



Disaster recovery workflow

NetApp Solutions

Allen Cao
October 15, 2021

This PDF was generated from https://docs.netapp.com/us-en/netapp-solutions/ent-apps-db/hybrid_dbops_snapcenter_dr.html on October 21, 2021. Always check docs.netapp.com for the latest.

Table of Contents

- Disaster recovery workflow 1
 - Clone an on-premises Oracle production DB to cloud for DR 1
 - Post DR clone validation and configuration for Oracle..... 10
 - Clone an on-premises SQL production DB to cloud for DR..... 11
 - Post DR clone validation and configuration for SQL 17
 - Where to go for help?..... 18

Disaster recovery workflow

Previous: [Workflow for dev/test bursting to cloud.](#)

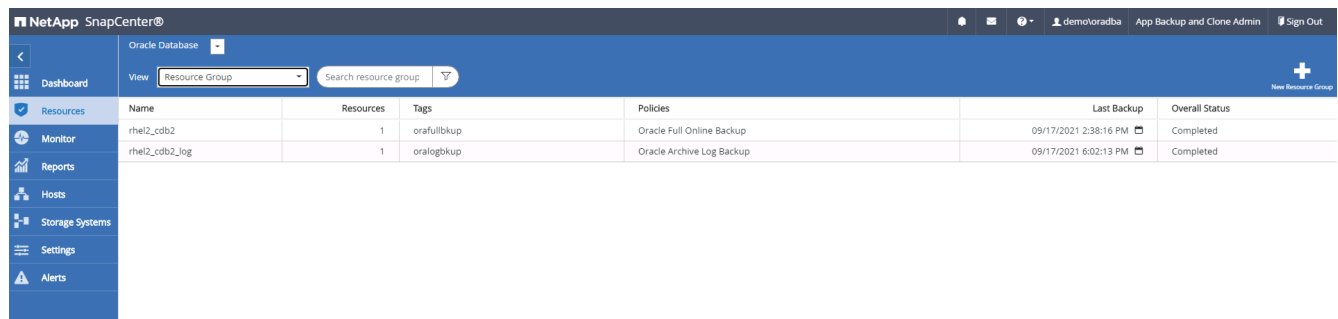
Enterprises have embraced the public cloud as a viable resource and destination for disaster recovery. SnapCenter makes this process as seamless as possible. This disaster recovery workflow is very similar to the clone workflow, but database recovery runs through the last available log that was replicated to cloud to recover all the business transactions possible. However, there are additional pre-configuration and post-configuration steps specific to disaster recovery.

Clone an on-premises Oracle production DB to cloud for DR

1. To validate that the clone recovery runs through last available log, we created a small test table and inserted a row. The test data would be recovered after a full recovery to last available log.

```
oracle@rhel2~$
SQL> create table dr_test(
  2 id integer,
  3 event varchar(200),
  4 dt timestamp);
Table created.
SQL> insert into dr_test values(1, 'testing DB clone for DR and roll forward DB to last available log', sysdate);
1 row created.
SQL> select * from dr_test;
      ID
-----
EVENT
-----
DT
-----
1
testing DB clone for DR and roll forward DB to last available log
17-SEP-21 02.12.13.000000 PM
SQL> commit;
Commit complete.
SQL>
```

2. Log into SnapCenter as a database management user ID for Oracle. Navigate to the Resources tab, which shows the Oracle databases being protected by SnapCenter.



Name	Resources	Tags	Policies	Last Backup	Overall Status
rhel2_cdb2	1	orafullbkup	Oracle Full Online Backup	09/17/2021 2:38:16 PM	Completed
rhel2_cdb2_log	1	oralogbkup	Oracle Archive Log Backup	09/17/2021 6:02:13 PM	Completed

3. Select the Oracle log resource group and click Backup Now to manually run an Oracle log backup to flush the latest transaction to the destination in the cloud. In a real DR scenario, the last transaction recoverable depends on the database log volume replication frequency to the cloud, which in turn depends on the RTO or RPO policy of the company.

NetApp SnapCenter®

Oracle Database

Search resource groups

Search

demo@oradba App Backup and Clone Admin Sign Out

Modify Resource Group Back up Now Maintenance Delete

Name	Resource Name	Type	Host
rhel2_cdb2	cdb2	Oracle Database	rhel2.demo.netapp.com
rhel2_cdb2_log			

Backup

Create a backup for the selected resource group

Resource Group

Policy ⓘ



Asynchronous SnapMirror loses data that has not made it to the cloud destination in the database log backup interval in a disaster recovery scenario. To minimize data loss, more frequent log backup can be scheduled. However there is a limit to the log backup frequency that is technically achievable.

4. Select the last log backup on the Secondary Mirror Backup(s), and mount the log backup.

NetApp SnapCenter®

Oracle Database

Search databases

cdb2

cdb2dev

cdb2test

Manage Copies

185 Backups
0 Clones
Local copies

185 Backups
2 Clones
Mirror copies

Summary Card

370 Backups

16 Data Backups

354 Log Backups

2 Clones

Secondary Mirror Backup(s)

search

Backup Name	Count	Type	LF	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_log_09-17-2021_18.20.04.1177_1	1	Log		09/17/2021 6:20:13 PM	Not Applicable	False	Not Cataloged	5994710
rhel2_cdb2_log_09-17-2021_18.00.01.2424_1	1	Log		09/17/2021 6:00:09 PM	Not Applicable	False	Not Cataloged	5992079
rhel2_cdb2_log_09-17-2021_17.00.01.1566_1	1	Log		09/17/2021 5:00:20 PM	Not Applicable	False	Not Cataloged	5988842

Mount backups

Choose the host to mount the backup

ora-standby.demo.netapp.com

Mount path : /var/opt/snapcenter/sco/backup_mount/rhel2_cdb2_log_09-17-2021_18.20.04.1177_1/cdb2

Secondary storage location : Snap Vault / Snap Mirror

Source Volume

svm_onPrem:rhel2_u03

Destination Volume

svm_hybridcvo:rhel2_u03_dr

Mount Cancel

5. Select the last full database backup and click Clone to initiate the clone workflow.

NetApp SnapCenter®

Oracle Database

Search databases

cdb2

cdb2dev

cdb2test

Manage Copies

185 Backups
0 Clones
Local copies

185 Backups
2 Clones
Mirror copies

Summary Card

370 Backups

16 Data Backups

354 Log Backups

2 Clones

Secondary Mirror Backup(s)

search

Backup Name	Count	Type	LF	End Date	Verified	Mounted	RMAN Cataloged	SCN
rhel2_cdb2_log_09-17-2021_18.20.04.1177_1	1	Log		09/17/2021 6:20:13 PM	Not Applicable	True	Not Cataloged	5994710
rhel2_cdb2_log_09-17-2021_18.00.01.2424_1	1	Log		09/17/2021 6:00:09 PM	Not Applicable	False	Not Cataloged	5992079
rhel2_cdb2_log_09-17-2021_17.00.01.1566_1	1	Log		09/17/2021 5:00:20 PM	Not Applicable	False	Not Cataloged	5988842
rhel2_cdb2_log_09-17-2021_16.00.01.2156_1	1	Log		09/17/2021 4:00:10 PM	Not Applicable	False	Not Cataloged	5985272
rhel2_cdb2_log_09-17-2021_3.00.01.1317_1	1	Log		09/17/2021 3:00:10 PM	Not Applicable	False	Not Cataloged	5982003
rhel2_cdb2_log_09-17-2021_14.35.01.4997_1	1	Log		09/17/2021 2:35:21 PM	Not Applicable	False	Not Cataloged	5980629
rhel2_cdb2_log_09-17-2021_14.35.01.4997_0	1	Data		09/17/2021 2:35:12 PM	Unverified	False	Not Cataloged	5980588

Total 3

6. Select a unique clone DB ID on the host.

Clone from cdb2

1 Name

2 Locations

3 Credentials

4 PreOps

5 PostOps

6 Notification

7 Summary

☒ Complete Database Clone

Clone SID:

Exclude PDBs:

☐ PDB Clone

Secondary storage location : Snap Vault / Snap Mirror

☒ Data

Source Volume: svm_onPrem:rhel2_u02

Destination Volume:

☒ Logs

Source Volume: svm_onPrem:rhel2_u03

Destination Volume:

Previous Next

7. Provision a log volume and mount it to the target DR server for the Oracle flash recovery area and online logs.

ONTAP System Manager

Search actions, objects, and pages

DASHBOARD

STORAGE

Overview

Applications

Volumes

LUNs

Shares

Qtrees

Quotas

Storage VMs

Tiers

NETWORK

EVENTS & JOBS

PROTECTION

HOSTS

Volumes

+ Add More

	Name	Storage VM	Status	Capacity
▼	ora_standby_u01	svm_hybridcvo	Online	12.3 GB used 17.7 GB available 31.6 GB
▼	rhel2_u01_dr	svm_hybridcvo	Online	
▼	rhel2_u02_dr	svm_hybridcvo	Online	
▼	rhel2_u02_dr0917211608119360	svm_hybridcvo	Online	
▼	rhel2_u02_dr0917211703534863	svm_hybridcvo	Online	
▼	rhel2_u03_dr	svm_hybridcvo	Online	
▼	rhel2_u03_dr0917211824574775	svm_hybridcvo	Online	

Add Volume

NAME:

CAPACITY: GB

More Options Cancel Save

```

ec2-user@ora-standby:tmp
[ec2-user@ora-standby tmp]$ sudo mkdir /u03_cdb2dr
[ec2-user@ora-standby tmp]$ chown oracle:oinstall /u03_cdb2dr
chown: changing ownership of '/u03_cdb2dr': Operation not permitted
[ec2-user@ora-standby tmp]$ sudo chown oracle:oinstall /u03_cdb2dr
[ec2-user@ora-standby tmp]$ sudo mount -t nfs 10.221.1.6:/ora_standby_u03 /u03_cdb2dr
[ec2-user@ora-standby tmp]$ df -h
Filesystem                Size      Used Avail Use% Mounted on
devtmpfs                  7.6G         0   7.6G   0% /dev
tmpfs                     7.6G         0   7.6G   0% /dev/shm
tmpfs                     7.6G      17M   7.6G   1% /run
tmpfs                     7.6G         0   7.6G   0% /sys/fs/cgroup
/dev/nvme0nlp2            10G         0   10G   0% /
10.221.1.6:/ora_standby_u01 21G      13G   8.0G  62% /u01
tmpfs                     1.6G         0   1.6G   0% /run/user/1000
10.221.1.6:/Sc28182452-3fa8-448c-9e4a-c5a9e465f353 100G    3.1G   97G   4% /u02_cdb2dev
tmpfs                     1.6G         0   1.6G   0% /run/user/54321
10.221.1.6:/Sc39c05df8-4b00-4b3a-853c-9d6d338e5df7 100G    3.7G   97G   4% /u02_cdb2test
10.221.1.6:/Sccf886a5c-3273-475e-ad97-472b2a8dccee 100G    3.8G   97G   4% /var/opt/snapcenter/sco/backup_mount/rhel2_cdb2_log_09-17-2021_18.20.04.1177_1/cdb2/1
10.221.1.6:/ora_standby_u03 21G     320K   20G   1% /u03_cdb2dr
[ec2-user@ora-standby tmp]$

```



The Oracle clone procedure does not create a log volume, which needs to be provisioned on the DR server before cloning.

8. Select the target clone host and location to place the data files, control files, and redo logs.

Clone from cdb2

1 Name

2 Locations

3 Credentials

4 PreOps

5 PostOps

6 Notification

7 Summary

Select the host to create a clone

Clone host

ora-standby.demo.netapp.com

Datafile locations

/u02_cdb2dr

Reset

Control files

/u02_cdb2dr/cdb2dr/control/control01.ctl

/u03_cdb2dr/cdb2dr/control/control02.ctl

Reset

Redo logs

Group	Size	Unit	Number of files
RedoGroup 1	200	MB	1
/u03_cdb2dr/cdb2dr/redolog/redo03.log			
RedoGroup 2	200	MB	1

Reset

Previous

Next

9. Select the credentials for the clone. Fill in the details of the Oracle home configuration on the target server.

Clone from cdb2

1 Name

2 Locations

3 Credentials

4 PreOps

5 PostOps

6 Notification

7 Summary

Database Credentials for the clone

Credential name for sys user

None

+

i

Database port

1521

Oracle Home Settings

i

Oracle Home

/u01/app/oracle/product/19800/cdb2

Oracle OS User

oracle

Oracle OS Group

oinstall

Previous

Next

10. Specify the scripts to run before cloning. Database parameters can be adjusted if needed.

Clone from cdb2

1 Name

2 Locations

3 Credentials

4 PreOps

5 PostOps

6 Notification

7 Summary

Specify scripts to run before clone operation

Prescript full path

/var/opt/snapcenter/spl/scripts/

Enter Prescript path

Arguments

Script timeout

60

secs

Database Parameter settings

audit_file_dest	/u01/app/oracle/admin/cdb2dr/adump	X
audit_trail	DB	X
open_cursors	300	X
pga_aggregate_target	1432354816	X

+

Reset

Previous

Next

11. Select Until Cancel as the recovery option so that the recovery runs through all available archive logs to recoup the last transaction replicated to the secondary cloud location.

Clone from cdb2

1 Name

2 Locations

3 Credentials

4 PreOps

5 PostOps

6 Notification

7 Summary

Provide email settings ⓘ

Email preference

Never

From

From email

To

Email to

Subject

Notification

☐ Attach job report

⚠

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

✕

Previous

Next

13. DR clone summary.

Clone from cdb2

1 Name

2 Locations

3 Credentials

4 PreOps

5 PostOps

6 Notification

7 Summary

Summary

Clone from backup

rhel2_cdb2_09-17-2021_14.35.01.4997_0

Clone SID

cdb2dr

Clone server

ora-standby.demo.netapp.com

Exclude PDBs

none

Oracle home

/u01/app/oracle/product/19800/cdb2

Oracle OS user

oracle

Oracle OS group

oinstall

Datafile mountpaths

/u02_cdb2dr

Control files

/u02_cdb2dr/cdb2dr/control/control01.ctl
/u03_cdb2dr/cdb2dr/control/control02.ctl

Redo groups

RedoGroup =1 TotalSize =200 Path =/u03_cdb2dr/cdb2dr/redolog/redo03.log
RedoGroup =2 TotalSize =200 Path =/u03_cdb2dr/cdb2dr/redolog/redo02.log
RedoGroup =3 TotalSize =200 Path =/u03_cdb2dr/cdb2dr/redolog/redo01.log

Recovery scope

Until Cancel

Prescript full path

none

Prescript arguments

Postscript full path

none

Postscript arguments

Previous

Finish

- Cloned DBs are registered with SnapCenter immediately after clone completion and are then available for backup protection.

NetApp SnapCenter®								
Oracle Database		View Database Search databases						
	Name	Oracle Database Type	Host/Cluster	Resource Group	Policies	Last Backup	Overall Status	
	cdb2	Single Instance (Multitenant)	rhel2.demo.netapp.com	rhel2_cdb2 rhel2_cdb2_log	Oracle Archive Log Backup Oracle Full Online Backup	09/17/2021 7:00:10 PM	Backup succeeded	
	cdb2dev	Single Instance (Multitenant)	ora-standby.demo.netapp.com				Not protected	
	cdb2dr	Single Instance (Multitenant)	ora-standby.demo.netapp.com				Not protected	
	cdb2test	Single Instance (Multitenant)	ora-standby.demo.netapp.com				Not protected	

Post DR clone validation and configuration for Oracle

- Validate the last test transaction that has been flushed, replicated, and recovered at the DR location in the cloud.

```
oracle@ora-standby:/u01/app/oracle/product/19800/cdb2/dbs
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.3.0.0.0

SQL> set lin 200
SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME      HOST_NAME
-----
cdb2dr             ora-standby.demo.netapp.com

SQL> alter pluggable database cdb2_pdb1 open;

Pluggable database altered.

SQL> alter session set container=cdb2_pdb1;

Session altered.

SQL> select * from pdbadmin.dr_test;

      ID
-----
EVENT
-----
DT
-----
1
testing DB clone for DR and roll forward DB to last available log
17-SEP-21 02.12.13.000000 PM

SQL>
```

2. Configure the flash recovery area.

```
oracle@ora-standby:/u01/app/oracle/product/19800/cdb2/dbs
[oracle@ora-standby:dba]$ sqlplus / as sysdba

SQL*Plus: Release 19.0.0.0.0 - Production on Fri Sep 17 22:07:11 2021
Version 19.3.0.0.0

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

Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.3.0.0.0

SQL> show parameter db_recovery_file_dest

NAME                                TYPE      VALUE
-----
db_recovery_file_dest               string    /u03_cdb2dr/cdb2dr
db_recovery_file_dest_size          big integer 17208M
SQL> alter system set db_recovery_file_dest='/u03_cdb2dr/cdb2dr' scope=both;

System altered.

SQL> show parameter db_recovery_file_dest

NAME                                TYPE      VALUE
-----
db_recovery_file_dest               string    /u03_cdb2dr/cdb2dr
db_recovery_file_dest_size          big integer 17208M
SQL>
```

- 3. Configure the Oracle listener for user access.
- 4. Split the cloned volume off of the replicated source volume.
- 5. Reverse replication from the cloud to on-premises and rebuild the failed on-premises database server.



Clone split may incur temporary storage space utilization that is much higher than normal operation. However, after the on-premises DB server is rebuilt, extra space can be released.

Clone an on-premises SQL production DB to cloud for DR

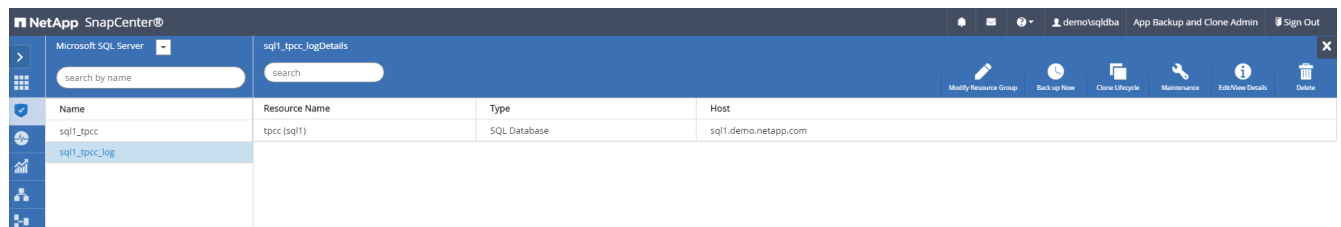
- 1. Similarly, to validate that the SQL clone recovery ran through last available log, we created a small test table and inserted a row. The test data would be recovered after a full recovery to the last available log.

```
Administrator Command Prompt - sqlcmd - SQLCMD
C:\Users\administrator.DEMO>sqlcmd
1> select host_name()
2> go

-----
SQL1
(1 rows affected)
1> use tpcc
2> go
Changed database context to 'tpcc'.
1> insert into snap_sync values ('test snap mirror DR for SQL', getdate())
2> go

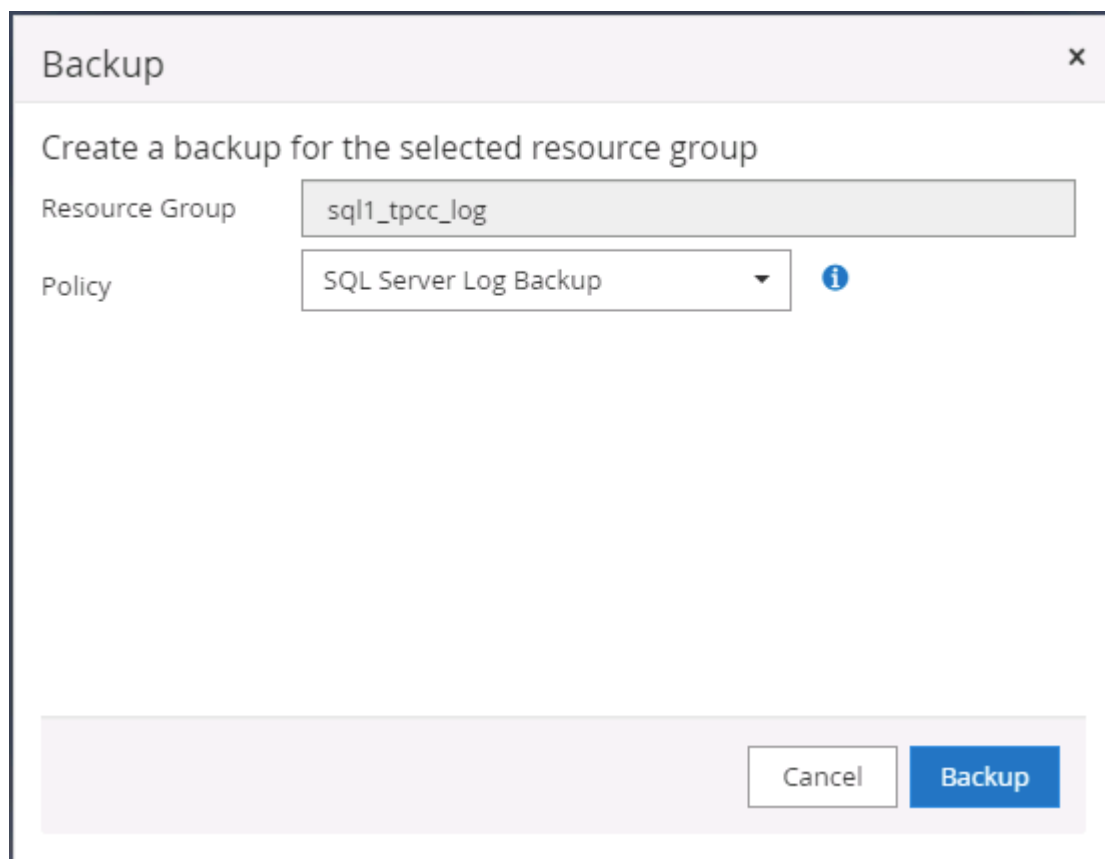
(1 rows affected)
1> select * from snap_sync
2> go
event                                         dt
-----
test snap mirror DR for SQL                  2021-09-20 14:23:04.533
(1 rows affected)
1>
```

2. Log into SnapCenter with a database management user ID for SQL Server. Navigate to the Resources tab, which shows the SQL Server protection resources group.



Name	Resource Name	Type	Host
sql1_tpcc	tpcc (sql1)	SQL Database	sql1.demo.netapp.com
sql1_tpcc_log			

3. Manually run a log backup to flush the last transaction to be replicated to secondary storage in the public cloud.



Backup

Create a backup for the selected resource group

Resource Group: sql1_tpcc_log

Policy: SQL Server Log Backup

Cancel Backup

4. Select the last full SQL Server backup for the clone.

NetApp SnapCenter®

Microsoft SQL Server

tpcc (sql1) Topology

search by name

Manage Copies

7 Backups
0 Clones
Local copies

7 Backups
2 Clones
Mirror copies

Summary Card

14 Backups
2 Clones

Secondary Mirror Backup(s)

search

Backup Name	Count	Type	if	End Date	Verified
sql1_tpcc_09-19-2021_18.25.01.4134	1	Full backup		09/19/2021 6:25:05 PM	Unverified
sql1_tpcc_09-18-2021_18.25.01.3963	1	Full backup		09/18/2021 6:25:05 PM	Unverified
sql1_tpcc_09-17-2021_18.25.01.4218	1	Full backup		09/17/2021 6:25:05 PM	Unverified

- Set the clone setting such as the Clone Server, Clone Instance, Clone Name, and mount option. The secondary storage location where cloning is performed is auto-populated.

Clone from backup

1 Clone Options

2 Logs

3 Script

4 Notification

5 Summary

Clone settings

Clone server: sql-standby.demo.netapp.com

Clone instance: sql-standby

Clone name: tpcc_dr

Choose mount option

☒ Auto assign mount point

☐ Auto assign volume mount point under path: full file path

Secondary storage location : Snap Vault / Snap Mirror

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

Previous Next

- Select all log backups to be applied.

Clone from backup

1 Clone Options

2 Logs

3 Script

4 Notification

5 Summary

Choose logs

☒ All log backups

☐ By log backups until

9/19/2021 6:25:10 PM

☐ By specific date until

09/19/2021 6:25:05 PM

☐ None

Previous

Next

7. Specify any optional scripts to run before or after cloning.

Clone from backup

1 Clone Options

2 Logs

3 Script

4 Notification

5 Summary

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

Prescript full path

Prescript arguments

Choose optional arguments...

Postscript full path

Postscript arguments

Choose optional arguments...

Script timeout

60

secs

Previous

Next

8. Specify an SMTP server if email notification is desired.

Clone from backup

1 Clone Options

2 Logs

3 Script

4 Notification

5 Summary

Provide email settings ⓘ

Email preference

Never

From

From email

To

Email to

Subject

Notification

☐ Attach Job Report

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

✕

Previous

Next

9. DR clone summary. Cloned databases are immediately registered with SnapCenter and available for backup protection.

Clone from backup

1 Clone Options

2 Logs

3 Script

4 Notification

5 Summary

Summary

Clone server

sql-standby.demo.netapp.com

Clone instance

sql-standby

Clone name

tpcc_dr

Mount option

Auto Mount

Prescript full path

None

Prescript arguments

Postscript full path

None

Postscript arguments

Send email

No

Previous

Finish

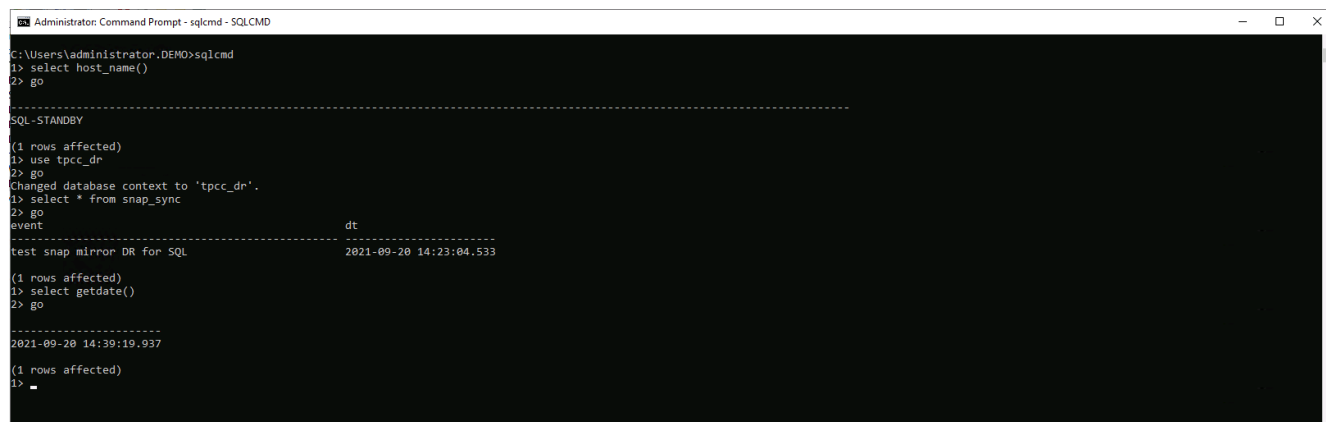
NetApp SnapCenter®							
Microsoft SQL Server							
View Database search by name							
Resources	Name	Instance	Host	Last Backup	Overall Status	Type	
Monitor	master	sql1	sql1.demo.netapp.com		Not available for backup	System database	
Reports	model	sql1	sql1.demo.netapp.com		Not available for backup	System database	
Hosts	msdb	sql1	sql1.demo.netapp.com		Not available for backup	System database	
Storage Systems	tempdb	sql1	sql1.demo.netapp.com		Not available for backup	System database	
Settings	tpcc	sql1	sql1.demo.netapp.com	09/22/2021 5:35:08 PM	Backup failed, Schedules on hold	User database	
Alerts	master	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database	
	model	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database	
	msdb	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database	
	tempdb	sql-standby	sql-standby.demo.netapp.com		Not available for backup	System database	
	tpcc_clone	sql-standby	sql-standby.demo.netapp.com		Not protected	User database	
	tpcc_dev	sql-standby	sql-standby.demo.netapp.com		Not protected	User database	
	tpcc_dr	sql-standby	sql-standby.demo.netapp.com		Not protected	User database	

Post DR clone validation and configuration for SQL

1. Monitor clone job status.

NetApp SnapCenter®							
Jobs Schedules Events Logs							
search by name							
Jobs - Filter							
ID	Status	Name	Start date	End date	Owner		
1052	✓	Clone from backup 'sql1_tpcc_09-19-2021_18.25.01.4134'	09/20/2021 2:36:17 PM	09/20/2021 2:37:06 PM	demo/sqlqdba		
1047	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/20/2021 2:35:01 PM	09/20/2021 2:37:08 PM	demo/sqlqdba		
1045	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/20/2021 2:28:17 PM	09/20/2021 2:30:25 PM	demo/sqlqdba		
1044	✓	Clone from backup 'sql1_tpcc_09-17-2021_18.25.01.4218'	09/20/2021 1:39:24 PM	09/20/2021 1:40:09 PM	demo/sqlqdba		
1042	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/20/2021 1:35:01 PM	09/20/2021 1:37:08 PM	demo/sqlqdba		
1040	✓	Backup of Resource Group 'sql1_tpcc_log' with policy 'SQL Server Log Backup'	09/20/2021 12:35:01 PM	09/20/2021 12:37:08 PM	demo/sqlqdba		

2. Validate that last transaction has been replicated and recovered with all log file clones and recovery.



```
Administrator: Command Prompt - sqlcmd - SQLCMD
C:\Users\administrator.DEMO>sqlcmd
1> select host_name()
2> go

SQL-STANDBY
(1 rows affected)
1> use tpcc_dr
2> go
Changed database context to 'tpcc_dr'.
1> select * from snap_sync
2> go
event                                     dt
-----
test snap mirror DR for SQL               2021-09-20 14:23:04.533
(1 rows affected)
1> select getdate()
2> go

2021-09-20 14:39:19.937
(1 rows affected)
1>
```

3. Configure a new SnapCenter log directory on the DR server for SQL Server log backup.
4. Split the cloned volume off of the replicated source volume.
5. Reverse replication from the cloud to on-premises and rebuild the failed on-premises database server.

Where to go for help?

If you need help with this solution and use cases, please join the [NetApp Solution Automation community support Slack channel](#) and look for the solution-automation channel to post your questions or inquiries.

Copyright Information

Copyright © 2021 NetApp, Inc. All rights reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means-graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system-without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP "AS IS" AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

RESTRICTED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.277-7103 (October 1988) and FAR 52-227-19 (June 1987).

Trademark Information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.