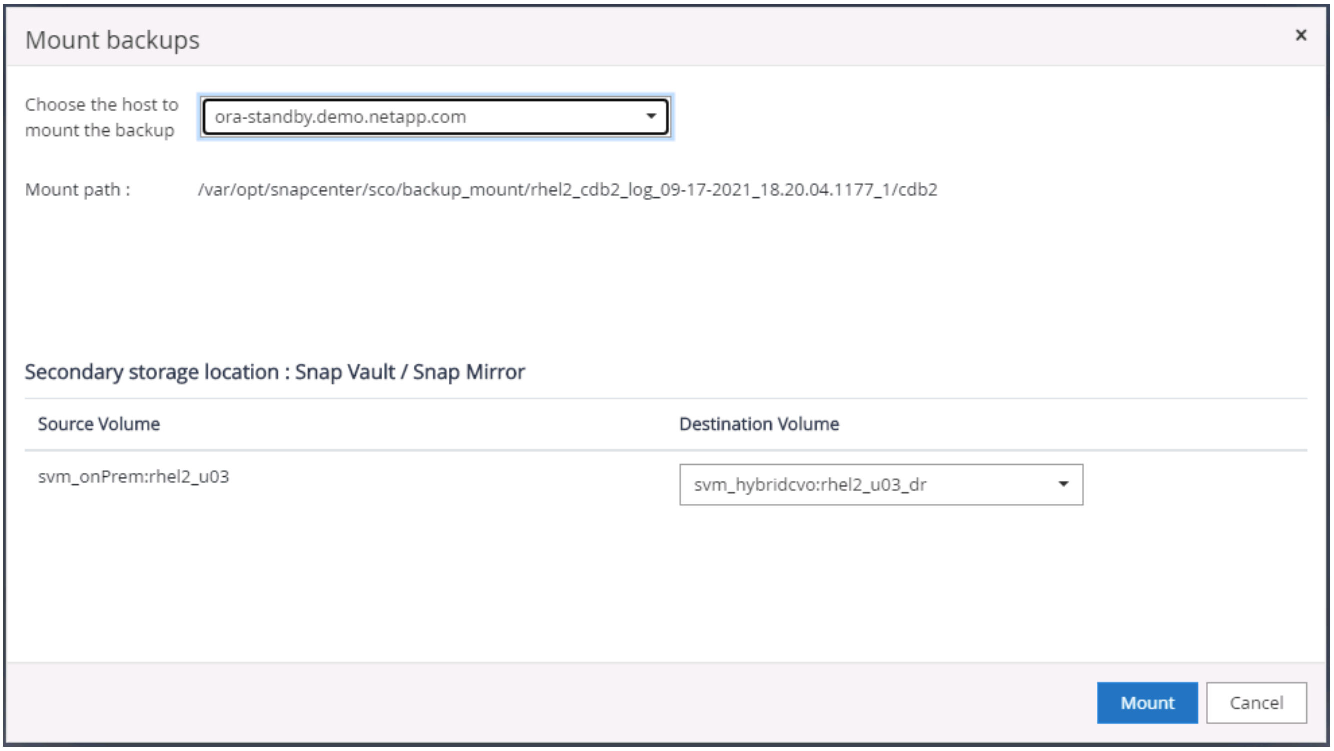
Policy: Oracle Archive Log Backup

Asynchronous SnapMirror loses data that has not made it to the cloud destination in the database log backup interval in a disaster recovery scenario. To minimize data loss, more frequent log backup can be scheduled. However there is a limit to the log backup frequency that is technically achievable.

4. Select the last log backup on the Secondary Mirror Backup(s), and mount the log backup.



Backup Name	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_log_09-17-2021_18.20.04.1177_1	1	Log	09/17/2021 6:20:13 PM	Not Applicable	False	Not Cataloged	5994710
rhel2_cdb2_log_09-17-2021_18.00.01.2424_1	1	Log	09/17/2021 6:00:09 PM	Not Applicable	False	Not Cataloged	5992079
rhel2_cdb2_log_09-17-2021_17.00.01.1566_1	1	Log	09/17/2021 5:00:20 PM	Not Applicable	False	Not Cataloged	5988842



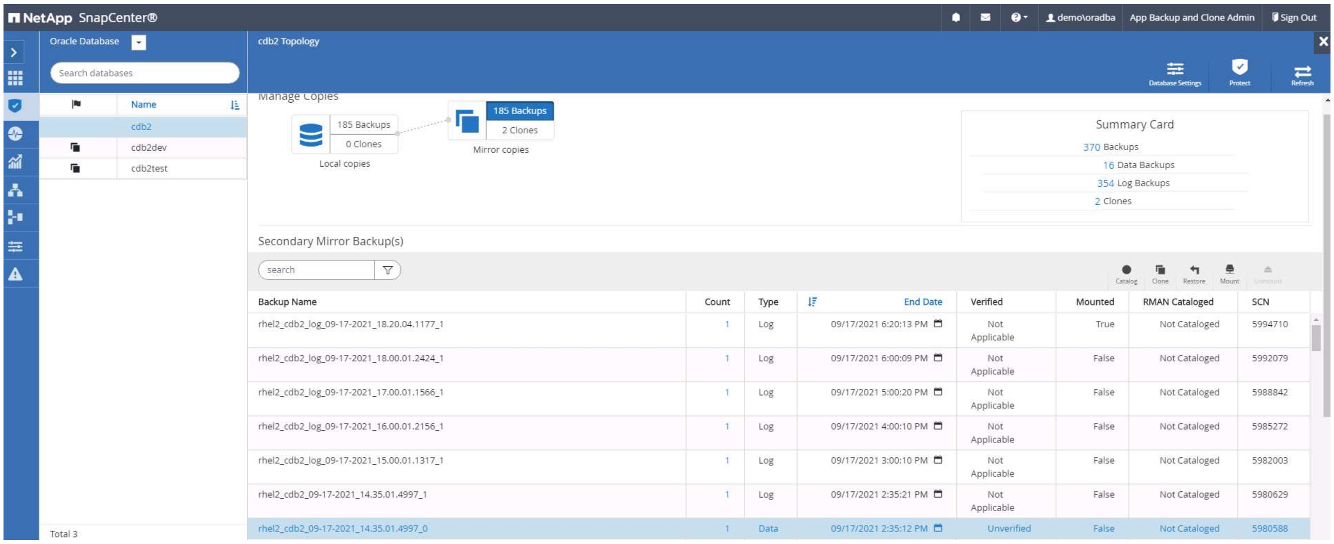
Choose the host to mount the backup: ora-standby.demo.netapp.com

Mount path : /var/opt/snapcenter/sco/backup_mount/rhel2_cdb2_log_09-17-2021_18.20.04.1177_1/cdb2

Secondary storage location : Snap Vault / Snap Mirror

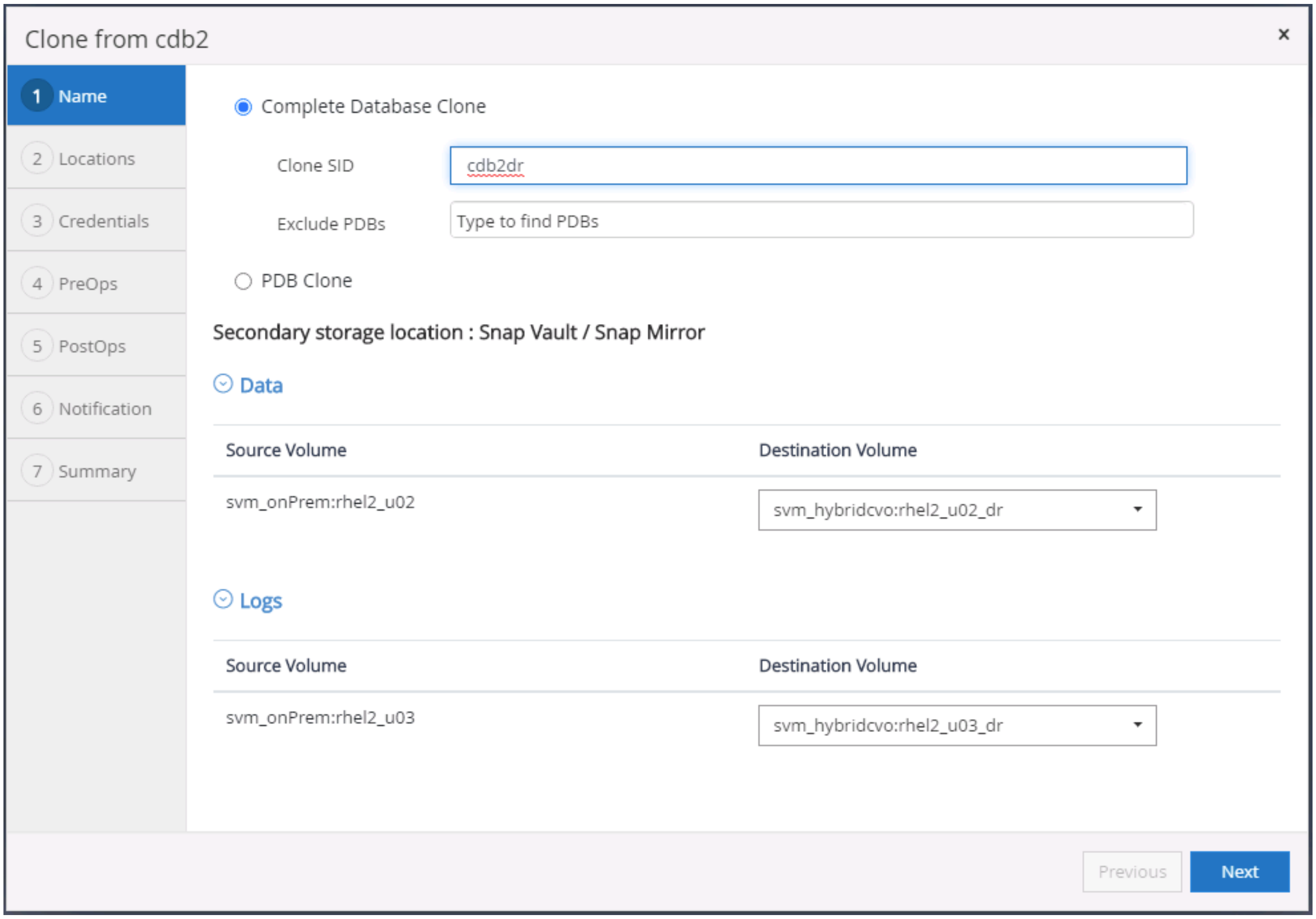
Source Volume	Destination Volume
svm_onPrem:rhel2_u03	svm_hybridcvo:rhel2_u03_dr

5. Select the last full database backup and click Clone to initiate the clone workflow.



Backup Name	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_log_09-17-2021_18.20.04.1177_1	1	Log	09/17/2021 6:20:13 PM	Not Applicable	True	Not Cataloged	5994710
rhel2_cdb2_log_09-17-2021_18.00.01.2424_1	1	Log	09/17/2021 6:00:09 PM	Not Applicable	False	Not Cataloged	5992079
rhel2_cdb2_log_09-17-2021_17.00.01.1566_1	1	Log	09/17/2021 5:00:20 PM	Not Applicable	False	Not Cataloged	5988842
rhel2_cdb2_log_09-17-2021_16.00.01.2156_1	1	Log	09/17/2021 4:00:10 PM	Not Applicable	False	Not Cataloged	5985272
rhel2_cdb2_log_09-17-2021_15.00.01.1317_1	1	Log	09/17/2021 3:00:10 PM	Not Applicable	False	Not Cataloged	5982003
rhel2_cdb2_09-17-2021_14.35.01.4997_1	1	Log	09/17/2021 2:35:21 PM	Not Applicable	False	Not Cataloged	5980629
rhel2_cdb2_09-17-2021_14.35.01.4997_0	1	Data	09/17/2021 2:35:12 PM	Unverified	False	Not Cataloged	5980588

6. Select a unique clone DB ID on the host.



● Complete Database Clone

Clone SID: cdb2dr

Exclude PDBs: Type to find PDBs

○ PDB Clone

Secondary storage location : Snap Vault / Snap Mirror

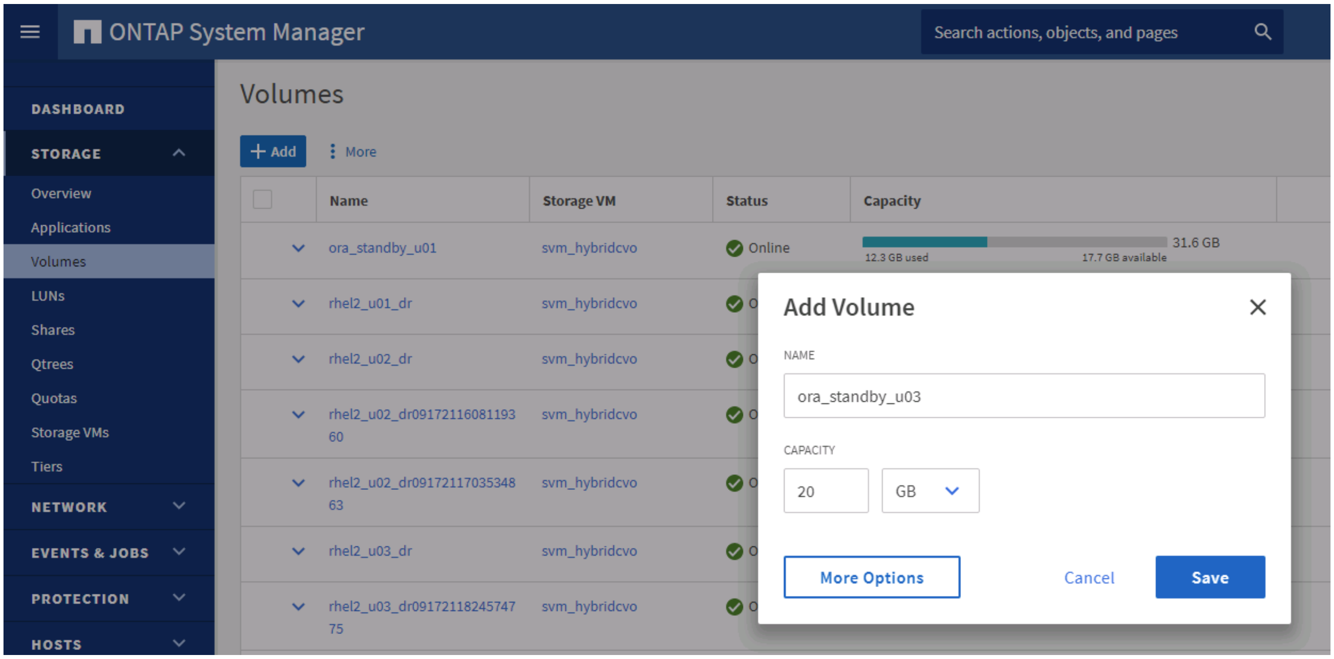
Data

Source Volume	Destination Volume
svm_onPrem:rhel2_u02	svm_hybridcvo:rhel2_u02_dr

Logs

Source Volume	Destination Volume
svm_onPrem:rhel2_u03	svm_hybridcvo:rhel2_u03_dr

7. Provision a log volume and mount it to the target DR server for the Oracle flash recovery area and online logs.

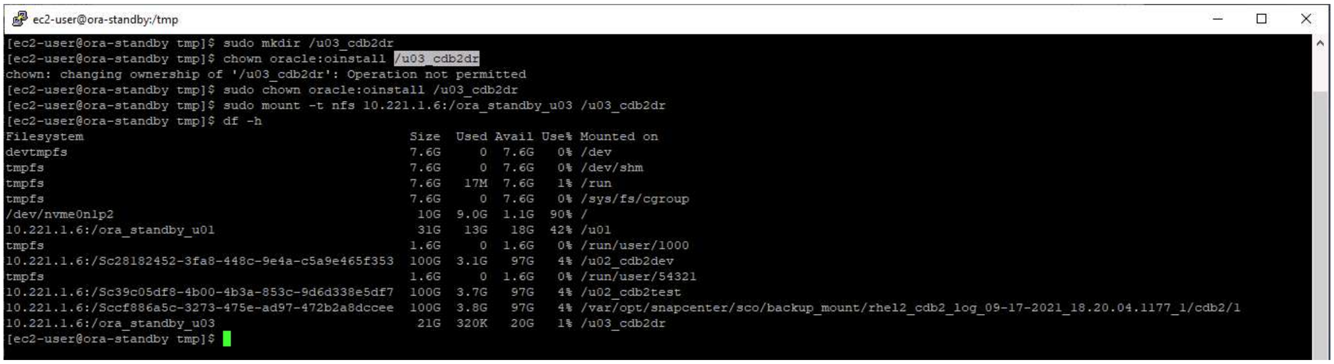


Name	Storage VM	Status	Capacity
ora_standby_u01	svm_hybridcvo	✓ Online	31.6 GB 12.3 GB used 17.7 GB available
rhel2_u01_dr	svm_hybridcvo	✓ O	
rhel2_u02_dr	svm_hybridcvo	✓ O	
rhel2_u02_dr0917211608119360	svm_hybridcvo	✓ O	
rhel2_u02_dr0917211703534863	svm_hybridcvo	✓ O	
rhel2_u03_dr	svm_hybridcvo	✓ O	
rhel2_u03_dr0917211824574775	svm_hybridcvo	✓ O	

Add Volume

NAME: ora_standby_u03

CAPACITY: 20 GB

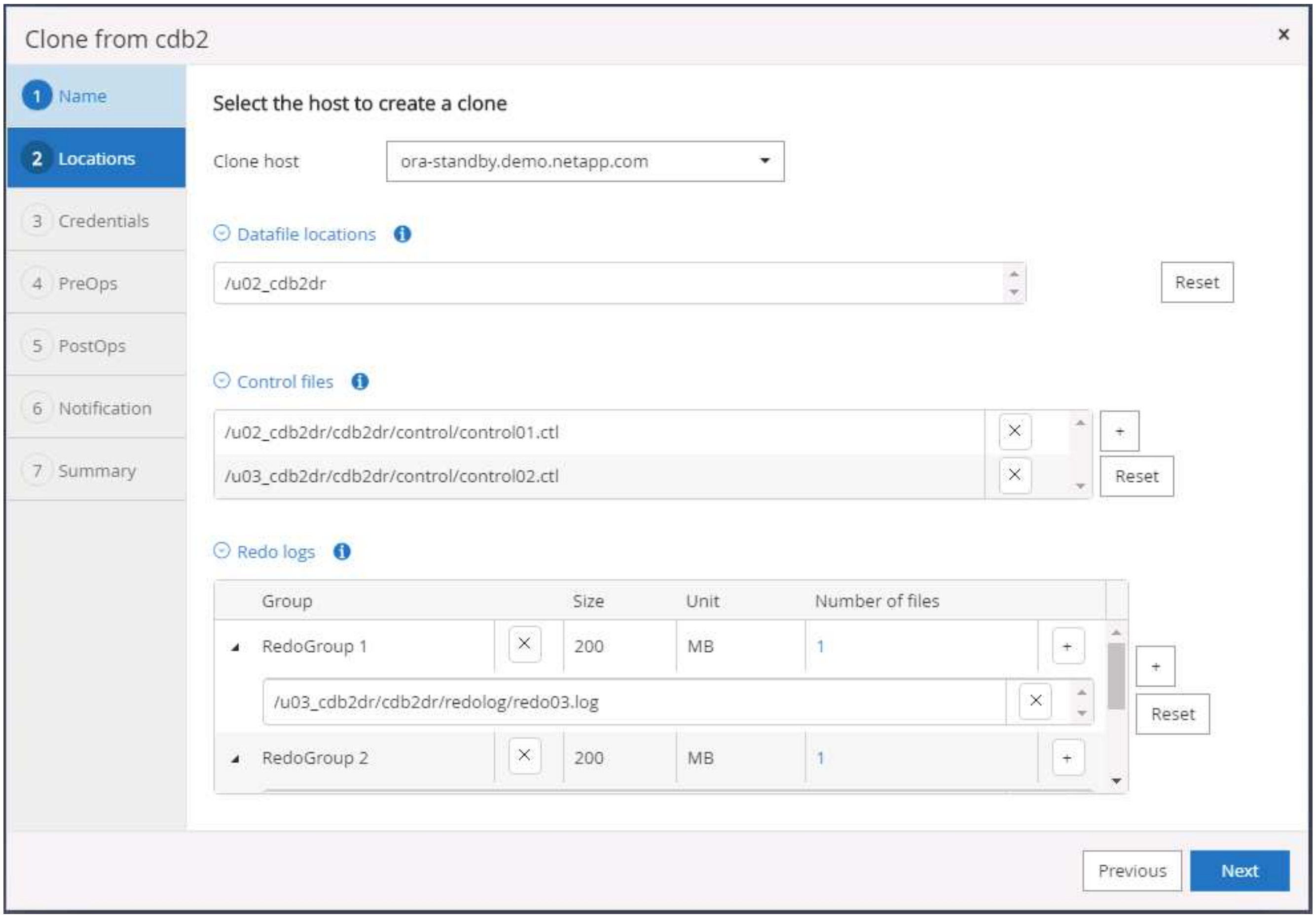


ec2-user@ora-standby:/tmp

```
[ec2-user@ora-standby tmp]$ sudo mkdir /u03_cdb2dr
[ec2-user@ora-standby tmp]$ chown oracle:oinstall /u03_cdb2dr
chown: changing ownership of '/u03_cdb2dr': Operation not permitted
[ec2-user@ora-standby tmp]$ sudo chown oracle:oinstall /u03_cdb2dr
[ec2-user@ora-standby tmp]$ sudo mount -t nfs 10.221.1.6:/ora_standby_u03 /u03_cdb2dr
[ec2-user@ora-standby tmp]$ df -h
Filesystem                                         Size  Used Avail Use% Mounted on
devtmpfs                                           7.6G     0  7.6G   0% /dev
tmpfs                                              7.6G     0  7.6G   0% /dev/shm
tmpfs                                              7.6G   17M  7.6G   1% /run
tmpfs                                              7.6G     0  7.6G   0% /sys/fs/cgroup
/dev/nvme0n1p2                                      10G  9.0G  1.1G  90% /
10.221.1.6:/ora_standby_u01                         31G   13G   18G  42% /u01
tmpfs                                              1.6G     0  1.6G   0% /run/user/1000
10.221.1.6:/Sc28182452-3fa8-448c-9e4a-c5a9e465f353 100G  3.1G   97G   4% /u02_cdb2dev
tmpfs                                              1.6G     0  1.6G   0% /run/user/54321
10.221.1.6:/Sc39c05df8-4b00-4b3a-853c-9d6d338e5df7 100G  3.7G   97G   4% /u02_cdb2test
10.221.1.6:/Sccf886a5c-3273-475e-ad97-472b2a8dccee 100G  3.8G   97G   4% /var/opt/snapcenter/sco/backup_mount/rhel2_cdb2_log_09-17-2021_18.20.04.1177_1/cdb2/1
10.221.1.6:/ora_standby_u03                         21G  320K   20G   1% /u03_cdb2dr
[ec2-user@ora-standby tmp]$
```

The Oracle clone procedure does not create a log volume, which needs to be provisioned on the DR server before cloning.

8. Select the target clone host and location to place the data files, control files, and redo logs.



Clone from cdb2

Select the host to create a clone

Clone host: ora-standby.demo.netapp.com

Datafile locations

/u02_cdb2dr

Control files

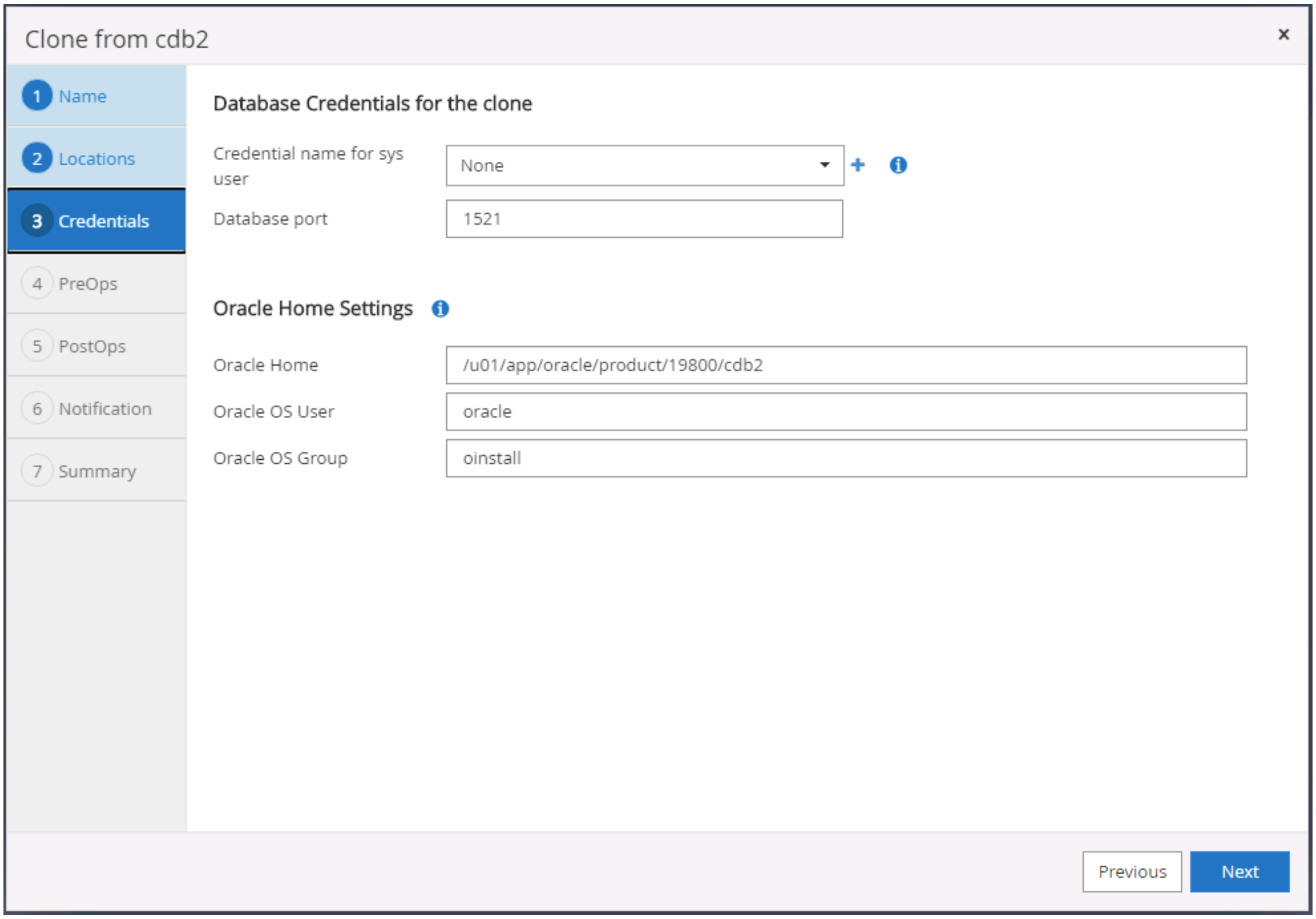
/u02_cdb2dr/cdb2dr/control/control01.ctl

/u03_cdb2dr/cdb2dr/control/control02.ctl

Redo logs

Group	Size	Unit	Number of files
RedoGroup 1	200	MB	1
/u03_cdb2dr/cdb2dr/redolog/redo03.log			
RedoGroup 2	200	MB	1

9. Select the credentials for the clone. Fill in the details of the Oracle home configuration on the target server.



Clone from cdb2

Database Credentials for the clone

Credential name for sys user: None

Database port: 1521

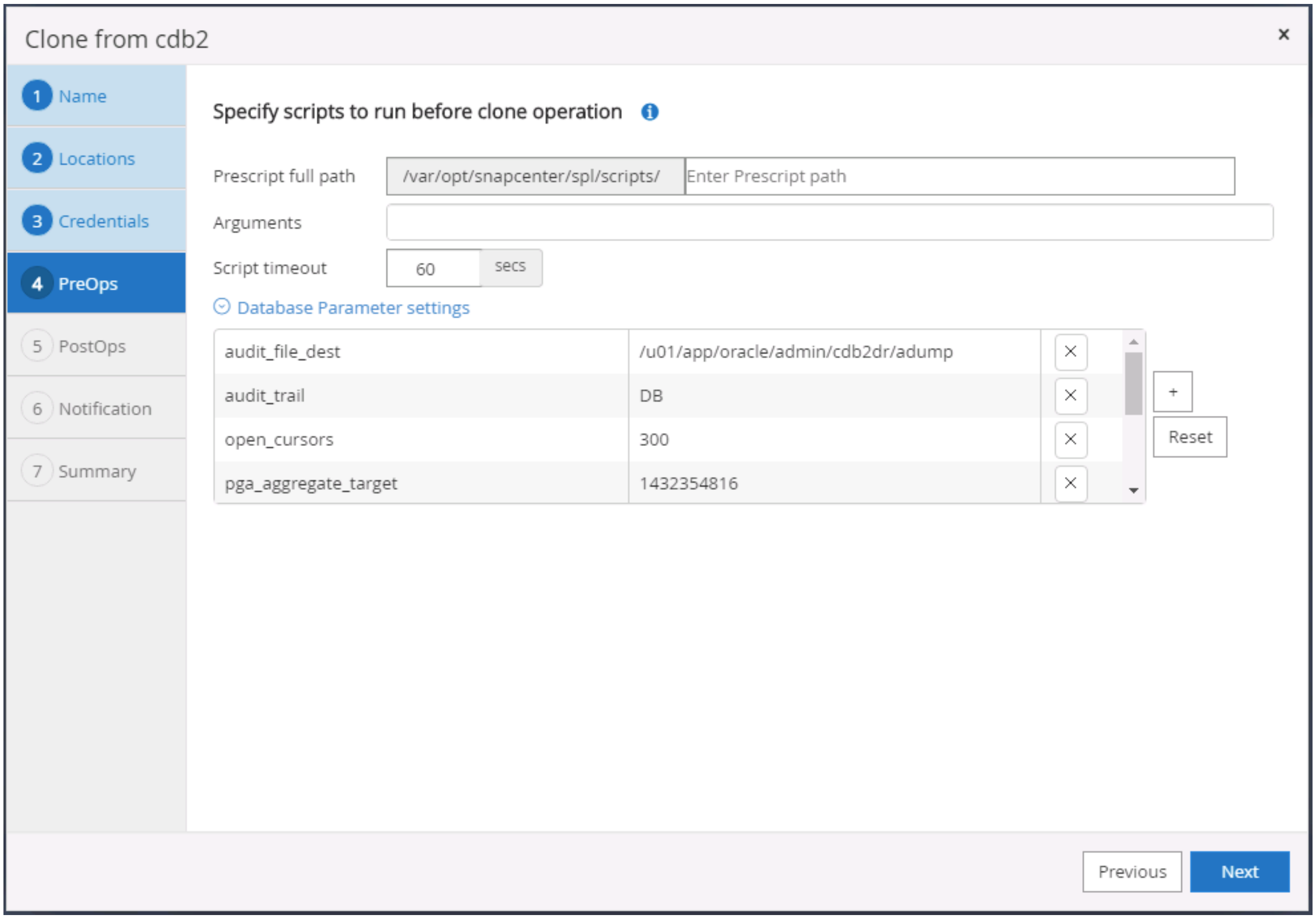
Oracle Home Settings

Oracle Home: /u01/app/oracle/product/19800/cdb2

Oracle OS User: oracle

Oracle OS Group: oinstall

10. Specify the scripts to run before cloning. Database parameters can be adjusted if needed.



Clone from cdb2

Specify scripts to run before clone operation

Prescript full path: /var/opt/snapcenter/spl/scripts/ Enter Prescript path

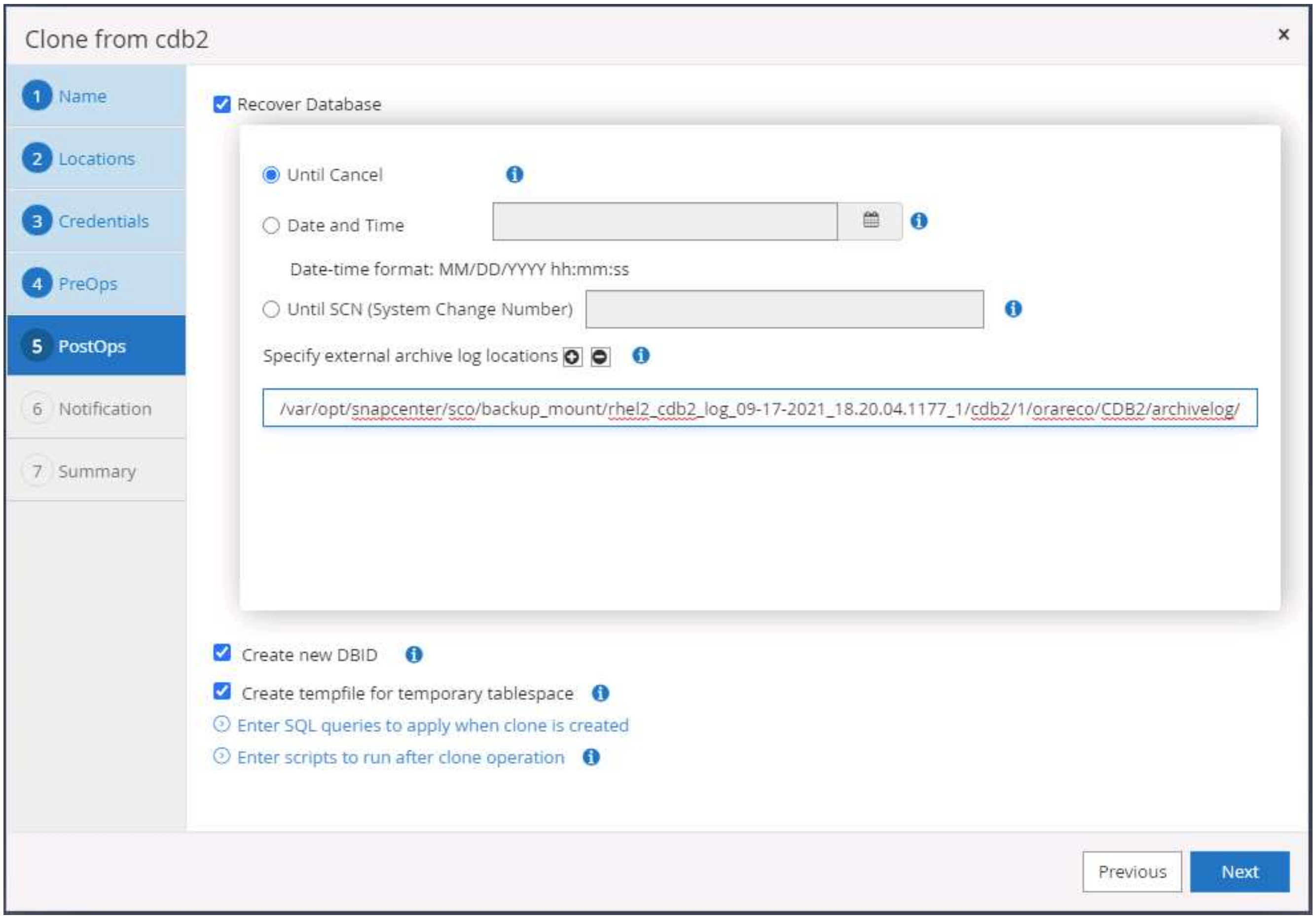
Arguments:

Script timeout: 60 secs

Database Parameter settings

audit_file_dest	/u01/app/oracle/admin/cdb2dr/adump
audit_trail	DB
open_cursors	300
pga_aggregate_target	1432354816

11. Select Until Cancel as the recovery option so that the recovery runs through all available archive logs to recoup the last transaction replicated to the secondary cloud location.



Clone from cdb2

☑ Recover Database

● Until Cancel

○ Date and Time

Date-time format: MM/DD/YYYY hh:mm:ss

○ Until SCN (System Change Number)

Specify external archive log locations

/var/opt/snapcenter/sco/backup_mount/rhel2_cdb2_log_09-17-2021_18.20.04.1177_1/cdb2/1/orareco/CDB2/archivelog/

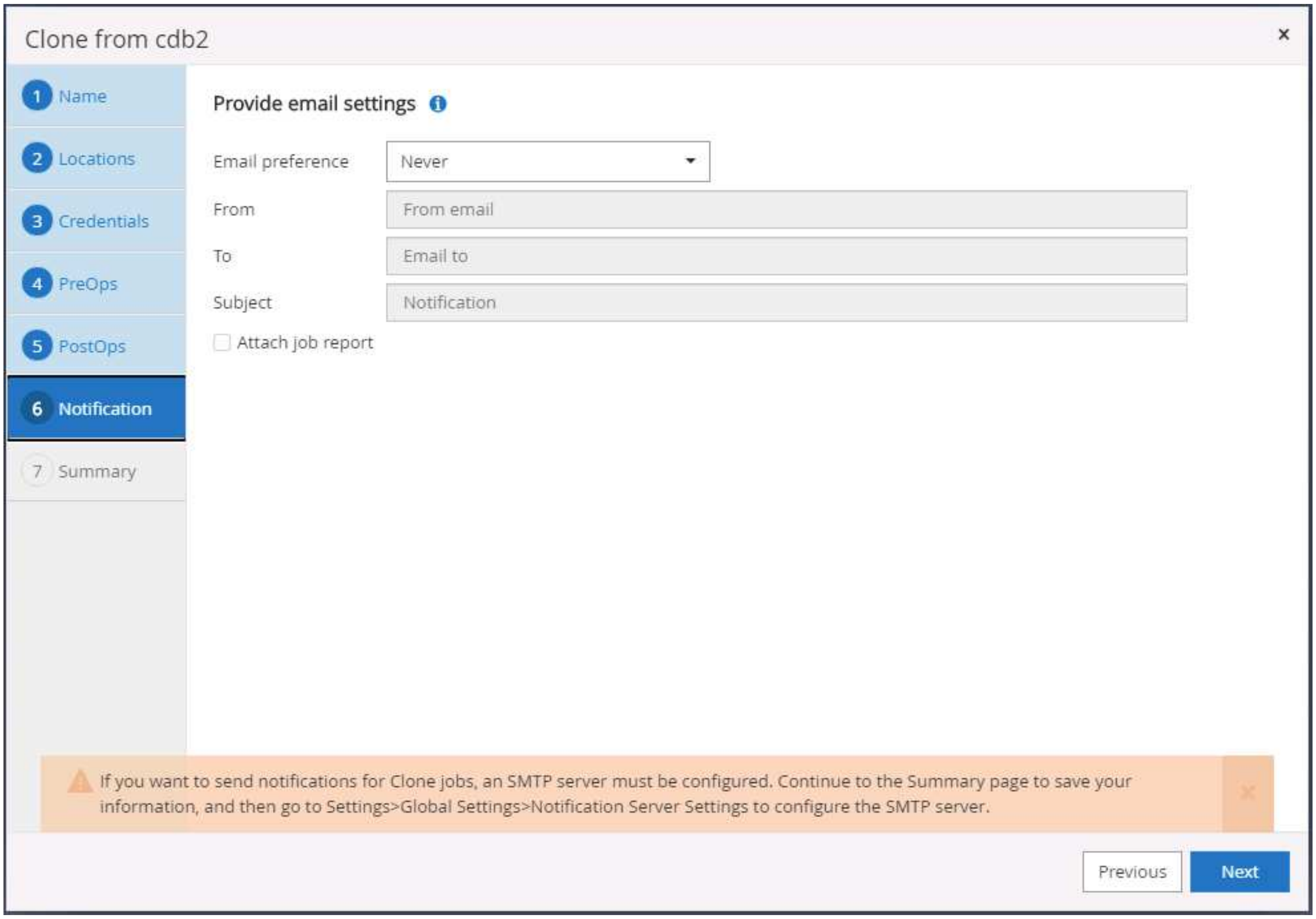
☑ Create new DBID

☑ Create tempfile for temporary tablespace

Enter SQL queries to apply when clone is created

Enter scripts to run after clone operation

12. Configure the SMTP server for email notification if needed.



Clone from cdb2

Provide email settings

Email preference: Never

From: From email

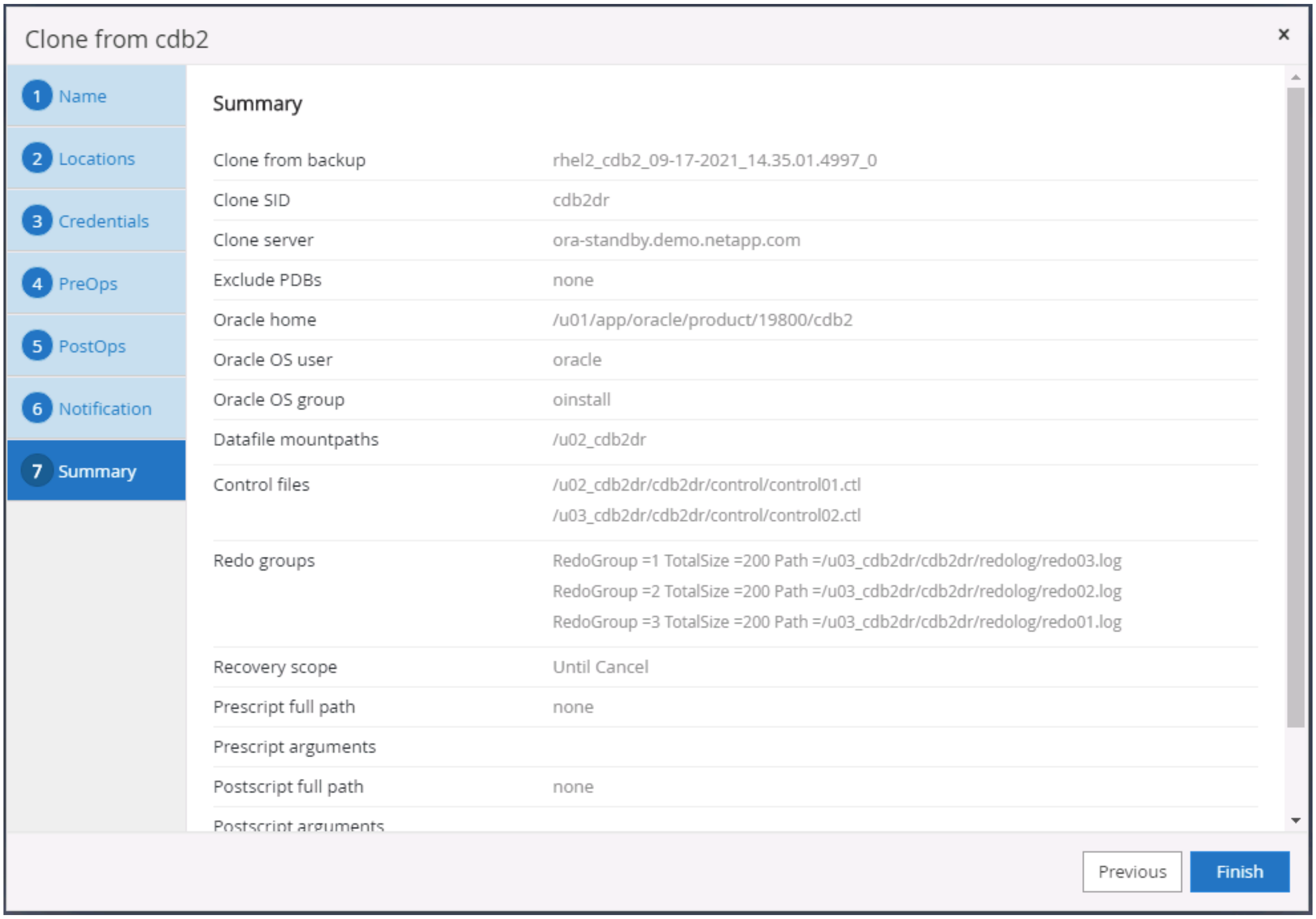
To: Email to

Subject: Notification

□ Attach job report

If you want to send notifications for Clone jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTP server.

13. DR clone summary.



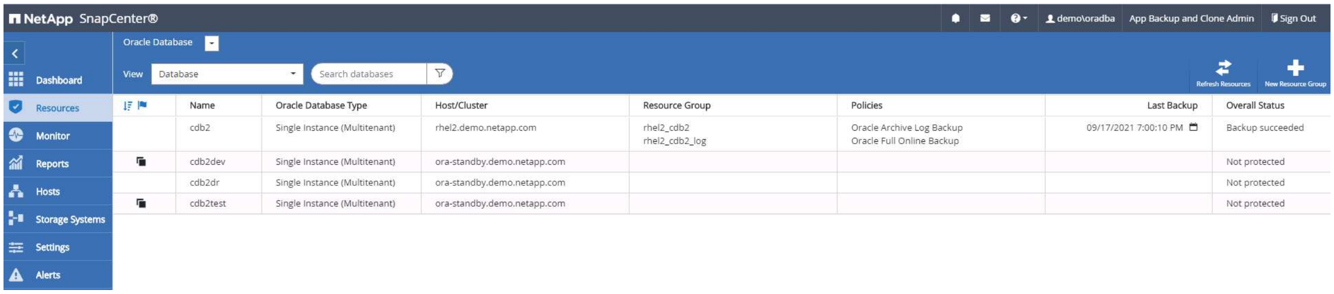
Summary

Clone from backup	rhel2_cdb2_09-17-2021_14.35.01.4997_0
Clone SID	cdb2dr
Clone server	ora-standby.demo.netapp.com
Exclude PDBs	none
Oracle home	/u01/app/oracle/product/19800/cdb2
Oracle OS user	oracle
Oracle OS group	oinstall
Datafile mountpaths	/u02_cdb2dr
Control files	/u02_cdb2dr/cdb2dr/control/control01.ctl /u03_cdb2dr/cdb2dr/control/control02.ctl

Redo groups	RedoGroup =1 TotalSize =200 Path =/u03_cdb2dr/cdb2dr/redolog/redo03.log
	RedoGroup =2 TotalSize =200 Path =/u03_cdb2dr/cdb2dr/redolog/redo02.log
	RedoGroup =3 TotalSize =200 Path =/u03_cdb2dr/cdb2dr/redolog/redo01.log

Recovery scope	Until Cancel
Prescript full path	none
Prescript arguments	
Postscript full path	none
Postscript arguments	

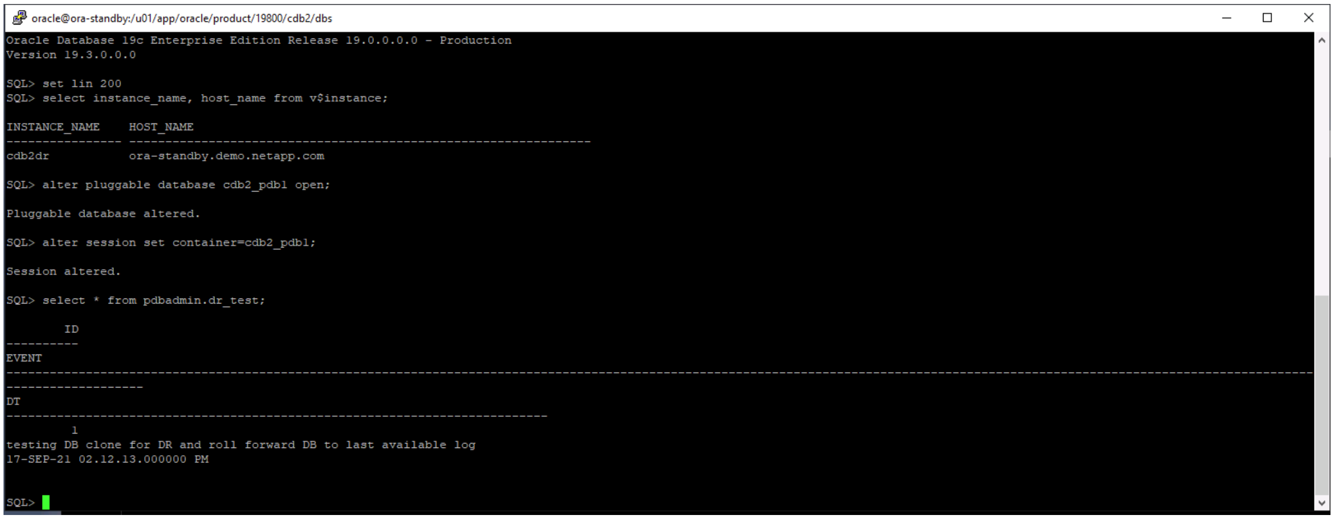
14. Cloned DBs are registered with SnapCenter immediately after clone completion and are then available for backup protection.



	Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status
	cdb2	Single Instance (Multitenant)	rhel2.demo.netapp.com	rhel2_cdb2 rhel2_cdb2_log	Oracle Archive Log Backup Oracle Full Online Backup	09/17/2021 7:00:10 PM	Backup succeeded
	cdb2dev	Single Instance (Multitenant)	ora-standby.demo.netapp.com				Not protected
	cdb2dr	Single Instance (Multitenant)	ora-standby.demo.netapp.com				Not protected
	cdb2test	Single Instance (Multitenant)	ora-standby.demo.netapp.com				Not protected

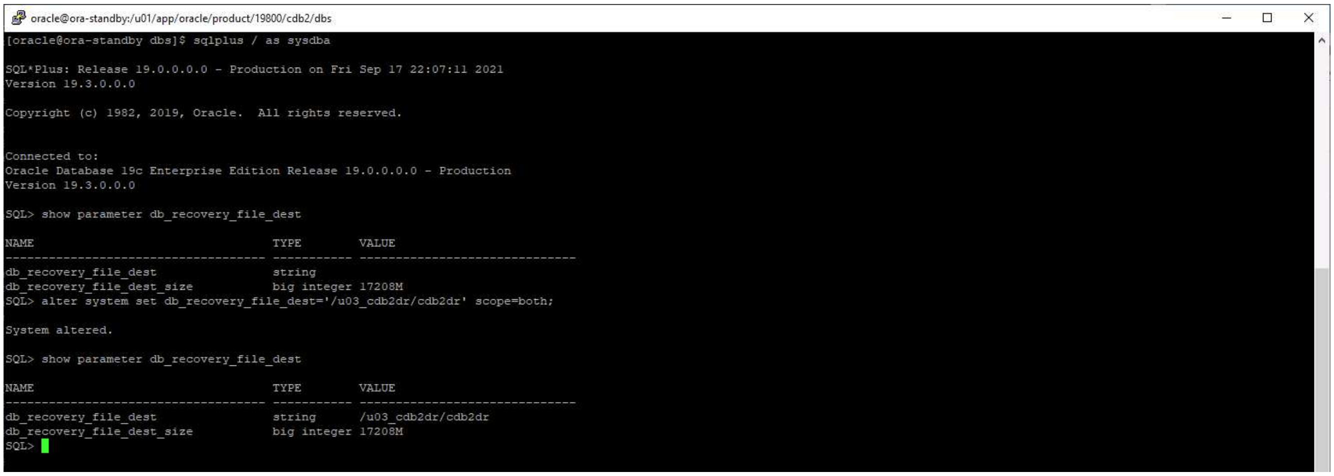
Post DR clone validation and configuration for Oracle

1. Validate the last test transaction that has been flushed, replicated, and recovered at the DR location in the cloud.



```
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.3.0.0.0

SQL> set lin 200
SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME    HOST_NAME
---------------- ----------------------------------------------------------------
cdb2dr           ora-standby.demo.netapp.com

SQL> alter pluggable database cdb2_pdb1 open;

Pluggable database altered.

SQL> alter session set container=cdb2_pdb1;

Session altered.

SQL> select * from pdbadmin.dr_test;

        ID
----------
EVENT
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
-------------------
DT
---------------------------------------------------------------------------
         1
testing DB clone for DR and roll forward DB to last available log
17-SEP-21 02.12.13.000000 PM


SQL>
```

2. Configure the flash recovery area.



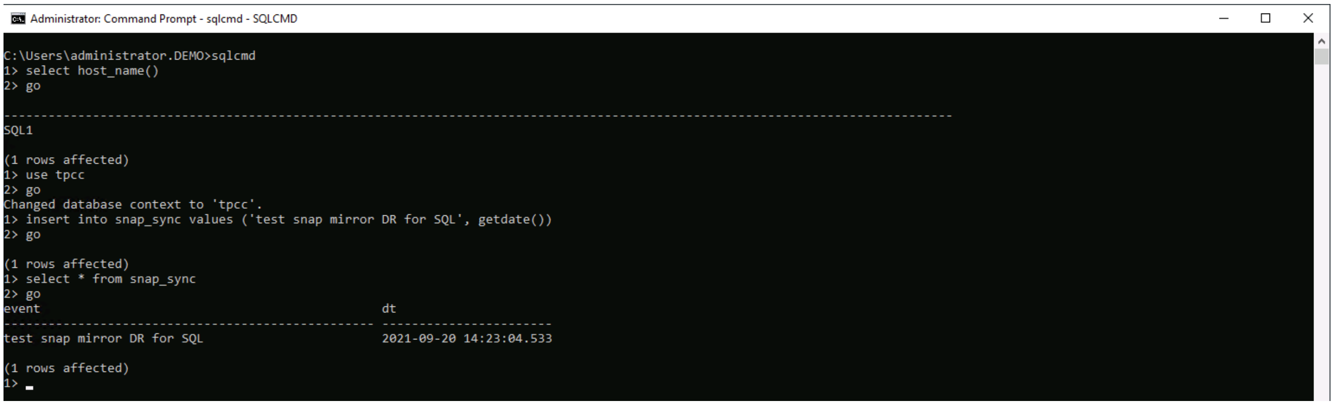
```
[oracle@ora-standby dbs]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Fri Sep 17 22:07:11 2021
Version 19.3.0.0.0

Copyright (c) 1982, 2019, Oracle.  All rights reserved.


Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.3.0.0.0

SQL> show parameter db_recovery_file_dest

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------------------------------
db_recovery_file_dest                string
db_recovery_file_dest_size           big integer 17208M
SQL> alter system set db_recovery_file_dest='/u03_cdb2dr/cdb2dr' scope=both;

System altered.

SQL> show parameter db_recovery_file_dest

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------------------------------
db_recovery_file_dest                string      /u03_cdb2dr/cdb2dr
db_recovery_file_dest_size           big integer 17208M
SQL>
```

3. Configure the Oracle listener for user access.
4. Split the cloned volume off of the replicated source volume.
5. Reverse replication from the cloud to on-premises and rebuild the failed on-premises database server.

> ⓘ Clone split may incur temporary storage space utilization that is much higher than normal operation. However, after the on-premises DB server is rebuilt, extra space can be released.

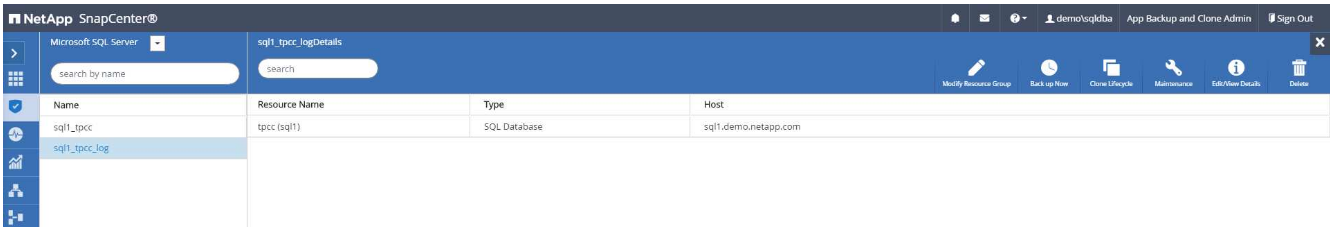
Clone an on-premises SQL production DB to cloud for DR

1. Similarly, to validate that the SQL clone recovery ran through last available log, we created a small test table and inserted a row. The test data would be recovered after a full recovery to the last available log.


Administrator: Command Prompt - sqlcmd - SQLCMD

```
C:\Users\administrator.DEMO>sqlcmd
1> select host_name()
2> go

--------------------------------------------------------------------------------------------------------------------------------
SQL1

(1 rows affected)
1> use tpcc
2> go
Changed database context to 'tpcc'.
1> insert into snap_sync values ('test snap mirror DR for SQL', getdate())
2> go

(1 rows affected)
1> select * from snap_sync
2> go
event                                              dt
-------------------------------------------------- -----------------------
test snap mirror DR for SQL                        2021-09-20 14:23:04.533

(1 rows affected)
1> _
```

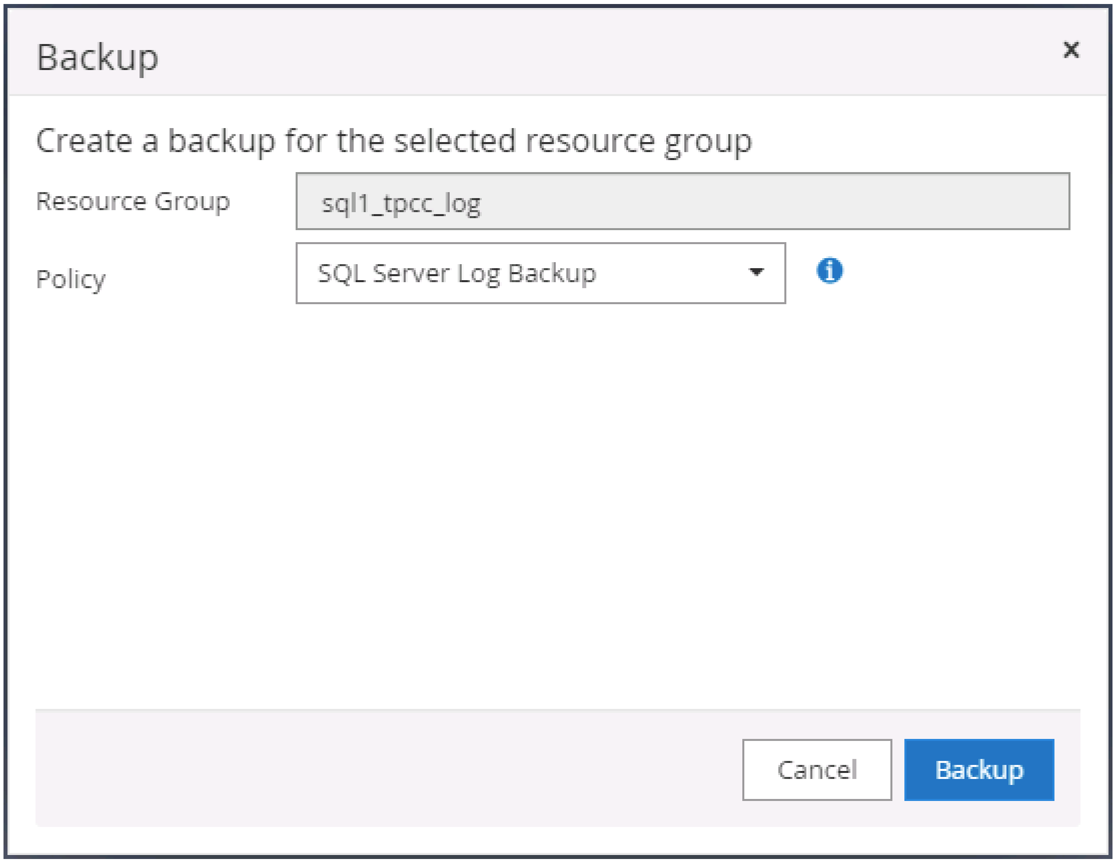
2. Log into SnapCenter with a database management user ID for SQL Server. Navigate to the Resources tab, which shows the SQL Server protection resources group.



Name
sql1_tpcc
sql1_tpcc_log

Resource Name	Type	Host
tpcc (sql1)	SQL Database	sql1.demo.netapp.com

3. Manually run a log backup to flush the last transaction to be replicated to secondary storage in the public cloud.

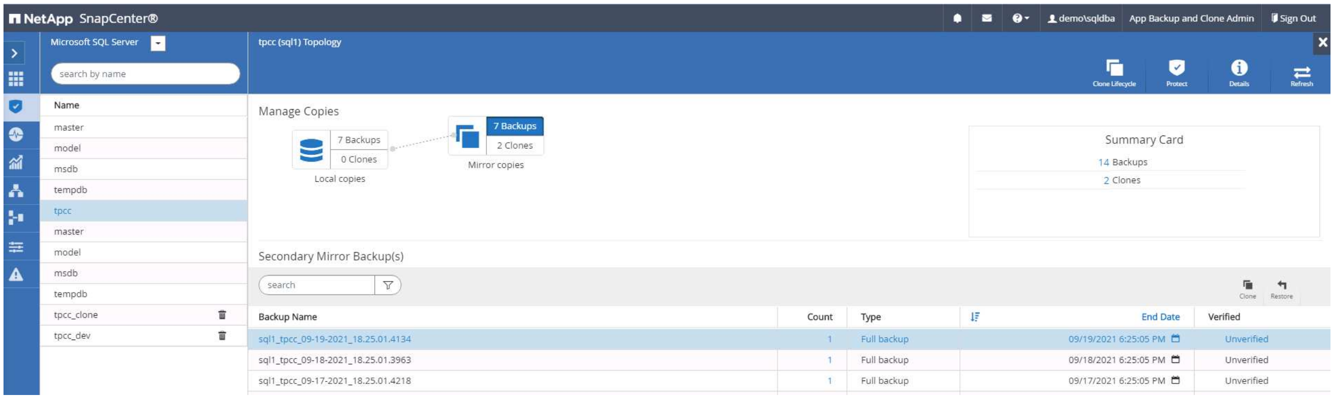

Backup

Create a backup for the selected resource group

Resource Group: sql1_tpcc_log

Policy: SQL Server Log Backup

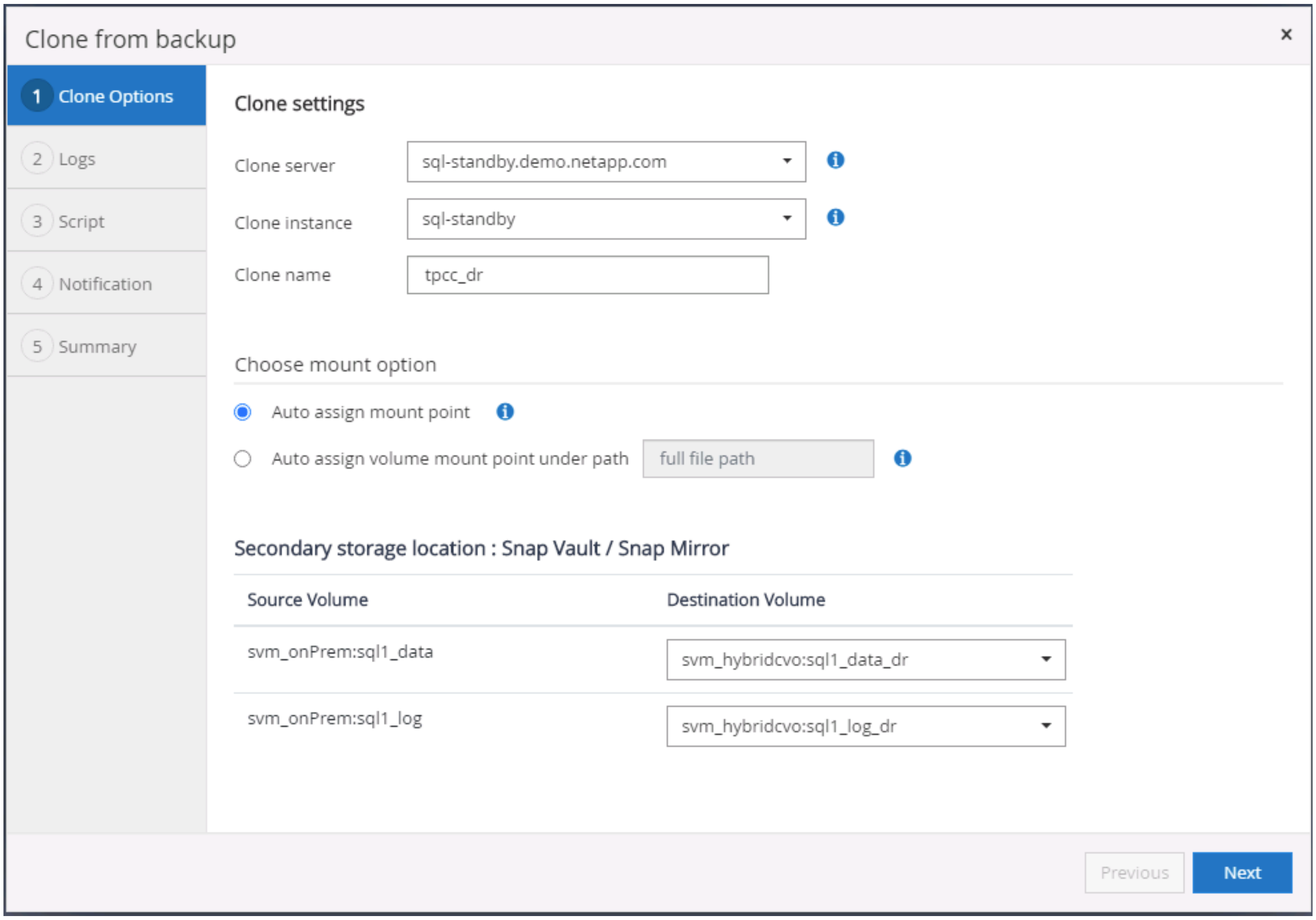
4. Select the last full SQL Server backup for the clone.



Name
master
model
msdb
tempdb
tpcc
master
model
msdb
tempdb
tpcc_clone
tpcc_dev

Backup Name	Count	Type	End Date	Verified
sql1_tpcc_09-19-2021_18.25.01.4134	1	Full backup	09/19/2021 6:25:05 PM	Unverified
sql1_tpcc_09-18-2021_18.25.01.3963	1	Full backup	09/18/2021 6:25:05 PM	Unverified
sql1_tpcc_09-17-2021_18.25.01.4218	1	Full backup	09/17/2021 6:25:05 PM	Unverified

5. Set the clone setting such as the Clone Server, Clone Instance, Clone Name, and mount option. The secondary storage location where cloning is performed is auto-populated.



Clone settings

Clone server: sql-standby.demo.netapp.com

Clone instance: sql-standby

Clone name: tpcc_dr

Choose mount option

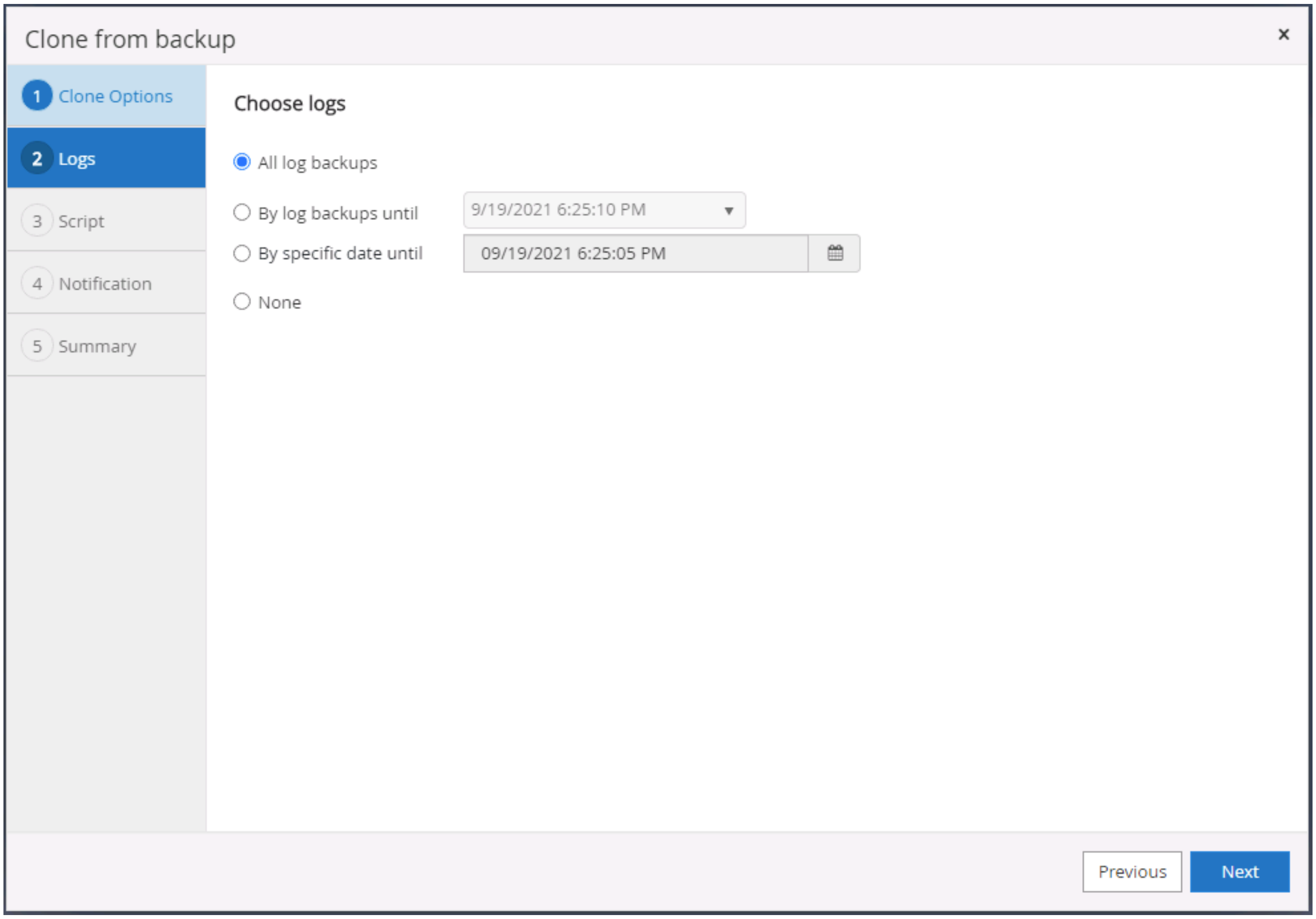
● Auto assign mount point

○ Auto assign volume mount point under path: full file path

Secondary storage location : Snap Vault / Snap Mirror

Source Volume	Destination Volume
svm_onPrem:sql1_data	svm_hybridcvo:sql1_data_dr
svm_onPrem:sql1_log	svm_hybridcvo:sql1_log_dr

6. Select all log backups to be applied.



Clone from backup

Choose logs

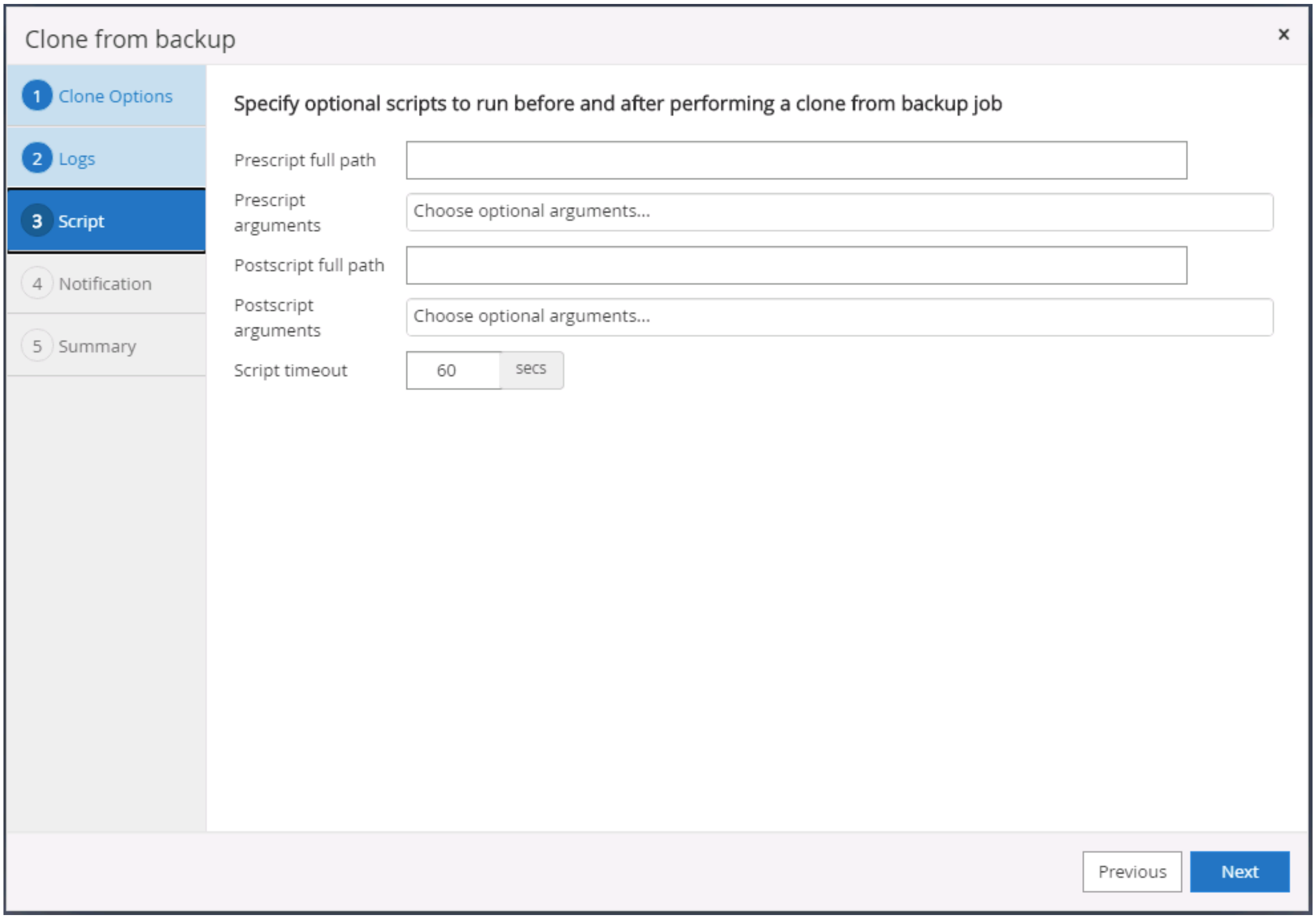
● All log backups

○ By log backups until 9/19/2021 6:25:10 PM

○ By specific date until 09/19/2021 6:25:05 PM

○ None

7. Specify any optional scripts to run before or after cloning.



Clone from backup

Specify optional scripts to run before and after performing a clone from backup job

Prescript full path

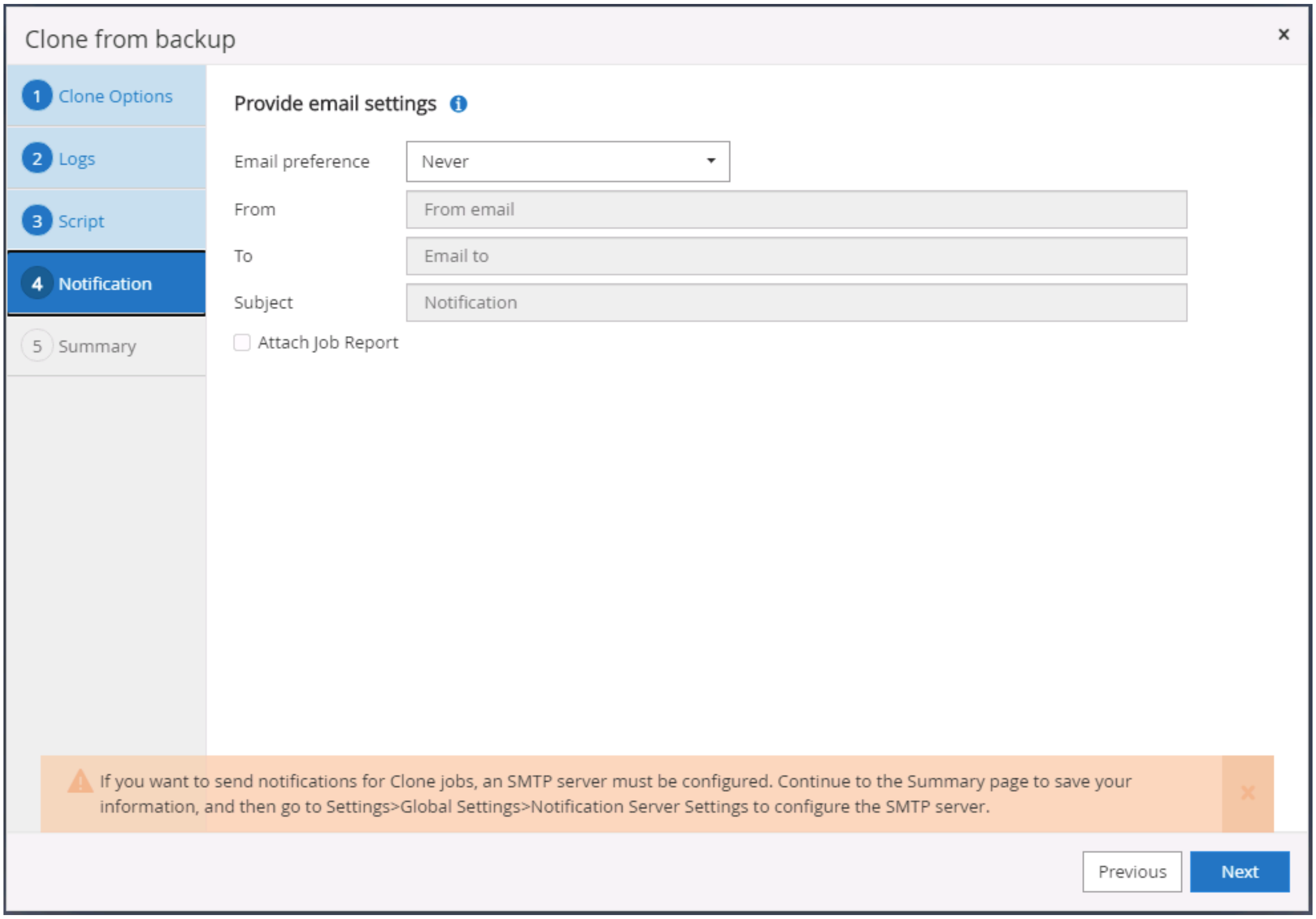
Prescript arguments: Choose optional arguments...

Postscript full path

Postscript arguments: Choose optional arguments...

Script timeout: 60 secs

8. Specify an SMTP server if email notification is desired.



Provide email settings

Email preference: Never

From: From email

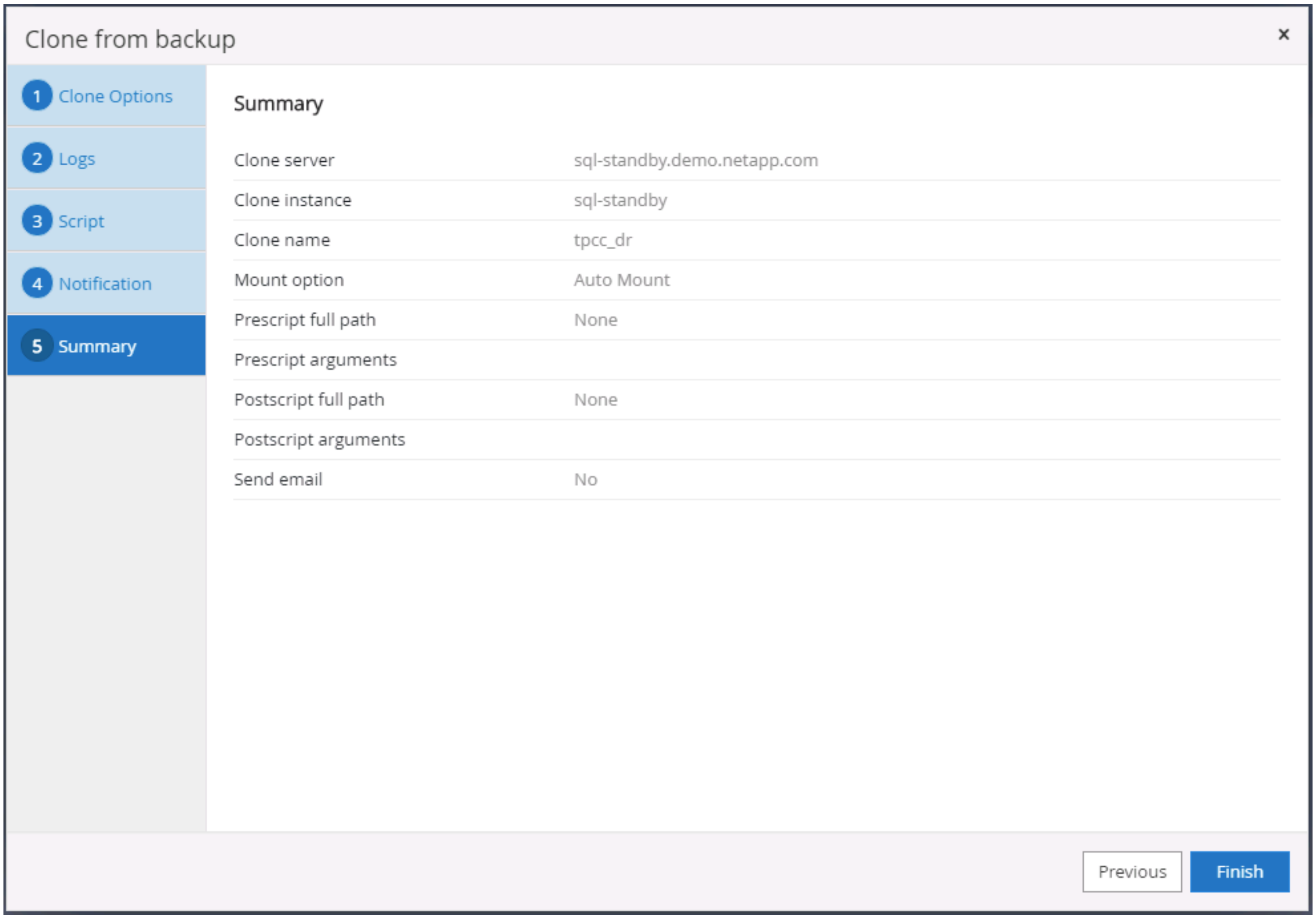
To: Email to

Subject: Notification

□ Attach Job Report

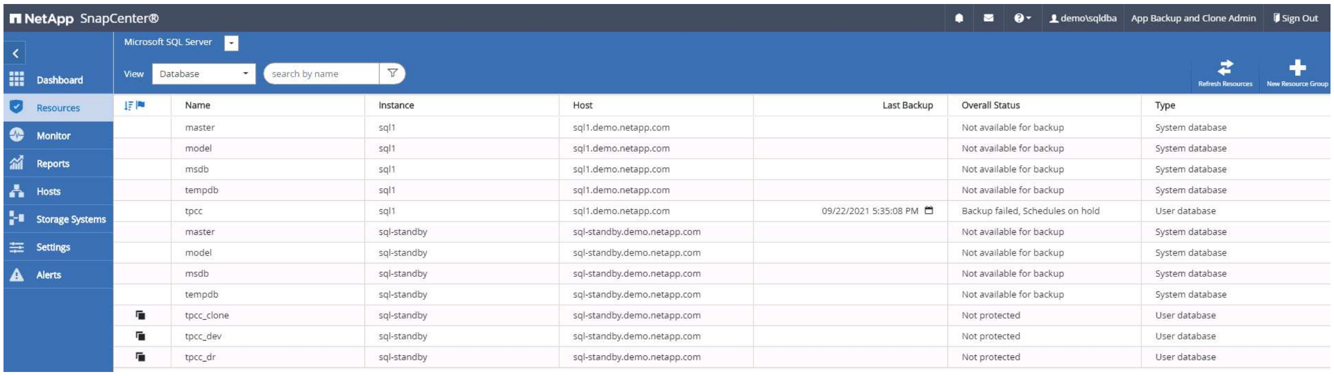
If you want to send notifications for Clone jobs, an SMTP server must be configured. Continue to the Summary page to save your information, and then go to Settings>Global Settings>Notification Server Settings to configure the SMTP server.

9. DR clone summary. Cloned databases are immediately registered with SnapCenter and available for backup protection.



Summary

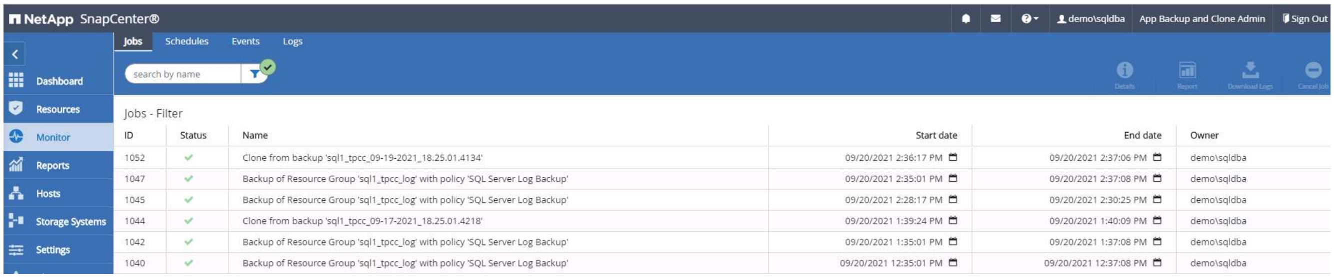
Clone server	sql-standby.demo.netapp.com
Clone instance	sql-standby
Clone name	tpcc_dr
Mount option	Auto Mount
Prescript full path	None
Prescript arguments	
Postscript full path	None
Postscript arguments	
Send email	No



	Name	Instance	Host	Last Backup	Overall Status	Type
	master	sql1	sql1.demo.netapp.com		Not available for backup	System database
	model	sql1	sql1.demo.netapp.com		Not available for backup	System database
	msdb	sql1	sql1.demo.netapp.com		Not available for backup	System database
	tempdb	sql1	sql1.demo.netapp.com		Not available for backup	System database
	tpcc	sql1	sql1.demo.netapp.com	09/22/2021 5:35:08 PM	Backup failed, Schedules on hold	User database
	master	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database
	model	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database
	msdb	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database
	tempdb	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database
	tpcc_clone	sql-standby	sql-standby.demo.netapp.com		Not protected	User database
	tpcc_dev	sql-standby	sql-standby.demo.netapp.com		Not protected	User database
	tpcc_dr	sql-standby	sql-standby.demo.netapp.com		Not protected	User database

Post DR clone validation and configuration for SQL

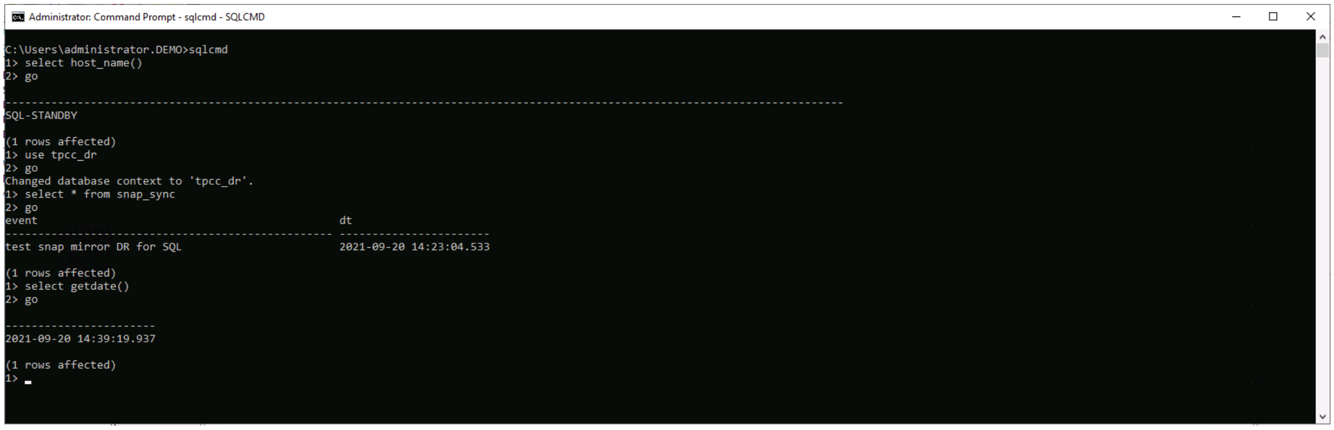
1. Monitor clone job status.



Jobs - Filter

ID	Status	Name	Start date	End date	Owner
1052	✓	Clone from backup 'sql1_tpcc_09-19-2021_18.25.01.4134'	09/20/2021 2:36:17 PM	09/20/2021 2:37:06 PM	demo\sqldba
1047	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/20/2021 2:35:01 PM	09/20/2021 2:37:08 PM	demo\sqldba
1045	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/20/2021 2:28:17 PM	09/20/2021 2:30:25 PM	demo\sqldba
1044	✓	Clone from backup 'sql1_tpcc_09-17-2021_18.25.01.4218'	09/20/2021 1:39:24 PM	09/20/2021 1:40:09 PM	demo\sqldba
1042	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/20/2021 1:35:01 PM	09/20/2021 1:37:08 PM	demo\sqldba
1040	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/20/2021 12:35:01 PM	09/20/2021 12:37:08 PM	demo\sqldba

2. Validate that last transaction has been replicated and recovered with all log file clones and recovery.



```
C:\Users\administrator.DEMO>sqlcmd
1> select host_name()
2> go

--------------------------------------------------------------------------------------------------------------------------------
SQL-STANDBY

(1 rows affected)
1> use tpcc_dr
2> go
Changed database context to 'tpcc_dr'.
1> select * from snap_sync
2> go
event                                              dt
-------------------------------------------------- -----------------------
test snap mirror DR for SQL                        2021-09-20 14:23:04.533

(1 rows affected)
1> select getdate()
2> go

-----------------------
2021-09-20 14:39:19.937

(1 rows affected)
1>
```

3. Configure a new SnapCenter log directory on the DR server for SQL Server log backup.
4. Split the cloned volume off of the replicated source volume.
5. Reverse replication from the cloud to on-premises and rebuild the failed on-premises database server.

Where to go for help?

If you need help with this solution and use cases, please join the NetApp Solution Automation community support Slack channel and look for the solution-automation channel to post your questions or inquires.

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