



## **Disaster recovery failover**

NetApp solutions for SAP

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# Disaster recovery failover

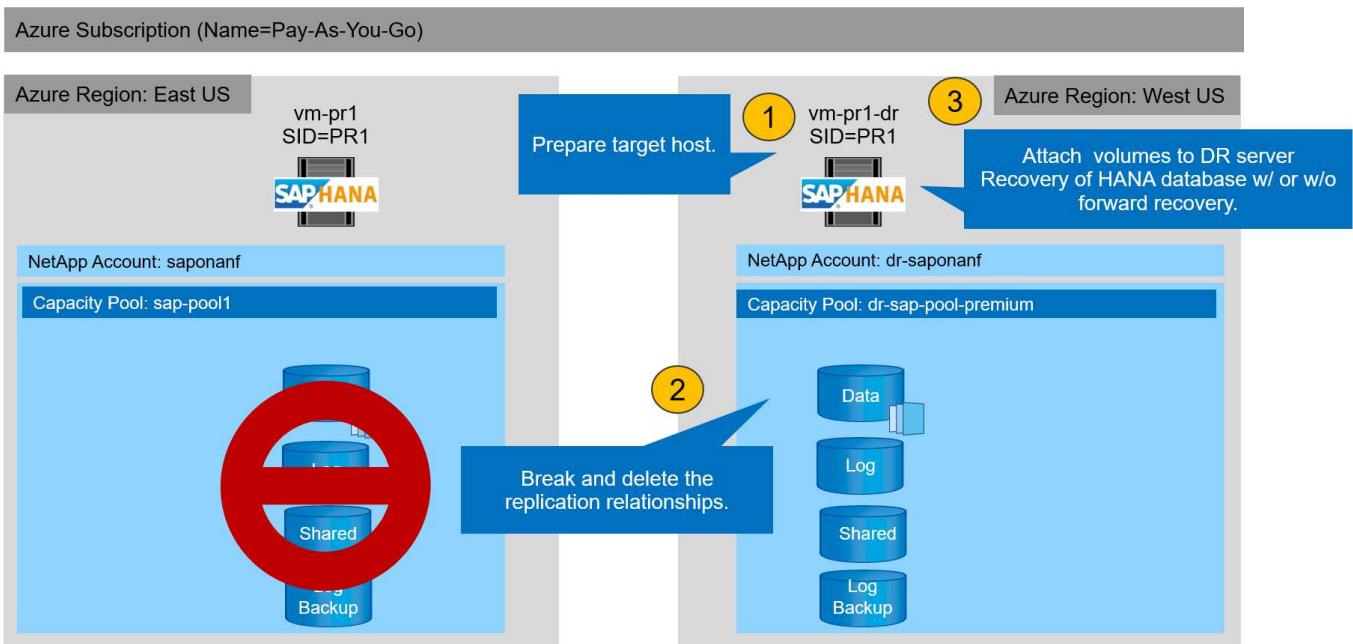
## Disaster recovery failover

Depending on whether the log backup replication is part of the disaster recovery setup, the steps for disaster recovery are slightly different. This section describes the disaster recovery failover for data-backup-only replication as well as for data volume replication combined with log backup volume replication.

To execute disaster recovery failover, complete these steps:

1. Prepare the target host.
2. Break and delete the replication relationships.
3. Restore the data volume to the latest application-consistent snapshot backup.
4. Mount the volumes at the target host.
5. Recover the HANA database.
  - Data volume recovery only.
  - Forward recovery using replicated log backups.

The following subsections describe these steps in detail, and the following figure depicts disaster failover testing.



## Prepare the target host

This section describes the preparation steps required at the server that is used for the disaster recovery failover.

During normal operation, the target host is typically used for other purposes, for example, as a HANA QA or

test system. Therefore, most of the described steps must be executed when disaster failover testing is executed. On the other hand, the relevant configuration files, like `/etc/fstab` and `/usr/sap/sapservices`, can be prepared and then put in production by simply copying the configuration file. The disaster recovery failover procedure ensures that the relevant prepared configuration files are configured correctly.

The target host preparation also includes shutting down the HANA QA or test system as well as stopping all services using `systemctl stop sapinit`.

## Target server host name and IP address

The host name of the target server must be identical to the host name of the source system. The IP address can be different.



Proper fencing of the target server must be established so that it cannot communicate with other systems. If proper fencing is not in place, then the cloned production system might exchange data with other production systems, resulting in logically corrupted data.

## Install required software

The SAP host agent software must be installed at the target server. For full information, see the [SAP Host Agent](#) at the SAP help portal.



If the host is used as a HANA QA or test system, the SAP host agent software is already installed.

## Configure users, ports, and SAP services

The required users and groups for the SAP HANA database must be available at the target server. Typically, central user management is used; therefore, no configuration steps are necessary at the target server. The required ports for the HANA database must be configured at the target hosts. The configuration can be copied from the source system by copying the `/etc/services` file to the target server.

The required SAP services entries must be available at the target host. The configuration can be copied from the source system by copying the `/usr/sap/sapservices` file to the target server. The following output shows the required entries for the SAP HANA database used in the lab setup.

```
vm-pr1:~ # cat /usr/sap/sapservices
#!/bin/sh
LD_LIBRARY_PATH=/usr/sap/PR1/HDB01/exe:$LD_LIBRARY_PATH;export
LD_LIBRARY_PATH;/usr/sap/PR1/HDB01/exe/sapstartsrv
pf=/usr/sap/PR1/SYS/profile/PR1_HDB01_vm-pr1 -D -u pr1adm
limit.descriptors=1048576
```

## Prepare HANA log volume

Because the HANA log volume is not part of the replication, an empty log volume must exist at the target host. The log volume must include the same subdirectories as the source HANA system.

```
vm-pr1:~ # ls -al /hana/log/PR1/mnt00001/
total 16
drwxrwxrwx 5 root      root      4096 Feb 19 16:20 .
drwxr-xr-x 3 root      root      22 Feb 18 13:38 ..
drwxr-xr-- 2 pr1adm    sapsys   4096 Feb 22 10:25 hdb00001
drwxr-xr-- 2 pr1adm    sapsys   4096 Feb 22 10:25 hdb00002.00003
drwxr-xr-- 2 pr1adm    sapsys   4096 Feb 22 10:25 hdb00003.00003
vm-pr1:~ #
```

## Prepare log backup volume

Because the source system is configured with a separate volume for the HANA log backups, a log backup volume must also be available at the target host. A volume for the log backups must be configured and mounted at the target host.

If log backup volume replication is part of the disaster recovery setup, the replicated log backup volume is mounted at the target host, and it is not necessary to prepare an additional log backup volume.

## Prepare file system mounts

The following table shows the naming conventions used in the lab setup. The volume names at the disaster recovery site are included in `/etc/fstab`.

HANA PR1 volumes	Volume and subdirectories at disaster recovery site	Mount point at target host
Data volume	PR1-data-mnt00001-sm-dest	/hana/data/PR1/mnt00001
Shared volume	PR1-shared-sm-dest/shared PR1-shared-sm-dest/usr-sap-PR1	/hana/shared /usr/sap/PR1
Log backup volume	hanabackup-sm-dest	/hanabackup



The mount points from this table must be created at the target host.

Here are the required `/etc/fstab` entries.

```
vm-pr1:~ # cat /etc/fstab
# HANA ANF DB Mounts
10.0.2.4:/PR1-data-mnt0001-sm-dest /hana/data/PR1/mnt0001 nfs
rw,vers=4,minorversion=1,hard,timeo=600,rsize=262144,wsize=262144,intr,noatime,lock,_netdev,sec=sys 0 0
10.0.2.4:/PR1-log-mnt0001-dr /hana/log/PR1/mnt0001 nfs
rw,vers=4,minorversion=1,hard,timeo=600,rsize=262144,wsize=262144,intr,noatime,lock,_netdev,sec=sys 0 0
# HANA ANF Shared Mounts
10.0.2.4:/PR1-shared-sm-dest/hana-shared /hana/shared nfs
rw,vers=4,minorversion=1,hard,timeo=600,rsize=262144,wsize=262144,intr,noatime,lock,_netdev,sec=sys 0 0
10.0.2.4:/PR1-shared-sm-dest/usr-sap-PR1 /usr/sap/PR1 nfs
rw,vers=4,minorversion=1,hard,timeo=600,rsize=262144,wsize=262144,intr,noatime,lock,_netdev,sec=sys 0 0
# HANA file and log backup destination
10.0.2.4:/hanabackup-sm-dest /hanabackup nfs
rw,vers=3,hard,timeo=600,rsize=262144,wsize=262144,nconnect=8,bg,noatime,noclock 0 0
```

## Break and delete replication peering

In case of a disaster failover, the target volumes must be broken off so that the target host can mount the volumes for read and write operations.



For the HANA data volume, you must restore the volume to the latest HANA snapshot backup created with AzAcSnap. This volume revert operation is not possible if the latest replication snapshot is marked as busy due to the replication peering. Therefore, you must also delete the replication peering.

The next two screenshots show the break and delete peering operation for the HANA data volume. The same operations must be performed for the log backup and the HANA shared volume as well.

PR1-data-mnt0001-sm-dest (dr-saponanf/dr-sap-pool-premium/PR1-data-mnt0001-sm-dest)

Volume

Search (Ctrl+ /) Edit Break peering Delete Refresh

Essentials

End point type : Destination Source

Healthy : Healthy Relationship state

Mirror state : Mirrored Replication schedule

Total progress

Show data for last: 1 hour 6 hours 12 hours 1 day 7 days

Volume replication lag time

9.72hours 100

8.33hours 90

6.94hours 80

5.56hours 70

Is volume replication transfer

100

90

80

70

60

50

Settings

Properties

Locks

Storage service

Mount instructions

Export policy

Snapshots

Replication

## Break replication peering

Break replication peering

⚠ Warning! This action will stop data replication between the volumes and might result in loss of data.

Type 'yes' to proceed

yes

X

PR1-data-mnt0001-sm-dest (dr-saponanf/dr-sap-pool-premium/PR1-data-mnt0001-sm-dest)

Volume

Search (Ctrl+ /) Resync Delete Refresh

Essentials

End point type : Destination Source

Healthy : Healthy Relationship state

Mirror state : Broken Replication schedule

Total progress

Show data for last: 1 hour 6 hours 12 hours 1 day 7 days

Volume replication lag time

1.67min 100

1.5min 90

1.33min 80

1.17min 70

1min 60

50sec 50

Is volume replication transfer

100

90

80

70

60

50

Settings

Properties

Locks

Storage service

Mount instructions

Export policy

Snapshots

Replication

## Delete replication

Delete replication object

⚠ Warning this operation will delete the connection between PR1-data-mnt0001 and PR1-data-mnt0001-sm-dest

This will delete the replication object of PR1-data-mnt0001, type 'yes' to proceed

yes

X

Since replication peering was deleted, it is possible to revert the volume to the latest HANA snapshot backup. If peering is not deleted, the selection of revert volume is grayed out and is not selectable. The following two screenshots show the volume revert operation.

PR1-data-mnt0001-sm-dest (dr-saponanf/dr-sap-pool-premium/PR1-data-mnt0001-sm-dest) | Snapshots X

Volume

Search (Ctrl+/ ) + Add snapshot ⟳ Refresh

Overview Activity log Access control (IAM) Tags

**Settings** Properties Locks

Storage service Mount instructions Export policy

**Snapshots** Replication

Monitoring Metrics

Automation Tasks (preview)

Export template

Support + troubleshooting New support request

Search snapshots  

Name	Location	Created	...
azacsnap_2021-02-18T120002-2150721Z	West US	02/18/2021, 01:00:05 PM	...
azacsnap_2021-02-18T160002-1442691Z	West US	02/18/2021, 05:00:49 PM	...
azacsnap_2021-02-18T200002-0758687Z	West US	02/18/2021, 09:00:05 PM	...
azacsnap_2021-02-19T000002-0039686Z	West US	02/19/2021, 01:00:05 AM	...
azacsnap_2021-02-19T040001-8773748Z	West US	02/19/2021, 05:00:06 AM	...
azacsnap_2021-02-19T080001-5198653Z	West US	02/19/2021, 09:00:05 AM	...
azacsnap_2021-02-19T120002-1495322Z	West US	02/19/2021, 01:00:06 PM	...
azacsnap_2021-02-19T160002-3698678Z	West US	02/19/2021, 05:00:05 PM	...
azacsnap_2021-02-22T120002-3145398Z	West US	02/22/2021, 01:00:06 PM	...
azacsnap_2021-02-22T160002-0144647Z	West US	02/22/2021, 05:00:05 PM	...
azacsnap_2021-02-22T200002-0649581Z	West US	02/22/2021, 09:00:05 PM	...
azacsnap_2021-02-23T000002-0311379Z	West US	02/23/2021, 01:00:05 PM	...
azacsnap_2021-02-23T040001-7114-11eb-b147-d039ea...	West US	02/23/2021, 01:10:00 AM	...

Restore to new volume Revert volume Delete

PR1-data-mnt0001-sm-dest (dr-saponanf/dr-sap-pool-premium/PR1-data-mnt0001-sm-dest) X

Volume

Search (Ctrl+/ ) + Add snapshot ⟳ Refresh

Overview Activity log Access control (IAM) Tags

**Settings** Properties Locks

Storage service Mount instructions Export policy

**Snapshots** Replication

Monitoring Metrics

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Export template

Support + troubleshooting New support request

Search snapshots  

Name	Location
azacsnap_2021-02-18T120002-2150721Z	West US
azacsnap_2021-02-18T160002-1442691Z	West US
azacsnap_2021-02-18T200002-0758687Z	West US
azacsnap_2021-02-19T000002-0039686Z	West US
azacsnap_2021-02-19T040001-8773748Z	West US
azacsnap_2021-02-19T080001-5198653Z	West US
azacsnap_2021-02-19T120002-1495322Z	West US
azacsnap_2021-02-19T160002-3698678Z	West US
azacsnap_2021-02-22T120002-3145398Z	West US
azacsnap_2021-02-22T160002-0144647Z	West US
azacsnap_2021-02-22T200002-0649581Z	West US
azacsnap_2021-02-23T000002-0311379Z	West US
azacsnap_2021-02-23T040001-7114-11eb-b147-d039ea...	West US

**Revert volume to snapshot** X

Revert volume PR1-data-mnt0001-sm-dest to snapshot azacsnap\_2021-02-23T000002-0311379Z

⚠ This action is irreversible and it will delete all the volumes snapshots that are newer than azacsnap\_2021-02-23T000002-0311379Z. Please type 'PR1-data-mnt0001-sm-dest' to confirm.

Are you sure you want to revert 'PR1-data-mnt0001-sm-dest' to state of 'azacsnap\_2021-02-23T000002-0311379Z'?
   

✓

After the volume revert operation, the data volume is based on the consistent HANA snapshot backup and can now be used to execute forward recovery operations.



If a capacity pool with a low performance tier has been used, the volumes must now be moved to a capacity pool that can provide the required performance.

## Mount the volumes at the target host

The volumes can now be mounted at the target host, based on the `/etc/fstab` file created before.

```
vm-pr1:~ # mount -a
```

The following output shows the required file systems.

```
vm-pr1:~ # df
Filesystem           1K-blocks      Used
Available  Use% Mounted on
devtmpfs                8201112        0
8201112    0% /dev
tmpfs                  12313116        0
12313116    0% /dev/shm
tmpfs                  8208744      9096
8199648    1% /run
tmpfs                  8208744        0
8208744    0% /sys/fs/cgroup
/dev/sda4                29866736  2543948
27322788    9% /
/dev/sda3                1038336    79984
958352    8% /boot
/dev/sda2                524008      1072
522936    1% /boot/efi
/dev/sdb1                32894736    49180
31151556    1% /mnt
10.0.2.4:/PR1-log-mnt0001-dr        107374182400    6400
107374176000    1% /hana/log/PR1/mnt0001
tmpfs                  1641748        0
1641748    0% /run/user/0
10.0.2.4:/PR1-shared-sm-dest/hana-shared 107377178368 11317248
107365861120    1% /hana/shared
10.0.2.4:/PR1-shared-sm-dest/usr-sap-PR1 107377178368 11317248
107365861120    1% /usr/sap/PR1
10.0.2.4:/hanabackup-sm-dest        107379678976 35249408
107344429568    1% /hanabackup
10.0.2.4:/PR1-data-mnt0001-sm-dest 107376511232 6696960
107369814272    1% /hana/data/PR1/mnt0001
vm-pr1:~ #
```

## HANA database recovery

The following shows the steps for HANA database recovery

Start the required SAP services.

```
vm-pr1:~ # systemctl start sapinit
```

The following output shows the required processes.

```
vm-pr1:/ # ps -ef | grep sap
root      23101      1  0 11:29 ?          00:00:00
/usr/sap/hostctrl/exe/saphostexec pf=/usr/sap/hostctrl/exe/host_profile
pr1adm    23191      1  3 11:29 ?          00:00:00
/usr/sap/PR1/HDB01/exe/sapstartsrv
pf=/usr/sap/PR1/SYS/profile/PR1_HDB01_vm-pr1 -D -u pr1adm
sapadm   23202      1  5 11:29 ?          00:00:00
/usr/sap/hostctrl/exe/sapstartsrv pf=/usr/sap/hostctrl/exe/host_profile -D
root      23292      1  0 11:29 ?          00:00:00
/usr/sap/hostctrl/exe/saposcol -l -w60
pf=/usr/sap/hostctrl/exe/host_profile
root      23359  2597  0 11:29 pts/1    00:00:00 grep --color=auto sap
```

The following subsections describe the recovery process with and without forward recovery using the replicated log backups. The recovery is executed using the HANA recovery script for the system database and hdbsql commands for the tenant database.

## Recovery to latest HANA data volume backup savepoint

The recovery to the latest backup savepoint is executed with the following commands as user pr1adm:

- System database

```
recoverSys.py --command "RECOVER DATA USING SNAPSHOT CLEAR LOG"
```

- Tenant database

```
Within hdbsql: RECOVER DATA FOR PR1 USING SNAPSHOT CLEAR LOG
```

You can also use HANA Studio or Cockpit to execute the recovery of the system and the tenant database.

The following command output show the recovery execution.

### System database recovery

```

pr1adm@vm-pr1:/usr/sap/PR1/HDB01> HDBSettings.sh recoverSys.py
--command="RECOVER DATA USING SNAPSHOT CLEAR LOG"
[139702869464896, 0.008] >> starting recoverSys (at Fri Feb 19 14:32:16
2021)
[139702869464896, 0.008] args: ()
[139702869464896, 0.009] keys: {'command': 'RECOVER DATA USING SNAPSHOT
CLEAR LOG'}
using logfile /usr/sap/PR1/HDB01/vm-pr1/trace/backup.log
recoverSys started: =====2021-02-19 14:32:16 =====
testing master: vm-pr1
vm-pr1 is master
shutdown database, timeout is 120
stop system
stop system on: vm-pr1
stopping system: 2021-02-19 14:32:16
stopped system: 2021-02-19 14:32:16
creating file recoverInstance.sql
restart database
restart master nameserver: 2021-02-19 14:32:21
start system: vm-pr1
sapcontrol parameter: ['-function', 'Start']
sapcontrol returned successfully:
2021-02-19T14:32:56+00:00  P0027646      177bab4d610  INFO      RECOVERY
RECOVER DATA finished successfully
recoverSys finished successfully: 2021-02-19 14:32:58
[139702869464896, 42.017] 0
[139702869464896, 42.017] << ending recoverSys, rc = 0 (RC_TEST_OK), after
42.009 secs
pr1adm@vm-pr1:/usr/sap/PR1/HDB01>

```

## Tenant database recovery

If a user store key has not been created for the pr1adm user at the source system, a key must be created at the target system. The database user configured in the key must have privileges to execute tenant recovery operations.

```

pr1adm@vm-pr1:/usr/sap/PR1/HDB01> hdbuserstore set PR1KEY vm-pr1:30113
<backup-user> <password>

```

The tenant recovery is now executed with hdbsql.

```
pr1adm@vm-pr1:/usr/sap/PR1/HDB01> hdbsql -U PR1KEY
Welcome to the SAP HANA Database interactive terminal.
Type:  \h for help with commands
      \q to quit
hdbsql SYSTEMDB=> RECOVER DATA FOR PR1 USING SNAPSHOT CLEAR LOG
0 rows affected (overall time 66.973089 sec; server time 66.970736 sec)
hdbsql SYSTEMDB=>
```

The HANA database is now up and running, and the disaster recovery workflow for the HANA database has been tested.

## Recovery with forward recovery using log/catalog backups

Log backups and the HANA backup catalog are being replicated from the source system.

The recovery using all available log backups is executed with the following commands as user pr1adm:

- System database

```
recoverSys.py --command "RECOVER DATABASE UNTIL TIMESTAMP '2021-02-20
00:00:00' CLEAR LOG USING SNAPSHOT"
```

- Tenant database

```
Within hdbsql: RECOVER DATABASE FOR PR1 UNTIL TIMESTAMP '2021-02-20
00:00:00' CLEAR LOG USING SNAPSHOT
```



To recover using all available logs, you can just use any time in the future as the timestamp in the recovery statement.

You can also use HANA Studio or Cockpit to execute the recovery of the system and the tenant database.

The following command output show the recovery execution.

### System database recovery

```

pr1adm@vm-pr1:/usr/sap/PR1/HDB01> HDBSettings.sh recoverSys.py --command
"RECOVER DATABASE UNTIL TIMESTAMP '2021-02-20 00:00:00' CLEAR LOG USING
SNAPSHOT"
[140404915394368, 0.008] >> starting recoverSys (at Fri Feb 19 16:06:40
2021)
[140404915394368, 0.008] args: ()
[140404915394368, 0.008] keys: {'command': "RECOVER DATABASE UNTIL
TIMESTAMP '2021-02-20 00:00:00' CLEAR LOG USING SNAPSHOT"}
using logfile /usr/sap/PR1/HDB01/vm-pr1/trace/backup.log
recoverSys started: =====2021-02-19 16:06:40 =====
testing master: vm-pr1
vm-pr1 is master
shutdown database, timeout is 120
stop system
stop system on: vm-pr1
stopping system: 2021-02-19 16:06:40
stopped system: 2021-02-19 16:06:41
creating file recoverInstance.sql
restart database
restart master nameserver: 2021-02-19 16:06:46
start system: vm-pr1
sapcontrol parameter: ['-function', 'Start']
sapcontrol returned successfully:
2021-02-19T16:07:19+00:00  P0009897      177bb0b4416 INFO      RECOVERY
RECOVER DATA finished successfully, reached timestamp 2021-02-
19T15:17:33+00:00, reached log position 38272960
recoverSys finished successfully: 2021-02-19 16:07:20
[140404915394368, 39.757] 0
[140404915394368, 39.758] << ending recoverSys, rc = 0 (RC_TEST_OK), after
39.749 secs

```

## Tenant database recovery

```

pr1adm@vm-pr1:/usr/sap/PR1/HDB01> hdbsql -U PR1KEY
Welcome to the SAP HANA Database interactive terminal.
Type: \h for help with commands
      \q to quit

hdbsql SYSTEMDB=> RECOVER DATABASE FOR PR1 UNTIL TIMESTAMP '2021-02-20
00:00:00' CLEAR LOG USING SNAPSHOT
0 rows affected (overall time 63.791121 sec; server time 63.788754 sec)

hdbsql SYSTEMDB=>

```

The HANA database is now up and running, and the disaster recovery workflow for the HANA database has been tested.

## Check consistency of latest log backups

Because log backup volume replication is performed independently of the log backup process executed by the SAP HANA database, there might be open, inconsistent log backup files at the disaster recovery site. Only the latest log backup files might be inconsistent, and those files should be checked before a forward recovery is performed at the disaster recovery site using the `hdbbackupcheck` tool.

If the `hdbbackupcheck` tool reports an error for the latest log backups, the latest set of log backups must be removed or deleted.

```
pr1adm@hana-10: > hdbbackupcheck
/hanabackup/PR1/log/SYSTEMDB/log_backup_0_0_0_0.1589289811148
Loaded library 'libhdbcaccessor'
Loaded library 'libhdblivecache'
Backup '/mnt/log-backup/SYSTEMDB/log_backup_0_0_0_0.1589289811148'
successfully checked.
```

The check must be executed for the latest log backup files of the system and the tenant database.

If the `hdbbackupcheck` tool reports an error for the latest log backups, the latest set of log backups must be removed or deleted.

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