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TR-4990：《使用ANF上的增量合并快速恢复Oracle VLDB》

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本解决方案提供了有关快速恢复在Azure NetApp Files容量池上使用NFS挂载部署到Azure VM计算实例的Oracle VLDB的概述和详细信息、以暂存备用数据库副本、该副本将通过RMAN不断进行增量合并。

目的

使用Oracle Recovery Manager (RMAN)备份工具在Oracle中恢复超大型数据库(VLDB)可能是一项极具挑战性的任务。发生故障时从备份介质还原数据库的过程可能会非常耗时、从而会延迟数据库恢复、并可能显著影响服务协议协议(Service Level Agreement、SLA)。但是、从10g开始、Oracle引入了RMAN功能、允许用户在DB服务器主机上的其他磁盘存储上创建Oracle数据库数据文件的暂存映像副本。这些映像副本可以每天使用RMAN进行增量更新。如果发生故障、数据库管理员(Database Administrator、DBA)可以快速将Oracle数据库从故障介质切换到映像副本、而无需进行完整的数据库介质恢复。结果是SLA得到了大幅改进、尽管成本是所需数据库存储的两倍。

如果您对VLDB的SLA非常感兴趣、并考虑将Oracle数据库迁移到Azure等公共云、则可以使用Microsoft Azure NetApp Files (ANF)等资源设置类似的数据库保护结构、以便暂存备用数据库映像副本。在本文档中、我们将演示如何从ANF容量池配置和导出NFS文件系统、以便挂载到Oracle数据库服务器上、暂存备用数据库副本、以便在主存储发生故障时快速恢复。

此解决方案 可解决以下使用情形：

- Oracle VLDB映像副本通过RMAN在Microsoft ANF容量池存储以外的NFS挂载点上增量合并。
- 在同一Azure数据库服务器VM发生故障时快速恢复Oracle VLDB。
- 在备用Azure数据库服务器VM发生故障时快速恢复Oracle VLDB。

audience

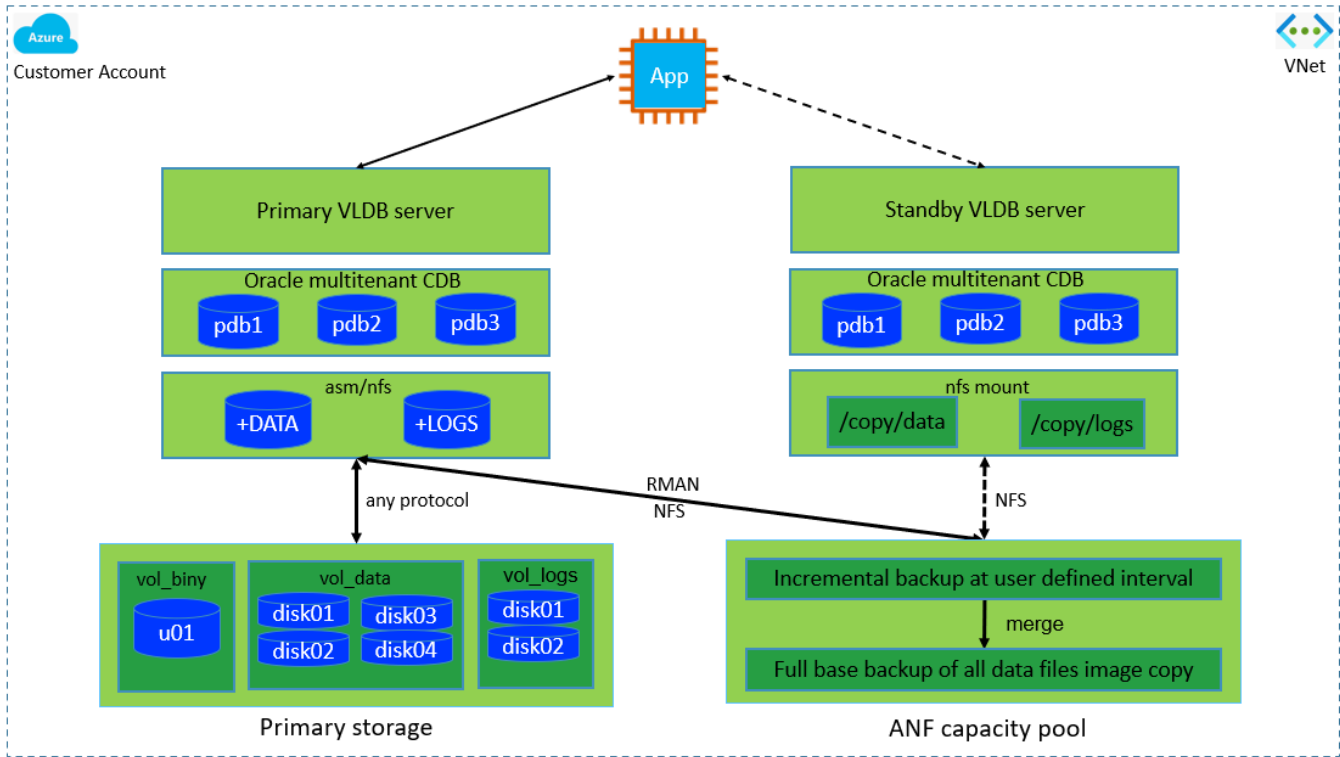
此解决方案 适用于以下人员：

- 在Azure中通过RMAN设置Oracle VLDB映像副本增量合并以加快数据库恢复的数据库提供商。
- 在Azure公共云中测试Oracle工作负载的数据库解决方案架构师。
- 负责管理部署到ANF容量池存储的Oracle数据库的存储管理员。
- 希望在Azure云环境中设置Oracle数据库的应用程序所有者。

解决方案 测试和验证环境

此解决方案的测试和验证是在Microsoft ANF容量池存储和Azure VM计算环境中执行的、这些环境可能与最终部署环境不匹配。有关详细信息，请参见一节 [\[部署注意事项的关键因素\]](#)。

Oracle VLDB Incremental Merge via RMAN on ANF



硬件和软件组件

* 硬件 *		
ANF存储	Microsoft提供的当前版本	具有高级服务级别的2 TiB ANF容量池存储
适用于数据库服务器的Azure VM	standard_B4ms—4个vCPU、16 GiB	2个VM、一个用作主数据库服务器、另一个用作备用
软件		
RedHat Linux	RHEL Linux 8.6 (LVM)- x64 Gen2	已部署RedHat订阅以进行测试
Oracle 数据库	版本19.18	已应用RU修补程序p34765931_190000_Linux-x86-64.zip
Oracle OPatch	版本12.2.0.1.36	最新修补程序p6880880_190000_Linux-x86-64.zip
NFS	版本 3.0	已启用Oracle DNFS

部署注意事项的关键因素

- *用于RMAN增量合并的Oracle VLDB存储布局。*在我们的测试和验证中、用于Oracle增量备份和合并的NFS卷是从一个ANF容量池中分配的、该容量池每个卷具有100 TiB的容量限制、总容量限制为1000 TiB。

对于超过阈值的部署、可以将多个卷和ANF容量池与多个NFS挂载点并行连接、以提供更高的容量。

- 使用**RMAN**增量合并的**Oracle**可恢复性。RMAN增量备份和合并通常根据RTO和RPO目标以用户定义的频率执行。如果主数据存储和/或归档日志完全丢失、则可能会发生数据丢失。Oracle数据库可以恢复到ANF数据库备份映像副本提供的最后一次增量备份。为了最大限度地减少数据丢失、可以在ANF NFS挂载点上设置Oracle闪存恢复区域、并将归档日志与数据库映像副本一起备份到ANF NFS挂载。
- *在ANF NFS文件系统之外运行Oracle VLDB。*与用于数据库备份的其他批量存储不同、Microsoft ANF是支持云的生产级存储、可提供高级别的性能和存储效率。Oracle VLDB从主存储切换到ANF NFS文件系统上的映像副本后、可以在解决主存储故障的同时保持较高的数据库性能。您可以放心地知道、主存储故障不会影响用户应用程序体验。
- * Azure计算实例。*在这些测试和验证中、我们使用Standard"标准B4ms Azure VM作为Oracle数据库服务器。还有其他Azure VM可能已经过优化、更适合数据库工作负载。此外、您还需要根据实际工作负载要求、根据vCPU数量和RAM量相应地调整Azure VM的大小。
- * ANF容量池服务级别。* ANF容量池提供三种服务级别：标准、高级、超级。默认情况下、自动QoS会对容量池中创建的卷执行适用场景操作、从而限制卷上的吞吐量。可以根据容量池大小和服务级别手动调整卷上的吞吐量。
- **DNFS**配置。DNFS内置在Oracle内核中、众所周知、在将Oracle部署到NFS存储时、它可以显著提高Oracle数据库性能。DNFS打包到Oracle二进制文件中、但默认情况下不启用。对于NFS上的任何Oracle数据库部署、都应启用此功能。对于VLDB的多个ANF容量池部署、应正确配置指向不同ANF容量池存储的DNFS多路径。

解决方案 部署

我们假定您已将Oracle VLDB部署在VNet中的Azure云环境中。如果您需要有关在Azure中部署Oracle的帮助、请参阅以下技术报告以获取帮助。

- ["使用NFS在Azure NetApp Files上简化、自动化的Oracle部署"](#)
- ["Azure NetApp Files 上的Oracle数据库部署和保护"](#)

Oracle VLDB可以运行在ANF存储上、也可以运行在Azure云生态系统中的任何其他可选存储上。下一节介绍了为Oracle VLDB的映像副本设置RMAN增量合并的分步部署过程、该副本暂存在ANF存储的NFS挂载中。

部署的前提条件

部署需要满足以下前提条件。

1. 已设置Azure帐户、并且已在Azure帐户中创建必要的Azure vNet和网段。
2. 从Azure门户控制台中、您必须部署两个Azure VM实例、一个用作主Oracle数据库服务器、另一个用作可选备用数据库服务器。有关环境设置的详细信息、请参见上一节中的架构图。另请查看 ["Azure虚拟机系列"](#) 有关详细信息 ...
3. 从Azure门户控制台中、部署ANF存储以托管用于存储Oracle数据库备用映像副本的NFS卷。如果您不熟悉ANF的部署、请参见文档 ["快速入门：设置 Azure NetApp Files 并创建 NFS 卷"](#) 了解分步说明。



确保您已在Azure VM根卷中至少分配128 G、以便有足够的空间来暂存Oracle安装文件。

配置和导出要挂载到**Oracle**主**VLDB**服务器上的**NFS**卷

在本节中、我们将介绍通过Azure门户控制台从ANF容量池配置NFS卷。如果设置了多个ANF容量池来容纳数据库的大小、请对其他ANF容量池重复上述过程。

1. 首先、从Azure门户控制台导航到用于暂存Oracle VLDB映像副本的ANF容量池。

The screenshot shows the Azure portal interface for the 'database (ANFAVSAcct/database)' capacity pool. The left sidebar contains the navigation menu with 'Capacity pools' selected. The main content area displays the 'database' pool with a table listing pools: 'database' (2 TiB) and 'nimcp' (2 TiB). Below the table, a donut chart shows '63.5% 1.27 TiB ALLOCATED'.


2. 从选定容量池- database`下、单击 `Volumes 然后、Add volume 以启动添加卷工作流。

The screenshot shows the Azure portal interface for the 'database (ANFAVSAcct/database)' Volumes page. The left sidebar contains the navigation menu with 'Volumes' selected. The main content area displays a table of volumes with columns: Name, Quota, Max. Throughput, Protocol type, Mount path, and Service level. The table lists several volumes, including 'ora-01-u01', 'ora-01-u02', 'ora-01-u03', 'ora-02-u01', 'ora-02-u02', and 'ora-02-u03'.








3. 填写 Volume name, Quota, Virtual network, 和 Delegated subnet 移动到 Protocol 页面。

Create a volume ...

Basics Protocol Tags Review + create

This page will help you create an Azure NetApp Files volume in your subscription and enable you to access the volume from within your virtual network. [Learn more about Azure NetApp Files](#) 

Volume details

Volume name *	<input type="text" value="ora-01-u02-copy"/> 
Available quota (GiB) ⓘ	<input type="text" value="748"/> 748 GiB
Quota (GiB) * ⓘ	<input type="text" value="500"/>  500 GiB
Available throughput (MiB/s) ⓘ	<input type="text" value="46.75"/>
Max. Throughput (MiB/s) ⓘ	<input type="text" value="31.25"/>
Enable Cool Access ⓘ	<input type="checkbox"/>
Coolness Period ⓘ	<input type="text" value="31"/>
Cool Access Retrieval Policy ⓘ	<input type="text" value="Default"/> 
Virtual network * ⓘ	<input type="text" value="ANFAVSVal (172.30.136.64/26,172.30.137.128/25,172.30.152.0/27)"/>  Create new virtual network
Delegated subnet * ⓘ	<input type="text" value="ANF_Sub (172.30.136.64/26)"/>  Create new subnet
Network features ⓘ	<input type="radio"/> Basic <input checked="" type="radio"/> Standard
Availability Zone ⓘ	<input type="text" value="None"/> 
Encryption key source ⓘ	<input type="text"/> 
Show advanced section	<input type="checkbox"/>

Review + create

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4. 记下文件路径、输入允许的客户端CIDR范围、然后启用 Root Access 卷。

Create a volume ...

Basics Protocol Tags Review + create

Configure access to your volume.

Access

Protocol type ☒ NFS ☐ SMB ☐ Dual-protocol

Configuration

File path * ⓘ

Versions * ▼

Kerberos ☐ Enabled ☒ Disabled

LDAP ☐ Enabled ☒ Disabled

Unix Permissions ⓘ

Azure VMware Solution DataStore ⓘ ☐

Export policy

Configure the volume's export policy. This can be edited later. [Learn more](#) ⓘ

↑ Move up ↓ Move down ↗ Move to top ↘ Move to bottom 🗑 Delete

<input type="checkbox"/> Index	Allowed clients	Access	Root Access	Chown Mode
<input type="checkbox"/> 1	<input type="text" value="172.30.137.128/25,1"/> ✓	<input type="text" value="Read & Write"/> ▼	<input type="text" value="On"/> ▼	<input type="text" value="Restricted"/>
	<input type="text"/>	<input type="text"/> ▼	<input type="text"/> ▼	

Review + create

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5. 根据需要添加卷标记。

Create a volume ...

Basics Protocol Tags Review + create

Tags are name/value pairs that enable you to categorize resources and view consolidated billing by applying the same tag to multiple resources and resource groups. [Learn more about tags](#) 

Note that if you create tags and then change resource settings on other tabs, your tags will be automatically updated.

Name ⓘ		Value ⓘ	
<input type="text" value="database"/>	:	<input type="text" value="oracle"/>	
<input type="text"/>	:	<input type="text"/>	

[Review + create](#)

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6. 查看并创建卷。

Create a volume ...

✓ Validation passed

Basics Protocol Tags Review + create

Basics

Subscription	Hybrid Cloud TME Onprem
Resource group	ANFAVSRG
Region	South Central US
Volume name	ora-01-u02-copy
Capacity pool	database
Service level	Premium
Quota	500 GiB
Encryption key source	None
Availability Zone	None

Networking

Virtual network	ANFAVSVnet (172.30.136.64/26,172.30.137.128/25,172.30.152.0/27)
Delegated subnet	ANF_Sub (172.30.136.64/26)
Network features	Standard

Protocol

Protocol	NFSv3
File path	ora-01-u02-copy
Unix Permissions	0770

Tags

database	oracle
----------	--------

Create

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[Download a template for automation](#)

7. 以具有sudo权限的用户身份登录到主Oracle VLDB服务器、然后挂载从ANF存储导出的NFS卷。根据需
要更改ANF NFS服务器IP地址和文件路径。可以从ANF卷控制台页面检索ANF NFS服务器IP地址。

```
sudo mkdir /nfsanf
```

```
sudo mount 172.30.136.68:/ora-01-u02-copy /nfsanf -o  
rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=262144,wsiz=262144,noin  
tr
```

8. 将挂载点所有权更改为oracle: oinstall、根据需要更改为Oracle用户名和主组。

```
sudo chown oracle:oinstall /nfsanf
```

将**Oracle RMAN**增量合并设置为**ANF**上的映像副本

RMAN增量合并会在每个增量备份/合并间隔持续更新暂存数据库数据文件映像副本。数据库备份的映像副本将与您执行增量备份/合并的频率相同。因此、在确定RMAN增量备份和合并的频率时、应考虑数据库性能、RTO和RPO目标。

1. 以Oracle用户身份登录到主Oracle VLDB服务器。
2. 在挂载点/nfsanf下创建oracopy目录、用于存储Oracle闪存恢复区域的Oracle数据文件映像副本和归档日志目录。

```
mkdir /nfsanf/oracopy
```

```
mkdir /nfsanf/archlog
```

3. 通过sqlplus登录到Oracle数据库、启用块更改跟踪以加快增量备份、如果Oracle闪存恢复区域当前位于主存储上、则将其更改为ANF NFS挂载。这样可以将RMAN默认控制文件/spfile自动备份和归档日志备份到ANF NFS挂载以进行恢复。

```
sqlplus / as sysdba
```

从sqlplus提示符处、执行以下命令。

```
alter database enable block change tracking using file  
'/nfsanf/oracopy/bct_ntap1.ctf'
```

```
alter system set db_recovery_file_dest='/nfsanf/archlog/'  
scope=both;
```

预期输出：

```
[oracle@ora-01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Wed Mar 20 16:44:21
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 database enable block change tracking using file
'/nfsanf/oracopy/bct_ntap1.ctf';

Database altered.

SQL> alter system set db_recovery_file_dest='/nfsanf/archlog/'
scope=both;

System altered.

SQL>
```

4. 创建RMAN备份和增量合并脚本。该脚本会为并行RMAN备份和合并分配多个通道。首次执行将生成初始完整基线映像副本。在完整运行中、它会首先清除保留窗口之外的过时备份、以保持暂存区域干净。然后、它会在合并和备份之前切换当前日志文件。增量备份会在合并后进行、以便数据库映像副本会在当前数据库状态后经过一个备份/合并周期。可以反转合并和备份顺序、以便根据用户的偏好加快恢复速度。RMAN脚本可以集成到一个简单的shell脚本中、以便从主数据库服务器上的crontab执行。确保在RMAN设置中打开控制文件自动备份。

```
vi /home/oracle/rman_bkup_merge.cmd
```

Add following lines:

RUN

```
{
    allocate channel c1 device type disk format '/nfsanf/oracopy/%U';
    allocate channel c2 device type disk format '/nfsanf/oracopy/%U';
    allocate channel c3 device type disk format '/nfsanf/oracopy/%U';
    allocate channel c4 device type disk format '/nfsanf/oracopy/%U';
    delete obsolete;
    sql 'alter system archive log current';
    recover copy of database with tag 'OraCopyBKUPonANF_level_0';
    backup incremental level 1 copies=1 for recover of copy with tag
'OraCopyBKUPonANF_level_0' database;
}
```

5. 在主Oracle VLDB服务器上、以Oracle用户身份本地登录到RMAN、无论是否具有RMAN目录。在此演示中、我们不会连接到RMAN目录。

```
rman target / nocatalog;
```

output:

```
[oracle@ora-01 ~]$ rman target / nocatalog
```

```
Recovery Manager: Release 19.0.0.0.0 - Production on Wed Mar 20
16:54:24 2024
Version 19.18.0.0.0
```

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

```
connected to target database: NTAP1 (DBID=2441823937)
using target database control file instead of recovery catalog
```

6. 从RMAN提示符处、执行该脚本。首次执行时创建基线数据库映像副本、后续执行时合并并增量更新基线映像副本。下面介绍了如何执行该脚本以及典型输出。设置通道数、使其与主机上的CPU核匹配。

```
RMAN> @/home/oracle/rman_bkup_merge.cmd
```

```
RMAN> RUN
```

```
2> {
```

```
3>     allocate channel c1 device type disk format
```

```

'/nfsanf/oracopy/%U';
4> allocate channel c2 device type disk format
'/nfsanf/oracopy/%U';
5> allocate channel c3 device type disk format
'/nfsanf/oracopy/%U';
6> allocate channel c4 device type disk format
'/nfsanf/oracopy/%U';
7> delete obsolete;
8> sql 'alter system archive log current';
9> recover copy of database with tag 'OraCopyBKUPonANF_level_0';
10> backup incremental level 1 copies=1 for recover of copy with
tag 'OraCopyBKUPonANF_level_0' database;
11> }
allocated channel: c1
channel c1: SID=142 device type=DISK

allocated channel: c2
channel c2: SID=277 device type=DISK

allocated channel: c3
channel c3: SID=414 device type=DISK

allocated channel: c4
channel c4: SID=28 device type=DISK

RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 1
Deleting the following obsolete backups and copies:

```

Type	Key	Completion Time	Filename/Handle
Backup Set	1	18-MAR-24	
Backup Piece	1	18-MAR-24	/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163958359__04h19dgr_.bkp
Backup Set	2	18-MAR-24	
Backup Piece	2	18-MAR-24	/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163961675__0711m21g_.bkp
Backup Set	3	18-MAR-24	
Backup Piece	3	18-MAR-24	/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163962888__08p6y71x_.bkp
Backup Set	4	18-MAR-24	
Backup Piece	4	18-MAR-24	/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163963796__09k8g1m4_.bkp

Backup Set	5	18-MAR-24
Backup Piece	5	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163964697__0bd3tqg3_.bkp		
Backup Set	6	18-MAR-24
Backup Piece	6	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163965895__0chx6mzt_.bkp		
Backup Set	7	18-MAR-24
Backup Piece	7	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163966806__0dbyx344_.bkp		
Backup Set	8	18-MAR-24
Backup Piece	8	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163968012__0fgvg805_.bkp		
Backup Set	9	18-MAR-24
Backup Piece	9	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163968919__0g9x5t1v_.bkp		
Backup Set	10	18-MAR-24
Backup Piece	10	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163969821__0h4rfdzj_.bkp		
Backup Set	11	18-MAR-24
Backup Piece	11	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163971026__0j8o4wk8_.bkp		
Backup Set	12	18-MAR-24
Backup Piece	12	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163971931__0k3pnn2o_.bkp		
Backup Set	13	18-MAR-24
Backup Piece	13	18-MAR-24
/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163972835__0kyg92t1_.bkp		
deleted backup piece		
backup piece		
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163963796__09k8g1m4_.bkp RECID=4 STAMP=1163963804		
deleted backup piece		
backup piece		
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163962888__08p6y7lx_.bkp RECID=3 STAMP=1163962897		
deleted backup piece		
backup piece		

handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163961675__
0711m2lg_.bkp RECID=2 STAMP=1163961683
deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163958359__
04h19dgr_.bkp RECID=1 STAMP=1163958361
deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163964697__
0bd3tqg3_.bkp RECID=5 STAMP=1163964705
deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163965895__
0chx6mzt_.bkp RECID=6 STAMP=1163965906
deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163966806__
0dbyx344_.bkp RECID=7 STAMP=1163966814
deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163968012__
0fgvg805_.bkp RECID=8 STAMP=1163968018
deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163968919__
0g9x5t1v_.bkp RECID=9 STAMP=1163968926
deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163969821__
0h4rfdzj_.bkp RECID=10 STAMP=1163969827
Deleted 3 objects

deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163971026__
0j8o4wk8_.bkp RECID=11 STAMP=1163971032
Deleted 3 objects

deleted backup piece
backup piece
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163971931__
0k3pnn2o_.bkp RECID=12 STAMP=1163971938
Deleted 3 objects

deleted backup piece
backup piece

```
handle=/u03/orareco/NTAP1/autobackup/2024_03_18/o1_mf_s_1163972835__
0kyg92t1_.bkp RECID=13 STAMP=1163972837
Deleted 4 objects

sql statement: alter system archive log current

Starting recover at 20-MAR-24
no copy of datafile 1 found to recover
no copy of datafile 3 found to recover
no copy of datafile 4 found to recover
.
.
no copy of datafile 31 found to recover
no copy of datafile 32 found to recover
Finished recover at 20-MAR-24

Starting backup at 20-MAR-24
no parent backup or copy of datafile 1 found
no parent backup or copy of datafile 3 found
no parent backup or copy of datafile 4 found
.
.
no parent backup or copy of datafile 19 found
no parent backup or copy of datafile 20 found
channel c1: starting datafile copy
input datafile file number=00021
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_01.dbf
channel c2: starting datafile copy
input datafile file number=00022
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_02.dbf
channel c3: starting datafile copy
input datafile file number=00023
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_03.dbf
channel c4: starting datafile copy
input datafile file number=00024
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_04.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-22_0g2m6brl tag=ORACOPYBKUPONANF_LEVEL_0 RECID=4
STAMP=1164132108
channel c2: datafile copy complete, elapsed time: 01:06:39
channel c2: starting datafile copy
input datafile file number=00025
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_05.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-24_0i2m6brl tag=ORACOPYBKUPONANF_LEVEL_0 RECID=5
```

```

STAMP=1164132121
channel c4: datafile copy complete, elapsed time: 01:06:45
channel c4: starting datafile copy
input datafile file number=00026
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_06.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-23_0h2m6brl tag=ORACOPYBKUPONANF_LEVEL_0 RECID=6
STAMP=1164132198
channel c3: datafile copy complete, elapsed time: 01:08:05
channel c3: starting datafile copy
input datafile file number=00027
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_07.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-21_0f2m6brl tag=ORACOPYBKUPONANF_LEVEL_0 RECID=7
STAMP=1164132248
channel c1: datafile copy complete, elapsed time: 01:08:57
channel c1: starting datafile copy
input datafile file number=00028
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_08.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-25_0j2m6fol tag=ORACOPYBKUPONANF_LEVEL_0 RECID=9
STAMP=1164136123
channel c2: datafile copy complete, elapsed time: 01:06:46
channel c2: starting datafile copy
input datafile file number=00029
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_09.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-26_0k2m6fot tag=ORACOPYBKUPONANF_LEVEL_0 RECID=8
STAMP=1164136113
channel c4: datafile copy complete, elapsed time: 01:06:36
channel c4: starting datafile copy
input datafile file number=00030
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_10.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-27_0l2m6frc tag=ORACOPYBKUPONANF_LEVEL_0 RECID=10
STAMP=1164136293
channel c3: datafile copy complete, elapsed time: 01:08:10
channel c3: starting datafile copy
input datafile file number=00031
name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_11.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-28_0m2m6fsu tag=ORACOPYBKUPONANF_LEVEL_0 RECID=11
STAMP=1164136333
channel c1: datafile copy complete, elapsed time: 01:07:52
channel c1: starting datafile copy
input datafile file number=00032

```

```

name=/u02/oradata/NTAP1/NTAP1_pdb1/soe_12.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-29_0n2m6jlr tag=ORACOPYBKUPONANF_LEVEL_0 RECID=12
STAMP=1164140082
channel c2: datafile copy complete, elapsed time: 01:06:01
channel c2: starting datafile copy
input datafile file number=00001
name=/u02/oradata/NTAP1/system01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-30_0o2m6jlr tag=ORACOPYBKUPONANF_LEVEL_0 RECID=13
STAMP=1164140190
channel c4: datafile copy complete, elapsed time: 01:07:49
channel c4: starting datafile copy
input datafile file number=00003
name=/u02/oradata/NTAP1/sysaux01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSTEM_FNO-1_0r2m6nhk tag=ORACOPYBKUPONANF_LEVEL_0 RECID=14
STAMP=1164140240
channel c2: datafile copy complete, elapsed time: 00:02:38
channel c2: starting datafile copy
input datafile file number=00004
name=/u02/oradata/NTAP1/undotbs01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
UNDOTBS1_FNO-4_0t2m6nml tag=ORACOPYBKUPONANF_LEVEL_0 RECID=15
STAMP=1164140372
channel c2: datafile copy complete, elapsed time: 00:02:15
channel c2: starting datafile copy
input datafile file number=00011
name=/u02/oradata/NTAP1/NTAP1_pdb1/undotbs01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSAux_FNO-3_0s2m6nl1 tag=ORACOPYBKUPONANF_LEVEL_0 RECID=16
STAMP=1164140377
channel c4: datafile copy complete, elapsed time: 00:03:01
channel c4: starting datafile copy
input datafile file number=00010
name=/u02/oradata/NTAP1/NTAP1_pdb1/sysaux01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-32_0q2m6jsi tag=ORACOPYBKUPONANF_LEVEL_0 RECID=17
STAMP=1164140385
channel c1: datafile copy complete, elapsed time: 01:07:29
channel c1: starting datafile copy
input datafile file number=00014
name=/u02/oradata/NTAP1/NTAP1_pdb2/sysaux01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SOE_FNO-31_0p2m6jrb tag=ORACOPYBKUPONANF_LEVEL_0 RECID=18
STAMP=1164140406

```

```

channel c3: datafile copy complete, elapsed time: 01:08:31
channel c3: starting datafile copy
input datafile file number=00018
name=/u02/oradata/NTAP1/NTAP1_pdb3/sysaux01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSAUX_FNO-10_0v2m6nqs tag=ORACOPYBKUPONANF_LEVEL_0 RECID=19
STAMP=1164140459
channel c4: datafile copy complete, elapsed time: 00:01:26
channel c4: starting datafile copy
input datafile file number=00006
name=/u02/oradata/NTAP1/pdbseed/sysaux01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSAUX_FNO-14_102m6nr3 tag=ORACOPYBKUPONANF_LEVEL_0 RECID=20
STAMP=1164140468
channel c1: datafile copy complete, elapsed time: 00:01:22
channel c1: starting datafile copy
input datafile file number=00009
name=/u02/oradata/NTAP1/NTAP1_pdb1/system01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
UNDOTBS1_FNO-11_0u2m6nqs tag=ORACOPYBKUPONANF_LEVEL_0 RECID=21
STAMP=1164140471
channel c2: datafile copy complete, elapsed time: 00:01:33
channel c2: starting datafile copy
input datafile file number=00013
name=/u02/oradata/NTAP1/NTAP1_pdb2/system01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSAUX_FNO-18_112m6nrt tag=ORACOPYBKUPONANF_LEVEL_0 RECID=22
STAMP=1164140476
channel c3: datafile copy complete, elapsed time: 00:00:57
channel c3: starting datafile copy
input datafile file number=00017
name=/u02/oradata/NTAP1/NTAP1_pdb3/system01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSAUX_FNO-6_122m6nti tag=ORACOPYBKUPONANF_LEVEL_0 RECID=23
STAMP=1164140488
channel c4: datafile copy complete, elapsed time: 00:00:25
channel c4: starting datafile copy
input datafile file number=00005
name=/u02/oradata/NTAP1/pdbseed/system01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSTEM_FNO-13_142m6ntp tag=ORACOPYBKUPONANF_LEVEL_0 RECID=24
STAMP=1164140532
channel c2: datafile copy complete, elapsed time: 00:01:06
channel c2: starting datafile copy
input datafile file number=00008
name=/u02/oradata/NTAP1/pdbseed/undotbs01.dbf

```

```

output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSTEM_FNO-17_152m6nts tag=ORACOPYBKUPONANF_LEVEL_0 RECID=25
STAMP=1164140539
channel c3: datafile copy complete, elapsed time: 00:01:03
channel c3: starting datafile copy
input datafile file number=00015
name=/u02/oradata/NTAP1/NTAP1_pdb2/undotbs01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSTEM_FNO-9_132m6ntm tag=ORACOPYBKUPONANF_LEVEL_0 RECID=26
STAMP=1164140541
channel c1: datafile copy complete, elapsed time: 00:01:13
channel c1: starting datafile copy
input datafile file number=00019
name=/u02/oradata/NTAP1/NTAP1_pdb3/undotbs01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSTEM_FNO-5_162m6nuc tag=ORACOPYBKUPONANF_LEVEL_0 RECID=27
STAMP=1164140541
channel c4: datafile copy complete, elapsed time: 00:00:41
channel c4: starting datafile copy
input datafile file number=00007 name=/u02/oradata/NTAP1/users01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
UNDOTBS1_FNO-8_172m6nvr tag=ORACOPYBKUPONANF_LEVEL_0 RECID=28
STAMP=1164140552
channel c2: datafile copy complete, elapsed time: 00:00:16
channel c2: starting datafile copy
input datafile file number=00012
name=/u02/oradata/NTAP1/NTAP1_pdb1/users01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
UNDOTBS1_FNO-15_182m6nvs tag=ORACOPYBKUPONANF_LEVEL_0 RECID=30
STAMP=1164140561
channel c3: datafile copy complete, elapsed time: 00:00:24
channel c3: starting datafile copy
input datafile file number=00016
name=/u02/oradata/NTAP1/NTAP1_pdb2/users01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
USERS_FNO-7_1a2m6o01 tag=ORACOPYBKUPONANF_LEVEL_0 RECID=29
STAMP=1164140560
channel c4: datafile copy complete, elapsed time: 00:00:16
channel c4: starting datafile copy
input datafile file number=00020
name=/u02/oradata/NTAP1/NTAP1_pdb3/users01.dbf
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
UNDOTBS1_FNO-19_192m6nvv tag=ORACOPYBKUPONANF_LEVEL_0 RECID=31
STAMP=1164140564
channel c1: datafile copy complete, elapsed time: 00:00:21
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-

```

```

USERS_FNO-12_1b2m6o0e tag=ORACOPYBKUPONANF_LEVEL_0 RECID=32
STAMP=1164140564
channel c2: datafile copy complete, elapsed time: 00:00:02
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
USERS_FNO-16_1c2m6o0k tag=ORACOPYBKUPONANF_LEVEL_0 RECID=34
STAMP=1164140565
channel c3: datafile copy complete, elapsed time: 00:00:01
output file name=/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
USERS_FNO-20_1d2m6o0k tag=ORACOPYBKUPONANF_LEVEL_0 RECID=33
STAMP=1164140565
channel c4: datafile copy complete, elapsed time: 00:00:01
Finished backup at 20-MAR-24

Starting Control File and SPFILE Autobackup at 20-MAR-24
piece
handle=/nfsanf/archlog/NTAP1/autobackup/2024_03_20/o1_mf_s_116414056
5__5g56ypks_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 20-MAR-24
released channel: c1
released channel: c2
released channel: c3
released channel: c4

RMAN> **end-of-file**

RMAN>

```

7. 在备份后列出数据库映像副本、以观察是否已在ANF NFS挂载点中创建数据库映像副本。

```

RMAN> list copy of database tag 'OraCopyBKUPonANF_level_0';

List of Datafile Copies
=====

Key          File S Completion Time Ckp SCN      Ckp Time      Sparse
-----
14           1      A 20-MAR-24      4161498      20-MAR-24      NO
            Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
            SYSTEM_FNO-1_0r2m6nhk
            Tag: ORACOPYBKUPONANF_LEVEL_0

16           3      A 20-MAR-24      4161568      20-MAR-24      NO
            Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
            SYSAUX_FNO-3_0s2m6nl1
            Tag: ORACOPYBKUPONANF_LEVEL_0

```


15	4	A	20-MAR-24	4161589	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-4_0t2m6nml						
Tag: ORACOPYBKUPONANF_LEVEL_0						
27	5	A	20-MAR-24	2379694	18-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-5_162m6nuc						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 2, PDB Name: PDB\$SEED						
23	6	A	20-MAR-24	2379694	18-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-6_122m6nti						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 2, PDB Name: PDB\$SEED						
29	7	A	20-MAR-24	4161872	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-7_1a2m6o01						
Tag: ORACOPYBKUPONANF_LEVEL_0						
28	8	A	20-MAR-24	2379694	18-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-8_172m6nvr						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 2, PDB Name: PDB\$SEED						
26	9	A	20-MAR-24	4161835	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-9_132m6ntm						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 3, PDB Name: NTAP1_PDB1						
19	10	A	20-MAR-24	4161784	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-10_0v2m6nqs						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 3, PDB Name: NTAP1_PDB1						
21	11	A	20-MAR-24	4161780	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-11_0u2m6nqs						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 3, PDB Name: NTAP1_PDB1						

32	12	A	20-MAR-24	4161880	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS- USERS_FNO-12_1b2m6o0e						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 3, PDB Name: NTAP1_PDB1						
24	13	A	20-MAR-24	4161838	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS- SYSTEM_FNO-13_142m6ntp						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 4, PDB Name: NTAP1_PDB2						
20	14	A	20-MAR-24	4161785	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS- SYS_AUX_FNO-14_102m6nr3						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 4, PDB Name: NTAP1_PDB2						
30	15	A	20-MAR-24	4161863	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS- UNDOTBS1_FNO-15_182m6nvs						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 4, PDB Name: NTAP1_PDB2						
34	16	A	20-MAR-24	4161884	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS- USERS_FNO-16_1c2m6o0k						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 4, PDB Name: NTAP1_PDB2						
25	17	A	20-MAR-24	4161841	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS- SYSTEM_FNO-17_152m6nts						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 5, PDB Name: NTAP1_PDB3						
22	18	A	20-MAR-24	4161810	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS- SYS_AUX_FNO-18_112m6nrt						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 5, PDB Name: NTAP1_PDB3						
31	19	A	20-MAR-24	4161869	20-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS- UNDOTBS1_FNO-19_192m6nvv						
Tag: ORACOPYBKUPONANF_LEVEL_0						

```

Container ID: 5, PDB Name: NTAP1_PDB3

33      20      A 20-MAR-24      4161887      20-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
USERS_FNO-20_1d2m6o0k
      Tag: ORACOPYBKUPONANF_LEVEL_0
      Container ID: 5, PDB Name: NTAP1_PDB3

7        21      A 20-MAR-24      4152514      20-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
21_0f2m6brl
      Tag: ORACOPYBKUPONANF_LEVEL_0
      Container ID: 3, PDB Name: NTAP1_PDB1

4        22      A 20-MAR-24      4152518      20-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
22_0g2m6brl
      Tag: ORACOPYBKUPONANF_LEVEL_0
      Container ID: 3, PDB Name: NTAP1_PDB1

6        23      A 20-MAR-24      4152522      20-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
23_0h2m6brl
      Tag: ORACOPYBKUPONANF_LEVEL_0
      Container ID: 3, PDB Name: NTAP1_PDB1

5        24      A 20-MAR-24      4152529      20-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
24_0i2m6brl
      Tag: ORACOPYBKUPONANF_LEVEL_0
      Container ID: 3, PDB Name: NTAP1_PDB1

9        25      A 20-MAR-24      4156120      20-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
25_0j2m6fol
      Tag: ORACOPYBKUPONANF_LEVEL_0
      Container ID: 3, PDB Name: NTAP1_PDB1

8        26      A 20-MAR-24      4156130      20-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
26_0k2m6fot
      Tag: ORACOPYBKUPONANF_LEVEL_0
      Container ID: 3, PDB Name: NTAP1_PDB1

10       27      A 20-MAR-24      4156159      20-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-

```

```

27_012m6frc
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

11      28      A 20-MAR-24      4156183      20-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
28_0m2m6fsu
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

12      29      A 20-MAR-24      4158795      20-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
29_0n2m6jlr
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

13      30      A 20-MAR-24      4158803      20-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
30_0o2m6jlr
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

18      31      A 20-MAR-24      4158871      20-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
31_0p2m6jrb
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

17      32      A 20-MAR-24      4158886      20-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
32_0q2m6jsi
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

```

8. 通过Oracle RMAN命令提示符报告架构、以观察当前VLDB数据文件是否位于主存储上。

```

RMAN> report schema;

Report of database schema for database with db_unique_name NTAP1

List of Permanent Datafiles
=====
File Size(MB) Tablespace          RB segs Datafile Name
-----
1      1060      SYSTEM          YES

```

```

/u02/oradata/NTAP1/system01.dbf
3      1000      SYSAUX              NO
/u02/oradata/NTAP1/sysaux01.dbf
4       695      UNDOTBS1            YES
/u02/oradata/NTAP1/undotbs01.dbf
5       400      PDB$SEED:SYSTEM      NO
/u02/oradata/NTAP1/pdbseed/system01.dbf
6       440      PDB$SEED:SYSAUX      NO
/u02/oradata/NTAP1/pdbseed/sysaux01.dbf
7        5       USERS              NO
/u02/oradata/NTAP1/users01.dbf
8       235      PDB$SEED:UNDOTBS1    NO
/u02/oradata/NTAP1/pdbseed/undotbs01.dbf
9       410      NTAP1_PDB1:SYSTEM    YES
/u02/oradata/NTAP1/NTAP1_pdb1/system01.dbf
10      520      NTAP1_PDB1:SYSAUX     NO
/u02/oradata/NTAP1/NTAP1_pdb1/sysaux01.dbf
11      580      NTAP1_PDB1:UNDOTBS1  YES
/u02/oradata/NTAP1/NTAP1_pdb1/undotbs01.dbf
12       5       NTAP1_PDB1:USERS     NO
/u02/oradata/NTAP1/NTAP1_pdb1/users01.dbf
13      410      NTAP1_PDB2:SYSTEM    YES
/u02/oradata/NTAP1/NTAP1_pdb2/system01.dbf
14      500      NTAP1_PDB2:SYSAUX     NO
/u02/oradata/NTAP1/NTAP1_pdb2/sysaux01.dbf
15      235      NTAP1_PDB2:UNDOTBS1  YES
/u02/oradata/NTAP1/NTAP1_pdb2/undotbs01.dbf
16       5       NTAP1_PDB2:USERS     NO
/u02/oradata/NTAP1/NTAP1_pdb2/users01.dbf
17      410      NTAP1_PDB3:SYSTEM    YES
/u02/oradata/NTAP1/NTAP1_pdb3/system01.dbf
18      500      NTAP1_PDB3:SYSAUX     NO
/u02/oradata/NTAP1/NTAP1_pdb3/sysaux01.dbf
19      235      NTAP1_PDB3:UNDOTBS1  YES
/u02/oradata/NTAP1/NTAP1_pdb3/undotbs01.dbf
20       5       NTAP1_PDB3:USERS     NO
/u02/oradata/NTAP1/NTAP1_pdb3/users01.dbf
21     31744     NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_01.dbf
22     31744     NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_02.dbf
23     31744     NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_03.dbf
24     31744     NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_04.dbf
25     31744     NTAP1_PDB1:SOE        NO

```

```

/u02/oradata/NTAP1/NTAP1_pdb1/soe_05.dbf
26    31744    NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_06.dbf
27    31744    NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_07.dbf
28    31744    NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_08.dbf
29    31744    NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_09.dbf
30    31744    NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_10.dbf
31    31744    NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_11.dbf
32    31744    NTAP1_PDB1:SOE        NO
/u02/oradata/NTAP1/NTAP1_pdb1/soe_12.dbf

```

List of Temporary Files

=====

File	Size (MB)	Tablespace	Maxsize (MB)	Tempfile Name
1	123	TEMP	32767	
/u02/oradata/NTAP1/temp01.dbf				
2	123	PDB\$SEED:TEMP	32767	
/u02/oradata/NTAP1/pdbseed/temp012024-03-18_16-07-32-463-PM.dbf				
3	31744	NTAP1_PDB1:TEMP	32767	
/u02/oradata/NTAP1/NTAP1_pdb1/temp01.dbf				
4	123	NTAP1_PDB2:TEMP	32767	
/u02/oradata/NTAP1/NTAP1_pdb2/temp01.dbf				
5	123	NTAP1_PDB3:TEMP	32767	
/u02/oradata/NTAP1/NTAP1_pdb3/temp01.dbf				
6	31744	NTAP1_PDB1:TEMP	31744	
/u02/oradata/NTAP1/NTAP1_pdb1/temp02.dbf				

RMAN>

9. 验证从操作系统NFS挂载点复制的数据库映像。

```

[oracle@ora-01 ~]$ ls -l /nfsanf/oracopy
total 399482176
-rw-r----- 1 oracle oinstall 11600384 Mar 20 21:44 bct_ntap1.ctf
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 18:03 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-21_0f2m6brl
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 18:01 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-22_0g2m6brl
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 18:03 data_D-

```

```

NTAP1_I-2441823937_TS-SOE_FNO-23_0h2m6brl
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 18:02 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-24_0i2m6brl
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 19:08 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-25_0j2m6fol
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 19:08 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-26_0k2m6fot
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 19:11 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-27_0l2m6frc
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 19:12 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-28_0m2m6fsu
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 20:14 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-29_0n2m6jlr
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 20:16 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-30_0o2m6jlr
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 20:20 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-31_0p2m6jrb
-rw-r----- 1 oracle oinstall 33286004736 Mar 20 20:19 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-32_0q2m6jsi
-rw-r----- 1 oracle oinstall 545267712 Mar 20 20:20 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-10_0v2m6nqs
-rw-r----- 1 oracle oinstall 524296192 Mar 20 20:21 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-14_102m6nr3
-rw-r----- 1 oracle oinstall 524296192 Mar 20 20:21 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-18_112m6nrt
-rw-r----- 1 oracle oinstall 1048584192 Mar 20 20:19 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-3_0s2m6nl1
-rw-r----- 1 oracle oinstall 461381632 Mar 20 20:21 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-6_122m6nti
-rw-r----- 1 oracle oinstall 1111498752 Mar 20 20:17 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-1_0r2m6nhk
-rw-r----- 1 oracle oinstall 429924352 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-13_142m6ntp
-rw-r----- 1 oracle oinstall 429924352 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-17_152m6nts
-rw-r----- 1 oracle oinstall 419438592 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-5_162m6nuc
-rw-r----- 1 oracle oinstall 429924352 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-9_132m6ntm
-rw-r----- 1 oracle oinstall 608182272 Mar 20 20:21 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-11_0u2m6nqs
-rw-r----- 1 oracle oinstall 246423552 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-15_182m6nvs
-rw-r----- 1 oracle oinstall 246423552 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-19_192m6nvv
-rw-r----- 1 oracle oinstall 728768512 Mar 20 20:19 data_D-

```

```
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-4_0t2m6nml
-rw-r----- 1 oracle oinstall 246423552 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-8_172m6nvr
-rw-r----- 1 oracle oinstall 5251072 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-USERS_FNO-12_1b2m6o0e
-rw-r----- 1 oracle oinstall 5251072 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-USERS_FNO-16_1c2m6o0k
-rw-r----- 1 oracle oinstall 5251072 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-USERS_FNO-20_1d2m6o0k
-rw-r----- 1 oracle oinstall 5251072 Mar 20 20:22 data_D-
NTAP1_I-2441823937_TS-USERS_FNO-7_1a2m6o01
[oracle@ora-01 ~]$
```

至此、Oracle VLDB备用映像副本备份和合并的设置完成。

将**Oracle VLDB**切换到映像副本、以便快速恢复

如果因主存储问题描述发生故障(例如数据丢失或损坏)、则可以快速将数据库切换到ANF NFS挂载上的映像副本、并将其恢复到当前状态、而无需还原数据库。消除介质还原可显著加快VLDB的数据库恢复速度。此使用情形假定Oracle VLDB数据库服务器完好无损、并且数据库控制文件、归档日志和当前日志均可用于恢复。

1. 在切换之前、以Oracle用户身份登录到Azure主VLDB服务器主机并创建测试表。

```
[oracle@ora-01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Thu Mar 21 15:13:52
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> show pdbs

          CON_ID CON_NAME                                OPEN MODE  RESTRICTED
-----
          2 PDB$SEED                                READ ONLY  NO
          3 NTAP1_PDB1                                READ WRITE NO
          4 NTAP1_PDB2                                READ WRITE NO
          5 NTAP1_PDB3                                READ WRITE NO
SQL> alter session set container=ntap1_pdb1;

Session altered.

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

Table created.

SQL> insert into test values(1, sysdate, 'test oracle incremental
merge switch to copy');

1 row created.

SQL> commit;

Commit complete.
```

```
SQL> select * from test;

          ID
-----
DT
-----
EVENT
-----
          1
21-MAR-24 03.15.03.000000 PM
test oracle incremental merge switch to copy
```

2. 通过关闭中止数据库、然后在挂载阶段启动Oracle来模拟故障。

```
SQL> shutdown abort;
ORACLE instance shut down.
SQL> startup mount;
ORACLE instance started.

Total System Global Area 6442449688 bytes
Fixed Size                  9177880 bytes
Variable Size              1325400064 bytes
Database Buffers           5100273664 bytes
Redo Buffers                7598080 bytes
Database mounted.
SQL> exit
```

3. 作为Oracle用户、通过RMAN连接到Oracle数据库、以切换要复制的数据库。

```
[oracle@ora-01 ~]$ rman target / nocatalog

Recovery Manager: Release 19.0.0.0.0 - Production on Thu Mar 21
15:20:58 2024
Version 19.18.0.0.0

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

connected to target database: NTAP1 (DBID=2441823937, not open)
using target database control file instead of recovery catalog
```

```
RMAN> switch database to copy;
```

```
datafile 1 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-1_0r2m6nhk"
datafile 3 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-3_0s2m6nl1"
datafile 4 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-4_0t2m6nml"
datafile 5 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-5_162m6nuc"
datafile 6 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-6_122m6nti"
datafile 7 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-7_1a2m6o01"
datafile 8 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-8_172m6nvr"
datafile 9 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-9_132m6ntm"
datafile 10 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-10_0v2m6nqs"
datafile 11 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-11_0u2m6nqs"
datafile 12 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-12_1b2m6o0e"
datafile 13 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-13_142m6ntp"
datafile 14 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-14_102m6nr3"
datafile 15 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-15_182m6nvs"
datafile 16 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-16_1c2m6o0k"
datafile 17 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-17_152m6nts"
datafile 18 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-18_112m6nrt"
datafile 19 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-19_192m6nvv"
datafile 20 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-20_1d2m6o0k"
datafile 21 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-21_0f2m6brl"
datafile 22 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-22_0g2m6brl"
datafile 23 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-23_0h2m6brl"
```

```

datafile 24 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-24_0i2m6brl"
datafile 25 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-25_0j2m6fol"
datafile 26 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-26_0k2m6fot"
datafile 27 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-27_0l2m6frc"
datafile 28 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-28_0m2m6fsu"
datafile 29 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-29_0n2m6jlr"
datafile 30 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-30_0o2m6jlr"
datafile 31 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-31_0p2m6jrb"
datafile 32 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-32_0q2m6jsi"

```

4. 恢复并打开数据库、使其从上次增量备份恢复到最新状态。

```

RMAN> recover database;

Starting recover at 21-MAR-24
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=392 device type=DISK
channel ORA_DISK_1: starting incremental datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from backup
set
destination for restore of datafile 00009: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-9_0q1sd7cm
destination for restore of datafile 00023: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-23_041sd6s5
destination for restore of datafile 00027: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-27_081sd70i
destination for restore of datafile 00031: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-31_0c1sd74u
destination for restore of datafile 00034: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-34_0f1sd788
channel ORA_DISK_1: reading from backup piece
/nfsanf/oracopy/321sfous_98_1_1
channel ORA_DISK_1: piece handle=/nfsanf/oracopy/321sfous_98_1_1
tag=ORACOPYBKUPONANF_LEVEL_0
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: restore complete, elapsed time: 00:00:01

```

```

channel ORA_DISK_1: starting incremental datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from backup
set
destination for restore of datafile 00010: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-10_0k1sd7bb
destination for restore of datafile 00021: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-21_021sd6pv
destination for restore of datafile 00025: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-25_061sd6uc
.
.
.
channel ORA_DISK_1: starting incremental datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from backup
set
destination for restore of datafile 00016: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-16_121sd7dn
channel ORA_DISK_1: reading from backup piece
/nfsanf/oracopy/3i1sfov0_114_1_1
channel ORA_DISK_1: piece handle=/nfsanf/oracopy/3i1sfov0_114_1_1
tag=ORACOPYBKUPONANF_LEVEL_0
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: restore complete, elapsed time: 00:00:01
channel ORA_DISK_1: starting incremental datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from backup
set
destination for restore of datafile 00020: /nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-20_131sd7do
channel ORA_DISK_1: reading from backup piece
/nfsanf/oracopy/3j1sfov0_115_1_1
channel ORA_DISK_1: piece handle=/nfsanf/oracopy/3j1sfov0_115_1_1
tag=ORACOPYBKUPONANF_LEVEL_0
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: restore complete, elapsed time: 00:00:01

starting media recovery
media recovery complete, elapsed time: 00:00:01

Finished recover at 21-MAR-24

RMAN> alter database open;

Statement processed

RMAN>

```

5. 在恢复后从sqlplus检查数据库结构、观察所有VLDB数据文件(控制、临时和当前日志文件除外)现在都已切换到ANF NFS文件系统上的副本。

```
SQL> select name from v$datafile
2 union
3 select name from v$tempfile
4 union
5 select name from v$controlfile
6 union
7* select member from v$logfile
SQL> /
```

NAME

```
-----
-----
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-21_0f2m6brl
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-22_0g2m6brl
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-23_0h2m6brl
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-24_0i2m6brl
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-25_0j2m6fol
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-26_0k2m6fot
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-27_0l2m6frc
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-28_0m2m6fsu
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-29_0n2m6jlr
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-30_0o2m6jlr
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-31_0p2m6jrb
```

NAME

```
-----
-----
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-32_0q2m6jsi
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-10_0v2m6nqs
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-14_102m6nr3
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-18_112m6nrt
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-3_0s2m6n1l
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-6_122m6nti
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-13_142m6ntp
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-17_152m6nts
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-1_0r2m6nhk
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-5_162m6nuc
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-9_132m6ntm
```

NAME

```
-----
-----
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-
```

```

11_0u2m6nqs
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-
15_182m6nvs
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-
19_192m6nvv
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-4_0t2m6nm1
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-8_172m6nvr
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-12_1b2m6o0e
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-16_1c2m6o0k
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-20_1d2m6o0k
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-7_1a2m6o01
/u02/oradata/NTAP1/NTAP1_pdb1/temp01.dbf
/u02/oradata/NTAP1/NTAP1_pdb1/temp02.dbf

NAME
-----
-----
/u02/oradata/NTAP1/NTAP1_pdb2/temp01.dbf
/u02/oradata/NTAP1/NTAP1_pdb3/temp01.dbf
/u02/oradata/NTAP1/control01.ctl
/u02/oradata/NTAP1/pdbseed/temp012024-03-18_16-07-32-463-PM.dbf
/u02/oradata/NTAP1/temp01.dbf
/u03/orareco/NTAP1/control02.ctl
/u03/orareco/NTAP1/onlinelog/redo01.log
/u03/orareco/NTAP1/onlinelog/redo02.log
/u03/orareco/NTAP1/onlinelog/redo03.log

42 rows selected.

```

6. 从SQL plus中、检查切换到复制之前插入的测试表的内容。

```
SQL> alter session set container=ntapl_pdb1;
```

```
Session altered.
```

```
SQL> select * from test;
```

```

          ID
-----
DT
-----
EVENT
-----
          1
21-MAR-24 03.15.03.000000 PM
test oracle incremental merge switch to copy

SQL>
```

7. 您可以在ANF NFS挂载中长时间运行Oracle VLDB、同时保持预期的性能级别。修复主存储问题描述后、您可以通过反转增量备份合并过程并将停机时间降至最低来回滚到该主存储LUN。

从映像副本到备用数据库服务器的**Oracle VLDB**恢复

如果发生故障、并且主存储和主数据库服务器主机均丢失、则无法从原始服务器执行恢复。但是、ANF NFS文件系统上提供的Oracle数据库备份映像副本非常方便。您可以使用备份映像副本将主数据库快速恢复到备用数据库服务器(如果有)。在本节中、我们将展示此类恢复的分步过程。

1. 插入一行以测试我们之前为Oracle VLDB还原到备用主机验证创建的表。

```
SQL> insert into test values(2, sysdate, 'test recovery on a new
Azure VM host with image copy on ANF');
```

```
1 row created.
```

```
SQL> commit;
```

```
Commit complete.
```

```
SQL> select * from test;
```

ID	DT	EVENT
1	21-MAR-24 03.15.03.000000 PM	test oracle incremental merge switch to copy
2	22-MAR-24 02.22.06.000000 PM	test recovery on a new Azure VM host with image copy on ANF

ID	DT	EVENT
----	----	-------

```
SQL>
```

2. 以Oracle用户身份运行RMAN增量备份并合并、以将事务转储到ANF NFS挂载上的备份集。

```
[oracle@ip-172-30-15-99 ~]$ rman target / nocatalog

Recovery Manager: Release 19.0.0.0.0 - Production on Tue May 30
17:26:03 2023
Version 19.18.0.0.0

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reserved.

connected to target database: NTAP1 (DBID=2441823937)
using target database control file instead of recovery catalog

RMAN> @rman_bkup_merge.cmd
```

3. 关闭主VLDB服务器主机、以模拟存储和数据库服务器主机完全故障。
4. 在操作系统和版本相同的备用数据库服务器ora-02上、应将操作系统内核作为主VLDB服务器主机进行修补。此外、使用纯软件选项在备用数据库服务器上安装和配置了相同版本的Oracle和修补程序。
5. 将Oracle环境配置为类似于主VLDB服务器ora_01、例如oratab和Oracle用户.bash_profile等 最好将这些文件备份到ANF NFS挂载点。
6. 然后、将ANF NFS文件系统上的Oracle数据库备份映像副本挂载到备用数据库服务器上恢复。以下步骤演示了流程详细信息。

以azueruser身份创建挂载点。

```
sudo mkdir /nfsanf
```

以azureuser身份挂载用于存储Oracle VLDB备份映像副本的NFS卷。

```
sudo mount 172.30.136.68:/ora-01-u02-copy /nfsanf -o
rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=262144,wsiz=262144,noi
tr
```

7. 验证ANF NFS挂载点上的Oracle数据库备份映像副本。

```
[oracle@ora-02 ~]$ ls -ltr /nfsanf/oracopy/
total 400452728
-rw-r-----. 1 oracle oinstall 461381632 Mar 21 23:47 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-6_242m9oan
-rw-r-----. 1 oracle oinstall 419438592 Mar 21 23:49 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-5_282m9oem
```

```

-rw-r----- . 1 oracle oinstall 246423552 Mar 21 23:49 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-8_292m9oem
-rw-r----- . 1 oracle oinstall 21438464 Mar 22 14:35
2h2mbccv_81_1_1
-rw-r----- . 1 oracle oinstall 17956864 Mar 22 14:35
2i2mbcd0_82_1_1
-rw-r----- . 1 oracle oinstall 17956864 Mar 22 14:35
2j2mbcd1_83_1_1
-rw-r----- . 1 oracle oinstall 15245312 Mar 22 14:35
2k2mbcd3_84_1_1
-rw-r----- . 1 oracle oinstall 1638400 Mar 22 14:35
2m2mbcdn_86_1_1
-rw-r----- . 1 oracle oinstall 40042496 Mar 22 14:35
2l2mbcdn_85_1_1
-rw-r----- . 1 oracle oinstall 21856256 Mar 22 14:35
2n2mbcd0_87_1_1
-rw-r----- . 1 oracle oinstall 3710976 Mar 22 14:35
2o2mbcdv_88_1_1
-rw-r----- . 1 oracle oinstall 3416064 Mar 22 14:35
2p2mbcdv_89_1_1
-rw-r----- . 1 oracle oinstall 2596864 Mar 22 14:35
2r2mbce0_91_1_1
-rw-r----- . 1 oracle oinstall 2531328 Mar 22 14:35
2s2mbce1_92_1_1
-rw-r----- . 1 oracle oinstall 4718592 Mar 22 14:35
2v2mbce2_95_1_1
-rw-r----- . 1 oracle oinstall 4243456 Mar 22 14:35
302mbce2_96_1_1
-rw-r----- . 1 oracle oinstall 57344 Mar 22 14:35
312mbce3_97_1_1
-rw-r----- . 1 oracle oinstall 57344 Mar 22 14:35
322mbce3_98_1_1
-rw-r----- . 1 oracle oinstall 57344 Mar 22 14:35
332mbce3_99_1_1
-rw-r----- . 1 oracle oinstall 608182272 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-11_202m9o22
-rw-r----- . 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-30_1q2m9k7a
-rw-r----- . 1 oracle oinstall 555753472 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-10_212m9o52
-rw-r----- . 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-26_1m2m9g9j
-rw-r----- . 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-27_1n2m9gcg
-rw-r----- . 1 oracle oinstall 429924352 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-9_252m9oc5

```

```

-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-22_1i2m9cap
-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-23_1j2m9cap
-rw-r-----. 1 oracle oinstall      5251072 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-USERS_FNO-12_2d2m9ofs
-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-28_1o2m9gd4
-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-31_1r2m9kfk
-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-29_1p2m9ju6
-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-32_1s2m9kgg
-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-25_1l2m9g3u
-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-24_1k2m9cap
-rw-r-----. 1 oracle oinstall 33286004736 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SOE_FNO-21_1h2m9cap
-rw-r-----. 1 oracle oinstall  1121984512 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-1_1t2m9nij
-rw-r-----. 1 oracle oinstall  1142956032 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-3_1u2m9nog
-rw-r-----. 1 oracle oinstall   728768512 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-4_1v2m9nu6
-rw-r-----. 1 oracle oinstall   534781952 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-14_222m9o53
-rw-r-----. 1 oracle oinstall   534781952 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-18_232m9oa8
-rw-r-----. 1 oracle oinstall   429924352 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-13_262m9oca
-rw-r-----. 1 oracle oinstall   246423552 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-15_2a2m9of6
-rw-r-----. 1 oracle oinstall   429924352 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-17_272m9oel
-rw-r-----. 1 oracle oinstall      5251072 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-USERS_FNO-7_2c2m9ofn
-rw-r-----. 1 oracle oinstall      5251072 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-USERS_FNO-16_2e2m9og8
-rw-r-----. 1 oracle oinstall   246423552 Mar 22 15:31 data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-19_2b2m9ofn
-rw-r-----. 1 oracle oinstall      5251072 Mar 22 15:32 data_D-
NTAP1_I-2441823937_TS-USERS_FNO-20_2f2m9og8
-rw-r-----. 1 oracle oinstall   76546048 Mar 22 15:37
362mbft5_102_1_1

```

```

-rw-r----- . 1 oracle oinstall      14671872 Mar 22 15:37
392mbg1i_105_1_1
-rw-r----- . 1 oracle oinstall      79462400 Mar 22 15:37
372mbftb_103_1_1
-rw-r----- . 1 oracle oinstall        917504 Mar 22 15:37
3a2mbg23_106_1_1
-rw-r----- . 1 oracle oinstall    428498944 Mar 22 15:37
352mbfst_101_1_1
-rw-r----- . 1 oracle oinstall    88702976 Mar 22 15:37
382mbftm_104_1_1
-rw-r----- . 1 oracle oinstall     5021696 Mar 22 15:37
3b2mbg2b_107_1_1
-rw-r----- . 1 oracle oinstall      278528 Mar 22 15:38
3c2mbg2f_108_1_1
-rw-r----- . 1 oracle oinstall      278528 Mar 22 15:38
3d2mbg2i_109_1_1
-rw-r----- . 1 oracle oinstall      425984 Mar 22 15:38
3f2mbg2m_111_1_1
-rw-r----- . 1 oracle oinstall      442368 Mar 22 15:38
3g2mbg2q_112_1_1
-rw-r----- . 1 oracle oinstall      278528 Mar 22 15:38
3j2mbg37_115_1_1
-rw-r----- . 1 oracle oinstall     270336 Mar 22 15:38
3k2mbg3a_116_1_1
-rw-r----- . 1 oracle oinstall       57344 Mar 22 15:38
3l2mbg3f_117_1_1
-rw-r----- . 1 oracle oinstall       57344 Mar 22 15:38
3n2mbg3k_119_1_1
-rw-r----- . 1 oracle oinstall       57344 Mar 22 15:38
3m2mbg3g_118_1_1
-rw-r----- . 1 oracle oinstall    11600384 Mar 22 15:52 bct_ntap1.ctf
[oracle@ora-02 ~]$

```

8. 验证ANF NFS挂载上可用于恢复的Oracle归档日志、并记下最后一个日志文件日志顺序号。在本例中、此值为10。我们的恢复点最高为日志顺序编号11。

```
[oracle@ora-02 ~]$ ls -ltr
/nfsanf/archlog/NTAP1/archivelog/2024_03_22
total 1429548
-r--r-----. 1 oracle oinstall 176650752 Mar 22 12:00
o1_mf_1_2__9m198x6t_.arc
-r--r-----. 1 oracle oinstall 17674752 Mar 22 14:34
o1_mf_1_3__9vn701r5_.arc
-r--r-----. 1 oracle oinstall 188782080 Mar 22 15:20
o1_mf_1_4__9y6gn5co_.arc
-r--r-----. 1 oracle oinstall 183638016 Mar 22 15:21
o1_mf_1_5__9y7p68s6_.arc
-r--r-----. 1 oracle oinstall 193106944 Mar 22 15:21
o1_mf_1_6__9y8ygtss_.arc
-r--r-----. 1 oracle oinstall 179439104 Mar 22 15:22
o1_mf_1_7__9ybjdp55_.arc
-r--r-----. 1 oracle oinstall 198815232 Mar 22 15:23
o1_mf_1_8__9yctxjgy_.arc
-r--r-----. 1 oracle oinstall 185494528 Mar 22 15:24
o1_mf_1_9__9yfrj0b1_.arc
-r--r-----. 1 oracle oinstall 134470144 Mar 22 15:29
o1_mf_1_10__9yomybbc_.arc
[oracle@ora-02 ~]$
```

9. 作为Oracle用户、将oracle_home变量设置为备用数据库服务器ora-02上的当前Oracle安装、将oracle_sid设置为主Oracle实例SID。在本示例中、此值为NTAP1。

```
[oracle@ora-02 ~]$ export
ORACLE_HOME=/u01/app/oracle/product/19.0.0/NTAP2
[oracle@ora-02 ~]$ export ORACLE_SID=NTAP1
[oracle@ora-02 ~]$ export PATH=$PATH:$ORACLE_HOME/bin
```

10. 以Oracle用户身份、在\$ORACLE_HOME/dbs目录中创建一个通用Oracle init文件、并配置适当的管理目录。最重要的是、拥有Oracle flash recovery area 指向主Oracle VLDB服务器中定义的ANF NFS挂载路径。flash recovery area 第节介绍了配置 Setup Oracle RMAN incremental merge to image copy on ANF。将Oracle控制文件设置为ANF NFS文件系统。

```
vi $ORACLE_HOME/dbs/initNTAP1.ora
```

包含以下示例条目：

```

*.audit_file_dest='/u01/app/oracle/admin/NTAP1/adump'
*.audit_trail='db'
*.compatible='19.0.0'
*.control_files=('/nfsanf/oracopy/NTAP1.ctl')
*.db_block_size=8192
*.db_create_file_dest='/nfsanf/oracopy/'
*.db_domain='solutions.netapp.com'
*.db_name='NTAP1'
*.db_recovery_file_dest_size=85899345920
*.db_recovery_file_dest='/nfsanf/archlog/'
*.diagnostic_dest='/u01/app/oracle'
*.dispatchers='(PROTOCOL=TCP) (SERVICE=NTAP1XDB) '
*.enable_pluggable_database=true
*.local_listener='LISTENER'
*.nls_language='AMERICAN'
*.nls_territory='AMERICA'
*.open_cursors=300
*.pga_aggregate_target=1024m
*.processes=320
*.remote_login_passwordfile='EXCLUSIVE'
*.sga_target=10240m
*.undo_tablespace='UNDOTBS1'

```

如果出现差异、应将上述init文件替换为从主Oracle VLDB服务器还原的备份init文件。

11. 以Oracle用户身份启动RMAN、以便在备用数据库服务器主机上运行Oracle恢复。首先、在中启动Oracle实例 nomount 状态。

```
[oracle@ora-02 ~]$ rman target / nocatalog

Recovery Manager: Release 19.0.0.0.0 - Production on Fri Mar 22
16:02:55 2024
Version 19.18.0.0.0

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reserved.

connected to target database (not started)

RMAN> startup nomount;

Oracle instance started

Total System Global Area      10737418000 bytes

Fixed Size                     9174800 bytes
Variable Size                  1577058304 bytes
Database Buffers               9126805504 bytes
Redo Buffers                    24379392 bytes
```

12. 设置数据库ID。数据库ID可从ANF NFS挂载点上映像副本的Oracle文件名中检索。

```
RMAN> set dbid = 2441823937;

executing command: SET DBID
```

13. 从自动备份还原控制文件。如果启用了Oracle控制文件和spfile自动备份、则它们会在每个增量备份和合并周期中进行备份。如果有多个副本可用、则会还原最新备份。


```

RMAN> restore controlfile from autobackup;

Starting restore at 22-MAR-24
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=2 device type=DISK


recovery area destination: /nfsanf/archlog/
database name (or database unique name) used for search: NTAP1
channel ORA_DISK_1: AUTOBACKUP
/nfsanf/archlog/NTAP1/autobackup/2024_03_22/o1_mf_s_1164296325__9z77
zyxb_.bkp found in the recovery area
channel ORA_DISK_1: looking for AUTOBACKUP on day: 20240322
channel ORA_DISK_1: restoring control file from AUTOBACKUP
/nfsanf/archlog/NTAP1/autobackup/2024_03_22/o1_mf_s_1164296325__9z77
zyxb_.bkp
channel ORA_DISK_1: control file restore from AUTOBACKUP complete
output file name=/nfsanf/oracopy/NTAP1.ctl
Finished restore at 22-MAR-24

```

14. 将init文件从spfile还原到/tmp文件夹、以便稍后更新参数文件以与主VLDB匹配。

```

RMAN> restore spfile to pfile '/tmp/archive/initNTAP1.ora' from
autobackup;

Starting restore at 22-MAR-24
using channel ORA_DISK_1


recovery area destination: /nfsanf/archlog/
database name (or database unique name) used for search: NTAP1
channel ORA_DISK_1: AUTOBACKUP
/nfsanf/archlog/NTAP1/autobackup/2024_03_22/o1_mf_s_1164296325__9z77
zyxb_.bkp found in the recovery area
channel ORA_DISK_1: looking for AUTOBACKUP on day: 20240322
channel ORA_DISK_1: restoring spfile from AUTOBACKUP
/nfsanf/archlog/NTAP1/autobackup/2024_03_22/o1_mf_s_1164296325__9z77
zyxb_.bkp
channel ORA_DISK_1: SPFILE restore from AUTOBACKUP complete
Finished restore at 22-MAR-24

```

15. 挂载控制文件并验证数据库备份映像副本。

```

RMAN> alter database mount;

released channel: ORA_DISK_1

```

Statement processed

RMAN> list copy of database tag 'ORACOPYBKUPONANF_LEVEL_0';

List of Datafile Copies

=====

Key	File S	Completion Time	Ckp SCN	Ckp Time	Sparse
82	1 A	22-MAR-24	4598427	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-1_1t2m9nij					
Tag: ORACOPYBKUPONANF_LEVEL_0					
83	3 A	22-MAR-24	4598423	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-3_1u2m9nog					
Tag: ORACOPYBKUPONANF_LEVEL_0					
84	4 A	22-MAR-24	4598431	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-4_1v2m9nu6					
Tag: ORACOPYBKUPONANF_LEVEL_0					
58	5 A	21-MAR-24	2379694	18-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-5_282m9oem					
Tag: ORACOPYBKUPONANF_LEVEL_0					
Container ID: 2, PDB Name: PDB\$SEED					
52	6 A	21-MAR-24	2379694	18-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-6_242m9oan					
Tag: ORACOPYBKUPONANF_LEVEL_0					
Container ID: 2, PDB Name: PDB\$SEED					
90	7 A	22-MAR-24	4598462	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-7_2c2m9ofn					
Tag: ORACOPYBKUPONANF_LEVEL_0					
59	8 A	21-MAR-24	2379694	18-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-8_292m9oem					
Tag: ORACOPYBKUPONANF_LEVEL_0					
Container ID: 2, PDB Name: PDB\$SEED					

71	9	A	22-MAR-24	4598313	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-						
SYSTEM_FNO-9_252m9oc5						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 3, PDB Name: NTAP1_PDB1						
68	10	A	22-MAR-24	4598308	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-						
SYSAUX_FNO-10_212m9o52						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 3, PDB Name: NTAP1_PDB1						
66	11	A	22-MAR-24	4598304	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-						
UNDOTBS1_FNO-11_202m9o22						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 3, PDB Name: NTAP1_PDB1						
74	12	A	22-MAR-24	4598318	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-						
USERS_FNO-12_2d2m9ofs						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 3, PDB Name: NTAP1_PDB1						
86	13	A	22-MAR-24	4598445	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-						
SYSTEM_FNO-13_262m9oca						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 4, PDB Name: NTAP1_PDB2						
85	14	A	22-MAR-24	4598437	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-						
SYSAUX_FNO-14_222m9o53						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 4, PDB Name: NTAP1_PDB2						
87	15	A	22-MAR-24	4598454	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-						
UNDOTBS1_FNO-15_2a2m9of6						
Tag: ORACOPYBKUPONANF_LEVEL_0						
Container ID: 4, PDB Name: NTAP1_PDB2						
89	16	A	22-MAR-24	4598466	22-MAR-24	NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-						
USERS_FNO-16_2e2m9og8						
Tag: ORACOPYBKUPONANF_LEVEL_0						

Container ID: 4, PDB Name: NTAP1_PDB2

91 17 A 22-MAR-24 4598450 22-MAR-24 NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYSTEM_FNO-17_272m9oel
Tag: ORACOPYBKUPONANF_LEVEL_0
Container ID: 5, PDB Name: NTAP1_PDB3

88 18 A 22-MAR-24 4598441 22-MAR-24 NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
SYS_AUX_FNO-18_232m9oa8
Tag: ORACOPYBKUPONANF_LEVEL_0
Container ID: 5, PDB Name: NTAP1_PDB3

92 19 A 22-MAR-24 4598458 22-MAR-24 NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
UNDOTBS1_FNO-19_2b2m9ofn
Tag: ORACOPYBKUPONANF_LEVEL_0
Container ID: 5, PDB Name: NTAP1_PDB3

93 20 A 22-MAR-24 4598470 22-MAR-24 NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-
USERS_FNO-20_2f2m9og8
Tag: ORACOPYBKUPONANF_LEVEL_0
Container ID: 5, PDB Name: NTAP1_PDB3

81 21 A 22-MAR-24 4598318 22-MAR-24 NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
21_1h2m9cap
Tag: ORACOPYBKUPONANF_LEVEL_0
Container ID: 3, PDB Name: NTAP1_PDB1

72 22 A 22-MAR-24 4598304 22-MAR-24 NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
22_1i2m9cap
Tag: ORACOPYBKUPONANF_LEVEL_0
Container ID: 3, PDB Name: NTAP1_PDB1

73 23 A 22-MAR-24 4598308 22-MAR-24 NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
23_1j2m9cap
Tag: ORACOPYBKUPONANF_LEVEL_0
Container ID: 3, PDB Name: NTAP1_PDB1

80 24 A 22-MAR-24 4598313 22-MAR-24 NO
Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-

```

24_1k2m9cap
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

79      25    A 22-MAR-24      4598318      22-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
25_1l2m9g3u
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

69      26    A 22-MAR-24      4598304      22-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
26_1m2m9g9j
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

70      27    A 22-MAR-24      4598308      22-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
27_1n2m9gcg
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

75      28    A 22-MAR-24      4598313      22-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
28_1o2m9gd4
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

77      29    A 22-MAR-24      4598318      22-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
29_1p2m9ju6
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

67      30    A 22-MAR-24      4598304      22-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
30_1q2m9k7a
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

76      31    A 22-MAR-24      4598308      22-MAR-24      NO
    Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
31_1r2m9kfk
    Tag: ORACOPYBKUPONANF_LEVEL_0
    Container ID: 3, PDB Name: NTAP1_PDB1

```

```

78      32      A 22-MAR-24      4598313      22-MAR-24      NO
      Name: /nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-
32_1s2m9kgg
      Tag: ORACOPYBKUPONANF_LEVEL_0
      Container ID: 3, PDB Name: NTAP1_PDB1

```

16. 切换要复制的数据库、以便在不还原数据库的情况下运行恢复。

```

RMAN> switch database to copy;

Starting implicit crosscheck backup at 22-MAR-24
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=12 device type=DISK
Crosschecked 33 objects
Finished implicit crosscheck backup at 22-MAR-24

Starting implicit crosscheck copy at 22-MAR-24
using channel ORA_DISK_1
Crosschecked 31 objects
Finished implicit crosscheck copy at 22-MAR-24

searching for all files in the recovery area
cataloging files...
cataloging done

List of Cataloged Files
=====
File Name:
/nfsanf/archlog/NTAP1/autobackup/2024_03_20/o1_mf_s_1164140565__5g56
ypks_.bkp
File Name:
/nfsanf/archlog/NTAP1/autobackup/2024_03_22/o1_mf_s_1164296325__9z77
zyxb_.bkp

datafile 1 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-1_1t2m9nij"
datafile 3 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-3_1u2m9nog"
datafile 4 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-4_1v2m9nu6"
datafile 5 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-5_282m9oem"
datafile 6 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-6_242m9oan"
datafile 7 switched to datafile copy "/nfsanf/oracopy/data_D-

```

NTAP1_I-2441823937_TS-USERS_FNO-7_2c2m9ofn"
datafile 8 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-8_292m9oem"
datafile 9 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-9_252m9oc5"
datafile 10 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-10_212m9o52"
datafile 11 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-11_202m9o22"
datafile 12 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-12_2d2m9ofs"
datafile 13 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-13_262m9oca"
datafile 14 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-14_222m9o53"
datafile 15 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-15_2a2m9of6"
datafile 16 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-16_2e2m9og8"
datafile 17 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSTEM_FNO-17_272m9oel"
datafile 18 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SYSAUX_FNO-18_232m9oa8"
datafile 19 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-UNDOTBS1_FNO-19_2b2m9ofn"
datafile 20 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-USERS_FNO-20_2f2m9og8"
datafile 21 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-21_1h2m9cap"
datafile 22 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-22_1i2m9cap"
datafile 23 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-23_1j2m9cap"
datafile 24 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-24_1k2m9cap"
datafile 25 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-25_1l2m9g3u"
datafile 26 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-26_1m2m9g9j"
datafile 27 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-27_1n2m9gcg"
datafile 28 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-28_1o2m9gd4"
datafile 29 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-29_1p2m9ju6"
datafile 30 switched to datafile copy "/nfsanf/oracopy/data_D-

```
NTAP1_I-2441823937_TS-SOE_FNO-30_1q2m9k7a"
datafile 31 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-31_1r2m9kfk"
datafile 32 switched to datafile copy "/nfsanf/oracopy/data_D-
NTAP1_I-2441823937_TS-SOE_FNO-32_1s2m9kkg"
```

17. 在闪存恢复区域运行Oracle恢复、直到最后一个可用归档日志为止。

```
RMAN> run {
2> set until sequence=11;
3> recover database;
4> }
```

executing command: SET until clause

Starting recover at 22-MAR-24
using channel ORA_DISK_1

starting media recovery

```
archived log for thread 1 with sequence 4 is already on disk as file
/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_4__9y6gn5co_.arc
archived log for thread 1 with sequence 5 is already on disk as file
/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_5__9y7p68s6_.arc
archived log for thread 1 with sequence 6 is already on disk as file
/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_6__9y8ygtss_.arc
archived log for thread 1 with sequence 7 is already on disk as file
/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_7__9ybjdp55_.arc
archived log for thread 1 with sequence 8 is already on disk as file
/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_8__9yctxjgy_.arc
archived log for thread 1 with sequence 9 is already on disk as file
/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_9__9yfrj0b1_.arc
archived log for thread 1 with sequence 10 is already on disk as
file
/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_10__9yomybbc_.ar
c
archived log file
name=/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_4__9y6gn5co
_.arc thread=1 sequence=4
archived log file
name=/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_5__9y7p68s6
_.arc thread=1 sequence=5
archived log file
name=/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_6__9y8ygtss
_.arc thread=1 sequence=6
```



```

archived log file
name=/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_7__9ybjdp55
_.arc thread=1 sequence=7
archived log file
name=/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_8__9yctxjgy
_.arc thread=1 sequence=8
archived log file
name=/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_9__9yfrj0b1
_.arc thread=1 sequence=9
archived log file
name=/nfsanf/archlog/NTAP1/archivelog/2024_03_22/o1_mf_1_10__9yomybb
c_.arc thread=1 sequence=10
media recovery complete, elapsed time: 00:01:17
Finished recover at 22-MAR-24

RMAN> exit

```

Recovery Manager complete.



要加快恢复速度、请使用`recovery _parlism`参数启用并行会话、或者在恢复命令中指定并行程度以进行数据库恢复：`RECOVER DATABASE PARALLEL (DEGREE d INSTANCES DEFAULT);`。通常、并行度应等于主机上的CPU核数。

18. 退出RMAN、以Oracle用户身份通过sqlplus登录到Oracle、以便在恢复不完整后打开数据库并重置日志。

```

SQL> select name, open_mode from v$database;

NAME          OPEN_MODE
-----
NTAP1         MOUNTED

SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME
-----
HOST_NAME
-----
NTAP1
ora-02

SQL>

```

```
SQL> select member from v$logfile;
```

```
MEMBER
```

```
-----  
-----
```

```
/u03/orareco/NTAP1/onlineelog/redo03.log  
/u03/orareco/NTAP1/onlineelog/redo02.log  
/u03/orareco/NTAP1/onlineelog/redo01.log
```

```
SQL> alter database rename file  
'/u03/orareco/NTAP1/onlineelog/redo01.log' to  
'/nfsanf/oracopy/redo01.log';
```

```
Database altered.
```

```
SQL> alter database rename file  
'/u03/orareco/NTAP1/onlineelog/redo02.log' to  
'/nfsanf/oracopy/redo02.log';
```

```
Database altered.
```

```
SQL> alter database rename file  
'/u03/orareco/NTAP1/onlineelog/redo03.log' to  
'/nfsanf/oracopy/redo03.log';
```

```
Database altered.
```

```
SQL> alter database open resetlogs;
```

```
Database altered.
```

```
SQL> show pdbs
```

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

19. 验证已还原到新主机的数据库结构、以及在主VLDB发生故障之前插入的测试行。

```
SQL> select name from v$datafile;
```

```
NAME
```

```
-----
```

```
-----  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-1_1t2m9nij  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-3_1u2m9nog  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-4_1v2m9nu6  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-5_282m9oem  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-6_242m9oan  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-7_2c2m9ofn  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-8_292m9oem  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-9_252m9oc5  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-10_212m9o52  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-  
11_202m9o22  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-12_2d2m9ofs
```

NAME

```
-----  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-13_262m9oca  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-14_222m9o53  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-  
15_2a2m9of6  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-16_2e2m9og8  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSTEM_FNO-17_272m9oel  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SYSAUX_FNO-18_232m9oa8  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-UNDOTBS1_FNO-  
19_2b2m9ofn  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-USERS_FNO-20_2f2m9og8  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-21_1h2m9cap  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-22_1i2m9cap  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-23_1j2m9cap
```

NAME

```
-----  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-24_1k2m9cap  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-25_1l2m9g3u  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-26_1m2m9g9j  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-27_1n2m9g9j  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-28_1o2m9gd4  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-29_1p2m9ju6  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-30_1q2m9k7a  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-31_1r2m9kfk  
/nfsanf/oracopy/data_D-NTAP1_I-2441823937_TS-SOE_FNO-32_1s2m9k9g
```

31 rows selected.

```
SQL> select member from v$logfile;
```

```
MEMBER
```

```
-----  
-----
```

```
/nfsanf/oracopy/redo03.log
```

```
/nfsanf/oracopy/redo02.log
```

```
/nfsanf/oracopy/redo01.log
```

```
SQL> select name from v$controlfile;
```

```
NAME
```

```
-----  
-----
```

```
/nfsanf/oracopy/NTAP1.ctl
```

```
SQL> alter session set container=ntap1_pdb1;
```

```
Session altered.
```

```
SQL> select * from test;
```

```
          ID
```

```
-----
```

```
DT
```

```
-----
```

```
-----
```

```
EVENT
```

```
-----
```

```
-----
```

```
          1
```

```
21-MAR-24 03.15.03.000000 PM
```

```
test oracle incremental merge switch to copy
```

```
          2
```

```
22-MAR-24 02.22.06.000000 PM
```

```
test recovery on a new Azure VM host with image copy on ANF
```

20. 删除无效的临时文件并将新的临时文件添加到临时表空间。

```
SQL> select name from v$tempfile;
```

```
NAME
```

```
-----
```

```
-----
```

```
/u02/oradata/NTAP1/NTAP1_pdb1/temp01.dbf
```

```
/u02/oradata/NTAP1/NTAP1_pdb1/temp02.dbf
```

```
SQL> alter tablespace temp add tempfile  
'/nfsanf/oracopy/ntap1_pdb1_temp01.dbf' size 100M;
```

Tablespace altered.

```
SQL> select name from v$tempfile;
```

NAME

```
-----  
-----
```

```
/u02/oradata/NTAP1/NTAP1_pdb1/temp01.dbf
```

```
/u02/oradata/NTAP1/NTAP1_pdb1/temp02.dbf
```

```
/nfsanf/oracopy/ntap1_pdb1_temp01.dbf
```

```
SQL> alter database tempfile  
'/u02/oradata/NTAP1/NTAP1_pdb1/temp01.dbf' offline;
```

Database altered.

```
SQL> alter database tempfile  
'/u02/oradata/NTAP1/NTAP1_pdb1/temp01.dbf' drop;
```

Database altered.

```
SQL> alter database tempfile  
'/u02/oradata/NTAP1/NTAP1_pdb1/temp02.dbf' offline;
```

Database altered.

```
SQL> alter database tempfile  
'/u02/oradata/NTAP1/NTAP1_pdb1/temp02.dbf' drop;
```

Database altered.

```
SQL> select name from v$tempfile;
```

NAME

```
-----  
-----
```

```
/nfsanf/oracopy/ntap1_pdb1_temp01.dbf
```

```
SQL>
```

21. 其他恢复后任务

- Add ANF NFS mount to fstab so that the NFS file system will be mounted when DB server host rebooted.

As azureuser, sudo vi /etc/fstab and add following entry:

```
172.30.136.68:/ora-01-u02-copy          /nfsanf          nfs
rw,bg,hard,vers=3,proto=tcp,timeo=600,rsz=262144,wsz=262144,noi
tr 0 0
```

- Update the Oracle init file from primary database init file backup that is restored to /tmp/archive and create spfile as needed.

这样、Oracle VLDB数据库便可从ANF NFS文件系统上的备份映像副本恢复到备用数据库服务器主机。

从何处查找追加信息

要了解有关本文档中所述信息的更多信息，请查看以下文档和 / 或网站：

- RMAN：合并增量备份策略(文档ID 745798.1)

["https://support.oracle.com/knowledge/Oracle%20Database%20Products/745798_1.html"](https://support.oracle.com/knowledge/Oracle%20Database%20Products/745798_1.html)

- RMAN备份和恢复用户指南

["https://docs.oracle.com/en/database/oracle/oracle-database/19/bradv/getting-started-rman.html"](https://docs.oracle.com/en/database/oracle/oracle-database/19/bradv/getting-started-rman.html)

- Azure NetApp Files

["https://azure.microsoft.com/en-us/products/netapp"](https://azure.microsoft.com/en-us/products/netapp)

TR-4987：《在采用NFS的Azure NetApp Files上简化的自动化Oracle部署》

NetApp公司Allen Cao、Niyaz Mohamed

本解决方案提供了有关在Microsoft Azure NetApp Files中自动部署Oracle作为使用NFS协议的主数据库存储以及在启用了DNFS的情况下将Oracle数据库部署为容器数据库的概述和详细信息。

目的

在云中运行性能密集型和延迟敏感型Oracle工作负载可能会带来挑战。借助Azure NetApp Files (ANF)、企业业务部门(LOB)和存储专业人员可以轻松迁移和运行要求苛刻的Oracle工作负载、而无需更改代码。Azure NetApp Files广泛用作各种情形下的底层共享文件存储服务、例如、在内部部署或将Oracle数据库迁移(迁移)到Azure等

情形下。

本文档演示了如何使用Azure NetApp Files自动化通过NFS挂载简化Oracle数据库在Oracle中的部署。Oracle数据库部署在启用了Oracle DNFS协议的容器数据库(CDB)和可插拔数据库(PDB)配置中、以提高性能。此外、可以使用自动化PDB重新定位方法将内部Oracle单实例数据库(PDB)迁移到Azure中新部署的容器数据库中、同时最大限度地减少服务中断。此外、还提供了有关使用Azure云中的NetApp SnapCenter UI工具快速备份、还原和克隆Oracle数据库的信息。

此解决方案 可解决以下使用情形：

- 在Azure NetApp Files上自动部署Oracle容器数据库
- 在内部未命中和Azure云之间自动迁移Oracle数据库

audience

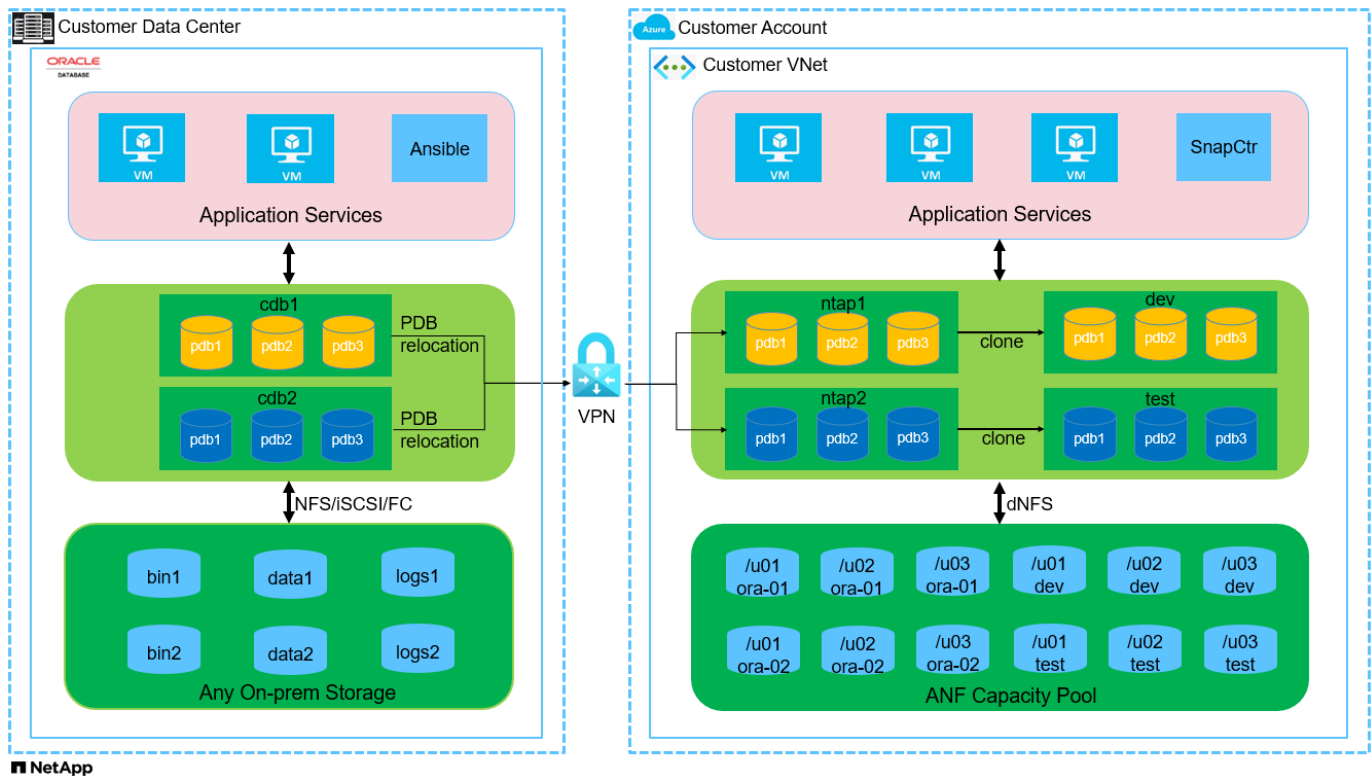
此解决方案 适用于以下人员：

- 希望在Azure NetApp Files上部署Oracle的数据库开发人员。
- 希望在Azure NetApp Files上测试Oracle工作负载的数据库解决方案架构师。
- 希望在Azure NetApp Files上部署和管理Oracle数据库的存储管理员。
- 希望在Azure NetApp Files上建立Oracle数据库的应用程序所有者。

解决方案 测试和验证环境

此解决方案的测试和验证是在实验室环境中执行的、可能与最终部署环境不匹配。请参见一节 [\[部署注意事项的关键因素\]](#) 有关详细信息 ...

架构



硬件和软件组件

* 硬件 *		
Azure NetApp Files	Azure中由Microsoft提供的最新产品	一个具有高级服务级别的容量池
适用于数据库服务器的Azure VM	standard_B4ms—4个vCPU、16 GiB	两个Linux虚拟机实例、用于并发部署
适用于SnapCenter的Azure VM	standard_B4ms—4个vCPU、16 GiB	一个Windows虚拟机实例
软件		
RedHat Linux	RHEL Linux 8.6 (LVM)- x64 Gen2	已部署RedHat订阅以进行测试
Windows服务器	2022 DataCenter; Azure Edition HotPatch - x64 Gen2	托管SnapCenter服务器
Oracle 数据库	版本19.18	已应用RU修补程序p34765931_190000_Linux-x86-64.zip
Oracle OPatch	版本12.2.0.1.36	最新修补程序p6880880_190000_Linux-x86-64.zip
SnapCenter 服务器	版本5.0	工作组部署
打开JDK	版本java-11-OpenJDK	DB VM上的SnapCenter插件要求
NFS	版本 3.0	已启用Oracle DNFS
Ansible	核心2.16.2.	Python 3.6.8

* 服务器 *	* 数据库 *	DB存储
ORA-01	NTAP1 (NTAP1_PDB1、NTAP1_PDB2、NTAP_PDB3)	/u01、/u02、/u03 NFS挂载到ANF容量池上
ORA-02.	NTAP2 (NTAP2_PDB1、NTAP2_PDB2、NTAP2_PDB3)	/u01、/u02、/u03 NFS挂载到ANF容量池上

部署注意事项的关键因素

- *Oracle数据库存储布局。*在此自动化Oracle部署中、我们会默认为每个数据库配置三个数据库卷、以托管Oracle二进制文件、数据和日志。卷会通过NFS以/u01 -二进制、/u02 -数据、/u03 -日志的形式挂载在Oracle数据库服务器上。在/u02和/u03挂载点上配置双控制文件、以实现冗余。
- *部署多个数据库服务器。*自动化解决方案可以在一次运行的AnsablePlaybook中将一个Oracle容器数据库部署到多个数据库服务器。无论数据库服务器的数量如何、该操作手册的执行都保持不变。通过使用不同的数据库实例ID (Oracle SID)重复部署、您可以将多个容器数据库部署到一个VM实例。但是、请确保主机上有足够的内存来支持已部署的数据库。
- *DNFS配置。*通过使用DNFS (自Oracle 11g起提供)、在Azure虚拟机上运行的Oracle数据库可以比本机NFS客户端驱动更多的I/O。默认情况下、Oracle自动化部署会在NFSv3上配置DNFS。
- 分配大容量卷以加快部署速度。ANF文件系统IO吞吐量根据卷大小进行调节。对于初始部署、分配大容量卷可以加快部署速度。之后、可以动态缩减卷的大小、而不会对应用程序造成影响。
- 数据库备份。NetApp提供了一个SnapCenter软件套件、可通过用户友好的用户界面进行数据库备份、还原和克隆。NetApp建议实施此类管理工具、以实现快速(不到一分钟)的快照备份、快速(几分钟)的数据库还原和数据库克隆。

解决方案 部署

以下各节提供了在Azure NetApp Files上通过NFS直接挂载数据库卷自动部署Oracle 19c以及将数据库迁移到Azure VM的分步过程。

部署的前提条件

部署需要满足以下前提条件。

1. 已设置Azure帐户、并且已在Azure帐户中创建必要的vNet和网段。
2. 在Azure云门户中、将Azure Linux VM部署为Oracle数据库服务器。为Oracle数据库创建Azure NetApp Files容量池和数据库卷。为azureuser到DB服务器启用VM SSH私有/公共密钥身份验证。有关环境设置的详细信息、请参见上一节中的架构图。另见 ["Azure VM和Azure NetApp Files 上的Oracle分步部署过程"](#) 了解详细信息。



对于部署了本地磁盘冗余的Azure VM、请确保在VM根磁盘中至少分配了128 G的空间、以便有足够的空间来暂存Oracle安装文件和添加操作系统交换文件。相应地展开/tmp/v和/root/v OS分区。确保数据库卷命名遵循vmname-u01、vmname-u02和vmname-u03约定。

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

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

3. 从Azure云门户中、配置Windows服务器以使用最新版本运行NetApp SnapCenter UI工具。有关详细信息、请参见以下链接： ["安装 SnapCenter 服务器"](#)
4. 将Linux VM配置为安装了最新版本的Ansible和Git的Ansible控制器节点。有关详细信息、请参见以下链接： ["NetApp解决方案 自动化入门"](#) 在第-节中
Setup the Ansible Control Node for CLI deployments on RHEL / CentOS 或
Setup the Ansible Control Node for CLI deployments on Ubuntu / Debian。



只要通过ssh端口访问Azure数据库VM、则Ansible控制器节点就可以查找内部未命中或Azure云中的位置。

5. 克隆一份适用于NFS的NetApp Oracle部署自动化工具包副本。

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

6. Stage Follows 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. 观看以下视频：

自动化参数文件

Ans可 通过预定义的参数执行数据库安装和配置任务。对于此Oracle自动化解决方案、有三个用户定义的参数文件需要用户输入才能执行操作手册。

- 主机—定义运行自动化操作手册的目标。
- vars/vars.yml—用于定义应用于所有目标的变量的全局变量文件。
- host_vars/host_name.yml—用于定义仅适用于指定目标的变量的本地变量文件。在我们的使用情形中、这些是Oracle数据库服务器。

除了这些用户定义的变量文件之外、还有多个默认变量文件包含默认参数、除非必要、否则不需要更改这些参数。以下各节介绍如何配置用户定义的变量文件。

参数文件配置

1. 可逆目标 hosts 文件配置:

```
# Enter Oracle servers names to be deployed one by one, follow by
each Oracle server public IP address, and ssh private key of
azureuser for the server.
[oracle]
ora-01 ansible_host=10.61.180.21 ansible_ssh_private_key_file=ora-
01.pem
ora-02 ansible_host=10.61.180.23 ansible_ssh_private_key_file=ora-
02.pem
```

2. 全局 vars/vars.yml 文件配置

```
#####
##
##### Oracle 19c deployment user configuration variables
#####
##### Consolidate all variables from ANF, linux and oracle
#####
#####
#####

#####
### ANF env specific config variables ###
#####

# Prerequisite to create three volumes in NetApp storage pool from
cloud dashboard with following naming convention:
# db_hostname-u01 - Oracle binary
# db_hostname-u02 - Oracle data
# db_hostname-u03 - Oracle redo
# It is important to strictly follow the name convention or the
automation will fail.

# NFS lif ip address to access database volumes in ANF storage pool
(retrievable from cloud dashboard)
nfs_lif: 172.30.136.68

#####
### Linux env specific config variables ###
#####

redhat_sub_username: XXXXXXXXX
redhat_sub_password: XXXXXXXXX

#####
### DB env specific install and config variables ###
#####

# Database domain name
db_domain: solutions.netapp.com

# Set initial password for all required Oracle passwords. Change
them after installation.
initial_pwd_all: XXXXXXXXX
```

3. 本地数据库服务器 `host_vars/host_name.yml` 配置, 如 `ora_01.yml`、`ora_02.yml` ...

```
# User configurable Oracle host specific parameters

# Enter container database SID. By default, a container DB is
created with 3 PDBs within the CDB
oracle_sid: NTAP1

# Enter database shared memory size or SGA. CDB is created with SGA
at 75% of memory_limit, MB. The grand total of SGA should not exceed
75% available RAM on node.
memory_limit: 8192
```

执行操作手册

自动化工具包中共有五本操作手册。每个任务执行不同的任务块、并用于不同的用途。

```
0-all_playbook.yml - execute playbooks from 1-4 in one playbook run.
1-ansible_requirements.yml - set up Ansible controller with required
libs and collections.
2-linux_config.yml - execute Linux kernel configuration on Oracle DB
servers.
4-oracle_config.yml - install and configure Oracle on DB servers and
create a container database.
5-destroy.yml - optional to undo the environment to dismantle all.
```

使用以下命令可通过三个选项运行这些操作手册。

1. 一次运行即可执行所有部署操作手册。

```
ansible-playbook -i hosts 0-all_playbook.yml -u azureuser -e
@vars/vars.yml
```

2. 使用1-4的数字顺序执行一次一个操作手册。

```
ansible-playbook -i hosts 1-ansible_requirements.yml -u azureuser -e
@vars/vars.yml
```

```
ansible-playbook -i hosts 2-linux_config.yml -u azureuser -e
@vars/vars.yml
```

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

3. 使用标记执行0-all_playbook.yml。

```
ansible-playbook -i hosts 0-all_playbook.yml -u azureuser -e
@vars/vars.yml -t ansible_requirements
```

```
ansible-playbook -i hosts 0-all_playbook.yml -u azureuser -e
@vars/vars.yml -t linux_config
```

```
ansible-playbook -i hosts 0-all_playbook.yml -u azureuser -e  
@vars/vars.yml -t oracle_config
```

4. 撤消环境

```
ansible-playbook -i hosts 5-destroy.yml -u azureuser -e  
@vars/vars.yml
```

执行后验证

运行此操作手册后、登录到Oracle数据库服务器VM、以验证是否已安装和配置Oracle以及是否已成功创建容器数据库。以下是在主机ora-01上验证Oracle数据库的示例。

1. 验证NFS挂载

```
[azureuser@ora-01 ~]$ cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Thu Sep 14 11:04:01 2023
#
# Accessible filesystems, by reference, are maintained under
# '/dev/disk/'.
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for
# more info.
#
# After editing this file, run 'systemctl daemon-reload' to update
# systemd
# units generated from this file.
#
/dev/mapper/rootvg-rootlv / xfs defaults
0 0
UUID=268633bd-f9bb-446d-9a1d-8fca4609a1e1 /boot
xfs defaults 0 0
UUID=89D8-B037 /boot/efi vfat
defaults,uid=0,gid=0,umask=077,shortname=winnt 0 2
/dev/mapper/rootvg-homelv /home xfs defaults
0 0
/dev/mapper/rootvg-tmplv /tmp xfs defaults
0 0
/dev/mapper/rootvg-usrlv /usr xfs defaults
0 0
/dev/mapper/rootvg-varlv /var xfs defaults
0 0
/mnt/swapfile swap swap defaults 0 0
172.30.136.68:/ora-01-u01 /u01 nfs
rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=65536,wsiz=65536 0 0
172.30.136.68:/ora-01-u02 /u02 nfs
rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=65536,wsiz=65536 0 0
172.30.136.68:/ora-01-u03 /u03 nfs
rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=65536,wsiz=65536 0 0

[azureuser@ora-01 ~]$ 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	8.6M	7.7G	1%	/run
tmpfs	7.8G	0	7.8G	0%	/sys/fs/cgroup
/dev/mapper/rootvg-rootlv	22G	17G	5.8G	74%	/
/dev/mapper/rootvg-usrlv	10G	2.0G	8.1G	20%	/usr
/dev/mapper/rootvg-varlv	8.0G	890M	7.2G	11%	/var
/dev/sda1	496M	106M	390M	22%	/boot
/dev/mapper/rootvg-homelv	1014M	40M	975M	4%	/home
/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-01-u01	500G	11G	490G	3%	/u01
172.30.136.68:/ora-01-u03	250G	1.2G	249G	1%	/u03
172.30.136.68:/ora-01-u02	250G	7.1G	243G	3%	/u02
tmpfs	1.6G	0	1.6G	0%	/run/user/1000

2. 验证Oracle侦听器

```
[azureuser@ora-01 ~]$ sudo su
[root@ora-01 azureuser]# su - oracle
Last login: Thu Feb  1 16:13:44 UTC 2024
[oracle@ora-01 ~]$ lsnrctl status listener.ntap1

LSNRCTL for Linux: Version 19.0.0.0.0 - Production on 01-FEB-2024
16:25:37

Copyright (c) 1991, 2022, Oracle.  All rights reserved.

Connecting to (DESCRIPTION=(ADDRESS=(PROTOCOL=TCP) (HOST=ora-
01.internal.cloudapp.net) (PORT=1521)))
STATUS of the LISTENER
-----
Alias                     LISTENER.NTAP1
Version                   TNSLSNR for Linux: Version 19.0.0.0.0 -
Production
Start Date                01-FEB-2024 16:13:49
Uptime                    0 days 0 hr. 11 min. 49 sec
Trace Level               off
Security                  ON: Local OS Authentication
SNMP                      OFF
Listener Parameter File   /u01/app/oracle/product/19.0.0/NTAP1/network/admin/listener.ora
Listener Log File         /u01/app/oracle/diag/tnslsnr/ora-
01/listener.ntap1/alert/log.xml
Listening Endpoints Summary...
```

```

      (DESCRIPTION=(ADDRESS=(PROTOCOL=tcp) (HOST=ora-
01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net) (PORT=1521)))
      (DESCRIPTION=(ADDRESS=(PROTOCOL=ipc) (KEY=EXTPROC1521)))
      (DESCRIPTION=(ADDRESS=(PROTOCOL=tcps) (HOST=ora-
01.hr2z2nbmhnqutdsxgscjtuxizd.jx.internal.cloudapp.net) (PORT=5500)) (
Security=(my_wallet_directory=/u01/app/oracle/product/19.0.0/NTAP1/a
dmin/NTAP1/xdb_wallet)) (Presentation=HTTP) (Session=RAW))
Services Summary...
Service "104409ac02da6352e063bb891eacf34a.solutions.netapp.com" has
1 instance(s).
    Instance "NTAP1", status READY, has 1 handler(s) for this
service...
Service "104412c14c2c63cae063bb891eacf64d.solutions.netapp.com" has
1 instance(s).
    Instance "NTAP1", status READY, has 1 handler(s) for this
service...
Service "1044174670ad63ffe063bb891eac6b34.solutions.netapp.com" has
1 instance(s).
    Instance "NTAP1", status READY, has 1 handler(s) for this
service...
Service "NTAP1.solutions.netapp.com" has 1 instance(s).
    Instance "NTAP1", status READY, has 1 handler(s) for this
service...
Service "NTAP1XDB.solutions.netapp.com" has 1 instance(s).
    Instance "NTAP1", status READY, has 1 handler(s) for this
service...
Service "ntap1_pdb1.solutions.netapp.com" has 1 instance(s).
    Instance "NTAP1", status READY, has 1 handler(s) for this
service...
Service "ntap1_pdb2.solutions.netapp.com" has 1 instance(s).
    Instance "NTAP1", status READY, has 1 handler(s) for this
service...
Service "ntap1_pdb3.solutions.netapp.com" has 1 instance(s).
    Instance "NTAP1", status READY, has 1 handler(s) for this
service...
The command completed successfully

```

3. 验证Oracle数据库和DNFS

```

[oracle@ora-01 ~]$ 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.
#
#
NTAP1:/u01/app/oracle/product/19.0.0/NTAP1:Y
```

```
[oracle@ora-01 ~]$ sqlplus / as sysdba
```

```
SQL*Plus: Release 19.0.0.0.0 - Production on Thu Feb 1 16:37:51 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
NTAP1	READ WRITE	ARCHIVELOG

```
SQL> show pdbs
```

CON_ID	CON_NAME	OPEN MODE	RESTRICTED
2	PDB\$SEED	READ ONLY	NO
3	NTAP1_PDB1	READ WRITE	NO
4	NTAP1_PDB2	READ WRITE	NO

```
SQL> select name from v$datafile;
```

```
NAME
```

```
-----
-----
/u02/oradata/NTAP1/system01.dbf
/u02/oradata/NTAP1/sysaux01.dbf
/u02/oradata/NTAP1/undotbs01.dbf
/u02/oradata/NTAP1/pdbseed/system01.dbf
/u02/oradata/NTAP1/pdbseed/sysaux01.dbf
/u02/oradata/NTAP1/users01.dbf
/u02/oradata/NTAP1/pdbseed/undotbs01.dbf
/u02/oradata/NTAP1/NTAP1_pdb1/system01.dbf
/u02/oradata/NTAP1/NTAP1_pdb1/sysaux01.dbf
/u02/oradata/NTAP1/NTAP1_pdb1/undotbs01.dbf
/u02/oradata/NTAP1/NTAP1_pdb1/users01.dbf
```

```
NAME
```

```
-----
-----
/u02/oradata/NTAP1/NTAP1_pdb2/system01.dbf
/u02/oradata/NTAP1/NTAP1_pdb2/sysaux01.dbf
/u02/oradata/NTAP1/NTAP1_pdb2/undotbs01.dbf
/u02/oradata/NTAP1/NTAP1_pdb2/users01.dbf
/u02/oradata/NTAP1/NTAP1_pdb3/system01.dbf
/u02/oradata/NTAP1/NTAP1_pdb3/sysaux01.dbf
/u02/oradata/NTAP1/NTAP1_pdb3/undotbs01.dbf
/u02/oradata/NTAP1/NTAP1_pdb3/users01.dbf
```

```
19 rows selected.
```

```
SQL> select name from v$controlfile;
```

```
NAME
```

```
-----
-----
/u02/oradata/NTAP1/control01.ctl
/u03/orareco/NTAP1/control02.ctl
```

```
SQL> select member from v$logfile;
```

```
MEMBER
```

```
-----
-----
/u03/orareco/NTAP1/onlineelog/redo03.log
```

```
/u03/orareco/NTAP1/onlineelog/redo02.log
```

```
/u03/orareco/NTAP1/onlineelog/redo01.log
```

```
SQL> select svrname, dirname, nfsversion from v$dnfs_servers;
```

```
SVRNAME
```

```
-----
```

```
-----
```

```
DIRNAME
```

```
-----
```

```
-----
```

```
NFSVERSION
```

```
-----
```

```
172.30.136.68
```

```
/ora-01-u02
```

```
NFSv3.0
```

```
172.30.136.68
```

```
/ora-01-u03
```

```
NFSv3.0
```

```
SVRNAME
```

```
-----
```

```
-----
```

```
DIRNAME
```

```
-----
```

```
-----
```

```
NFSVERSION
```

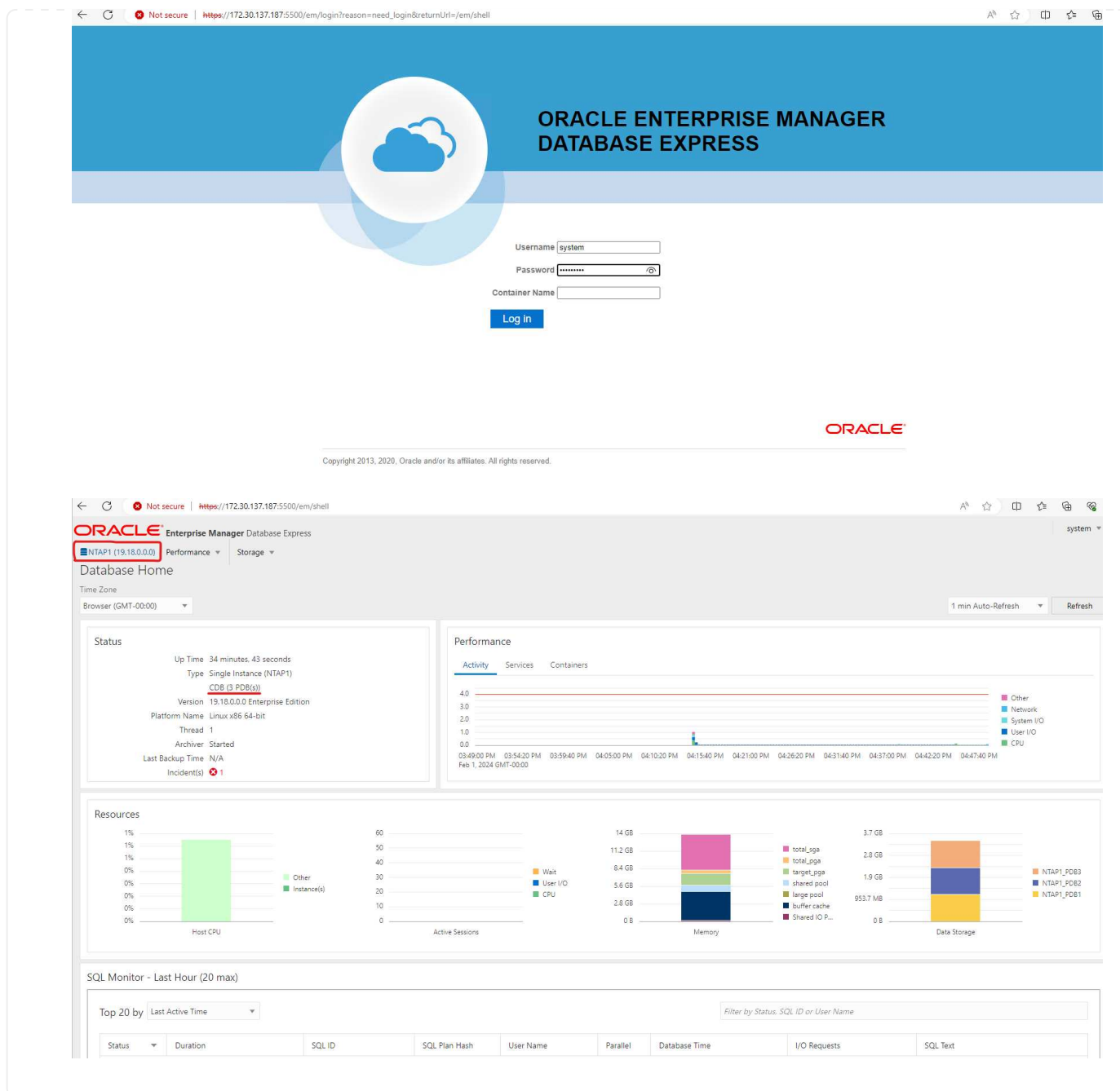
```
-----
```

```
172.30.136.68
```

```
/ora-01-u01
```

```
NFSv3.0
```

4. 登录到Oracle Enterprise Manager Express以验证数据库。



将Oracle数据库迁移到Azure

Oracle数据库从内部迁移到云是一项繁重的工作。使用正确的策略和自动化可以使流程顺畅进行、并最大限度地减少服务中断和停机时间。请遵循此详细说明 ["将数据库从内部迁移到Azure云"](#) 指导您的数据库迁移之旅。

使用SnapCenter进行Oracle备份、还原和克隆

NetApp建议使用SnapCenter UI工具来管理部署在Azure云中的Oracle数据库。请参阅TR-4988: ["使用SnapCenter在ANF上执行Oracle数据库备份、恢复和克隆"](#) 了解详细信息。

从何处查找追加信息

要了解有关本文档中所述信息的更多信息，请查看以下文档和 / 或网站：

- 使用SnapCenter在ANF上执行Oracle数据库备份、恢复和克隆

["使用SnapCenter在ANF上执行Oracle数据库备份、恢复和克隆"](#)

- Azure NetApp Files

["https://azure.microsoft.com/en-us/products/netapp"](https://azure.microsoft.com/en-us/products/netapp)

- 部署Oracle Direct NFS

["https://docs.oracle.com/en/database/oracle/oracle-database/19/ladbi/deploying-dnfs.html#GUID-D06079DB-8C71-4F68-A1E3-A75D7D96DCE2"](https://docs.oracle.com/en/database/oracle/oracle-database/19/ladbi/deploying-dnfs.html#GUID-D06079DB-8C71-4F68-A1E3-A75D7D96DCE2)

- 使用响应文件安装和配置Oracle数据库

["https://docs.oracle.com/en/database/oracle/oracle-database/19/ladbi/installing-and-configuring-oracle-database-using-response-files.html#GUID-D53355E9-E901-4224-9A2A-B882070EDDF7"](https://docs.oracle.com/en/database/oracle/oracle-database/19/ladbi/installing-and-configuring-oracle-database-using-response-files.html#GUID-D53355E9-E901-4224-9A2A-B882070EDDF7)

Azure NetApp Files 上的Oracle数据库部署和保护

TR-4954：《Azure NetApp Files 上的Oracle数据库部署和保护》

本最佳实践指南详细介绍了在Azure NetApp文件存储和Azure VM上部署和保护Oracle数据库的解决方案。

作者：NetApp公司Allen Cao、Niyaz Mohamed

概述

许多任务关键型Oracle企业数据库仍托管在内部、许多企业都希望将这些Oracle数据库迁移到公共云。这些Oracle数据库通常以应用程序为中心、因此需要用户专用配置、而许多数据库即服务公共云产品都缺少这一功能。因此、当前的数据库环境要求基于公共云的Oracle数据库解决方案、该数据库是基于高性能、可扩展的计算和存储服务构建的、可满足独特的需求。Azure虚拟机计算实例和Azure NetApp Files 存储服务可能是这一难题中缺少的部分、您可以利用它构建任务关键型Oracle数据库工作负载并将其迁移到公共云。

Azure虚拟机

Azure虚拟机是Azure提供的多种按需、可扩展计算资源之一。通常、如果您需要比其他选项更好地控制计算环境、则可以选择虚拟机。Azure虚拟机提供了一种快速简单的方法来创建运行Oracle数据库所需的特定配置的计算机、无论该数据库是用于计算密集型工作负载还是内存密集型工作负载。Azure虚拟网络中的虚拟机可以轻松连接到您组织的网络、例如、通过安全的VPN通道。

Azure NetApp 文件 (ANF)

Azure NetApp Files 是一项完全受管的Microsoft服务、它可以让您的数据库工作负载以前所未有的速度更安全地迁移到云中。它旨在满足在云中运行高性能工作负载(例如Oracle数据库)的核心要求、并提供了能够反映实际IOPS需求范围、低延迟、高可用性、高持久性、大规模易管理性的性能层。以及快速高效的备份、恢复和克隆

隆。之所以能够提供这些功能、是因为Azure NetApp Files 基于在Azure数据中心环境中运行的物理全闪存NetApp ONTAP 系统。Azure NetApp Files 完全集成到Azure DC和门户中、客户可以使用与任何其他Azure对象相同的舒适图形界面和API来创建和管理共享文件。借助Azure NetApp文件、您可以在不增加风险、成本或时间的情况下充分发挥Azure的全部功能、并信任Azure自带的唯一企业级文件服务。

结论

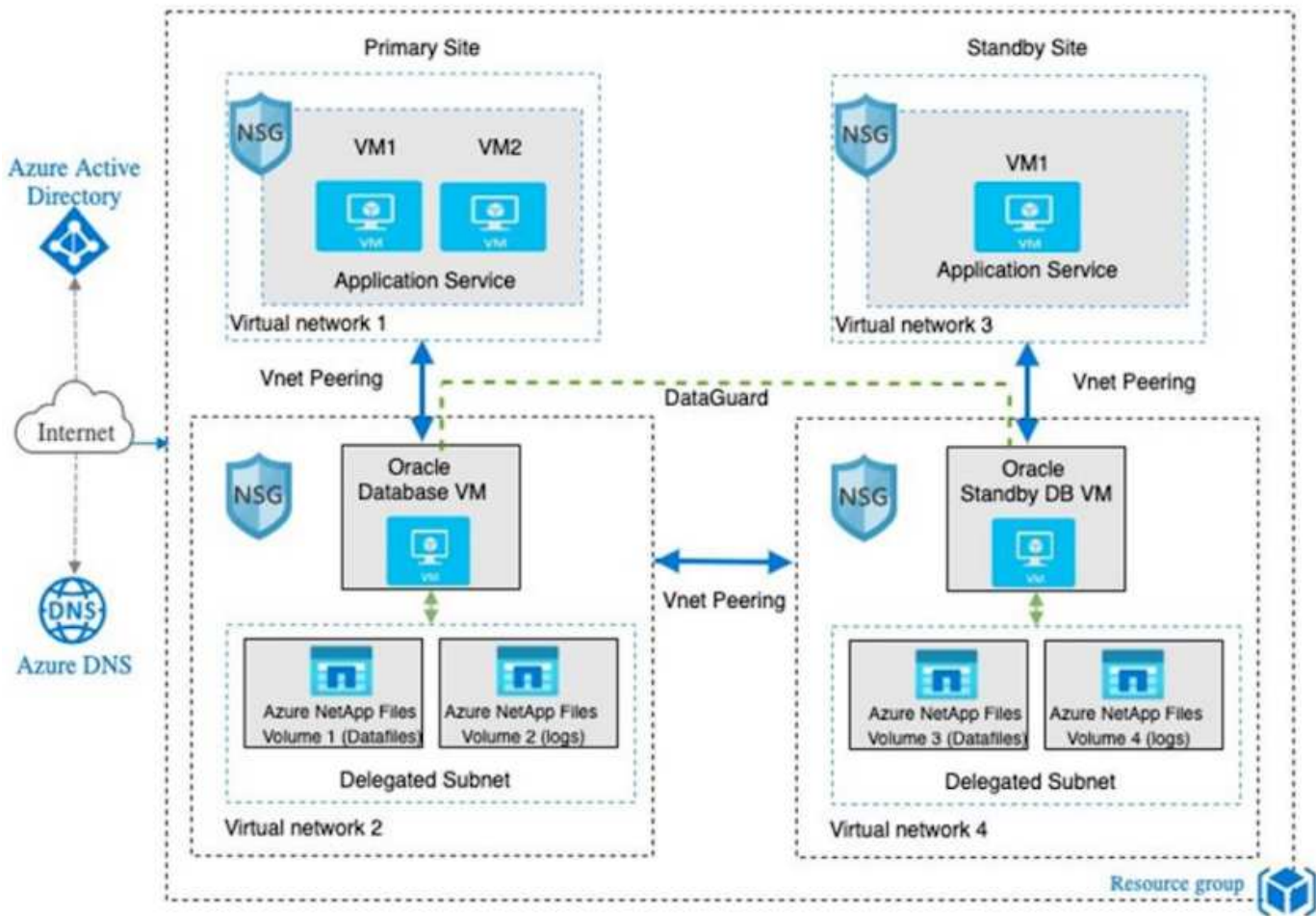
本文档详细介绍了如何使用Azure虚拟机和Azure NetApp Files 存储服务部署、配置和保护Oracle数据库、该服务可提供与内部系统类似的性能和持久性。有关最佳实践指导、请参见TR-4780 "[Microsoft Azure上的Oracle数据库](#)"。更重要的是、NetApp还提供了自动化工具包、可自动执行在Azure公共云中部署、配置、数据保护、迁移和管理Oracle数据库工作负载所需的大部分任务。这些自动化工具包可从NetApp公共GitHub站点下载：["NetApp-Automation"](#)。

解决方案架构

以下架构图展示了在Azure VM实例和Azure NetApp Files 存储上部署高可用性Oracle数据库的情况。

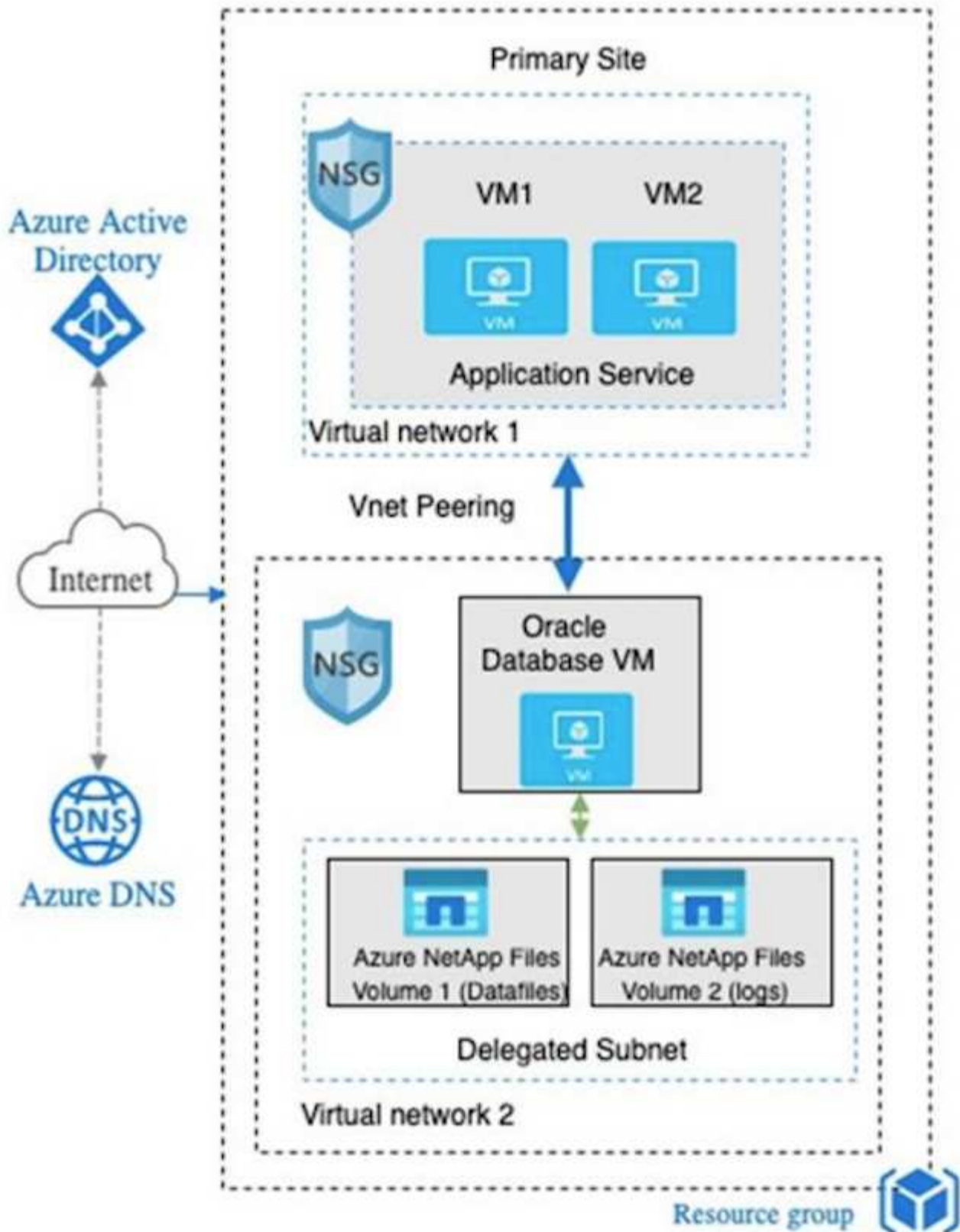
在环境中、Oracle计算实例通过Azure服务VM控制台进行部署。控制台提供了多种Azure实例类型。NetApp建议部署一个面向数据库的Azure VM实例、以满足您的预期工作负载。

另一方面、Oracle数据库存储则通过Azure控制台提供的Azure NetApp Files 服务进行部署。随后、Oracle二进制卷、数据卷或日志卷将显示并挂载到Azure VM实例Linux主机上。



在许多方面、在Azure云中实施Azure NetApp Files 与具有许多内置冗余功能(例如RAID和双控制器)的内部ONTAP 数据存储架构非常相似。对于灾难恢复、可以在不同区域设置备用站点、并且可以使用应用程序级复制(例如Oracle Data Guard)将数据库与主站点同步。

在我们对Oracle数据库部署和数据保护进行的测试验证中、Oracle数据库部署在一个Azure虚拟机上、如下图所示：



Azure Oracle环境可通过Ansible控制器节点进行管理、以便使用NetApp提供的用于数据库部署、备份、恢复和数据库迁移的工具包实现自动化。可以并行执行对Oracle Azure VM实例操作系统内核或Oracle修补的任何更新、以使主系统和备用系统保持同步。事实上、初始工具包可以轻松扩展、以便在需要时执行日常Oracle任务。如果您需要有关设置CLI Ansible控制器的帮助、请参见 ["NetApp 解决方案自动化"](#) 开始使用。

部署Oracle数据库时需要考虑的因素

公有云为计算和存储提供了多种选择、使用正确类型的计算实例和存储引擎是开始部署数据库的好地方。您还应选择针对Oracle数据库进行优化的计算和存储配置。

以下各节介绍在采用Azure NetApp Files 存储的Azure虚拟机实例上的Azure公共云中部署Oracle数据库时的主要注意事项。

VM类型和规模估算

选择合适的VM类型和大小对于优化公共云中关系数据库的性能非常重要。Azure虚拟机提供了各种计算实例、可用于托管Oracle数据库工作负载。请参见Microsoft文档 ["Azure中虚拟机的大小"](#) 不同类型的Azure虚拟机及其规模估算。一般来说、NetApp建议使用通用Azure虚拟机来部署中小型Oracle数据库。对于部署大型Oracle数据库、适合使用经过内存优化的Azure VM。利用更多可用RAM、可以配置更大的Oracle SGA或智能闪存缓存、以减少物理I/O、进而提高数据库性能。

Azure NetApp Files 用作连接到Azure虚拟机的NFS挂载、可提供更高的吞吐量、并通过本地存储克服存储优化的VM吞吐量限制。因此、在Azure NetApp Files 上运行Oracle可以减少可获得许可的Oracle CPU核心数量和许可成本。请参见 ["TR-4780: Microsoft Azure上的Oracle数据库"](#)第7节—Oracle许可的工作原理

需要考虑的其他因素包括：

- 根据工作负载特征选择正确的vCPU和RAM组合。随着VM上的RAM大小增加、vCPU核心数也会增加。由于Oracle许可证费用是按vCPU核心数收取的、因此应在某一时刻保持平衡。
- 向VM添加交换空间。默认Azure VM部署不会创建交换空间、而交换空间对于数据库来说并不是最佳选择。

Azure NetApp Files 性能

Azure NetApp Files 卷从客户必须在其Azure NetApp Files 存储帐户中配置的容量池中分配。每个容量池的分配如下：

- 定义整体性能功能的服务级别。
- 最初为此容量池配置的存储容量或分层。一种服务质量(QoS)级别、用于定义每个已配置空间的总最大吞吐量。

服务级别和初始配置的存储容量决定了特定Oracle数据库卷的性能级别。

1. Azure NetApp Files 的服务级别

Azure NetApp Files 支持三种服务级别："超"、"高级"和"标准"。

- *超存储。*此层可为分配的卷配额的每1 TiB提供高达128 MiB的吞吐量。
- *高级存储。*此层分配的卷配额每1 TiB可提供高达64 MiB的吞吐量。
- *标准存储。*此层可为分配的卷配额的每1 TiB提供高达16 MiB的吞吐量。

2. 容量池和服务质量

每个所需的服务级别都与已配置容量相关、并包括一个服务质量(QoS)级别、用于定义已配置空间的总最大吞吐量。

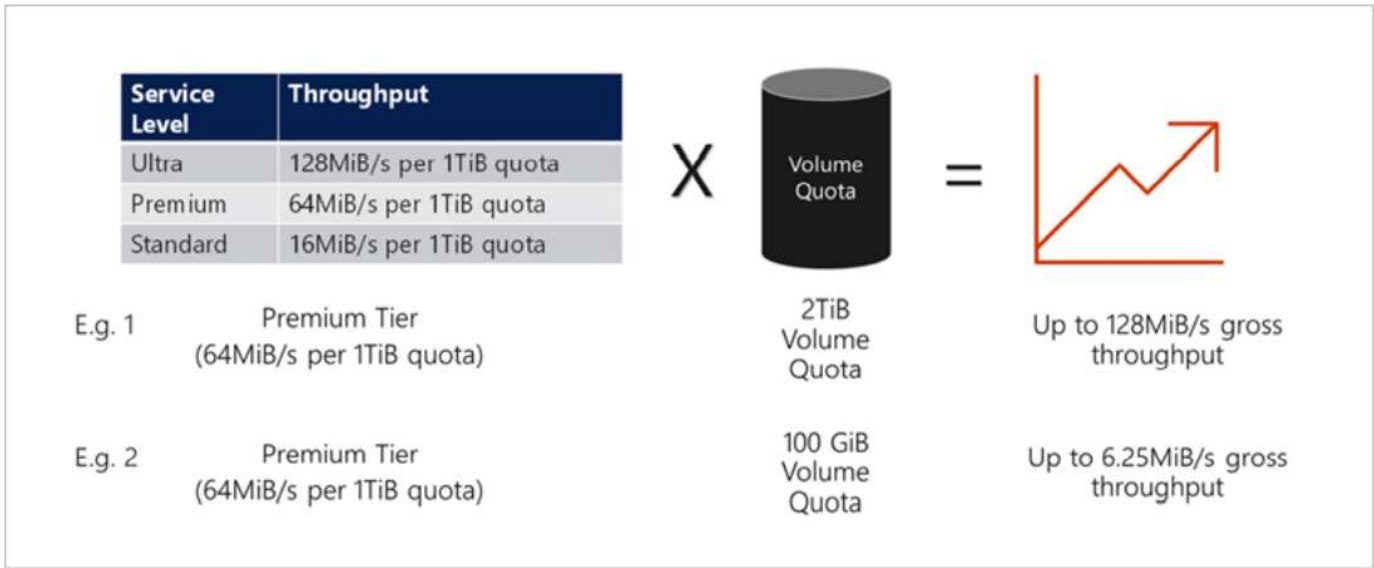
例如、具有高级服务级别的10 TiB配置单容量池可为该容量池中的所有卷提供10倍64 MBps的整体可用吞吐量、因此、640 MBps可提供40、000 (16 K)个IOPS或80、000 (8 K)个IOPS。

最小容量池大小为4 TiB。您可以根据工作负载需求的变化以1 TiB为增量更改容量池的大小、以管理存储需求和成本。

3.计算数据库卷的服务级别

Oracle数据库卷的吞吐量限制由以下因素组合决定：卷所属容量池的服务级别以及分配给卷的配额。

下图显示了如何计算Oracle数据库卷的吞吐量限制。



在示例1中、如果容量池中的高级存储层分配了2 TiB的配额、则该卷的吞吐量限制为128 MiBps (2 TiB * 64 MiBps)。无论容量池大小或实际卷占用情况如何、此方案都适用。

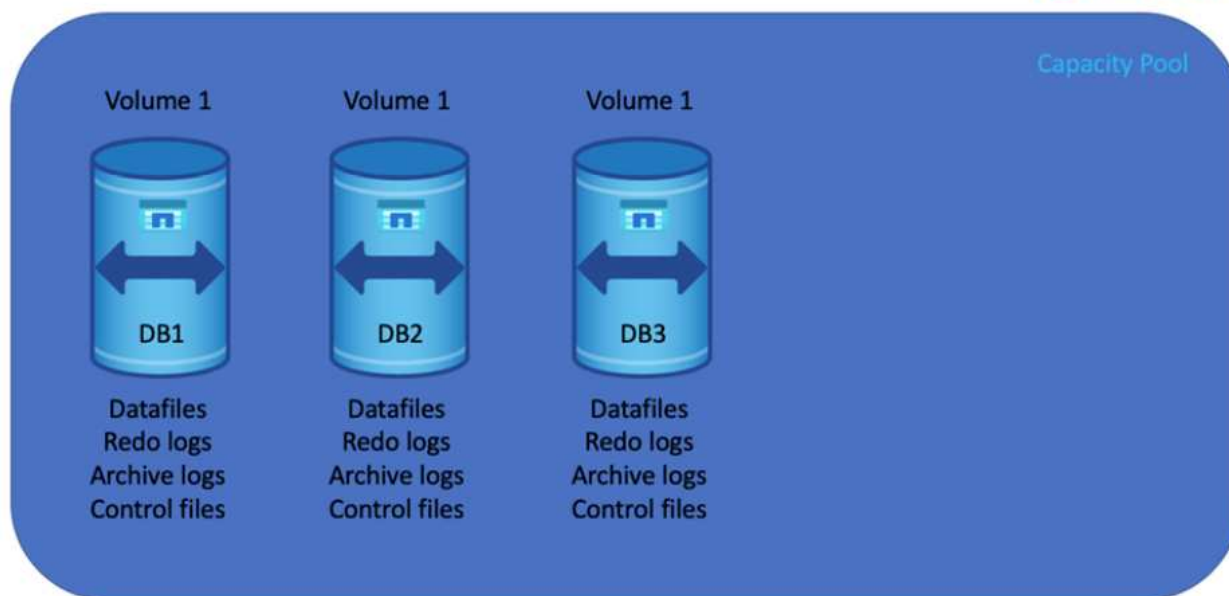
在示例2中、如果容量池中的高级存储层分配了100 GiB的配额、则该卷的吞吐量限制为6.25 MiBps (0.09765625TiB * 64 MiBps)。无论容量池大小或实际卷占用情况如何、此方案都适用。

请注意、最小卷大小为100GiB。

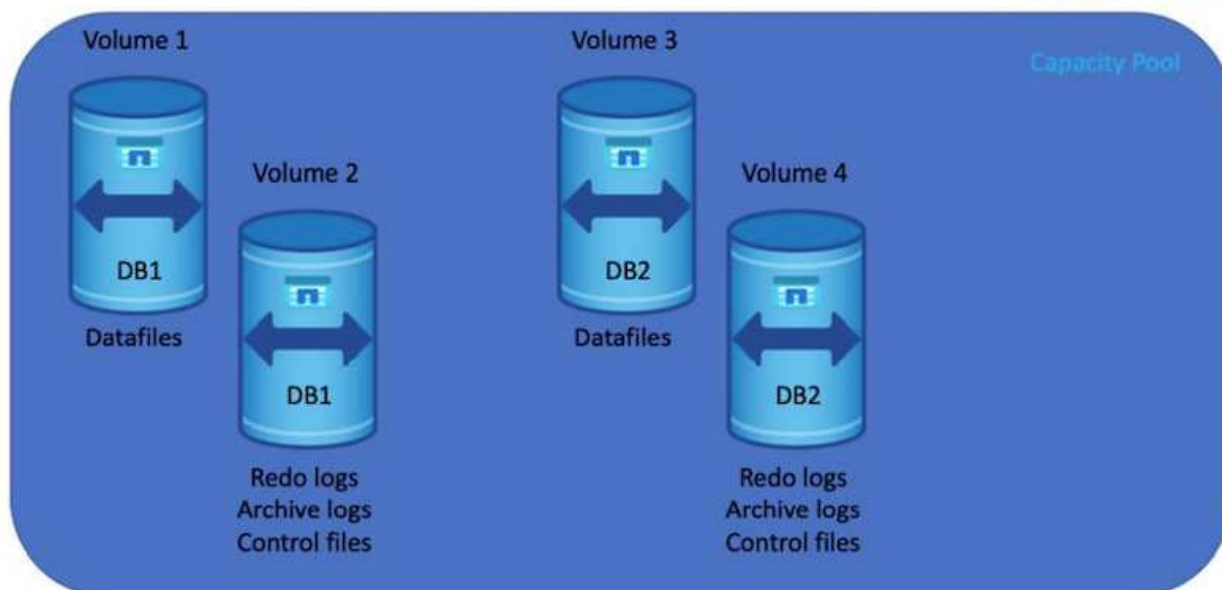
存储布局 and 设置

NetApp建议采用以下存储布局：

- 对于小型数据库、对所有Oracle文件使用单个卷布局。



- 对于大型数据库、建议的卷布局为多个卷：一个用于Oracle数据和另一个重复的控制文件、一个用于Oracle活动日志、归档日志和控制文件。NetApp强烈建议为Oracle二进制文件而不是本地驱动器分配一个卷、以便可以将数据库重新定位到新主机并快速还原。

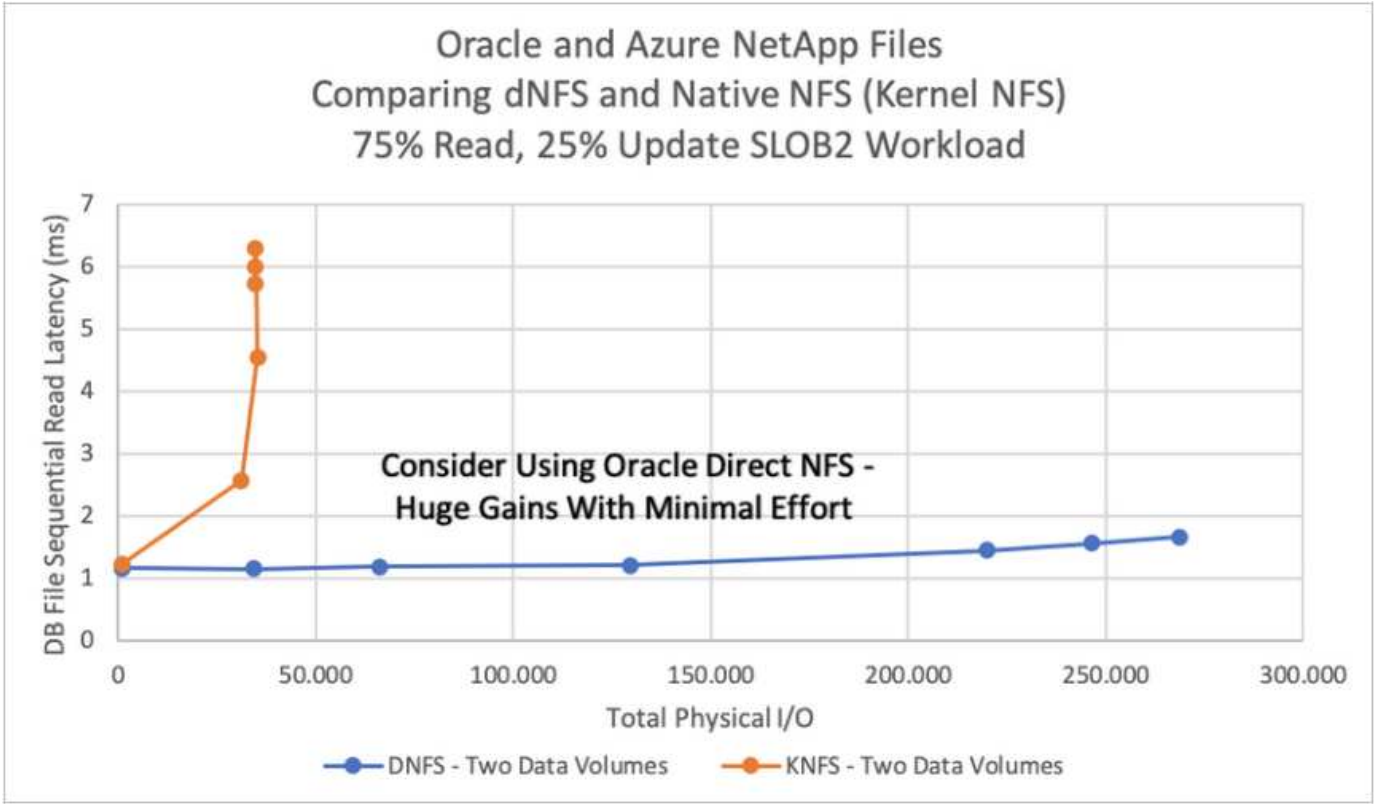


NFS 配置

最常见的操作系统Linux具有原生 NFS功能。Oracle提供了一个直接NFS (DNFS)客户端、该客户端本机集成到Oracle中。Oracle DNFS可绕过操作系统缓存并启用并行处理以提高数据库性能。Oracle支持NFSv3的时间已超过20年、而Oracle 12.1.0.2及更高版本支持NFSv4。

通过使用DNFS (自Oracle 11g起提供)、在Azure虚拟机上运行的Oracle数据库可以比本机NFS客户端驱动更多的I/O。使用NetApp自动化工具包自动部署Oracle会自动在NFSv3上配置DNFS。

下图展示了采用Oracle DNFS的Azure NetApp Files 上的SLOB基准测试。



需要考虑的其他因素：

- TCP插槽表是主机总线适配器(host-bus-adapter、HBA)队列深度的NFS等效项。这些表可控制任何时候都可以处理的NFS操作的数量。默认值通常为16、该值太低、无法实现最佳性能。在较新的Linux内核上会出现相反的问题、这会自动将TCP插槽表限制增加到使NFS服务器充满请求的级别。

为了获得最佳性能并防止出现性能问题、请将控制TCP插槽表的内核参数调整为128。

```
sysctl -a | grep tcp.*.slot_table
```

- 下表提供了单个Linux NFSv3实例的建议NFS挂载选项。

File Type	Mount Options
<ul style="list-style-type: none">• Control files• Data files• Redo logs	rw,bg,hard,vers=3,proto=tcp,timeo=600,rsz=65536,wsz=65536
<ul style="list-style-type: none">• ORACLE_HOME• ORACLE_BASE	rw,bg,hard,vers=3,proto=tcp,timeo=600,rsz=65536,wsz=65536



在使用DNFS之前、请验证是否已安装Oracle文档1495104.1中所述的修补程序。NetApp针对NFSv3和NFSv4的支持列表不包括特定的操作系统。支持所有符合RFC的操作系统。在联机IMT 中搜索NFSv3或NFSv4支持时、请勿选择特定操作系统、因为不会显示任何匹配项。常规策略隐式支持所有操作系统。

Azure VM和Azure NetApp Files 上的Oracle分步部署过程

本节介绍使用FSX存储部署Oracle RDS自定义数据库的部署过程。

通过**Azure**门户控制台使用适用于**Oracle**的**ANF**部署**Azure**虚拟机

如果您是Azure的新用户、则首先需要设置Azure帐户环境。这包括注册您的组织以使用Azure Active Directory。以下部分总结了这些步骤。有关详细信息、请参见特定于Azure的链接文档。

创建和使用**Azure**资源

设置Azure环境并创建帐户并将其与订阅关联后、您可以使用帐户登录到Azure门户以创建运行Oracle所需的资源。

1.创建虚拟网络或vNet

Azure虚拟网络(vNet)是Azure中专用网络的基本组件。VNet支持Azure虚拟机(VM)等多种类型的Azure资源安全地相互通信、并与Internet和内部网络进行通信。在配置Azure VM之前、必须先配置vNet (部署VM的位置)。

请参见 ["使用Azure门户创建虚拟网络"](#) 创建vNet。

2.为ANF创建NetApp存储帐户和容量池

在此部署场景中、Azure VM操作系统使用常规Azure存储进行配置、但ANF卷配置为通过NFS运行Oracle数据库。首先、您需要创建NetApp存储帐户和容量池来托管存储卷。

请参见 ["设置Azure NetApp Files 并创建NFS卷"](#) 设置ANF容量池。

3.为Oracle配置Azure VM

根据您的工作负载、确定您需要哪种类型的Azure VM以及要为Oracle部署的VM vCPU和RAM的大小。然后、在Azure控制台中、单击虚拟机图标以启动虚拟机部署工作流。

1. 在Azure VM页面中、单击*创建*、然后选择* Azure虚拟机*。

Microsoft Azure

Search resources, services, and docs (G+)

acaio@netapp.com

HYBRID CLOUD TME

Home

Virtual machines

Hybrid Cloud TME

Create

Switch to classic

Reservations

Manage view

Refresh

Export to CSV

Open query

Assign tags

Start

Restart

Stop

Delete

Services

Maintenance

Filter for any field...

Subscription equals all

Type equals all

Resource group equals all

Location equals all

Add filter

No grouping

List view

<input type="checkbox"/> Name ↑↓	Type ↑↓	Subscription ↑↓	Resource group ↑↓	Location ↑↓	Status ↑↓	Operating system ↑↓	Size ↑↓	Public IP address ↑↓	Disks ↑↓	
<input type="checkbox"/> acao-ora01	Virtual machine	Hybrid Cloud TME Onprem	TMEtstres	South Central US	Stopped (deallocated)	Linux	Standard_B4ms	13.65.63.157	1	...
<input type="checkbox"/> ANFAVFa2JH	Virtual machine	Hybrid Cloud TME Onprem	ANFAVSVAL2	West Europe	Running	Windows	Standard_DS2_v2	20.229.80.88	1	...
<input type="checkbox"/> ANFAVSfo01	Virtual machine	Hybrid Cloud TME Onprem	anfavsg	South Central US	Stopped (deallocated)	Linux	Standard_DS2ds_v4	-	1	...
<input type="checkbox"/> ANFAVSfoAZ1	Virtual machine	Hybrid Cloud TME Onprem	anfavsg	South Central US	Running	Linux	Standard_E32as_v4	40.124.74.246	1	...
<input type="checkbox"/> ANFAVSfoAZ2	Virtual machine	Hybrid Cloud TME Onprem	anfavsg	South Central US	Stopped (deallocated)	Linux	Standard_E32as_v4	40.124.178.111	1	...
<input type="checkbox"/> ANFAVSfoAZ3	Virtual machine	Hybrid Cloud TME Onprem	anfavsg	South Central US	Stopped (deallocated)	Linux	Standard_E32as_v4	40.124.194.32	1	...
<input type="checkbox"/> ANFAVSvalDC	Virtual machine	Hybrid Cloud TME Onprem	anfavsg	South Central US	Stopped (deallocated)	Windows	Standard_B4ms	-	1	...
<input type="checkbox"/> ANFAVSvalIH	Virtual machine	Hybrid Cloud TME Onprem	anfavsg	South Central US	Running	Windows	Standard_B2ms	70.37.66.218	1	...
<input type="checkbox"/> ANFAVSvalIH2	Virtual machine	Hybrid Cloud TME Onprem	anfavsg	South Central US	Running	Windows	Standard_B2s	20.225.210.195	1	...
<input type="checkbox"/> ANFCVOCM	Virtual machine	Hybrid Cloud TME Onprem	anfavsva2	West Europe	Running	Linux	Standard_DS3_v2	-	1	...
<input type="checkbox"/> ANFCVOORDC2	Virtual machine	Hybrid Cloud TME Onprem	anfavsva2	West Europe	Running	Windows	Standard_B2s	-	1	...
<input type="checkbox"/> ANFCVOORDemo	Virtual machine	Hybrid Cloud TME Onprem	anfcvodrdemo-rg	West Europe	Running	Linux	Standard_E4s_v3	-	5	...
<input type="checkbox"/> AVSCVOPerfinguest	Virtual machine	Hybrid Cloud TME Onprem	avscvoperfinguest-rg	West Europe	Stopped (deallocated)	Linux	Standard_DS15_v2	-	5	...

2. 选择部署的订阅ID、然后选择资源组、区域、主机名、VM映像、大小、和身份验证方法。转到磁盘页面。

[Home](#) > [Virtual machines](#) >

Create a virtual machine ...

[Basics](#) [Disks](#) [Networking](#) [Management](#) [Advanced](#) [Tags](#) [Review + create](#)

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more](#)

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription *

Hybrid Cloud TME Onprem



Resource group *

ANFAVSRG

[Create new](#)

Instance details

Virtual machine name *

acao-ora01

Region *

(US) South Central US

Availability options

No infrastructure redundancy required

Security type

Standard

Image *

Red Hat Enterprise Linux 8.0 (LVM) - Gen2

[See all images](#) | [Configure VM generation](#)

Run with Azure Spot discount

☐

Size *

Standard_D8s_v3 - 8 vcpus, 32 GiB memory (\$273.02/month)

[See all sizes](#)

Administrator account

Authentication type

- ☐ SSH public key
- ☒ Password

[Review + create](#)

< Previous

Next : Disks >

Create a virtual machine ...

Size * ⓘ Standard_D8s_v3 - 8 vcpus, 32 GiB memory (\$273.02/month) ▼
[See all sizes](#)

Administrator account

Authentication type ⓘ ☐ SSH public key
☒ Password

Username * ⓘ azureuser ✓

Password * ⓘ ✓

Confirm password * ⓘ ✓

Inbound port rules

Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular network access on the Networking tab.

Public inbound ports * ⓘ ☐ None
☒ Allow selected ports

Select inbound ports * SSH (22) ▼

⚠ This will allow all IP addresses to access your virtual machine. This is only recommended for testing. Use the Advanced controls in the Networking tab to create rules to limit inbound traffic to known IP addresses.

Licensing

If you have eligible Red Hat Enterprise Linux subscriptions that are enabled for Red Hat Cloud Access, you can use Azure Hybrid Benefit to attach your Red Hat subscriptions to this VM and save money on compute costs [Learn more](#)

Your Azure subscription is currently not a part of Red Hat Cloud Access. In order to enable AHB for this VM, you must add this Azure subscription to Cloud Access. [Learn more](#)

[Review + create](#)

[< Previous](#)

[Next : Disks >](#)

- 选择*高级SSD*以实现操作系统本地冗余、并将数据磁盘留空、因为数据磁盘是从ANF存储挂载的。转到网络连接页面。

Home > Virtual machines >

Create a virtual machine ...

Basics **Disks** Networking Management Advanced Tags Review + create

Azure VMs have one operating system disk and a temporary disk for short-term storage. You can attach additional data disks. The size of the VM determines the type of storage you can use and the number of data disks allowed. [Learn more](#)


Disk options

OS disk type * ⓘ

Premium SSD (locally-redundant storage) ▼

Delete with VM ⓘ☒

Enable encryption at host ⓘ☐

 Encryption at host is not registered for the selected subscription. [Learn more about enabling this feature](#)

Encryption type *

(Default) Encryption at-rest with a platform-managed key ▼

Enable Ultra Disk compatibility ⓘ☐

Data disks for acao-ora01

You can add and configure additional data disks for your virtual machine or attach existing disks. This VM also comes with a temporary disk.

LUN	Name	Size (GiB)	Disk type	Host caching	Delete with VM ⓘ
Create and attach a new disk Attach an existing disk					

▼ **Advanced**

Review + create

< Previous

Next : Networking >

4. 选择vNet和子网。为外部VM访问分配公共IP。然后转到"管理"页面。

Create a virtual machine ...

Network interface

When creating a virtual machine, a network interface will be created for you.

Virtual network * ⓘ

ANFAVSVal

Create new

Subnet * ⓘ

VM_Sub (172.30.137.128/25)

Manage subnet configuration

Public IP ⓘ

(new) acao-ora01-ip

Create new

NIC network security group ⓘ

☐ None

☒ Basic

☐ Advanced

Public inbound ports * ⓘ

☐ None

☒ Allow selected ports

Select inbound ports *

SSH (22)

This will allow all IP addresses to access your virtual machine. This is only recommended for testing. Use the Advanced controls in the Networking tab to create rules to limit inbound traffic to known IP addresses.

Delete public IP and NIC when VM is deleted ⓘ

☒

Enable accelerated networking ⓘ

☒

Load balancing

You can place this virtual machine in the backend pool of an existing Azure load balancing solution. [Learn more](#)

Place this virtual machine behind an existing load balancing solution?

☐

Review + create

< Previous

Next : Management >

5. 保留Management的所有默认值、然后转到Advanced页面。

Home > Virtual machines >

Create a virtual machine ...

Basics Disks Networking **Management** Advanced Tags Review + create

Configure monitoring and management options for your VM.

Microsoft Defender for Cloud

Microsoft Defender for Cloud provides unified security management and advanced threat protection across hybrid cloud workloads. [Learn more](#)

✔ Your subscription is protected by Microsoft Defender for Cloud basic plan.

Monitoring

Boot diagnostics ⓘ ☒ Enable with managed storage account (recommended)
☐ Enable with custom storage account
☐ Disable

Enable OS guest diagnostics ⓘ ☐

Identity

Enable system assigned managed identity ⓘ ☐

Azure AD

Login with Azure AD ⓘ ☐

ℹ RBAC role assignment of Virtual Machine Administrator Login or Virtual Machine User Login is required when using Azure AD login. [Learn more](#)

ℹ Azure AD login now uses SSH certificate-based authentication. You will need to use an SSH client that supports OpenSSH certificates. You can use Azure CLI or Cloud Shell from the Azure Portal. [Learn more](#)

Auto-shutdown

Enable auto-shutdown ⓘ ☐

Backup

Review + create

< Previous

Next : Advanced >

6. 保留"高级"页面的所有默认值、除非您需要在自定义脚本部署后自定义VM。然后转到"标记"页面。

Home > Virtual machines >

Create a virtual machine ...

Basics Disks Networking Management Advanced Tags Review + create

Add additional configuration, agents, scripts or applications via virtual machine extensions or cloud-init.

Extensions

Extensions provide post-deployment configuration and automation.

Extensions ⓘ [Select an extension to install](#)

VM applications

VM applications contain application files that are securely and reliably downloaded on your VM after deployment. In addition to the application files, an install and uninstall script are included in the application. You can easily add or remove applications on your VM after create. [Learn more](#) ⓘ

[Select a VM application to install](#)

Custom data

Pass a script, configuration file, or other data into the virtual machine **while it is being provisioned**. The data will be saved on the VM in a known location. [Learn more about custom data for VMs](#) ⓘ

Custom data

i Your image must have a code to support consumption of custom data. If your image supports cloud-init, custom-data will be processed by cloud-init. [Learn more about custom data for VMs](#) ⓘ

User data

Pass a script, configuration file, or other data that will be accessible to your applications **throughout the lifetime of the virtual machine**. Don't use user data for storing your secrets or passwords. [Learn more about user data for VMs](#) ⓘ

Enable user data ☐

Review + create

< Previous

Next : Tags >

7. 如果需要、为虚拟机添加一个标记。然后、转到Review + create页面。

[Home](#) > [Virtual machines](#) >

Create a virtual machine ...

Basics Disks Networking Management Advanced Tags Review + create

Tags are name/value pairs that enable you to categorize resources and view consolidated billing by applying the same tag to multiple resources and resource groups. [Learn more about tags](#)

Note that if you create tags and then change resource settings on other tabs, your tags will be automatically updated.

Name ⓘ	Value ⓘ	Resource
<input type="text" value="database"/>	<input type="text" value="oracle"/>	12 selected  
<input type="text"/>	<input type="text"/>	12 selected 

[Review + create](#)

[< Previous](#)

[Next : Review + create >](#)

8. 部署 workflow 将对配置运行验证、如果验证通过、请单击*创建*以创建虚拟机。

Create a virtual machine ...

✓ Validation passed

Basics Disks Networking Management Advanced Tags Review + create

i Cost given below is an estimate and not the final price. Please use [Pricing calculator](#) for all your pricing needs.

PRODUCT DETAILS

1 X Standard D8s v3
by Microsoft
[Terms of use](#) | [Privacy policy](#)

Subscription credits apply ⓘ
0.3740 USD/hr
[Pricing for other VM sizes](#)

TERMS

By clicking "Create", I (a) agree to the legal terms and privacy statement(s) associated with the Marketplace offering(s) listed above; (b) authorize Microsoft to bill my current payment method for the fees associated with the offering(s), with the same billing frequency as my Azure subscription; and (c) agree that Microsoft may share my contact, usage and transactional information with the provider(s) of the offering(s) for support, billing and other transactional activities. Microsoft does not provide rights for third-party offerings. See the [Azure Marketplace Terms](#) for additional details.

Name

Preferred e-mail address

Preferred phone number

⚠ You have set SSH port(s) open to the internet. This is only recommended for testing. If you want to change this setting, go back to Basics tab.

Basics

Create

< Previous

Next >

[Download a template for automation](#)

4.为Oracle配置ANF数据库卷

您必须分别为Oracle二进制卷、数据卷和日志卷的ANF容量池创建三个NFS卷。

1. 在Azure控制台中的Azure服务列表下、单击Azure NetApp Files 以打开卷创建工作流。如果您有多个ANF存储帐户、请单击要从中配置卷的帐户。

Microsoft Azure

Search resources, services, and docs (G+/I)

Azure services

Create a resource

Azure NetApp Files

Virtual networks

Virtual machines

Storage accounts

Users

Subscriptions

Azure Active Directory

Quickstart Center

More services

Resources

Recent Favorite

Name	Type	Last Viewed
ANFAVSAcct	NetApp account	a few seconds ago
ANFAVSVol	Virtual network	3 hours ago
acao-ora01	Virtual machine	5 days ago
Hybrid Cloud TME Onprem	Subscription	2 weeks ago
WEANFAVSAcct	NetApp account	2 weeks ago
ANFAVSAcct/CapPool/acao-ora01-u03	Volume	2 weeks ago
ANFAVSAcct/CapPool/acao-ora01-u02	Volume	2 weeks ago
ANFAVSAcct/CapPool/acao-ora01-u01	Volume	2 weeks ago
acao-ora01_OsDisk_1_673bad70ccce4709afc81278e2bc97cb	Disk	2 weeks ago
acao-ora0166	Network Interface	3 weeks ago
TMEIstres	Resource group	3 weeks ago

See all

2. 在NetApp存储帐户下、单击*卷*、然后单击*添加卷*以创建新的Oracle卷。

Microsoft Azure

Search resources, services, and docs (G+/I)

Home > Azure NetApp Files >

Azure NetApp Files

Hybrid Cloud TME

Create Manage view

Filter for any field...

Name ↑

ANFAVSAcct

WEANFAVSAcct

ANFAVSAcct

NetApp account

Search (Ctrl+/)

Delete

Overview

Activity log

Access control (IAM)

Tags

Settings

Quota

Properties

Locks

Azure NetApp Files

Active Directory connections

Storage service

Capacity pools

Volumes

Data protection

Snapshot policies

Storage service add-ons

NetApp add-ons

Automation

Tasks (preview)

Export template

Support + troubleshooting

New Support Request

Essentials

Provisioning state : Succeeded

Resource group (move) : ANFAVSRG

Location : South Central US

Subscription (move) : Hybrid Cloud TME Onprem

Subscription ID : 0efa2dfb-917c-4497-b56a-b3f4eadb8111

Tags (edit) : product_line : Field use - various

Enterprise files storage, powered by NetApp

Azure NetApp Files makes it easy for enterprise line-of-business (LOB) and storage professionals to migrate and run complex, file-based applications with no code change. Learn more

Connect to Active Directory

Connect your NetApp to Active Directory

Learn more

View AD connections

Capacity pools

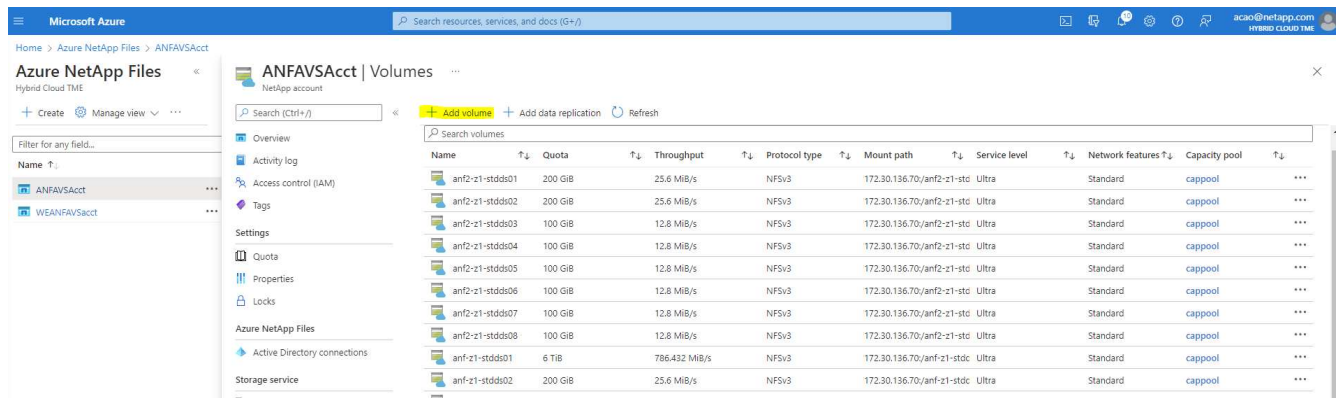
Purchase pools of capacity with a service level in which you provision volumes. Learn more

View capacity pools

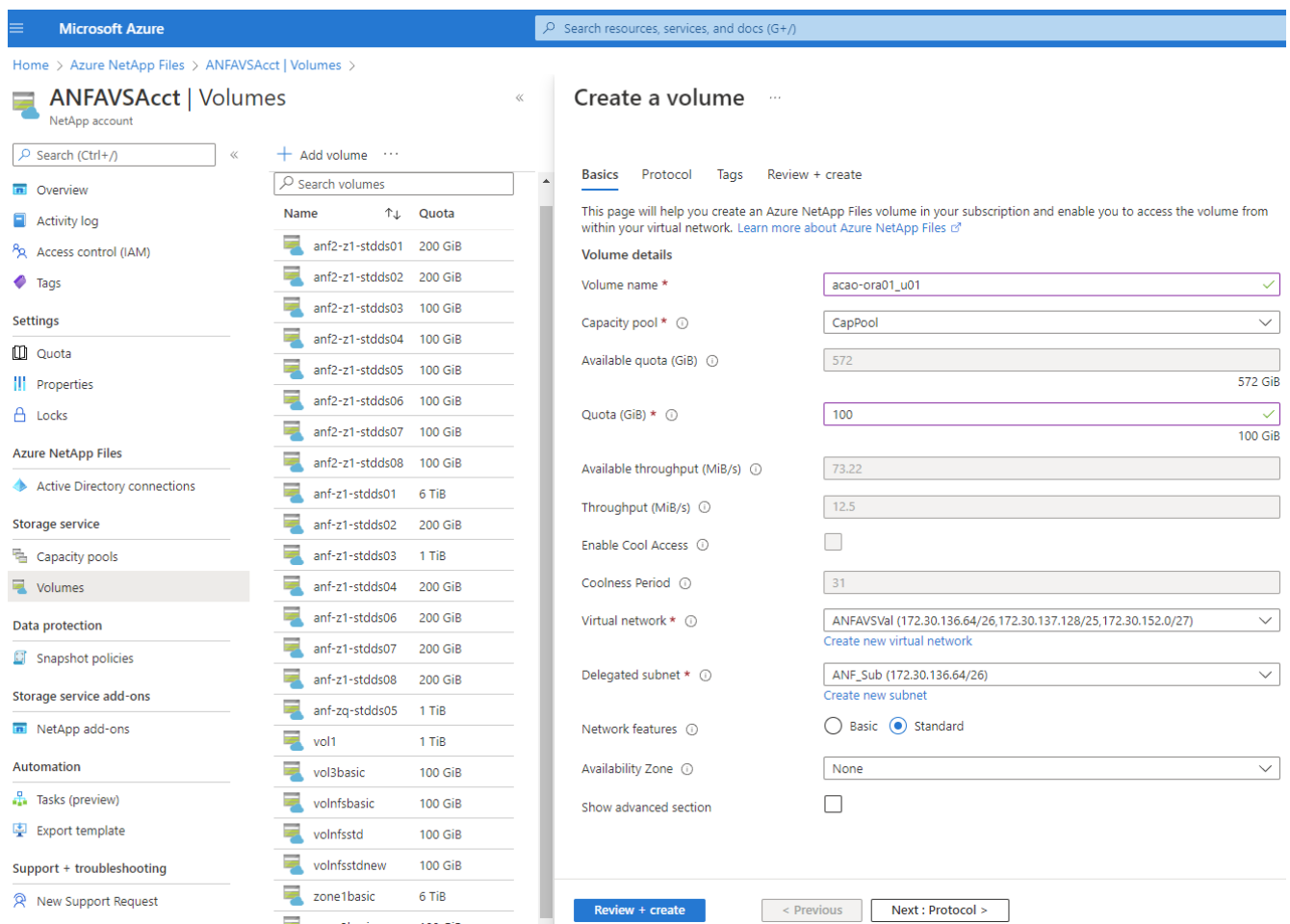
Volumes

Container for active file system, associated meta-data, and snapshots. Learn more

View volumes



3. 作为一种良好做法、请先确定使用VM主机名作为前缀的Oracle卷、然后再确定主机上的挂载点、例如、对于Oracle二进制文件、可以使用u01表示Oracle数据、可以使用u02表示Oracle数据、也可以使用u03表示Oracle日志。为卷选择与VM相同的vNet。单击*下一步：协议>。



4. 选择NFS协议、将Oracle主机IP地址添加到允许的客户端、然后删除允许所有IP地址0.0.0.0/0的默认策略。然后单击*下一步：标记>。

Microsoft Azure

Search resources, services, and docs (G+)

Home > Azure NetApp Files > ANFAVSAcct | Volumes >

ANFAVSAcct | Volumes

NetApp account

Search (Ctrl+/)

«

+ Add volume ...

Search volumes

Name	Quota
anf2-z1-stdds01	200 GiB
anf2-z1-stdds02	200 GiB
anf2-z1-stdds03	100 GiB
anf2-z1-stdds04	100 GiB
anf2-z1-stdds05	100 GiB
anf2-z1-stdds06	100 GiB
anf2-z1-stdds07	100 GiB
anf2-z1-stdds08	100 GiB
anf-z1-stdds01	6 TiB
anf-z1-stdds02	200 GiB
anf-z1-stdds03	1 TiB
anf-z1-stdds04	200 GiB
anf-z1-stdds06	200 GiB
anf-z1-stdds07	200 GiB
anf-z1-stdds08	200 GiB
anf-zq-stdds05	1 TiB
vol1	1 TiB
vol3basic	100 GiB
volnfsbasic	100 GiB
volnfsstd	100 GiB
volnfsstdnew	100 GiB
zone1basic	6 TiB
zone2basic	100 GiB

Overview

Activity log

Access control (IAM)

Tags

Settings

Quota

Properties

Locks

Azure NetApp Files

Active Directory connections

Storage service

Capacity pools

Volumes

Data protection

Snapshot policies

Storage service add-ons

NetApp add-ons

Automation

Tasks (preview)

Export template

Support + troubleshooting

New Support Request

Create a volume ...

Basics Protocol Tags Review + create

Configure access to your volume.

Access

Protocol type

NFS SMB Dual-protocol

Configuration

File path *

acao-ora01_u01

Versions *

NFSv3

Kerberos

Enabled Disabled

LDAP

Enabled Disabled

Azure VMware Solution DataStore

Export policy

Configure the volume's export policy. This can be edited later. Learn more

Move up Move down Move to top Move to bottom Delete

	Index	Allowed clients	Access	Root Access	
<input type="checkbox"/>	1	10.0.0.0/0	Read & Write	On	...
<input type="checkbox"/>	2	172.30.137.142	Read & Write	On	...

Review + create

< Previous

Next : Tags >

5. 根据需要添加卷标记。然后单击*审阅+创建>。

Microsoft Azure

Search resources, services, and docs (G+)

Home > Azure NetApp Files > ANFAVSAcct | Volumes >

ANFAVSAcct | Volumes

NetApp account

Search (Ctrl+/)

Overview

Activity log

Access control (IAM)

Tags

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New Support Request

Search volumes

Name	Quota
anf2-z1-stdds01	200 GiB
anf2-z1-stdds02	200 GiB
anf2-z1-stdds03	100 GiB
anf2-z1-stdds04	100 GiB
anf2-z1-stdds05	100 GiB
anf2-z1-stdds06	100 GiB
anf2-z1-stdds07	100 GiB
anf2-z1-stdds08	100 GiB
anf-z1-stdds01	6 TiB
anf-z1-stdds02	200 GiB
anf-z1-stdds03	1 TiB
anf-z1-stdds04	200 GiB
anf-z1-stdds06	200 GiB
anf-z1-stdds07	200 GiB
anf-z1-stdds08	200 GiB
anf-zq-stdds05	1 TiB
vol1	1 TiB
vol3basic	100 GiB
volnfsbasic	100 GiB
volnfsstd	100 GiB
volnfsstdnew	100 GiB
zone1basic	6 TiB
zone2basic	100 GiB

Create a volume

BasicsProtocolTagsReview + create

Tags are name/value pairs that enable you to categorize resources and view consolidated billing by applying the same tag to multiple resources and resource groups. [Learn more about tags](#)

Note that if you create tags and then change resource settings on other tabs, your tags will be automatically updated.

Name

Value

database

:

oracle

:

Review + create

< Previous

Next : Review + create >

6. 如果验证通过、请单击*创建*以创建卷。

使用ANF在Azure虚拟机上安装和配置Oracle

NetApp解决方案团队创建了许多基于Ansible的自动化工具包、可帮助您在Azure中顺利部署Oracle。按照以下步骤在Azure虚拟机上部署Oracle。

设置Ansible控制器

如果尚未设置Ansible控制器、请参见 ["NetApp 解决方案自动化"](#)、其中详细说明了如何设置Ansible控制器。

获取Oracle部署自动化工具包

在您的主目录中、使用您用于登录到Ansible控制器的用户ID克隆一份Oracle部署工具包副本。

```
git clone https://github.com/NetApp-Automation/na_oracle19c_deploy.git
```

根据您的配置执行工具包

请参见 ["CLI 部署 Oracle 19c 数据库"](#) 使用命令行界面执行攻略手册。从Azure控制台而非命令行界面创建数据库卷时、您可以忽略全局VARS文件中变量配置的ONTAP 部分。



该工具包默认部署Oracle 19c和RU 19.8。它可以轻松地适应任何其他修补程序级别、并对默认配置进行少量更改。此外、默认的种子数据库活动日志文件也会部署到数据卷中。如果需要日志卷上的活动日志文件、应在初始部署后重新定位。如有必要、请联系NetApp解决方案 团队以获得帮助。

为Oracle的应用程序一致快照设置AzAcSnap备份工具

Azure应用程序一致的Snapshot工具(AzAcSnap)是一个命令行工具、可通过处理在创建存储快照之前将第三方数据库置于应用程序一致状态所需的所有流程编排来为第三方数据库提供数据保护。然后、它会将这些数据库返回到运行状态。NetApp建议在数据库服务器主机上安装此工具。请参见以下安装和配置过程。

安装AzAcSnap工具

1. 获取最新版本 "[AzArcSnap安装程序](#)"。
2. 将下载的自安装程序复制到目标系统。
3. 使用默认安装选项以root用户身份执行自安装程序。如有必要、请使用使文件可执行 `chmod +x *.run` 命令：

```
./azacsnap_installer_v5.0.run -I
```

配置Oracle连接

快照工具与Oracle数据库进行通信、并且需要具有适当权限的数据库用户来启用或禁用备份模式。

1.设置AzAcSnap数据库用户

以下示例显示了Oracle数据库用户的设置以及使用sqlplus与Oracle数据库进行通信。示例命令用于在Oracle数据库中设置用户(AZACSNAP)、并根据需要更改IP地址、用户名和密码。

1. 在Oracle数据库安装中、启动sqlplus以登录到数据库。

```
su - oracle
sqlplus / AS SYSDBA
```

2. 创建用户。

```
CREATE USER azacsnap IDENTIFIED BY password;
```

3. 授予用户权限。此示例设置了AZACSNAP用户启用将数据库置于备份模式的权限。

```
GRANT CREATE SESSION TO azacsnap;
GRANT SYSBACKUP TO azacsnap;
```

4. 将默认用户的密码到期时间更改为无限制。

```
ALTER PROFILE default LIMIT PASSWORD_LIFE_TIME unlimited;
```

5. 验证数据库的azacsnap连接。

```
connect azacsnap/password  
quit;
```

2.使用Oracle Wallet为数据库访问配置Linux用户azacsnap

AzAcSnap默认安装会创建一个azacsnap操作系统用户。必须使用存储在Oracle Wallet中的密码为其Bash shell环境配置Oracle数据库访问。

1. 以root用户身份运行 `cat /etc/oratab` 用于标识主机上的ORACLE_HOME和ORACLE_SID变量的命令。

```
cat /etc/oratab
```

2. 将ORACLE_HOME、ORACLE_SID、TNS_admin和路径变量添加到azacsnap用户bash配置文件中。根据需要更改变量。

```
echo "export ORACLE_SID=ORATEST" >> /home/azacsnap/.bash_profile  
echo "export ORACLE_HOME=/u01/app/oracle/product/19800/ORATST" >>  
/home/azacsnap/.bash_profile  
echo "export TNS_ADMIN=/home/azacsnap" >> /home/azacsnap/.bash_profile  
echo "export PATH=\$PATH:\$ORACLE_HOME/bin" >>  
/home/azacsnap/.bash_profile
```

3. 作为Linux用户azacsnap、创建电子钱包。系统将提示您输入电子邮件密码。

```
sudo su - azacsnap  
  
mkstore -wrl $TNS_ADMIN/.oracle_wallet/ -create
```

4. 将连接字符串凭据添加到Oracle Wallet。在以下示例命令中、AZACSNAP是AzAcSnap要使用的ConnectionString、azacsnap是Oracle数据库用户、AzPasswd1是Oracle用户的数据库密码。系统会再次提示您输入电子邮件密码。

```
mkstore -wrl $TNS_ADMIN/.oracle_wallet/ -createCredential AZACSNAP  
azacsnap AzPasswd1
```


5. 创建 `tnsnames.ora` 文件在以下示例命令中、应将主机设置为Oracle数据库的IP地址、并将服务器SID设置为Oracle数据库SID。

```
echo "# Connection string
AZACSNAP=\"(DESCRIPTION=(ADDRESS=(PROTOCOL=TCP) (HOST=172.30.137.142) (PORT=1521)) (CONNECT_DATA=(SID=ORATST)))\"
" > $TNS_ADMIN/tnsnames.ora
```

6. 创建 `sqlnet.ora` 文件

```
echo "SQLNET.WALLET_OVERRIDE = TRUE
WALLET_LOCATION=(
    SOURCE=(METHOD=FILE)
    (METHOD_DATA=(DIRECTORY=\"$TNS_ADMIN/.oracle_wallet))
) " > $TNS_ADMIN/sqlnet.ora
```

7. 使用Wallet测试Oracle访问。

```
sqlplus /@AZACSNAP as SYSBACKUP
```

命令的预期输出：

```
[azacsnap@acao-ora01 ~]$ sqlplus /@AZACSNAP as SYSBACKUP

SQL*Plus: Release 19.0.0.0.0 - Production on Thu Sep 8 18:02:07 2022
Version 19.8.0.0.0

Copyright (c) 1982, 2019, Oracle. All rights reserved.

Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.8.0.0.0

SQL>
```

配置ANF连接

本节介绍如何启用与Azure NetApp Files (与VM)的通信。

1. 在Azure Cloud Shell会话中、确保您已登录到默认要与服务主体关联的订阅。

```
az account show
```

2. 如果订阅不正确、请使用以下命令：

```
az account set -s <subscription name or id>
```

3. 使用Azure命令行界面创建服务主体、如以下示例所示：

```
az ad sp create-for-rbac --name "AzAcSnap" --role Contributor --scopes /subscriptions/{subscription-id} --sdk-auth
```

预期输出：

```
{
  "clientId": "00aa000a-aaaa-0000-00a0-00aa000aaa0a",
  "clientSecret": "00aa000a-aaaa-0000-00a0-00aa000aaa0a",
  "subscriptionId": "00aa000a-aaaa-0000-00a0-00aa000aaa0a",
  "tenantId": "00aa000a-aaaa-0000-00a0-00aa000aaa0a",
  "activeDirectoryEndpointUrl": "https://login.microsoftonline.com",
  "resourceManagerEndpointUrl": "https://management.azure.com/",
  "activeDirectoryGraphResourceId": "https://graph.windows.net/",
  "sqlManagementEndpointUrl":
  "https://management.core.windows.net:8443/",
  "galleryEndpointUrl": "https://gallery.azure.com/",
  "managementEndpointUrl": "https://management.core.windows.net/"
}
```

4. 剪切输出内容并将其粘贴到名为的文件中 `oracle.json` 存储在Linux用户azacsnap用户箱目录中、并使用适当的系统权限保护文件。



请确保JSON文件的格式与上述格式完全相同、尤其是使用双引号(")括起的URL。

完成**AzAcSnap**工具的设置

按照以下步骤配置和测试快照工具。成功测试后、您可以执行第一个数据库一致的存储快照。

1. 更改为Snapshot用户帐户。

```
su - azacsnap
```

2. 更改命令的位置。

```
cd /home/azacsnap/bin/
```

3. 配置存储备份详细信息文件。这将创建 azacsnap.json 配置文件。

```
azacsnap -c configure --configuration new
```

三个Oracle卷的预期输出:

```
[azacsnap@acao-ora01 bin]$ azacsnap -c configure --configuration new
Building new config file
Add comment to config file (blank entry to exit adding comments): Oracle
snapshot bkup
Add comment to config file (blank entry to exit adding comments):
Enter the database type to add, 'hana', 'oracle', or 'exit' (for no
database): oracle

=== Add Oracle Database details ===
Oracle Database SID (e.g. CDB1): ORATST
Database Server's Address (hostname or IP address): 172.30.137.142
Oracle connect string (e.g. /@AZACSNAP): /@AZACSNAP

=== Azure NetApp Files Storage details ===
Are you using Azure NetApp Files for the database? (y/n) [n]: y
--- DATA Volumes have the Application put into a consistent state before
they are snapshot ---
Add Azure NetApp Files resource to DATA Volume section of Database
configuration? (y/n) [n]: y
Full Azure NetApp Files Storage Volume Resource ID (e.g.
/subscriptions/.../resourceGroups/.../providers/Microsoft.NetApp/netAppA
ccounts/.../capacityPools/Premium/volumes/...): /subscriptions/0efa2dfb-
917c-4497-b56a-
b3f4eadb8111/resourceGroups/ANFAVSRG/providers/Microsoft.NetApp/netAppAc
counts/ANFAVSAacct/capacityPools/CapPool/volumes/acao-ora01-u01
Service Principal Authentication filename or Azure Key Vault Resource ID
(e.g. auth-file.json or https://...): oracle.json
Add Azure NetApp Files resource to DATA Volume section of Database
configuration? (y/n) [n]: y
Full Azure NetApp Files Storage Volume Resource ID (e.g.
/subscriptions/.../resourceGroups/.../providers/Microsoft.NetApp/netAppA
ccounts/.../capacityPools/Premium/volumes/...): /subscriptions/0efa2dfb-
917c-4497-b56a-
b3f4eadb8111/resourceGroups/ANFAVSRG/providers/Microsoft.NetApp/netAppAc
counts/ANFAVSAacct/capacityPools/CapPool/volumes/acao-ora01-u02
```

```

Service Principal Authentication filename or Azure Key Vault Resource ID
(e.g. auth-file.json or https://...): oracle.json
Add Azure NetApp Files resource to DATA Volume section of Database
configuration? (y/n) [n]: n
--- OTHER Volumes are snapshot immediately without preparing any
application for snapshot ---
Add Azure NetApp Files resource to OTHER Volume section of Database
configuration? (y/n) [n]: y
Full Azure NetApp Files Storage Volume Resource ID (e.g.
/subscriptions/.../resourceGroups/.../providers/Microsoft.NetApp/netAppAc
ccounts/.../capacityPools/Premium/volumes/...): /subscriptions/0efa2dfb-
917c-4497-b56a-
b3f4eadb8111/resourceGroups/ANFAVSRG/providers/Microsoft.NetApp/netAppAc
counts/ANFAVSAcct/capacityPools/CapPool/volumes/acao-ora01-u03
Service Principal Authentication filename or Azure Key Vault Resource ID
(e.g. auth-file.json or https://...): oracle.json
Add Azure NetApp Files resource to OTHER Volume section of Database
configuration? (y/n) [n]: n

=== Azure Managed Disk details ===
Are you using Azure Managed Disks for the database? (y/n) [n]: n

=== Azure Large Instance (Bare Metal) Storage details ===
Are you using Azure Large Instance (Bare Metal) for the database? (y/n)
[n]: n

Enter the database type to add, 'hana', 'oracle', or 'exit' (for no
database): exit

Editing configuration complete, writing output to 'azacsnap.json'.

```

4. 以azacsnap Linux用户身份、对Oracle备份运行azacsnap test命令。

```

cd ~/bin
azacsnap -c test --test oracle --configfile azacsnap.json

```

预期输出：

```
[azacsnap@acao-ora01 bin]$ azacsnap -c test --test oracle --configfile
azacsnap.json
BEGIN : Test process started for 'oracle'
BEGIN : Oracle DB tests
PASSED: Successful connectivity to Oracle DB version 1908000000
END   : Test process complete for 'oracle'
[azacsnap@acao-ora01 bin]$
```

5. 运行第一个快照备份。

```
azacsnap -c backup --volume data --prefix ora_test --retention=1
```

在Azure云中保护Oracle数据库

NetApp解决方案工程部的Allen Cao

本节介绍如何使用azacsnap工具以及快照备份、还原和快照分层到Azure Blob来保护Oracle数据库。

使用AzAcSnap工具使用Snapshot备份Oracle数据库

Azure应用程序一致的Snapshot工具(AzAcSnap)是一个命令行工具、可通过处理在创建存储快照之前将第三方数据库置于应用程序一致状态所需的所有流程编排来为其提供数据保护、之后、它会将数据库恢复为运行状态。

对于Oracle、您可以将数据库置于备份模式以创建快照、然后将数据库退出备份模式。

备份数据和日志卷

可以使用执行snapshot命令的简单shell脚本在数据库服务器主机上设置备份。然后、可以计划从crontab运行此脚本。

通常、备份频率取决于所需的RTO和RPO。频繁创建快照会占用更多存储空间。备份频率与空间占用之间存在一定的权衡。

数据卷通常比日志卷占用更多的存储空间。因此、您可以每几小时在数据卷上创建一次快照、而每15到30分钟在日志卷上创建一次更频繁的快照。

请参见以下备份脚本和计划示例。

对于数据卷快照：

```
# /bin/sh
cd /home/azacsnap/bin
. ~/.bash_profile
azacsnap -c backup --volume data --prefix acao-ora01-data --retention 36
azacsnap -c backup --volume other --prefix acao-ora01-log --retention 250
```

对于日志卷快照：

```
# /bin/sh
cd /home/azacsnap/bin
. ~/.bash_profile
azacsnap -c backup --volume other --prefix acao-ora01-log --retention 250
```

crontab计划：

```
15,30,45 * * * * /home/azacsnap/snap_log.sh
0 */2 * * * /home/azacsnap/snap_data.sh
```



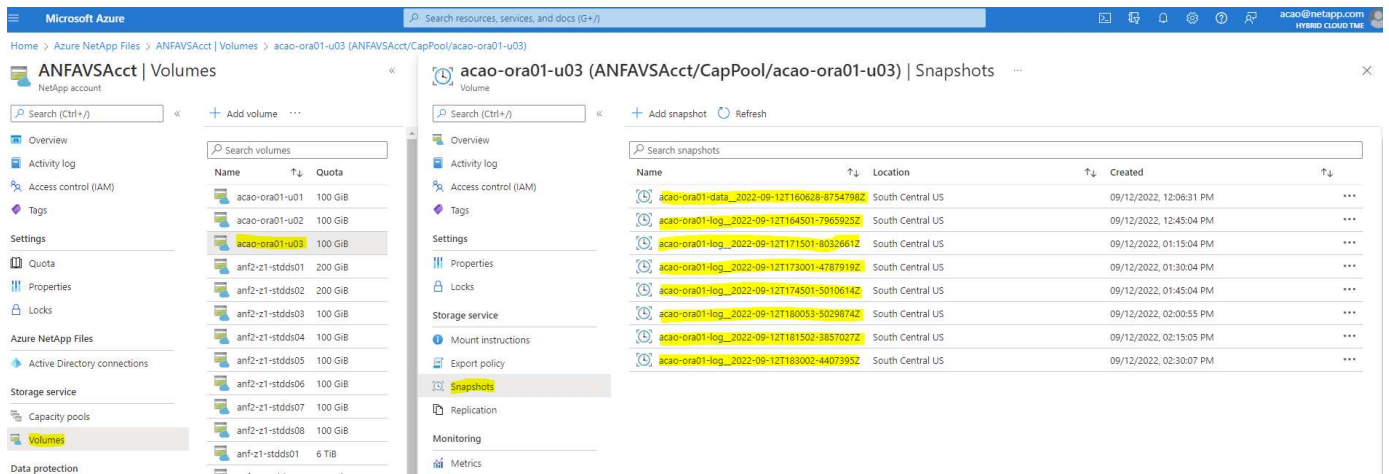
设置备份时 azacsnap.json 配置文件中、将所有数据卷(包括二进制卷)添加到 dataVolume 以及所有日志卷 otherVolume。快照的最大保留空间为250个副本。

验证快照

转至Azure门户> Azure NetApp文件/卷以检查是否已成功创建快照。

The screenshot displays the Azure portal interface. On the left, the 'Volumes' page for 'ANFAVSAcct' is shown, listing various volumes. The main pane shows the 'Snapshots' page for the volume 'acao-ora01-u01'. It lists two snapshots with their names, locations, and creation times.

Name	Location	Created
acao-ora01-data_2022-09-09T165255-82586522	South Central US	09/09/2022, 12:53:22 PM
acao-ora01-data_2022-09-12T160536-98098392	South Central US	09/12/2022, 12:05:55 PM



Oracle从本地备份还原和恢复

Snapshot备份的一个主要优势是、它与源数据库卷共存、并且主数据库卷几乎可以即时回滚。

在主服务器上还原和恢复Oracle

以下示例演示了如何从同一Oracle主机上的Azure信息板和CLI还原和恢复Oracle数据库。

1. 在要还原的数据库中创建一个测试表。

```

[oracle@acao-ora01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Mon Sep 12 19:02:35 2022
Version 19.8.0.0.0

Copyright (c) 1982, 2019, Oracle. All rights reserved.

Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.8.0.0.0

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

Table created.

SQL> insert into testsnapshot values(1,'insert a data marker to validate
snapshot restore',sysdate);

1 row created.

SQL> commit;

Commit complete.

SQL> select * from testsnapshot;

   ID
-----
EVENT
-----
DT
-----
---
          1
insert a data marker to validate snapshot restore
12-SEP-22 07.07.35.000000 PM

```

2. 将此表放到快照备份之后。


```

[oracle@acao-ora01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Tue Sep 13 14:20:22 2022
Version 19.8.0.0.0

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Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.8.0.0.0

SQL> drop table testsnapshot;

Table dropped.

SQL> select * from testsnapshot;
select * from testsnapshot
      *
ERROR at line 1:
ORA-00942: table or view does not exist

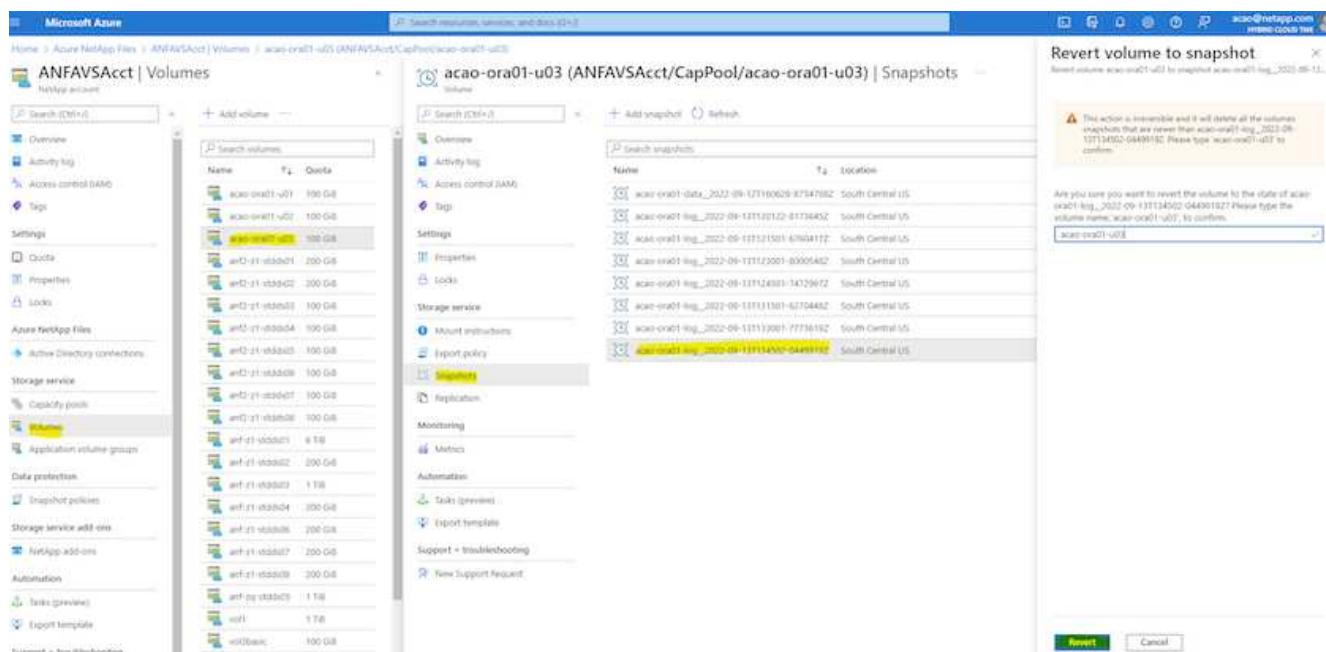
SQL> shutdown immediate;
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL> exit
Disconnected from Oracle Database 19c Enterprise Edition Release
19.0.0.0.0 - Production
Version 19.8.0.0.0

```

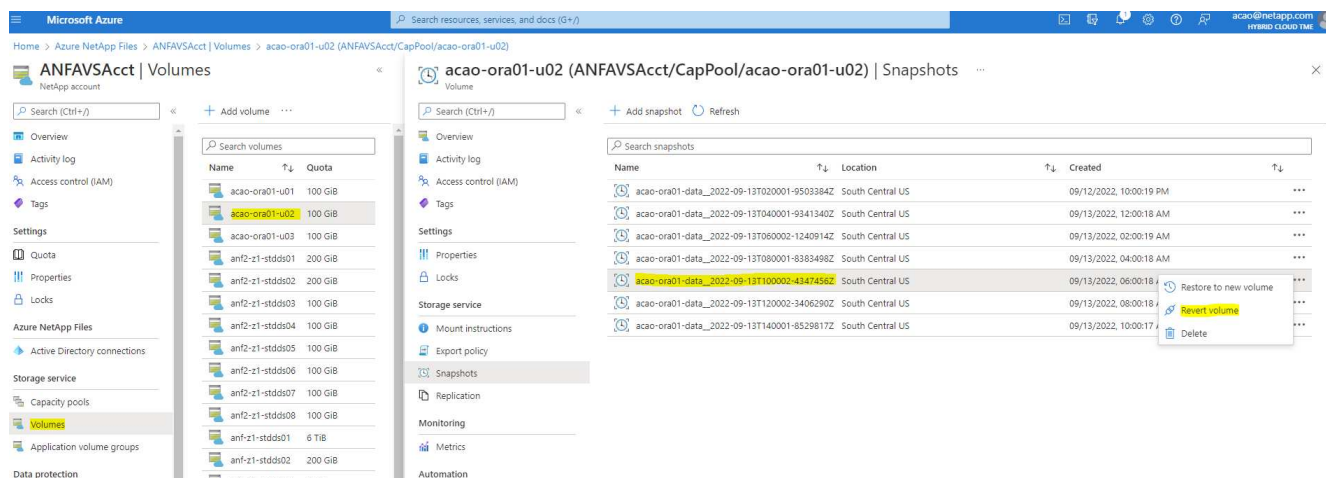
3. 从Azure NetApp Files 信息板中、将日志卷还原到最后一个可用快照。选择*还原卷*。

The screenshot displays the Azure portal interface for managing NetApp Files. On the left, the 'Volumes' section is expanded, showing a list of volumes including 'acao-ora01-u01', 'acao-ora01-u02', and 'acao-ora01-u03'. The 'Snapshots' section for 'acao-ora01-u03' is open on the right. It shows a table of snapshots with columns for Name, Location, and Created. The selected snapshot is 'acao-ora01-log_2022-09-13T1450Z-0449919Z'. A context menu is visible over this snapshot, offering the options 'Restore to new volume', 'Revert volume', and 'Delete'.

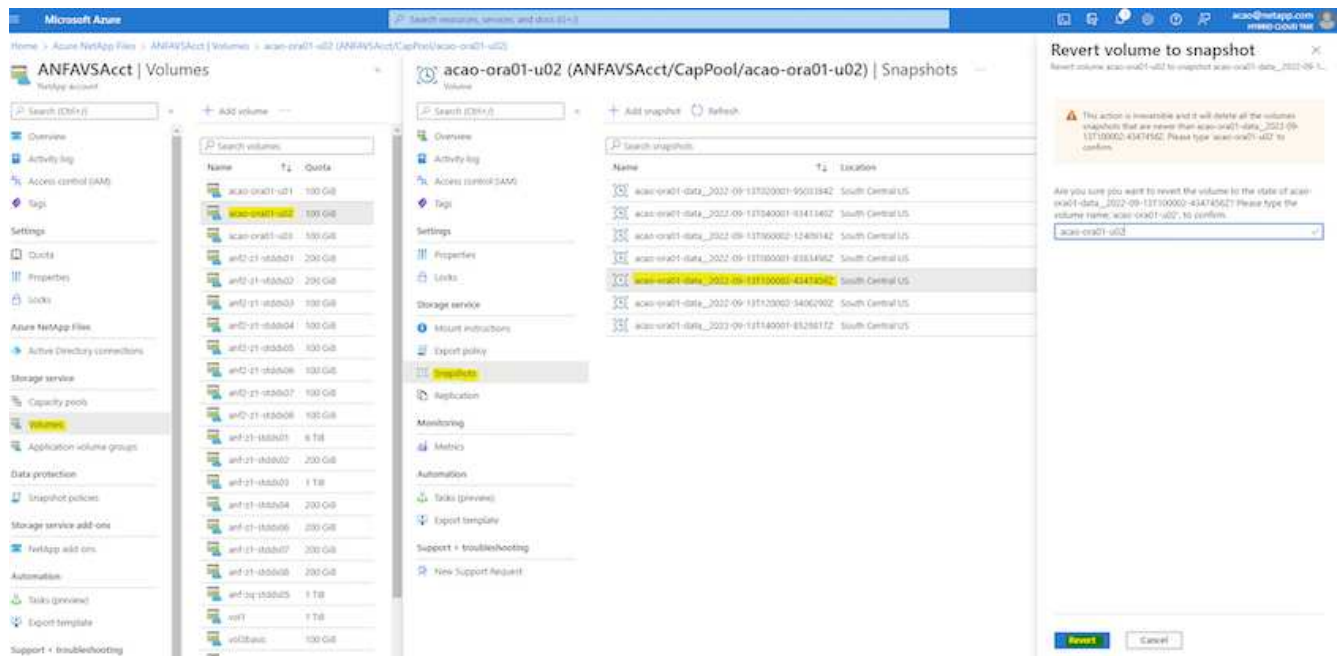
4. 确认还原卷并单击*还原*以完成卷还原到最新可用备份的过程。



5. 对数据卷重复相同的步骤、并确保备份包包含要恢复的表。



6. 再次确认卷还原、然后单击"还原"。



7. 如果您有多个控制文件副本、请重新同步这些控制文件、并将旧控制文件替换为可用的最新副本。

```
[oracle@acao-ora01 ~]$ mv /u02/oradata/ORATST/control01.ctl
/u02/oradata/ORATST/control01.ctl.bk
[oracle@acao-ora01 ~]$ cp /u03/orareco/ORATST/control02.ctl
/u02/oradata/ORATST/control01.ctl
```

8. 登录到Oracle服务器VM并使用sqlplus运行数据库恢复。

```
[oracle@acao-ora01 ~]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Tue Sep 13 15:10:17 2022
Version 19.8.0.0.0

Copyright (c) 1982, 2019, Oracle. All rights reserved.

Connected to an idle instance.

SQL> startup mount;
ORACLE instance started.

Total System Global Area 6442448984 bytes
Fixed Size 8910936 bytes
Variable Size 1090519040 bytes
Database Buffers 5335154688 bytes
Redo Buffers 7864320 bytes
Database mounted.
SQL> recover database using backup controlfile until cancel;
```

ORA-00279: change 3188523 generated at 09/13/2022 10:00:09 needed for thread 1

ORA-00289: suggestion :

/u03/orareco/ORATST/archivelog/2022_09_13/o1_mf_1_43__22rnjq9q_.arc

ORA-00280: change 3188523 for thread 1 is in sequence #43

Specify log: {<RET>=suggested | filename | AUTO | CANCEL}

ORA-00279: change 3188862 generated at 09/13/2022 10:01:20 needed for thread 1

ORA-00289: suggestion :

/u03/orareco/ORATST/archivelog/2022_09_13/o1_mf_1_44__29f2lgb5_.arc

ORA-00280: change 3188862 for thread 1 is in sequence #44

ORA-00278: log file

'/u03/orareco/ORATST/archivelog/2022_09_13/o1_mf_1_43__22rnjq9q_.arc' no longer

needed for this recovery

Specify log: {<RET>=suggested | filename | AUTO | CANCEL}

ORA-00279: change 3193117 generated at 09/13/2022 12:00:08 needed for thread 1

ORA-00289: suggestion :

/u03/orareco/ORATST/archivelog/2022_09_13/o1_mf_1_45__29h6qqyw_.arc

ORA-00280: change 3193117 for thread 1 is in sequence #45

ORA-00278: log file

'/u03/orareco/ORATST/archivelog/2022_09_13/o1_mf_1_44__29f2lgb5_.arc' no longer

needed for this recovery

Specify log: {<RET>=suggested | filename | AUTO | CANCEL}

ORA-00279: change 3193440 generated at 09/13/2022 12:01:20 needed for thread 1

ORA-00289: suggestion :

/u03/orareco/ORATST/archivelog/2022_09_13/o1_mf_1_46_%u_.arc

ORA-00280: change 3193440 for thread 1 is in sequence #46

ORA-00278: log file

'/u03/orareco/ORATST/archivelog/2022_09_13/o1_mf_1_45__29h6qqyw_.arc' no longer

needed for this recovery

Specify log: {<RET>=suggested | filename | AUTO | CANCEL}

cancel

Media recovery cancelled.

SQL> alter database open resetlogs;

```

Database altered.

SQL> select * from testsnapshot;

   ID
-----
EVENT
-----
-----
DT
-----
---
          1
insert a data marker to validate snapshot restore
12-SEP-22 07.07.35.000000 PM

SQL> select systimestamp from dual;

SYSTIMESTAMP
-----
---
13-SEP-22 03.28.52.646977 PM +00:00

```

此屏幕显示已删除的表已使用本地快照备份进行恢复。

将数据库从内部迁移到Azure云

由于Oracle决定逐步淘汰单实例数据库、许多组织已将单实例Oracle数据库转换为多租户容器数据库。这样、可以使用最大可用性选项将一组称为PDB的容器数据库轻松地重新定位到云、从而最大限度地减少迁移期间的停机时间。

但是、如果您仍有一个Oracle数据库实例、则可以先将其转换为多租户容器数据库、然后再尝试PDB重新定位。

以下各节详细介绍了在这两种情况下将内部Oracle数据库迁移到Azure云的相关信息。

将单个实例非CDB转换为多租户CDB中的PDB

如果您仍有单实例Oracle数据库、则无论是否要将其迁移到云、都必须将其转换为多租户容器数据库、因为Oracle不久将停止支持单实例数据库。

以下过程会将单个实例数据库作为可插拔数据库或PDB插入容器数据库。

1. 在与单实例数据库相同的主机上单独构建Shell容器数据库 ORACLE_HOME。
2. 关闭单个实例数据库并在只读模式下重新启动它。
3. 运行 DBMS_PDB.DESCRIBE 用于生成数据库元数据的操作步骤。

```

BEGIN
    DBMS_PDB.DESCRIBE (
        pdb_descr_file => '/home/oracle/ncdb.xml');
END;
/

```

4. 关闭单实例数据库。
5. 启动容器数据库。
6. 运行 DBMS_PDB.CHECK_PLUG_COMPATIBILITY 用于确定非CDB是否与CDB兼容的函数。

```

SET SERVEROUTPUT ON
DECLARE
    compatible CONSTANT VARCHAR2(3) :=
        CASE DBMS_PDB.CHECK_PLUG_COMPATIBILITY(
            pdb_descr_file => '/disk1/oracle/ncdb.xml',
            pdb_name        => 'NCDB')
            WHEN TRUE THEN 'YES'
            ELSE 'NO'
        END;
BEGIN
    DBMS_OUTPUT.PUT_LINE(compatible);
END;
/

```

如果输出为Yes、则表示非CDB兼容、您可以继续执行下一步。

如果输出为no、则表示非CDB不兼容、您可以检查 PDB PLUG IN VIOLATIONS 查看其不兼容的原因。必须先更正所有违规、然后才能继续。例如、任何版本或修补程序不匹配的问题都应通过运行升级或opatch实用程序来解决。更正违规后、运行 DBMS_PDB.CHECK_PLUG_COMPATIBILITY 再次确认、以确保非CDB与CDB兼容。

7. 插入单个实例非CDB。

```

CREATE PLUGGABLE DATABASE ncdb USING '/home/oracle/ncdb.xml'
COPY
    FILE_NAME_CONVERT = ('/disk1/oracle/dbs/', '/disk2/oracle/ncdb/')
;

```



如果主机上没有足够的空间、则 NOCOPY 选项可用于创建PDB。在这种情况下、单实例非CDB在作为PDB插入后不可用、因为PDB已使用原始数据文件。请确保在转换之前创建备份、以便在发生任何错误时可以恢复运行。

8. 如果源单实例非CDB与目标CDB之间的版本不同、则在转换后开始PDB升级。对于相同版本的转换、可以跳

过此步骤。

```
sqlplus / as sysdba;
alter session set container=ncdb
alter pluggable database open upgrade;
exit;
dbupgrade -c ncdb -l /home/oracle
```

查看中的升级日志文件 /home/oracle 目录。

9. 打开可插拔数据库、检查PDB插件违规、然后重新编译无效对象。

```
alter pluggable database ncdb open;
alter session set container=ncdb;
select message from pdb_plug_in_violations where type like '%ERR%' and
status <> 'RESOLVED';
$ORACLE_HOME/perl/bin/perl $ORACLE_HOME/rdbms/admin/catcon.pl -n 1 -c
'ncdb' -e -b utlrp -d $ORACLE_HOME/rdbms/admin utlrp.sql
```

10. 执行 noncdb_to_pdb.sql 更新数据词典。

```
sqlplus / as sysdba
alter session set container=ncdb;
@$ORACLE_HOME/rdbms/admin/noncdb_to_pdb.sql;
```

关闭并重新启动容器数据库。ncdb已退出受限模式。

通过PDB重新定位将内部Oracle数据库迁移到Azure

使用最大可用性选项的Oracle PDB重新定位采用PDB热克隆技术、这样、在PDB复制到目标时、可以使用源PDB。切换时、用户连接会自动重定向到目标PDB。因此、无论PDB的大小如何、都可以最大限度地减少停机时间。NetApp提供了一个基于Ansible的工具包、用于自动执行迁移操作步骤。

1. 在Azure公共云中使用相同版本和修补程序级别在Azure虚拟机上创建CDB。
2. 从Ansible控制器克隆自动化工具包的副本。

```
git clone https://github.com/NetApp-Automation/na_ora_aws_migration.git
```

3. 阅读README文件中的说明。
4. 为源和目标Oracle服务器配置Ansible主机变量文件、并为数据库服务器主机的配置文件配置名称解析。
5. 在Ansible控制器上安装Ansible控制器前提条件。

```
ansible-playbook -i hosts requirements.yml
ansible-galaxy collection install -r collections/requirements.yml
--force
```

6. 对内部服务器执行任何迁移前任务。

```
ansible-playbook -i hosts ora_pdb_relocate.yml -u admin -k -K -t
ora_pdb_relo_onprem
```



admin用户是内部Oracle服务器主机上具有sudo权限的管理用户。管理员用户使用密码进行身份验证。

7. 执行从内部环境到目标Azure Oracle主机的Oracle PDB重新定位。

```
ansible-playbook -i hosts ora_pdb_relocate.yml -u azureuser --private
-key db1.pem -t ora_pdb_relo_primary
```



Ansible控制器可以位于内部或Azure云中。控制器需要连接到内部Oracle服务器主机和Azure Oracle VM主机。内部Oracle服务器主机和Azure Oracle VM主机之间的Oracle数据库端口(如1521)处于打开状态。

其他Oracle数据库迁移选项

有关其他迁移选项、请参见Microsoft文档：["Oracle数据库迁移决策过程"](#)。

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