MICROSOFT SNAPSHOT TOOLS FOR SAP HANA ON AZURE

Abstract

How to guide for the snapshot tools Microsoft provide to perform snapshots and disaster recovery failover of SAP HANA on Azure Large Instances.

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Version

This document is for the SAP HANA on Azure Large Instance snapshot tools **version 4.2**.

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Overview

This document provides details on the snapshot tools used for the SAP HANA on Azure Large Instances. These snapshot tools are tested and supported by Microsoft and serve the following purposes:

1. Create storage snapshots of SAP HANA.
2. Check status, backup and removal of storage snapshots.
3. Self Service Disaster Recovery failover when the DR scenario has been deployed.

This document is intended to provide “How To” details about these snapshot tools which are developed and supported by Microsoft for the specific purpose of performing database consistent storage snapshots on SAP HANA on Azure Large Instances.

Disclaimer: *This guide is written based on successfully testing the set up in Microsoft’s lab containing SAP HANA on Azure Large Instances. Customers are responsible for monitoring and testing to ensure the snapshot tools are performing as expected.*

Terms and Definitions

Glossary of terms and definitions used in this documentation:

- **SID**: A system identifier for HANA system.
- **Multipurpose DR**: A disaster recovery system which has more than one instances configured. One of the instances is intended to provide DR for the production SID, other instances are non-production HANA instances.
- **Normal DR**: A disaster recovery system which just has a primary SID configured with storage replication running. There is no other workload running on a “Normal DR” while production instance is up and running at primary site.
- **Single SID system**: A system which has only one HANA instance configured.
- **Multi SID system**: A system which has more than one HANA instances configured. Also known in SAP documentation as MCOS deployment.
- **HLI**: SAP HANA on Azure Large Instances Unit.
- **DR**: Disaster Recovery.
- **HSR**: HANA System Replication.

What are these snapshot tools?

The (new for v4.0) self-installer provides a single file bundle for customers to install and configure the storage snapshot tools for SAP HANA on Azure Large Instance.

The snapshot tools included in the installation file are described as follows:

- **azure_hana_backup:** The primary tool to execute database consistent storage snapshots for the SAP HANA data & shared, logbackups, or boot volumes.
    - With the SSL option this command requires two files per SID, each with the PEM extension (text-based certificate file as defined in RFC 1421 through RFC 1424).

- **azure_hana_replication_status:** Provides basic details around the replication status from the production site to the disaster-recovery site. The snapshot command monitors to ensure that the replication is taking place, and it shows the size of the items that are being replicated. It also provides guidance if a replication is taking too long or if the link is down.

- **azure_hana_snapshot_details:** Provides a list of basic details about the snapshots, per volume, that exist in your environment. This command can be run on the primary server or on a server in the disaster-recovery location. The command provides the following information broken down by each volume that contains snapshots:
    - Size of total snapshots in a volume.
    - Each snapshot in that volume includes the following details:
        - Snapshot name
        - Create time
        - Size of the snapshot
        - Frequency of the snapshot
        - HANA Backup ID associated with that snapshot, if relevant

- **azure_hana_snapshot_delete:** This command deletes a storage snapshot or a set of snapshots. You can use either the SAP HANA Backup ID as found in HANA Studio or the storage snapshot name. The Backup ID is only tied to the 'hana' snapshots which are created for the data & shared volumes. Otherwise, if the snapshot name is entered, it searches for all snapshots that match the entered snapshot name.

- **HANABackupCustomerDetails.txt:** This file is a modifiable configuration file that you need to modify to adapt to your SAP HANA configuration.

- **testHANAConnection:** This command tests the connection to the SAP HANA instance and is required to validate set up of the snapshot tools.
    - With the SSL option this command requires two files per SID, each with the PEM extension (text-based certificate file as defined in RFC 1421 through RFC 1424).

- **testStorageSnapshotConnection:** This snapshot command has two main steps. First, it ensures that the SAP HANA on Azure Large Instance system that runs the snapshot tools can communicate with the underlying storage interface. Second, it creates a temporary storage snapshot for the SAP HANA on Azure Large Instance being tested. This command should be run for every HANA instance on a server to ensure the snapshot tools can communicate with the storage so they function as expected.

- **removeTestStorageSnapshot:** This snapshot command deletes the test snapshot as created with the snapshot command *testStorageSnapshotConnection*.

- **azure_hana_dr_failover:** This command forces a DR Failover into another paired region. This snapshot command **stops** storage replication from the primary site to the secondary site, and presents the latest available snapshot on the DR volumes along with recommended filesystem mountpoints for the DR volumes. This command must be run on the HANA Large Instance system **in the DR region** (i.e. the target fail-over system).

- **azure_hana_test_dr_failover:** This command performs a test failover to the paired DR site. Unlike the azure_hana_dr_failover command, this execution does not interrupt the storage replication from primary to secondary. Instead clones of the latest available snapshot are created at the DR site and recommended filesystem mountpoints of the cloned volumes are presented. This command must be run on the HANA Large Instance system **in the DR region** (i.e. the target fail-over system).

Getting the snapshot tools

It is recommended customers get the most recent version of the self-installation file (e.g. azure_hana_snapshot_installer_v4.0.run or later) which contains the snapshot tools from GitHub (https://github.com/Azure/hana-large-instances-self-service-scripts). Then follow the steps in the Technical Setup section of this guide to install.

The self-installation file is also signed with Microsoft's public key to allow for GPG verification of the download.

Verifying the download

The installer, which is downloadable per above, has an associated PGP signature file with a .asc filename extension. This file can be used to verify the downloaded installer to ensure this is a Microsoft provided file. The Microsoft PGP Public Key used for signing Linux packages is available here (http://packages.microsoft.com/keys/microsoft.asc) and has been used to sign the signature file.

The Microsoft PGP Public Key can be imported to a user's local as follows:

Terminal session

```
$ wget http://packages.microsoft.com/keys/microsoft.asc
$ gpg --import microsoft.asc
```

The following commands trust the Microsoft PGP Public Key:

1. List the keys in the store.
2. Edit the Microsoft key.
3. Check the fingerprint with fpr
4. Sign the key to trust it.

```
Terminal session
$ gpg --list-keys
----<snip>----
pub   rsa2048 2015-10-28 [SC]
      BC528686B50D79E339D3721CEB3E94ADBE1229CF
uid           [ unknown] Microsoft (Release signing) gpgsecurity@microsoft.com

$ gpg --edit-key gpgsecurity@microsoft.com
gpg (GnuPG) 2.1.18; Copyright (C) 2017 Free Software Foundation, Inc.
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.


pub  rsa2048/EB3E94ADBE1229CF
     created: 2015-10-28  expires: never       usage: SC
     trust: unknown       validity: unknown
[ unknown] (1). Microsoft (Release signing) <gpgsecurity@microsoft.com>

gpg> fpr
pub   rsa2048/EB3E94ADBE1229CF 2015-10-28 Microsoft (Release signing)
<gpgsecurity@microsoft.com>
 Primary key fingerprint: BC52 8686 B50D 79E3 39D3  721C EB3E 94AD BE12 29CF

gpg> sign

pub  rsa2048/EB3E94ADBE1229CF
     created: 2015-10-28  expires: never       usage: SC
     trust: unknown       validity: unknown
 Primary key fingerprint: BC52 8686 B50D 79E3 39D3  721C EB3E 94AD BE12 29CF

     Microsoft (Release signing) <gpgsecurity@microsoft.com>

Are you sure that you want to sign this key with your
key "XXX XXXX <xxxxxxx@xxxxxxxx.xxx>" (A1A1A1A1A1A1)

Really sign? (y/N) y

gpg> quit
Save changes? (y/N) y
```

The PGP signature file for the installer can be checked as follows:

```
Terminal session
$ gpg --verify azure_hana_snapshot_installer_v4.0.run.asc
azure_hana_snapshot_installer_v4.0.run
gpg: Signature made Sat 13 Apr 2019 07:51:46 AM STD
gpg:                using RSA key EB3E94ADBE1229CF
gpg: Good signature from "Microsoft (Release signing)
<gpgsecurity@microsoft.com>" [full]
```

More details on using GPG can be found in the online manual:

- https://www.gnupg.org/gph/en/manual/book1.html

Supported Scenarios

The snapshot tools can be used in the following scenarios.

- Single SID
- Multiple SID
- HSR
- Scale-out
- MDC (Only single tenant supported)
- Single Container
- SUSE Operating System
- RHEL Operating System
- SKU TYPE I
- SKU TYPE II

ref: https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/hana-supported-scenario

Important things to remember

- SAP does not support snapshot on the MDC environment for the following releases. Though snapshot is supported with non-MDC setup for the following releases. The snapshot command does not work if you have following HANA releases with MDC setup.
  - HANA 2 SP00
  - HANA 1 SP 12
  - HANA 1 SP11
  - HANA 1 SP10
- For HANA 2 SPS04 and later releases: for MDC environment with more than one tenant, a database consistent storage snapshot is supported by SAP_and works with these snapshot tools.
- For HANA 2 SP1 and releases prior to SPS04: for MDC environment with more than one tenant, a database consistent storage snapshot is not supported by SAP. For single tenant it is supported by SAP and works with these snapshot tools.
- After setup of the snapshot tools, continuously monitor the storage space available and if required, delete the old snapshots on a regular basis to avoid storage fill out.
- Always use the latest snapshot tools. You can download the latest version from GitHub.
- Use the same version of the snapshot tools across the landscape.
- Test the snapshot tools and get comfortable with the parameters required and output of the snapshot command before using in the production system.
- Don't change the mount point name of the server provisioned by the Microsoft Operations. These snapshot tools rely on these standard mount point names to be available for a successful execution.
- When setting up the HANA user for backup (details below in this document), you need to setup the user for each HANA instance. Create an SAP HANA user account to access HANA instance under the SYSTEMDB (and not in the SID database) for MDC. In the single container environment, it can be setup under the tenant database.
- Customers must provide the SSH public key for storage access. This must be done once per node and for each user under which the snapshot command is executed.
- The number of snapshots per volume is limited to 250.
- If asked to modify the configuration file, always use the Linux text editor such as "vi" and not the Windows editors like notepad. Using Windows editor may corrupt the file format.
- The snapshot tools can now (v4.0+) run as a non-root user. Previously, they were only supported to run under root or sidadm user. The installer will setup and configure this automatically if the following pre-requisites are met as the root user.
  - Setup hdbuserstore for the SAP HANA user to communicate with SAP HANA.
  - Setup SSH private/public key pairs for the user to communicate with the storage sub-system.
- For DR: The snapshot tools must be tested on DR node before DR is setup.
- Monitor disk space regularly, automated log deletion is managed with the --trim option of the azure_hana_backup tool for SAP HANA 2 and later releases.

Guidance provided in this document

The following guidance is provided in this document to illustrate the usage of the snapshot tools.

Snapshots

- What are the prerequisite for the storage snapshot?
- How to setup snapshots?
- How to take snapshots manually?
- How to setup automatic snapshot backup?
- How to monitor the snapshots?
- How to delete a snapshot?
- How to restore a snapshot?
- What are key facts to know about the snapshots?

Note	Snapshot is tested for both single SID and multi SID.

Disaster Recovery

- What are the prerequisites for DR setup?
- How to setup a disaster recovery?
- How to monitor the data sync from Primary to DR site?
- How to perform a failover to DR site?

Note	DR is tested for single SID failover on a multipurpose DR setup.

Technical Setup

To test and document these snapshot tools, the following set up was used. All the screen shots and information presented correspond to **version 4.0** of the snapshot tools.

- Operating System: SLES 12 SP2 for SAP
- HANA Large Instances: 2xS192 (four sockets, 2 TB); One for Primary site and second for DR site
  - Primary site HLI unit (sapprdhdb80) has 3 SIDs configured: H80, H81, and H82
  - DR site HLI unit (sapdrhdb80) has 2 SIDs configured: Q85, and H80 (replication from the Primary site)
- HANA Version: HANA 2.0 SP1
- Server Names: sapprdhdb80 (Primary) and sapdrhdb80 (DR node).
  - Note ‘prd’ and ‘dr’ in their hostnames.

CAUTION!	You may have different screens for operating system or HANA depending on the version you are using. Also, based on your HANA version, the snapshot tools parameter may differ. Refer the snapshot command details before using them.

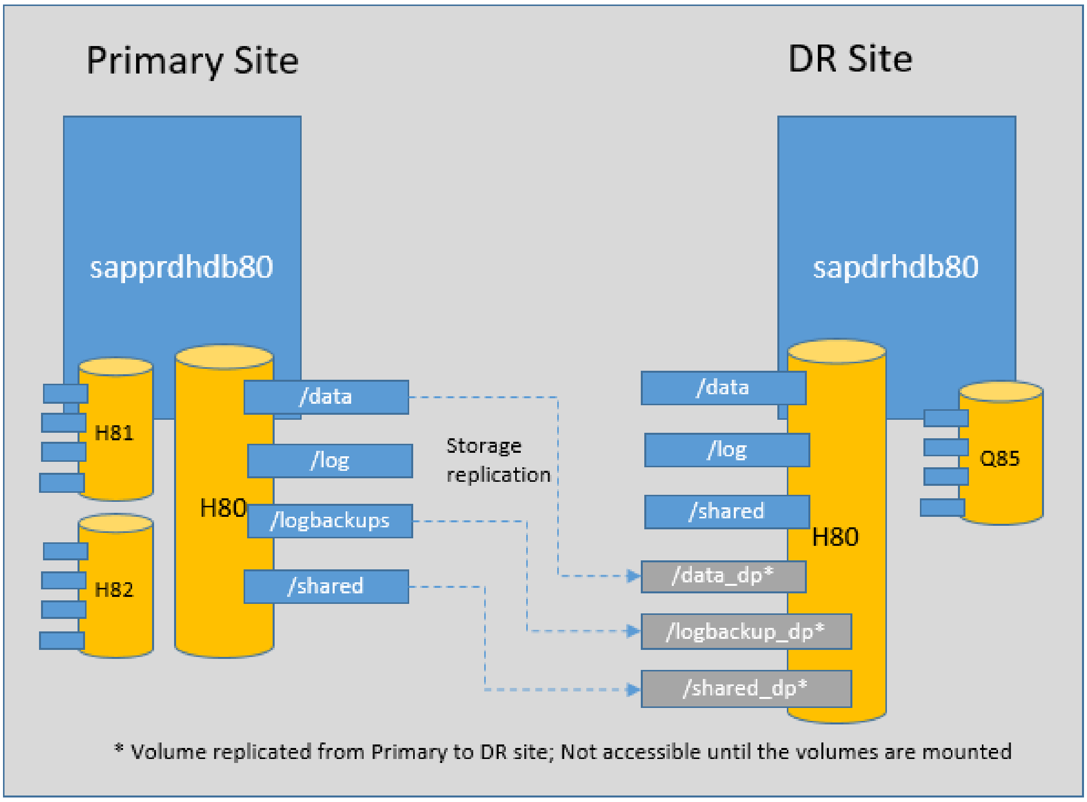


Figure 1 - Technical Setup

Pre-requisites for installation

Please follow the guidelines to setup and execute the snapshots and disaster recovery commands. It is recommended the following steps are completed as root before installing and using the snapshot tools.

1. **OS is patched**: Please refer for patching and SMT setup https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/hana-installation#setting-up-smt-server-for-suse-linux

2. **Time Synchronization is setup**. The customer will need to provide a NTP compatible time server, and configure the OS accordingly.
3. **HANA is installed**: Please refer for HANA installation instructions: https://blogs.msdn.microsoft.com/saponsqlserver/2017/11/21/sap-netweaver-installation-on-hana-database/ .
    a. In this document, we installed HANA 2.0 SP1 with multi SID as following:
        i. **Primary site HLI unit** (sapprdhdb80) has three HANA instances configured with the SIDs: H80, H81, and H82. To install three instances, you need to run the hana installer (hdblcmgui) three times with “new instance” option, and then provide SID information each time for each instance. So, in this example, you run hdblcmgui, three times with H80, H81, and H82 SIDs.
        ii. **DR site HLI unit** (sapdrhdb80) has two HANA instances configured: Q85, and H80. To install two instances, you need to run the hana installer (hdblcmgui) two times with “new instance” option, and then provide SID information each time for each instance. So, in this example, you run hdblcmgui, 2 times with H80 and Q85 SIDs.
4. **Enable communication with storage (refer separate section for details)**: Customer must setup SSH with a private/public key pair, and provide the public key for each node where the snapshot tools are planned to be executed to Microsoft Operations for setup on the storage back-end.
    a. Test this by running the command "ssh -l <Storage User Name eg: clt1h80backup> < Storage IP Address>" from one of the nodes to ensure the connectivity of the node to the storage. Type "exit" to logout of the storage prompt.
    b. Microsoft operations will provide the storage user and storage IP at the time of provisioning. Refer section HANABackupCustomerDetails.txt for more details.
5. **Enable communication with SAP HANA (refer separate section for details)**: Customer must setup an appropriate SAP HANA user with the required privileges to perform the snapshot.
    a. This can be tested from the command line as follows using the text in grey
        i. HANAv1 hdbsql -n <HANA IP address> -i <HANA instance> -U <HANA user> “\s”
        ii. HANAv2 hdbsql -n <HANA IP address> -i <HANA instance> -d SYSTEMDB -U <HANA user> “\s”

    The examples above are for non-SSL communication to SAP HANA.

Enable communication with storage

Communication with the storage back-end executes over an encrypted SSH channel. The following example steps are to provide guidance on setup of SSH for this communication.

1. Modify the /etc/ssh/ssh_config file.

    Change /etc/ssh/ssh_config by adding the MACs hmac-sha1 line as per the following example:

Terminal session

```
#   RhostsRSAAuthentication no
#   RSAAuthentication yes
#   PasswordAuthentication yes
#   HostbasedAuthentication no
#   GSSAPIAuthentication no
#   GSSAPIDelegateCredentials no
#   GSSAPIKeyExchange no
#   GSSAPITrustDNS no
#   BatchMode no
#   CheckHostIP yes
#   AddressFamily any
#   ConnectTimeout 0
#   StrictHostKeyChecking ask
#   IdentityFile ~/.ssh/identity
#   IdentityFile ~/.ssh/id_rsa
#   IdentityFile ~/.ssh/id_dsa
#   Port 22
Protocol 2
#   Cipher 3des
#   Ciphers aes128-ctr,aes192-ctr,aes256-ctr,arcfour256,arcfour128,aes128-cbc,3des-
cbc
#   MACs hmac-md5,hmac-sha1,umac-64@openssh.com,hmac-ripemd160
MACs hmac-sha1
#   EscapeChar ~
#   Tunnel no
#   TunnelDevice any:any
#   PermitLocalCommand no
#   VisualHostKey no
#   ProxyCommand ssh -q -W %h:%p gateway.example.com
```

2. Create a private/public key pair.

Refer to the following example command, do not enter a password when generating a key.

Terminal session

```
# ssh-keygen -t rsa –b 5120 -C ""
```

3. Send the public key to Microsoft Operations

Send the output of the cat /root/.ssh/id_rsa.pub command (example below) to Microsoft Operations to enable the snapshot tools to communicate with the storage sub-system.

Terminal session

```
# cat /root/.ssh/id_rsa.pub
ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAABAQDoaRCgwn1Ll31NyDZy0UsOCKcc9nu2qdAPHdCzleiTWISvPW
FzIFxz8iOaxpeTshH7GRonGs9HNtRkkz6mpK7pCGNJdxS4wJC9MZdXNt+JhuT23NajrTEnt1jXiVFH
bh3jD7LjJGMb4GNvqeiBExyBDA2pXdlednOaE4dtiZ1N03Bc/J4TNuNhhQbdsIWZsqKt9OPUuTfD95
j0XvwUTLQbR4peGNfN1/cefcLxDlAgI+TmKdfgnLXIsSfbacXoTbqyBRwCi7p+bJnJD07zSc9YCZJa
wKGAIilSg7s6Bq/2lAPDN1TqwIF8wQhAg2C7yeZHyE/ckaw/eQYuJtN+RNBD
```

Enable communication with SAP HANA

The snapshot tools communicate with SAP HANA and need a user with appropriate permissions to initiate and release the database save-point. The following provides an example on setup of the SAP HANA v2 user and the hdbuserstore for communication to the SAP HANA database.

The following example commands setup a user (SHOASNAP) in the SYSTEMDB on SAP HANA 2.0 database, change the IP address, usernames and passwords as appropriate:

1. Connect to the SYSTEMDB to create the user

Terminal session

```
> hdbsql -n <IP_address_of_host>:30013 -i 00 -u SYSTEM -p <SYSTEM_USER_PASSWORD>

Welcome to the SAP HANA Database interactive terminal.

Type:  \h for help with commands
       \q to quit

hdbsql SYSTEMDB=>
```

2. Create the user

This example creates the SHOASNAP user in the SYSTEMDB.

Terminal session

```
hdbsql SYSTEMDB=> CREATE USER SHOASNAP PASSWORD <SHOASNAP_PASSWORD_CHANGE_ME> NO
FORCE_FIRST_PASSWORD_CHANGE;
```

3. Grant the user permissions

This example sets the permission for the SHOASNAP user to allow for performing a database consistent storage snapshot.

Terminal session

```
hdbsql SYSTEMDB=> GRANT BACKUP ADMIN, CATALOG READ, MONITORING TO SHOASNAP;
```

4. Setup the SAP HANA Secure User Store (change the password)

This example uses the hdbuserstore command to setup the SAP HANA Secure User store.

Terminal session

```
# hdbuserstore Set SHOASNAP <IP_address_of_host>:30013 SHOASNAP
<SHOASNAP_PASSWORD_CHANGE_ME>
```

5. Check the SAP HANA Secure User Store

To check if the secure user store is setup correctly, use the hdbuserstore command to list the output which should be similar to the following. More details on using hdbuserstore are available on the SAP website.

Terminal session

```
# hdbuserstore List
DATA FILE       : /home/shoasnap/.hdb/sapprdhdb80/SSFS_HDB.DAT
KEY FILE        : /home/shoasnap/.hdb/sapprdhdb80/SSFS_HDB.KEY

KEY SHOASNAP
  ENV : <IP_address_of_host>:30013
  USER: SHOASNAP
```

Additional instructions for using the log trimmer (SAP HANA 2.0 and later)

If using the log trimmer, then the following example commands setup a user (SHOASNAP) in the TENANT database(s) on a SAP HANA 2.0 database system. Remember to change the IP address, usernames and passwords as appropriate:

1. Connect to the TENANT database to create the user, tenant specific details highlighted

Terminal session

```
> hdbsql -n <IP_address_of_host>:30015 -i 00 -u SYSTEM -p <SYSTEM_USER_PASSWORD>

Welcome to the SAP HANA Database interactive terminal.

Type:  \h for help with commands
       \q to quit

hdbsql TENANTDB=>
```

2. Create the user

This example creates the SHOASNAP user in the SYSTEMDB.

Terminal session

```
hdbsql TENANTDB=> CREATE USER SHOASNAP PASSWORD <SHOASNAP_PASSWORD_CHANGE_ME> NO
FORCE_FIRST_PASSWORD_CHANGE;
```

3. Grant the user permissions

This example sets the permission for the SHOASNAP user to allow for performing a database consistent storage snapshot.

Terminal session

```
hdbsql TENANTDB=> GRANT BACKUP ADMIN, CATALOG READ, MONITORING TO SHOASNAP;
```

Repeat the process for all the tenant databases. It's possible to get the connection details for all the tenants using the following SQL query against the SYSTEMDB.

```
SELECT HOST, SQL_PORT, DATABASE_NAME FROM SYS_DATABASES.M_SERVICES WHERE SQL_PORT
LIKE '3%'
```

See the following example query.

Terminal session

```
> hdbsql -jaxC -n 10.90.0.31:30013 -i 00 -u SYSTEM  -p SapHana@1234 " SELECT HOST,
SQL_PORT, DATABASE_NAME FROM SYS_DATABASES.M_SERVICES WHERE SQL_PORT LIKE '3%' "
sapprdhdb80,30013,SYSTEMDB
sapprdhdb80,30015,H81
sapprdhdb80,30041,H82
```

Installing the snapshot tools

The downloadable self-installer is designed to make the snapshot tools easy to setup and run with non-root user privileges (e.g. shoasnap). The installer will setup the user and put the snapshot tools into the users $HOME/bin subdirectory (default = /home/shoasnap/bin).

The self-installer tries to determine the correct settings and paths for all the files based on the configuration of the user performing the installation (e.g. root). If the previous setup steps (Enable communication with storage and SAP HANA) were run as root, then the installation will copy the private key and the hdbuserstore to the backup user's location. However, it is possible for the steps which enable communication with the storage back-end and SAP HANA to be manually done by a knowledgeable administrator after the installation.

Note

For earlier SAP HANA on Azure Large Instance installations, the directory of pre-installed snapshot tools was /hana/shared/<SID>/exe/linuxx86_64/hdb..

With these pre-requisite steps completed, it's now possible to install the snapshot tools using the self-installer as follows:

1. Copy the downloaded self-installer to the target system.
2. Execute the self-installer as the root user, see the following example. If necessary, make the file executable using the 'chmod +x' command.

Running the self-installer command without any arguments will display help on using the installer to install the snapshot tools as follows:

Terminal session

```
# chmod +x azure_hana_snapshot_installer_v4.0.run
# ./azure_hana_snapshot_installer_v4.0.run

Usage: ./azure_hana_snapshot_installer_v4.0.run [-v] -I [-u <HLI Snapshot Command
user>]
       ./azure_hana_snapshot_installer_v4.0.run [-v] -X [-d <directory>]
       ./azure_hana_snapshot_installer_v4.0.run [-h]

       Switches enclosed in [] are optional for each command line.

       -h prints out this usage.
       -v turns on verbose output.
       -I starts the installation.
       -u is the Linux user to install the scripts into, by default this is
'shoasnap'.
       -X will only extract the snapshot commands.
       -d is the target directory to extract into, by default this is
'./snapshot_cmds'.
               Examples of a target directory are ./tmp or /usr/local/bin
```

Note

The self-installer has an option to extract (-X) the snapshot tools from the bundle without performing any user creation and setup. This allows an experienced administrator to complete the setup steps manually, or to copy the commands to upgrade an existing installation.

Easy installation of snapshot tools (default)

The installer has been designed to quickly install the snapshot tools for SAP HANA on Azure. The manual steps are within each step.

By default, if the installer is run with only the -I option, it will do the following:

1. Create Snapshot user 'shoasnap', home directory, and set group membership.
2. Configure the user shoasnap's login .profile.
3. Search filesystem for directories to add to shoasnap's $PATH, these are typically the paths to the SAP HANA tools, such as hdbsql and hdbuserstore.
4. Search filesystem for directories to add to shoasnap's $LD_LIBRARY_PATH. Many commands require a library path to be set in order to execute correctly, this configures it for the installed user.
5. Copy the SSH keys for back-end storage for shoasnap from the "root" user (the user running the install). This assumes the "root" user has already configured connectivity to the storage – see section "Enable communication with storage".
6. Copy the SAP HANA connection secure user store for the target user, shoasnap. This assumes the "root" user has already configured the secure user store – see section "Enable communication with SAP HANA".
7. The snapshot tools are extracted into /home/shoasnap/bin/.
8. The commands in /home/shoasnap/bin/ have their permissions set (ownership and executable bit, etc).

The following example shows the correct output of the installer when run with the default installation option.

Terminal session

```
# ./azure_hana_snapshot_installer_v4.0.run -I
+-------------------------------------------------------------+
|   Azure HANA Large Instance Snapshot Command Installer      |
+-------------------------------------------------------------+
|-> Installer version '4.0'
|-> Create Snapshot user 'shoasnap', home directory, and set group membership.
|-> Configure shoasnap .profile
|-> Search filesystem for directories to add to shoasnap's $PATH
|-> Search filesystem for directories to add to shoasnap's $LD_LIBRARY_PATH
|-> Copying SSH keys for back-end storage for shoasnap.
|-> Copying HANA connection keystore for shoasnap.
|-> Extracting commands into /home/shoasnap/bin/.
|-> Making commands in /home/shoasnap/bin/ executable.
|-> Creating symlink for hdbsql command in /home/shoasnap/bin/.
+-------------------------------------------------------------+
|  Install complete!  Follow the steps below to configure.    |
+-------------------------------------------------------------+

1. Change into the snapshot user account.....
     su - shoasnap
2. Setup the HANA Secure User Store..... (command format below)
     hdbuserstore Set <ADMIN_USER> <HOSTNAME>:<PORT> <admin_user> <password>
3. Change to location of commands.....
     cd /home/shoasnap/bin/
4. Configure the customer details file.....
     vi HANABackupCustomerDetails.txt
5. Test the connection to storage.....
     testStorageSnapshotConnection
6. Test the connection to HANA.....
   a. without SSL
     testHANAConnection --nossl
   b. with SSL,  you will need to choose the correct SSL option
     testHANAConnection --ssl=<commoncrypto|openssl>
7. Run your first snapshot backup..... (example below)
     azure_hana_backup --type=hana --prefix=hana_test --frequency=15min --
retention=1
```

Uninstallation of the snapshot tools

If the snapshot tools have been installed using the default settings, uninstallation only requires removing the user the commands have been installed for (default = shoasnap).

Terminal session

```
# userdel -f -r shoasnap
```

Manual installation of the snapshot tools

In some cases, it is necessary to install the tools manually, but the recommendation is to use the installer’s default option to ease this process.

Each line starting with a # character demonstrates the example commands following the character are run by the root user. The \ at the end of a line is the standard line-continuation character for a shell command.

As the root superuser, a manual installation can be achieved as follows:

1. Get the “sapsys” group id
   ```
   # grep sapsys /etc/group
   sapsys:x:1010:
   ```

2. Create Snapshot user 'shoasnap', home directory, and set group membership.
   ```
   # useradd -m -g 1010 -G wheel -c "Azure SAP HANA Snapshots User" shoasnap
   ```

3. Make sure the user shoasnap’s login .profile exists.
   ```
   # echo "" >> /home/shoasnap/.profile
   ```

4. Search filesystem for directories to add to shoasnap's $PATH, these are typically the paths to the SAP HANA tools, such as hdbsql and hdbuserstore.
   ```
   # HDBSQL_PATH=`find -L /usr/sap -name hdbsql -exec dirname {} \; \
   | grep SYS | sort | uniq | tr '\n' ':'`
   ```

5. Add the updated PATH to the user’s profile
   ```
   # echo "export PATH=\"\$PATH:$HDBSQL_PATH\"" >> /home/shoasnap/.profile
   ```

6. Search filesystem for directories to add to shoasnap's $LD_LIBRARY_PATH.
   ```
   # NEW_LIB_PATH=`find -L /usr/sap -name "*.so" -exec dirname {} \; \
   | sort | uniq | tr '\n' ':'`
   ```

7. Add the updated library path to the user’s profile
   ```
   # echo "export LD_LIBRARY_PATH=\"\$LD_LIBRARY_PATH:$NEW_LIB_PATH\"" \
   >> /home/shoasnap/.profile
   ```

8. Copy the SSH keys for back-end storage for shoasnap from the “root” user (the user running the install). This assumes the “root” user has already configured connectivity to the storage – see section “Enable communication with storage”.
   ```
   # cp -pr ~/.ssh /home/shoasnap/.
   ```

9. Set the user permissions correctly for the SSH files
   ```
   # chown -R shoasnap.sapsys /home/shoasnap/.ssh
   ```

10. Copy the SAP HANA connection secure user store for the target user, shoasnap. This assumes the “root” user has already configured the secure user store – see section “Enable communication with SAP HANA”.

```
# cp -pr ~/.hdb /home/shoasnap/.
```

11. Set the user permissions correctly for the hdbuserstore files

```
# chown -R shoasnap.sapsys /home/shoasnap/.hdb
```

12. Extract the snapshot tools into /home/shoasnap/bin/.

```
# ./azure_hana_snapshot_installer_v4.1.run -X -d /home/shoasnap/bin
```

13. Make the snapshot commands executable

```
# chmod 700 /home/shoasnap/bin/*
```

14. Ensure the correct ownership permissions are set on the user’s home directory

```
# chown -R shoasnap.sapsys /home/shoasnap/*
```

Complete setup of snapshot tools

The installer provides steps to complete after the installation of the snapshot tools has been done. Follow these steps to complete the configuration of the snapshot tools and perform the first database consistent storage snapshot.

The following are the steps to complete after running the installer with the default installation options:

Terminal session

```
1. Change into the snapshot user account.....
     su - shoasnap
2. Setup the HANA Secure User Store..... (command format below)
     hdbuserstore Set <ADMIN_USER> <HOSTNAME>:<PORT> <admin_user> <password>
3. Change to location of commands.....
     cd /home/shoasnap/bin/
4. Configure the customer details file.....
     vi HANABackupCustomerDetails.txt
5. Test the connection to storage.....
     testStorageSnapshotConnection
6. Test the connection to HANA.....
   a. without SSL
     testHANAConnection --nossl
   b. with SSL,  you will need to choose the correct SSL option
     testHANAConnection --ssl=<commoncrypto|openssl>
7. Run your first snapshot backup..... (example below)
     azure_hana_backup --type=hana --prefix=hana_test --frequency=15min --
retention=1
```

Step 2 will be necessary if “Enable communication with SAP HANA” was not done before the installation.

CAUTION	The test commands should execute correctly otherwise the snapshot command, “azure_hana_backup” may fail.

Configuration file for snapshot tools

Before testing connection to SAP HANA and the storage sub-system, the configuration file needs to be correctly configured.

An example configuration (HANABackupCustomerDetails.txt) file is as follows:

```
Terminal session
```

```
# head -n 18 HANABackupCustomerDetails.txt
The following document is for all customers using the Azure HANA Backup and Recovery scripts. Please fill in all necessary
fields for each SID you wish to backup or recover. You may also comment out fields that you do not wish to backup for a period
of time by adding a # in front of a required field. You also do not need to enter all SIDs that are contained on a particular server if
there is no need to backup or recover that particular SID. The format below must be kept for all fields otherwise all scripts will
present an error message and the script will terminate.  You may however delete additional required fields of any SID Information
Details you will not be using after the last usable SID.  All fields must either be filled in, commented out, or deleted.

HANA Server Name: testing01
HANA Server IP Address: 172.18.18.50

######***SID #1 Information***#####
SID1: h80
###Provided by Microsoft Operations###
SID1 Storage Backup Name: clt1h80backup
SID1 Storage IP Address: 172.18.18.11
######     Customer Provided    ######
SID1 HANA instance number: 00
SID1 HANA HDBuserstore Name: SHOASNAP
```

Upgrading the snapshot tools

This section is intended to provide a high-level workflow for customers to use as a base to aid them in upgrading the snapshot tools they are currently using.

> **Note** The snapshot tools continue to be backward compatible with both the configuration file, snapshot process and the stored snapshots.

Gather Existing Installation details

All the tools and configuration files are installed and run from the same directory. Use the following commands to understand the current installation and record information for configuring the system after the upgrade.

To find where the existing installation is:

- check the crontab file (for the current schedule)

  Terminal session

  ```
  # crontab -l
  ```

- search the filesystem for the configuration file (and locate the commands which are in the same location):

  Terminal session

  ```
  # find / -name “HANABackupCustomerDetails.txt”
  ```

From version 4.0

If version 4.0 of the snapshot tools have been installed, then follow either of the sub-sections based on whether the tools are being run as ‘root’ super-user or a standard user.

Currently running as standard non-root user (e.g. shoasnap):

The installer allows a user to upgrade an existing system by using the -X switch to extract the commands and then manually copy them into the target location.

In the following example, the installer has been copied into the $HOME directory for the user the commands are currently run as.

To perform an upgrade, the user should:

1. Backup the existing snapshot tools.
2. Extract the commands into a temporary directory using the -X and -d switches.
3. Remove the empty `HANABackupCustomerDetails.txt` to avoid overwriting the existing version.
4. Copy the commands into the default location (e.g. /home/shoasnap/bin/.)
5. Test the tools by running the standard testing tools.
   a. After testing a storage snapshot, run the removeTestStorageSnapshot command to clean up the storage test snapshots and avoid additional disk usage by storing test snapshots.

Terminal session

```
shoasnap@sapprdhdb80:~> mkdir –p ~/archive/snapshot_tools_4.0

shoasnap@sapprdhdb80:~> cp ~/bin/* ~/archive/snapshot_tools_4.0/.

shoasnap@sapprdhdb80:~> ./azure_hana_snapshot_installer _v4.0.run -X -d tmp/
+-------------------------------------------------------------+
|   Azure HANA Large Instance Snapshot Command Installer     |
+-------------------------------------------------------------+
|-> Installer version '4.0'
|-> Extracting commands into tmp/.

shoasnap@sapprdhdb80:~> rm tmp/HANABackupCustomerDetails.txt

shoasnap@sapprdhdb80:~> cp tmp/* bin/.

shoasnap@sapprdhdb80:~> ./testHANAConnection

shoasnap@sapprdhdb80:~> ./testStorageSnapshotConnection

shoasnap@sapprdhdb80:~> ./removeTestStorageSnapshot
```

Note It is possible to complete an initial install using this method, but requires thorough knowledge of setting Unix/Linux user profiles for the correct paths, etc.

Currently running as 'root' user, follow the guide to install.

If the current tools are being run as the 'root' superuser account, it is recommended to follow the installation process as defined in the "Microsoft Snapshot Tools for SAP HANA on Azure" guide to install as a non-root user. If the system is already performing snapshots as the root user, then the pre-requisites (enabling communication with storage and SAP HANA) are assumed to be met.

Note If the tools are being run as root, it is possible they are installed in the /hana/shared/<SID>/exe/linuxx86_64/hdb directory as this was the original installation target directory.

From version <=3.4.1

The older versions of the snapshot tools did not have an installer, and the guidance was to install the snapshot tools into the same directory as other SAP HANA files and run them as the 'root' superuser.

Note For earlier SAP HANA on Azure Large Instance installations, the directory of pre-installed snapshot tools was /hana/shared/<SID>/exe/linuxx86_64/hdb.

If the administrator has followed the guidance in the section "Gather Existing Installation details", then the location of the tools and config file will already be recorded.

The general recommendation is to install the snapshot tools, using the "Microsoft Snapshot Tools for SAP HANA on Azure" guide allowing the tools to be run as a non-root user.

Before starting the installation, here are some useful tips:

- Use the existing configuration file (HANABackupCustomerDetails.txt), as the tools are backward compatible with both the configuration file and the snapshots.
- Use the existing crontab as an example for creating the schedule for the new user (if following the installation guide).
- Comment out the entries in the existing crontab before setting up the schedule for the newly installed user to avoid snapshot commands being run in parallel.

CAUTION	Ensure the old crontab file has been updated to comment out running the older commands. If upgrading from <=3.4.1, make sure the all the snapshot tools commands are updated to remove the '.pl' extension as from version 4.0 they are provided as binaries.

SAP HANA Configuration

There are some recommended changes to be applied to SAP HANA to ensure protection of the log backups and catalog. By default, the basepath_logbackup and basepath_catalogbackup will output their files to the $(DIR_INSTANCE)/backup/log directory, but this location is not protected by the azure_hana_backup command.

The following hdbsql command examples are intended to demonstrate setting the log and catalog paths to locations which will be protected with the snapshot tools. The values highlighted will need to be changed to match the local SAP HANA configuration.

Configure log backup location

In this example, the change is being made to the "basepath_logbackup" parameter.

Terminal session

```
> hdbsql -jaxC -n <HANA_ip_address>:30013 -i 00 -u SYSTEM -p <SYSTEM_PASSWORD> "ALTER
SYSTEM ALTER CONFIGURATION ('global.ini', 'SYSTEM') SET ('persistence',
'basepath_logbackup') = '/hana/logbackups/H80' WITH RECONFIGURE"
```

Configure catalog backup location

In this example, the change is being made to the "basepath_catalogbackup" parameter.

First, check to ensure the basepath_catalogbackup path exists, if not create the path with the same ownership as the directory.

Terminal session

```
> ls -ld /hana/logbackups/H80/catalog
drwxr-x--- 4 h80adm sapsys 4096 Jan 17 06:55 /hana/logbackups/H80/catalog
```

If the path needs to be created, the following example creates the path and sets the correct ownership and permissions. These commands will need to be run as root.

Terminal session

```
# mkdir /hana/logbackups/H80/catalog
# chown --reference=/hana/shared/H80/HDB00 /hana/logbackups/H80/catalog
# chmod --reference=/hana/shared/H80/HDB00 /hana/logbackups/H80/catalog
# ls -ld /hana/logbackups/H80/catalog
drwxr-x--- 4 h80adm sapsys 4096 Jan 17 06:55 /hana/logbackups/H80/catalog
```

The following example will change the SAP HANA setting.

Terminal session

```
> hdbsql -jaxC -n <HANA_ip_address>:30013 -i 00 -u SYSTEM -p <SYSTEM_PASSWORD> "ALTER
SYSTEM ALTER CONFIGURATION ('global.ini', 'SYSTEM') SET ('persistence',
'basepath_catalogbackup') = '/hana/logbackups/H80/catalog' WITH RECONFIGURE"
```

Check log and catalog backup locations

After making the changes above, confirm these are set correctly with the following command.

In this example, the settings which have been set following the guidance above will display as SYSTEM settings, but this query also returns the DEFAULT settings for comparison.

Terminal session

```
> hdbsql -jaxC -n <HANA_ip_address> -i 00 -U SHOASNAP "select * from
sys.m_inifile_contents where (key = 'basepath_databackup' or key =
'basepath_datavolumes' or key = 'basepath_logbackup' or key = 'basepath_logvolumes' or
key = 'basepath_catalogbackup')"
global.ini,DEFAULT,,,persistence,basepath_catalogbackup,$(DIR_INSTANCE)/backup/log
global.ini,DEFAULT,,,persistence,basepath_databackup,$(DIR_INSTANCE)/backup/data
global.ini,DEFAULT,,,persistence,basepath_datavolumes,$(DIR_GLOBAL)/hdb/data
global.ini,DEFAULT,,,persistence,basepath_logbackup,$(DIR_INSTANCE)/backup/log
global.ini,DEFAULT,,,persistence,basepath_logvolumes,$(DIR_GLOBAL)/hdb/log
global.ini,SYSTEM,,,persistence,basepath_catalogbackup,/hana/logbackups/H80/catalog
global.ini,SYSTEM,,,persistence,basepath_datavolumes,/hana/data/H80
global.ini,SYSTEM,,,persistence,basepath_logbackup,/hana/logbackups/H80
global.ini,SYSTEM,,,persistence,basepath_logvolumes,/hana/log/H80
```

Configure log backup timeout

The default setting for SAP HANA to perform a log backup is 900 seconds (15 minutes). It's recommended to reduce this to 300 seconds (i.e. 5 minutes).

Terminal session

```
> hdbsql -jaxC -n <HANA_ip_address>:30013 -i 00 -u SYSTEM -p <SYSTEM_PASSWORD> "ALTER
SYSTEM ALTER CONFIGURATION ('global.ini', 'SYSTEM') SET ('persistence',
'log_backup_timeout_s') = '300' WITH RECONFIGURE"
```

Check log backup timeout

After making the change to the log backup timeout, check to ensure this has been set as follows.

In this example, the settings which have just been set will display as the SYSTEM settings, but this query also returns the DEFAULT settings for comparison.

Terminal session

```
> hdbsql -jaxC -n <HANA_ip_address> -i 00 -U SHOASNAP "select * from
sys.m_inifile_contents where key like '%log_backup_timeout%' "
global.ini,DEFAULT,,,persistence,log_backup_timeout_s,900
global.ini,SYSTEM,,,persistence,log_backup_timeout_s,300
```

Warning about diskspace

In version 4.1 a new option (`--trim`) was added to allow customers better management of disk space usage. Refer to the section on the `azure_hana_backup` command for more details on this option.

Caution	SAP HANA can use up all the diskspace for the /hana/logbackups/<SID> filesystem which could halt the database. Previously there was no automated log deletion/trimming available with the snapshot tools. It was recommended a log deletion/trimming process be established otherwise

Snapshot Tools Execution and Details

This section provides an overview of each of the files provided as part of the Microsoft Snapshot Tools for SAP HANA on Azure.

Version 4 moved to a more standard Unix/Linux command line interface for each of the commands where they now use “switches” and where appropriate values for those options (e.g. azure_hana_backup –type=hana –prefix=hana_snapshot ….).

Logging of the commands is performed in the background, to provide a simpler user experience, but it is possible to still get the logging displayed in the console. This is done by using the -v (verbose) switch for the command being executed.

Config file - HANABackupCustomerDetails.txt

In the following screen, the *HANABackupCustomerDetails.txt* is configured with the three SIDs.

A customer may place a ‘#’ at the beginning of all the lines for a given SID grouping to skip that SID, either temporarily or permanently. Additionally, a customer may leave SID 2-10 blank if only a single SID is installed on that server.

The parameter values must be set to the customer’s specific SAP HANA environment.

CAUTION

The configuration file must not be altered by deleting fields, deleting additional lines, or modifying the original text of the document. Otherwise, an error might occur, and the command is halted. However, you may update the information of the parameter values on each line following the colon “:” character.

```
HANA Server Name: sapprdhdb80                 ← HANA Server Host Name (Case sensitive) *,**
HANA Server IP Address: 172.18.18.50          ← HANA Server IP address (eth0.xx IP) *,**

######***SID #1 Information***#####
SID1: h80                                     ← HANA SID (any case is OK)
###Provided by Microsoft Operations###
SID1 Storage Backup Name: clt1h80backup       ← Storage backup name (case sensitive) *
SID1 Storage IP Address: 172.18.18.11         ← Storage IP address*
######    Customer Provided    ######
SID1 HANA instance number: 00                 ← HANA Instance Number
SID1 HANA HDBuserstore Name: SCADMIN          ← HANA Instance Userstore name
```

Note

For the line in the configuration file referring to the SID “HANA HDBuserstore Name”, this is the Key as listed with the `hdbuserstore List` command.

Note

For a DR scenario where backups are to be run at the DR site, then the HANA Server Name configured in the HANABackupCustomerDetails.txt file at the DR site should be the same as the production server name.

* Information provided by Microsoft Service Management during onboarding/handover call, and made available in an Excel file which is provided during handover. Please open a service request if you need to be provided this information again.

** In the case you use the following setup, you must update the hostname and IP address accordingly.

Customer is responsible to enable/disable the snapshot command on active/passive node accordingly.

- Single node: IP and Hostname of the node
- HSR with STONITH: IP and Hostname of the node
- Scale-out (N+N, N+M): Current master node IP and host name
- HSR without STONITH: IP and Hostname of the node
- Multi SID on Single node: Hostname and IP of the node hosting those SIDs

Note	Your storage IP address must be in the same subnet as your server pool. For example, in this case, our server pool subnet is **172.18.18**.0/24 and our assigned storage IP is **172.18.18.11**.

Example complete *HANABackupCustomerDetails.txt* as follows with 3 SIDs configured:

CAUTION	Do NOT copy the output below, it will not be formatted correctly, edit the *HANABackupCustomerDetails.txt* with vi.

Terminal session

```
#  cat HANABackupCustomerDetails.txt
The following document is for all customers using the Azure HANA Backup and Recovery
snapshot commands. Please fill in all necessary
fields for each SID you wish to backup or recover. You may also comment out fields
that you do not wish to backup for a period
of time by adding a # in front of a required field. You also do not need to enter
all SIDs that are contained on a particular server if
there is no need to backup or recover that particular SID. The format below must be
kept for all fields otherwise all snapshot commands will
present an error message and the snapshot command will terminate.  You may however
delete additional required fields of any SID Information
Details you will not be using after the last usable SID.  All fields must either be
filled in, commented out, or deleted.

HANA Server Name: sapprdhdb80
HANA Server IP Address: 172.18.18.50

######***SID #1 Information***#####
SID1: h80
###Provided by Microsoft Operations###
SID1 Storage Backup Name: clt1h80backup
SID1 Storage IP Address: 172.18.18.11
######     Customer Provided    ######
SID1 HANA instance number: 00
SID1 HANA HDBuserstore Name: SCADMIN

######***SID #2 Information***#####
SID2: h81
###Provided by Microsoft Operations###
SID2 Storage Backup Name: clt1h81backup
SID2 Storage IP Address: 172.18.18.11
######     Customer Provided    ######
SID2 HANA instance number: 01
SID2 HANA HDBuserstore Name: SCADMIN81

######***SID #3 Information***#####
SID3: h82
###Provided by Microsoft Operations###
SID3 Storage Backup Name: clt1h82backup
SID3 Storage IP Address: 172.18.18.11
######     Customer Provided    ######
```

```
SID3 HANA instance number: 01
SID3 HANA HDBuserstore Name: SCADMIN82

######***SID #4 Information***#####
SID4:
###Provided by Microsoft Operations###
SID4 Storage Backup Name:
SID4 Storage IP Address:
######     Customer Provided    ######
SID4 HANA instance number:
SID4 HANA HDBuserstore Name:

######***SID #5 Information***#####
SID5:
###Provided by Microsoft Operations###
SID5 Storage Backup Name:
SID5 Storage IP Address:
######     Customer Provided    ######
SID5 HANA instance number:
SID5 HANA HDBuserstore Name:

######***SID #6 Information***#####
SID6:
###Provided by Microsoft Operations###
SID6 Storage Backup Name:
SID6 Storage IP Address:
######     Customer Provided    ######
SID6 HANA instance number:
SID6 HANA HDBuserstore Name:

######***SID #7 Information***#####
SID7:
###Provided by Microsoft Operations###
SID7 Storage Backup Name:
SID7 Storage IP Address:
######     Customer Provided    ######
SID7 HANA instance number:
SID7 HANA HDBuserstore Name:

######***SID #8 Information***#####
SID8:
###Provided by Microsoft Operations###
SID8 Storage Backup Name:
SID8 Storage IP Address:
######     Customer Provided    ######
```

```
SID8 HANA instance number:
SID8 HANA HDBuserstore Name:

######***SID #9 Information***#####
SID9:
###Provided by Microsoft Operations###
SID9 Storage Backup Name:
SID9 Storage IP Address:
######     Customer Provided    ######
SID9 HANA instance number:
SID9 HANA HDBuserstore Name:

######***SID #10 Information***#####
SID10:
###Provided by Microsoft Operations###
SID10 Storage Backup Name:
SID10 Storage IP Address:
######     Customer Provided    ######
SID10 HANA instance number:
SID10 HANA HDBuserstore Name:
```

Check connectivity with SAP HANA - testHANAConnection

This snapshot command checks the HANA connectivity for all the HANA instances configured in the *HANABackupCustomerDetails.txt*. It uses the HDBuserstore to connect to the SYSTEMDB and fetches the SID information.

This command takes the either of the following arguments:

- `--nossl` = avoids the use of an encrypted connection to the database.
- `--ssl` = forces an encrypted connection with the database and defines the encryption method used to communicate with SAP HANA, either `openssl` or `commoncrypto`. If defined, then this command expects to find two files in the same directory, these files must be named after the corresponding SID as follows:
    - `<SID>_keystore.pem` which is passed to the hdbsql command switch -sslkeystore (e.g. H80_keystore.pem)
    - `<SID>_truststore.pem` which is passed to the hdbsql command switch -ssltruststore (e.g. H80_truststore.pem)

In a Multi SID environment (also referred to as MCOS deployment in HANA documentation, you can execute this snapshot command under any instance. For example, you can still be under */hana/shared/H80/exe/linuxx86_64/hdb* and run the snapshot command and it runs for all the HANA instances mentioned in the *HANABackupCustomerDetails.txt* file.

```
> ./ testHANAConnection
```

Output of the snapshot command

```
Terminal session
> ./testHANAConnection --nossl
Running per the following command line:
./testHANAConnection --nossl
Command completed successfully.
Exiting with return code: 0
Log file created at ./statusLogs/HANAStatus.2019-04-07_2338.txt
```

Check connectivity with storage - testStorageSnapshotConnection

The snapshot command logs in to each IP Address listed on the HANA Backup Customer Details document and verify that it has access to the file systems for each HANA instance installed on the HLI unit. A temporary snapshot is created within each data, shared, log, and logbackups volume to verify snapshot access for each file system.

Before you execute the snapshot command *testStorageSnapshotConnection*, please execute the following commands for each storage users. This ensures that the connection to storage is already established.

```
# ssh -l <Storage Backup name> <Storage IP address>  ← actual command
# ssh -l clt1h80backup 172.18.18.11  ← example
```

Note

Your storage IP address must be in the same subnet as your server pool. For example, in this case, our server pool subnet is **172.18.18**.0/24 and our assigned storage IP is **172.18.18.11**.

This snapshot command does not require any input parameters. It reads the *HANABackupCustomerDetails.txt* file and connect the storage for each storage user defined.

```
> ./testStorageSnapshotConnection
```

Output of the snapshot command

```
Terminal session
> ./testStorageSnapshotConnection
Running per the following command line:
./testStorageSnapshotConnection
Command completed successfully.
Exiting with return code: 0
Log file created at ./statusLogs/StorageSnapshotStatus.2019-04-07_2325.txt
```

CAUTION

Customers are advised to remove the test snapshot created with the testStorageSnapshotConnection command by running the removeTestStorageSnapshot command otherwise additional storage space can be used by the test snapshots.

Perform snapshot backup - azure_hana_backup

This command performs the orchestration of a database consistent storage snapshot on either the HANA data/log/shared volumes, the /hana/logbackups volume, or the OS.

This command takes the following arguments:

- `--type` = backup type and this parameter may contain “hana”, “logs”, or “boot”
  - hana = snapshots of the volumes /hana/shared/SID (which contains /usr/sap/SID as well), and /hana/data/SID/mnt0001
  - logs = snapshots of the /hana/logbackups/SID
  - boot = TYPEI (for Type I SKUs) or TYPEII (for Type II SKUs)
- `--prefix` = the customer snapshot prefix for the snapshot name. It has two purposes. The one purpose is to provide a unique name for grouping of snapshots. The second purpose is for the snapshot command azure_hana_backup to determine the number of storage snapshots that are retained under that specific label. **Only alpha numeric (“A-Z,a-z,0-9”), underscore (“_”) and dash (“-“) characters are allowed.**
- `[--frequency]` = the snapshot frequency is an optional parameter reserved for future developments and does not have any impact. If using this parameter, then set it to "3min" when executing backups of the type log and "15min", when executing the other backup types.
- `--retention` = the number of snapshots of this prefix to be kept. The oldest storage snapshot is removed as part of housekeeping when a new snapshot is take for this prefix.
- `--trim` = Available for SAP HANA v2 and later, this option maintains the backup catalog and on disk log backups. The number of entries to keep in the backup catalog is determined by the `--retention` option above, and deletes older entries for the defined prefix (`--prefix`) from the backup catalog, and the related physical logs backup. It also deletes any logbackup entries which are older than the oldest non-logbackup entry. This helps to prevent the log backups from using up all available disk space.

CAUTION	Only use the trim option once per SID, with a single customer snapshot prefix for the hana backup type.

  - The following example command will keep 9 storage snapshots and ensure the backup catalog is continuously trimmed to match the 9 storage snapshots being retained.

```
> azure_hana_backup --type=hana --prefix=hana_TEST --frequency=15min
--retention=9 --trim
```

- `--ssl` = an optional parameter which defines the encryption method used to communicate with SAP HANA, either `openssl` or `commoncrypto`. If defined, then the azure_hana_backup command expects to find two files in the same directory, these files must be named after the corresponding SID as follows:
  - `<SID>_keystore.pem` which is passed to the hdbsql command switch -sslkeystore (e.g. H80_keystore.pem)
  - `<SID>_truststore.pem` which is passed to the hdbsql command switch -ssltruststore (e.g. H80_truststore.pem)

The following example takes a “hana” type snapshot with a prefix of “hana_TEST” and will keep “9” of them communicating with SAP HANA using SSL (“openssl”). Remember the frequency parameter is reserved and does not mean it will run every 15min.

```
> azure_hana_backup --type=hana --prefix=hana_TEST --frequency=15min --
retention=9 --ssl=openssl
```

without the optional `--frequency` parameter

```
> azure_hana_backup --type=hana --prefix=hana_TEST --retention=9 --ssl=openssl
```

! Snapshot backups are very fast, with the following snapshot taking 12 seconds to complete. The overall time taken to complete the snapshot will increase based on the number of snapshots for each prefix because additional storage housekeeping takes place to manage the additional snapshots.

With “hana” parameter

```
> ./azure_hana_backup --type=hana --prefix=hana_TEST --frequency=15min --retention=9
```

Output of the command

```
Terminal session
> ./azure_hana_backup --type=hana --prefix=hana_TEST --frequency=15min --retention=9
Running per the following command line:
./azure_hana_backup --type=hana --prefix=hana_TEST --frequency=15min --retention=9 -
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/azure_backup.hana_TEST.2019-04-07_2325.txt
```

With “logs” parameter

```
# ./azure_hana_backup --type= logs --prefix=Test_LOGS_Snapshot --frequency=3min --
retention=10
```

Output of the command with “logs” parameter

```
Terminal session
> ./azure_hana_backup --type=logs --prefix=logs_TEST --frequency=15min --retention=9
Running per the following command line:
./azure_hana_backup --type=hana --prefix=logs_TEST --frequency=15min --retention=9 -
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/azure_backup.logs_TEST.2019-04-07_2345.txt
```

With “boot” parameter

```
> ./azure_hana_backup --type=boot --boottype=TYPEI --prefix=boot_TEST --
frequency=3min --retention=7
```

- HANA Large Instance Type: There are two valid values with "TYPEI" or "TYPEII" dependent on the HANA Large Instance Unit.
- Refer to the online documentation to confirm the available SKUs
    - https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/hana-available-skus

Output of the command with “boot” parameter (to backup Host OS)

```
Terminal session
> ./azure_hana_backup --type=boot --boottype=TYPEI --prefix=boot_TEST --
frequency=3min --retention=7
Running per the following command line:
./azure_hana_backup --type=boot --boottype=TYPEI --prefix=boot_TEST --frequency=3min
--retention=7
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/azure_backup.boot_TEST.2019-04-09_0611.txt
```

Note	When you execute the snapshot command for the first time, it may show some unexpected errors on the Multi SID environment. Please rerun the snapshot command again and it should run without error.

Remove test snapshots - removeTestStorageSnapshot

This snapshot command deletes the temp snapshots taken by the snapshot command *testStorageSnapshotConnection*. This snapshot command does not delete any other snapshots than the temporary snapshot taken by the snapshot command *testStorageSnapshotConnection*.

Note The test snapshot may be deleted only if one or more than one regular snapshots with the regular backup snapshot command have been executed.

This snapshot command does not require any input parameters, and you can execute the snapshot command as following:

```
> ./removeTestStorageSnapshot
```

Output of the command

```
Terminal session
> ./removeTestStorageSnapshot
Running per the following command line:
./removeTestStorageSnapshot
Command completed successfully.
Exiting with return code: 0
Log file created at ./statusLogs/removeTestStorage.2019-04-07_2339.txt
```

List snapshots - azure_hana_snapshot_details

This snapshot command provides the details of the snapshots taken by the snapshot command *azure_hana_backup*.

This snapshot command does not require any input parameters. It reads the parameters from the *HANABackupCustomerDetails.txt* file.

CAUTION This snapshot command may fail if run while snapshot backups are scheduled with cron. Due to snapshot rotation by the backup snapshot commands, snapshots can disappear as they are rotated out – causing this snapshot command to fail. Just wait a few minutes and try again, or alternately pause running snapshots while running this command.

This snapshot command can take a few minutes (the example below takes about 4 minutes) to execute dependent on the number of snapshots already taken, as it processes each one to collect information for display.

Use the following command to execute this snapshot command.

```
> ./azure_hana_snapshot_details
```

Output of the command

In this example, there is a hana backup running and subsequently there is housekeeping being done on the storage as part of this process. Therefore, the details of these snapshots can't be obtained. After a few minutes, try running the command when the azure_hana_backup command isn't executing and the details of these snapshots should be displayed.

The output below has been trimmed for brevity - note the highlighted -----<snip>----- below.

```
Terminal session
> ./azure_hana_snapshot_details
Running per the following command line:
./azure_hana_snapshot_details
```

```
Can't get details for snapshot hana_TEST.2019-04-07_1859.7
A snapshot might be running, will collect details for other snapshots.
Can't get details for snapshot hana_TEST.2019-04-07_2059.6
A snapshot might be running, will collect details for other snapshots.
Can't get details for snapshot hana_TEST.2019-04-07_2259.5
A snapshot might be running, will collect details for other snapshots.
Can't get details for snapshot hana_TEST.2019-04-07_2229.2
A snapshot might be running, will collect details for other snapshots.
Can't get details for snapshot hana_TEST.2019-04-08_0029.1
A snapshot might be running, will collect details for other snapshots.
Can't get details for snapshot hana_TEST.2019-04-08_0229.0
A snapshot might be running, will collect details for other snapshots.
********************  Displaying Snapshot Details by Volume  ********************
**********************************************************
****Volume: hana_data_h80_sapprdhdb80_mnt00001_t250_vol
**********************************************************
Total Snapshot Size:  17.87GB
----------------------------------------------------------
Snapshot:   hana_PRE-SNAPSHOTPATH.2018-11-07_1757.0
Create Time:   "Wed Nov 07 17:57:59 2018"
Size:   6.58GB
Frequency:   15min
HANA Backup ID:   1541613478714
----------------------------------------------------------
Snapshot:   hana_test_2019.2019-01-10_0356.0
Create Time:   "Thu Jan 10 03:56:42 2019"
Size:   1.23GB
Frequency:   15min
HANA Backup ID:   1547092600090
------<snip>-------
Snapshot:   hana_TEST.2019-04-08_0423.0
Create Time:   "Mon Apr 08 03:23:08 2019"
Size:   308KB
Frequency:   15min
HANA Backup ID:   1554693786952
**********************************************************
****Volume: hana_shared_h80_soldub42_t250_vol
**********************************************************
Total Snapshot Size:  2.62MB
----------------------------------------------------------
Snapshot:   hana_TEST.2019-04-07_2229.2
Create Time:   n/a
Size:   n/a
Frequency:   n/a
HANA Backup ID:
----------------------------------------------------------
Snapshot:   hana_TEST.2019-04-08_0029.1
Create Time:   n/a
Size:   n/a
Frequency:   n/a
HANA Backup ID:
----------------------------------------------------------
Snapshot:   hana_TEST.2019-04-08_0229.0
Create Time:   n/a
Size:   n/a
Frequency:   n/a
HANA Backup ID:
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/SnapshotDetails.2019-04-08_0429.txt
```

Delete a snapshot - azure_hana_snapshot_delete

This snapshot command deletes the existing snapshots. You need to provide either the snapshot *backupid* (from HANA studio) or the snapshot name and volume name.

Snapshots created less than 10 minutes prior to running this command cannot be deleted due to the potential for interference with snapshot replication.

This command takes the following argument:

- `--sid` = the SID related to the snapshot being deleted.

```
> ./azure_hana_snapshot_delete --sid=h80
```

Output using the option backupid

Note the user input highlighted.

```
Terminal session
> ./azure_hana_snapshot_delete --sid=h80
Running per the following command line:
./azure_hana_snapshot_delete --sid=h80
This script is intended to delete either a single snapshot or all snapshots
that pertain to a particular HANA storage snapshot by its HANA Backup ID
found in HANA Studio.  A snapshot cannot be deleted if it is less than an
10 minutes old as deletion can interfere with replication. Please enter whether
you wish to delete by backupid or snapshot.

If by snapshot, enter the volume name and snapshot name where the snapshot is
found.  The azure_hana_snapshot_details command may be used to identify
individual snapshot names and volume locations.
Please enter (backupid/snapshot/quit): backupid
Please enter the backup id of the HANA Storage Snapshot you wish to delete:
1554787243119
Processing request to delete all snapshots associated with HANA Backup ID
1554787243119.
Any data that exists only on these snapshots is lost forever.
Delete this snapshot and all data only on this snapshot (yes/no): yes
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/snapshotDelete.h80.2019-04-09_0645.txt
```

Output using the option snapshot name

```
Terminal session
> ./azure_hana_snapshot_delete --sid=h80
Running per the following command line:
./azure_hana_snapshot_delete --sid=h80
This script is intended to delete either a single snapshot or all snapshots
that pertain to a particular HANA storage snapshot by its HANA Backup ID
found in HANA Studio.  A snapshot cannot be deleted if it is less than an
10 minutes old as deletion can interfere with replication. Please enter whether
you wish to delete by backupid or snapshot.

If by snapshot, enter the volume name and snapshot name where the snapshot is
```

```
found.  The azure_hana_snapshot_details command may be used to identify
individual snapshot names and volume locations.
Please enter (backupid/snapshot/quit): snapshot
Please enter the volume location of the snapshot you wish to delete:
hana_shared_h80_sapprdhdb80_t250_vol
Please enter the snapshot you wish to delete:   oneoff_3_4.2019-03-06_0003.0
Please enter (yes/no):  yes
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/snapshotDelete.h80.2019-04-08_0544.txt
```

Get DR replication status - azure_hana_replication_status

This snapshot command checks the storage replication status from the primary site to DR location. This snapshot command must be executed on the **DR site server**. This snapshot command does not require any input to be provided, rather it reads the HANABackupCustomerDetails.txt file.

```
> ./azure_hana_replication_status
```

Output of the snapshot command

The following example has broken replication status and, in this scenario, activating DR would likely result in incomplete data at the DR site.

CAUTION Note the warning in the following example about replication broken for two of the volumes.

Terminal session

```
> ./azure_hana_replication_status
Running per the following command line:
./azure_hana_replication_status
hana_data_h80_sapprdhdb80_mnt00001_t250_xdp
------------------------------------------------
Link Status:
Broken-Off
Please contact Microsoft Operations immediately.
Current Replication Activity: Idle
Latest Snapshot Replicated: snapmirror.21215d07-2653-11e8-8e4c-
00a098af659c_2157387233.2019-04-09_070719
Size of Latest Snapshot Replicated: 104.5MB
Current Lag Time between snapshots: -
   ***Less than 30 minutes is recommended***
************************************************
hana_log_backups_h80_sapprdhdb80_t250_xdp
------------------------------------------------
Link Status:
Broken-Off
Please contact Microsoft Operations immediately.
Current Replication Activity: Idle
Latest Snapshot Replicated: snapmirror.21215d07-2653-11e8-8e4c-
00a098af659c_2157387278.2019-04-09_070753
Size of Latest Snapshot Replicated: 48.42MB
Current Lag Time between snapshots: -
   ***Less than 10 minutes is recommended***
************************************************
hana_shared_h80_sapprdhdb80_t250_xdp
------------------------------------------------
```

```
Link Status:
Active
Current Replication Activity: Idle
Latest Snapshot Replicated: snapmirror.21215d07-2653-11e8-8e4c-
00a098af659c_2157387225.2019-04-09_071000
Size of Latest Snapshot Replicated: 430.8KB
Current Lag Time between snapshots: 0:2:3
   ***Less than 30 minutes is recommended***
*************************************************
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/replicationStatus.2019-04-09_0906.txt
```

This example has successful replication between the Primary site and the DR site, so these systems are ready to support a DR scenario.

Terminal session

```
>./azure_hana_replication_status
Running per the following command line:
./azure_hana_replication_status
hana_data_h80_mnt00001_t020_xdp
-------------------------------------------------
Link Status:
Active
Current Replication Activity: Idle
Latest Snapshot Replicated: snapmirror.21215d07-2653-11e8-8e4c-
00a098af659c_2157387233.2019-04-09_055000
Size of Latest Snapshot Replicated: 106.8MB
Current Lag Time between snapshots: 0:9:45
   ***Less than 30 minutes is recommended***
*************************************************
hana_log_backups_h80_mnt00001_t020_xdp
-------------------------------------------------
Link Status:
Active
Current Replication Activity: Idle
Latest Snapshot Replicated: snapmirror.21215d07-2653-11e8-8e4c-
00a098af659c_2157387278.2019-04-09_055700
Size of Latest Snapshot Replicated: 75.57MB
Current Lag Time between snapshots: 0:2:45
   ***Less than 10 minutes is recommended***
*************************************************
hana_shared_h80_mnt00001_t020_xdp
-------------------------------------------------
Link Status:
Active
Current Replication Activity: Idle
Latest Snapshot Replicated: snapmirror.21215d07-2653-11e8-8e4c-
00a098af659c_2157387225.2019-04-09_055000
Size of Latest Snapshot Replicated: 455.4KB
Current Lag Time between snapshots: 0:9:45
   ***Less than 30 minutes is recommended***
*************************************************
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/replicationStatus.2019-04-09_0754.txt
```

Perform a test DR failover - azure_hana_test_dr_failover

This snapshot command is like the “full” DR Failover snapshot command, but rather than breaking the replication between the primary site and the disaster recovery site, a clone volume is created out of the disaster recovery volumes which allows the restoration of the most recent snapshot in the DR site. Those cloned volumes are then usable by the customer to test Disaster Recovery without having to execute a complete failover of their HANA environment which breaks the replication agreement between the primary site and the disaster recovery site. When the test snapshot command is executed it requires the SID and a contact email for operations to manage the deletion of the clones after 4 weeks.

Each execution of the Test DR command creates a new clone that must be deleted by Microsoft Operations when the test is concluded. Multiple different restore points can be tested in this way, each with their own restoration point. The clone is designated by the time-stamp at when the snapshot command was executed and represents the most recent data and logbackups snapshot available when run.

CAUTION! Clone volumes created will be automatically deleted after 4 weeks.

```
> ./azure_hana_test_dr_failover
```

Output of the snapshot command (for Single-Node scenario)

Terminal session

```
> ./azure_hana_test_dr_failover
Running per the following command line:
./azure_hana_test_dr_failover
********** Introduction *****************************************************
This script is designed for those customers who have previously installed the
Production HANA instance in the Disaster Recovery Location either as a
stand-alone instance or as part of a multi-purpose environment. This script is
intended to allow the customer to simulate a Disaster Recovery failover without
actually requiring a failover and subsequent failback.  This script will clone
the most recent snapshot for both the Data and Log Backups filesystems.  Any
other restore points must be handled by Microsoft Operations.  Please enter the
HANA <SID> you wish to restore. This script must be executed from the Disaster
Recovery location otherwise unintended actions may occur.  As part of the script
process, a clone is created of the necessary Disaster Recovery volumes for Data
and Log Backups volumes.

Please enter (yes/no):  yes
Proceed with script: yes
Please enter either the HANA SID you wish to restore:   h80
Please enter either the HANA SID you wish to restore:   : h80
Please enter a contact email address for Microsoft Operations to confirm ok to
delete clones: person@nowhere.com
**************** Displaying Mount Points by Volume *****************************
10.230.251.43:/hana_data_h80_sapprdhdb80_mnt00001_t250_xdp_drclone_20190405_2229
/hana/data/H80/mnt00001   nfs
rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0
10.230.251.43:/hana_log_backups_h80_sapprdhdb80_t250_xdp_drclone_20190405_2229
/hana/logbackups/H80_SAPPRDHDB80   nfs
rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0
********************************************************************************

*******************  HANA Test DR Recovery Steps  ******************************
```

```
* Please complete the following steps to recover your HANA database:           *
* 1. Ensure ALL the target mount points exist to mount the snapshot clones.    *
*    e.g. mkdir /hana/logbackups/H99_SOURCE                                    *
* 2. Add Mount Point Details from 'Displaying Mount Points by Volume' as       *
*    output above into /etc/fstab of DR Server.                                *
* 3. Mount newly added filesystems.                                            *
* 4. Perform HANA Snapshot Recovery using HANA Studio.                         *
********************************************************************************
*  These snapshot copies (clones) are kept for 4 weeks before                  *
*  being automatically removed.                                                *
*  Please contact Microsoft Operations to delete them earlier.                 *
********************************************************************************

Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/testDR.h80.20190405_2229.txt
```

CAUTION! The “Displaying Mount Points by Volume” output is different for the various scenarios.

Perform full DR failover - azure_hana_dr_failover

This snapshot command stops storage replication from the primary site to the secondary site, restores the latest snapshot on the DR volumes, and provides the mountpoints for the DR volumes.

This snapshot command MUST be executed on the DR server ONLY!

You perform a failover to DR site, by executing a snapshot command azure_hana_dr_failover. This snapshot command requires a SID to be added as a parameter. This is the SID of the HANA instance, which needs to be recovered at the DR site.

Caution Only run this command you are planning to perform the DR exercise or a test. Snapshot command breaks the replication. You must reach out to the Microsoft Operations to set up the replication back. Also, once the replication is re-setup, all the data at DR storage for this SID get initialized.

At the high level, here are the steps for executing a DR failover:

- You must shut down the HANA instance at **primary** site. This is only needed if you are truly doing the failover to DR site so you don’t have data inconsistencies.
- Shutdown the HANA instance on the DR node for the production SID.
- Execute the snapshot command azure_hana_dr_failover on the DR node with the SID to be recovered
    - The snapshot command breaks the storage replication link from the Primary to the DR site
    - The snapshot command restores the /data and /logbackups volume only, /shared volume is NOT recovered, but rather it uses the existing /shared for SID at the DR location.
    - Mount the /data and /logbackups volume – ensure to add it to the fstab file
- Restore the HANA SYSTEMDB snapshot. Please note, HANA studio only shows you the latest HANA snapshot available under the storage snapshot restored as part of the snapshot command azure_hana_dr_failover execution.

- Recover the tenant database
- Start the HANA instance on the DR site for the Production SID (Example: H80 in this case)
- Perform the testing

Run the azure_hana_backup at the DR site

For a DR scenario where backups are to be run at the DR site, then the HANA Server Name configured in the HANABackupCustomerDetails.txt file at the DR site should be the same as the production server name.

CAUTION	Running the azure_hana_backup can create storage snapshots at the DR site, these are not automatically replicated to another site. Work with Microsoft Operations to better understand returning any files or data back to the original production site.

Here are the detailed steps for the failover.

Step1: Get the volume details of the DR node by executing the command “df –h”. This is so you can reference after the failover

Terminal session

```
#  df -h
Filesystem                                             Size  Used Avail Use% Mounted
on
devtmpfs                                               378G  8.0K  378G   1% /dev
tmpfs                                                  569G     0  569G   0%
/dev/shm
tmpfs                                                  378G   18M  378G   1% /run
tmpfs                                                  378G     0  378G   0%
/sys/fs/cgroup
/dev/mapper/3600a098038304445622b4b584c575a66-part2     47G   20G   28G  42% /
/dev/mapper/3600a098038304445622b4b584c575a66-part1    979M   57M  856M   7% /boot
172.18.20.241:/hana_log_h80_mnt00003_t020_vol          512G  2.1G  510G   1%
/hana/log/H80/mnt00003
172.18.20.241:/hana_log_h80_mnt00001_t020_vol          512G  5.5G  507G   2%
/hana/log/H80/mnt00001
172.18.20.241:/hana_data_h80_mnt00003_t020_vol         1.2T  332M  1.2T   1%
/hana/data/H80/mnt00003
172.18.20.241:/hana_log_h80_mnt00002_t020_vol          512G  2.1G  510G   1%
/hana/log/H80/mnt00002
172.18.20.241:/hana_data_h80_mnt00002_t020_vol         1.2T  300M  1.2T   1%
/hana/data/H80/mnt00002
172.18.20.241:/hana_data_h80_mnt00001_t020_vol         1.2T  6.4G  1.2T   1%
/hana/data/H80/mnt00001
172.18.20.241:/hana_shared_h80_t020_vol/usr_sap_node1  2.7T   11G  2.7T   1%
/usr/sap/H80
tmpfs                                                   76G     0   76G   0%
/run/user/0
172.18.20.241:/hana_shared_h80_t020_vol                2.7T   11G  2.7T   1%
/hana/shared
```

```
172.18.20.241:/hana_data_h80_mnt00001_t020_xdp        1.2T  6.4G  1.2T   1%
/hana/data/H80/mnt00001
172.18.20.241:/hana_data_h80_mnt00002_t020_xdp        1.2T  300M  1.2T   1%
/hana/data/H80/mnt00002
172.18.20.241:/hana_data_h80_mnt00003_t020_xdp        1.2T  332M  1.2T   1%
/hana/data/H80/mnt00003
172.18.20.241:/hana_log_backups_h80_t020_xdp          512G   15G  498G   3%
/hana/logbackups/H80_T250
```

Step2: Shut down the HANA instance on the primary site (The instance which is getting failed over)

Step3: Shut down the HANA instances on the DR site (The instance of the primary SID being failed over)

Step4: Execute the snapshot command

```
> ./azure_hana_dr_failover
```

Output of the DR failover command.

Terminal session

```
> ./azure_hana_dr_failover
Running per the following command line:
./azure_hana_dr_failover
********** Introduction *****************************************************
This script is designed for those customers who have previously installed the
Production HANA instance in the Disaster Recovery Location either as a
stand-alone instance or as part of a multi-purpose environment. This script
should only be run in the event of a declared disaster by Microsoft or as part
of required Disaster Recovery testing plans. A failback coordinated with
Microsoft Operations is required after this script has been executed.

WARNING: the failback process will not necessarily be a quick process and will
require multiple steps in coordination with Microsoft Operations so this script
should not be undertaken lightly.  This script will restore only the most recent
snapshot for both the Data and Log Backups filesystems.  Any other restore
points must be handled by Microsoft Operations.  Please enter the HANA <SID>
you wish to restore. This script must be executed from the Disaster Recovery
location otherwise unintended consequences may occur.

Please enter (yes/no): yes
Please enter (yes/no):  yes
Please enter either the HANA SID you wish to restore:   h80
Please enter either the HANA SID you wish to restore:   : h80
**************** Displaying Mount Points by Volume *****************************
10.230.251.43:/hana_data_h80_sapprdhdb80_mnt00001_t250_xdp   /hana/data/H80/mnt00001
nfs      rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0
0
10.230.251.43:/hana_log_backups_h80_sapprdhdb80_t250_xdp
/hana/logbackups/H80_SAPPRDHDB80   nfs
rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0
10.230.251.43:/hana_log_backups_h80_soldub42_t250_xdp
/hana/logbackups/H80_SOLDUB42   nfs
rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0
********************************************************************************

*******************  HANA DR Recovery Steps  ***********************************
* Please complete the following steps to recover your HANA database:          *
* 1. Ensure ALL the target mount points exist to mount the snapshot clones.   *
*    e.g. mkdir /hana/logbackups/H99_SOURCE                                   *
* 2. Add Mount Point Details from 'Displaying Mount Points by Volume' as      *
*    output above into /etc/fstab of DR Server.                               *
* 3. Mount newly added filesystems.                                           *
* 4. Perform HANA Snapshot Recovery using HANA Studio.                        *
********************************************************************************
Command completed successfully.
Exiting with return code: 0
Log file created at ./snapshotLogs/FullDR.h80.20190409_0901.txt
```

Note	The steps at the end of the console display need to be actioned to complete the storage preparation for a DR failover

Step5: Execute the command "**umount**" to unmount the necessary mountpoints.

```
# umount  <Mount point>
```

Unmount the data and logbackup mountpoints. Please note, you may have multiple data mountpoint in the scale-out scenario.

Step6: Modify the file **"/etc/fstab**" to comment out the data and logbackups entries for the primary SID (In this example, SID=H80) and add the new mount point entries created from the Primary site DR volumes. The new mount point entries are provided in the snapshot command output.

- Comment out the existing mount points running on the DR site:

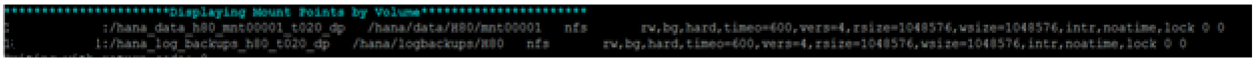
```
#172.18.20.241:/hana_data_h80_mnt00001_t020_vol       /hana/data/H80/mnt00001       nfs
rw,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0

#172.18.20.241:/hana_log_backups_h80_t020   /hana/logbackups/H80   nfs
rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0
```

- Add the following lines to fstab → this is a same output from the snapshot command

```
172.18.20.241:/hana_data_h80_mnt00001_t020_dp   /hana/data/H80/mnt00001   nfs
rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0

172.18.20.241:/hana_log_backups_h80_t020_dp   /hana/logbackups/H80   nfs
rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0
```



```
**********************Displaying Mount Points by Volume**********************
          :/hana_data_h80_mnt00001_t020_dp   /hana/data/H80/mnt00001   nfs       rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0
         1:/hana_log_backups_h80_t020_dp   /hana/logbackups/H80   nfs       rw,bg,hard,timeo=600,vers=4,rsize=1048576,wsize=1048576,intr,noatime,lock 0 0
```

Step7: Execute the command "**mount –a** "to mount all the mount points

```
# mount -a
```

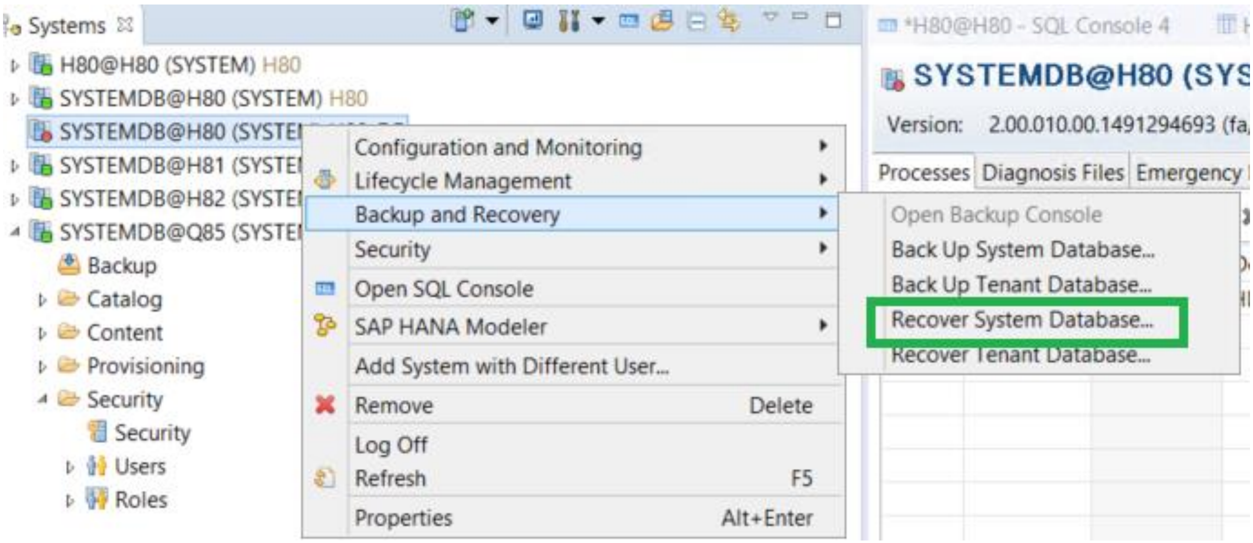
Terminal session

```
#  mount -a
#
```

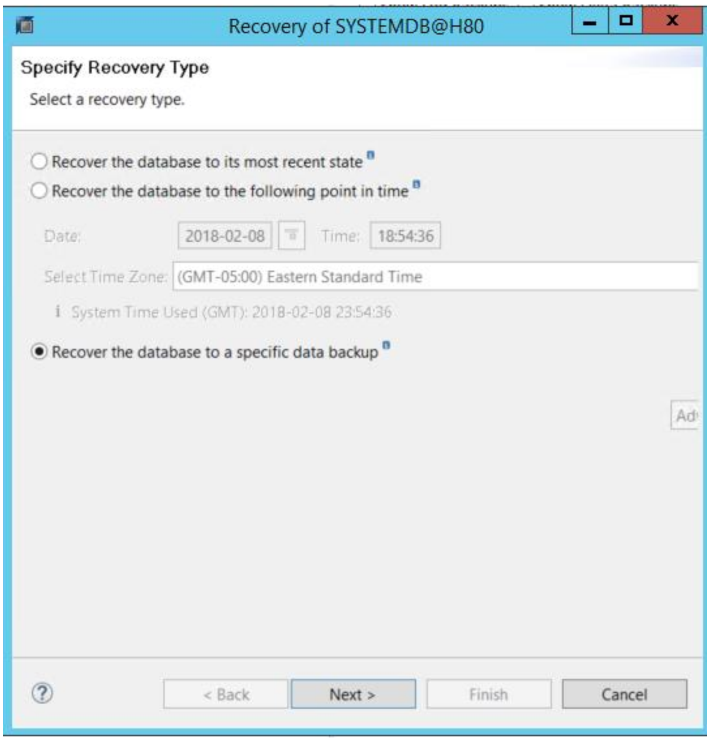
Now, If you execute “df –h” you should see the *_dp volumes mounted.

```
Terminal session
#  df -h
Filesystem                                            Size  Used Avail Use% Mounted
on
devtmpfs                                              378G  8.0K  378G   1% /dev
tmpfs                                                 569G     0  569G   0%
/dev/shm
tmpfs                                                 378G   18M  378G   1% /run
tmpfs                                                 378G     0  378G   0%
/sys/fs/cgroup
/dev/mapper/3600a098038304445622b4b584c575a66-part2    47G   20G   28G  42% /
/dev/mapper/3600a098038304445622b4b584c575a66-part1   979M   57M  856M   7% /boot
172.18.20.241:/hana_log_h80_mnt00003_t020_vol         512G  2.1G  510G   1%
/hana/log/H80/mnt00003
172.18.20.241:/hana_log_h80_mnt00001_t020_vol         512G  5.5G  507G   2%
/hana/log/H80/mnt00001
172.18.20.241:/hana_data_h80_mnt00003_t020_vol        1.2T  332M  1.2T   1%
/hana/data/H80/mnt00003
172.18.20.241:/hana_log_h80_mnt00002_t020_vol         512G  2.1G  510G   1%
/hana/log/H80/mnt00002
172.18.20.241:/hana_data_h80_mnt00002_t020_vol        1.2T  300M  1.2T   1%
/hana/data/H80/mnt00002
172.18.20.241:/hana_data_h80_mnt00001_t020_vol        1.2T  6.4G  1.2T   1%
/hana/data/H80/mnt00001
172.18.20.241:/hana_shared_h80_t020_vol/usr_sap_node1 2.7T   11G  2.7T   1%
/usr/sap/H80
tmpfs                                                  76G     0   76G   0%
/run/user/0
172.18.20.241:/hana_shared_h80_t020_vol               2.7T   11G  2.7T   1%
/hana/shared
172.18.20.241:/hana_data_h80_mnt00001_t020_xdp        1.2T  6.4G  1.2T   1%
/hana/data/H80/mnt00001
172.18.20.241:/hana_data_h80_mnt00002_t020_xdp        1.2T  300M  1.2T   1%
/hana/data/H80/mnt00002
172.18.20.241:/hana_data_h80_mnt00003_t020_xdp        1.2T  332M  1.2T   1%
/hana/data/H80/mnt00003
172.18.20.241:/hana_log_backups_h80_t020_xdp          512G   15G  498G   3%
/hana/logbackups/H80_T250
```

Step8: Recover the SYSTEMDB. From the HANA Studio, right click SYSTEMDB instance and chose “Backup and Recovery”, and then “Recover System Database”



You can choose an option based on your recovery requirements. In this example, “Recover the database to a specific data backup”.


Recovery of SYSTEMDB@H80

Specify Recovery Type

Select a recovery type.

○ Recover the database to its most recent state

○ Recover the database to the following point in time

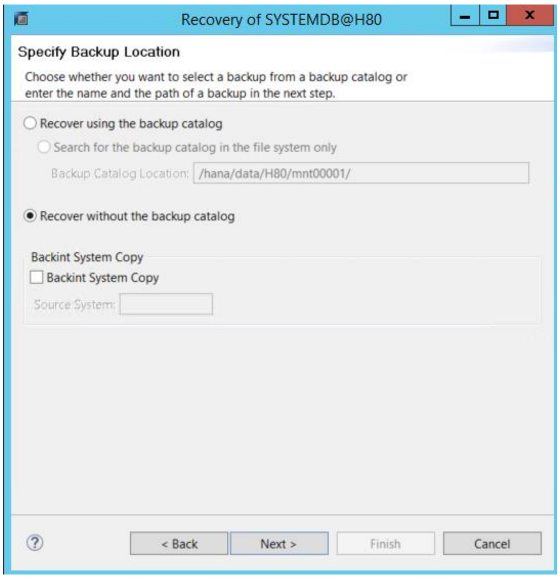
Date: 2018-02-08 Time: 18:54:36

Select Time Zone: (GMT-05:00) Eastern Standard Time

System Time Used (GMT): 2018-02-08 23:54:36

● Recover the database to a specific data backup

Specify the backup location. In this example, we chose “Recover without the backup catalog”.



Recovery of SYSTEMDB@H80

Specify Backup Location

Choose whether you want to select a backup from a backup catalog or enter the name and the path of a backup in the next step.

○ Recover using the backup catalog

○ Search for the backup catalog in the file system only

Backup Catalog Location: /hana/data/H80/mnt00001/

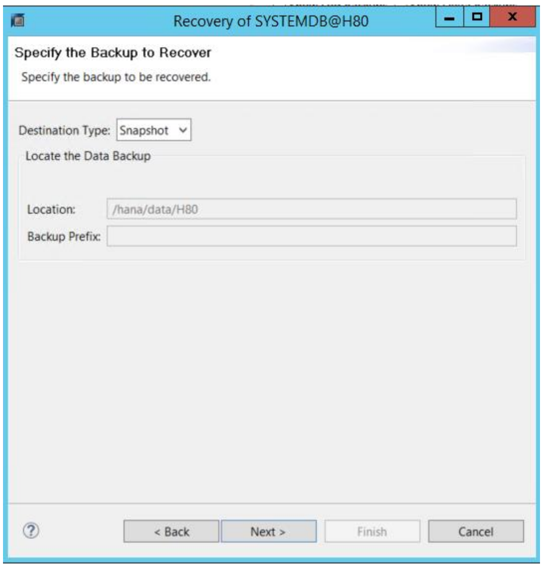
● Recover without the backup catalog

Backint System Copy

□ Backint System Copy

Source System:

Select the destination type “Snapshot”.



Recovery of SYSTEMDB@H80

Specify the Backup to Recover

Specify the backup to be recovered.

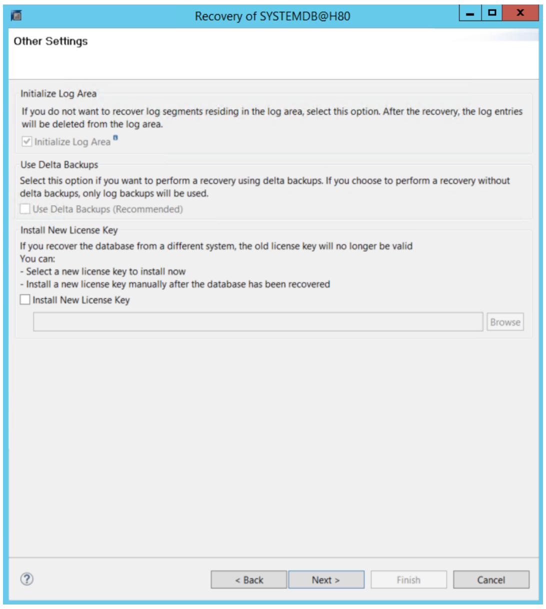
Destination Type: Snapshot

Locate the Data Backup

Location: /hana/data/H80

Backup Prefix:

Select the “Initialize Log Area”.



Recovery of SYSTEMDB@H80

Other Settings

Initialize Log Area

If you do not want to recover log segments residing in the log area, select this option. After the recovery, the log entries will be deleted from the log area.

☑ Initialize Log Area

Use Delta Backups

Select this option if you want to perform a recovery using delta backups. If you choose to perform a recovery without delta backups, only log backups will be used.

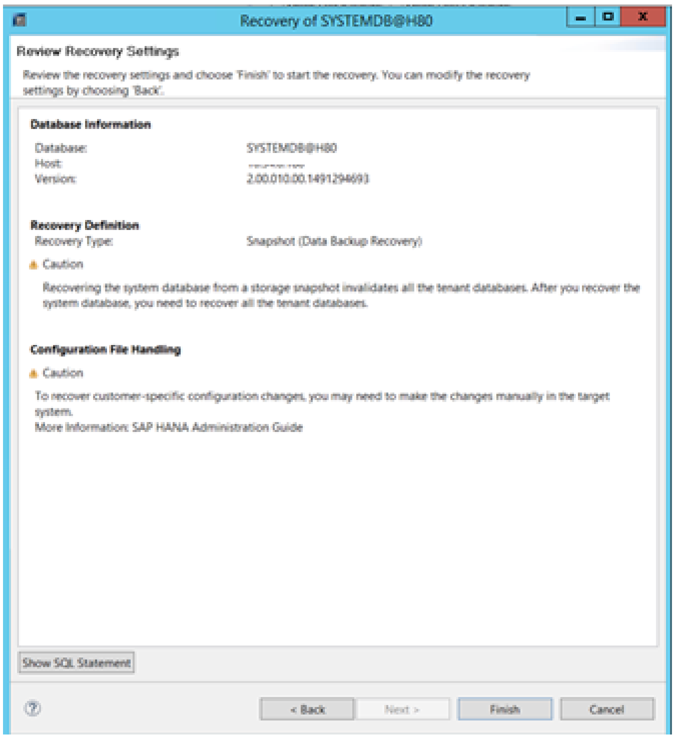
□ Use Delta Backups (Recommended)

Install New License Key

If you recover the database from a different system, the old license key will no longer be valid
You can:
- Select a new license key to install now
- Install a new license key manually after the database has been recovered

□ Install New License Key

Review the details.



Recovery of SYSTEMDB@H80

Review Recovery Settings

Review the recovery settings and choose 'Finish' to start the recovery. You can modify the recovery settings by choosing 'Back'.

Database Information

Database: SYSTEMDB@H80
Host: [illegible]
Version: 2.00.010.00.1491294693

Recovery Definition

Recovery Type: Snapshot (Data Backup Recovery)

Caution

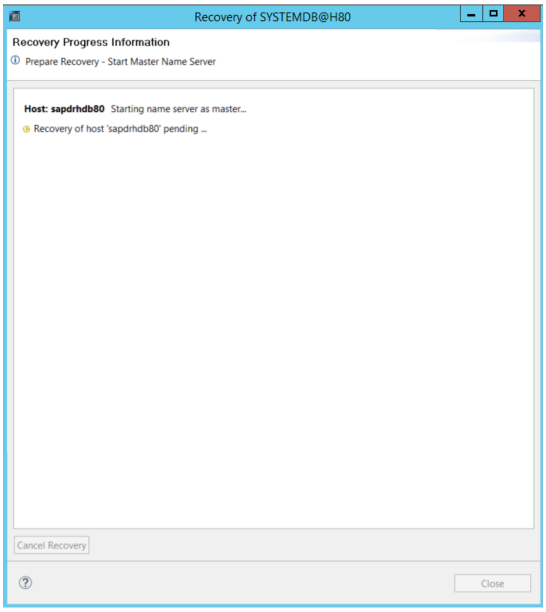
Recovering the system database from a storage snapshot invalidates all the tenant databases. After you recover the system database, you need to recover all the tenant databases.

Configuration File Handling

Caution

To recover customer-specific configuration changes, you may need to make the changes manually in the target system.
More Information: SAP HANA Administration Guide

Recovery initiates.



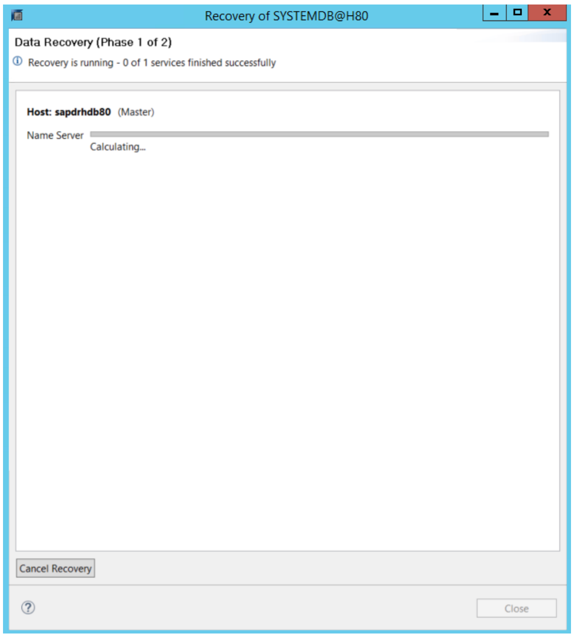
Recovery of SYSTEMDB@H80

Recovery Progress Information

Prepare Recovery - Start Master Name Server

Host: sapdrhdb80 Starting name server as master...

Recovery of host 'sapdrhdb80' pending ...



Recovery of SYSTEMDB@H80

Data Recovery (Phase 1 of 2)

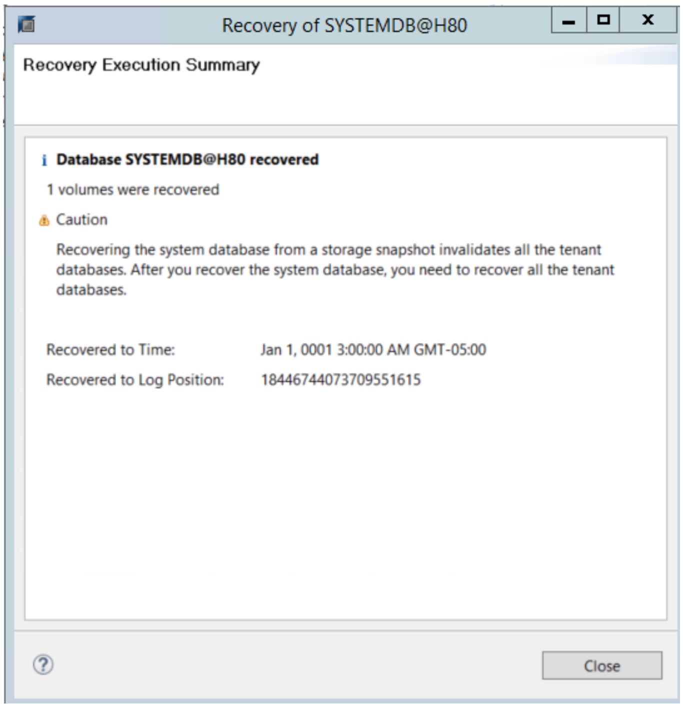
Recovery is running - 0 of 1 services finished successfully

Host: sapdrhdb80 (Master)

Name Server

Calculating...

Recovery completed.



Recovery of SYSTEMDB@H80

Recovery Execution Summary

Database SYSTEMDB@H80 recovered

1 volumes were recovered

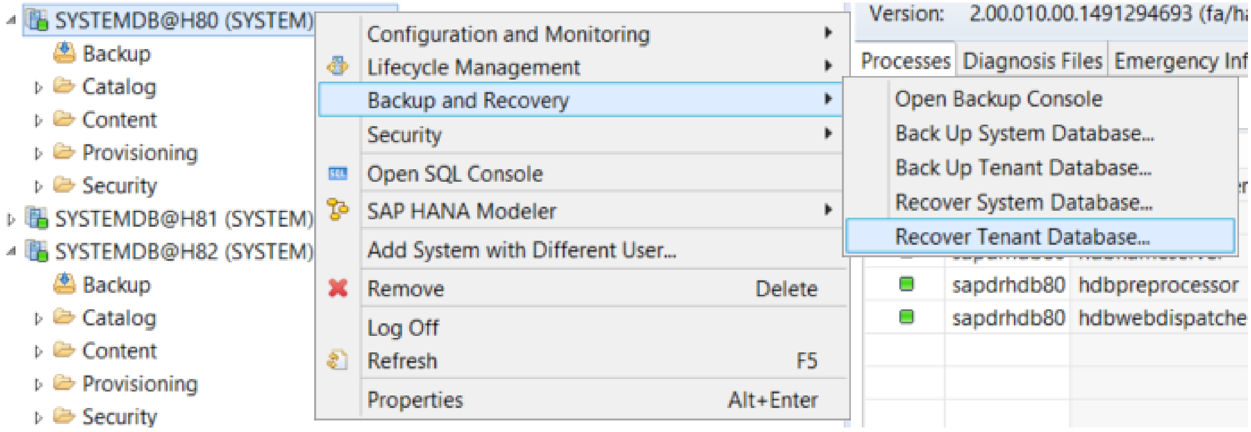
Caution

Recovering the system database from a storage snapshot invalidates all the tenant databases. After you recover the system database, you need to recover all the tenant databases.

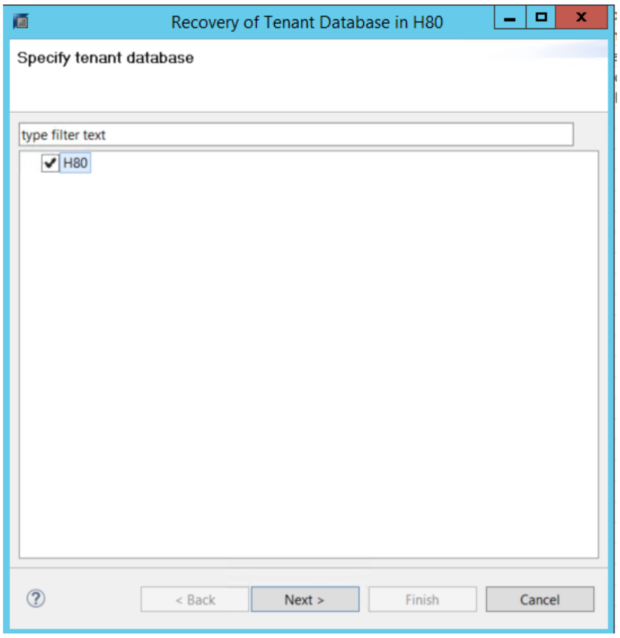
Recovered to Time: Jan 1, 0001 3:00:00 AM GMT-05:00

Recovered to Log Position: 18446744073709551615

Step9: Recover the tenant database. From the HANA Studio, right click SYSTEMDB instance and chose "Backup and Recovery", and then "Recover Tenant Database".



Select the tenant database.



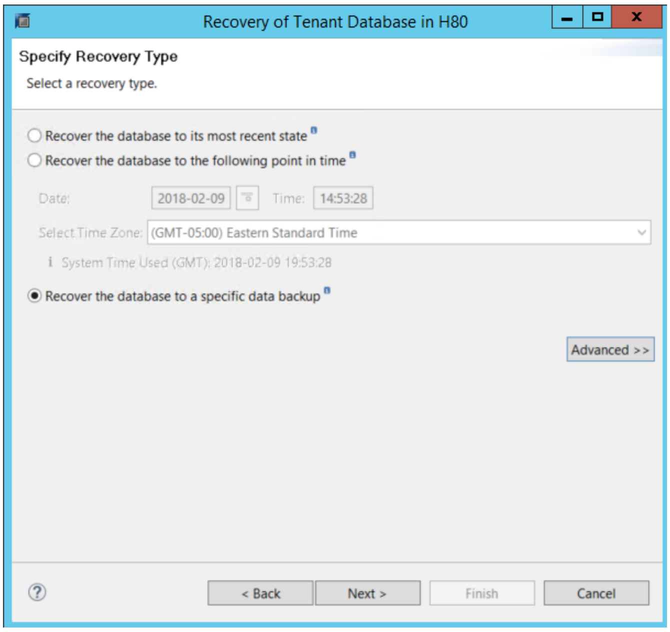
Recovery of Tenant Database in H80

Specify tenant database

type filter text

☑ H80

Select the recovery type. In this example, the option “Recover the database to a specific data backup” is selected.



Recovery of Tenant Database in H80

Specify Recovery Type

Select a recovery type.

○ Recover the database to its most recent state

○ Recover the database to the following point in time

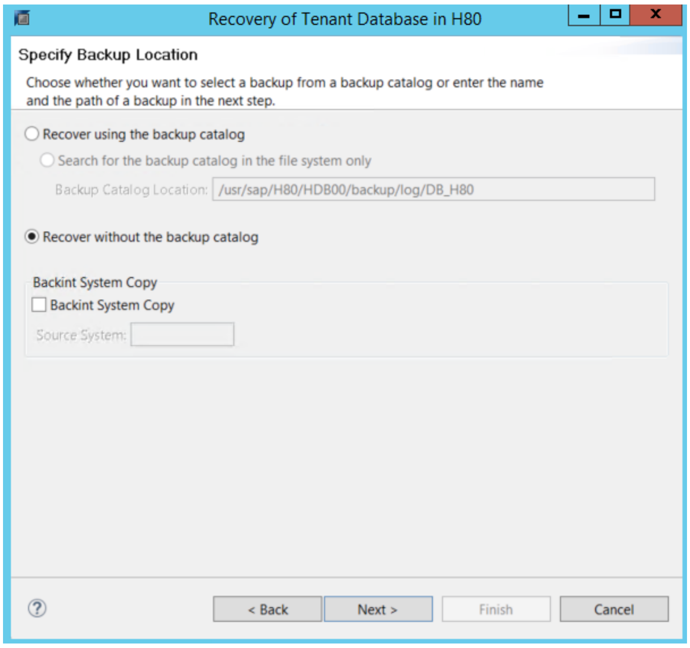
Date: 2018-02-09 Time: 14:53:28

Select Time Zone: (GMT-05:00) Eastern Standard Time

System Time Used (GMT): 2018-02-09 19:53:28

● Recover the database to a specific data backup

Select the backup location. In this example, the option “Recover without the backup catalog” is selected.



Recovery of Tenant Database in H80

Specify Backup Location

Choose whether you want to select a backup from a backup catalog or enter the name and the path of a backup in the next step.

○ Recover using the backup catalog

○ Search for the backup catalog in the file system only

Backup Catalog Location: /usr/sap/H80/HDB00/backup/log/DB_H80

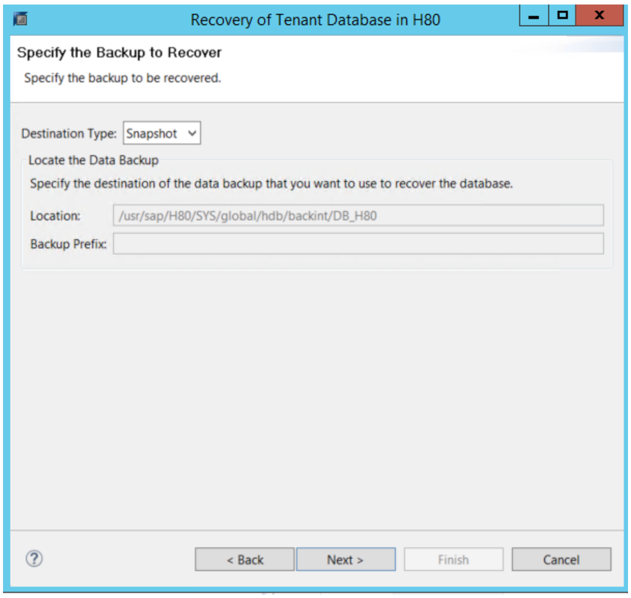
● Recover without the backup catalog

Backint System Copy

□ Backint System Copy

Source System:

Select the destination type “Snapshot”.



Recovery of Tenant Database in H80

Specify the Backup to Recover

Specify the backup to be recovered.

Destination Type: Snapshot

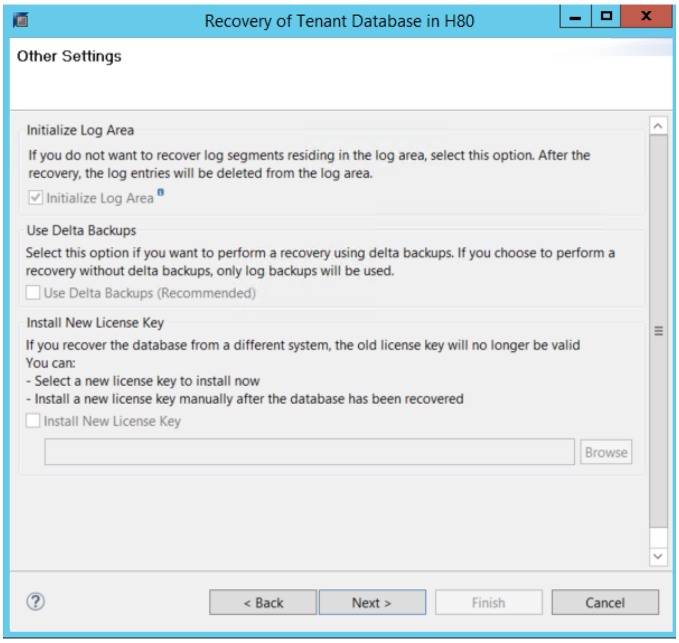
Locate the Data Backup

Specify the destination of the data backup that you want to use to recover the database.

Location: /usr/sap/H80/SYS/global/hdb/backint/DB_H80

Backup Prefix:

Ensure to select the “Initialize Log Area”. By default, this is selected and grated out.



Recovery of Tenant Database in H80

Other Settings

Initialize Log Area

If you do not want to recover log segments residing in the log area, select this option. After the recovery, the log entries will be deleted from the log area.

☑ Initialize Log Area

Use Delta Backups

Select this option if you want to perform a recovery using delta backups. If you choose to perform a recovery without delta backups, only log backups will be used.

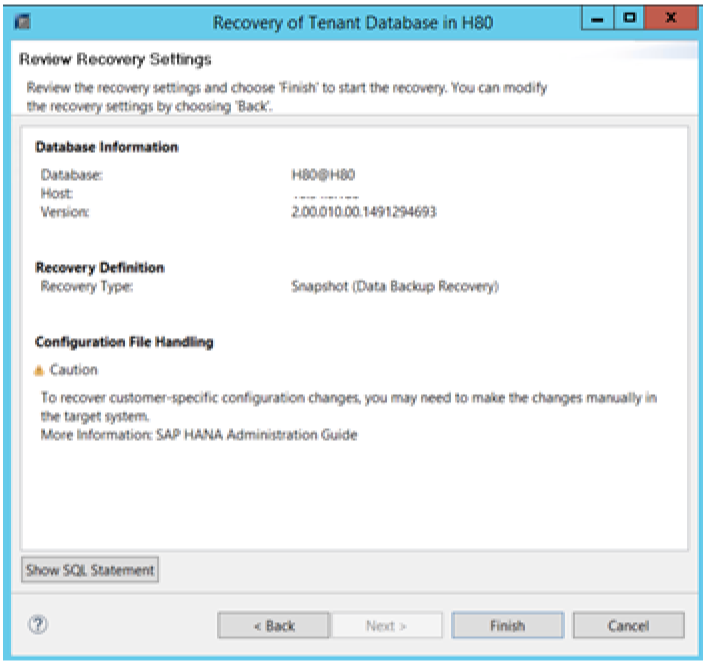
□ Use Delta Backups (Recommended)

Install New License Key

If you recover the database from a different system, the old license key will no longer be valid
You can:
- Select a new license key to install now
- Install a new license key manually after the database has been recovered

□ Install New License Key

Review the settings.



Recovery of Tenant Database in H80

Review Recovery Settings

Review the recovery settings and choose 'Finish' to start the recovery. You can modify the recovery settings by choosing 'Back'.

Database Information

Database: H80@H80
Host: [illegible]
Version: 2.00.010.00.1491294693

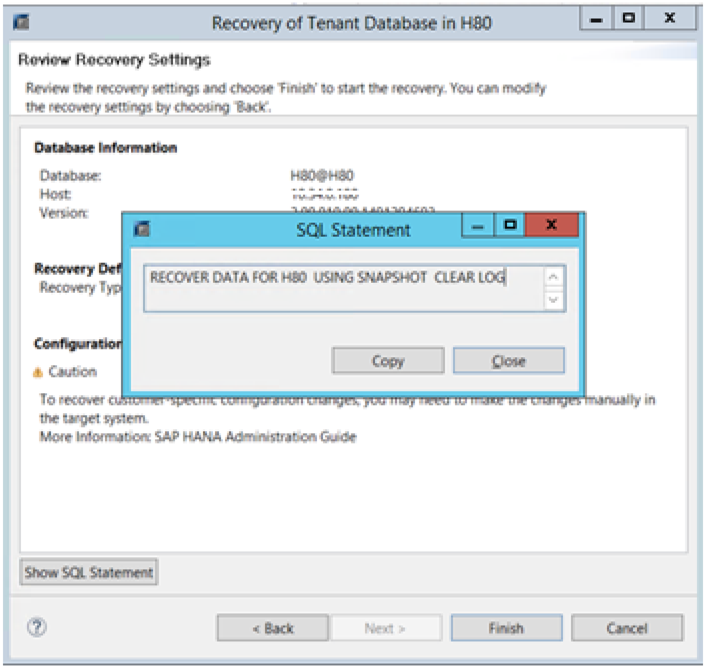
Recovery Definition

Recovery Type: Snapshot (Data Backup Recovery)

Configuration File Handling

⚠ Caution

To recover customer-specific configuration changes, you may need to make the changes manually in the target system.
More Information: SAP HANA Administration Guide



Review Recovery Settings

Review the recovery settings and choose 'Finish' to start the recovery. You can modify the recovery settings by choosing 'Back'.

Database Information

Database: H80@H80
Host: [illegible]
Version: [illegible]

Recovery Def
Recovery Typ

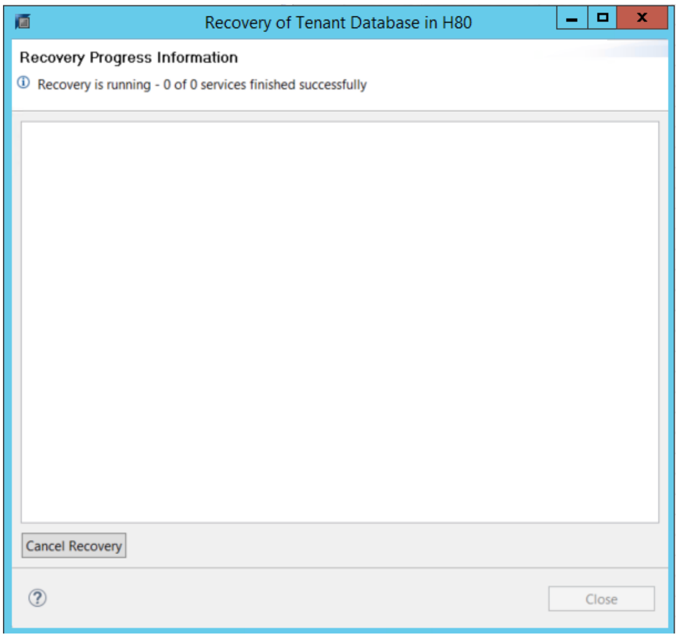
Configuration

⚠ Caution

To recover customer-specific configuration changes, you may need to make the changes manually in the target system.
More Information: SAP HANA Administration Guide

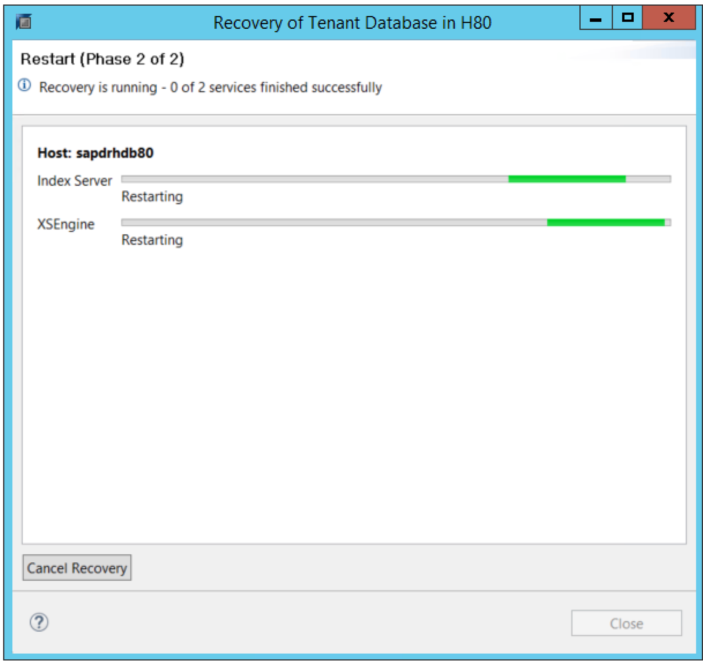
```
RECOVER DATA FOR H80  USING SNAPSHOT  CLEAR LOG
```

Recovery in progress.



Recovery Progress Information

ⓘ Recovery is running - 0 of 0 services finished successfully



Recovery of Tenant Database in H80

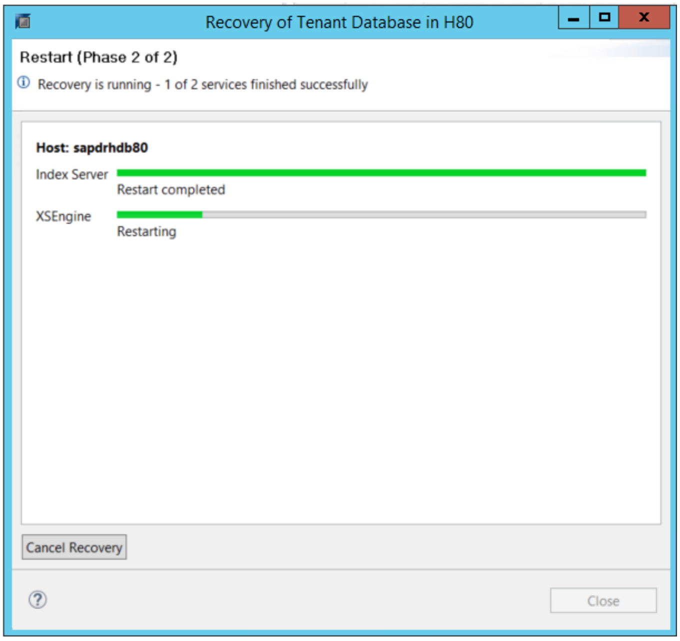
Restart (Phase 2 of 2)

Recovery is running - 0 of 2 services finished successfully

Host: sapdrhdb80

Index Server — Restarting

XSEngine — Restarting



Recovery of Tenant Database in H80

Restart (Phase 2 of 2)

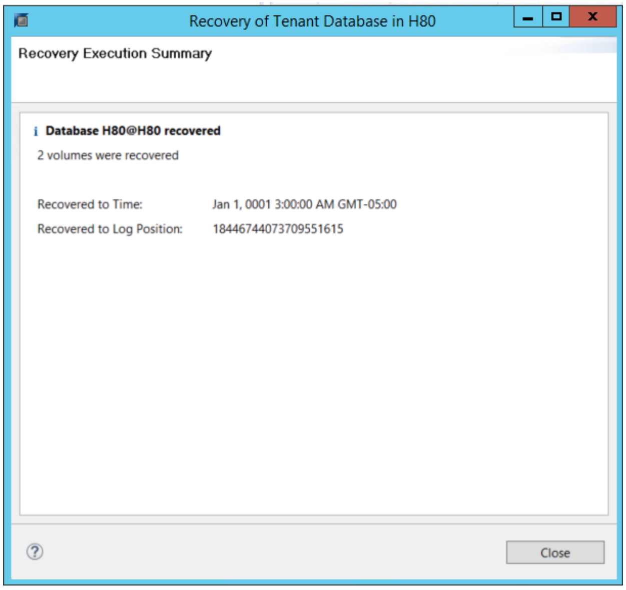
Recovery is running - 1 of 2 services finished successfully

Host: sapdrhdb80

Index Server — Restart completed

XSEngine — Restarting

Recovery of the tenant database complete.



Recovery of Tenant Database in H80

Recovery Execution Summary

Database H80@H80 recovered

2 volumes were recovered

Recovered to Time: Jan 1, 0001 3:00:00 AM GMT-05:00

Recovered to Log Position: 18446744073709551615

Guidance for using these tools

1. How to take snapshots manually?

Before executing the actual snapshot commands *azure_hana_backup*, please run the following test commands and check they get executed successfully. These tests ensure that snapshot tools can communicate with the installed SAP HANA database and the underlying storage system of the SAP HANA on Azure Large Instance system.

- testHANAConnection
- testStorageSnapshotConnection

To execute the snapshot tools, please refer to section: Snapshot commands Execution and details.

2. How to setup automatic snapshot backup?

It is common practice on Unix/Linux systems to use cron to automate running commands on a system. The standard practice for the snapshot tools is to setup the user’s crontab.

An example of a *crontab* for the user ‘shoasnap’ to automate snapshots is below.

CAUTION In the example below, some of the lines have been wrapped due to page size.

Terminal session

```
shoasnap@sapprdhdb80:~/bin> crontab -l
MAILTO=""
# =============== TEST snapshot schedule ===============
# __START__ logs snapshot every hour at approximately 5 minute intervals
06,11,16,21,26,31,36,41,46,51,56  * * * * ( . /home/shoasnap/.profile ; cd
/home/shoasnap/bin ; ./azure_hana_backup --prefix=logs_TEST --frequency=3min --
retention=9 --ssl=openssl --type=logs)
# __END__ logs snapshots
# __START__ logs snapshot every two hours at 1 minute past the hour.
# this setting avoids clashing with the ‘hana’ snapshot.
01  01,03,05,07,09,11,13,15,17,19,21,23 * * * ( . /home/shoasnap/.profile ; cd
/home/shoasnap/bin ; ./azure_hana_backup --prefix=logs_TEST --frequency=3min --
retention=9 --ssl=openssl --type=logs)
# __END__ logs snapshots
# __START__ hana snapshot every two hours at 59 minutes past the hour.
59  00,02,04,06,08,10,12,14,16,18,20,22 * * * ( . /home/shoasnap/.profile ; cd
/home/shoasnap/bin ; ./azure_hana_backup --type=hana --prefix=hana_TEST --
frequency=15min --retention=9 --ssl=openssl)
# __END__ hana snapshot
#
```

- 0,15,30,45: Every 15 minutes
- 0-23: Every hour
- * : Every day

- * : Every month
- * : Every day of the week

More crontab examples here: https://www.thegeekstuff.com/2009/06/15-practical-crontab-examples/.

In the above example, the ‘15min’ is a parameter that is reserved for future development and has no impact on the execution. The cron job schedule controls the backup timings.

CAUTION	Customers are responsible for monitoring the *cron* jobs to ensure snapshots are being generated successfully.

3. How to monitor the snapshots?

The following should be monitored to ensure a healthy system:

1. Available disk space. Snapshots will slowly consume disk space as keeping older disk blocks are retained in the snapshot.
2. Successful execution of the snapshot tools
3. Consistency of the snapshots by restoring then to another system periodically.

To get the snapshot details, please execute the snapshot command azure_hana_snapshot_details.

4. How to delete a snapshot?

To delete a snapshot, please execute the command azure_hana_snapshot_delete. However, if you had taken a temporary snapshot doing a test with testStorageSnapshotConnection, you can delete the temporary snapshot(s) using the command removeTestStorageSnapshot. You can't delete the snapshots from the OS level. You must use the correct command (azure_hana_snapshot_delete or removeTestStorageSnapshot) to delete the storage snapshots.

CAUTION	Be extra vigilant while deleting a snapshot. Once deleted, you can't recover the deleted snapshots. However, to avoid filling up the storage space, you must keep on cleaning up the old snapshots.

5. How to restore a snapshot?

In this version, there is **NO** restore snapshot command provided for the snapshot restore as a self-service (though snapshot restore can be performed as part of the self-service DR snapshot tools).

A snapshot can be copied back to the SAP HANA data area, but HANA must not be running when a copy is made.

Alternately, you could contact the Microsoft operations team by opening a service request to restore a desired snapshot from the existing available snapshots. You can open a service request from Azure portal: https://portal.azure.com.

If you decide to perform the disaster recovery failover, the snapshot command azure_hana_dr_failover automatically makes available the most recent available (/data and /logbackups) snapshots to allow for a SAP HANA recovery. Use this command with caution as it halts replication between production and DR sites.

6. What are key facts to know about the snapshots?

You must be familiar with the key attributes about the storage snapshots:

- **Location of snapshots**: The default location of the hana snapshots is under the .snapshot folder. Please note, **.snapshot** is a read-only hidden folder for the snapshot types as follows:
  - hana: /hana/data/<SID>/mnt00001/.snapshot
  - hana: /hana/shared/<SID>/.snapshot
  - logs: /hana/logbackups/<SID>/.snapshot
  - boot: boot snapshots are **not visible** from OS level
- **Max snapshot:** The hardware can sustain up to 250 snapshots per volume. The snapshot command will keep a maximum number of snapshots for the prefix based on the retention

set on the command line, and will delete the oldest snapshot if it goes beyond the maximum number to retain.

- **Snapshot name:** The snapshot name includes the prefix label provided by the customer.
- **Size of the snapshot:** Depends upon the size/changes on the database level.
- **Log file location:** /hana/shared/<SID>/exe/linuxx86_64/hdb/snapshotLogs and /hana/shared/<SID>/exe/linuxx86_64/hdb/statusLogs.

Disaster Recovery

1. What are the prerequisites for DR setup?

The following pre-requisites must be met before you plan the disaster recovery failover.

- You have a DR node provisioned at the DR site. There are two options for DR. One is normal DR, and other is multipurpose DR (See the definition: Terms and Definitions).
- You have storage replication working. The Microsoft operations team performs the storage replication setup at the time of DR provisioning automatically. You can monitor the storage replication using the snapshot command azure_hana_replication_status.
- You have setup and configured storage snapshots at the primary location.
- You have an HANA instance installed at the DR site for the primary with the same SID as the primary instance has.
- You read and understood the DR Failover procedure located at https://docs.microsoft.com/en-us/azure/virtual-machines/workloads/sap/hana-overview-high-availability-disaster-recovery#disaster-recovery-failover-procedure.
- The *HANABackupCustomerDetail.txt* file has been updated with the DR location storage information on the DR server.
- You completed the step 1, 2, 3 and 6 from the section How to Setup Snapshot?

2. How to setup a disaster recovery?

Currently, Microsoft supports storage level replication for DR recovery. There are two ways to setup the DR.

One is normal and **other** is multipurpose. In the normal DR, you have a dedicated instance at the DR location for failover. In the multipurpose DR scenario, you have another QA or development HANA instance running on the HANA large instance unit in the DR site. But you also installed a pre-installed HANA instance that is dormant and has the same SID as the HANA instance you want to failover to that HANA Large Instance unit. Microsoft operations sets up the environment for you including the storage replication based on the input provided in the Service Request Form (SRF) at the time of onboarding.

Also, ensure that all the prerequisites are met for the DR setup.

3. How to monitor the data replication from Primary to DR site?

Microsoft operations team already manage and monitor the DR link from Primary site to the DR site. You can monitor the data replication from your primary server to DR server using the snapshot command azure_hana_replication_status.

4. How to perform a failover to DR site?

You perform a failover to DR site, by executing a snapshot command azure_hana_dr_failover.

Caution	Use only when planning to perform a DR exercise. The azure_hana_dr_failover command breaks the storage replication. You must reach out to the Microsoft Operations to set up replication again. Once the replication is re-enabled, all the data at DR storage for this SID will get initialized. The command that performs the failover makes available the most recently replicated storage snapshot. If you need to restore back to an older snapshot, open a support request so operations can assist to provide an earlier snapshot restored in the DR site.

At a high level, here are the steps to follow for DR failover:

- You must shut down the HANA instance at **primary** site. This is only needed if you are truly doing the failover to DR site so you don't have data inconsistencies.
- Shutdown the HANA instance on the DR node for the production SID.
- Execute the snapshot command azure_hana_dr_failover on the DR node with the SID to be recovered
  - The snapshot command breaks the storage replication link from the Primary to the DR site
  - The snapshot command restores the /data and /logbackups volume only, /shared volume is NOT recovered, but rather it uses the existing /shared for SID at the DR location.
  - Mount the /data and /logbackups volume – ensure to add it to the fstab file
- Restore the HANA SYSTEMDB snapshot. Please note, HANA studio only shows you the latest HANA snapshot available under the storage snapshot restored as part of the snapshot command azure_hana_dr_failover execution.
- Recover the tenant database
- Start the HANA instance on the DR site for the Production SID (Example: H80 in this case)
- Perform the testing.

Detailed steps can be found at azure_hana_dr_failover.

Troubleshooting

The following are the common issues that you may encounter while running the snapshot tools. Please follow the resolution instructions mentioned to fix the issue. If you still encounter an issue, please open a Service Request from Azure portal and assign the request into the HANA large Instance queue, and Microsoft Operations team provides the necessary solution.

hdbuserstore location

The hdbuserstore program is found under /usr/sap/<SID>/SYS/exe/hdb/

Expected SID Storage Backup Name

You run a snapshot command *testHANAConnection* and receive the following error:

```
> ./testHANAConnection
WARNING: Expected SID3 Storage Backup Name:
WARNING: Verify line 34 is correct. Exiting.
```

Solution: Please check the proper SID information in the configuration file for each HANA instance you want a snapshot test conducted.

Also try to run the command below to verify if the hdbsql command is in the path and it can connect to the HANA Server.

```
> hdbsql -n 172.18.18.50 -i 00 -d SYSTEMDB -U SCADMIN "\s"
```

In this example, the hdbsql command isn't in the users $PATH.

```
Terminal session
# hdbsql -n 172.18.18.50  -i 00 -U SCADMIN "select version from sys.m_database"
If 'hdbsql' is not a typo you can use command-not-found to lookup the package that
contains it, like this:
    cnf hdbsql
```

In this example, the hdbsql command is temporarily added to the user's $PATH, and when run again shows the connection key hasn't been setup correctly with the "hdbuserstore Set" command (refer to SAP HANA documentation for details). To permanently add to the user's $PATH, update their $HOME/.profile

```
Terminal session
# export PATH=$PATH:/hana/shared/H80/exe/linuxx86_64/hdb/

> hdbsql -n 172.18.18.50 -i 00 -U SCADMIN "select version from sys.m_database"
* -10104: Invalid value for KEY (SCADMIN)
```

Storage check status command 'volume show -type RW -fields volume' failed: 65280

The snapshot command *testStorageSnapshotConnection* does not complete successfully.

```
> ./testStorageSnapshotConnection
Running per the following command line:
./testStorageSnapshotConnection
The authenticity of host '10.3.0.18 (10.3.0.18)' can't be established.
ECDSA key fingerprint is SHA256:cONAr0lpafb7gY4l31AdWTzM3s9LnKDtpMdPA+cxT7Y.
Are you sure you want to continue connecting (yes/no)?
```

Solution: Do not select Yes. Please ensure that your storage IP address is correct. If there is still an issue, please confirm the storage IP address with Microsoft operations team.

The authenticity of host '172.18.18.11 (172.18.18.11)' can't be established

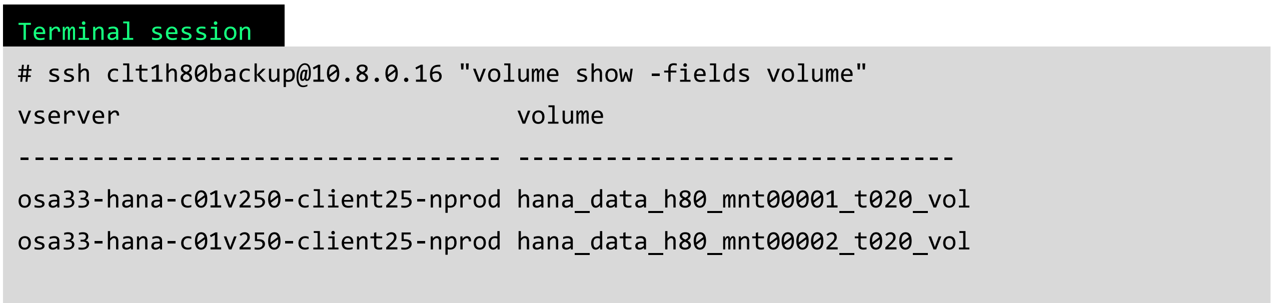
You encounter the following message while running the testStorageSnapshotConnection

```
Checking Snapshot Status for h80
*********************Checking access to Storage*********************
The authenticity of host '172.18.18.11 (172.18.18.11)' can't be established.
ECDSA key fingerprint is SHA256:QxamHRn3ZKbJAKnEimQpVVCknDSO9uB4c9Qd8komDec.
Are you sure you want to continue connecting (yes/no)?
```

Solution: The above error normally shows up when storage user has no access to the underlying storage. To check if you have access to storage using the storage user, please run the following command

```
# ssh -l <StorageBackupname> <Storage IP address>  ← actual command
# ssh -l clt1h80backup 172.18.18.11  ← example
```

Expected output is as following:



```
Terminal session
# ssh clt1h80backup@10.8.0.16 "volume show -fields volume"
vserver                           volume
--------------------------------- ------------------------------
osa33-hana-c01v250-client25-nprod hana_data_h80_mnt00001_t020_vol
osa33-hana-c01v250-client25-nprod hana_data_h80_mnt00002_t020_vol
```

Appendix - Changelog

The following lists changes made to the commands to provide new functionality or resolve defects.

Changes in v4.2

Published: Sun Sep 25 04:20:00 UTC 2019

Documentation:

- Added section to guide a manual installation, following the steps the installer automatically completes (5421385).

azure_hana_backup:

- Limit the `--trim` option to only remove backup catalog entries for the same `--prefix` as passed on the command line and remove any log entries older than the oldest non-log file backup entry in the backup catalog (5286457).
- Improve the `--trim` option to work with multiple tenants (4873256).
- Resolve logMsg output "uninitialized value $msgString in concatenation (.) or string at (eval 14) line 472" (4882230).

azure_hana_ snapshot_delete:

- No longer requires the `--sid` parameter to be in lower-case (5421378).

azure_hana_snapshot_installer_v4.2s.run:

- Updated to work with system with multiple instances installed (5421382).

Changes in v4.1

Published: Sun Jun 30 04:10:00 UTC 2019

ALL:

- Allow for Storage API change (4667060).

azure_hana_backup:

- Add backup catalog trimming (`--trim`) to help with disk space management (3788143).
- Allow snapshots at Disaster Recovery site where DR site hostname is different to production (4580377).
- Allow snapshot type “boot” even if an existing snapshot does not exist (4765161).
- Insert comment into the SAP HANA backup catalog containing the storage snapshot name (2719997).
- Prevent the new *_data_backups_* volumes from being included in snapshots. This volume is use for standard SAP HANA backups and not these snapshot tools (4667067).
- Remove `--frequency` from being a mandatory argument as this option is not currently used, will still parse this argument but won’t impact on execution (4521966).

azure_hana_snapshot_details:

- Improve output to be more easily read by a human, or machine parsed, including pasting into a spreadsheet (4521979).

azure_hana_dr_failover:

- Add clone expiry date into the Clone comment field (4521977).

testStorageSnapshot & removeTestStorageSnapshot:

- Resolve how these commands create and delete the temporary snapshots for testing (4764966).

Changes in v4.0

Published: Wed Apr 10 04:00:00 UTC 2019

ALL:

- Downloadable as a single self-extracting installer to ease system setup.

- Now provided as binary files to ensure they include all dependent libraries and can be more easily setup and supported.
- No longer have the .pl extension as they are provided as binaries.
- Added support for Generation 4 of SAP HANA on Azure Large Instance.
- Command line switches and parameters changed to meet the standard format expected of command line programs on Unix/Linux systems (e.g. `--prefix`). Refer to this documentation for guidance on using these commands.
- Various improvements in console output, especially reducing console output by default. Logging output to the console can be provided by passing the -v (verbose) switch to each command.
- hdbsql command needs to be part of the user's $PATH.

azure_hana_backup:

- Added support for SSL communication to SAP HANA. Use of this feature requires certificates to be named and stored in the location specified in this documentation.

azure_hana_dr_failover:

- Improved message to customers on steps to action after running this command.

azure_hana_test_dr_failover:

- Improved message to customers on steps to action after running this command.
- Changed to only allow a maximum of two clones, to prevent customers from unintentionally using up their free space.

Changes in v3.4.1

Published: Tue Oct 16 03:41:00 UTC 2018

azure_hana_backup: updated to v3.4.1) Following fix apply to these snapshot tools.
azure_hana_dr_failover: updated to v3.4.1)
azure_hana_replication_status: updated to v3.4.1)
azure_hana_snapshot_details: updated to v3.4.1)
azure_hana_test_dr_failover : updated to v3.4.1)
removeTestStorageSnapshot : updated to v3.4.1)
testStorageSnapshotConnection: updated to v3.4.1)

- Handle an environment where the HANA SID partially matches the Tenant ID (e.g. SID = H80 and Tenant ID = H800).

Changes in v3.4

ALL *:

- Addition of Common Log Format to start of each line written to the logs when this snapshot command is run, for better telemetry.
- Moved $version to just below opening header comment to avoid duplicating the version number in the snapshot command and ensure version# is consistent.

azure_hana_backup:

- Retry added to the runSSHDiagCmd function. Will try the to execute the command up to 4 times, with the wait in seconds between each attempt 7, 21, 63 seconds respectively.
- Now tests for HSR setup (new function runCheckHSRStatus), and if detects possibility of two nodes running as primary will exit without snapshot to avoid data snapshot taken on both nodes simultaneously.

azure_hana_test_dr_failover:

- Move the message ("This clone is kept for 4 weeks before it is automatically removed.") to the end of the output so it becomes part of the steps for customer to follow. Was at the start of the output and scrolled off the screen.
- Modify clone creation to thin provision the clone.
- Prompt for a contact email when doing the Test DR Failover to provide a customer contact to get confirmation it is ok to delete the clone.
- Add the contact email and an expiry date into the clone comment field for automated clone deletion 4 weeks from date of creation (see above).

azure_hana_dr_failover:) Following changes apply to both snapshot tools.
azure_hana_test_dr_failover:)

- Add capability to run DR failover against Scale-Out nodes.
- Ensure the latest HANA data snapshot volume is presented for recovery.
- Add log_backups volumes from both nodes for DR recovery of HSR configuration.
- Simplify the log backups mount point for non-HSR.
- Reduce display mount point output to only show the recovery volumes.
- Simplify guidance on mounting volumes for recovery when snapshot tools complete.

Changes between release v3.3 and v3.4

Published: Wed Jul 11 03:31:03 UTC 2018
removeTestStorageSnapshot: updated to v3.3.1

- Fix for two variables declared twice in snapshot command with "my $<var>" ($filename, $sshCmd), duplicate declarations removed.
- Fix missing my $LOG_CRIT declaration now added.

Published: Fri Jun 1 21:45:00 UTC 2018
azure_hana_backup: updated to v3.3.2

- Fix for hostnames which contain a hyphen (-), this character is not allowed in the volume name, so is converted to underscore (_).
- For HSR HANA installs, restrict the snapshot tools to only run against the volumes associated with the host they are being run from (i.e. where the volume name contains the same hostname).

Published: Wed May 30 01:43:37 UTC 2018
azure_hana_snapshot_delete: updated to v3.3.1

- Fix for time calculation to prevent a snapshot being deleted if it is less than 10 minutes old, all time calculations moved to UTC.

testStorageSnapshotConnection: updated to v3.3.1

- Snapshot command would sometimes fail the creation of the OS backups snapshot since a copy of that snapshot already existed with a given timestamp because of the placement of the calls for that snapshot command. Moved the OS backup calls to take place before creating snapshots for each of the SIDs.

Published: Mon May 28 07:34:45 UTC 2018
azure_hana_backup: updated to v3.3.1

- Fix for "if ($numKeep le 0 or $numKeep gt 250)" to change string comparison to the correct number comparison (e.g. "if ($numKeep <= 0 or $numKeep > 250)").

Published: Fri May 25 17:00:00 UTC 2018
Snapshot command Bundle v3.3 Released