



Automating SAP HANA System Copy and Clone Operations with SnapCenter

NetApp Solutions SAP

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Automating SAP HANA System Copy and Clone Operations with SnapCenter

TR-4667: Automating SAP HANA System Copy and Clone Operations with SnapCenter

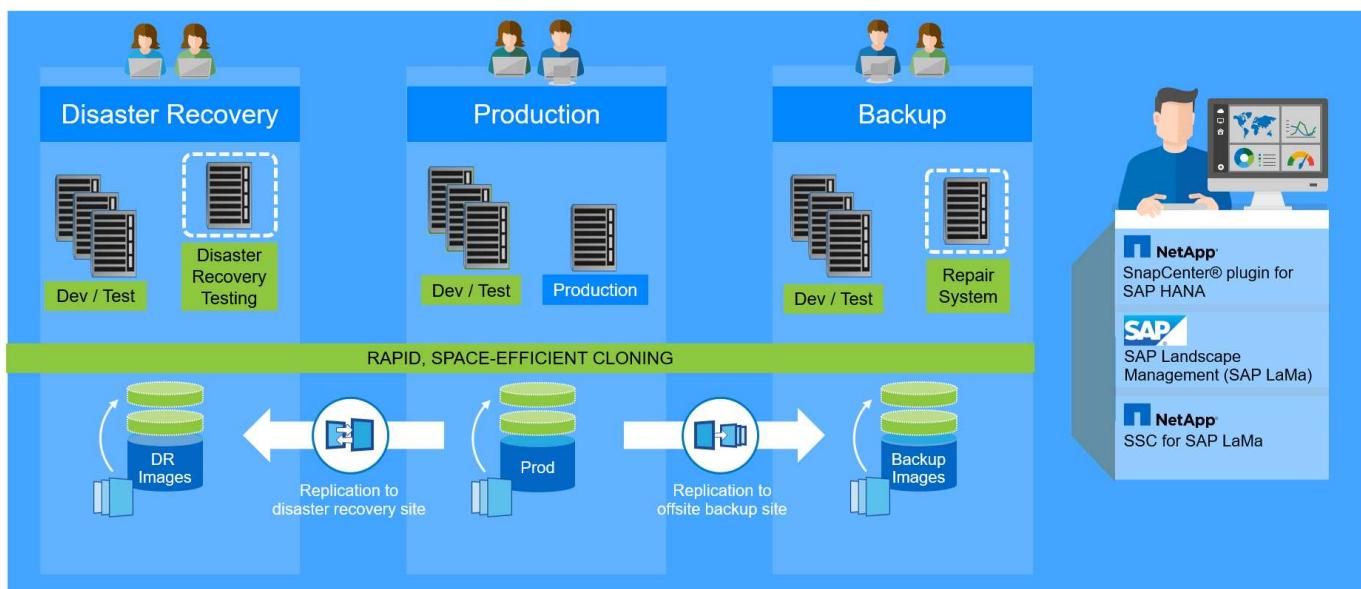
Nils Bauer, NetApp

In today's dynamic business environment, companies must provide ongoing innovation and react quickly to changing markets. Under these competitive circumstances, companies that implement greater flexibility in their work processes can adapt to market demands more effectively.

Changing market demands also affect a company's SAP environments such that they require regular integrations, changes, and updates. IT departments must implement these changes with fewer resources and over shorter time periods. Minimizing risk when deploying those changes requires thorough testing and training, which require additional SAP systems with actual data from production.

Traditional SAP lifecycle-management approaches to provision these systems are primarily based on manual processes. These manual processes are often error-prone and time-consuming, delaying innovation and the response to business requirements.

NetApp solutions for optimizing SAP lifecycle management are integrated into SAP HANA database and lifecycle management tools, combining efficient application-integrated data protection with the flexible provisioning of SAP test systems, as is shown in the following figure.



Application-integrated Snapshot backup operations

The ability to create application-consistent NetApp Snapshot backups on the storage layer is the foundation for the system copy and system clone operations described in this document. Storage-based Snapshot backups are created by using the NetApp SnapCenter Plug-In for SAP HANA and interfaces provided by the SAP HANA database. SnapCenter registers Snapshot backups in the SAP HANA backup catalog so that the backups can be used for restore and recovery as well as for cloning operations.

Off-site backup and/or disaster recovery data replication

Application-consistent Snapshot backups can be replicated on the storage layer to an off-site backup site or a disaster recovery site controlled by SnapCenter. Replication is based on block changes and is therefore space and bandwidth efficient.

Use any Snapshot backup for SAP system copy or clone operations

NetApp technology and software integration allows you to use any Snapshot backup of a source system for an SAP system copy or clone operation. This Snapshot backup can be either selected from the same storage that is used for the SAP production systems, the storage that is used for off-site backups, or the storage at the disaster recovery site. This flexibility allows you to separate development and test systems from production if required and covers other scenarios, such as the testing of disaster recovery at the disaster recovery site.

Automation with integration

There are various scenarios and use cases for the provisioning of SAP test systems, and you might also have different requirements for the level of automation. NetApp software products for SAP integrate into database and lifecycle management products from SAP to support different scenarios and levels of automation.

NetApp SnapCenter with the plug-in for SAP HANA is used to provision the required storage volumes based on an application-consistent Snapshot backup and to execute all required host and database operations up to a started SAP HANA database. Depending on the use case, SAP system copy, system clone, system refresh, or additional manual steps such as SAP postprocessing might be required. More details are covered in the next section.

A fully automated, end-to-end provision of SAP test systems can be performed by using SAP Landscape Management (LaMa). NetApp Storage Services Connector integrates into SAP LaMa and provides the required operations for SAP LaMa at the storage layer. More details can be found at [Integrating NetApp ONTAP Systems with SAP Landscape Management](#).

SAP system copy, refresh, and clone scenarios

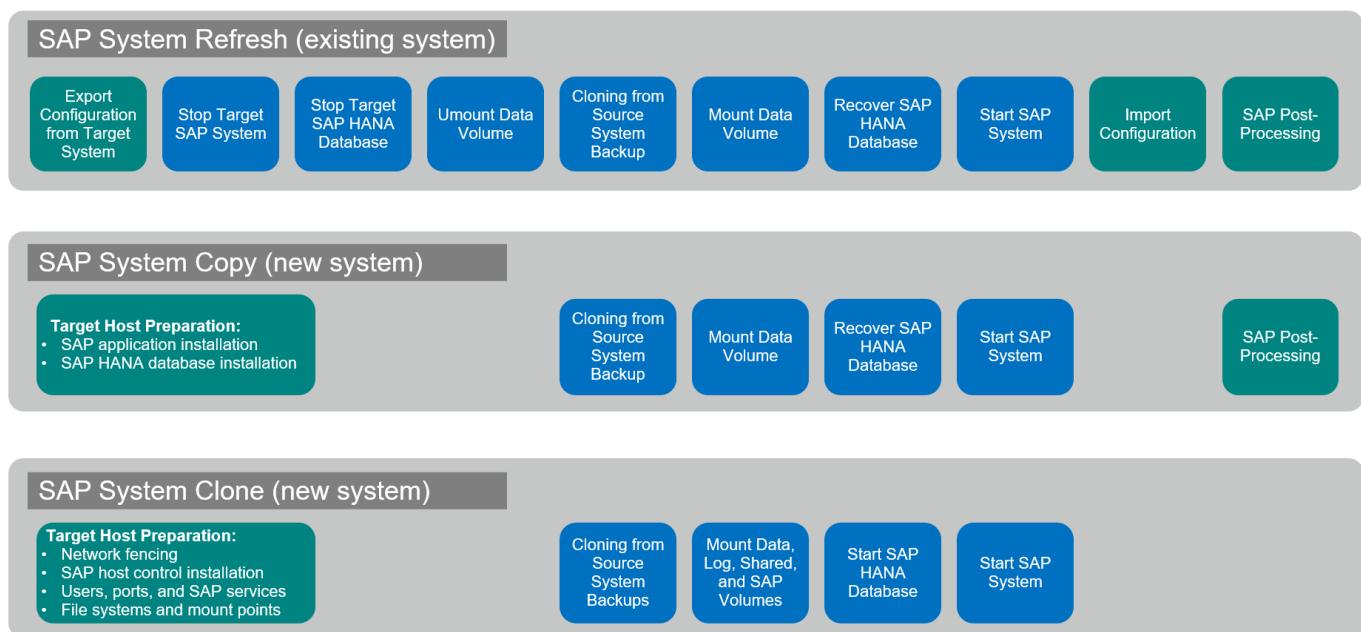
The term SAP system copy is often used as a synonym for three different processes: SAP system refresh, SAP system copy, or SAP system clone operations. It is important to distinguish between the different operations because the workflows and use cases differ for each one.

- **SAP system refresh.** An SAP system refresh is a refresh of an existing target SAP system with data from a source SAP system. The target system is typically part of an SAP transport landscape, for example a quality assurance system, that is refreshed with data from the production system. The hostname, instance number, and SID are different for the source and target systems.
- **SAP system copy.** An SAP system copy is a setup of a new target SAP system with data from a source SAP system. The new target system could be, for example, an additional test system with data from the production system. The hostname, instance number, and SID are different for the source and target systems.
- **SAP system clone.** An SAP system clone is an identical clone of a source SAP system. SAP system clones are typically used to address logical corruption or to test disaster recovery scenarios. With a system clone operation, the hostname, instance number, and SID remain the same. It is therefore important to establish proper network fencing for the target system to make sure that there is no communication with the production environment.

The following figure illustrates the main steps that must be performed during a system refresh, system copy, or system clone operation. The blue boxes indicate steps that can be automated with SnapCenter, while the green boxes indicate steps that must be performed outside of SnapCenter, either manually or by using third-party tools.

All three operations can be fully automated by using SAP LaMa and the NetApp Storage Services Connector. More details can be found at [Integrating NetApp ONTAP Systems with SAP Landscape Management](#).

NetApp has also worked with Libelle www.libelle.com to integrate SnapCenter cloning with Libelle SystemCopy to automate SAP pre- and post-processing. A detailed solution description is available at [Automating SAP System Copy Operations with Libelle SystemCopy](#).

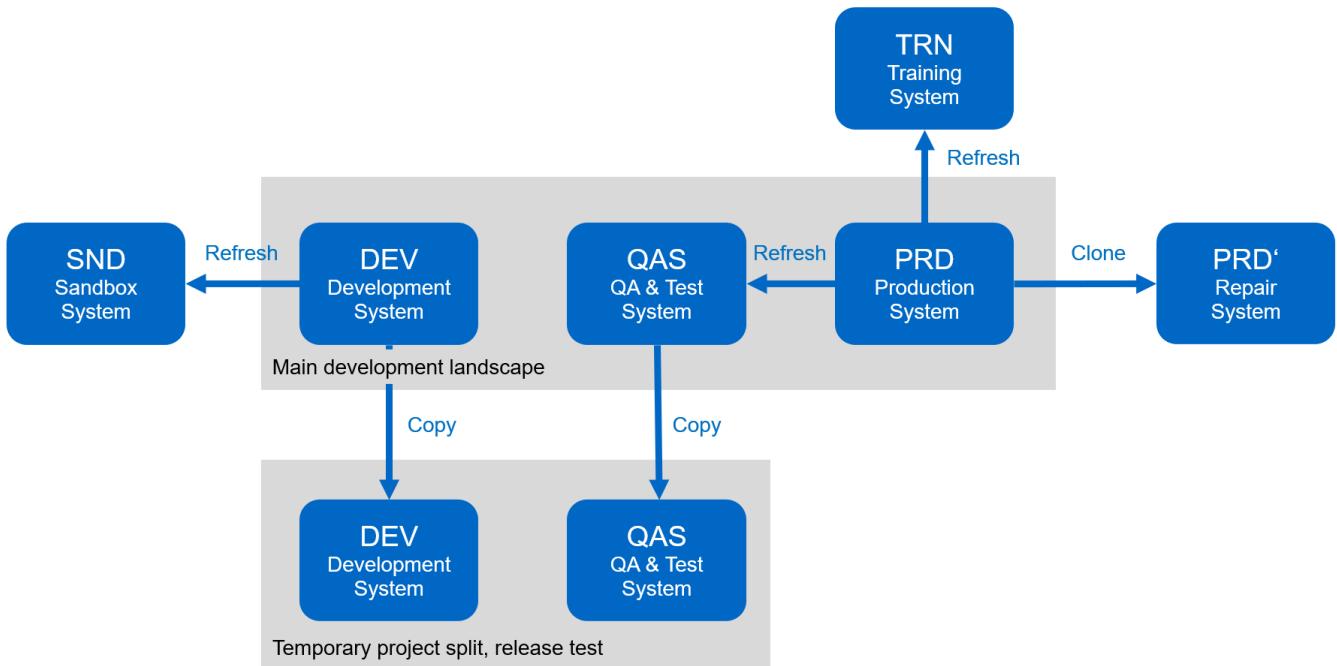


Use cases for system refresh and cloning

There are multiple scenarios in which data from a source system must be made available to a target system for testing or training purposes. These test and training systems must be updated with data from the source system on a regular basis to make sure that testing and training is performed with the current data set.

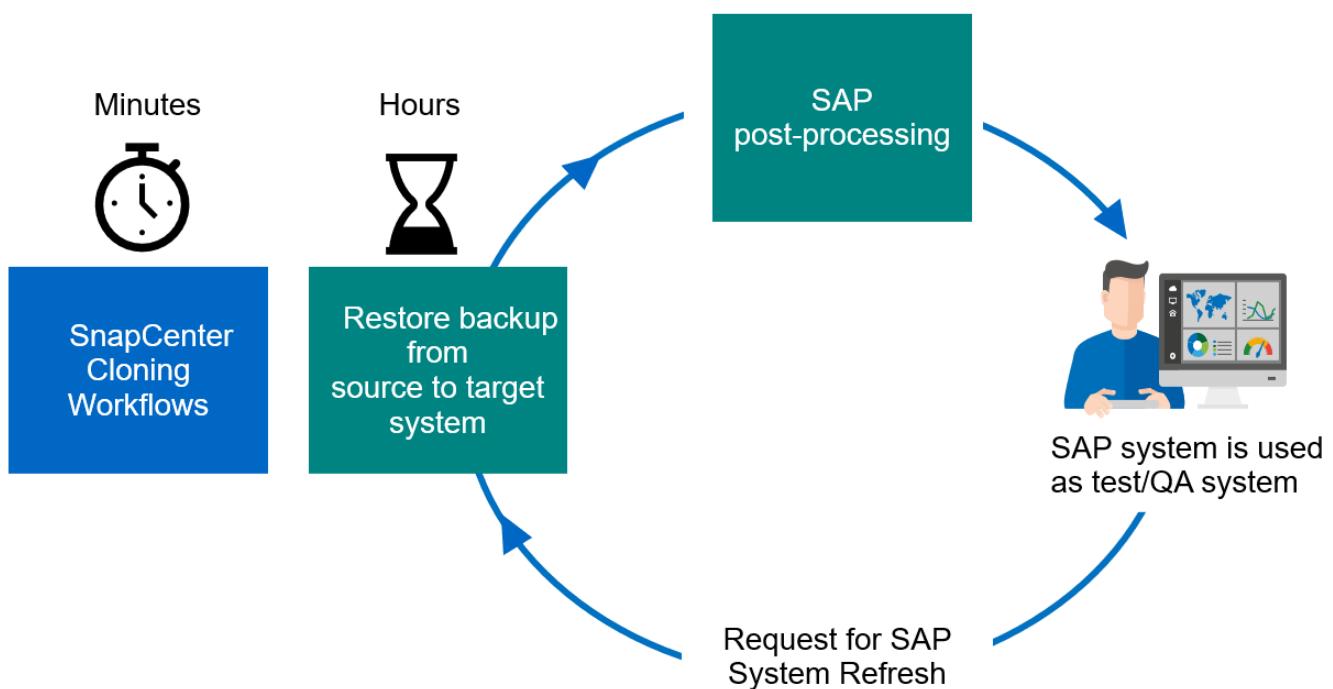
These system- refresh operations consist of multiple tasks on the infrastructure, database, and application layers, and they can take multiple days depending on the level of automation.

The following figure depicts SAP system refresh, copy, and clone operations.



SnapCenter cloning workflows can be used to accelerate and automate the required tasks at the infrastructure and database layers. Instead of restoring a backup from the source system to the target system, SnapCenter uses NetApp Snapshot copy and NetApp FlexClone technology, so that required tasks up to a started HANA database can be performed in minutes instead of hours as shown in the following figure. The time needed for the cloning process is independent from the size of the database, therefore even very large systems can be created in a couple of minutes.

The following figure depicts data refresh of QA, test, sandbox, or training systems.



The workflow for system-refresh operations is described in the section “[SAP HANA system refresh with SnapCenter](#).”

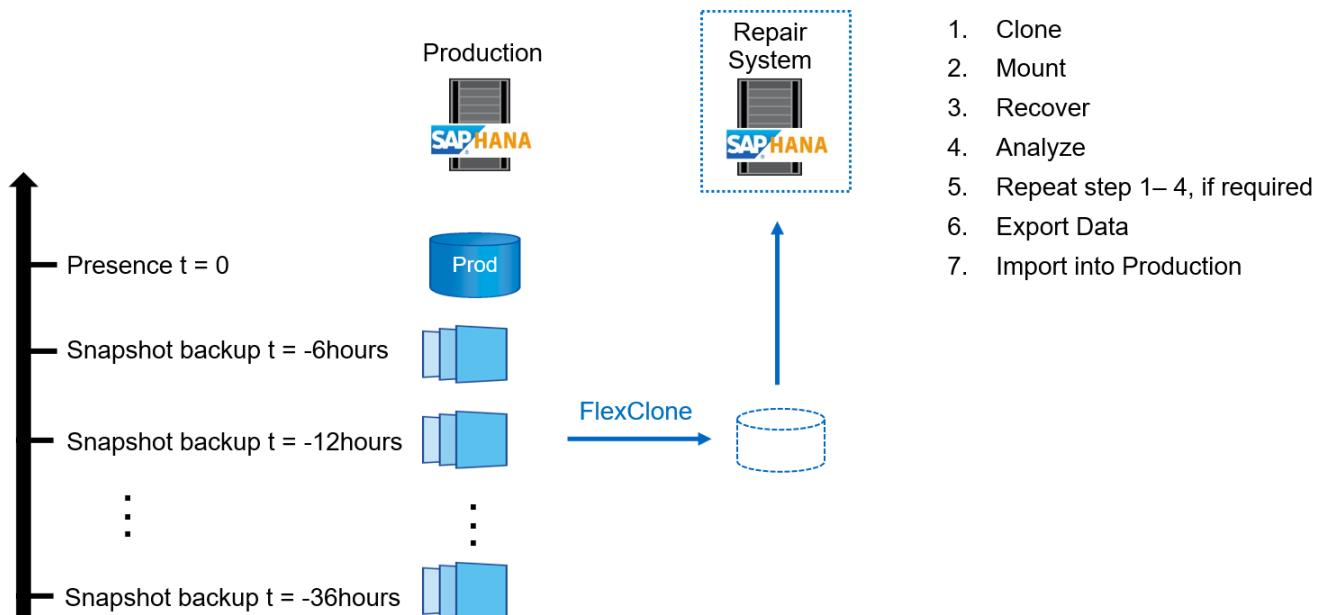
Address logical corruption

Logical corruption can be caused by software errors, human errors, or sabotage. Unfortunately, logical corruption often cannot be addressed with standard high-availability and disaster recovery solutions. As a result, depending on the layer, application, file system, or storage where the logical corruption occurred, minimal downtime and maximum data loss requirements can sometimes not be fulfilled.

The worst case is logical corruption in an SAP application. SAP applications often operate in a landscape in which different applications communicate with each other and exchange data. Therefore, restoring and recovering an SAP system in which a logical corruption has occurred is not the recommended approach. Restoring the system to a point in time before the corruption occurred results in data loss. Also, the SAP landscape would no longer be in sync and would require additional postprocessing.

Instead of restoring the SAP system, the better approach is to try to fix the logical error within the system by analyzing the problem in a separate repair system. Root cause analysis requires the involvement of the business process and application owner. For this scenario, you create a repair system (a clone of the production system) based on data stored before the logical corruption occurred. Within the repair system, the required data can be exported and imported to the production system. With this approach, the production system does not need to be stopped, and, in the best-case scenario, no data or only a small fraction of data is lost.

When setting up the repair system, flexibility and speed are crucial. With NetApp storage-based Snapshot backups, multiple consistent database images are available to create a clone of the production system by using NetApp FlexClone technology, as shown in the following figure. FlexClone volumes can be created in a matter of seconds rather than multiple hours if a redirected restore from a file-based backup is used to set up the repair system.



The workflow of the repair system creation is described in the section “[SAP system clone with SnapCenter](#).”

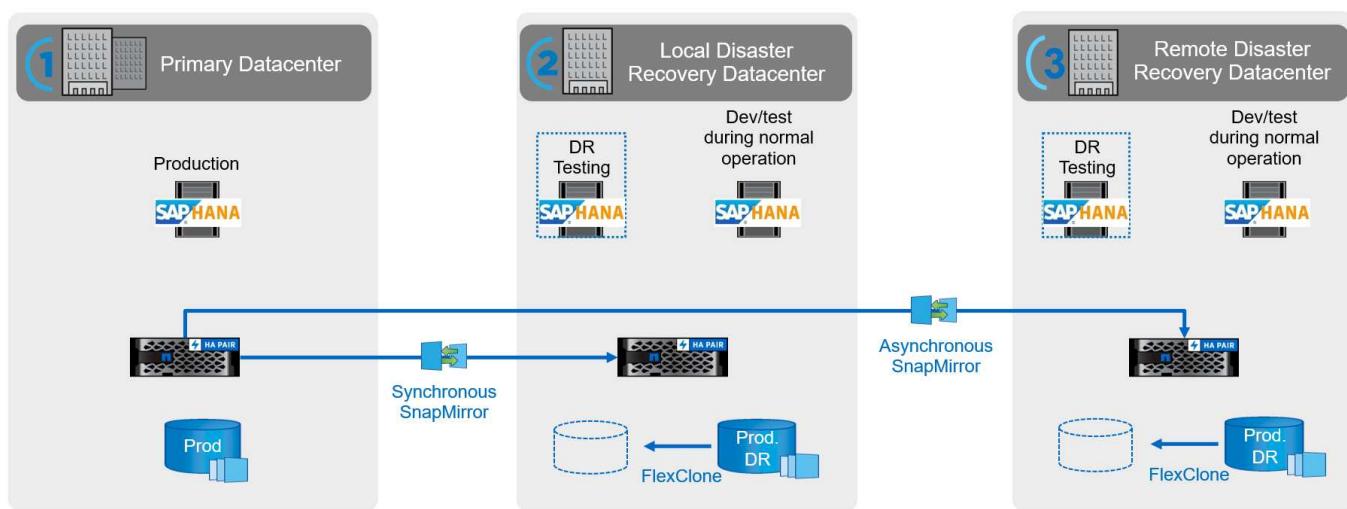
Disaster recovery testing

An effective disaster recovery strategy requires testing the required workflow. Testing demonstrates whether the strategy works and whether the internal documentation is sufficient. It also allows administrators to train on the required procedures.

Storage replication with SnapMirror makes it possible to execute disaster recovery testing without putting RTO and RPO at risk. Disaster recovery testing can be performed without interrupting data replication.

Disaster recovery testing for both asynchronous and synchronous SnapMirror uses Snapshot backups and FlexClone volumes at the disaster recovery target.

The following figure depicts disaster recovery testing.



A detailed step-by-step description can be found in the technical report [SAP HANA Disaster Recovery with Storage Replication](#).

Overview of SAP system refresh workflow with SnapCenter

SnapCenter provides workflows that allow you to manage clones of data sets from any existing Snapshot backup. This cloned data set, a FlexClone volume, can be used to rapidly provision a HANA data volume from a source system and attach it to a target system. It is therefore a perfect fit for executing system refresh operations for QA, test, sandbox, or training systems.

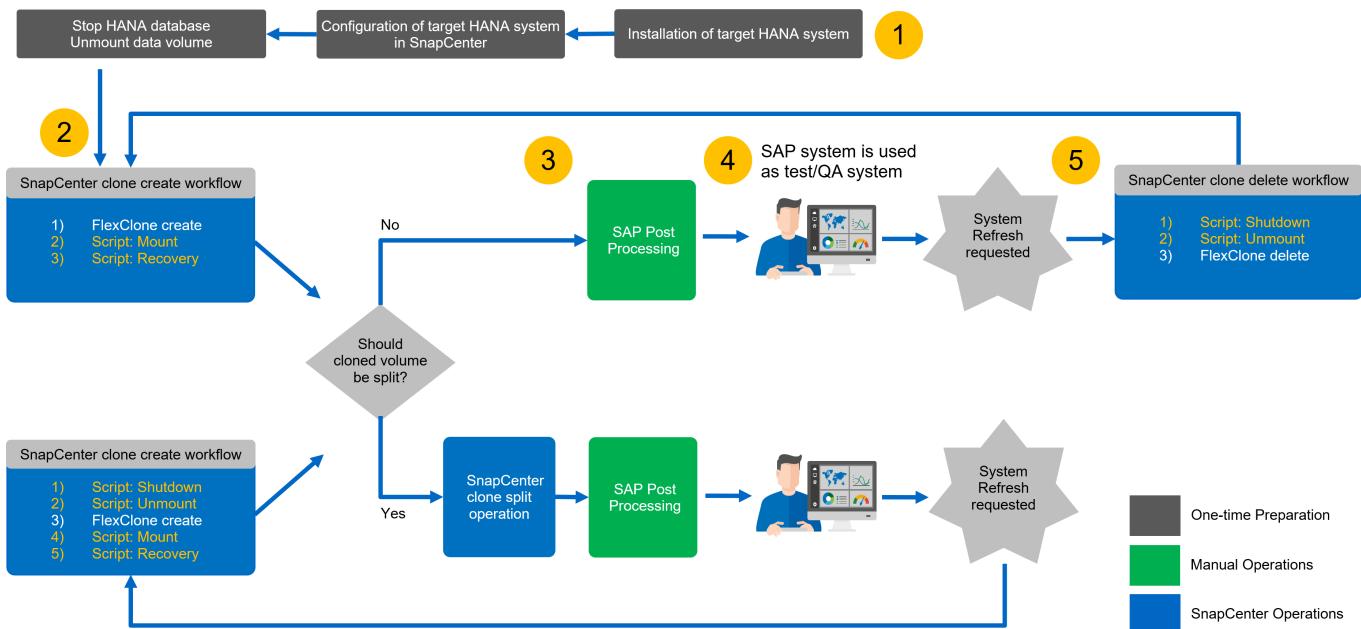
The SnapCenter cloning workflows handle all required operations on the storage layer and can be extended using scripts to execute host-specific and HANA database-specific operations. In this document, we use a script to execute mount and unmount operations on the target host as well as HANA database recovery and shutdown operations. SnapCenter workflows with further automation using the script handle all required HANA database operations but do not cover any required SAP post-processing steps. SAP post processing must be performed manually or with third party tools.



All the steps that are automated using the scripts can also be executed manually. However, for the mount operation at the target host, you need to know the storage system junction path of the FlexClone volume. The junction path is not visible within SnapCenter, so you need to either look up the junction path directly at the storage system or you could use a simple script that provides the SnapCenter environment variables at the target host. For more details see the section “Automation example scripts.”

The SAP system refresh workflow with SnapCenter consists of five main steps as shown in the following figure.

1. A one-time, initial installation and preparation of the target system.
2. The SnapCenter clone create workflow.
3. SAP post processing (manual or with a third-party tool).
4. The system can be used as test/QA system.
5. When a new system refresh is requested, the SnapCenter clone delete workflow is used to remove the FlexClone volume, and the refresh is restarted with step 2.



In most cases, target test/QA systems are used for at least a couple of weeks, and FlexClone capacity savings no longer exist after one to two weeks. It is important that the Snapshot backup of the source system gets released from the FlexClone volume so that it can be deleted by the SnapCenter retention management. Therefore, NetApp recommends splitting the FlexClone volume either immediately or after a couple of days. The clone split operation does not block use of the cloned volume and can therefore be performed at any time while the HANA database is in use.



When splitting the FlexClone volume, SnapCenter deletes all backups that were created at the target system.

The refresh operation including the clone split consists of the following steps (The following figure).

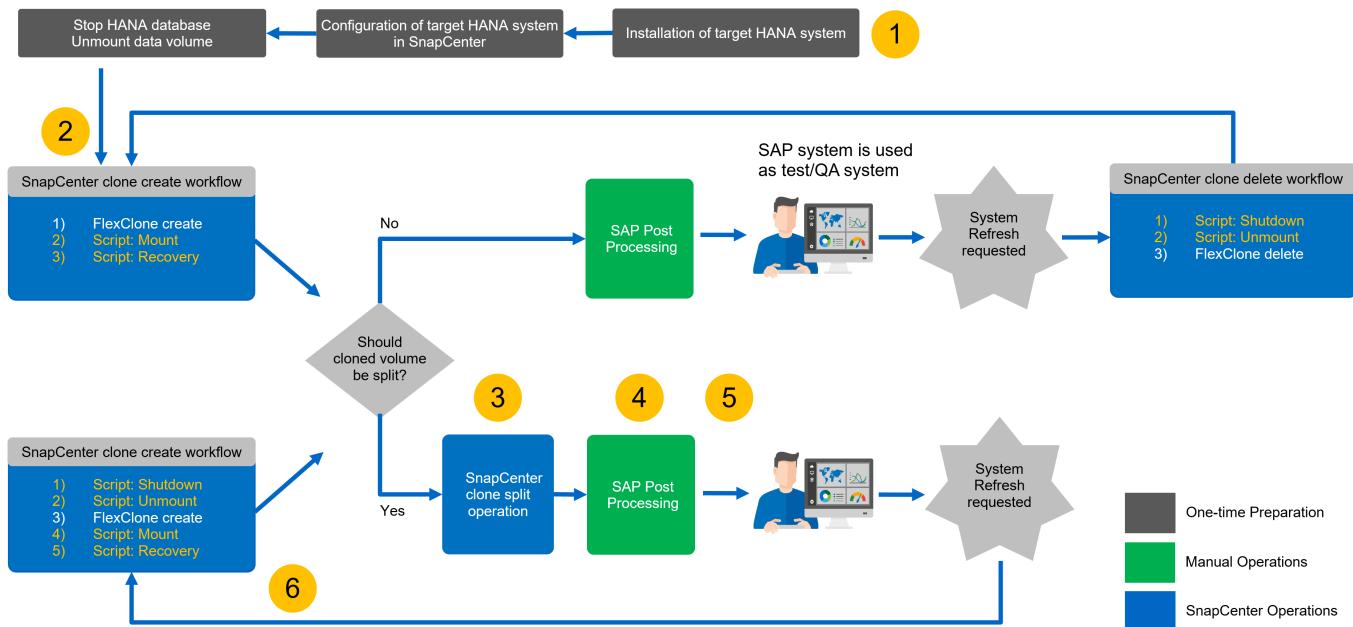
1. One-time, initial installation and preparation of the target system.
2. SnapCenter clone create workflow.

3. SnapCenter clone split workflow.
4. SAP post processing (manual or with a third-party tool).
5. Now the system can be used as a test/QA system.
6. When a new system refresh is requested, the SnapCenter clone create workflow is used with additional shutdown and unmount steps.



The old data volume, which was split previously, must be deleted manually on the storage system.

The following figure depicts an overview of SAP system refresh workflow with SnapCenter with clone split.

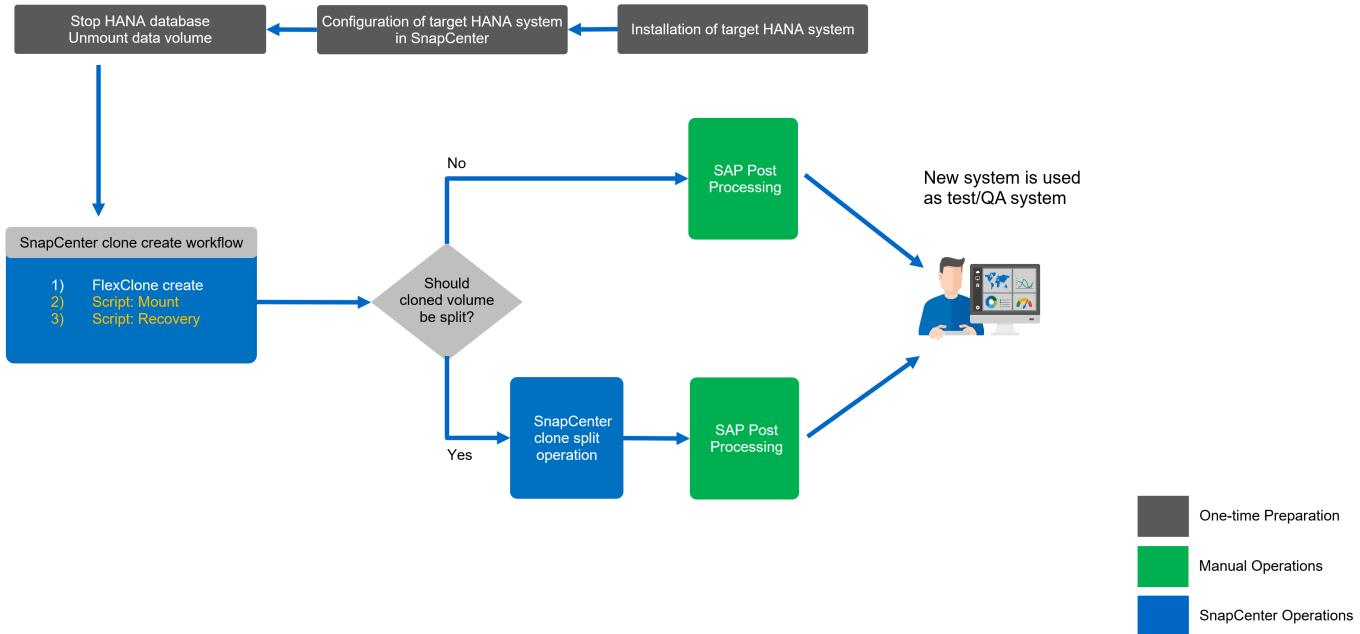


The section [“SAP HANA system refresh with SnapCenter”](#) provides a detailed step-by-step description of both system-refresh workflows.

Overview of SAP system copy workflow with SnapCenter

The SAP copy workflow is similar to the initial steps for a system refresh workflow. The workflow with SnapCenter consists of five main steps as shown in the following figure.

1. Initial installation and preparation of the target system.
2. The SnapCenter clone create workflow.
3. The SnapCenter clone split workflow (optional).
4. SAP post-processing (manual or with a third-party tool).
5. The new system can be used as a test/QA system.



Overview of SAP system clone workflow with SnapCenter

As discussed in the previous section, SnapCenter can manage clones of data sets from any existing Snapshot backup and can rapidly provision these data sets to any target system. The speed of provisioning production data to a repair system to address logical corruption is critical, since it is often necessary to reset the repair system and to choose a different production data set.

FlexClone technology enables a rapid provisioning process, and provides significant capacity savings, since the repair system is typically only used for a short time.

The following figure summarizes the required steps for an SAP system clone operation using SnapCenter.

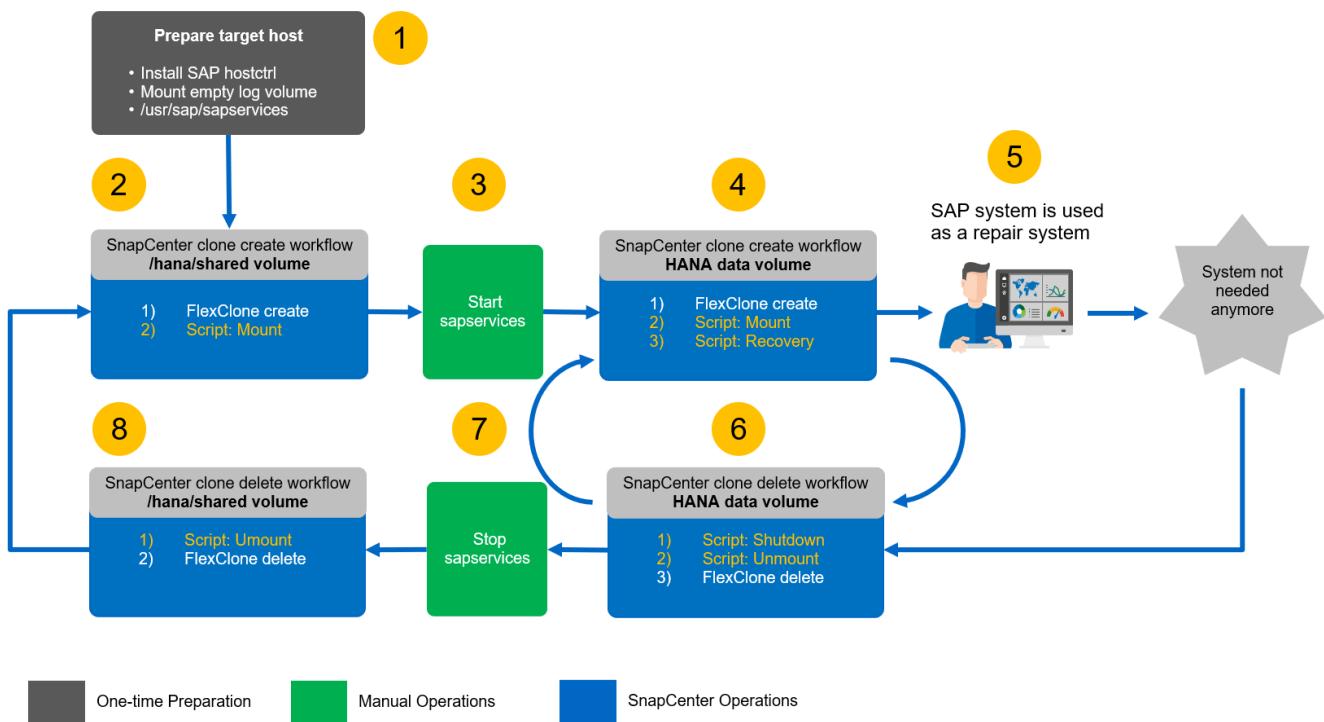
1. Prepare the target host.
2. SnapCenter clone create workflow for the HANA shared volume.
3. Start SAP HANA services.
4. SnapCenter clone create workflow for the HANA data volume including database recovery.
5. The HANA system can now be used as a repair system.



If you must reset the system to a different Snapshot backup, then step 6 and step 4 are sufficient. The HANA shared volume can continue to be mounted.

If the system is not needed anymore, the clean-up process is performed with the following steps.

1. SnapCenter clone delete workflow for the HANA data volume including database shutdown.
2. Stop SAP HANA services.
3. SnapCenter clone delete workflow for the HANA shared volume.



The section “[SAP system clone with SnapCenter](#)” provides a detailed step-by-step description of the system clone workflow.

SAP HANA system refresh operation workflows using storage snapshot backups

The steps required to perform an SAP HANA system refresh depend on the source system tenant configuration and the required tenant name at the target system, as shown in the following figure.

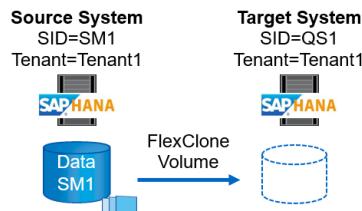
Since the tenant name is configured in the system database, the tenant name of the source system is also available at the target system after the recovery of the system database. Therefore, the tenant at the target system can only be recovered with the same name as the source tenant as shown in option 1 in the following figure. If the tenant name at the target system must be different, the tenant must first be recovered with the same name as the source tenant and then renamed to the required target tenant name. This is option 2 in the following figure.

An exception of this rule is a HANA system with a single tenant, where the tenant name is identical to the system SID. This configuration is the default after the initial HANA installation. This specific configuration is flagged by the HANA database. In this case, tenant recovery at the target system can be executed with the tenant name of the target system, which must be also identical to the system SID of the target system. This workflow is shown in option 3 in the following figure.

i As soon as any tenant create, rename, or drop operation is executed at the source system, this configuration flag is deleted by the HANA database. Therefore, even if the configuration has been brought back to tenant = SID, the flag is no longer available and the exception regarding tenant recovery with workflow 3 is no longer possible. In this case, option 2 is the required workflow.

1) Tenant name != SID
Source tenant = Target tenant

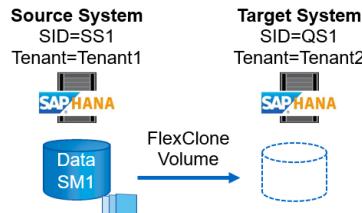
Source: SM1/Tenant1
Target: QS1/Tenant1



1. Create FlexClone volume of data volume
2. Mount FlexClone volume at target host
3. Recovery of System database
4. Recovery of tenant database with target name Tenant1

2) Tenant name != SID
Source tenant != Target tenant

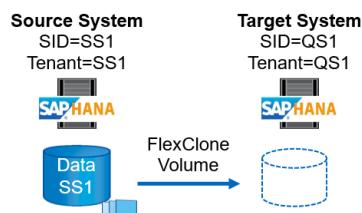
Source: SM1/Tenant1
Target: QS1/Tenant2



1. Create FlexClone volume of data volume
2. Mount FlexClone volume at target host
3. Recovery of System database
4. Recovery of tenant database with target name Tenant1
5. Stop Tenant1 database
6. Rename Tenant1 to Tenant2

3) Tenant name = SID

Source: SS1/SS1
Target: QS1/QS1



1. Create FlexClone volume of data volume
2. Mount FlexClone volume at target host
3. Recovery of System database
4. Recovery of tenant database with target name QS1

This figure shows the configuration flag for initial MDC single-tenant installation.

The screenshot shows the SAP HANA Studio interface with the following details:

- File Bar:** File, Edit, Navigate, Search, Run, Window, Help
- Left Sidebar:** Systems, showing nodes like Q51 - System Refresh Target, SYSTEMDB@Q51 (SYSTEM) Q51 - System Refresh Target, SYSTEMDB@SS1 (SYSTEM) Q51 - System Refresh Target, and SM1 - MDC multiple tenants - 2.0SP55.
- Central View:** SYSTEMDB@SS1 (SYSTEM) SS1 - MDC single tenant - 2.0SP55. This view displays various tabs: Overview, Landscape, Alerts, Performance, Volumes, Configuration, System Information, Diagnosis Files, and Trace Configuration.
- Configuration Table:** A table showing configuration flags. The "multidb" section is expanded, showing:

Name	Default	System	Database - SS1	Host - hana-1
database_isolation	low	low		
enforce_ssl_database_replici	true			
mode	singledb	multidb		
reserved_instance_numbers	0			
singlenetanant	yes			
systemdb_reserved_memory	0			
systemdb_separated_sql_no	false			
systemdb_ssl_listeninterface	.all			
persistence				
persistent_memory				
public_hostname_resolution				
resource_tracking				
runtimedump				
self_watchdog				
spark_communication				
storage				
system_information				
system_landscape_hostname_v				
system_replication				
system replication_communic				
- Bottom Panels:** Properties and Error Log.

Automation example scripts

In this document, two scripts are used to further automate SnapCenter clone create and clone delete operations.

- The script `sc-system-refresh.sh` is used for the system refresh and the system clone workflow to execute mount and unmount operations for the HANA data volume as well as for recovery and shutdown operations of the HANA database.
- The script `sc-mount-volume.sh` is used for the system clone workflow to execute mount and unmount operations for the HANA shared volume.



The example scripts are provided as is and are not supported by NetApp. You can request the scripts via email to ng-sapcc@netapp.com.

Script `sc-system-refresh.sh`

The example script `sc-system-refresh.sh` is used to execute mount and unmount operations for SAP HANA data volumes as well as recovery and shutdown operations. The script is called with specific command-line options within the SnapCenter workflows clone create and clone delete, as shown in the following figure.

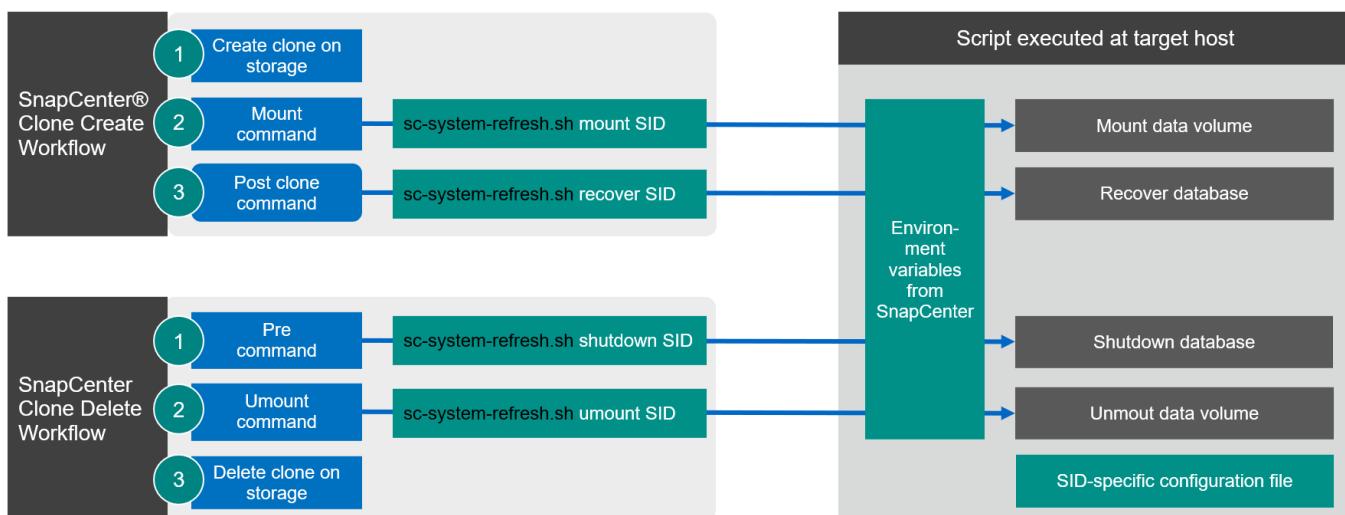
The script is generic and is configured with an SID-specific configuration file and environment variables, which are made available by SnapCenter when executing the script. The script and the configuration file must be available at the target host of the system refresh operation. If the script is used for multiple target hosts, you can provide an NFS share from which the script is made available to all target hosts.



The current version of the script supports single host systems with a single container, MDC single tenant, or MDC multiple tenant configurations. It does not support SAP HANA multiple-host systems.



The script supports HANA systems using NFS or Fibre Channel (FC) as a storage protocol.



Supported tenant recovery operations

As described in the section “[SAP HANA system refresh operation workflows using storage snapshot backups](#)” the possible tenant recovery operations at the target system depend on the tenant configuration of the source system. The script `sc-system-refresh.sh` supports all tenant recovery operations, which are possible dependent on the source system configuration, as shown in the following table.

If a different tenant name is required at the target system, the tenant must be renamed manually after the recovery operation.

HANA System	Tenant Configuration at Source System	Tenant Configuration at Target System
Single container	NA	NA
MDC single tenant	Source tenant name equal to source SID	Target tenant name is equal to target SID
MDC single tenant	Source tenant name not equal to source SID	Target tenant name is equal to source tenant name
MDC multiple tenants	Any tenant names	Only the first tenant is recovered and has the same name as the source tenant.

SID-specific configuration file

This script uses a configuration file to configure a few target system-specific parameters. The configuration file must have an SID-specific file name `sc-system-refresh- SID.cfg`.



The database user, which is configured with the `hdbuserstore` key for the target system, must exist in the source database and must have the correct rights to allow database recovery.

The configuration file parameters are shown in the following table.

Parameter		Description
KEY	For example:QS1KEY	SAP HANA <code>hdbuserstore</code> key, which should be used for the recovery operation of the target SAP HANA database. The key must be configured for the user <code><SID>adm</code> on the target host.
PROTOCOL	NFS or FCP	Storage protocol, that is used to connect the HANA database data volume.

The following output shows an example configuration file for an SAP HANA system with `SID=QS1`.

```

ss1adm@hana-1:/mnt/sapcc-share/SAP-System-Refresh> cat sc-system-refresh-
QS1.cfg
# -----
# Target database specific parameters
# -----
# hdbuserstore key, which should be used to connect to the target database
KEY="QS1KEY"
# Used storage protocol, NFS or FCP
PROTOCOL="NFS"
ss1adm@hana-1:/mnt/sapcc-share/SAP-System-Refresh>

```

SnapCenter environment variables

SnapCenter provides a set of environment variables that are available within the script that is executed at the target host. The script uses these variables to determine relevant configuration settings.

- The script variable `HANA_ARCHITECTURE` is used to determine the required recovery operation, either for single container or MDC systems.
 - Derived from `HANA_DATABASE_TYPE` environmental variable
 - For example: `MDC\SS1_HANA_DATABASE_TYPE=MULTIPLE_CONTAINERS`
- the script variables `TENANT_LIST`, `SOURCE_TENANT`, and `SOURCE_SID` are used to determine the target tenant name for a recovery operation.
 - Derived from `TENANT_DATABASE_NAMES` environmental variable
 - For example: `MDC\SM1_TENANT_DATABASE_NAMES=TENANT1,TENANT2`
- The script variable `STORAGE`, `JUNCTION_PATH` is used for the mount operation.
 - Derived from `CLONED_VOLUMES_MOUNT_PATH` environmental variable
 - For example:

```

CLONED_VOLUMES_MOUNT_PATH=192.168.175.117:/SS1_data_mnt00001_Clone_0511220
6115489411

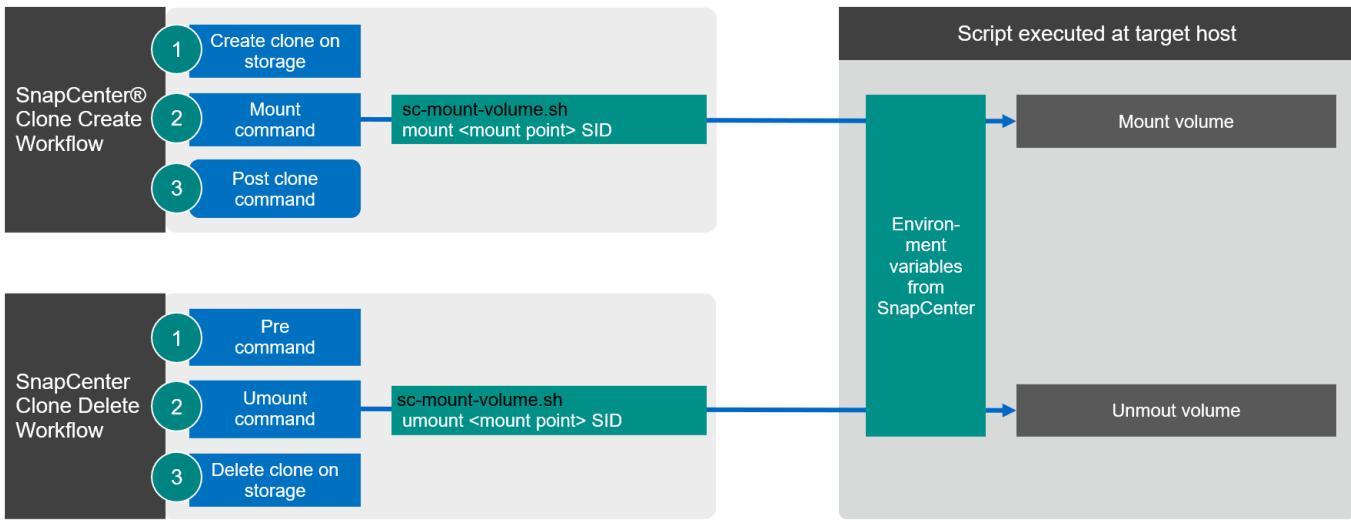
```

Script `sc-mount-volume.sh`

The example script `sc-mount-volume.sh` is used to execute mount and unmount for any volume. The script is used to mount the HANA shared volume with the SAP HANA system clone operation. The script is called with specific command-line options within the SnapCenter workflows clone create and clone delete, as shown in the following figure.



The script supports HANA systems using NFS as a storage protocol.



SnapCenter environment variables

SnapCenter provides a set of environment variables that are available within the script that is executed at the target host. The script uses these variables to determine relevant configuration settings.

- The script variable `STORAGE`, `JUNCTION_PATH` is used for the mount operation.
 - Derived from `CLONED_VOLUMES_MOUNT_PATH` environment variable.
 - For example:

```
CLONED_VOLUMES_MOUNT_PATH=192.168.175.117:/SS1_shared_Clone_05112206115489
411
```

Script to get SnapCenter environment variables

If the automation scripts should not be used and the steps should be executed manually, you need to know the storage system junction path of the FlexClone volume. The junction path is not visible within SnapCenter, so you need to either look up the junction path directly at the storage system, or you could use a simple script that provides the SnapCenter environment variables at the target host. This script needs to be added as a mount operation script within the SnapCenter clone create operation.

```
ss1adm@hana-1:/mnt/sapcc-share/SAP-System-Refresh> cat get-env.sh
#!/bin/bash
rm /tmp/env-from-sc.txt
env > /tmp/env-from-sc.txt
ss1adm@hana-1:/mnt/sapcc-share/SAP-System-Refresh>
```

Within the `env-from-sc.txt` file, look for the variable `CLONED_VOLUMES_MOUNT_PATH` to get the storage system IP address and junction path of the FlexClone volume.

For example:

```
CLONED_VOLUMES_MOUNT_PATH=192.168.175.117:/SS1_data_mnt00001_Clone_0511220  
6115489411
```

SAP HANA system refresh with SnapCenter

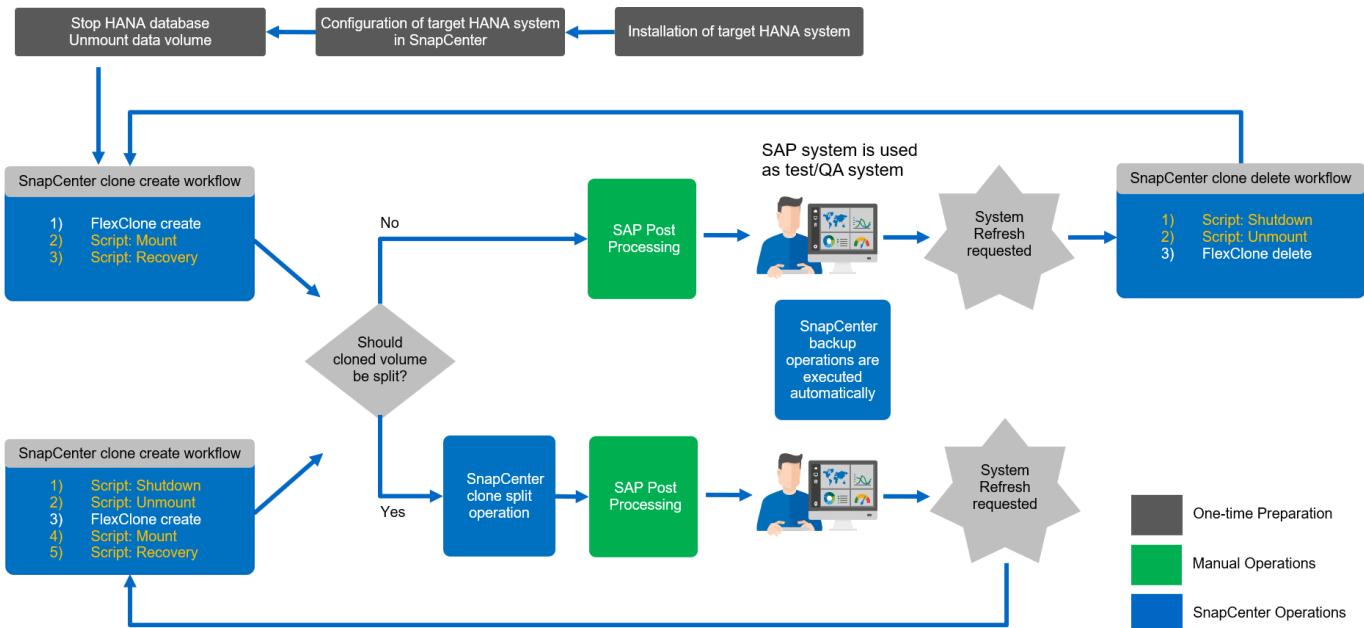
The following section provides a step-by-step description for the different system refresh operation options of an SAP HANA database.



The lab setup and validation does not include SAP application services. However, the required steps for SAP application services are highlighted within the documentation.

Within this section, the following scenarios are covered.

- SAP HANA system refresh without a clone split operation.
 - Cloning from primary storage with the tenant name equal to the SID
 - Cloning from offsite backup storage with the tenant name equal to the SID
 - Cloning from primary storage with the tenant name not equal to the SID
 - Clone delete operation
- SAP HANA system refresh with a clone split operation
 - Cloning from primary storage with the tenant name equal to the SID
 - Clone split operation



Prerequisites and limitations

The workflows described in the following sections have a few prerequisites and limitations regarding the HANA system architecture and the SnapCenter configuration.

- The described workflows are valid for single host SAP HANA MDC systems with single or multiple tenants. SAP HANA multiple host systems are not supported with the automation scripts.
- The SnapCenter HANA plug-in must be deployed on the target host to enable the execution of automation scripts. It is not required to have the HANA plug-in installed on the HANA source system host.
- The described workflow is only valid for the SnapCenter 4.6 P1 release or higher. Older releases have slightly different workflows.
- The workflows are valid for HANA systems using NFS and FCP.

Lab setup

The following figure shows the lab setup that was used for the different system refresh operation options.

1. Cloning from primary storage or offsite backup storage; the tenant name is equal to the SID.
 - a. Source HANA system: SS1 with tenant SS1
 - b. Target HANA system: QS1 with tenant QS1
2. Cloning from primary storage; the tenant name is not equal to the SID.
 - a. Source HANA system: SM1 with Tenant1 and Tenant2
 - b. Target HANA system: QS1 with Tenant1

The following software versions were used:

- SnapCenter 4.6 P1
- HANA systems: HANA 2.0 SPS6 rev.61 and HANA 2.0 SPS5 rev.52
- VMware 6.7.0
- SLES 15 SP2
- ONTAP 9.7P7

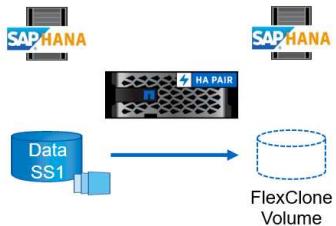
All HANA systems were configured based on the configuration guide [SAP HANA on NetApp AFF systems with NFS](#). SnapCenter and the HANA resources were configured based on the best practice guide [SAP HANA Backup and Recovery with SnapCenter](#).

Cloning from primary or offsite backup storage, Tenant name = SID

Source System
hana-1
SID=SS1
Tenant=SS1

Target System
hana-7
SID=QS1
Tenant=QS1

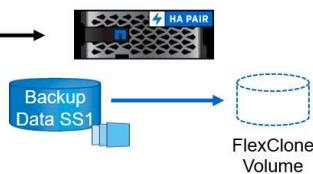
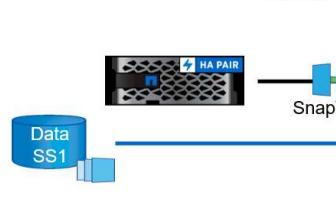
Target System
hana-7
SID=QS1
Tenant=QS1



Cloning from primary storage, Tenant name != SID

Source System
hana-2
SID=SM1
Tenants=Tenant1, Tenant2

Target System
hana-7
SID=QS1
Tenant=Tenant1



Initial one-time preparation steps

For initial step, the target HANA system and SAP application services must be installed, and the HANA system must then be configured within SnapCenter.

1. Installation of HANA target system and SAP application services
2. Configuration of HANA system in SnapCenter as described in [TR-4614: SAP HANA Backup and Recovery with SnapCenter](#)
 - a. Configuration of HANA database user for SnapCenter backup operations. This user must be identical at the source and the target system.
 - b. Configuration of hdbuserstore key with above backup user.
 - c. Deployment of SnapCenter HANA plug-in at target host. The HANA system is auto-discovered by SnapCenter.
 - d. Configuration of HANA resource protection (optional).

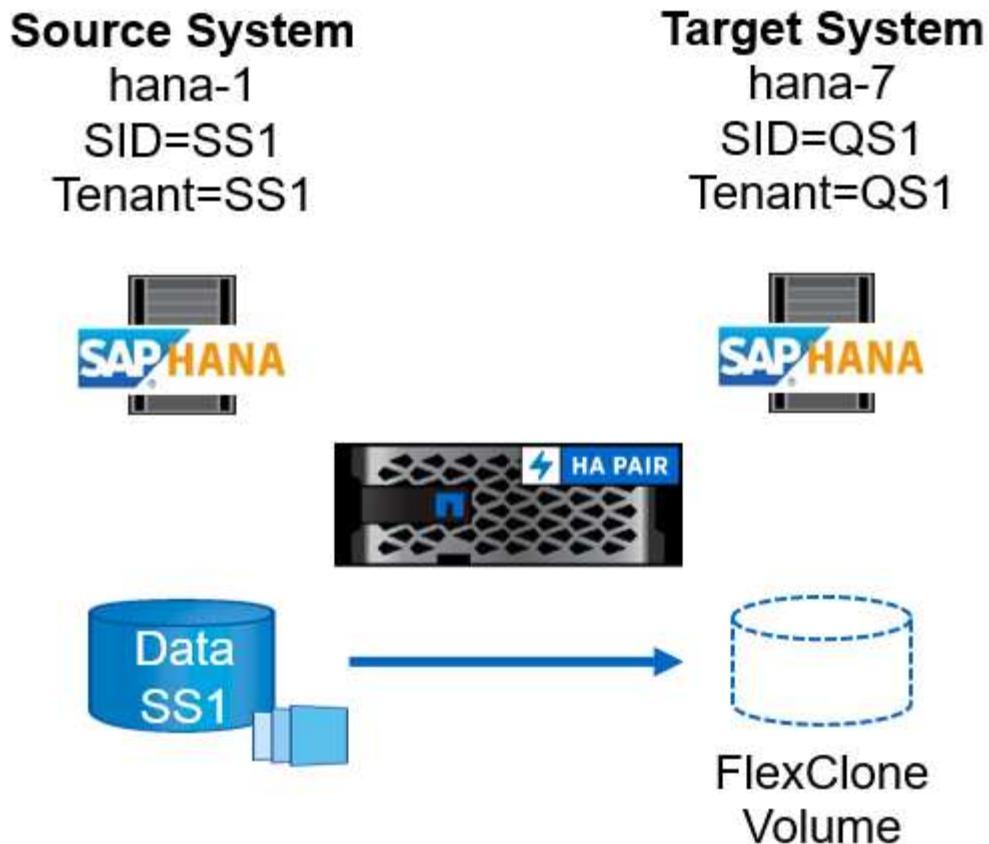
The first SAP system refresh operation after the initial installation is prepared with the following steps:

1. Shutdown SAP application services and target HANA system.
2. Unmount HANA data volume.

Cloning from primary storage with tenant name equal to SID

This section describes the HANA system refresh workflow in which the tenant name at the source and the target system is identical to the SID. The storage cloning is executed at the primary storage and further automated using the script `sc-system-refresh.sh`.

The following figure depicts cloning from primary storage with tenant name = SID.



The workflow consists of the following steps:

1. If the target HANA system has been protected in SnapCenter, then protection must first be removed.
2. Open the SnapCenter cloning wizard.
 - a. Select Snapshot backup from the source HANA system SS1.
 - b. Select the target host and provide the storage network interface for it.
 - c. Provide the SID of the target system (in our example, this is QS1).
 - d. Provide the script for the mount and post-clone operation.
3. To perform a SnapCenter cloning operation, complete the following steps:
 - a. Create a FlexClone volume based on the selected Snapshot backup of the source HANA system.
 - b. Export the FlexClone volume to the target host storage network interface.
 - c. Execute the mount operation script.
 - The FlexClone volume is mounted at the target host as a data volume.
 - Change ownership to qs1adm.
 - d. Execute the post-clone operation script.
 - Recovery of system database.
 - Recovery of tenant database with tenant name = QS1.
4. Start the SAP application services.
5. Optionally, protect the target HANA resource in SnapCenter.

The following screenshots show the required steps.

1. Select a Snapshot backup from the source system SS1, and click Clone from Backup.

The screenshot shows the NetApp SnapCenter interface for system SS1. In the 'Manage Copies' section, there are two categories: 'Local copies' (14 Backups, 0 Clones) and 'Vault copies' (10 Backups, 0 Clones). At the bottom right of the interface, there is a prominent 'Clone From Backup' button.

2. Select the host where the target system QS1 is installed. Enter QS1 as the target SID. The NFS export IP address must be the storage network interface of the target host.



The target SID that is entered here controls how SnapCenter manages the clone. If the target SID is already configured in SnapCenter on the target host, SnapCenter just assigns the clone to the host. If the SID is not configured on the target host, SnapCenter creates a new resource.

The screenshot shows the 'Clone From Backup' dialog box. The 'Location' tab is selected. In the 'Select the host to create the clone' section, the 'Plug-in host' is set to 'hana-7.sapcc.stl.netapp.com', the 'Target Clone SID' is set to 'QS1', and the 'NFS Export IP Address' is set to '192.168.175.75'. The other tabs (Scripts, Notification, Summary) are visible but not selected.

3. Enter the mount and post-clone scripts with the required command-line options.

Clone From Backup X

1 Location

2 Scripts

3 Notification

4 Summary

Enter optional commands to run before performing a clone operation i

Pre clone command

Enter optional commands to mount a file system to a host i

Mount command
/mnt/sapcc-share/SAP-System-Refresh/sc-system-refresh.sh
mount QS1

Enter optional commands to run after performing a clone operation i

Post clone command
/mnt/sapcc-share/SAP-System-Refresh/sc-system-refresh.sh
recover QS1

⚠ Configure an SMTP Server to send email notifications for Clone jobs by going to [Settings>Global Settings>Notification Server Settings](#). X

Previous Next

4. The Job Details screen in SnapCenter shows the progress of the operation. The job details also show that the overall runtime including database recovery has been less than 2 minutes.

Job Details

Clone from backup 'SnapCenter_LocalSnap_Hourly_04-21-2022_03.00.01.7085'

✓ ▾ Clone from backup 'SnapCenter_LocalSnap_Hourly_04-21-2022_03.00.01.7085'

✓ ▾ hana-7.sapcc.stl.netapp.com

✓ ▾ Clone

✓ ▶ Application Pre Clone

✓ ▶ Storage Clone

✓ ▶ Mount Commands

✓ ▶ Application Post Clone

✓ ▶ Post Clone Create Commands

✓ ▶ Register Clone Metadata

✓ ▶ Application Clean-Up

✓ ▶ Data Collection

✓ ▶ Agent Finalize Workflow

Task Name: Clone Start Time: 04/21/2022 5:19:58 AM End Time: 04/21/2022 5:22:22 AM

[View Logs](#)

[Cancel Job](#)

[Close](#)

5. The logfile of the `sc-system-refresh.sh` script shows the different steps that were executed for the mount and the recovery operation. The script automatically detected that the source system had a single tenant, and the name was identical to the source system SID SS1. The script therefore recovered the tenant with the tenant name QS1.



If the source tenant name is identical to the source tenant SID but the default tenant configuration flag, as described in the section “[SAP HANA system refresh operation workflows using storage snapshot backups](#),” is not set anymore, the recovery operation fails and must be performed manually.

```
20220421045731###hana-7###sc-system-refresh.sh: Version: 1.1
20220421045731###hana-7###sc-system-refresh.sh: Unmounting data volume.
20220421045731###hana-7###sc-system-refresh.sh: umount
/hana/data/QS1/mnt00001
20220421045731###hana-7###sc-system-refresh.sh: Deleting /etc/fstab
entry.
20220421045731###hana-7###sc-system-refresh.sh: Data volume unmounted
successfully.
20220421052009###hana-7###sc-system-refresh.sh: Version: 1.1
20220421052009###hana-7###sc-system-refresh.sh: Adding entry in
/etc/fstab.
20220421052009###hana-7###sc-system-refresh.sh:
192.168.175.117:/SS1_data_mnt00001_Clone_0421220520054605
/hana/data/QS1/mnt00001 nfs
rw,vers=3,hard,timeo=600,rsize=1048576,wsize=1048576,intr,noatime,nolock
0 0
20220421052009###hana-7###sc-system-refresh.sh: Mounting data volume:
mount /hana/data/QS1/mnt00001.
20220421052009###hana-7###sc-system-refresh.sh: Data volume mounted
successfully.
20220421052009###hana-7###sc-system-refresh.sh: Change ownership to
qs1adm.
20220421052019###hana-7###sc-system-refresh.sh: Version: 1.1
20220421052019###hana-7###sc-system-refresh.sh: Recover system database.
20220421052019###hana-7###sc-system-refresh.sh:
/usr/sap/QS1/HDB11/exe/Python/bin/python
/usr/sap/QS1/HDB11/exe/python_support/recoverSys.py --command "RECOVER
DATA USING SNAPSHOT CLEAR LOG"
20220421052049###hana-7###sc-system-refresh.sh: Wait until SAP HANA
database is started ....
20220421052049###hana-7###sc-system-refresh.sh: Status: GRAY
20220421052059###hana-7###sc-system-refresh.sh: Status: GRAY
20220421052110###hana-7###sc-system-refresh.sh: Status: GRAY
20220421052120###hana-7###sc-system-refresh.sh: Status: GRAY
20220421052130###hana-7###sc-system-refresh.sh: Status: GREEN
20220421052130###hana-7###sc-system-refresh.sh: SAP HANA database is
started.
20220421052130###hana-7###sc-system-refresh.sh: Source Tenant: SS1
20220421052130###hana-7###sc-system-refresh.sh: Source SID: SS1
20220421052130###hana-7###sc-system-refresh.sh: Source system has a
single tenant and tenant name is identical to source SID: SS1
```

```

20220421052130###hana-7###sc-system-refresh.sh: Target tenant will have
the same name as target SID: QS1.
20220421052130###hana-7###sc-system-refresh.sh: Recover tenant database
QS1.
20220421052130###hana-7###sc-system-refresh.sh:
/usr/sap/QS1/SYS/exe/hdb/hdbsql -U QS1KEY RECOVER DATA FOR QS1 USING
SNAPSHOT CLEAR LOG
0 rows affected (overall time 35.259489 sec; server time 35.257522 sec)
20220421052206###hana-7###sc-system-refresh.sh: Checking availability of
Indexserver for tenant QS1.
20220421052206###hana-7###sc-system-refresh.sh: Recovery of tenant
database QS1 successfully finished.
20220421052206###hana-7###sc-system-refresh.sh: Status: GREEN

```

- When the SnapCenter job is finished, the clone is visible within the topology view of the source system.

The screenshot shows the NetApp SnapCenter SAP HANA topology view. On the left, a sidebar lists systems: QS1, SM1, SS1, SS2, and SS2. The main area displays a summary card with 26 Backups, 24 Snapshot based backups, 2 File-Based backups, and 1 Clone. Below this, a 'Manage Copies' section shows 14 Backups and 1 Clone under 'Local copies', and 10 Backups and 0 Clones under 'Vault copies'. A table titled 'Primary Clone(s)' shows a single entry: Clone SID QS1, Clone Host hana-7.sapcc.stl.netapp.com, Clone Name hana-1_sapcc_stl_netapp_com_hana_MDC_SS1_clone_28750_MDC_SS1_04-21-2022_05.20.02, Start Date 04/21/2022 5:19:57 AM, and End date 04/21/2022 5:22:08 AM.

- The HANA database is now running, and the SAP application services can be started.
- If you want to protect the target HANA system, you must configure resource protection in SnapCenter.

The screenshot shows the NetApp SnapCenter SAP HANA resource protection view. The left sidebar includes options like Dashboard, Resources, Monitor, Reports, Hosts, Storage Systems, Settings, and Alerts. The main table lists resources across two hosts:

	System	System ID (SID)	Tenant Databases	Replication	Plug-in Host	Resource Groups	Policies	Last backup	Overall Status
hana-1	QS1	QS1	QS1	None	hana-1.sapcc.stl.netapp.com	LocalSnap	BlockIntegrityCheck LocalSnap LocalSnapAndSnapVault LocalSnap-OnDemand	04/21/2022 4:01:01 AM	Backup succeeded
	SS1	SS1	SS1	None	hana-1.sapcc.stl.netapp.com			04/21/2022 5:01:02 AM	Backup succeeded
hana-2	SS2	SS2	SS2	Enabled (Primary)	hana-2.sapcc.stl.netapp.com	SS2 - HANA System Replicatio	BlockIntegrityCheck LocalSnapKeep2	04/21/2022 4:57:22 AM	Backup succeeded
	SS2	SS2	SS2	Enabled (Secondary)	hana-3.sapcc.stl.netapp.com			04/11/2022 2:57:21 AM	Backup succeeded

Cloning from offsite backup storage with tenant name equal to SID

This section describes the HANA system refresh workflow for which the tenant name at the source and the target system is identical to the SID. Storage cloning is executed at the offsite backup storage and further automated using the script `sc-system-refresh.sh`.

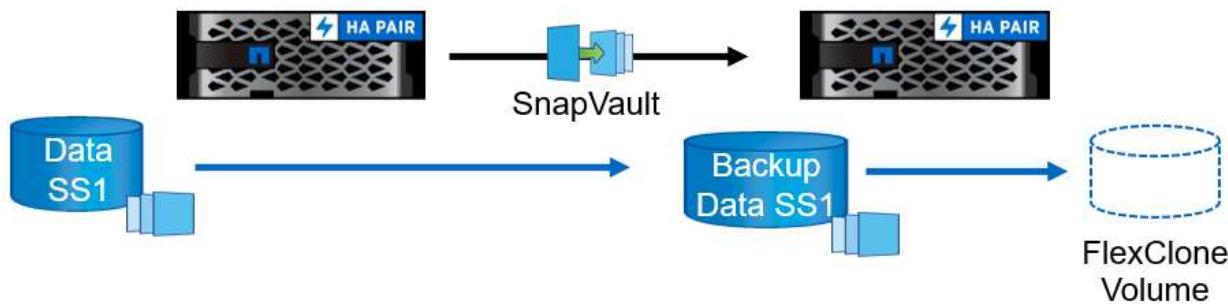
Source System

hana-1
SID=SS1
Tenant=SS1



Target System

hana-7
SID=QS1
Tenant=QS1



The only difference in the HANA system refresh workflow between primary and offsite backup storage cloning is the selection of the Snapshot backup in SnapCenter. For offsite backup storage cloning, the secondary backups must be selected first.

The screenshot shows the NetApp SnapCenter interface. On the left, a sidebar lists SAP HANA systems: QS1, SM1, SS1, SS2, and SS2. The SS1 system is selected. In the main pane, under 'Manage Copies', there are two sections: 'Local copies' (14 Backups, 0 Clones) and 'Vault copies' (9 Backups). A dashed arrow points from the 'Local copies' section to the 'Vault copies' section, indicating a selection action. Below this, a table titled 'Secondary Vault Backup(s)' lists multiple backup entries, each with a 'Count' of 1 and an 'End Date' ranging from May 11, 2022, to May 12, 2022. A 'Clone From Backup' button is visible at the top right of the table area.

Backup Name	Count	IF	End Date
SnapCenter_LocalSnapAndSnapVault_Daily_05-11-2022_05.00.02.9288	1		05/11/2022 5:01:01 AM
SnapCenter_LocalSnapAndSnapVault_Daily_05-10-2022_05.00.02.9444	1		05/10/2022 5:01:01 AM
SnapCenter_LocalSnapAndSnapVault_Daily_05-09-2022_05.00.02.9432	1		05/09/2022 5:01:01 AM
SnapCenter_LocalSnapAndSnapVault_Daily_05-08-2022_05.00.02.9894	1		05/08/2022 5:01:01 AM
SnapCenter_LocalSnapAndSnapVault_Daily_05-07-2022_05.00.02.9253	1		05/07/2022 5:01:01 AM
SnapCenter_LocalSnapAndSnapVault_Daily_05-06-2022_05.00.02.9333	1		05/06/2022 5:01:01 AM
SnapCenter_LocalSnapAndSnapVault_Daily_05-05-2022_05.00.03.8844	1		05/05/2022 5:01:02 AM
SnapCenter_LocalSnapAndSnapVault_Daily_05-04-2022_05.00.03.0342	1		05/04/2022 5:01:01 AM
SnapCenter_LocalSnapAndSnapVault_Daily_05-03-2022_05.00.02.9761	1		05/03/2022 5:01:01 AM

If there are multiple secondary storage locations for the selected backup, you need to select the required destination volume.

Clone From Backup

1 Location

Select the host to create the clone

Plug-in host	hana-7.sapcc.stl.netapp.com	i
Target Clone SID	QS1	i
NFS Export IP Address	192.168.175.75	i

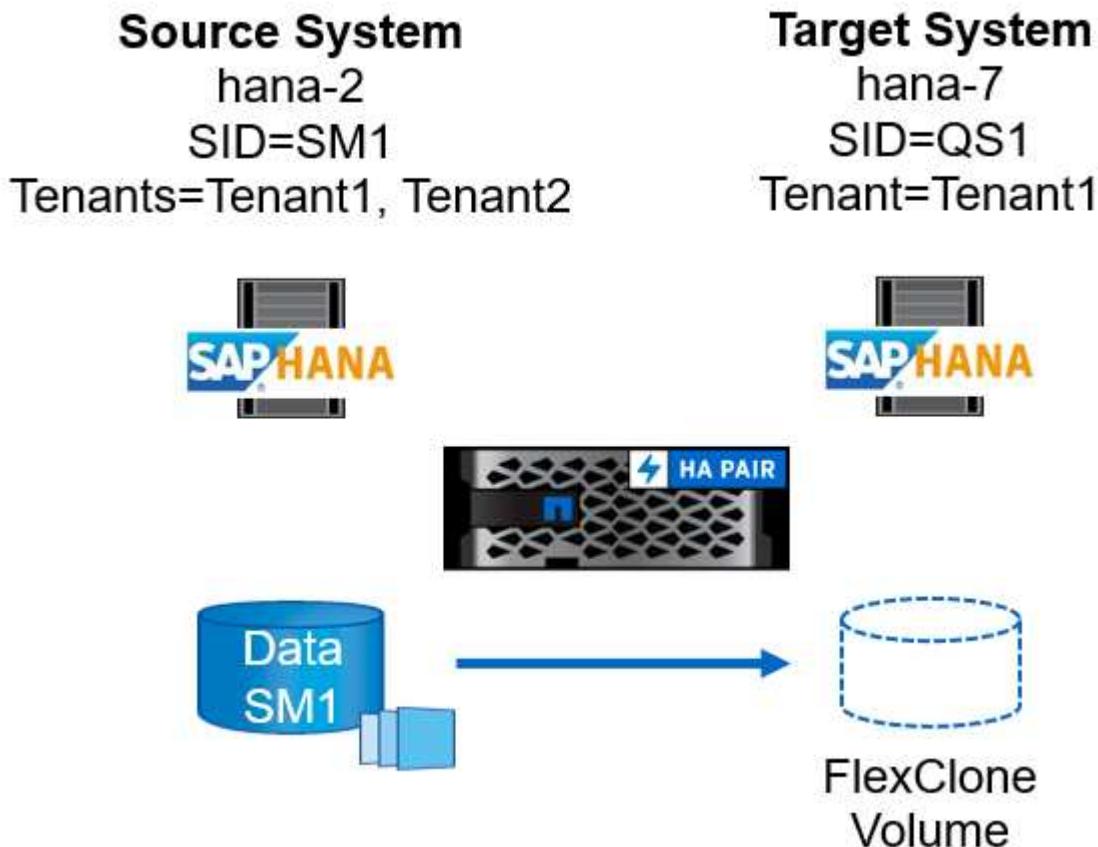
Secondary storage location : Snap Vault / Snap Mirror

Source Volume	Destination Volume
hana-primary.sapcc.stl.netapp.com:SS1_data_mnt00001	hana-backup.sapcc.stl.netapp.com:SS1_data▼

All subsequent steps are identical to the workflow for cloning from primary storage as described in the section “[Cloning from primary storage with tenant name equal to SID](#).”

Cloning from primary storage with tenant name not equal to SID

This section describes the HANA system refresh workflow in which the tenant name at the source is not equal to the SID. Storage cloning is executed at the primary storage and further automated using the script `sc-system-refresh.sh`.



The required steps in SnapCenter are identical to what has been described in the section “[Cloning from primary storage with tenant name equal to SID](#).”] The difference is in the tenant recovery operation within the script sc-system-refresh.sh.

If the script detects that the source system tenant name is different to the source system SID, the tenant recovery at the target system is executed using the same tenant name as the source tenant. If the target tenant name should have a different name, the tenant must be renamed manually afterwards.



If the source system has more than one tenant, the script only recovers the first tenant. Additional tenants must be recovered manually.

```

20201118121320##hana-7###sc-system-refresh.sh: Adding entry in
/etc/fstab.
20201118121320##hana-7###sc-system-refresh.sh:
192.168.175.117:/Scc71107fe-3211-498a-b6b3-d7d3591d7448
/hana/data/QS1/mnt00001 nfs
rw,vers=3,hard,timeo=600,rsize=1048576,wszie=1048576,intr,noatime,nolock 0
0
20201118121320##hana-7###sc-system-refresh.sh: Mounting data volume:
mount /hana/data/QS1/mnt00001.
20201118121320##hana-7###sc-system-refresh.sh: Data volume mounted
successfully.
20201118121320##hana-7###sc-system-refresh.sh: Change ownership to
qs1adm.
20201118121330##hana-7###sc-system-refresh.sh: Recover system database.
20201118121330##hana-7###sc-system-refresh.sh:
/usr/sap/QS1/HDB11/exe/Python/bin/python
/usr/sap/QS1/HDB11/exe/python_support/recoverSys.py --command "RECOVER
DATA USING SNAPSHOT CLEAR LOG"
20201118121402##hana-7###sc-system-refresh.sh: Wait until SAP HANA
database is started ....
20201118121402##hana-7###sc-system-refresh.sh: Status: GRAY
20201118121412##hana-7###sc-system-refresh.sh: Status: GREEN
20201118121412##hana-7###sc-system-refresh.sh: SAP HANA database is
started.
20201118121412##hana-7###sc-system-refresh.sh: Source system contains
more than one tenant, recovery will only be executed for the first tenant.
20201118121412##hana-7###sc-system-refresh.sh: List of tenants:
TENANT1, TENANT2
20201118121412##hana-7###sc-system-refresh.sh: Recover tenant database
TENANT1.
20201118121412##hana-7###sc-system-refresh.sh:
/usr/sap/QS1/SYS/exe/hdb/hdbsql -U QS1KEY RECOVER DATA FOR TENANT1 USING
SNAPSHOT CLEAR LOG
0 rows affected (overall time 34.777174 sec; server time 34.775540 sec)
20201118121447##hana-7###sc-system-refresh.sh: Checking availability of
Indexserver for tenant TENANT1.
20201118121447##hana-7###sc-system-refresh.sh: Recovery of tenant
database TENANT1 successfully finished.
20201118121447##hana-7###sc-system-refresh.sh: Status: GREEN

```

Clone delete operation

A new SAP HANA system refresh operation is started by cleaning up the target system using the SnapCenter clone delete operation.



SAP application services are not stopped with the SnapCenter clone delete workflow. The script could either be extended within the shutdown function, or the application services must be stopped manually.

If the target HANA system has been protected in SnapCenter, the protection must be removed first. Within the topology view of the target system, click Remove Protection.

SAP HANA

QS1 Topology

Manage Copies

Source of clone: SS1

Local copies: 1 Backup, 0 Clones

Primary Backup(s)

Backup Name: SnapCenter_hana-7_LocalSnap_Hourly_04-21-2022_05.50.48.5736

Count: 1

End Date: 04/21/2022 5:51:47 AM

Remove Protection

Do you want to remove protection for this resource?

Delete backups and detach policies associated with this resource

Cancel OK

The clone delete workflow is now executed with the following steps:

1. Select the clone within the topology view of the source system and click delete.

SAP HANA

SS1 Topology

Manage Copies

Source of clone: SS1

Local copies: 14 Backups, 1 Clone

Vault copies: 10 Backups, 0 Clones

Primary Clone(s)

Clone SID: QS1

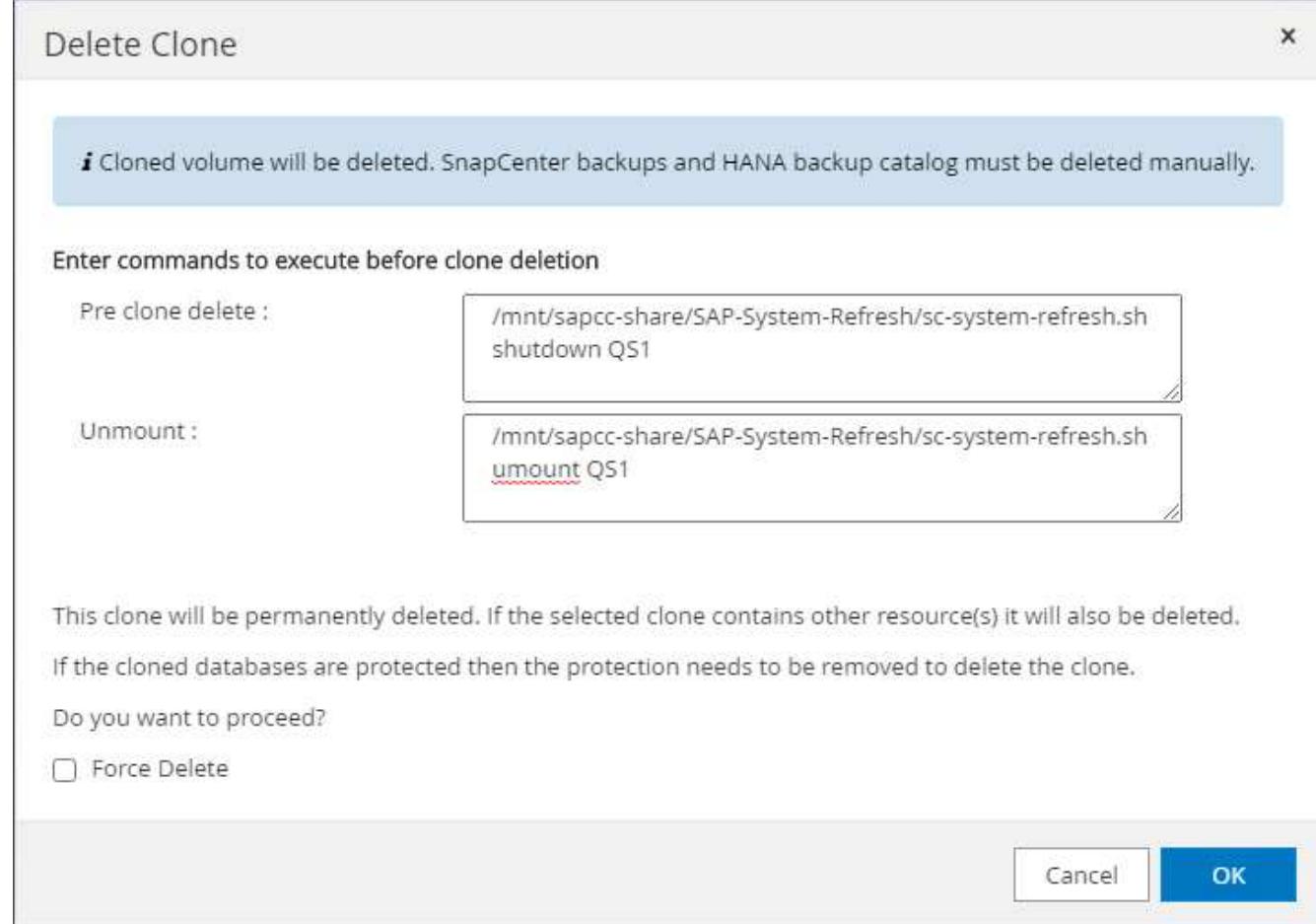
Clone Host: hana-7.sapcc.stl.netapp.com

Clone Name: hana-1_sapcc_stl_netapp_com_hana_MDC_SS1_clone_28750_MDC_SS1_04-21-2022_05.20.02

Start Date: 04/21/2022 5:19:57 AM

End date: 04/21/2022 5:22:08 AM

2. Enter the pre-clone and unmount scripts with the required command line options.



3. The job details screen in SnapCenter shows the progress of the operation.

Job Details

Deleting clone 'hana-1_sapcc_stl_netapp_com_hana_MDC_SS1_clone_28750_MDC_SS1_04-21-2022_05.20.02'

✓ ▾ Deleting clone 'hana-1_sapcc_stl_netapp_com_hana_MDC_SS1_clone_28750_MDC_SS1_04-21-2022_05.20.02'

✓ ▾ hana-7.sapcc.stl.netapp.com

✓ ▾ Delete Clone

✓ ▶ Validate Plugin Parameters

✓ ▶ Delete Pre Clone Commands

✓ ▶ Unmount Commands

✓ ▶ Unmount Filesystem

✓ ▶ Delete Storage Clone

✓ ▶ Unregister Clone Metadata

✓ ▶ Agent Finalize Workflow

✓ ▶ (Job 28767) (Job 28767) read UnmountBackup

ⓘ Task Name: Delete Clone Start Time: 04/21/2022 7:06:42 AM End Time: 04/21/2022 7:07:58 AM

[View Logs](#)

[Cancel Job](#)

[Close](#)

4. The log file of the `sc-system-refresh.sh` script shows the shutdown and unmount operation steps.

```

20220421070643###hana-7###sc-system-refresh.sh: Version: 1.1
20220421070643###hana-7###sc-system-refresh.sh: Stopping HANA database.
20220421070643###hana-7###sc-system-refresh.sh: sapcontrol -nr 11
-function StopSystem HDB
21.04.2022 07:06:43
StopSystem
OK
20220421070643###hana-7###sc-system-refresh.sh: Wait until SAP HANA
database is stopped ....
20220421070643###hana-7###sc-system-refresh.sh: Status: GREEN
20220421070653###hana-7###sc-system-refresh.sh: Status: GREEN
20220421070703###hana-7###sc-system-refresh.sh: Status: GREEN
20220421070714###hana-7###sc-system-refresh.sh: Status: GREEN
20220421070724###hana-7###sc-system-refresh.sh: Status: GRAY
20220421070724###hana-7###sc-system-refresh.sh: SAP HANA database is
stopped.
20220421070728###hana-7###sc-system-refresh.sh: Version: 1.1
20220421070728###hana-7###sc-system-refresh.sh: Unmounting data volume.
20220421070728###hana-7###sc-system-refresh.sh: umount
/hana/data/QS1/mnt00001
20220421070728###hana-7###sc-system-refresh.sh: Deleting /etc/fstab
entry.
20220421070728###hana-7###sc-system-refresh.sh: Data volume unmounted
successfully.

```

5. The SAP HANA refresh operation can now be started again using the SnapCenter clone create operation.

SAP HANA system refresh with clone split operation

If the target system of the system refresh operation is used for a longer timeframe (longer than 1-2 weeks), then there are typically not any FlexClone capacity savings. Also, the dependent Snapshot backup of the source system is blocked and not deleted by SnapCenter retention management.

Therefore, in most cases it makes sense to split the FlexClone volume as part of the system refresh operation.

- i The clone split operation does not block the use of the cloned volume and can therefore be executed at any time while the HANA database is in use.
- i With a clone split operation, SnapCenter deletes all backups created at the target system in the SnapCenter repository. For NetApp AFF systems, a clone split operation keeps the Snapshot copies on the volume; it is only for FAS systems that Snapshot copies are deleted by ONTAP. This is a known bug in SnapCenter that will be addressed in future releases.

The clone split workflow in SnapCenter is initiated in the topology view of the source system by selecting the clone and clicking on clone split.

A preview is shown in the next screen, which provides information on the required capacity for the split volume.

Clone Split hana-1_sapcc_stl_netapp_com_hana_MDC_SS1_clone_28768_MDC_SS1_04-21-2022_07.23.34 x

Info The clone will require 5218 MB of space. Clone split will happen on resource(s) - QS1. Snapshot backups will be deleted on storage, SnapCenter backups and HANA backup catalog must be deleted manually.

Resource name	QS1
Host Name or IP	hana-1.sapcc.stl.netapp.com

Clone split estimates ?

Volume	Aggregate	Required	Available	Storage Status
SS1_data_mnt00001_Clone_0421220723371897	hana-primary.sapcc.stl.netapp.com:aggr2_1	5218 MB	3028 GB	✓

Email notifications ?

Cancel Start

The SnapCenter job log shows the progress of the clone split operation.

Job Details

Clone Split Start of Resource 'hana-1_sapcc_stl_ne.....MDC_SS1_clone_28768_MDC_SS1_04-21-2022_07.23.34'

- ✓ ▾ Clone Split Start of Resource 'hana-1_sapcc_stl_netapp_com_hana_MDC_SS1_clone_28768_MDC_SS1_04-21-2022_07.23.34'
- ✓ ▾ SnapCenter.sapcc.stl.netapp.com
 - ✓ ▶ Volume Clone Estimate
 - ✓ ▶ Volume Clone Split Start
 - ✓ ▶ Delete Backups of Clone
 - ✓ ▾ Volume Clone Split Status
 - ✓ ▶ Clone Split Status for volume SS1_data_mnt00001_Clone_0421220723371897 is 'In Progress'
 - ✓ ▶ Clone Split Status for volume SS1_data_mnt00001_Clone_0421220723371897'Completed'
 - ✓ ▶ Register Clone Split
 - ✓ ▶ Data Collection
 - ✓ ▶ Send EMS Messages

Task Name: Volume Clone Split Status Start Time: 04/21/2022 7:51:16 AM End Time:

[View Logs](#)

[Cancel Job](#)

[Close](#)

When going back to the topology view of the source system, the clone is not visible anymore. The split volume is now independent from the Snapshot backup of the source system.

System		System ID (SID)	Tenant Databases	Replication	Plug-in Host	Resource Groups	Policies	Last backup	Overall Status
QS1		QS1	QS1	None	hana-7.sapcc.stl.netapp.com	LocalSnap	BlockIntegrityCheck LocalSnap LocalSnapAndSnapVault LocalSnapOnDemand	04/21/2022 7:30:50 AM	Backup succeeded
SM1		SM1	TENANT1	None	hana-2.sapcc.stl.netapp.com	LocalSnap	BlockIntegrityCheck LocalSnap LocalSnapAndSnapVault LocalSnapOnDemand	04/21/2022 4:01:01 AM	Backup succeeded
SS1		SS1	SS1	None	hana-1.sapcc.stl.netapp.com	SS2 - HANA System Replication	BlockIntegrityCheck LocalSnapKeep2	04/21/2022 7:01:01 AM	Backup succeeded
SS2		SS2	SS2	Enabled (Primary)	hana-3.sapcc.stl.netapp.com	SS2 - HANA System Replication	BlockIntegrityCheck LocalSnapKeep2	04/21/2022 7:57:22 AM	Backup succeeded
SS2		SS2	SS2	Enabled (Secondary)	hana-4.sapcc.stl.netapp.com	SS2 - HANA System Replication	BlockIntegrityCheck LocalSnapKeep2	04/11/2022 2:57:21 AM	Backup succeeded

Backup Name	Count	End Date
SnapCenter_LocalSnap_Hourly_04-21-2022_07.00.02.7865	1	04/21/2022 7:01:01 AM
SnapCenter_LocalSnapAndSnapVault_Daily_04-21-2022_05.00.02.8215	1	04/21/2022 5:01:02 AM
SnapCenter_LocalSnap_Hourly_04-21-2022_03.00.01.7085	1	04/21/2022 3:01:00 AM
SnapCenter_LocalSnap_Hourly_04-20-2022_23.00.01.7142	1	04/20/2022 11:01:00 PM
SnapCenter_LocalSnap_Hourly_04-20-2022_19.00.01.9499	1	04/20/2022 7:01:00 PM

The refresh workflow after a clone split operation looks slightly different than the operation without clone split. After a clone split operation, there is no clone delete operation required because the target data volume is not a FlexClone volume anymore.

The workflow consists of the following steps:

1. If the target HANA system has been protected in SnapCenter, the protection must be removed first.
2. Enter the SnapCenter cloning wizard.
 - a. Select the Snapshot backup from the source HANA system SS1.
 - b. Select the target host and provide the storage network interface of the target host.
 - c. Provide the script for the pre-clone, mount, and post-clone operations.
3. SnapCenter cloning operation.
 - a. Create a FlexClone volume based on the selected Snapshot backup of the source HANA system.
 - b. Export the FlexClone volume to the target host storage network interface.
 - c. Execute the mount operation script.
 - The FlexClone volume is mounted at the target host as a data volume.
 - Change the ownership to qs1adm.
 - d. Execute the post-clone operation script.
 - Recover the system database.
 - Recover the tenant database with the tenant name = QS1.
4. Manually delete the old split target volume.
5. Optionally, protect the target HANA resource in SnapCenter.

The following screenshots show the required steps.

- Select a Snapshot backup from the source system SS1, and click clone from backup.

The screenshot shows the NetApp SnapCenter interface for the SAP HANA system. In the left sidebar, 'SS1' is selected. The main pane shows 'Manage Copies' for 'SS1'. It displays two categories: 'Local copies' (14 Backups, 0 Clones) and 'Vault copies' (10 Backups, 0 Clones). To the right, a 'Summary Card' provides a quick overview of the backup status: 26 Backups total, 24 Snapshot-based backups, 2 File-Based Backups, and 0 Clones. A 'Clone From Backup' button is visible at the bottom right of the main pane.

- Select the host where the target system QS1 is installed. Enter QS1 as the target SID. The NFS export IP address must be the storage network interface of the target host.



The target SID, which is entered here, controls how SnapCenter manages the clone. If the target SID is already configured in SnapCenter on the target host, SnapCenter just assigns the clone to the host. If the SID is not configured on the target host, SnapCenter creates a new resource.

The screenshot shows the 'Clone From Backup' dialog box. Step 1: Location is selected, showing 'Select the host to create the clone'. The 'Plug-in host' dropdown is set to 'hana-7.sapcc.stl.netapp.com'. The 'Target Clone SID' field contains 'QS1'. Step 2: Scripts, Step 3: Notification, and Step 4: Summary are also visible in the tabs.

- Enter the pre-clone, mount, and post-clone scripts with the required command line options. In the pre-clone step, the script is used to shut down the HANA database and to unmount the data volume.

Clone From Backup X

1 Location

2 Scripts

3 Notification

4 Summary

Enter optional commands to run before performing a clone operation i

Pre clone command
`/mnt/sapcc-share/SAP-System-Refresh/sc-system-refresh.sh
shutdown QS1;/mnt/sapcc-share/SAP-System-Refresh/sc-
system-refresh.sh umount QS1`

Enter optional commands to mount a file system to a host i

Mount command
`/mnt/sapcc-share/SAP-System-Refresh/sc-system-refresh.sh
mount QS1`

Enter optional commands to run after performing a clone operation i

Post clone command
`/mnt/sapcc-share/SAP-System-Refresh/sc-system-refresh.sh
recover QS1`

⚠ Configure an SMTP Server to send email notifications for Clone jobs by going to [Settings>Global Settings>Notification Server Settings](#). X

Previous Next

4. The job details screen in SnapCenter shows the progress of the operation. The job details also show that the overall runtime including database recovery was less than 2 minutes.

Job Details X

Clone from backup 'SnapCenter_LocalSnap_Hourly_04-21-2022_07.00.02.7865'

- ✓ ▾ Clone from backup 'SnapCenter_LocalSnap_Hourly_04-21-2022_07.00.02.7865'
- ✓ ▾ hana-7.sapcc.stl.netapp.com
- ✓ ▾ Clone
- ✓ ▶ Application Pre Clone
- ✓ ▶ Pre Clone Create Commands
- ✓ ▶ Storage Clone
- ✓ ▶ Mount Commands
- ✓ ▶ Application Post Clone
- ✓ ▶ Post Clone Create Commands
- ✓ ▶ Register Clone Metadata
- ✓ ▶ Application Clean-Up
- ✓ ▶ Data Collection
- ✓ ▶ Agent Finalize Workflow

i Task Name: Clone Start Time: 04/21/2022 8:05:48 AM End Time: 04/21/2022 8:09:27 AM

View Logs Cancel Job Close

5. The logfile of the `sc-system-refresh.sh` script shows the different steps that were executed for the shutdown, unmount, mount, and recovery operations. The script automatically detected that the source system had a single tenant, and the name was identical to the source system SID SS1. The script therefore recovered the tenant with the tenant name QS1.

```
20220421080553###hana-7###sc-system-refresh.sh: Version: 1.1
20220421080553###hana-7###sc-system-refresh.sh: Stopping HANA database.
20220421080553###hana-7###sc-system-refresh.sh: sapcontrol -nr 11
-function StopSystem HDB
21.04.2022 08:05:53
StopSystem
OK
20220421080553###hana-7###sc-system-refresh.sh: Wait until SAP HANA
database is stopped ....
20220421080554###hana-7###sc-system-refresh.sh: Status: GREEN
20220421080604###hana-7###sc-system-refresh.sh: Status: GREEN
20220421080614###hana-7###sc-system-refresh.sh: Status: GREEN
20220421080624###hana-7###sc-system-refresh.sh: Status: GRAY
20220421080624###hana-7###sc-system-refresh.sh: SAP HANA database is
stopped.
20220421080628###hana-7###sc-system-refresh.sh: Version: 1.1
20220421080628###hana-7###sc-system-refresh.sh: Unmounting data volume.
20220421080628###hana-7###sc-system-refresh.sh: umount
/hana/data/QS1/mnt00001
20220421080628###hana-7###sc-system-refresh.sh: Deleting /etc/fstab
entry.
20220421080628###hana-7###sc-system-refresh.sh: Data volume unmounted
successfully.
20220421080639###hana-7###sc-system-refresh.sh: Version: 1.1
20220421080639###hana-7###sc-system-refresh.sh: Adding entry in
/etc/fstab.
20220421080639###hana-7###sc-system-refresh.sh:
192.168.175.117:/SS1_data_mnt00001_Clone_0421220806358029
/hana/data/QS1/mnt00001 nfs
rw,vers=3,hard,timeo=600,rsize=1048576,wsize=1048576,intr,noatime,nolock
0 0
20220421080639###hana-7###sc-system-refresh.sh: Mounting data volume:
mount /hana/data/QS1/mnt00001.
20220421080639###hana-7###sc-system-refresh.sh: Data volume mounted
successfully.
20220421080639###hana-7###sc-system-refresh.sh: Change ownership to
qs1adm.
20220421080649###hana-7###sc-system-refresh.sh: Version: 1.1
20220421080649###hana-7###sc-system-refresh.sh: Recover system database.
20220421080649###hana-7###sc-system-refresh.sh:
/usr/sap/QS1/HDB11/exe/Python/bin/python
/usr/sap/QS1/HDB11/exe/python_support/recoverSys. --comma"d "RECOVER
DATA USING SNAPSHOT CLEAR "OG"
20220421080719###hana-7###sc-system-refresh.sh: Wait until SAP HANA
database is started ....
20220421080719###hana-7###sc-system-refresh.sh: Status: GRAY
```

```

20220421080730###hana-7###sc-system-refresh.sh: Status: YELLOW
20220421080740###hana-7###sc-system-refresh.sh: Status: YELLOW
20220421080750###hana-7###sc-system-refresh.sh: Status: YELLOW
20220421080800###hana-7###sc-system-refresh.sh: Status: YELLOW
20220421080810###hana-7###sc-system-refresh.sh: Status: YELLOW
20220421080821###hana-7###sc-system-refresh.sh: Status: YELLOW
20220421080831###hana-7###sc-system-refresh.sh: Status: GREEN
20220421080831###hana-7###sc-system-refresh.sh: SAP HANA database is
started.
20220421080831###hana-7###sc-system-refresh.sh: Source Tenant: SS1
20220421080831###hana-7###sc-system-refresh.sh: Source SID: SS1
20220421080831###hana-7###sc-system-refresh.sh: Source system has a
single tenant and tenant name is identical to source SID: SS1
20220421080831###hana-7###sc-system-refresh.sh: Target tenant will have
the same name as target SID: QS1.
20220421080831###hana-7###sc-system-refresh.sh: Recover tenant database
QS1.
20220421080831###hana-7###sc-system-refresh.sh:
/usr/sap/QS1/SYS/exe/hdb/hdbsql -U QS1KEY RECOVER DATA FOR QS1 USING
SNAPSHOT CLEAR LOG
0 rows affected (overall time 37.900516 sec; server time 37.897472 sec)
20220421080909###hana-7###sc-system-refresh.sh: Checking availability of
Indexserver for tenant QS1.
20220421080909###hana-7###sc-system-refresh.sh: Recovery of tenant
database QS1 successfully finished.
20220421080909###hana-7###sc-system-refresh.sh: Status: GREEN

```

- After the refresh operation, the old target data volume still exists, and it must be deleted manually with, for example, ONTAP System Manager.

SnapCenter workflow automation with PowerShell scripts

In the previous sections, the different workflows were executed using the SnapCenter UI. All the workflows can also be executed with PowerShell scripts or REST API calls, allowing further automation. The following sections describe basic PowerShell script examples for the following workflows.

- Create clone
- Delete clone



The example scripts are provided as is and are not supported by NetApp.

All scripts must be executed in a PowerShell command window. Before the scripts can be run, a connection to the SnapCenter server must be established using the `Open-SmConnection` command.

Create clone

The simple script below demonstrates how a SnapCenter clone create operation can be executed using PowerShell commands. The SnapCenter `New-SmClone` command is executed with the required command

line option for the lab environment and the automation script discussed before.

```
$BackupName='SnapCenter_LocalSnap_Hourly_05-16-2022_11.00.01.0153'
$JobInfo=New-SmClone -AppPluginCode hana -BackupName $BackupName
/Resources @{"Host"="hana-1.sapcc.st1.netapp.com";"UID"="MDC\SS1"}
-CloneToInstance hana-7.sapcc.st1.netapp.com -mountcommand '/mnt/sapcc-
share/SAP-System-Refresh/sc-system-refresh.sh mount QS1'
-postclonecreateCommand ' /mnt/sapcc-share/SAP-System-Refresh/sc-system-
refresh.sh recover QS1' -NFSExportIPs 192.168.175.75 -CloneUid 'MDC\QS1'
# Get JobID of clone create job
$Job=Get-SmJobSummaryReport | ?{$_.JobType -eq "Clone" } | ?{$_.JobName
-Match $BackupName} | ?{$_.Status -eq "Running"}
$JobId=$Job.SmJobId
Get-SmJobSummaryReport -JobId $JobId
# Wait until job is finished
do { $Job=Get-SmJobSummaryReport -JobId $JobId; write-host $Job.Status;
sleep 20 } while ( $Job.Status -Match "Running" )
Write-Host " "
Get-SmJobSummaryReport -JobId $JobId
Write-Host "Clone create job has been finshed."
```

The screen output shows the execution of the clone create PowerShell script.

```

PS C:\NetApp> .\clone-create.ps1
SmJobId          : 31887
JobCreatedDateTime :
JobStartTime      : 5/17/2022 3:19:06 AM
JobEndTime        :
JobDuration       :
JobName           : Clone from backup 'SnapCenter_LocalSnap_Hourly_05-13-
2022_03.00.01.8016'
JobDescription    :
Status            : Running
IsScheduled       : False
JobError          :
JobType           : Clone
PolicyName        :
Running
Running
Running
Running
Running
Running
Running
Completed

SmJobId          : 31887
JobCreatedDateTime :
JobStartTime      : 5/17/2022 3:19:06 AM
JobEndTime        : 5/17/2022 3:21:14 AM
JobDuration       : 00:02:07.7530310
JobName           : Clone from backup 'SnapCenter_LocalSnap_Hourly_05-13-
2022_03.00.01.8016'
JobDescription    :
Status            : Completed
IsScheduled       : False
JobError          :
JobType           : Clone
PolicyName        :
Clone create job has been finshed.
PS C:\NetApp>

```

Delete clone

The simple script below demonstrates how a SnapCenter clone delete operation can be executed using PowerShell commands. The `SnapCenter Remove-SmClone` command is executed with the required command line option for the lab environment and the automation script discussed before.

```
$CloneInfo=Get-SmClone | ?{$_.CloneName -Match "hana-
1_sapcc_stl_netapp_com_hana_MDC_SS1" }
$JobInfo=Remove-SmClone -CloneName $CloneInfo.CloneName -PluginCode hana
-PreCloneDeleteCommands '/mnt/sapcc-share/SAP-System-Refresh/sc-system-
refresh.sh shutdown QS1' -UnmountCommands '/mnt/sapcc-share/SAP-System-
Refresh/sc-system-refresh.sh umount QS1' -Confirm: $False
Get-SmJobSummaryReport -JobId $JobInfo.Id
# Wait until job is finished
do { $Job=Get-SmJobSummaryReport -JobId $JobInfo.Id; write-host
$Job.Status; sleep 20 } while ( $Job.Status -Match "Running" )
Write-Host " "
Get-SmJobSummaryReport -JobId $JobInfo.Id
Write-Host "Clone delete job has been finshed."
PS C:\NetApp>
```

The screen output shows the execution of the clone delete PowerShell script.

```

PS C:\NetApp> .\clone-delete.ps1
SmJobId          : 31888
JobCreatedDateTime :
JobStartTime      : 5/17/2022 3:24:29 AM
JobEndTime        :
JobDuration       :
JobName          : Deleting clone 'hana-
1_sapcc_stl_netapp_com_hana_MDC_SS1__clone__31887_MDC_SS1_05-17-
2022_03.19.14'
JobDescription    :
Status           : Running
IsScheduled      : False
JobError          :
JobType          : DeleteClone
PolicyName        :
Running
Running
Running
Running
Running
Completed

SmJobId          : 31888
JobCreatedDateTime :
JobStartTime      : 5/17/2022 3:24:29 AM
JobEndTime        : 5/17/2022 3:25:57 AM
JobDuration       : 00:01:27.7598430
JobName          : Deleting clone 'hana-
1_sapcc_stl_netapp_com_hana_MDC_SS1__clone__31887_MDC_SS1_05-17-
2022_03.19.14'
JobDescription    :
Status           : Completed
IsScheduled      : False
JobError          :
JobType          : DeleteClone
PolicyName        :
Clone delete job has been finshed.
PS C:\NetApp>

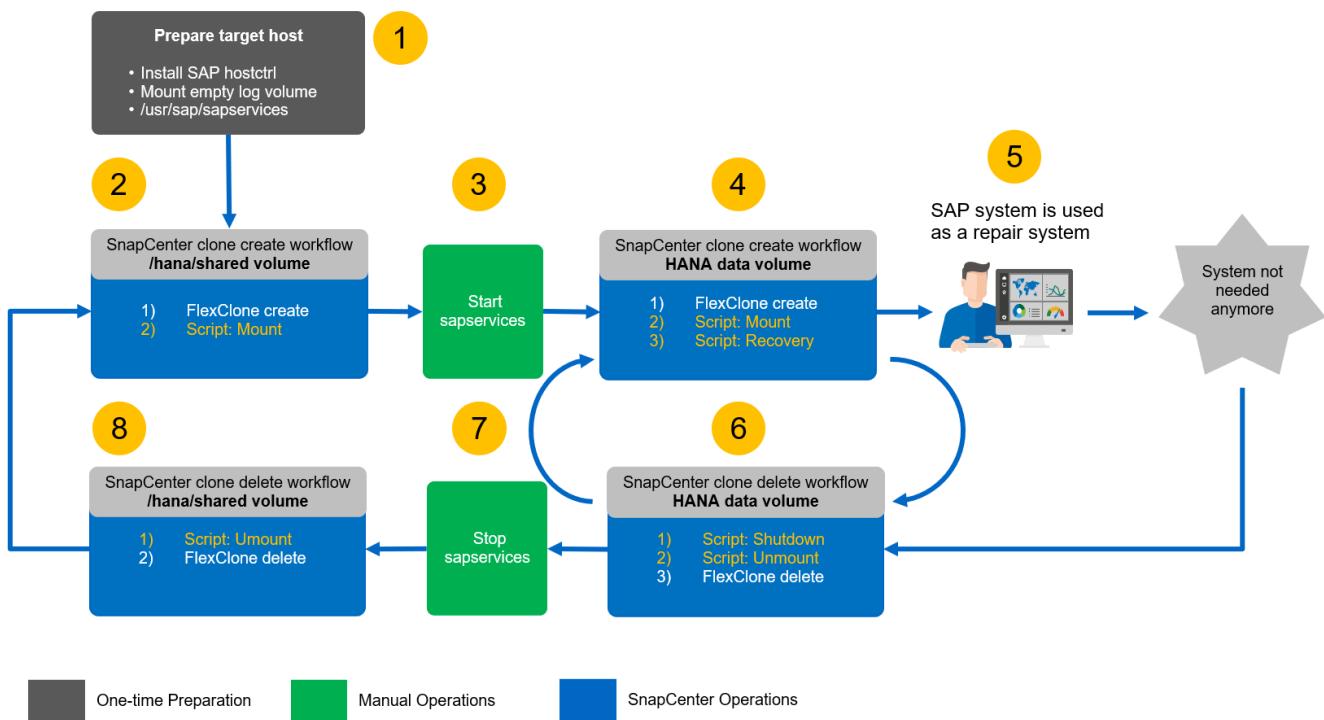
```

SAP system clone with SnapCenter

This section provides a step-by-step description for the SAP system clone operation, which can be used to set up a repair system to address logical corruption.



The lab setup and validation does not include SAP application services. However, the required steps for SAP application services are highlighted within the documentation.



Prerequisites and limitations

The workflows described in the following sections have a few prerequisites and limitations regarding the HANA system architecture and the SnapCenter configuration.

- The described workflow is valid for single host SAP HANA MDC systems with a single tenant.
- The SnapCenter HANA plug-in must be deployed on the target host to enable the execution of automation scripts. It is not necessary to install the HANA plug-in on the HANA source system host.
- The workflow has been validated for NFS. The automation script `sc-mount-volume.sh`, which is used to mount the HANA shared volume, does not support FCP. This step must be either done manually or by extending the script.
- The described workflow is only valid for the SnapCenter 4.6 P1 release or later. Older releases have slightly different workflows.

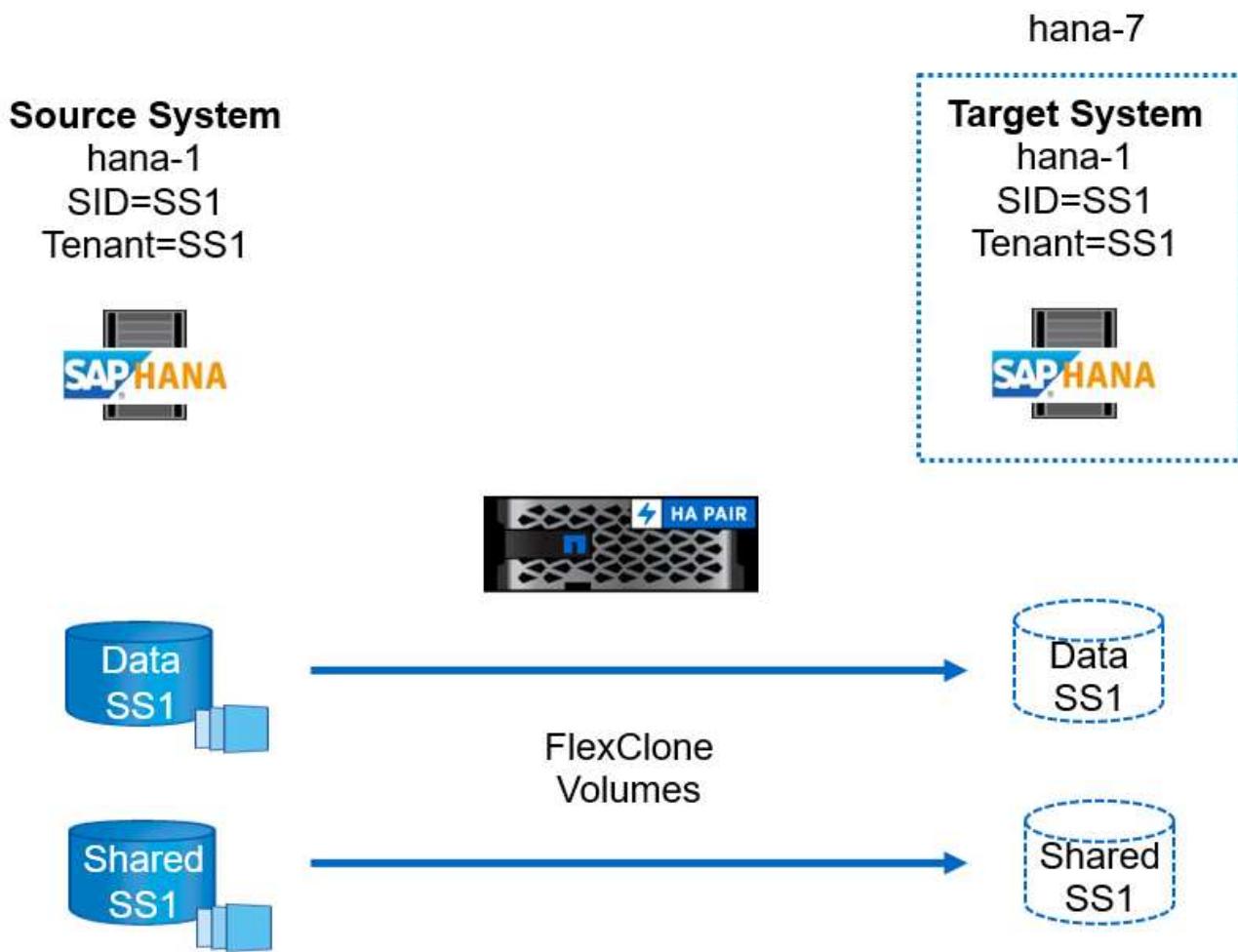
Lab setup

The following figure shows the lab setup used for a system clone operation.

The following software versions were used:

- SnapCenter 4.6 P1
- HANA systems: HANA 2.0 SPS6 rev.61
- VMware 6.7.0
- SLES 15 SP2

- ONTAP 9.7P7All HANA systems were configured based on the configuration guide [SAP HANA on NetApp AFF systems with NFS](#). SnapCenter and the HANA resources were configured based on the best practice guide [SAP HANA Backup and Recovery with SnapCenter](#).



Target host preparation

This section describes the preparation steps required at a server that is used as a system clone target.

During normal operation, the target host might be used for other purposes, for example, as a HANA QA or test system. Therefore, most of the described steps must be executed when the system clone operation is requested. On the other hand, the relevant configuration files, like `/etc/fstab` and `/usr/sap/sapservices`, can be prepared and then put in production simply by copying the configuration file.

The target host preparation also includes shutting down the HANA QA or test system.

Target server host name and IP address

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



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



In our lab setup, we changed the host name of the target system only internally from the target system perspective. Externally the host was still accessible with the hostname hana-7. When logged into the host, the host itself is hana-1.

Install required software

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

The SnapCenter HANA plug-in must be deployed on the target host using the add host operation within SnapCenter.

Configure users, ports, and SAP services

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

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

```
#!/bin/sh
LD_LIBRARY_PATH=/usr/sap/SS1/HDB00/exe:$LD_LIBRARY_PATH;export
LD_LIBRARY_PATH;/usr/sap/SS1/HDB00/exe/sapstartsrv
pf=/usr/sap/SS1/SYS/profile/SS1_HDB00_hana-1 -D -u ssladm
limit.descriptors=1048576
```

Prepare log and log backup volume

Because you do not need to clone the log volume from the source system and any recovery is performed with the clear log option, an empty log volume must be prepared at the target host.

Because the source system has been configured with a separate log backup volume, an empty log backup volume must be prepared and mounted to the same mount point as at the source system.

```
hana- 1:/# cat /etc/fstab
192.168.175.117:/SS1_repair_log_mnt00001 /hana/log/SS1/mnt00001 nfs
rw,vers=3,hard,timeo=600,rsize=1048576,wszie=1048576,intr,noatime,nolock 0
0
192.168.175.117:/SS1_repair_log_backup /mnt/log-backup nfs
rw,vers=3,hard,timeo=600,rszie=1048576,wszie=1048576,intr,noatime,nolock 0
0
```

Within the log volume hdb*, you must create subdirectories in the same way as at the source system.

```
hana- 1:/ # ls -al /hana/log/SS1/mnt00001/
total 16
drwxrwxrwx 5 root      root    4096 Dec  1 06:15 .
drwxrwxrwx 1 root      root     16 Nov 30 08:56 ..
drwxr-xr-- 2 ssladm    sapsys  4096 Dec  1 06:14 hdb00001
drwxr-xr-- 2 ssladm    sapsys  4096 Dec  1 06:15 hdb00002.00003
drwxr-xr-- 2 ssladm    sapsys  4096 Dec  1 06:15 hdb00003.00003
```

Within the log backup volume, you must create subdirectories for the system and the tenant database.

```
hana- 1:/ # ls -al /mnt/log-backup/
total 12
drwxr-xr-x 4 root      root    4096 Dec  1 04:48 .
drwxr-xr-x 1 root      root     48 Dec  1 03:42 ..
drwxrwxrwx 2 root      root    4096 Dec  1 06:15 DB_SS1
drwxrwxrwx 2 root      root    4096 Dec  1 06:14 SYSTEMDB
```

Prepare file system mounts

You must prepare mount points for the data and the shared volume.

With our example, the directories /hana/data/SS1/mnt00001, /hana/shared and /usr/sap/SS1 must be created.

Prepare SID-specific configuration file for SnapCenter script

You must create the configuration file for the SnapCenter automation script sc-system-refresh.sh.

```
hana- 1:/mnt/sapcc-share/SAP-System-Refresh # cat sc-system-refresh-
SS1.cfg
# -----
# Target database specific parameters
# -----
# hdbuserstore key, which should be used to connect to the target database
KEY="SS1KEY"
# Used storage protocol, NFS or FCP
PROTOCOL
```

Cloning the HANA shared volume

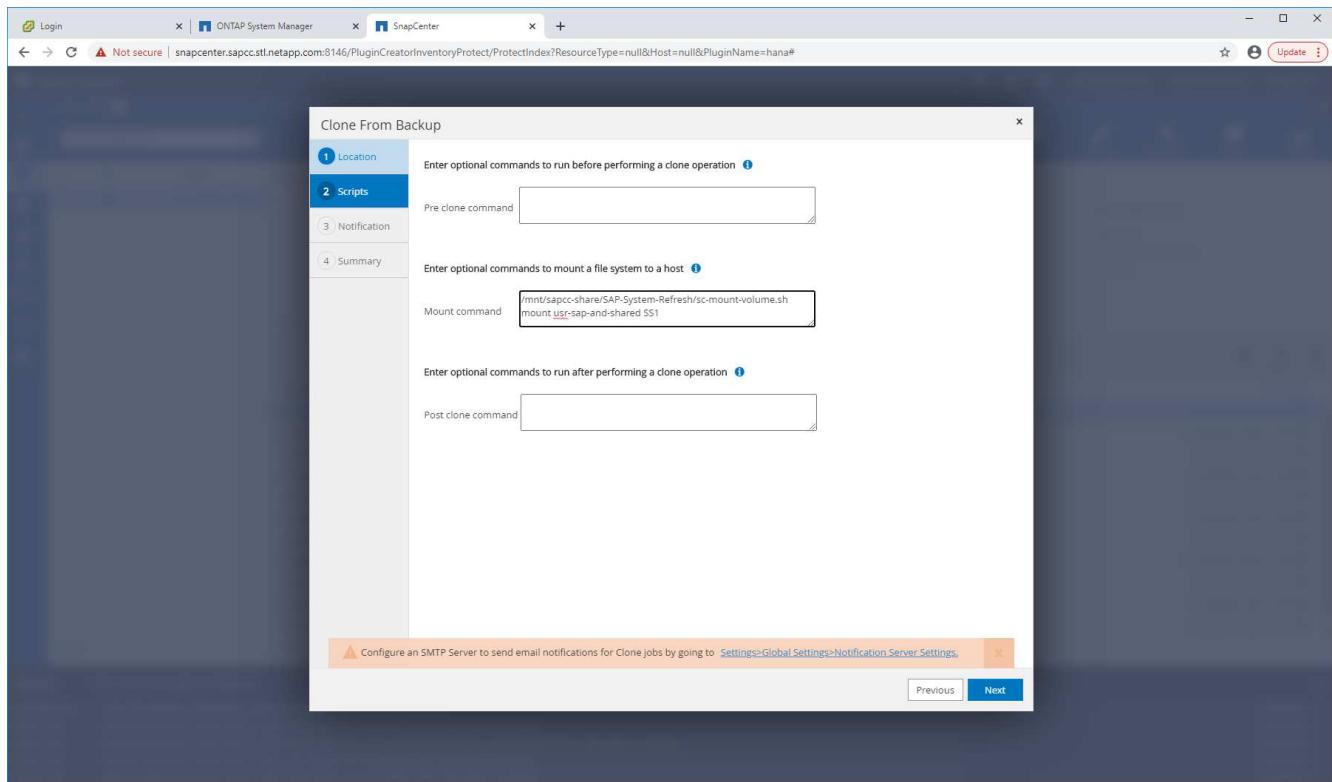
1. Select a Snapshot backup from the source system SS1 shared volume and click Clone from Backup.

2. Select the host where the target repair system has been prepared. The NFS export IP address must be the storage network interface of the target host. As target SID keep the same SID as the source system; in our example, this is SS1.

3. Enter the mount script with the required command line options.



The HANA system uses a single volume for `/hana/shared` as well as for `'/usr/sap/SS1`, separated in subdirectories as recommended in the configuration guide [SAP HANA on NetApp AFF systems with NFS](#). The script `sc-mount-volume.sh` supports this configuration using a special command line option for the mount path. If the mount path command line option is equal to `usr-sap-and-shared`, the script mounts the subdirectories `shared` and `usr-sap` in the volume accordingly.



4. The job details screen in SnapCenter shows the progress of the operation.

Job Details

Clone from backup 'SnapCenter_LocalSnap_Hourly_05-13-2022_05.04.01.8012'

- ✓ ▾ Clone from backup 'SnapCenter_LocalSnap_Hourly_05-13-2022_05.04.01.8012'
- ✓ ▾ hana-7.sapcc.stl.netapp.com
 - ✓ ▾ Clone
 - ✓ ► Storage Clone
 - ✓ ► Register Clone Metadata
 - ✓ ► Data Collection
 - ✓ ► Agent Finalize Workflow

Task Name: Clone Start Time: 05/13/2022 5:14:02 AM End Time: 05/13/2022 5:14:16 AM

[View Logs](#) [Cancel Job](#) [Close](#)

5. The logfile of the `sc-mount-volume.sh` script shows the different steps executed for the mount operation.

```

20201201041441###hana-1###sc-mount-volume.sh: Adding entry in
/etc/fstab.
20201201041441###hana-1###sc-mount-volume.sh:
192.168.175.117://SS1_shared_Clone_05132205140448713/usr-sap
/usr/sap/SS1 nfs
rw,vers=3,hard,timeo=600,rsize=1048576,wsize=1048576,intr,noatime,nolock
0 0
20201201041441###hana-1###sc-mount-volume.sh: Mounting volume: mount
/usr/sap/SS1.
20201201041441###hana-1###sc-mount-volume.sh: 192.168.175.117:
/SS1_shared_Clone_05132205140448713/shared /hana/shared nfs
rw,vers=3,hard,timeo=600,rsize=1048576,wsize=1048576,intr,noatime,nolock
0 0
20201201041441###hana-1###sc-mount-volume.sh: Mounting volume: mount
/hana/shared.
20201201041441###hana-1###sc-mount-volume.sh: usr-sap-and-shared mounted
successfully.
20201201041441###hana-1###sc-mount-volume.sh: Change ownership to
ss1adm.

```

- When the SnapCenter workflow is finished, the `usr/sap/SS1` and the `/hana/shared` filesystems are mounted at the target host.

```

hana-1:~ # df
Filesystem                                              1K-
blocks      Used Available Use% Mounted on
192.168.175.117:/SS1_repair_log_mnt00001
262144000      320 262143680    1% /hana/log/SS1/mnt00001
192.168.175.100:/sapcc_share
1020055552 53485568 966569984    6% /mnt/sapcc-share
192.168.175.117:/SS1_repair_log_backup
104857600      256 104857344    1% /mnt/log-backup
192.168.175.117: /SS1_shared_Clone_05132205140448713/usr-sap 262144064
10084608 252059456    4% /usr/sap/SS1
192.168.175.117: /SS1_shared_Clone_05132205140448713/shared   262144064
10084608 252059456    4% /hana/shared

```

- Within SnapCenter, a new resource for the cloned volume is visible.

- Now that the /hana/shared volume is available, the SAP HANA services can be started.

```
hana-1:/mnt/sapcc-share/SAP-System-Refresh # systemctl start sapinit
```

- The SAP Host Agent and sapstartsrv processes are now started.

```
hana-1:/mnt/sapcc-share/SAP-System-Refresh # ps -ef |grep sap
root      12377      1  0 04:34 ?          00:00:00
/usr/sap/hostctrl/exe/saphostexec pf=/usr/sap/hostctrl/exe/host_profile
sapadm    12403      1  0 04:34 ?          00:00:00 /usr/lib/systemd/systemd
--user
sapadm    12404 12403  0 04:34 ?          00:00:00 (sd-pam)
sapadm    12434      1  1 04:34 ?          00:00:00
/usr/sap/hostctrl/exe/sapstartsrv pf=/usr/sap/hostctrl/exe/host_profile
-D
root      12485 12377  0 04:34 ?          00:00:00
/usr/sap/hostctrl/exe/saphostexec pf=/usr/sap/hostctrl/exe/host_profile
root      12486 12485  0 04:34 ?          00:00:00
/usr/sap/hostctrl/exe/saposcol -l -w60
pf=/usr/sap/hostctrl/exe/host_profile
ssladm   12504      1  0 04:34 ?          00:00:00
/usr/sap/SS1/HDB00/exe/sapstartsrv
pf=/usr/sap/SS1/SYS/profile/SS1_HDB00_hana-1 -D -u ssladm
root      12582 12486  0 04:34 ?          00:00:00
/usr/sap/hostctrl/exe/saposcol -l -w60
pf=/usr/sap/hostctrl/exe/host_profile
root      12585 7613  0 04:34 pts/0    00:00:00 grep --color=auto sap
hana-1:/mnt/sapcc-share/SAP-System-Refresh #
```

Cloning additional SAP application services

Additional SAP application services are cloned in the same way as the SAP HANA shared volume as described in the section “[Cloning the HANA shared volume](#).” Of course, the required storage volume(s) of the SAP application servers must be protected with SnapCenter as well.

You must add the required services entries to `/usr/sap/sapservices`, and the ports, users, and the file system mount points (for example, `/usr/sap/SID`) must be prepared.

Cloning the data volume and recovery of the HANA database

1. Select a HANA Snapshot backup from the source system SS1.

The screenshot shows the NetApp SnapCenter interface for SAP HANA. The left sidebar lists systems: Q51, SM1, SS1 (selected), SS2, and SS2. The main area displays the 'SS1 Topology' with a 'Manage Copies' section. It shows 15 backups and 0 clones under 'Local copies', and 11 backups and 0 clones under 'Vault copies'. A summary card on the right shows 28 Backups total, with 26 Snapshot based backups and 2 File-Based backups. Below this, a table lists primary backups with their names, counts, and end dates:

Backup Name	Count	End Date
SnapCenter_LocalSnap_Daily_05-13-2022_05.00.03.0030	1	05/13/2022 5:01:01 AM
SnapCenter_LocalSnap_Hourly_05-13-2022_03.00.01.8016	1	05/13/2022 3:01:00 AM
SnapCenter_LocalSnap_Hourly_05-12-2022_23.00.01.8743	1	05/12/2022 11:01:00 PM
SnapCenter_LocalSnap_Hourly_05-12-2022_19.00.01.9803	1	05/12/2022 7:01:00 PM

2. Select the host where the target repair system has been prepared. The NFS export IP address must be the storage network interface of the target host. A target SID keep the same SID as the source system; in our example, this is SS1.

The screenshot shows the 'Clone From Backup' dialog box. Step 1: Location is selected. It shows the host 'hana-7.sapcc.stl.netapp.com', Target Clone SID 'SS1', and NFS Export IP Address '192.168.175.75'.

3. Enter the mount and post-clone scripts with the required command line options.



The script for the recovery operation recovers the HANA database to the point in time of the Snapshot operation and does not execute any forward recovery. If a forward recovery to a specific point in time is required, the recovery must be performed manually. A manual forward recovery also requires that the log backups from the source system are available at the target host.

Clone From Backup

X

1 Location

2 Scripts

3 Notification

4 Summary

Enter optional commands to run before performing a clone operation [i](#)

Pre clone command

Enter optional commands to mount a file system to a host [i](#)

Mount command

```
/mnt/sapcc-share/SAP-System-Refresh/sc-system-refresh.sh  
mount SS1
```

Enter optional commands to run after performing a clone operation [i](#)

Post clone command

```
/mnt/sapcc-share/SAP-System-Refresh/sc-system-refresh.sh  
recover SS1
```



Configure an SMTP Server to send email notifications for Clone jobs by going to [Settings>Global Settings>Notification Server Settings](#).



Previous

Next

The job details screen in SnapCenter shows the progress of the operation.

Job Details

X

Clone from backup 'SnapCenter_LocalSnap_Hourly_05-13-2022_03.00.01.8016'

✓ ▾ Clone from backup 'SnapCenter_LocalSnap_Hourly_05-13-2022_03.00.01.8016'

✓ ▾ hana-7.sapcc.stl.netapp.com

✓ ▾ Clone

✓ ▶ Application Pre Clone

✓ ▶ Storage Clone

✓ ▶ Application Post Clone

✓ ▶ Register Clone Metadata

✓ ▶ Application Clean-Up

✓ ▶ Data Collection

✓ ▶ Agent Finalize Workflow

Task Name: Clone Start Time: 05/13/2022 5:24:36 AM End Time: 05/13/2022 5:25:05 AM

[View Logs](#)

[Cancel Job](#)

[Close](#)

The logfile of the `sc-system-refresh.sh` script shows the different steps that are executed for the mount and the recovery operation.

```

20201201052114##hana-1###sc-system-refresh.sh: Adding entry in
/etc/fstab.
20201201052114##hana-1###sc-system-refresh.sh:
192.168.175.117:/SS1_data_mnt00001_Clone_0421220520054605
/hana/data/SS1/mnt00001 nfs
rw,vers=3,hard,timeo=600,rsize=1048576,wszie=1048576,intr,noatime,nolock 0
0
20201201052114##hana-1###sc-system-refresh.sh: Mounting data volume:
mount /hana/data/SS1/mnt00001.
20201201052114##hana-1###sc-system-refresh.sh: Data volume mounted
successfully.
20201201052114##hana-1###sc-system-refresh.sh: Change ownership to
ssladm.
20201201052124##hana-1###sc-system-refresh.sh: Recover system database.
20201201052124##hana-1###sc-system-refresh.sh:
/usr/sap/SS1/HDB00/exe/Python/bin/python
/usr/sap/SS1/HDB00/exe/python_support/recoverSys.py --command "RECOVER
DATA USING SNAPSHOT CLEAR LOG"
20201201052156##hana-1###sc-system-refresh.sh: Wait until SAP HANA
database is started ....
20201201052156##hana-1###sc-system-refresh.sh: Status: GRAY
20201201052206##hana-1###sc-system-refresh.sh: Status: GREEN
20201201052206##hana-1###sc-system-refresh.sh: SAP HANA database is
started.
20201201052206##hana-1###sc-system-refresh.sh: Source system has a single
tenant and tenant name is identical to source SID: SS1
20201201052206##hana-1###sc-system-refresh.sh: Target tenant will have
the same name as target SID: SS1.
20201201052206##hana-1###sc-system-refresh.sh: Recover tenant database
SS1.
20201201052206##hana-1###sc-system-refresh.sh:
/usr/sap/SS1/SYS/exe/hdb/hdbsql -U SS1KEY RECOVER DATA FOR SS1 USING
SNAPSHOT CLEAR LOG
0 rows affected (overall time 34.773885 sec; server time 34.772398 sec)
20201201052241##hana-1###sc-system-refresh.sh: Checking availability of
Indexserver for tenant SS1.
20201201052241##hana-1###sc-system-refresh.sh: Recovery of tenant
database SS1 succesfully finished.
20201201052241##hana-1###sc-system-refresh.sh: Status: GREEN

```

After the mount and recovery operation, the HANA data volume is mounted at the target host.

```

hana-1:/mnt/log-backup # df
Filesystem                                1K-blocks
Used   Available  Use% Mounted on
192.168.175.117:/SS1_repair_log_mnt00001    262144000
760320 261383680   1% /hana/log/SS1/mnt00001
192.168.175.100:/sapcc_share                1020055552
53486592 966568960   6% /mnt/sapcc-share
192.168.175.117:/SS1_repair_log_backup      104857600
512 104857088   1% /mnt/log-backup
192.168.175.117: /SS1_shared_Clone_05132205140448713/usr-sap 262144064
10090496 252053568   4% /usr/sap/SS1
192.168.175.117: /SS1_shared_Clone_05132205140448713/shared 262144064
10090496 252053568   4% /hana/shared
192.168.175.117:/SS1_data_mnt00001_Clone_0421220520054605
262144064 3732864 258411200   2% /hana/data/SS1/mnt00001

```

The HANA system is now available and can be used, for example, as a repair system.

Where to find additional information

To learn more about the information described in this document, refer to the following documents and/or websites:

- TR-4614: SAP HANA Backup and Recovery with SnapCenter

<https://docs.netapp.com/us-en/netapp-solutions-sap/backup/saphana-br-scs-overview.html>

- TR-4018: Integrating NetApp ONTAP Systems with SAP Landscape Management

<https://www.netapp.com/us/media/tr-4018.pdf>

- TR-4646: SAP HANA Disaster Recovery with Storage Replication

<https://www.netapp.com/us/media/tr-4646.pdf>

- TR-4436: SAP HANA on NetApp All Flash FAS Systems with Fibre Channel Protocol

https://docs.netapp.com/us-en/netapp-solutions-sap/bp/saphana_aff_fc_introduction.html

- TR-4435: SAP HANA on NetApp All Flash FAS Systems with NFS

https://docs.netapp.com/us-en/netapp-solutions-sap/bp/saphana_aff_nfs_introduction.html

- NetApp SAP Software Solutions product page

<http://www.netapp.com/us/solutions/applications/sap/index.aspx>

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