TR-5002: Oracle Active Data Guard Cost Reduction with Azure NetApp Files

NetApp database solutions

NetApp

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TR-5002: Oracle Active Data Guard Cost Reduction with Azure NetApp Files

The solution provides an overview and details for configuring Oracle Data Guard using Microsoft Azure NetApp Files (ANF) as primary and standby database storage to reduce the licensing and operational cost of the Oracle Data Guard HA/DR solution in the Azure cloud.

Purpose

Oracle Data Guard ensures high availability, data protection, and disaster recovery for enterprise data in a primary database and standby database replication configuration. Oracle Active Data Guard empowers users to access standby databases while data replication is active from the primary database to standby databases. Data Guard is a feature of Oracle Database Enterprise Edition. It does not require separate licensing. On the other hand, Active Data Guard is an Oracle Database Enterprise Edition Option therefore requires separate licensing. Multiple standby databases can receive data replication from a primary database in the Active Data Guard setup. However, each additional standby database requires an Active Data Guard license and extra storage as the size of primary database. The operational costs add up quickly.

If you are keen on cutting back cost of your Oracle database operation and are planning to set up an Active Data Guard in Azure cloud, you should consider an alternative. Instead of Active Data Guard, use Data Guard to replicate from primary database to a single physical standby database on Azure NetApp Files storage. Subsequently, multiple copies of this standby database can be cloned and opened for read/write access to serve many other use cases such as reporting, development, test etc. The net results effectively deliver functionalities of Active Data Guard while eliminating Active Data Guard license. In this documentation, we demonstrate how to setup an Oracle Data Guard with your existing primary database and physical standby database on ANF storage. The standby database is backed up and cloned for read/write access for use cases as desired via NetApp SnapCenter database management tool. NetApp Solutions Engineering team also provides an automation tool kit to refresh clone on user defined schedule for a complete, automated database clone lifecycle management without needs of user intervention.

This solution addresses the following use cases:

- Implementation of Oracle Data Guard between a primary database and physical standby database on Microsoft Azure NetApp Files storage across Azure regions.
- Backup and clone the physical standby database to serve use cases such as reporting, dev, test, etc.
- Oracle database clone refresh lifecycle management via automation.

Audience

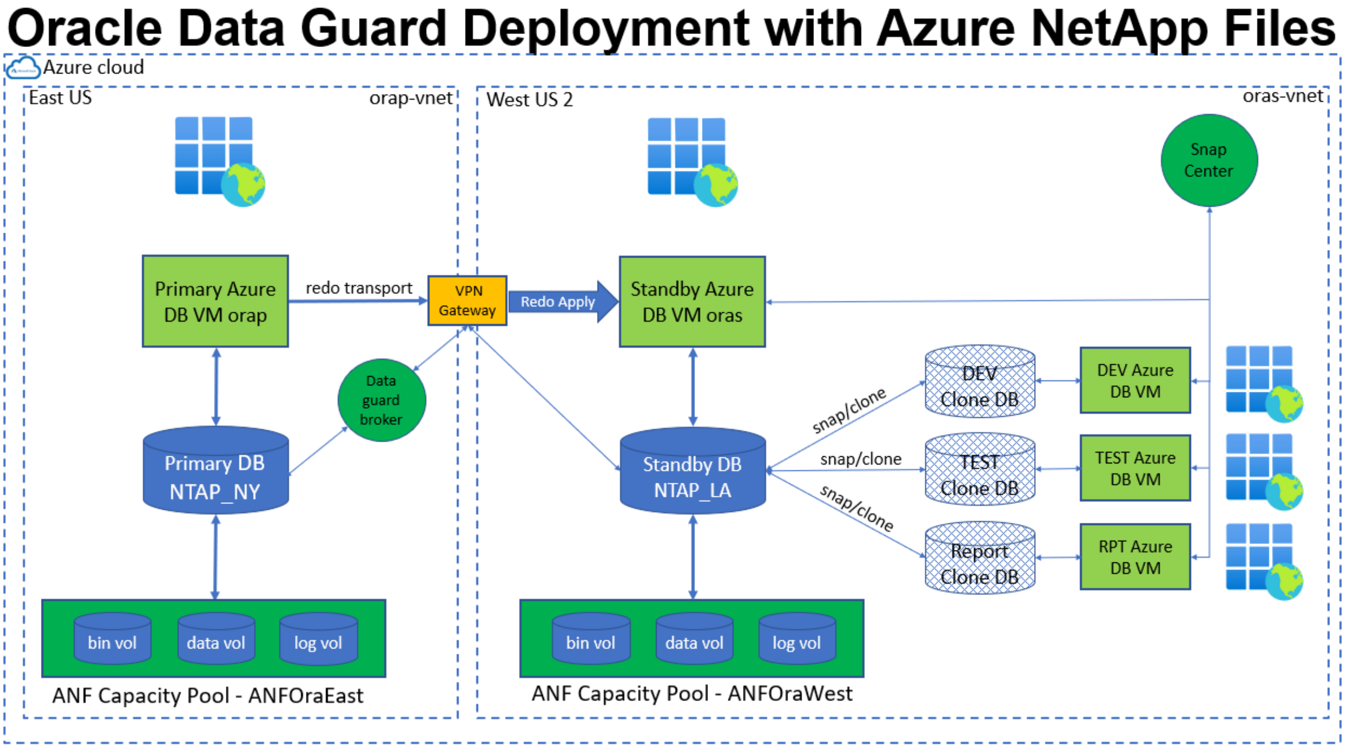
This solution is intended for the following people:

- A DBA who sets up Oracle Active Data Guard in Azure cloud for high availability, data protection, and disaster recovery.
- A database solution architect interested in Oracle Active Data Guard configuration in the Azure cloud.
- A storage administrator who manages Azure NetApp Files storage that supports Oracle Data Guard.
- An application owner who likes to stand up Oracle Data Guard in an Azure cloud environment.

Solution test and validation environment

The testing and validation of this solution was performed in an Azure cloud lab setting that might not match the actual user deployment environment. For more information, see the section Key factors for deployment consideration.

Architecture



Hardware and software components

Hardware		
Azure NetApp Files	Current version offered by Microsoft	Two 3 TiB Capacity Pools, Standard Service Level, Auto QoS
Azure VMs for DB Servers	Standard B4ms (4 vcpus, 16 GiB memory)	Three DB VMs, one as the primary DB server, one as the standby DB server, and the third as a clone DB server
Software		
RedHat Linux	Red Hat Enterprise Linux 8.6 (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	Version 6.0.1	Build 6.0.1.4487
NFS	Version 3.0	dNFS enabled for Oracle

Oracle Data Guard configuration with hypothetical NY to LA DR setup

Database	DB_UNIQUE_NAME	Oracle Net Service Name
Primary	NTAP_NY	NTAP_NY.internal.cloudapp.net
Standby	NTAP_LA	NTAP_LA.internal.cloudapp.net

Key factors for deployment consideration

- **Standby Database Clone.** While receiving and applying transaction logs from primary database, physical standby database can be cloned and mounted on a DB VM to support other workloads such as DEV, TEST, or Report. The clone can be a thin or thick clone. At this moment, ANF only support thick clone, which is a full copy of standby database. The ANF thin clone option will be released shortly. For a thinly cloned copies of database volumes, it shares the same DB volumes of standby database and utilize copy-on-write technology to service write IOs. Thus, the clone are very storage efficient that can be used for many other use cases with minimal and incremental new storage allocation for new write IOs. This provides tremendous storage cost saving by substantially reducing Active Data Guard storage footprint. NetApp recommends to minimize FlexClone activities in the event of database switching over from primary storage to standby ANF storage in order to maintain Oracle performance at high level.
- **Oracle Software Requirements.** In general, a physical standby database must have the same Database Home version as the primary database including Patch Set Exceptions (PSEs), Critical Patch Updates (CPUs), and Patch Set Updates (PSUs), unless an Oracle Data Guard Standby-First Patch Apply process is in progress (as described in My Oracle Support note 1265700.1 at support.oracle.com.
- **Standby Database Directory Structure Considerations.** If possible, the data files, log files, and control files on the primary and standby systems should have the same names and path names and use Optimal Flexible Architecture (OFA) naming conventions. The archival directories on the standby database should also be identical between sites, including size and structure. This strategy allows other operations such as backups, switchovers, and failovers to execute the same set of steps, reducing the maintenance complexity.
- **Force Logging Mode.** To protect against unlogged direct writes in the primary database that cannot be propagated to the standby database, turn on FORCE LOGGING at the primary database before performing data file backups for standby creation.
- **Azure VM Sizing.** In these tests and validations, we used an Azure VM - Standard_B4ms with 4 vCPUs and16 GiB memory. You need to size the Azure DB VM appropriately for the number of vCPUs and the amount of RAM based on actual workload requirements.
- **Azure NetApp Files Configuration.** Azure NetApp Files are allocated in the Azure NetApp storage account as `Capacity Pools`. In these tests and validations, we deployed a 3 TiB capacity pool to host Oracle primary at the East region and a standby database at the West 2 region. ANF capacity pool has three service levels: Standard, Premium, and Ultra. The IO capacity of ANF capacity pool is based on the size of the capacity pool and its service level. For production deployment, NetApp recommends taking a full assessment of your Oracle database throughput requirement and sizing the database capacity pool accordingly. At a capacity pool creation, you can set QoS to Auto or Manual and data encryption at rest Single or Double.
- **dNFS Configuration.** By using dNFS, an Oracle database running on an Azure Virtual Machine with ANF storage can drive significantly more I/O than the native NFS client. Automated Oracle deployment using the

NetApp automation toolkit automatically configures dNFS on NFSv3.

Solution deployment

It is assumed that you already have your primary Oracle database deployed in an Azure cloud environment within a VNet as the starting point for setting up the Oracle Data Guard. Ideally, the primary database is deployed on ANF storage with NFS mount. Three NFS mount points are created for the Oracle database storage: mount /u01 for the Oracle binary files, mount /u02 for the Oracle data files and a control file, mount /u03 for the Oracle current and archived log files, and a redundant control file.

Your primary Oracle database can also be running on a NetApp ONTAP storage or any other storage of choices either within the Azure ecosystem or a private data center. The following section provides step-by-step deployment procedures for setting up an Oracle Data Guard between a primary Oracle DB in Azure with ANF storage to a physical standby Oracle DB in Azure with ANF storage.

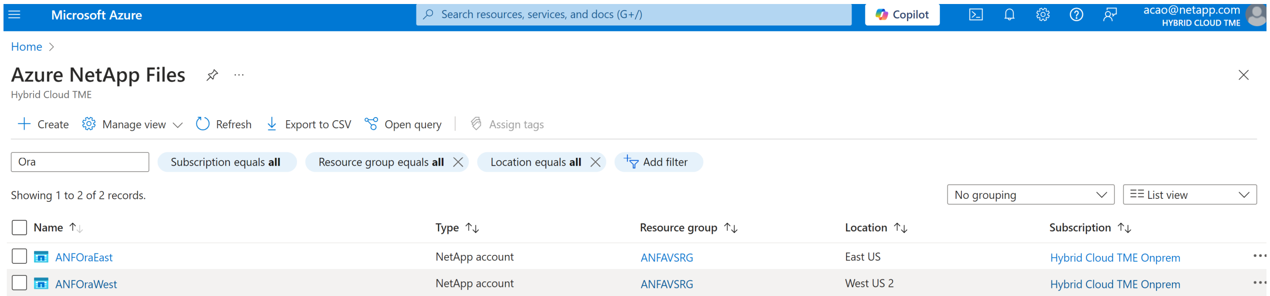
Prerequisites for deployment

Deployment requires the following prerequisites.

1. An Azure cloud account has been set up, and the necessary VNet and network subnets have been created within your Azure account.
2. From the Azure cloud portal console, you need to deploy minimum three Azure Linux VMs, one as the primary Oracle DB server, one as the standby Oracle DB server, and a clone target DB server for reporting, dev, and test etc. See the architecture diagram in the previous section for more details about the environment setup. Also review the Microsoft Azure Virtual Machines for more information.
3. The primary Oracle database should have been installed and configured in the primary Oracle DB server. On the other hand, in the standby Oracle DB server or the clone Oracle DB server, only Oracle software is installed and no Oracle databases are created. Ideally, the Oracle files directories layout should be exactly matching on all Oracle DB servers. For details on NetApp recommendation for automated Oracle deployment in the Azure cloud and ANF, please refer to the following technical reports for help.
   - TR-4987: Simplified, Automated Oracle Deployment on Azure NetApp Files with NFS

   > Ensure that you have allocated at least 128G in the Azure VMs root volume in order to have sufficient space to stage Oracle installation files.

4. From the Azure cloud portal console, deploy two ANF storage capacity pools to host Oracle database volumes. The ANF storage capacity pools should be situated in different regions to mimic a true DataGuard configuration. If you are not familiar with the deployment of ANF storage, see the documentation Quickstart: Set up Azure NetApp Files and create an NFS volume for step-by-step instructions.

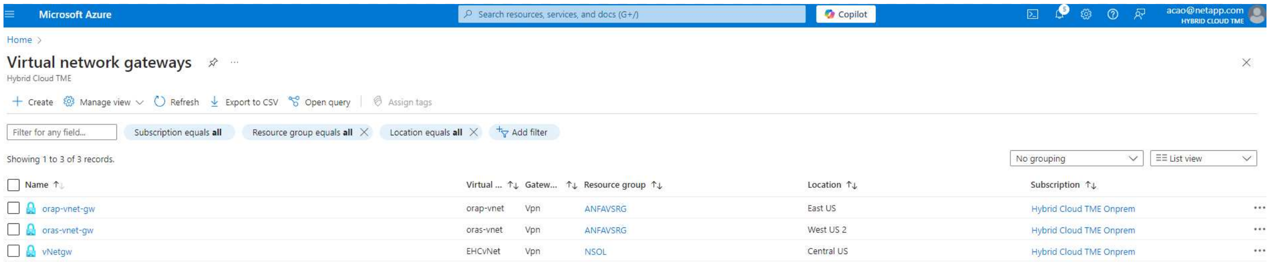
   

   Showing 1 to 2 of 2 records.

Name	Type	Resource group	Location	Subscription
ANFOraEast	NetApp account	ANFAVSRG	East US	Hybrid Cloud TME Onprem
ANFOraWest	NetApp account	ANFAVSRG	West US 2	Hybrid Cloud TME Onprem

5. When the primary Oracle database and the standby Oracle database are situated in two different regions, a VPN gateway should be configured to allow data traffic flow between two separate VNets. Detailed networking configuration in Azure is beyond the scope of this document. Following screen shots provides some reference on how the VPN gateways are configured, connected, and the data traffics flow are confirmed in the lab.

   Lab VPN gateways:



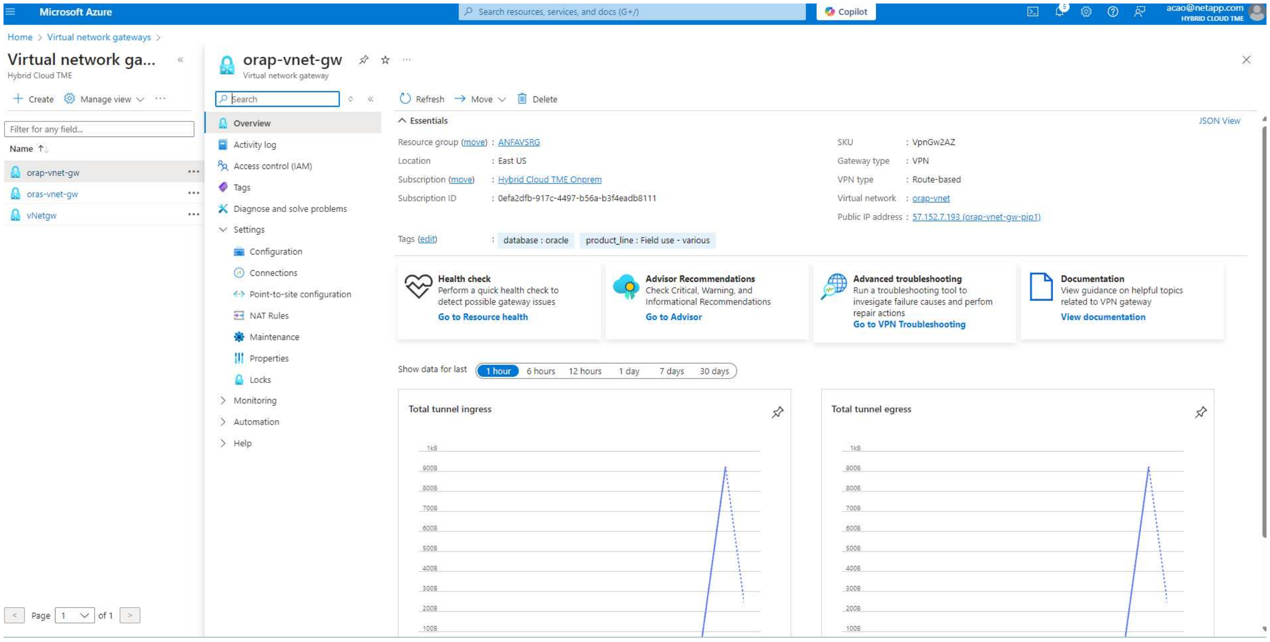
Virtual network gateways

Hybrid Cloud TME

Showing 1 to 3 of 3 records.

Name	Virtual ...	Gatew...	Resource group	Location	Subscription
orap-vnet-gw	orap-vnet	Vpn	ANFAVSRG	East US	Hybrid Cloud TME Onprem
oras-vnet-gw	oras-vnet	Vpn	ANFAVSRG	West US 2	Hybrid Cloud TME Onprem
vNetgw	EHCvNet	Vpn	NSOL	Central US	Hybrid Cloud TME Onprem

The primary vnet gateway:

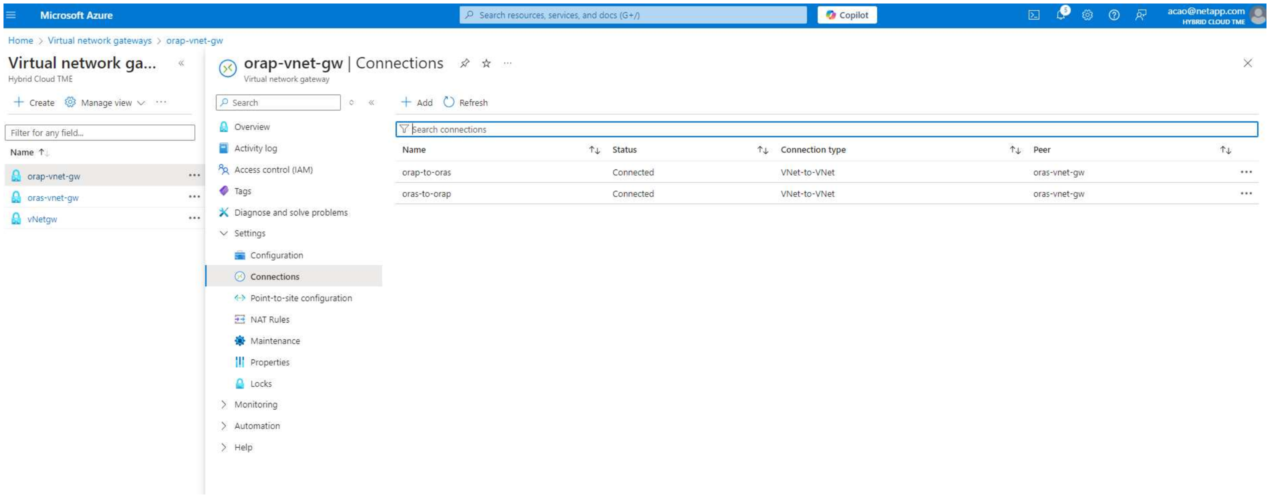


orap-vnet-gw

Virtual network gateway

Resource group (move) : ANFAVSRG
Location : East US
Subscription (move) : Hybrid Cloud TME Onprem
Subscription ID : 0efa2dfb-917c-4497-b56a-b3f4eadb8111
SKU : VpnGw2AZ
Gateway type : VPN
VPN type : Route-based
Virtual network : orap-vnet
Public IP address : 57.152.7.193 (orap-vnet-gw-pip1)
Tags (edit) : database : oracle product_line : Field use - various

Vnet gateway connection status:

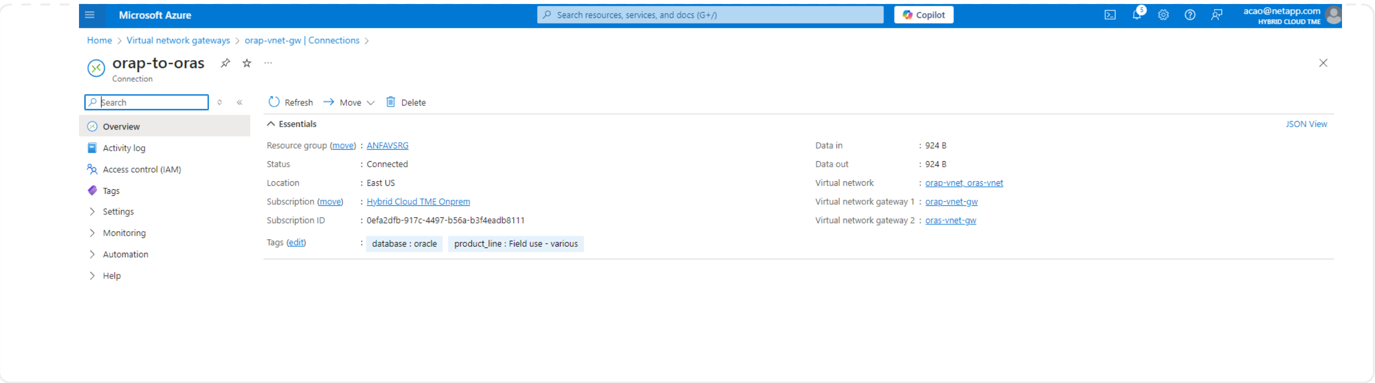


orap-vnet-gw | Connections

Virtual network gateway

Name	Status	Connection type	Peer
orap-to-oras	Connected	VNet-to-VNet	oras-vnet-gw
oras-to-orap	Connected	VNet-to-VNet	oras-vnet-gw

Validate that the traffic flows are established (click on three dots to open the page):



Resource group (move) : ANFAVSRG
Status : Connected
Location : East US
Subscription (move) : Hybrid Cloud TME Onprem
Subscription ID : 0efa2dfb-917c-4497-b56a-b3f4eadb8111
Tags (edit) : database : oracle product_line : Field use - various

Data in : 924 B
Data out : 924 B
Virtual network : orap-vnet, oras-vnet
Virtual network gateway 1 : orap-vnet-gw
Virtual network gateway 2 : oras-vnet-gw

Prepare the primary database for Data Guard

In this demonstration, we have setup a primary Oracle database called NTAP on the primary Azure DB server with three NFS mount points: /u01 for the Oracle binary, /u02 for the Oracle data files, and an Oracle control file, /u03 for the Oracle active logs, archived log files, and a redundant Oracle control file. Following illustrates the detailed procedures for setting up primary database for the Oracle Data Guard protection. All steps should be executed as the Oracle database owner or the default `oracle` user.

1. The primary database NTAP on the primary Azure DB server orap.internal.cloudapp.net is initially deployed as a standalone database with the ANF as database storage.

```
orap.internal.cloudapp.net:
resource group: ANFAVSRG
Location: East US
size: Standard B4ms (4 vcpus, 16 GiB memory)
OS: Linux (redhat 8.6)
pub_ip: 172.190.207.231
pri_ip: 10.0.0.4

[oracle@orap ~]$ df -h
Filesystem                  Size  Used Avail Use% Mounted on
devtmpfs                    7.7G  4.0K  7.7G   1% /dev
tmpfs                       7.8G     0  7.8G   0% /dev/shm
tmpfs                       7.8G  209M  7.5G   3% /run
tmpfs                       7.8G     0  7.8G   0% /sys/fs/cgroup
/dev/mapper/rootvg-rootlv    22G  413M   22G   2% /
/dev/mapper/rootvg-usrlv     10G  2.1G  8.0G  21% /usr
/dev/sda1                   496M  181M  315M  37% /boot
/dev/mapper/rootvg-homelv  2.0G   47M  2.0G   3% /home
/dev/sda15                  495M  5.8M  489M   2% /boot/efi
/dev/mapper/rootvg-varlv   8.0G  1.1G  7.0G  13% /var
/dev/mapper/rootvg-tmplv    12G  120M   12G   1% /tmp
/dev/sdb1                    32G   49M   30G   1% /mnt
10.0.2.36:/orap-u02         500G  7.7G  493G   2% /u02
10.0.2.36:/orap-u03         450G  6.1G  444G   2% /u03
10.0.2.36:/orap-u01         100G  9.9G   91G  10% /u01

[oracle@orap ~]$ 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.
#
#
NTAP:/u01/app/oracle/product/19.0.0/NTAP:N
```

2. Login to primary DB server as the oracle user. Login to database via sqlplus, enable forced logging on primary.

```
alter database force logging;
```

```
[oracle@orap admin]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Tue Nov 26 20:12:02
2024
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> alter database force logging;

Database altered.
```

3. From sqlplus, enable flashback on the primary DB. Flashback allows easy reinstate primary database as a standby after a failover.

```
alter database flashback on;
```

```
SQL> alter database flashback on;

Database altered.
```

4. Configure redo transport authentication using Oracle password file - create a pwd file on the primary using orapwd utility if it is not set and copy it over to standby database $ORACLE_HOME/dbs directory.
5. Create standby redo logs on the primary DB with same size as current online log file. Log groups are one more than online log file groups. The primary database then can quickly transition to the standby role when a failover happens and begins to receive redo data. Repeat the following command four times to create four standby log files.

```
alter database add standby logfile thread 1 size 200M;
```

```
SQL> alter database add standby logfile thread 1 size 200M;

Database altered.

SQL> /

Database altered.

SQL> /

Database altered.

SQL> /

Database altered.


SQL> set lin 200
SQL> col member for a80
SQL> select group#, type, member from v$logfile;

    GROUP# TYPE    MEMBER
---------- -------
--------------------------------------------------------------------
------------
         3 ONLINE  /u03/orareco/NTAP/onlinelog/redo03.log
         2 ONLINE  /u03/orareco/NTAP/onlinelog/redo02.log
         1 ONLINE  /u03/orareco/NTAP/onlinelog/redo01.log
         4 STANDBY
/u03/orareco/NTAP/onlinelog/o1_mf_4__2m115vkv_.log
         5 STANDBY
/u03/orareco/NTAP/onlinelog/o1_mf_5__2m3c5cyd_.log
         6 STANDBY
/u03/orareco/NTAP/onlinelog/o1_mf_6__2m4d7dhh_.log
         7 STANDBY
/u03/orareco/NTAP/onlinelog/o1_mf_7__2m5ct7g1_.log
```

6. From the sqlplus, create a pfile from spfile for editing.

```
create pfile='/home/oracle/initNTAP.ora' from spfile;
```

7. Revise the pfile and add following parameters.

```
vi /home/oracle/initNTAP.ora
```

```
Update the following parameters if not set:

DB_NAME=NTAP
DB_UNIQUE_NAME=NTAP_NY
LOG_ARCHIVE_CONFIG='DG_CONFIG=(NTAP_NY,NTAP_LA)'
LOG_ARCHIVE_DEST_1='LOCATION=USE_DB_RECOVERY_FILE_DEST
VALID_FOR=(ALL_LOGFILES,ALL_ROLES) DB_UNIQUE_NAME=NTAP_NY'
LOG_ARCHIVE_DEST_2='SERVICE=NTAP_LA ASYNC
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE) DB_UNIQUE_NAME=NTAP_LA'
REMOTE_LOGIN_PASSWORDFILE=EXCLUSIVE
FAL_SERVER=NTAP_LA
STANDBY_FILE_MANAGEMENT=AUTO
```

8. From sqlplus, recreate spfile from revised pfile to overwrite the existing spfile in $ORACLE_HOME/dbs directory.

```
create spfile='$ORACLE_HOME/dbs/spfileNTAP.ora' from
pfile='/home/oracle/initNTAP.ora';
```

9. Modify Oracle tnsnames.ora in $ORACLE_HOME/network/admin directory to add db_unique_name for name resolution.

```
vi $ORACLE_HOME/network/admin/tnsnames.ora
```

```
# tnsnames.ora Network Configuration File:
/u01/app/oracle/product/19.0.0/NTAP/network/admin/tnsnames.ora
# Generated by Oracle configuration tools.

NTAP_NY =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST =
orap.internal.cloudapp.net)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SID = NTAP)
    )
  )

NTAP_LA =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST =
oras.internal.cloudapp.net)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SID = NTAP)
    )
  )

LISTENER_NTAP =
  (ADDRESS = (PROTOCOL = TCP)(HOST =
orap.internal.cloudapp.net)(PORT = 1521))
```

If you choose to name your Azure DB server differently than the default, add the names to local host file for host name resolution.

10. Add data guard service name NTAP_NY_DGMGRL.internal.cloudapp.net for the primary database to listener.ora file.

```
vi $ORACLE_HOME/network/admin/listener.ora
```

```
# listener.ora Network Configuration File:
/u01/app/oracle/product/19.0.0/NTAP/network/admin/listener.ora
# Generated by Oracle configuration tools.

LISTENER.NTAP =
  (DESCRIPTION_LIST =
    (DESCRIPTION =
      (ADDRESS = (PROTOCOL = TCP)(HOST =
orap.internal.cloudapp.net)(PORT = 1521))
      (ADDRESS = (PROTOCOL = IPC)(KEY = EXTPROC1521))
    )
  )

SID_LIST_LISTENER.NTAP =
  (SID_LIST =
    (SID_DESC =
      (GLOBAL_DBNAME = NTAP_NY_DGMGRL.internal.cloudapp.net)
      (ORACLE_HOME = /u01/app/oracle/product/19.0.0/NTAP)
      (SID_NAME = NTAP)
    )
  )
```

11. Shutdown and restart database via sqlplus and validate that data guard parameters are now active.

```
shutdown immediate;
```

```
startup;
```

```
SQL> show parameter name

NAME                                 TYPE        VALUE
------------------------------------ -----------
------------------------------
cdb_cluster_name                     string
cell_offloadgroup_name               string
db_file_name_convert                 string
db_name                              string      NTAP
db_unique_name                       string      NTAP_NY
global_names                         boolean     FALSE
instance_name                        string      NTAP
lock_name_space                      string
log_file_name_convert                string
```

```
pdb_file_name_convert                string
processor_group_name                 string

NAME                                 TYPE        VALUE
------------------------------------ -----------
------------------------------
service_names                        string
NTAP_NY.internal.cloudapp.net
SQL> sho parameter log_archive_dest

NAME                                 TYPE        VALUE
------------------------------------ -----------
------------------------------
log_archive_dest                     string
log_archive_dest_1                   string
LOCATION=USE_DB_RECOVERY_FILE_
                                                 DEST
VALID_FOR=(ALL_LOGFILES,A
                                                 LL_ROLES)
DB_UNIQUE_NAME=NTAP_
                                                 NY
log_archive_dest_10                  string
log_archive_dest_11                  string
log_archive_dest_12                  string
log_archive_dest_13                  string
log_archive_dest_14                  string
log_archive_dest_15                  string

NAME                                 TYPE        VALUE
------------------------------------ -----------
------------------------------
log_archive_dest_16                  string
log_archive_dest_17                  string
log_archive_dest_18                  string
log_archive_dest_19                  string
log_archive_dest_2                   string      SERVICE=NTAP_LA
ASYNC VALID_FO

R=(ONLINE_LOGFILES,PRIMARY_ROL
                                                 E)
DB_UNIQUE_NAME=NTAP_LA
log_archive_dest_20                  string
log_archive_dest_21                  string
.
.
```

This completes the primary database setup for Data Guard.

Prepare standby database and activate Data Guard

Oracle Data Guard requires OS kernel configuration and Oracle software stacks including patch sets on standby DB server to match with primary DB server. For easy management and simplicity, the database storage configuration of the standby DB server ideally should match with the primary DB server as well, such as the database directory layout and sizes of NFS mount points. Following are detail procedures for setting up the standby Oracle DB server and activating the Oracle DataGuard for HA/DR protection. All commands should be executed as the default Oracle owner user id `oracle`.

1. First, review the configuration of the primary database on primary Oracle DB server. In this demonstration, we have setup a primary Oracle database called NTAP in the primary DB server with three NFS mounts on ANF storage.
2. If you follow the NetApp documemntation TR-4987 to setup the Oracle standby DB server TR-4987: Simplified, Automated Oracle Deployment on Azure NetApp Files with NFS, use a tag `-t software_only_install` in step 2 of `Playbook execution` to run automated Oracle installation. The revised command syntax is listed below. The tag will allow the Oracle software stack installed and configured but stop short of creating a database.

   ```
   ansible-playbook -i hosts 4-oracle_config.yml -u azureuser -e
   @vars/vars.yml -t software_only_install
   ```

3. The standby Oracle DB server configuration at standby site in the demo lab.

```
oras.internal.cloudapp.net:
resource group: ANFAVSRG
Location: West US 2
size: Standard B4ms (4 vcpus, 16 GiB memory)
OS: Linux (redhat 8.6)
pub_ip: 172.179.119.75
pri_ip: 10.0.1.4

[oracle@oras ~]$ 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  265M  7.5G   4% /run
tmpfs                       7.8G     0  7.8G   0% /sys/fs/cgroup
/dev/mapper/rootvg-rootlv    22G  413M   22G   2% /
/dev/mapper/rootvg-usrlv     10G  2.1G  8.0G  21% /usr
/dev/sda1                   496M  181M  315M  37% /boot
/dev/mapper/rootvg-varlv    8.0G  985M  7.1G  13% /var
/dev/mapper/rootvg-homelv   2.0G   52M  2.0G   3% /home
/dev/mapper/rootvg-tmplv     12G  120M   12G   1% /tmp
/dev/sda15                  495M  5.8M  489M   2% /boot/efi
/dev/sdb1                    32G   49M   30G   1% /mnt
10.0.3.36:/oras-u01         100G  9.5G   91G  10% /u01
10.0.3.36:/oras-u02         500G  8.1G  492G   2% /u02
10.0.3.36:/oras-u03         450G  4.8G  446G   2% /u03
```

4. Once Oracle software is installed and configured, set oracle home and path. Also, from the standby $ORACLE_HOME dbs directory, copy oracle password from primary database if you have not done so.

```
export ORACLE_HOME=/u01/app/oracle/product/19.0.0/NTAP
```

```
export PATH=$PATH:$ORACLE_HOME/bin
```

```
scp oracle@10.0.0.4:$ORACLE_HOME/dbs/orapwNTAP .
```

5. Update tnsnames.ora file with following entries.

```
vi $ORACLE_HOME/network/admin/tnsnames.ora
```

```
# tnsnames.ora Network Configuration File:
/u01/app/oracle/product/19.0.0/NTAP/network/admin/tnsnames.ora
# Generated by Oracle configuration tools.

NTAP_NY =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST =
orap.internal.cloudapp.net)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SID = NTAP)
    )
  )

NTAP_LA =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST =
oras.internal.cloudapp.net)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SID = NTAP)
    )
  )
```

6. Add DB data guard service name to listener.ora file.

```
vi $ORACLE_HOME/network/admin/listener.ora
```

```
# listener.ora Network Configuration File:
/u01/app/oracle/product/19.0.0/NTAP/network/admin/listener.ora
# Generated by Oracle configuration tools.

LISTENER.NTAP =
  (DESCRIPTION_LIST =
    (DESCRIPTION =
      (ADDRESS = (PROTOCOL = TCP)(HOST =
oras.internal.cloudapp.net)(PORT = 1521))
      (ADDRESS = (PROTOCOL = IPC)(KEY = EXTPROC1521))
    )
  )

SID_LIST_LISTENER =
  (SID_LIST =
    (SID_DESC =
      (SID_NAME = NTAP)
    )
  )

SID_LIST_LISTENER.NTAP =
  (SID_LIST =
    (SID_DESC =
      (GLOBAL_DBNAME = NTAP_LA_DGMGRL.internal.cloudapp.net)
      (ORACLE_HOME = /u01/app/oracle/product/19.0.0/NTAP)
      (SID_NAME = NTAP)
    )
  )

LISTENER =
  (ADDRESS_LIST =
    (ADDRESS = (PROTOCOL = TCP)(HOST =
oras.internal.cloudapp.net)(PORT = 1521))
  )
```

7. Launch dbca to instantiate the standby database from the primary database NTAP.

```
dbca -silent -createDuplicateDB -gdbName NTAP
-primaryDBConnectionString
orap.internal.cloudapp.net:1521/NTAP_NY.internal.cloudapp.net -sid
NTAP -initParams fal_server=NTAP_NY -createAsStandby -dbUniqueName
NTAP_LA
```

```
[oracle@oras admin]$ dbca -silent -createDuplicateDB -gdbName NTAP
-primaryDBConnectionString
orap.internal.cloudapp.net:1521/NTAP_NY.internal.cloudapp.net -sid
NTAP -initParams fal_server=NTAP_NY -createAsStandby -dbUniqueName
NTAP_LA
Enter SYS user password:

Prepare for db operation
22% complete
Listener config step
44% complete
Auxiliary instance creation
67% complete
RMAN duplicate
89% complete
Post duplicate database operations
100% complete

Look at the log file
"/u01/app/oracle/cfgtoollogs/dbca/NTAP_LA/NTAP_LA.log" for further
details.
```

8. Validate the duplicated standby database. Newly duplicated standby database open in READ ONLY mode initially.

```
[oracle@oras 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 $ORACLE_SID are not allowed.
#
#
NTAP:/u01/app/oracle/product/19.0.0/NTAP:N
[oracle@oras admin]$ export ORACLE_SID=NTAP
[oracle@oras admin]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Tue Nov 26 23:04:07
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 from v$database;

NAME      OPEN_MODE
--------- --------------------
NTAP      READ ONLY

SQL> show parameter name

NAME                                 TYPE        VALUE
------------------------------------ -----------
------------------------------
cdb_cluster_name                     string
cell_offloadgroup_name               string
db_file_name_convert                 string
db_name                              string      NTAP
db_unique_name                       string      NTAP_LA
global_names                         boolean     FALSE
instance_name                        string      NTAP
lock_name_space                      string
log_file_name_convert                string
pdb_file_name_convert                string
processor_group_name                 string

NAME                                 TYPE        VALUE
```

```
------------------------------------ -----------
------------------------------
service_names                        string
NTAP_LA.internal.cloudapp.net
SQL> show parameter log_archive_config

NAME                                 TYPE        VALUE
------------------------------------ -----------
------------------------------
log_archive_config                   string
DG_CONFIG=(NTAP_NY,NTAP_LA)
SQL> show parameter fal_server

NAME                                 TYPE        VALUE
------------------------------------ -----------
------------------------------
fal_server                           string      NTAP_NY
SQL> select name from v$datafile;

NAME
--------------------------------------------------------------------
------------
/u02/oradata/NTAP/system01.dbf
/u02/oradata/NTAP/sysaux01.dbf
/u02/oradata/NTAP/undotbs01.dbf
/u02/oradata/NTAP/pdbseed/system01.dbf
/u02/oradata/NTAP/pdbseed/sysaux01.dbf
/u02/oradata/NTAP/users01.dbf
/u02/oradata/NTAP/pdbseed/undotbs01.dbf
/u02/oradata/NTAP/NTAP_pdb1/system01.dbf
/u02/oradata/NTAP/NTAP_pdb1/sysaux01.dbf
/u02/oradata/NTAP/NTAP_pdb1/undotbs01.dbf
/u02/oradata/NTAP/NTAP_pdb1/users01.dbf

NAME
--------------------------------------------------------------------
------------
/u02/oradata/NTAP/NTAP_pdb2/system01.dbf
/u02/oradata/NTAP/NTAP_pdb2/sysaux01.dbf
/u02/oradata/NTAP/NTAP_pdb2/undotbs01.dbf
/u02/oradata/NTAP/NTAP_pdb2/users01.dbf
/u02/oradata/NTAP/NTAP_pdb3/system01.dbf
/u02/oradata/NTAP/NTAP_pdb3/sysaux01.dbf
/u02/oradata/NTAP/NTAP_pdb3/undotbs01.dbf
/u02/oradata/NTAP/NTAP_pdb3/users01.dbf
```

```
19 rows selected.

SQL> select name from v$controlfile;

NAME
--------------------------------------------------------------------
------------
/u02/oradata/NTAP/control01.ctl
/u03/orareco/NTAP_LA/control02.ctl

SQL> col member form a80
SQL> select group#, type, member from v$logfile order by 2, 1;

    GROUP# TYPE    MEMBER
---------- -------
--------------------------------------------------------------------
------------
         1 ONLINE
/u03/orareco/NTAP_LA/onlinelog/o1_mf_1_mndl6mxh_.log
         2 ONLINE
/u03/orareco/NTAP_LA/onlinelog/o1_mf_2_mndl7jdb_.log
         3 ONLINE
/u03/orareco/NTAP_LA/onlinelog/o1_mf_3_mndl8f03_.log
         4 STANDBY
/u03/orareco/NTAP_LA/onlinelog/o1_mf_4_mndl99m7_.log
         5 STANDBY
/u03/orareco/NTAP_LA/onlinelog/o1_mf_5_mndlb67d_.log
         6 STANDBY
/u03/orareco/NTAP_LA/onlinelog/o1_mf_6_mndlc2tw_.log
         7 STANDBY
/u03/orareco/NTAP_LA/onlinelog/o1_mf_7_mndlczhb_.log

7 rows selected.
```

9. Restart the standby database in `mount` stage and execute following command to activate standby database managed recovery.

```
alter database recover managed standby database disconnect from
session;
```

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

Total System Global Area 6442449688 bytes
Fixed Size                  9177880 bytes
Variable Size            1090519040 bytes
Database Buffers         5335154688 bytes
Redo Buffers                7598080 bytes
Database mounted.
SQL> alter database recover managed standby database disconnect from
session;

Database altered.
```

10. Validate the standby database recovery status. Notice the `recovery logmerger` in `APPLYING_LOG` action.

```
SELECT ROLE, THREAD#, SEQUENCE#, ACTION FROM V$DATAGUARD_PROCESS;
```

```
SQL> SELECT ROLE, THREAD#, SEQUENCE#, ACTION FROM V$DATAGUARD_PROCESS;

ROLE                        THREAD#  SEQUENCE# ACTION
------------------------ ---------- ---------- ------------
post role transition              0          0 IDLE
recovery apply slave              0          0 IDLE
recovery apply slave              0          0 IDLE
recovery apply slave              0          0 IDLE
recovery apply slave              0          0 IDLE
recovery logmerger                1         18 APPLYING_LOG
managed recovery                  0          0 IDLE
RFS async                         1         18 IDLE
RFS ping                          1         18 IDLE
archive redo                      0          0 IDLE
redo transport timer              0          0 IDLE

ROLE                        THREAD#  SEQUENCE# ACTION
------------------------ ---------- ---------- ------------
gap manager                       0          0 IDLE
archive redo                      0          0 IDLE
archive redo                      0          0 IDLE
redo transport monitor            0          0 IDLE
log writer                        0          0 IDLE
archive local                     0          0 IDLE

17 rows selected.

SQL>
```

This completes the Data Guard protection setup for NTAP from primary to standby with managed standby recovery enabled.

Setup Data Guard Broker

Oracle Data Guard broker is a distributed management framework that automates and centralizes the creation, maintenance, and monitoring of Oracle Data Guard configurations. Following section demonstrate how to setup Data Guard Broker to manage Data Guard environment.

1. Start data guard broker on both the primary and the standby databases with following command via sqlplus.

   ```
   alter system set dg_broker_start=true scope=both;
   ```

2. From primary database, connect to Data Guard Borker as SYSDBA.

   ```
   [oracle@orap ~]$ dgmgrl sys@NTAP_NY
   DGMGRL for Linux: Release 19.0.0.0.0 - Production on Wed Dec 11
   20:53:20 2024
   Version 19.18.0.0.0

   Copyright (c) 1982, 2019, Oracle and/or its affiliates.  All rights
   reserved.

   Welcome to DGMGRL, type "help" for information.
   Password:
   Connected to "NTAP_NY"
   Connected as SYSDBA.
   DGMGRL>
   ```

3. Create and enable Data Guard Broker configuration.

```
DGMGRL> create configuration dg_config as primary database is
NTAP_NY connect identifier is NTAP_NY;
Configuration "dg_config" created with primary database "ntap_ny"
DGMGRL> add database NTAP_LA as connect identifier is NTAP_LA;
Database "ntap_la" added
DGMGRL> enable configuration;
Enabled.
DGMGRL> show configuration;

Configuration - dg_config

  Protection Mode: MaxPerformance
  Members:
  ntap_ny - Primary database
    ntap_la - Physical standby database

Fast-Start Failover:  Disabled

Configuration Status:
SUCCESS   (status updated 3 seconds ago)
```

4. Validate the database status within the Data Guard Broker management framework.

```
DGMGRL> show database db1_ny;

Database - db1_ny

  Role:                PRIMARY
  Intended State:      TRANSPORT-ON
  Instance(s):
    db1

Database Status:
SUCCESS

DGMGRL> show database db1_la;

Database - db1_la

  Role:                PHYSICAL STANDBY
  Intended State:      APPLY-ON
  Transport Lag:       0 seconds (computed 1 second ago)
  Apply Lag:           0 seconds (computed 1 second ago)
  Average Apply Rate: 2.00 KByte/s
  Real Time Query:     OFF
  Instance(s):
    db1

Database Status:
SUCCESS

DGMGRL>
```

In the event of a failure, Data Guard Broker can be used to failover the primary database to the standby instantaniouly. If `Fast-Start Failover` is enabled, Data Guard Broker can failover the primary database to the standby when a failure is detected without an user intervention.

Clone standby database for other use cases

The key benefit of hosting the Oracle standby database on the ANF in the Oracle Data Guard setup is that it can be quickly cloned to serve many other use cases with minimal additional storage investment if a thin clone is enabled. NetApp recommends to use SnapCenter UI tool to manage your Oracle DataGuard database. In the following section, we demonstrate how to snapshot and clone the mounted and under recovery standby database volumes on the ANF for other purposes, such as DEV, TEST, REPORT, etc., using the NetApp SnapCenter tool.

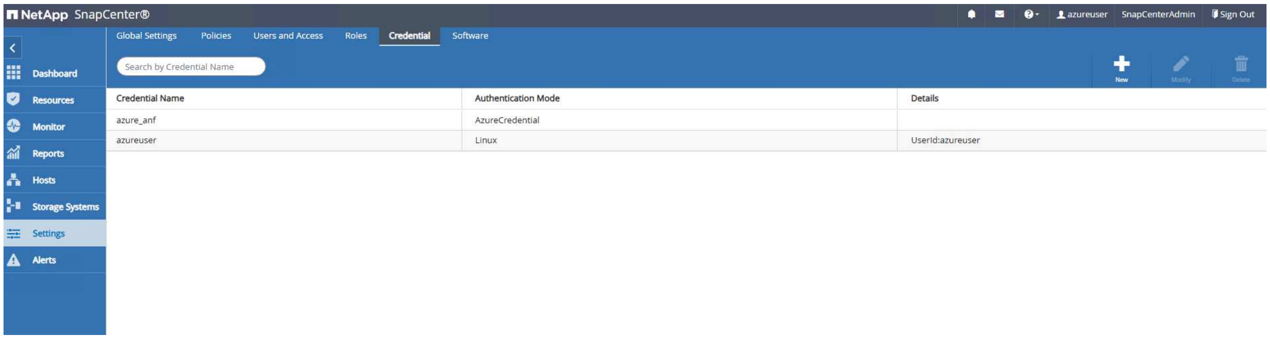
Below are high level procedures to clone a READ/WRITE database from the managed physical standby database in the Oracle Data Guard using SnapCenter. For detail instructions on how to setup and configure SnapCenter for Oracle on ANF, please refer to TR-4988 Oracle Database Backup, Recovery, and Clone on ANF with SnapCenter for details.

1. We begin the usecase validation by creating a test table and inserting a row into the test table at the primary database. We will then validate that the transaction traverses down to standby and finally the clone.

```
[oracle@orap ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Wed Dec 11 16:33:17
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> alter session set container=ntap_pdb1;

Session altered.

SQL> create table test(id integer, dt timestamp, event
varchar(100));

Table created.

SQL> insert into test values(1, sysdate, 'a test transaction at
primary database NTAP on DB server orap.internal.cloudapp.net');

1 row created.

SQL> commit;

Commit complete.
```

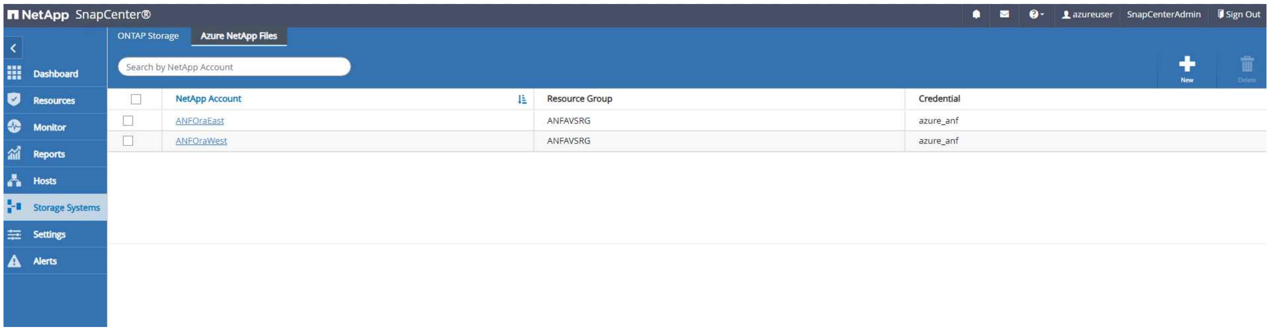
```
SQL> select * from test;

        ID
----------
DT
--------------------------------------------------------------------
-------
EVENT
--------------------------------------------------------------------
------------
         1
11-DEC-24 04.38.44.000000 PM
a test transaction at primary database NTAP on DB server
orap.internal.cloudapp.
net


SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME
----------------
HOST_NAME
----------------------------------------------------------------
NTAP
orap


SQL>
```

2. In SnapCenter configuration, an unix user (azureuser for demo) and an Azure credential (azure_anf for demo) has been added to `Credential` in `Settings`.



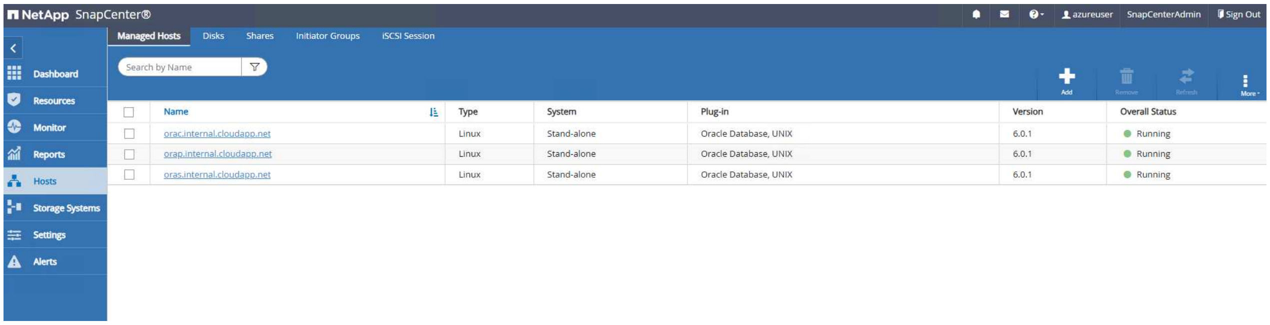
Credential Name	Authentication Mode	Details
azure_anf	AzureCredential	
azureuser	Linux	UserId:azureuser

3. Use azure_anf credential to add the ANF storage to `Storage Systems`. If you have multiple ANF storage accounts in your Azure subsciption, make sure click the drop down list to choose the right storage account. We have created two dedicated Oracle storage accounts for this demonstration.



	NetApp Account	Resource Group	Credential
□	ANFOraEast	ANFAVSRG	azure_anf
□	ANFOraWest	ANFAVSRG	azure_anf

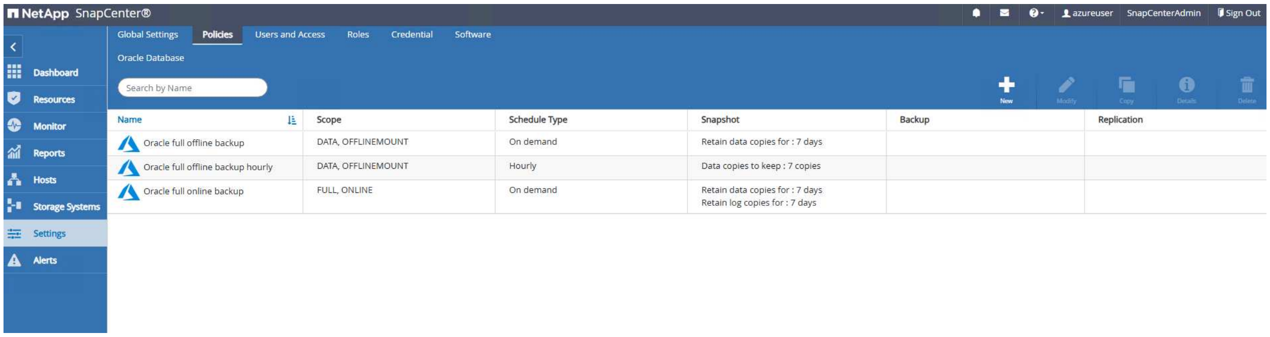
4. All Oracle DB servers have been added to SnapCenter `Hosts`.



	Name	Type	System	Plug-in	Version	Overall Status
□	orac.internal.cloudapp.net	Linux	Stand-alone	Oracle Database, UNIX	6.0.1	● Running
□	orap.internal.cloudapp.net	Linux	Stand-alone	Oracle Database, UNIX	6.0.1	● Running
□	oras.internal.cloudapp.net	Linux	Stand-alone	Oracle Database, UNIX	6.0.1	● Running

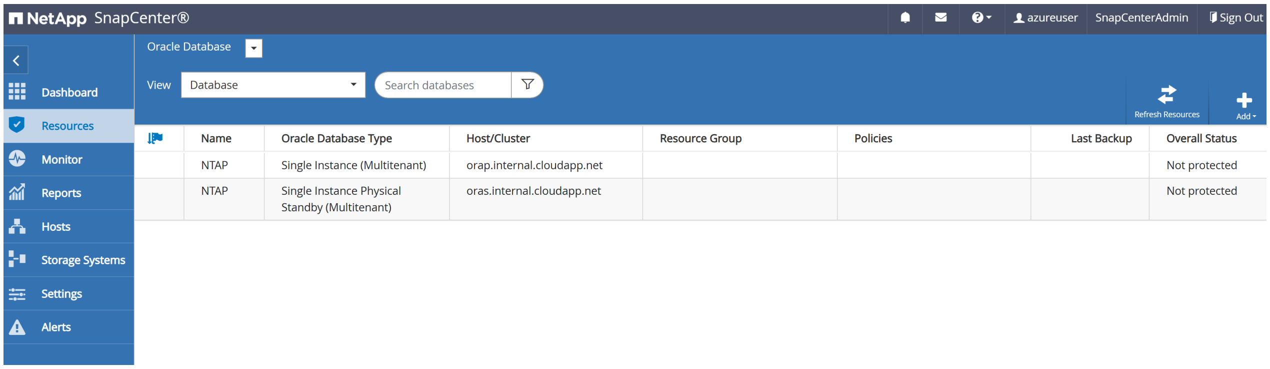
The clone DB server should have identtical Oracle software stacks installed and configured. In our test case, Oracle 19C software is installed and configured but no database created.

5. Create a backup policy that is tailored for offline/mount full database backup.



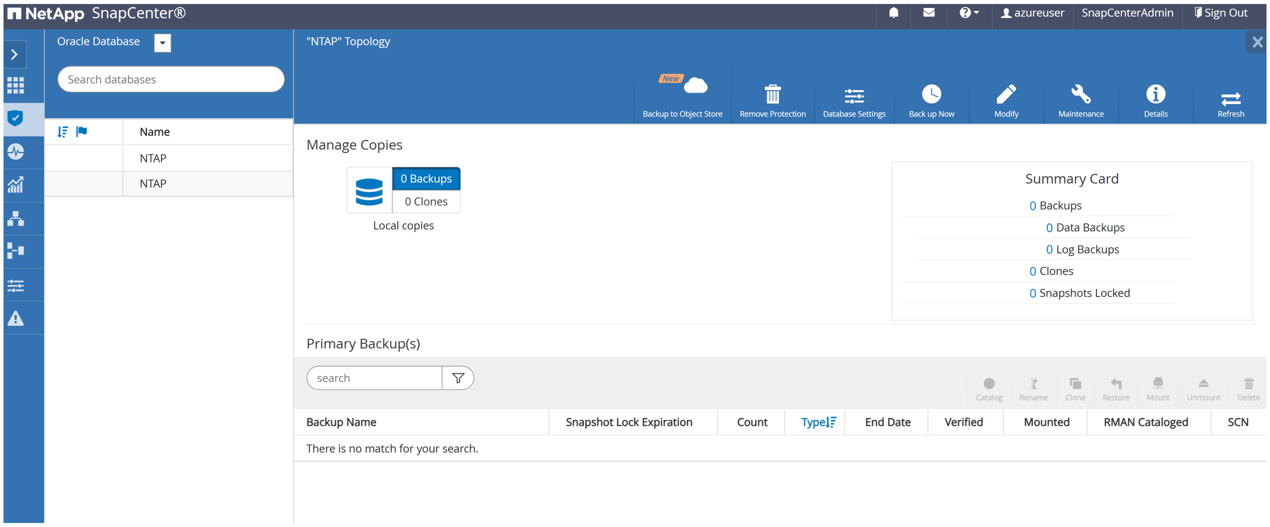
Name	Scope	Schedule Type	Snapshot	Backup	Replication
Oracle full offline backup	DATA, OFFLINEMOUNT	On demand	Retain data copies for : 7 days		
Oracle full offline backup hourly	DATA, OFFLINEMOUNT	Hourly	Data copies to keep : 7 copies		
Oracle full online backup	FULL, ONLINE	On demand	Retain data copies for : 7 days Retain log copies for : 7 days		

6. Apply backup policy to protect standby database in `Resources` tab. When initially discovered, the database status shows as `Not protected`.



	Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status
	NTAP	Single Instance (Multitenant)	orap.internal.cloudapp.net				Not protected
	NTAP	Single Instance Physical Standby (Multitenant)	oras.internal.cloudapp.net				Not protected

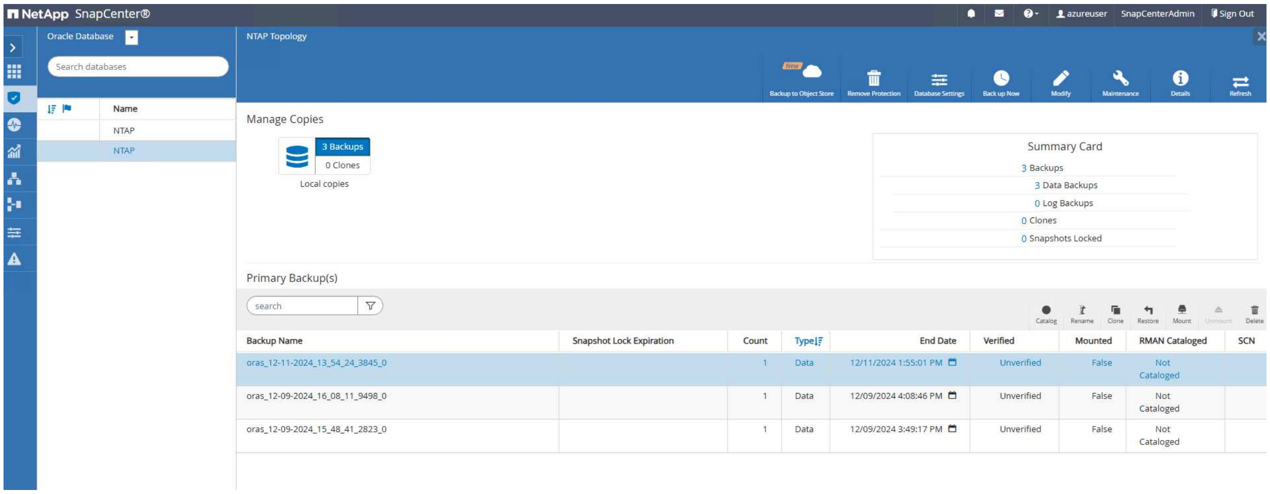
7. You have option to either trigger a backup manually or put it on a schedule at a set time after a backup policy applied.



Backup Name	Snapshot Lock Expiration	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN

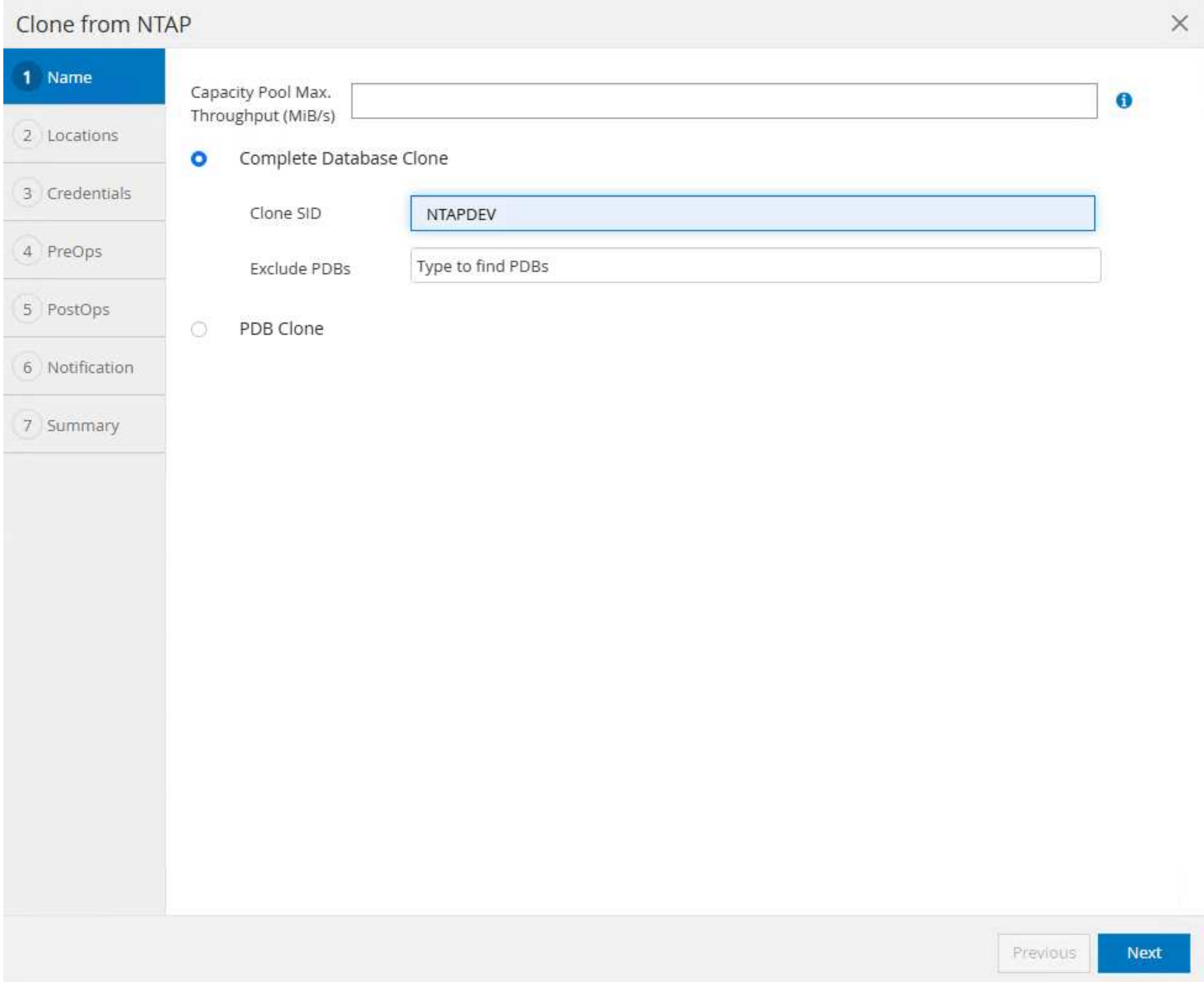
There is no match for your search.

8. After a backup, click on database name to open the database backups page. Select a backup to be used for database clone and click on `Clone` button to launch clone workflow.



Backup Name	Snapshot Lock Expiration	Count	Type	End Date	Verified	Mounted	RMAN Cataloged	SCN
oras_12-11-2024_13_54_24_3845_0		1	Data	12/11/2024 1:55:01 PM	Unverified	False	Not Cataloged	
oras_12-09-2024_16_08_11_9498_0		1	Data	12/09/2024 4:08:46 PM	Unverified	False	Not Cataloged	
oras_12-09-2024_15_48_41_2823_0		1	Data	12/09/2024 3:49:17 PM	Unverified	False	Not Cataloged	

9. Select the `Complete Database Clone` and name the clone instance SID.


Clone from NTAP

Capacity Pool Max. Throughput (MiB/s):

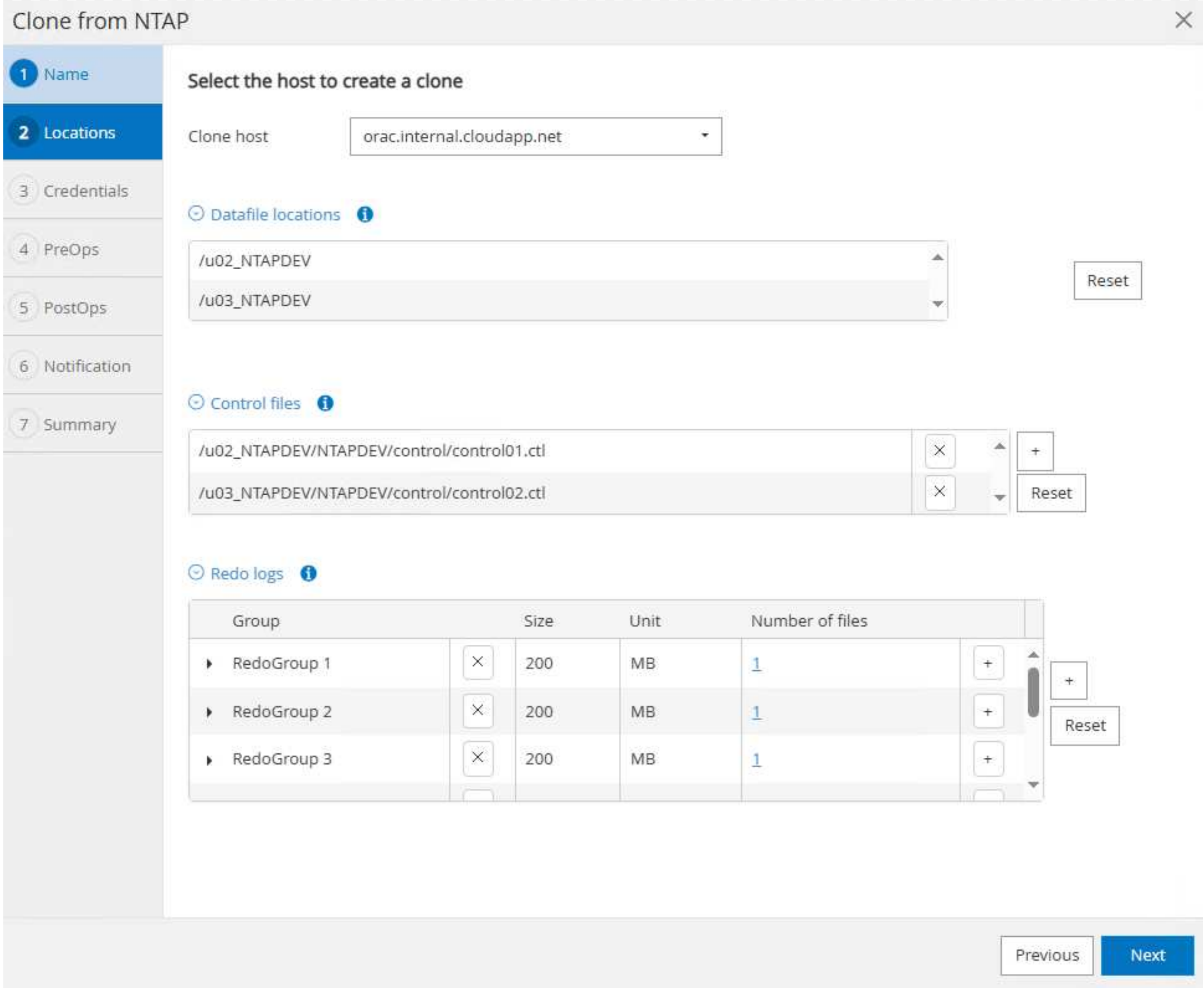
● Complete Database Clone

Clone SID: NTAPDEV

Exclude PDBs: Type to find PDBs

○ PDB Clone

10. Select the clone DB server, which hosts the cloned database from the standby DB. Accept the default for data files, redo logs. Put a controlfile on /u03 mount point.



Select the host to create a clone

Clone host: orac.internal.cloudapp.net

Datafile locations

/u02_NTAPDEV
/u03_NTAPDEV

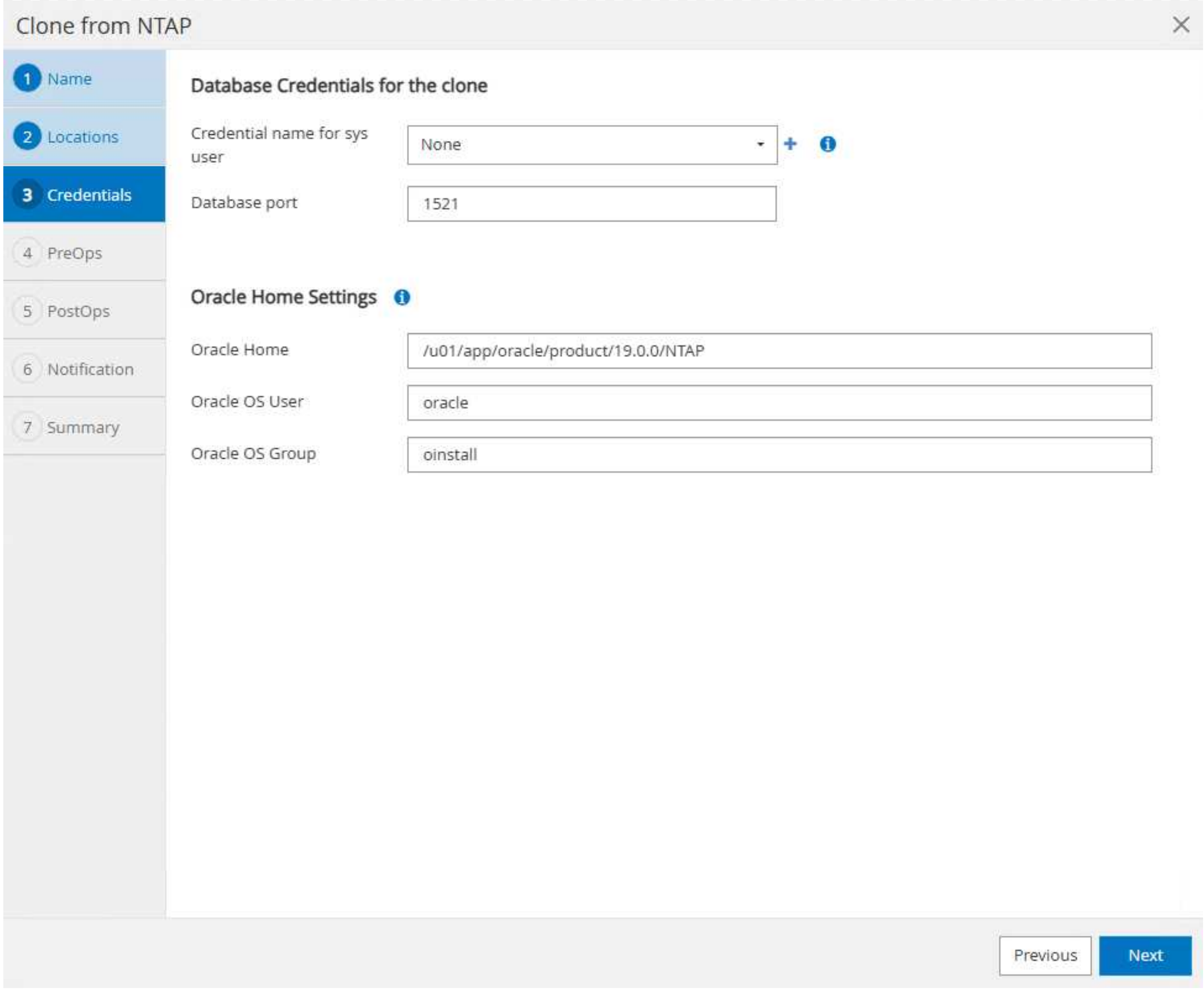
Control files

/u02_NTAPDEV/NTAPDEV/control/control01.ctl
/u03_NTAPDEV/NTAPDEV/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

11. No database credentials are needed for OS based authentication. Match Oracle home setting with what is configured on the clone DB server.



Database Credentials for the clone

Credential name for sys user: None

Database port: 1521

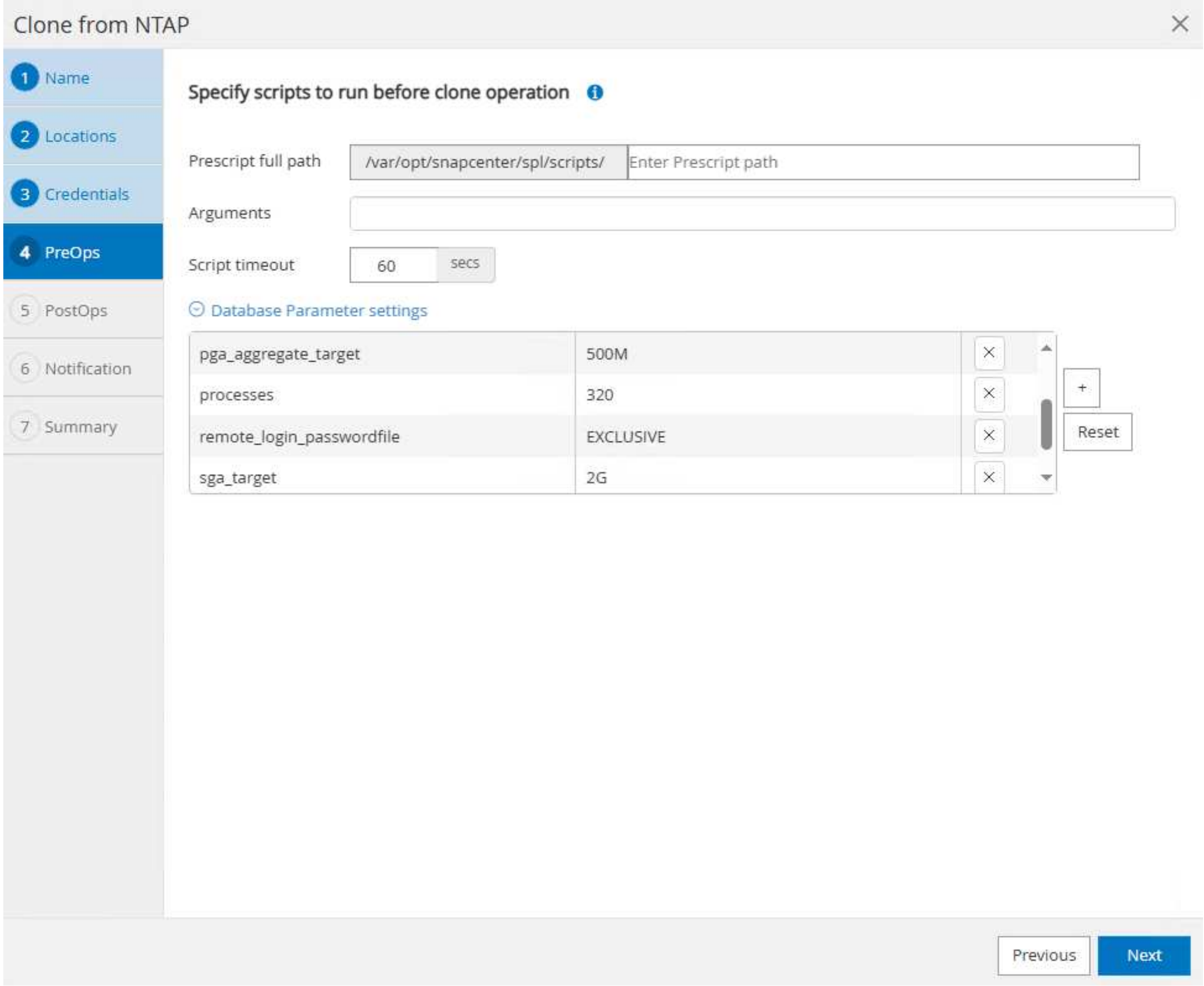
Oracle Home Settings

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

Oracle OS User: oracle

Oracle OS Group: oinstall

12. Change clone database parameters if needed such as lowering PGA or SGA size for a clone DB. Specify scripts to run before the clone if any.



Specify scripts to run before clone operation

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

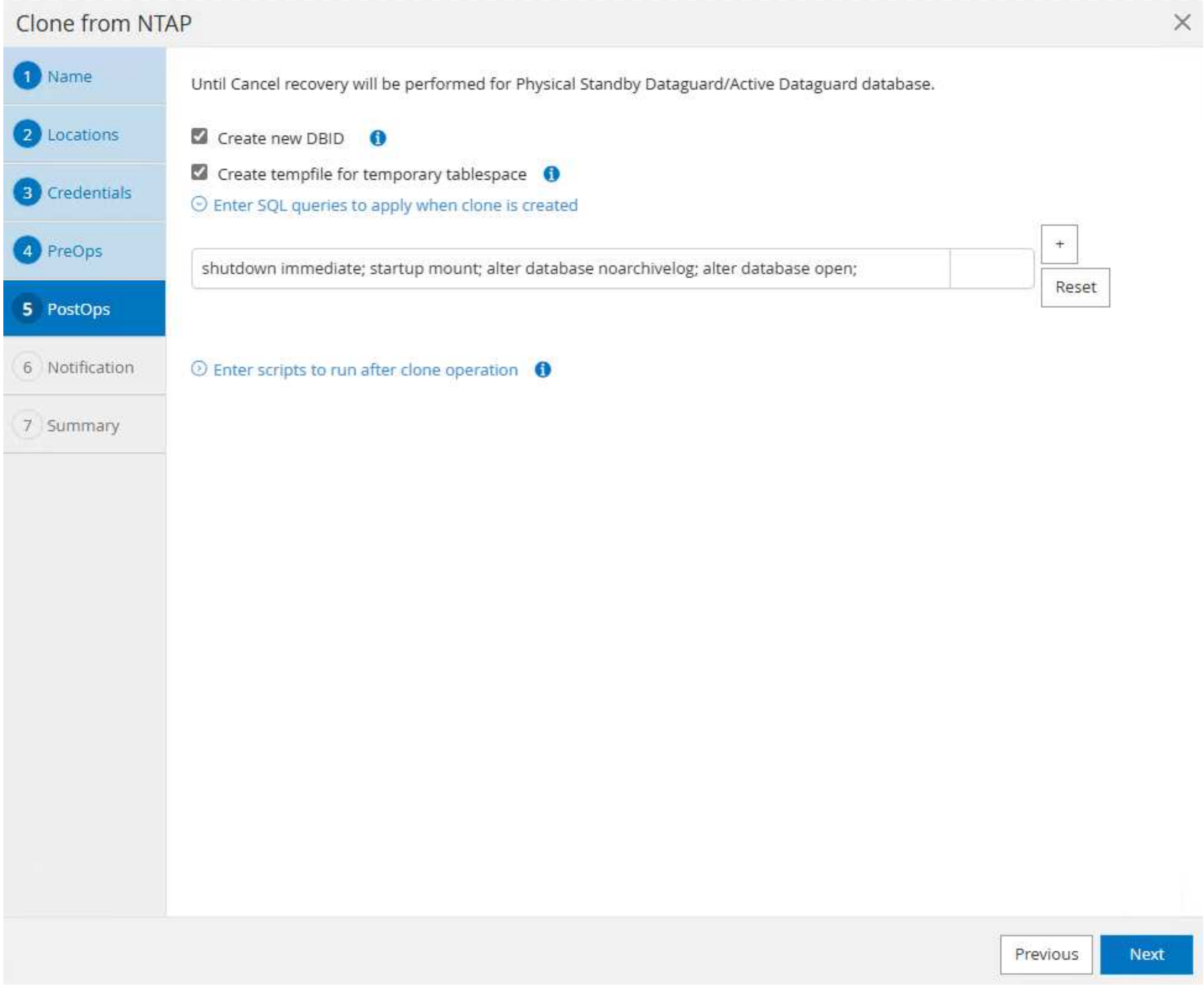
Arguments

Script timeout: 60 secs

Database Parameter settings

pga_aggregate_target	500M
processes	320
remote_login_passwordfile	EXCLUSIVE
sga_target	2G

13. Enter SQL to run after the clone. In the demo, we executed commands to turn off database archive mode for a dev/test/report database.



Until Cancel recovery will be performed for Physical Standby Dataguard/Active Dataguard database.

☑ Create new DBID

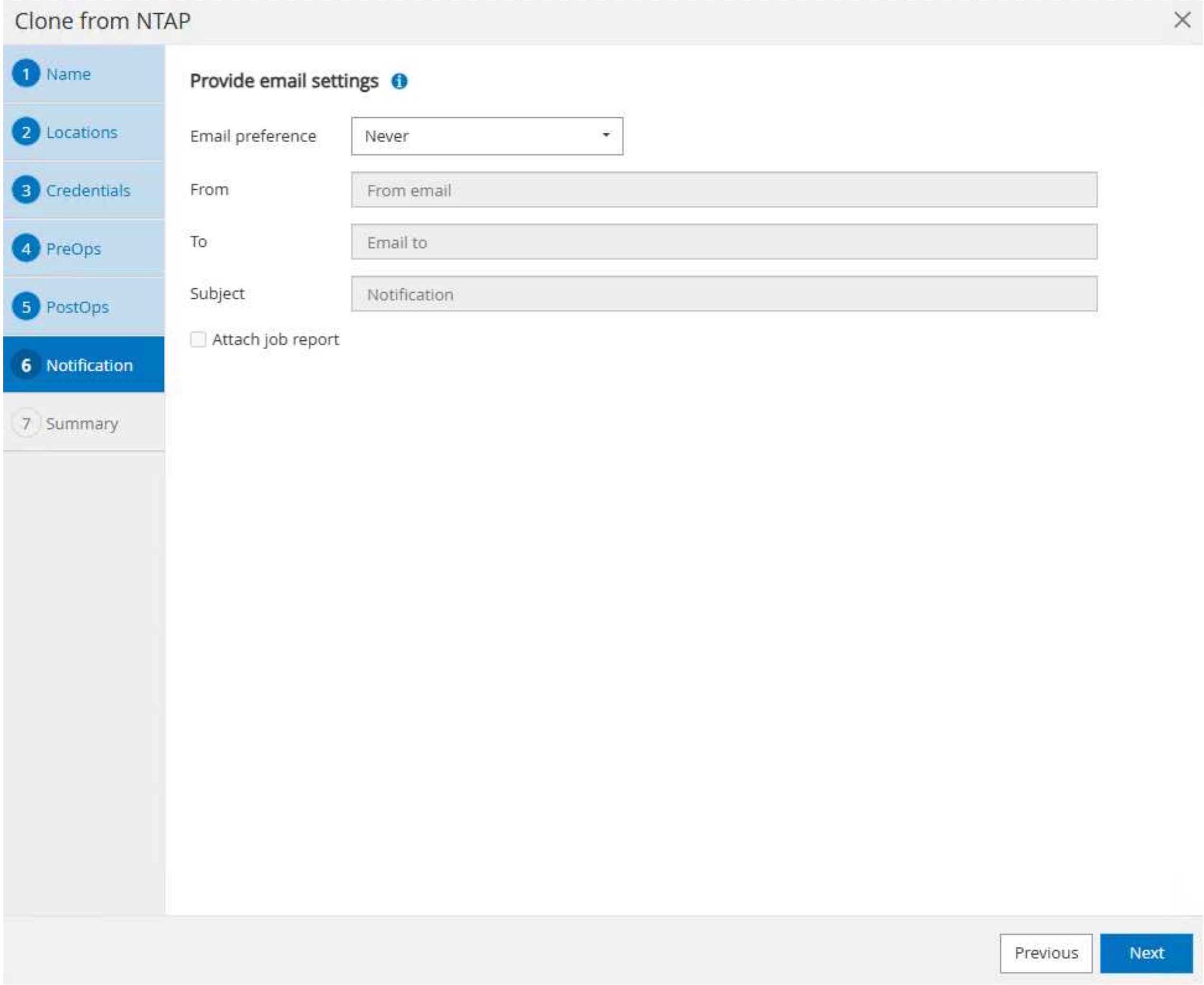
☑ Create tempfile for temporary tablespace

Enter SQL queries to apply when clone is created

```
shutdown immediate; startup mount; alter database noarchivelog; alter database open;
```

Enter scripts to run after clone operation

14. Configure email notification if desired.



Clone from NTAP

Provide email settings

Email preference: Never

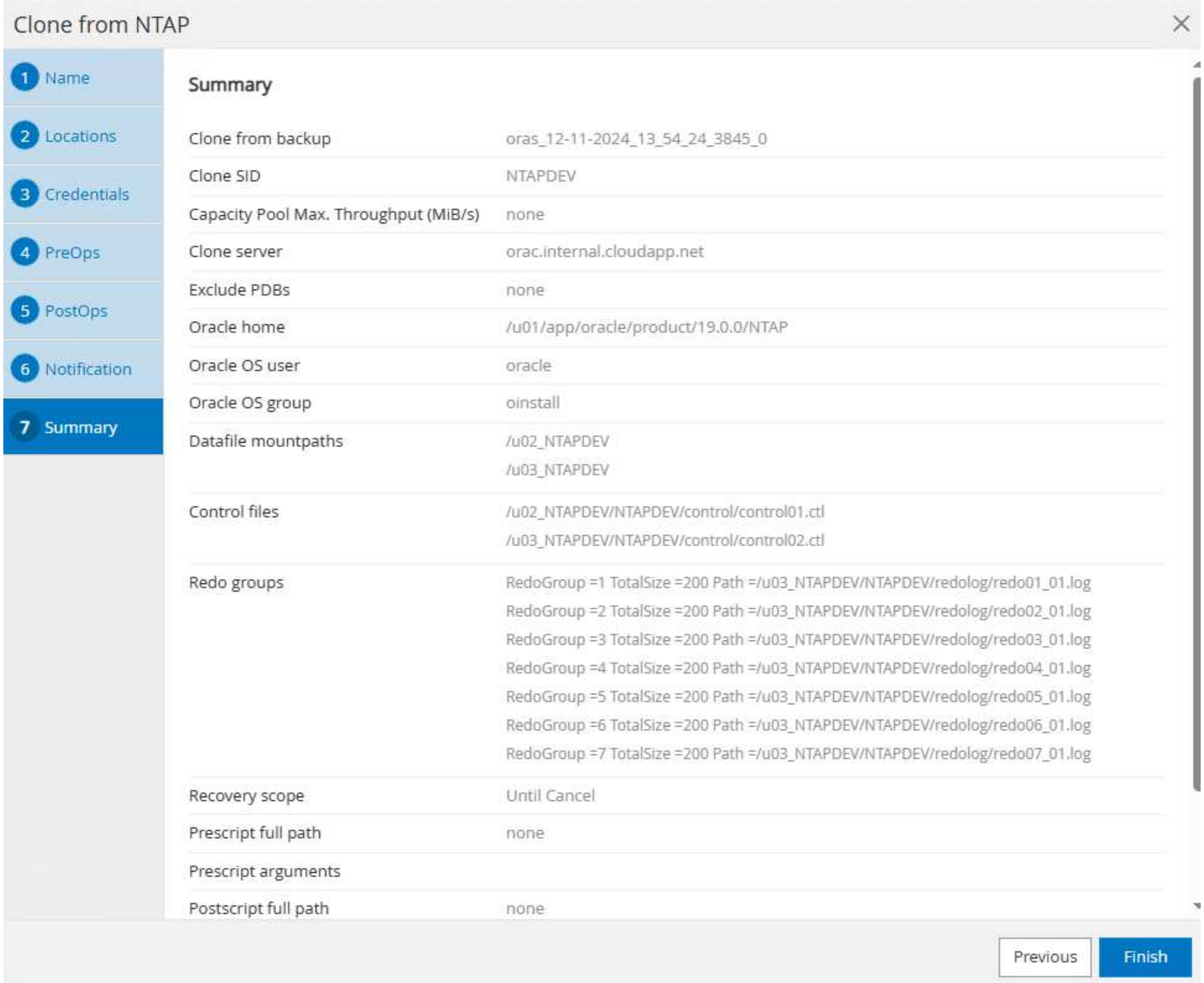
From: From email

To: Email to

Subject: Notification

□ Attach job report

15. Review the summary, click `Finish` to start the clone.



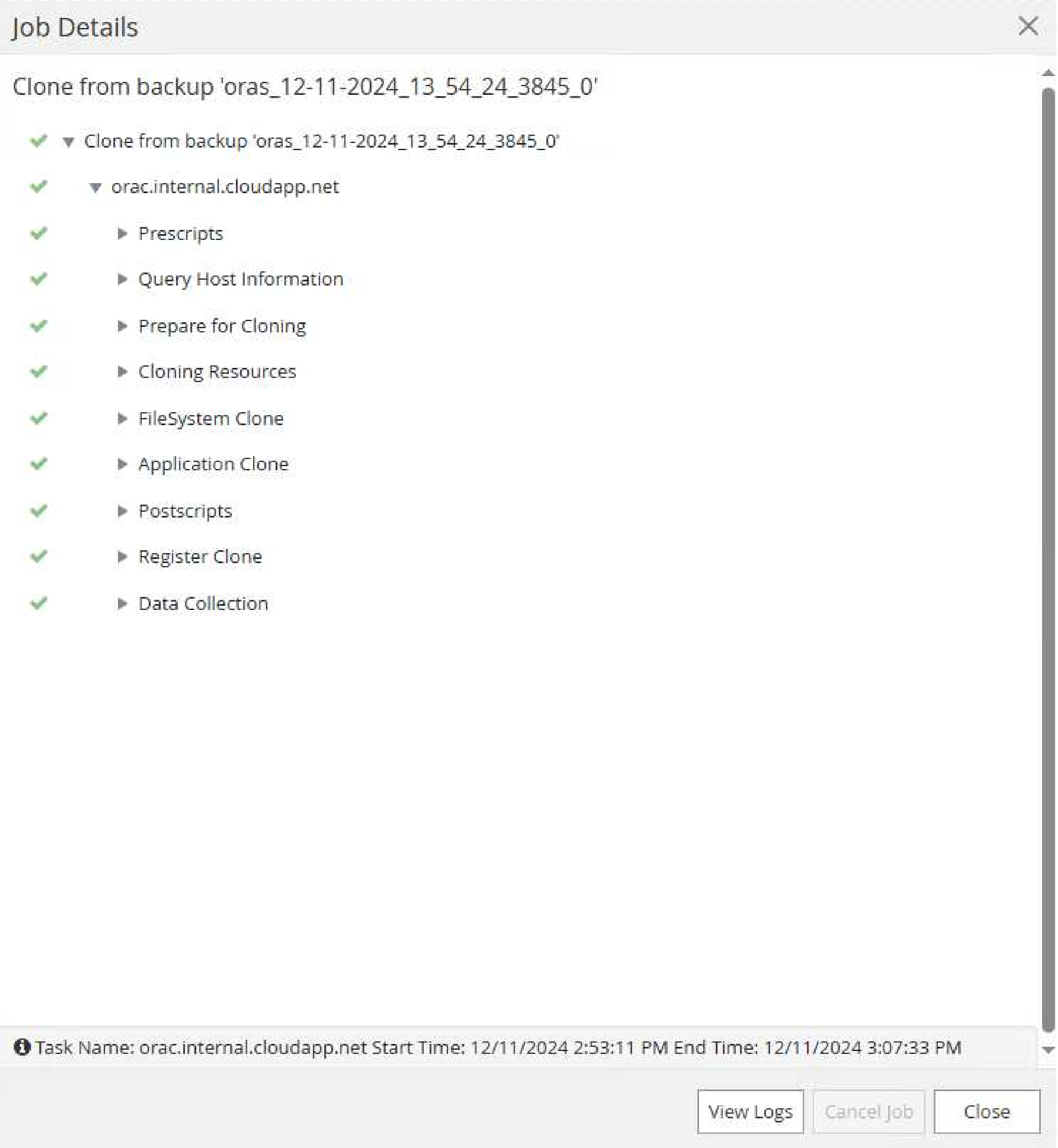
Summary

Clone from backup	oras_12-11-2024_13_54_24_3845_0
Clone SID	NTAPDEV
Capacity Pool Max. Throughput (MiB/s)	none
Clone server	orac.internal.cloudapp.net
Exclude PDBs	none
Oracle home	/u01/app/oracle/product/19.0.0/NTAP
Oracle OS user	oracle
Oracle OS group	oinstall
Datafile mountpaths	/u02_NTAPDEV /u03_NTAPDEV
Control files	/u02_NTAPDEV/NTAPDEV/control/control01.ctl /u03_NTAPDEV/NTAPDEV/control/control02.ctl

Redo groups	RedoGroup =1 TotalSize =200 Path =/u03_NTAPDEV/NTAPDEV/redolog/redo01_01.log
	RedoGroup =2 TotalSize =200 Path =/u03_NTAPDEV/NTAPDEV/redolog/redo02_01.log
	RedoGroup =3 TotalSize =200 Path =/u03_NTAPDEV/NTAPDEV/redolog/redo03_01.log
	RedoGroup =4 TotalSize =200 Path =/u03_NTAPDEV/NTAPDEV/redolog/redo04_01.log
	RedoGroup =5 TotalSize =200 Path =/u03_NTAPDEV/NTAPDEV/redolog/redo05_01.log
	RedoGroup =6 TotalSize =200 Path =/u03_NTAPDEV/NTAPDEV/redolog/redo06_01.log
	RedoGroup =7 TotalSize =200 Path =/u03_NTAPDEV/NTAPDEV/redolog/redo07_01.log

Recovery scope	Until Cancel
Prescript full path	none
Prescript arguments	
Postscript full path	none

16. Monitor the clone job in `Monitor` tab. We observed that it took around 14 minutes to clone a database about 950GB in database volume size.



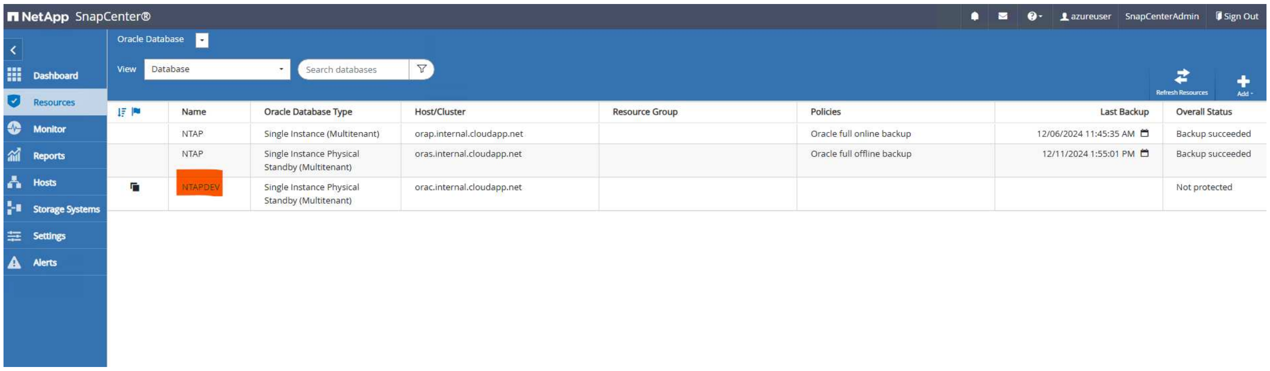
Job Details

Clone from backup 'oras_12-11-2024_13_54_24_3845_0'

- ✓ ▼ Clone from backup 'oras_12-11-2024_13_54_24_3845_0'
  - ✓ ▼ orac.internal.cloudapp.net
    - ✓ ▶ Prescripts
    - ✓ ▶ Query Host Information
    - ✓ ▶ Prepare for Cloning
    - ✓ ▶ Cloning Resources
    - ✓ ▶ FileSystem Clone
    - ✓ ▶ Application Clone
    - ✓ ▶ Postscripts
    - ✓ ▶ Register Clone
    - ✓ ▶ Data Collection

Task Name: orac.internal.cloudapp.net Start Time: 12/11/2024 2:53:11 PM End Time: 12/11/2024 3:07:33 PM

17. Validate the clone database from SnapCenter, which is immediately registered in `Resources` tab right after clone operation.



Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status
NTAP	Single Instance (Multitenant)	orap.internal.cloudapp.net		Oracle full online backup	12/06/2024 11:45:35 AM	Backup succeeded
NTAP	Single Instance Physical Standby (Multitenant)	oras.internal.cloudapp.net		Oracle full offline backup	12/11/2024 1:55:01 PM	Backup succeeded
NTAPDEV	Single Instance Physical Standby (Multitenant)	orac.internal.cloudapp.net				Not protected

18. Query the clone database from clone DB server. We validated that test transaction that occurred in primary database had traversed down to the clone database.

```
[oracle@orac ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Wed Dec 11 20:16:09
2024
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, log_mode from v$database;

NAME      OPEN_MODE            LOG_MODE
--------- -------------------- ------------
NTAPDEV   READ WRITE           NOARCHIVELOG

SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME
----------------
HOST_NAME
----------------------------------------------------------------
NTAPDEV
orac


SQL> alter pluggable database all open;

Pluggable database altered.

SQL> alter pluggable database all save state;

Pluggable database altered.


SQL> alter session set container=ntap_pdb1;

Session altered.
```

```
SQL> select * from test;

        ID
----------
DT
--------------------------------------------------------------------
-------
EVENT
--------------------------------------------------------------------
------------
         1
11-DEC-24 04.38.44.000000 PM
a test transaction at primary database NTAP on DB server
orap.internal.cloudapp.
net
```

This completes the demonstration of the Oracle standby database clone in the Oracle Data Guard on Azure ANF storage for DEV, TEST, REPORT, or any other use cases. Multiple Oracle databases can be cloned off the same standby database in the Oracle Data Guard on ANF.

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

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

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

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

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

- Oracle Data Guard Concepts and Administration

  https://docs.oracle.com/en/database/oracle/oracle-database/19/sbydb/index.html#Oracle%C2%AE-Data-Guard

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