

NetApp SAP Landscape Management Integration using Ansible

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NetApp SAP Landscape Management Integration using Ansible

TR-4953: NetApp SAP Landscape Management Integration using Ansible

SAP Landscape Management (LaMa) enables SAP system administrators to automate SAP system operations, including end-to-end SAP system clone, copy, and refresh operations.

Authors: Michael Schlosser, Nils Bauer, NetApp

NetApp offers a rich set of Ansible modules that allows SAP LaMa to access technologies such as NetApp Snapshot and FlexClone through SAP LaMa Automation Studio. These technologies help to simplify and accelerate SAP system clone, copy, and refresh operations.

The integration can be used by customers who run NetApp storage solutions on-premises or by customers using NetApp storage services at public cloud providers such as Amazon Web Services, Microsoft Azure, or Google Cloud Platform.

This document describes the configuration of SAP LaMa with NetApp storage features for SAP system copy, clone, and refresh operations using Ansible automation.

SAP system clone, copy, and refresh scenarios

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

- **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.
- **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 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.

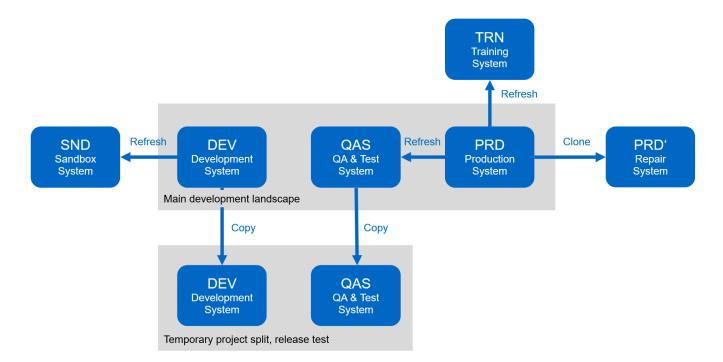
The following figure illustrates the main steps that must be performed during a system clone, system copy, or system refresh operation. The purple boxes indicate steps where NetApp storage features can be integrated. All three operations can be fully automated by using SAP LaMa.

						NetApp storage	SAP LaMa
System Clone				r.			
	Storage Cloning	Prepare System	Activate Isolation		Start System		
System Copy							
	Storage Cloning	Prepare System	Activate Isolation	System Rename	Start System	Import Configuration + Post Copy Automation	Deactivate Isolation
System Refresh							
Export Stop Unprepare Storage Clone	Storage Cioning	Prepare System	Activate Isolation	System Rename	Start System	Import Configuration + Post Copy Automation	Deactivate

Use cases for system refresh, copy, and cloning

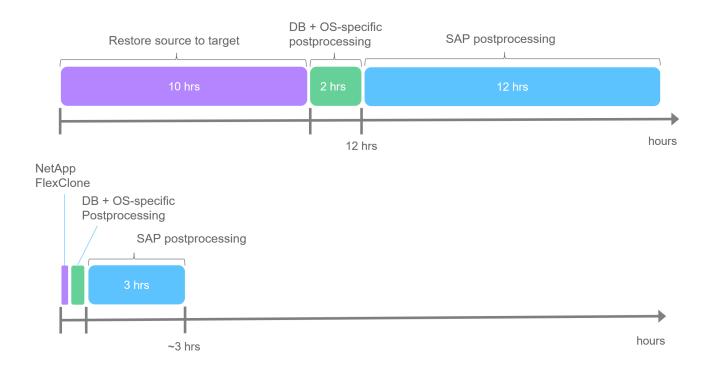
There are multiple scenarios in which data from a source system must be made available to a target system for testing or training purposes. These test and training systems must be updated with data from the source system on a regular basis to make sure that testing and training is performed with the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



SAP LaMa and NetApp 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, SAP LaMa 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. Further reduction of the runtime is accomplished by automating tasks on the operating system and database layer as well as on the SAP post processing side.



Address logical corruption

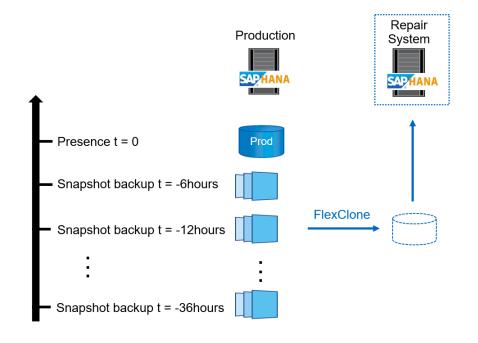
Logical corruption can be caused by software errors, human errors, or sabotage. Unfortunately, logical corruption often cannot be addressed with standard high-availability and disaster recovery solutions. As a result, depending on the layer, application, file system, or storage where the logical corruption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



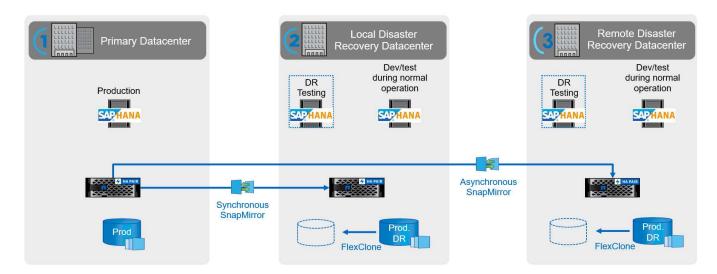
- 1. Clone
- 2. Mount
- 3. Recover
- 4. Analyze
- 5. Repeat step 1–4, if required
- 6. Export Data
- 7. Import into Production

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.

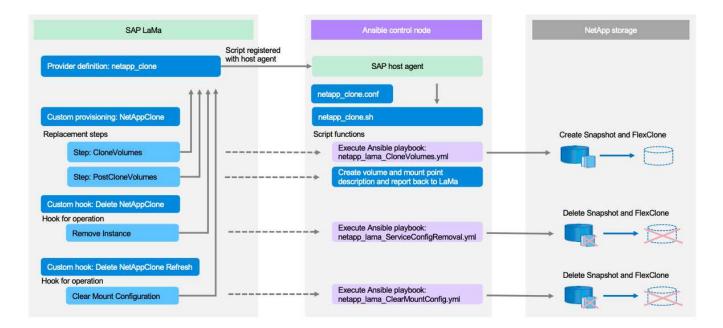
Storage replication with SnapMirror makes it possible to execute disaster recovery testing without putting RTO and RPO at risk. Disaster recovery testing can be performed without interrupting data replication. Disaster recovery testing for both asynchronous and synchronous SnapMirror uses Snapshot backups and FlexClone volumes at the disaster recovery target.

SAP LaMa can be used to orchestrate the entire testing procedure, and it also takes care of network fencing, target host maintenance, and so on.



NetApp SAP LaMa integration using Ansible

The integration approach uses SAP LaMa custom provisioning and operation hooks combined with Ansible playbooks for NetApp storage management. The following figure shows a high-level overview of the configuration on the LaMa side as well as the corresponding components of the example implementation.



A central host acting as an Ansible control node is used to execute the requests from SAP LaMa and to trigger the NetApp storage operations using Ansible playbooks. The SAP host agent components must be installed on this host so that the host can be used as a communication gateway to SAP LaMa.

Within LaMa Automation Studio, a provider is defined that is registered at the Ansible host's SAP host agent. A host agent configuration file points to a shell script that is called by SAP LaMa with a set of command line parameters, depending on the requested operation.

Within LaMa Automation Studio, custom provisioning and a custom hook is defined to execute storage cloning operations during provisioning and also during clean-up operations when the system is deprovisioned. The shell script on the Ansible control node then executes the corresponding Ansible playbooks, which trigger the Snapshot and FlexClone operations as well as the deletion of the clones with the deprovisioning workflow.

More information on NetApp Ansible modules and the LaMa provider definitions can be found at:

- NetApp Ansible modules
- SAP LaMa documentation provider definitions

Example implementation

Due to the large number of options available for system and storage setups, the example implementation should be used as a template your individual system setup and configuration requirements.



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

Validated configurations and limitations

The following principles were applied to the example implementation and might need to be adapted to meet customer needs:

- Managed SAP systems used NFS to access NetApp storage volumes and were set up based on the adaptive design principle.
- You can use all ONTAP releases supported by NetApp Ansible modules (ZAPI and REST API).
- Credentials for a single NetApp cluster and SVM were hard coded as variables in the provider script.
- Storage cloning was performed on the same storage system that was used by the source SAP system.
- Storage volumes for the target SAP system had the same names as the source with an appendix.
- No cloning at secondary storage (SV/SM) was implemented.
- FlexClone split was not implemented.
- Instance numbers were identical for the source and target SAP systems.

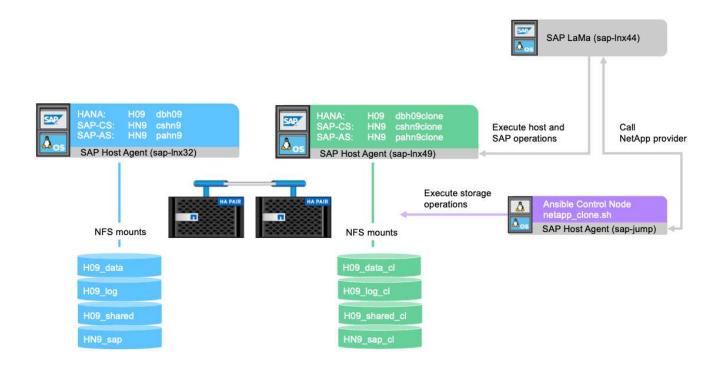
Lab setup

The following figure shows the lab setup we used. The source SAP system HN9 used for the system clone operation consisted of the database H09, the SAP CS, and the SAP AS services running on the same host (sap-Inx32) with installed adaptive design enabled. An Ansible control node was prepared according to the Ansible Playbooks for NetApp ONTAP documentation.

The SAP host agent was installed on this host as well. The NetApp provider script as well as the Ansible playbooks were configured on the Ansible control node as described in the "Appendix: Provider Script Configuration."

The host sap-lnx49 was used as the target for the SAP LaMa cloning operations, and the isolation-ready feature was configured there.

Different SAP systems (HNA as source and HN2 as target) were used for system copy and refresh operations, because Post Copy Automation (PCA) was enabled there.



The following software releases were used in the lab setup:

- SAP LaMa Enterprise Edition 3.00 SP23_2
- SAP HANA 2.00.052.00.1599235305
- SAP 7.77 Patch 27 (S/4 HANA 1909)
- SAP Host Agent 7.22 Patch 56
- SAPACEXT 7.22 Patch 69
- Linux SLES 15 SP2
- Ansible 2. 13.7
- NetApp ONTAP 9.8P8

SAP LaMa configuration

SAP LaMa provider definition

The provider definition is performed within Automation Studio of SAP LaMa as shown in the following screenshot. The example implementation uses a single provider definition that is used for different custom provisioning steps and operation hooks as explained before.

≡	< > SAP s	SAP Lan	dscape Management			Q Refrest	v → Working Set: All	LN1 on sap-lnx44 (17:11)	⑦ lamaa	idmin
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-	Operations Provisioning	>	All Providers (1)						e e 1	t1
°		~	Name	Туре	Target			Used		
	Provider Definitions Custom Operations Custom Hooks Custom Notifications Custom Provisioning Provisioning Blueprints Custom Processes		netspp_clone	Script registered with Host Agent	netapp_clo	ne		۷ ک	1 / 8	>

The provider netapp_clone is defined as the script netapp_clone.sh registered at the SAP host agent. The SAP host agent runs on the central host sap-jump, which also acts as the Ansible control node.

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B Provisioning Provider Definitions Custom Operations Custom Hooks Custom Notifications Custom Provisioning	<pre> netapp_clone Script registered with Host Agent: Summary Central Host: sap-jump </pre>								
Provisioning Blueprints Custom Processes I Customizations I Configuration Configuration Extensions Infrastructure Infrastructure Extension	Used for Operations: Instance, Host Hooks: Instance, Host Notifications: Not Used Provisoning Replacement: Used Parameter Supplier: Not Used Supplier Default Value: Not Used Options								
	Registered Script: netapp_clone Allow HTML Output: Not Used Use Parameter File: Not Used Use Mount Data XML: Not Used Update Custom Properties: Used Execute on Central Host Only: Not Used								

The **Used in** tab shows which custom operations the provider is used for. The configuration for the custom provisioning **NetAppClone** and the custom hooks **Delete NetAppClone** and **Delete NetAppClone Refresh** are shown in the next chapters.

≡	$\langle \rangle$ sap	SAP Land	scape Management	Refresh 🗸	Working Set: All	LN1 on sap-lnx44 (10:32)		lamaadmin
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	Operations Provisioning	>	General Used in Parameters Properties					
°	Automation Studio Provider Definitions	~	Used in (3)					
_	Custom Operations		Name		Туре			
	Custom Hooks		Delete NetAppClone		Hook			
	Custom Notifications		Delete NetAppClone Refresh		Hook			
	Custom Provisioning		NetAppClone		Provisio	ning		
	Provisioning Blueprints	s						
	Custom Processes							

The parameters **ClonePostFix** and **SnapPostFix** are requested during the execution of the provisioning workflow and are used for the Snapshot and FlexClone volume names.

	SAP Lan	dscape Management							Refresh 🗸	Work	ing Set: All	LN1 on sap-lnx4	14 (17:15)		lamaadr
Dashboard Visualization	×	Provider Definitions / netapp_clone											Сору	Edit	Delete
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Custom Operations		Name		Label	Туре	Value	N	andator	Ŋ	Secu	ure	Multivalue			
Custom Hooks		ClonePostFix		ClonePostFix	String									1	8
Custom Notifications		SnapPostFix		SnapPostFix	String			C						0	8

SAP LaMa custom provisioning

In the SAP LaMa custom provisioning configuration, the customer provider described before is used to replace the provisioning workflow steps **Clone Volumes** and **PostCloneVolumes**.

≡	< > SAP Lan	dscape Management			Q, Refresh \vee Working Set: A	ll LN1 on sap-lnx44 (16:51) ⑦ lamaadmin
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*	Operations >					
201	Provisioning	All Custom Provisioning Processes > NetAppClone (2	1			Add Replacement Step
ô	Automation Studio 🗸 🗸	Name	Provider Parameters		Instance Type	
	Provider Definitions	CloneVolumes				
	Custom Operations Custom Hooks	Clone Volumes	netapp_clone		Default (all unused instance types)	
	Custom Notifications	FinalizeCloneVolumes				
	Custom Provisioning	Modify Mountpoints and add Custom Properties	netapp_clone		Default (all unused instance types)	1 8
	Provisioning Blueprints Custom Processes UI Customizations					

SAP LaMa custom hook

If a system is deleted with the system destroy workflow, the hook **Delete NetAppClone** is used to call the provider definition netapp_clone. The **Delete NetApp Clone Refresh** hook is used during the system refresh workflow because the instance is preserved during the execution.

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Custom Hooks	Delete NetAppClone	Instance	netapp_clone	Pre hoo	k for 'Remove Instance'	
Custom Notifications Custom Provisioning Provisioning Blueprints						
Custom Processes						

It is important to configure **Use Mount Data XML** for the custom hook, so that SAP LaMa provides the information of the mount point configuration to the provider.

To ensure that the custom hook is only used and executed when the system was created with a custom provisioning workflow, the following constraint is added to it.

≡	< > <u>SA</u>	SAP L	andscape Manage	ement					Refresh	Working Set: All	LN1 on sap-lnx4	4 (10:43)		lamaadmin
12	Overview Dashboard Visualization	~	Custom Ho	^{ooks /} NetAppClor	ne							Сору	Edit	Delete
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	Operations Provisioning	>	General	Parameters	Constraints									
Ŷ	Automation Studio		Constr	raints (1) 👔]							Add	I Constra	aint
	Custom Operation		Name			Operator		Value						
	Custom Hooks		Custom	clone process n	name (Static)	=		NetAppClone					0	8
	Custom Notificatio													
	Custom Provisioni Provisioning Blue	prints												
	Custom Processes	5												

More information about the use of custom hooks can be found in the SAP LaMa Documentation.

Enable custom provisioning workflow for SAP source system

To enable the custom provisioning workflow for the source system, it must be adapted in the configuration. The **Use Custom Provisioning Process** checkbox with the corresponding custom provisioning definition must be selected.

Landscape Manageme	nt				Working Set:	All>	i Go	🗢 🔿 🛛 LN
Automation Studio	Infrastructure							
Pools Systems Hosts	Characteristics							
Dverview of Systems and Instances								=
Discover Remove Instance and System	Reassign Instances Mass Configuration Filtering Export Import							۵ 🏼 🧞
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7								
 HN9: NetWeaver ABAP 7.77, cshn9 					MUCCBC			
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Central services: 01, cshn9			2		MUCCBC	MUCCBC-SAP-Front		
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HNA: NetWeaver ABAP 7.77, cshna			ж	×	MUCCBC			
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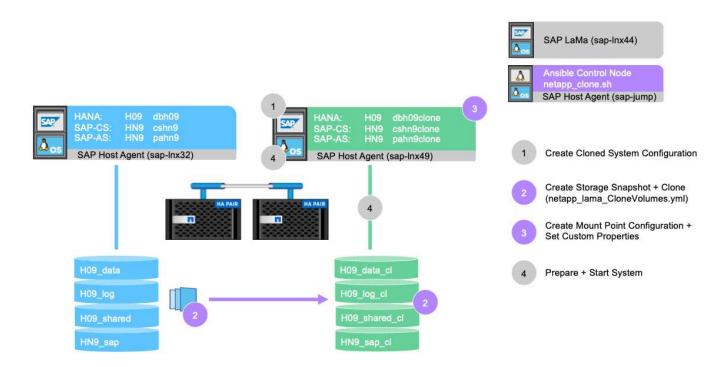
SAP LaMa provisioning workflow - clone system

The following figure highlights the main steps executed with the system clone workflow.

System Clone	
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In this section, we go through the complete SAP LaMa system cloning workflow based on the source SAP system HN9 with HANA database H09. The following picture gives an overview of the steps executed during the workflow.



1. To start the cloning workflow, open **Provisioning** in the menu tree and select the source system (in our example HN9). Then start the **Clone System** wizard.

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	Dashboard Visualization SAP Database Administration Search	Provisioning Systems View V					∑ Hide Filt
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2. Enter the requested values. Screen 1 of the wizard asks for the pool name for the cloned system. This step specifies the instances (virtual or physical) on which the cloned system will be started. The default is to clone the system into the same pool as the target system.

\equiv <	> SAP Landscape Management		lamaadmin
Dash Visua SAP I	Clone System (1) HN9: NetWeaver ABAP 7:77, cdm9	Show Source Data Create Provisioning Blueprint Remote Execution	Hide Filters)
Searce Coper B Provi	Provide Basic Data for Target System		⊽ _x ⊽,
Custo	*Pool MUCCBC [7] *Short Name		•
Custo	Cione of System 'NN9'		ning 🗸
Custo Provi Custo			ning 🗸
Confi			
く Confi 品 Infras 品 Setup			
	O Ignore Warnings for This Step Validate Step Reset Step	< Previous Next > Finish Execute Cancel	

3. Screen 2 of the wizard asks for the target hosts that the new SAP instances are started on. The target hosts for this instance(s) can be selected out of the host pool specified in the previous screen. Each instance or service can be started on a different host. In our example, all three services run on the same host.

=	$\langle \rangle$	SAP SAP Landscape Management Q	Refres	h 😪 Working Set: All 🔒	N1 on sap-lnx4	4 (17:23)) lamaadmin
Vi	vervie ashbo sualiz NP Da	Clone System HN9: NetWeaver ABAP 7.77, cshn9 Basic Hots Names Custom Clone Consistency Revert To DB Snapshot Summary	Data	Create Provisioning Blueprint	Remote Exec	ution	Hide Filters
Se • 01	iarch beratie	Host Selection of Target System					Vx V+
BB Pr	ovisio	Instance		Target Host/Virtual Host			** *+
% AL	ıtoma	System database: MASTER (configured) : SAP HANA 02		sap-lnx49		CP	# ©
	ovide	AS instance: 00		sap-lnx49		e	
	ustorn	Central services: 01.		sap-Inx49		c	oning 🗸
Cu	ustom	Provisioned/Cloned Virtual Hosts				Add	
	ovisio	Target Virtual Host Source Virtual Host					
Cu	istom	No data					oning 🗸
図 UI M A C C A C C III A A C C III A A C C	onitor onfigu onfigu frastri						
		Ignore Warnings for This Step Validate Step Reset Step		< Previous Next >	Finish Execu	ute Cance	

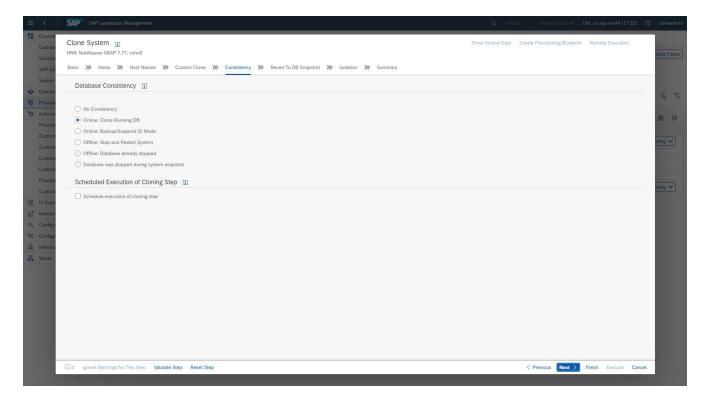
4. Provide the information requested in screen 3, which asks for virtual host names and networks. Typically, the host names are maintained in DNS, so the IP addresses are prepopulated accordingly.

HN9: NetWeaver ABAP 7.77,		>>> Consistency >>> Revert To	DB Snapshot 💥 Isolation 💥 Sum	mary		
Virtual Host Names a		m consistency m recert to	oo ongonot yy isaanon yy san	ine i		
Host Name	Auto IP Address	IP Address	Target Network	Instance/Virtual Host	Host Name Usage	Add
dbh09clone.muccbc.hq.n		172.30.15.157	MUCCBC-SAP-Front V	System database: MASTER (co	Communication Host Name	8
pahn9clone.muccbc.hq.n	etap	172.30.15.159	MUCCBC-SAP-Front V	AS instance: 00	Communication Host Name	8
cshn9clone.muccbc.hq.n	etap	172.30.15.158	MUCCBC-SAP-Front 🗸	Central services: 01	Communication Host Name	8

5. In screen 4, the custom clone operations are listed. A clone and a **SnapPostfix** name are provided, which are used during the storage clone operation for the FlexClone volume and Snapshot name, respectively. If you leave these fields empty, the default value configured in the variable section of the provider script netapp clone.sh is used.

≡ <	SAP SAP SAP Landscape Management		Q Refresh - Working Set: All LNI on sap-inx44 (17:23)	② lamaadmin
Dashb Visual SAP D	Clone System T HN9: NetWever ABAP 7.77, cshn9 Basic XX Hots XX Hots Names XX Custom Clone XX Consistency	>>> Revert To DB Snapshot >>>> Isolation >>>> Summary	Show Source Data Create Provisioning Blueprint Remote Execution	Hide Filters
Search	Custom Clone			V. V.
B Provis	Operation	Hook	Selected Instances	
% Autom	Clone Volumes	Clone Volumes	Central services (ABAP): 01, cshn9, AS instance (ABAP): 00, pahn9, System database (ABAP): MASTER : H09, SAP HANA 02, dbh09	۵
Provid	Finalize Clone Volumes	Modify Mountpoints and add Custom Properties	Central services (ABAP): 01, cshn9, AS instance (ABAP): 00, pahn9, System database (ABAP): MASTER : HN9, SAP HANA 02, dbh09	oning 🗸 🔪
Custor	Operation Parameters		Show All Parameters	nung 🗸
	ClonePostFix			
Custor	_clone_20221115			
Provis	SnapPostFix			aning 🗸
Custo	_snap_20221115			
🧟 Ul Cur				
Monito				
S Config				
🕸 Config				
🔏 Infrast				
Setup				
dik Setup				
	O Ignore Warnings for This Step Validate Step Reset Step		Y Previous Next > Finish Execute Cance	el

6. In screen 5, the database consistency option is selected. In our example, we selected **Online: Clone running DB**.



7. In screen 6, input is only required if you perform a tenant clone.

= < >			
26 Overvie Dashbo	Clone System	Show Source Data Create Provisioning Blueprint Remote Execution	lide Filters
Visualiz SAP Da	Basic XXX Hosts XXX Host Names XXX Custom Clone XXX Consistency XXX Revert To DB Snapshot XXX Isolation XXX Summary		
Search Operation B Provision	This step is required only for HANA single tenant database clone, using a database snapshot. For any other scenarios you can proceed without entering any credentials.]	∇ _x ∇ ₊
C Automa Provide	Provide Username and Password Source SystemDB Administrator User		@ @
Custom	Source SystemDB Administrator Password		ning 🗸
Custom Custom Provisio			
Custom			ning 🗸
Configu			
ペ Configu品 Infrastru品 Setup			
ais Setap			
	O Ignore Warnings for This Step Validate Step Reset Step	C Previous Next > Finish Execute Cancel	

8. In screen 7, system isolation can be configured.

Define Allowed Outgoing Conne Rule Type	ections for System Isolation				
Rule Type				ce Host 🗸 Host Name: sap-Inx49 🗸 Get Connecti	ans Ad
	Target Host	Target Port	Predefined	Explanation Allow communication to host (localhost) on all	
Host 🗸	locathost	Any port		Allow communication to nost (localnost) on all ports	\otimes
Port ~	Any host name	nfs	V	 Allow communication to all hosts on port/service (nfs) 	\otimes
Port 🗸	Any host name	ldap	V	 Allow communication to all hosts on port/service (Idap) 	\otimes
Port \vee	Any host name	ldaps	V	 Allow communication to all hosts on port/service (Idaps) 	8
Port ~	Any host name	cifs	V	 Allow communication to all hosts on port/service (cifs) 	\otimes
Port 🗸	Any host name	microsoft-ds	V	 Allow communication to all hosts on port/service (microsoft-ds) 	\otimes

9. In screen 8, a summary page contains all the settings for final confirmation before the workflow is started. Click **Execute** to start the workflow.

: NetWeaver ABAP 7.77, cshn9					
ic 🐝 Hosts 🐝 Host Names 🕽	Solution Clone Con	sistency 💓 Revert To DB Snapshot 💥	Isolation XX Summary		
✓ Host Names					
 Host Names 					
Virtual Host Names and Networ	rks				
Host Name	Auto IP Address	IP Address	Target Network	Instance/Virtual Host	Host Name Usage
dbh09clone.muccbc.hq.netapp.com		172.30.15.157	MUCCBC-SAP-Front 🗸	System database: MASTER (configu	Communication Host Name
pahn9clone.muccbc.hq.netapp.com		172.30.15.159	MUCCBC-SAP-Front 🗸	AS instance: 00	Communication Host Name
cshn9clone.muccbc.hq.netapp.com		172.30.15.158	MUCCBC-SAP-Front V	Central services: 01	Communication Host Name
 Custom Clone 					
Custom Clone Operation		Hook		Selected Instances	
Custom Clone		Hook Clone Volumes		Central services (ABAP): 01, cshn9, AS in	
Custom Clone Operation			stom Properties		ANA 02, dbh09 stance (ABAP): 00, pahn9, System
Custom Clone Operation Clone Volumes		Clone Volumes	stom Properties	Central services (ABAP): 01, cshn9, AS in database (ABAP): MASTER : H09, SAP H Central services (ABAP): 01, cshn9, AS in	ANA 02, dbh09 stance (ABAP): 00, pahn9, System ANA 02, dbh09
Custom Clone Operation Clone Volumes Finalize Clone Volumes		Clone Volumes	stom Properties	Central services (ABAP): 01, cshn9, AS in database (ABAP): MASTER : H09, SAP H Central services (ABAP): 01, cshn9, AS in	ANA 02, dbh09 stance (ABAP): 00, pahn9, System ANA 02, dbh09
Custom Clone Operation Clone Volumes Finalize Clone Volumes Operation Parameters ClonePostFix clone_20221115		Clone Volumes	stom Properties	Central services (ABAP): 01, cshn9, AS in database (ABAP): MASTER : H09, SAP H Central services (ABAP): 01, cshn9, AS in	ANA 02, dbh09 stance (ABAP): 00, pahn9, System ANA 02, dbh09
Custom Clone Operation Clone Volumes Finalize Clone Volumes Operation Parameters ClonePostFix chone_20221115 SnapPostFix		Clone Volumes	stom Properties	Central services (ABAP): 01, cshn9, AS in database (ABAP): MASTER : H09, SAP H Central services (ABAP): 01, cshn9, AS in	ANA 02, dbh09 stance (ABAP): 00, pahn9, System
Custom Clone Operation Clone Volumes Finalize Clone Volumes Operation Parameters ClonePostFix clone_20221115		Clone Volumes	atom Properties	Central services (ABAP): 01, cshn9, AS in database (ABAP): MASTER : H09, SAP H Central services (ABAP): 01, cshn9, AS in	ANA 02, dbh09 stance (ABAP): 00, pahn9, System ANA 02, dbh09

SAP LaMa now performs all the actions indicated in the configuration. These actions include creating the storage volume clones and exports, mounting them to the target host, adding the firewall rules for isolation, and starting the HANA database and SAP services.

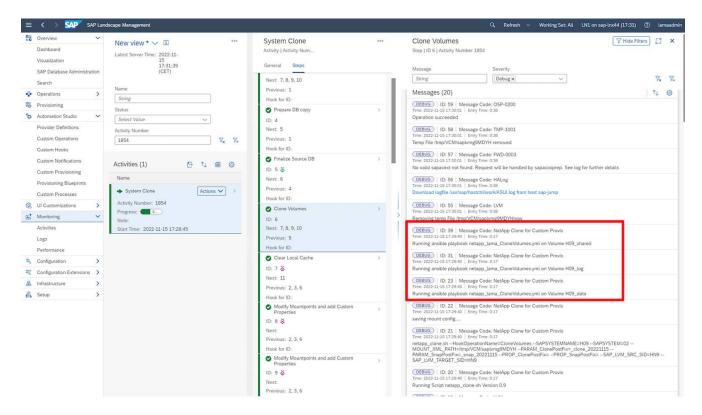
10. You can monitor the progress of the clone workflow under the **Monitoring** menu.

=	< > SAP SAP Lar	idscape Management						Q, Refresh	 Working Set: All LN1 on sap-Inx44 (17:2 	3) (?) Lai	ımaadmin
87 45	Overview Visualization	New view * 🔽 🛙 Latest Server Time: 202							Mass Actions	V THid	le Filters
	SAP Database Administration	Name	Statu	s	Activity Number						
	Search	String	Sele	ect Value 🗸 🗸	1854					V	V _x V ₊
•:•	Operations >										
暍	Provisioning	Activities (1)							6	1. ∰	0
°o	Automation Studio	Name	Activity Number	Progress	Note	Start Time	Duration	User	Retry Of Root Activity		
	Provider Definitions	System Clone	1854	(0%)	1000	2022-11-15 17:28:45		lamaadmin	neay of nour heavily	Actions V	
	Custom Operations Custom Hooks										_
	Custom Notifications										
	Custom Provisioning										
	Provisioning Blueprints										
	Custom Processes										
08	UI Customizations										
•	Monitoring 🗸 🗸										
	Activities										
	Logs										
	Performance										
2	Configuration >										
*	Configuration Extensions $\$										
品	Infrastructure >										
dī.	Setup >										

Within the detailed log, the operations **Clone Volume** and **Modify Mountpoints and add Custom Properties** are executed at the Ansible node, the sap-jump host. These steps are executed for each service, the HANA database, the SAP central services, and the SAP AS service.

E Outraine										<i>(</i>		
Overview Dashboard Visualization SAP Database Administration	New view * > 1 Mass / Latest Server Time: 2022-11-15 17:30:11 (CET)	Actions V	System Clone Activity Activity Numbe General Steps	r 1854						Support Informatio	n) []	×
Search	Name String		Steps (29)							V Hide Filters	↑↓	0
Operations >	Status		Status		Operation							
Provisioning		~	Select Value	~	String						V.	74
Automation Studio											10	a
Provider Definitions	1854	Vx V+	Operation	ID	Next	Previous	Hook for ID	Instance/Virtual Element	Host/Parent Virtual Element	Step Time	Duratio	
Custom Operations Custom Hooks Custom Notifications	Activities (1)	tı ∰ ⊚	Create Target System	1	2, 3, 4			HN9: NetWeaver ABAP 7.77, dbh09clone.muccbc. hq.netapp.com		0:00	0:00	0 >
Custom Provisioning Provisioning Blueprints	System Clone	ictions 🗸 🔿	Clone Volumes	2	7, 8, 9, 10	1		HN9 AS instance (ABAP): 00, pahn9	sap-jump	0:00	0:13	3 >
Custom Processes	Activity Number: 1854 Progress: 24%		Clone Volumes	3	7, 8, 9, 10	1		HN9 Central services (ABAP): 01, cshn9	sap-jump	0:00	0:13	з о
UI Customizations > Monitoring ~ Activities	Note:	, , , , ,	Prepare DB copy	4	5	1		H09 System database (ABAP): MASTER : SAP HANA 02, dbh09	sap-lnx32	0:00	0:1/	5 >
Logs Performance			Finalize Source DB	5	6	4		H09 System database (ABAP): MASTER : SAP HANA 02, dbh09	sap-lnx32	0:16	0:2	1 >
Configuration Extensions > Infrastructure >			Clone Volumes	6	7, 8, 9, 10	5		H09 System database (ABAP): MASTER : SAP HANA 02, dbh09	sap-jump	0:37	0:3	8)
Setup >			Clear Local Cache	7	п	2, 3, 6		HN9: NetWeaver ABAP 7.77, dbh09clone.muccbc. hq.netapp.com	sap-lnx49	1:15	0:0	0 >
			 Modify Mountpoints and add Custom Properties 	8		2, 3, 6		H09 System database (ABAP): MASTER : SAP HANA 02, dbh09clone.muccbc. hq.netapp.com	sap-jump	1:15	0:0	9 >
			 Modify Mountpoints and add Custom Presenting 	9		2, 3, 6		HN9 AS Instance (ABAP): 00, pahn9clone.muccbc. ho.netapp.com	sap-jump	1:15	0:0	9 >

11. By selecting the **Clone Volumes** task the detailed log for that step is displayed and the execution of the Ansible Playbook is shown here. You can see, that the Ansible playbook netapp_lama_CloneVolumes.yml is executed for each HANA database volume, data, log, and shared.



12. In the details view of the step **Modify Mountpoints and add Custom Properties**, you can find information about the mount points and the custom properties handed over by the execution script.

Overview 🗸		2			[
Dashboard	Latest Server Time: 2022-11-	System Clone Activity Activity Num	030	Modify Mountpoints and add Custom Properties Step ID 10 Activity Number 1854		×
	17:32:39	General Steps		Message Severity		
SAP Database Administration	(CET)	Previous: 1		String Debug X Result X V	7.	5
Search	Name	Hook for ID:				
Operations >	String	Finalize Source DB		Messages (15)	t.	6
Provisioning	Status	ID: 5		DEBUG ID: 40 Message Code: LVM		0
Automation Studio	Select Value	Next: 6		Time: 2022-11-15 17:30:31 Entry Time: 0:30		
Provider Definitions	Activity Number	Previous: 4		Updates Persisted		
Custom Operations	1854 V _x V ₄	Hook for ID:		DEBUG ID: 39 Message Code: LVM Time: 2022-11-15 17:30:31 Entry Time: 0:30		
Custom Hooks		Clone Volumes	2	obraring adsteamprutational randominion and concrete adstead by com-		
Custom Notifications	Activities (1)	ID: 6 📚		RESULT ID: 24 Message Code: NetApp Clone for Custom Provis		
Custom Provisioning		Next: 7, 8, 9, 10		Time: 2022-11-15 17:30:20 Entry Time: 0:18 Got new property SnapPostFix= snap 20221115		
Provisioning Blueprints	Name	Previous: 5				
Custom Processes	➡ System Clone Actions ♥ >	Hook for ID:		RESULT ID: 23 Message Code: NetApp Clone for Custom Provis Time: 2022-11-15 17:30:20 Entry Time: 0:18		
UI Customizations	Activity Number: 1854	Clear Local Cache	>	Got new property ClonePostFix=_clone_20221115		
Monitoring ~	Progress: 83%	ID: 7	>	DEBUG ID: 22 Message Code: NetApp Clone for Custom Provis		
Activities	Note:	Next: 11 Previous: 2, 3, 6		Time: 2022-11-15 17:30:20 Entry Time: 0:18 netapp_clone.shHookOperationName=FinalizeCloneVolumesSAPSYSTEMNAME=HN9	SAPSYSTEM=01	
Logs	Start Time: 2022-11-15 17:28:45	Hook for ID:		MOUNT_XML_PATH=PARAM_ClonePostFix=_clone_20221115PARAM_SnapPostFix=_sr PROP_ClonePostFix=PROP_SnapPostFix=SAP_LVM_SRC_SID=HN9SAP_LVM_TARGI	ap_20221115 ET_SID=HN9	
Performance		Modify Mountpoints and add Custom Properties	>	DEBUG ID: 21 Message Code: NetApp Clone for Custom Provis Time: 2022-11-15 17:30:20 Entry Time: 0:18		
Configuration >		ID: 8		Running Script netapp_clone.sh Version 0.9		
Configuration Extensions		Next:		DEBUG ID: 12 Message Code: LVM		
Infrastructure >		Previous: 2, 3, 6		Time: 2022-11-15 17:30:01 Entry Time: 0:00 Retrieved the following parameters from hostagent [name: ClonePostFix, is a CustomProperty	u nomer ClanePostEirr in	
Setup >		Hook for ID: Modify Mountpoints and add Custom Properties	>	CustomParamoter, name: SnapPostFix, is a CustomPorperty, name: MOUNT_XML_PATH, nan name: HookOperationName, name: SnapPostFix, is a CustomParameter, name: SAP_LVM_SI SAP_LVM_TARGET_SID, name: SAPPOstFix	me: SAPSYSTEMNAME.	0.0
		ID: 9		DEBUG ID: 10 Message Code: LVM		
		Next:		Time: 2022-11-15 17:30:01 Entry Time: 0:00		
		Previous: 2, 3, 6		Updating logs		
		Hook for ID:		DEBUG ID: 9 Message Code: LVM Time: 2022-11-15 17:30:01 Entry Time: 0:00		
		 Modify Mountpoints and add Custom Properties 	>	Generic Transferred Parameters:		
		ID: 10		CustomOpid: 'e0c689cc-6017-11ed-c90e-0000007e9672' HookOperationName: 'FinalizeCloneVolumes'		
		Next:		HostName: 'sap-Inx49' Previous Service ID: 'SystemID.HN9.Number.01.InstanceHost.cshn9'		
		Previous: 2, 3, 6		Serviceld: 'SystemID.HN9.Number.01.InstanceHost.cshn9clone.muccbc.hq.netapp.com'		

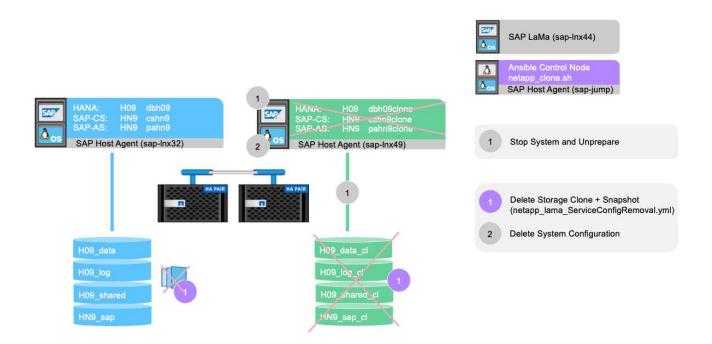
After the workflow has been completed, the cloned SAP system is prepared, started, and ready for use.

SAP LaMa deprovisioning workflow - system destroy

The following figure highlights the main steps executed with the system destroy workflow.



1. To decommission a cloned system, it must be stopped and prepared in advance. Afterwards the system destroy workflow can be started.



- 2. In this example, we run the system destroy workflow for the system created before. We select the system in the **System View** screen and start the system destroy workflow under **Destroy Processes**.
- 3. All the mount points maintained during the provisioning phase are shown here and are deleted during the system destroy workflow process.

Storage Volum	Volume	Storage Manager	Storage System	Storage Pool	1	olume Group	Latest Moni	itaria e Tima
Detete	volume	Stolage manager	No data		,	orame droup	Latest MUTH	noring time
Mount Data V	Without Corresponding St	orade Volume	110 0818					
	without corresponding 5t							
Instance		Storage Type	Export Path		Mount Point		Mount Options	
AS instance: 00		NETES	192.168.10.14:/HN9_sap_	_	/home/hn9adm			e=65536,wsize=65536,r
AS instance: 00 AS instance: 00		NETFS	192.168.10.14:/HN9_sap_		/sapmnt/HN9 /usr/sap/HN9			e=65536,wsize=65536,r e=65536,wsize=65536,r
AS instance: 00 AS instance: 00		NETES	192.168.10.14:/HN9_sap_ 192.168.10.14:/HN9_sap_		/usr/sap/miv9			e=65536,wsize=65536,r
AS instance: 00		NETFS	192.168.10.14:/HN9_sap_		/usr/sap/trans			e=65536,wsize=65536,r
	: MASTER : H09, SAP HANA 02	NETFS	192.168.10.14:/H09_data		/hana/data/H09			e=65536,wsize=65536,r
	: MASTER : H09, SAP HANA 02	NETFS	192.168.10.14:/H09_log_c		/hana/log/H09			e=65536.wsize=65536.r
	: MASTER : H09, SAP HANA 02	NETFS	192.168.10.14:/H09_share		/hana/shared/H09			e=65536,wsize=65536,r
Central services:		NETFS	192.168.10.14:/HN9_sap		/home/hn9adm			e=65536,wsize=65536,r
Central services:	01	NETFS	192.168.10.14:/HN9_sap_	clone_20221115/sapmnt	/sapmnt/HN9		rw,noatime,vers=3,rsize	e=65536,wsize=65536,r
Central services:	01	NETFS	192.168.10.14:/HN9_sap_	clone_20221115/HN9	/usr/sap/HN9		rw,noatime,vers=3,rsize	e=65536,wsize=65536,r
Central services:	01	NETFS	192.168.10.14:/HN9_sap_	clone_20221115/ccms	/usr/sap/ccms/HN9_00		rw,noatime,vers=3,rsize	e=65536,wsize=65536,r
Central services:	01	NETFS	192.168.10.14:/HN9_sap_	clone_20221115/saptr	/usr/sap/trans		rw,noatime,vers=3,rsize	e=65536,wsize=65536,r
Monitoring Time:][Monitoring Data						

No virtual hostnames are deleted because they are maintained through DNS and have been assigned automatically.

≡ < >	SAP Landscape Management	Q Refresh 🗸 Working Set: All	LN1 on sap-inx44 (17:52) 🤇) lamaadmi
Dashbo Visualiz	Destroy System I HN9: NetWeaver ABAP 7.77, dbh09clone.muccbc.hq.r	Show Source Data Create Provisioning Blueprint	Remote Execution	Hide Filters
SAP Da	Delete Storage Volumes 🔉 Delete Host Names	3 Summary		
Search	Host Names			
	Delete DNS Server	Host Name IP Address		$\nabla_{\mathbf{x}} = \nabla_{\mathbf{x}}$
% Automa		No data		
Provide				
Custom				oning 🗸
Custom				aning 🗸
Custom				
Provisio				
Custom				
CUI Cust				oning 🗸
🚓 Monitor				
Activitie				
Logs				
Perform				
2 Configu				
& Infrastru				
E Setup				
	O Ignore Warnings for This Step Validate Step	Reset Step C Previous Next >	Finish Execute Cancel	

4. The operation is started by clicking the execute button.

SAP advises that it is the cu	stomer's responsibility to	o ensure that no data is lost when the se	lected volumes/virtual hosts are deleted by	SAP Landscape Man	agement.	
 Delete Storage Volum Storage Volumes 	es					
Delete Vol	ume	Storage Manager	Storage System	Storage Pool	Volume Group	Latest Monitoring Time
			No data			
Mount Data Without	Corresponding Sto	orage Volume				
Instance		Storage Type	Export Path		Mount Point	Mount Options
AS instance: 00		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/hn9	/home/hn9adm	rw,noatime,vers=3,rsize=65536,wsize=65536,
AS instance: 00		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/sap	/sapmnt/HN9	rw,noatime,vers=3,rsize=65536,wsize=65536,
AS instance: 00		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/HN9	/usr/sap/HN9	rw,noatime,vers=3,rsize=65536,wsize=65536,
AS instance: 00		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/ccms	/usr/sap/ccms/HN9_00	rw,noatime,vers=3,rsize=65536,wsize=65536,
AS instance: 00		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/sapt	/usr/sap/trans	rw,noatime,vers=3,rsize=65536,wsize=65536,
System database: MASTER	2 : H09, SAP HANA 02	NETFS	192.168.10.14:/H09_data_clo	one_20221115/data	/hana/data/H09	rw,noatime,vers=3,rsize=65536,wsize=65536,
System database: MASTER	2 : H09, SAP HANA 02	NETFS	192.168.10.14:/H09_log_clor	ne_20221115/log	/hana/log/H09	rw,noatime,vers=3,rsize=65536,wsize=65536,
System database: MASTER	2 : H09, SAP HANA 02	NETFS	192.168.10.14:/H09_shared_	clone_20221115/s	/hana/shared/H09	rw,noatime,vers=3,rsize=65536,wsize=65536,
Central services: 01		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/hn9	/home/hn9adm	rw,noatime,vers=3,rsize=65536,wsize=65536,
Central services: 01		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/sap	/sapmnt/HN9	rw,noatime,vers=3,rsize=65536,wsize=65536,
Central services: 01		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/HN9	/usr/sap/HN9	rw,noatime,vers=3,rsize=65536,wsize=65536,
Central services: 01		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/ccms	/usr/sap/ccms/HN9_00	rw,noatime,vers=3,rsize=65536,wsize=65536,
Central services: 01		NETFS	192.168.10.14:/HN9_sap_clo	ne_20221115/sapt	/usr/sap/trans	rw,noatime,vers=3,rsize=65536,wsize=65536,

SAP LaMa now performs the deletion of the volume clones and deletes the configuration of the cloned system.

5. You can monitor the progress of the clone workflow under the **Monitoring** menu.

Overview Dashboard Visualization SAP Database Administration	New view * V I Latest Server Time: 2022-11-15 17:52:54 (CET)	Mass Actions 🗸 🚥	System destroy Activity Activity Numb General Steps	er 1861						Support Informa	tion	23
Search	Name		Steps (4)							V Hide Filters	ন 🕰	. 6
Operations >	String									p mac man	9e	
Provisioning	Status Select Value	~]	Status Select Value	~	Operation							Z
🗘 Automation Studio 🗸 🗸	Activity Number	×	Select Value	~	String						V×	v
Provider Definitions Custom Operations	1861	V _x V ₄	Operation	ID	Next	Previous	Hook for ID	Instance/Virtual Element	Host/Parent Virtua Element	al Step Time	Duratio	on
Custom Hooks Custom Notifications	Activities (1)	ᠿ ∿ ∰ ⊚	Delete NetAppClone	1	2, 3, 4		4	HN9 Central services (ABAP): 01, cshn9clone.muccbc.h q.netapp.com	sap-jump	0:00	0::	:11
Custom Provisioning Provisioning Blueprints Custom Processes	System destroy Activity Number: 1861	Actions V >	Delete NetAppClone	2	3, 4	1	4	HN9 AS instance (ABAP): 00, pahn9clone.muccbc. hq.netapp.com	sap-jump			
2 UI Customizations	Progress: 0%							H09 System				
Monitoring V Activities	Start Time: 2022-11-15 17:55:03		> Delete NetAppClone	3	4	1, 2	4	02, dbh09clone.muccbc.	sap-jump			
Logs								hq.netapp.com HN9: NetWeaver				
Performance			O Remove	4		1, 2, 3		ABAP 7.77,				
Configuration			Instance					dbh09clone.muccbc. hq.netapp.com				
-												
R Infrastructure >												

6. By selecting the **Delete NetAppClone** task, the detailed log for that step is displayed. The execution of the Ansible Playbook is shown here. As you can see, the Ansible playbook

netapp_lama_ServiceConfigRemoval.yml is executed for each HANA database volume, data, log, and shared.

Overview 🗸					
Dashboard Visualization	New view * V II **** Latest Server Time: 2022-11- 15	System destroy Activity Activity Numb	***	Delete NetAppClone Step ID 3 Activity Number 1861	[]
SAP Database Administration	17:56:28 (CET)	General Steps		Message Severity	
	(CEI)			String Debug x Result x V	٧,
Search	Name	Steps (4) V Hide Filters	0		
Operations >	String	Status		Messages (19)	
Provisioning	Status	Select Value			×
Automation Studio	Select Value ~	Operation		DEBUG ID: 60 Message Code: OSP-0200 Time: 2022-11-15 17:56:23 Entry Time: 0:37	
Provider Definitions	Activity Number	String 🗸	₩.	Operation succeeded	
Custom Operations	1861 V _× V ₊			DEBUG ID: 59 Message Code: TMP-1001	
Custom Hooks		Operation		Time: 2022-11-15 17:56:23 Entry Time: 0:37 Temp File /tmp/VCM/saply/mZJM1D2 removed	
Custom Notifications		 Delete NetAppClone 	>	DEBUG ID: 58 Message Code: FWD-0003	
Custom Provisioning	Activities (1) 🕒 🔃 🌐 🐵	ID: 1 🐳		Time: 2022-11-15 17:56:23 Entry Time: 0:37	
Provisioning Blueprints	Name	Next: 2, 3, 4		No valid sapacext not found. Request will be handled by sapacosprep. See log for further details	
Custom Processes	➡ System destroy	Previous:		DEBUG ID: 57 Message Code: HALog Time: 2022:11-15 17:56:23 Entry Time: 0:37	
UI Customizations	Activity Number: 1861	Hook for ID: 4		Download logfile /usr/sap/hostctrl/work/ASUI.log from host sap-jump	
	Progress: 75%	Delete NetAppClone	>	DEBUG ID: 56 Message Code: LVM	
Monitoring ~	Note:	ID: 2 😻	í	Time: 2022-11-15 17:56:23 Entry Time: 0:37	
Activities	Start Time: 2022-11-15 17:55:03	Next: 3, 4		Removing temp File /tmp/VCM/saplvmZJM1D2now	
Logs		Previous: 1		DEBUG ID: 39 Message Code: NetApp Clone for Custom Provis Time: 2022-11-15 17:56:00 Entry Time: 0:14	
Performance		Hook for ID: 4	_	Running ansible playbook netapp_lama_ServiceConfigRemoval.yml on Volume H09_shared	
Configuration >		Delete NetAppClone	>	DEBUG ID: 31 Message Code: NetApp Clone for Custom Provis	
Configuration Extensions		ID: 3 Next: 4		Time: 2022-11-15 17:56:00 Entry Time: 0:14 Running ansible playbook netapp Jama ServiceConfigRemoval.yml on Volume H09. log	
Infrastructure >		Previous: 1. 2			
Setup >		Hook for ID: 4		DEBUG ID: 23 Message Code: NetApp Clone for Custom Provis Time: 2022-11-15 17:56:00 Entry Time: 0:14	
		Remove Instance	~	Running ansible playbook netapp_lama_ServiceConfigRemoval.yml on Volume H09_data	
				DEBUG ID: 22 Message Code: NetApp Clone for Custom Provis	
		Next:		Time: 2022-11-15 17:56:00 Entry Time: 0:14 netapp_clone.shHookOperationName=ServiceConfigRemovalSAPSYSTEMNAME=H09SAPSYSTEM=02	
		Previous: 1, 2, 3		MOUNT_XML_PATH=/tmp/VCM/saplvmZJM1D2PARAM_ClonePostFix=PARAM_SnapPostFix= PROP_ClonePostFix=_clone_20221115PROP_SnapPostFix=_snap_20221115SAP_LVM_SRC_SID=	
		Hook for ID:		SAP_LVM_TARGET_SID=	
		-		DEBUG ID: 21 Message Code: NetApp Clone for Custom Provis	
				Time: 2022-11-15 17:56:00 Entry Time: 0:14 Running Script netapp_clone.sh Version 0.9	
				DEBUG ID: 13 Message Code: LVM	
				Time: 2022-11-15 17:55:46 Entry Time: 0:00	
				Retrieved the following parameters from hostagent [name: ClonePostFix, is a CustomProperty, name: ClonePostFix	ĸ

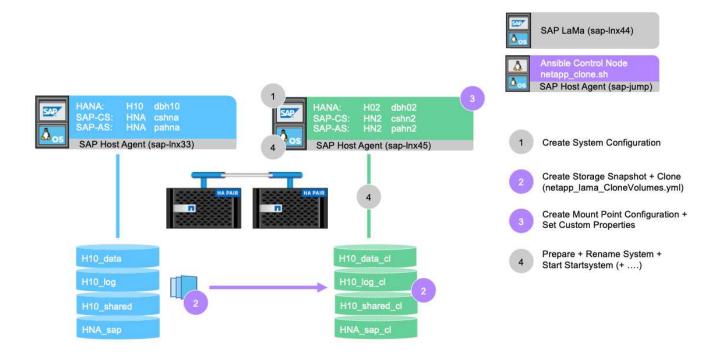
SAP LaMa provisioning workflow - copy system

The following figure highlights the primary steps executed with the system copy workflow.

System Copy

Storage	Prepare	Activate	System	Start	Import Configuration +	Deactivate
Cloning	System	Isolation	Rename	System	Post Copy Automation	Isolation

In this chapter, we briefly discuss the differences for the system clone workflow and input screens. As you can see in the following image, nothing changes in the storage workflow.



1. The system copy workflow can be started when the system is prepared accordingly. This is not a specific task for this configuration, and we do not explain it in detail. If you need further information, review the SAP LaMa documentation.

=	< > SAP SAP Land	scape Management		Q, Re	fresh 🗸 Working Set: All	LN1 on sap-lnx44 (11	.:13) (?) lamaadr
1	Overview 🗸	Systems Virtualization Cloud					
	Dashboard Visualization SAP Database Administration	Provisioning Systems View V					THIde Filte
	Search	Name Status Pool					
	Operations >	String Select Value V Select Value V					Vx 1
Ş	Provisioning						
þ	Automation Studio	Systems (2)				E	汪 ↑↓ 曲 @
ŝ	UI Customizations	Name	Pool	Description	Assigned Host	Virtualized	
L)	Monitoring 🗸	> O HN9: NetWeaver ABAP 7.77, cshn9	MUCCBC	beschpton	7.051gild 1105t	Filtduized	Provisioning V
	Activities						
	Logs	> O HNA: NetWeaver ABAP 7.77, cshna	MUCCBC				Provisioning V
	Performance					V Search	
6	Configuration >					径 Clone System	1
	Configuration Extensions >					Manage Syste	em Snapshots
	Infrastructure >					径 Copy System	
	Setup >						

2. During the copy workflow, the system is renamed, as must be specified in the first screen.

		SAP SAP SAP Landscape Management Q Roberth v Working Set All LN1 on sap-bree44 (11:16) (7)	
Dashi Visua	oo liz	Copy SystemShow Source Data Create Provisioning Blueprint Remote Execution HNA: NetWeaver ABAP 7.77, cahna	Hide Filters
SAP I Searc	h	Basic XX Hosts XX Host Names XX Instance Number XX Custom Clone XX Consistency XX Users XX Rename XX Isolation XX ABAP PCA XX Summary Provide Basic Data for Target System	
Provis	iid na	*System ID *Pool HN2 MUCCBC (9	∇x 7. ∰ ⊚
UI Cu Monit Activity	or	Y Use different Database Name Description *HANA SID Copy of System 'HNA' H02	ning 🗸
Logs Perfo	nii	Set Master Password for OS and DB Users	oning 🗸
へ Confi<べ Confi品 Infras	gu	*Confirm Password	
Setup			
	L		
	L		
	L		
		□ 0 Ignore Warnings for This Step Validate Step Reset Step	

3. During the workflow, you can change the instance numbers.

		SA	P																																
	Overvie Dashbo Visualiz		py Sy NetW			77, cshn	а																				Show So	urce Dati	a Create	Provision	ing Blueprint	Remo	e Execution	i	Hide Filters
	SAP Da	Bas	ic 💥	Hos	s 渊	Host	Name	s »»	Insta	nce Num	nber	>>> 0	Custom Cl	one	>>>	Consist	ency)	🔊 Use	rs 🚿	Ren	ame X	> Isol	lation	>>>	ABAP PC	A 渊	Summa	iry							
	Search		SAP	nstan	ce Nu	mbers																													
*	Operatio	*	System	databa	e: MAS	TER (co	onfigure	∋d) : SAI	P HANA	02																									$\nabla_{\mathbf{x}} = \nabla_{\!\!+}$
and the local distance	Automa	E	02																																
and the second se	UI Cust		AS inst	nce: 00																															•
E.			00																																
	Activitie		Central 01	service	: 01																														
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	Perform																																		
25	Configu																																		
*	Configu																																		
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16	Setup																																		
		0	Igni	re War	lings fo	r This St	tep	Validate	Step	Reset	Step																		<	Previous	Next >	Finish	Execute	Cancel	
																												_				_			



Changing instance numbers has not been tested and might require changes in the provider script.

4. As described, the **Custom Clone** screen does not differ from the cloning workflow, as is shown here.

=		SAP																						
	Overvie Dashbo /isualiz		ystem													3	Show Sourc	ce Data 🛛 🔾	ireate Provisio	ning Blueprint	Remot	e Execution		Hide Filters
	AP Da	Basic)	> Hosts	>> Host Na	mes 渊	Instance Nu	imber 渊	Custom Clo	ne »»	Consistency	>>>> Users	🔊 🔊 Rena	me 渊	Isolation)	ABAP PC	A 渊	Summary							
s o	iearch	Cust	om Clone																					
166 P		Operat	on						Hook							Selected	I Instances							$\nabla_{\!\mathbf{x}} = \nabla_{\!\!\mathbf{x}}$
°o 4	lutoma	Clone '	/olumes						Clone '	/olumes									ГЕR : H10, SAI (ABAP): 00, р		bh10, Cent	ral services		● ●
		Post C	one Volumes						Modify	Mountpoints a	nd add Custor	m Properties							TER : HN2, SA (ABAP): 00, p		bh10, Cent	ral services		
	Activitie .ogs		ation Para	neters																	Shov	v All Paramet	ers	ning V
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		🛄 0 lg	iore Warnings	for This Step	Validate	Step Resi	et Step												< Previous	Next >	Finish	Execute	Cancel	

5. As we already described, the remaining input masks do not deviate from the standard, and we do not go into them any further here. The final screen shows a summary, and execution can now be started.

≡ <		
Dashbo Visualiz SAP Da	Copy System 👔 HNA: NetWeaver ABAP 7.77, cshna Basic 🐝 Hosts 🐝 Host Names 🐝 Instance Number 🐝 Custom Clone 🐝 Consistency 🐝 Users 🐝 Rename 🐝 Isolation 🐝 ABAP PCA	Show Source Data Create Provisioning Blueprint Remote Execution Hide Filters
Search Coperation	SAP advises that it is the customer's responsibility to ensure that it has all necessary third party license rights required to done and/or copy an environment using this software, and to use the functionality described herein, including, without limitation, the license right to operate the target system landscape after cloning and/or copying.	nd the customer has obtained and will maintain all such license rights necessary \mathbb{V}_{μ} \mathbb{V}_{μ}
90 Automa (E) UI Cust (E) Monitor Activitie	 Basic Provide Basic Data for Target System 	
Configu Configu Configu Logs Perform Configu Configu Scotup	*System ID *Pool HN2 MUCCBC Use different Database Name Description *HANA SID Copy of System 'HNA' H02 Set Master Password for OS and DB Users I	ning V
l	*Confirm Password *Confirm Password *One for the second	
	Host Selection of Target System	
	Instance	Target Host/Virtual Host
	System database: MASTER (configured) : SAP HANA 02	sap-Inx45
	口 Ignore Warnings for This Step Validate Step Reset Step	Cancel

After the copy process, the target instance is not enabled for the custom cloning process.

Landscape Management						Working Set	(≪All> ▼ Se	arch:) 💠 💠	LN1 on sap	o-Inx44(11:56) _ Related Links & Help _ lamaac
Automation Studio	Infrastructure										Setup
Pools Systems Hosts Character	eristics										
Overview of Systems and Instances									[
Discover Remove Instance and System . Reat	ssign Instances Mass	Configuration Filtering Export Import							۵ ۵.		
Name			Managed	AC-Enabled	Operational	Pool	Network	Description		Ē	
8											
HN2: NetWeaver ABAP 7.77, dbh02.muccbc	hg netapp.com					MUCCBC		Copy of System 'HNA'			
HN9: NetWeaver ABAP 7.77, cshn9					н	MUCCBC					
HNA: NetWeaver ABAP 7.77, cshna				×	н	MUCCBC					
Systems: 3 Selected: HN2: NetWeaver ABAP 7.77, c	ibh02.muccbc.hq.neta	ipp.com									
System Details Log											
and the second se											
Edit									Show In ,		
General				Intersystem Dependencies							
System Name:	HN2: NetWeaver AB	SAP 7.77, dbh02.muccbc.hq.netapp.com		From Instance			To Instance				
SID:	HN2			• [I Outgoing (0)							
Instance ID:	SystemID HN2 Syst	emHost dbh02 muccbc hq netapp.com		• [de Incoming (0)						•	
Solution Manager settings				Entity Relations							
Assign Solution Manager System:				Custom Relation Type		Target Entity T	line	Target Entity			
Focused Run Settings				Table is empty		inger chury i	70%	ninger chiny			
Assign Focused Run System:				I Table is empty							
Disable Workmode Management:				E-Mail Notification							
System and AS Provisioning											
This system was provided by:	Copy			Custom Notification Enable Custom Notification:							
Source System: This system can be used for:	HNA: NetWeaver AE										
mis system can be used tot.	Cloning	Application Server (Un-)Installation		ACM Settings ACM-Managed:							
	Copying	Diagnostic Agent (Un-)Installation		AGM-Managed.							
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the Onder Description D		Replication Configuration									
Use Custom Provisioning Process											
Use as TDMS Control System:											
Is BW Source System:											
Use Replication for Single Tenant Database Refresh	n: []										
Network Isolation - Allowed Outgoing Connectio	ns										
Enable Network Fencing:										-	
1 P											

It must be adopted manually to run the pre-hook step during the system destroy process because a constraint is set and would prevent execution.

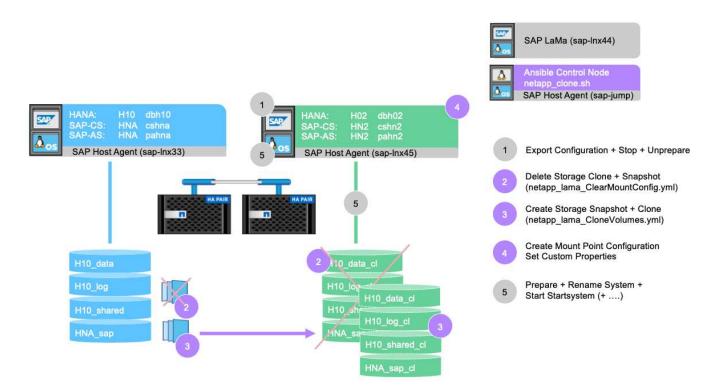
Landscape Management					Working S	et <ali> • Si</ali>	arch:) (pa) (.N1 on sap-inx44(11:58)	Related Links & Help Jamaadmin
Automation Studio Configuration	Infrastructure									Setup
Pools Systems Hosts Chara	acteristics									
Overview of Systems and Instances								-	1 -	
	Leassign Instances Mass Configuration Filtering Export Import							0 0.		
Name		Managed	AC-Enabled	Operational	Pool	Network	Description			
8										
HN2: NetWeaver ABAP 7.77, dbh02.muct	cbc hq netapp com				MUCCBC		Copy of System 'HNA'			
HN9: NetWeaver ABAP 7.77, cshn9			E		MUCCBC					
HNA: NetWeaver ABAP 7.77, cshna			E		MUCCBC					
					_					
					_					
					-					
									9	
Systems: 3 Selected: HN2: NetWeaver ABAP 7.7	7, dbh02.muccbc.hq.netapp.com								-	
System Details Log										
Edit								Show In "		
General			Intersystem Dependencies							
System Name:	HN2: NetWeaver ABAP 7.77, dbh02 muccbc hq.netapp.com		From Instance			To Instance				
SID:	HN2		 						•	
Instance ID:	SystemID.HN2.SystemHost.dbh02.muccbc.hq.netapp.com		• [] d= Incoming (0)							
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Disable Workmode Management:			E-Mail Notification							
System and AS Provisioning			Enable Email Notification:							
This system was provided by:	Сору		Custom Notification							
Source System:	HNA: NetWeaver ABAP 7.77, cshna		Enable Custom Notification:							
This system can be used for:	Cloning Application Server (Un-)Installation		ACM Settings							
	Copying Diagnostic Agent (Un-)Installation		ACM-Managed:							
	Renaming DZDM Java									
	Standalone PCA Replication Configuration									
Use Custom Provisioning Process:	V NetAppClone									
Use as TDMS Control System:										
Is BW Source System:										
Use Replication for Single Tenant Database Refr	esh:									
Network Isolation - Allowed Outgoing Connec	tions								-	

SAP LaMa provisioning workflow - system refresh

The following figure highlights the main steps executed with the system refresh workflow.



During the refresh workflow, the storage clone must be deleted. You can use the same Ansible playbook as for the system destroy workflow. However, the custom hook is defined to a different step, so the playbook is named accordingly. The process step for the clone doesn't differ.



The refresh workflow can be triggered through the provisioning screen for a copied system.

≡ <	> 💁 sa	P Land	dscape Management				Q Refre	sh ~ Working Set: All LI	N1 on sap-lnx44 (11:55) () lamaadmin
	nboard	~	Systems Virtualization Cloud Provisioning Systems View						ſ	V Hide Filters
	alization Database Administrat rch	tion	Systems: 3, Instances: 9							
	rations	~	Name String	Status Select Value	Pool Select Value ~					$\nabla_{\!x} = \nabla_{\!\!\!+}$
Sche	ration Templates adules		Systems (3) Name			Pool	Description	Assigned Host	E 注 ↑. Virtualized	ι 🕮 🎯
Prov	isioning mation Studio	>	> 📀 HN2: NetWeaver ABAP 7.77, 4	dbh02.muccbc.hq.netapp.com		MUCCBC	Copy of System 'HNA'		Pro	visioning 🗸
	ustomizations	>	 HN9: NetWeaver ABAP 7.77, 4 HNA: NetWeaver ABAP 7.77, 5 			MUCCBC			Search Destroy Processes	
Activ	vities	~		canne		MOCODO		 Refresh System Refresh Database 	Refresh Processes Manage System Snaps	> hots >
Perf	ormance figuration	>						Restore-Based Refresh		
💐 Con	figuration Extensions									
🖁 Infra		>								

Again, nothing differs in the input screens from the standard, and the workflow execution can be started from the summary screen.

≡ <	> S	SAP Landscape Management	Q Refresh 🔗 Working Set: All	LN1 on sap-Inx44 (12:0)	2) ⑦	lamaadmin
Dash Visua SAP	bo R HI	efresh System 👔 N2: NetWeaver ABAP 7.77, dbh02.muccbc.hq.netapp.com asic 🐝 Hosts 🐝 Host Names 🐝 Custom Clone 🐝 Consistency 🐝 Users 🐝 Rename 🐝 Isolation 🐝 ABAP PCA 🐝 Summary	Show Source Data Create Provisioning Blueprint	Remote Execution		Hide Filters
Sean 🍄 Oper Oper	ati	SAP advises that it is the custome's responsibility to ensure that it has all necessary third party license rights required to clone and/or copy an environment using this software, are to use the functionality described herein, including, without limitation, the license right to operate the target system landscape after cloning and/or copying.	nd the customer has obtained and will maintain all such i	icense rights necessary		V _x V _t
Oper Sche	du	 ✓ Basic Basic Data of System to Be Refreshed Ⅰ 				ming V
C Auto	este	Refresh from System HNA: NetWeaver ABAP 7.77, cshna				ning V
Activ Logs Perfe	itle	Export of System Configuration Data Export already exists *Export to Directory /mpVCM_positN2/				
冬 Cont 冬 Cont 品 Infra	igu igu	C Remove Export After Import Set Master Password for OS and DB Users				
E Setu		Password Confirm Password				
		✓ Hosts				
		Host Selection of Target System	Target Host/Virtual Host			
	Q	0 Ignore Warnings for This Step Validate Step Reset Step	< Previous Next >	Finish Execute Ca	incel	
	-					

Provider script configuration and Ansible playbooks

The following provider configuration file, execution script, and Ansible playbooks are used

during the sample deployment and workflow execution in this documentation.



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

Provider configuration file netapp_clone.conf

The configuration file is created as described in the SAP LaMa Documentation - Configuring SAP Host Agent Registered Scripts. This configuration file must be located on the Ansible control node where the SAP host agent is installed.

The configured os-user sapuser must have the appropriate permissions to execute the script and the called Ansible playbooks. You can place the script in a common script directory. SAP LaMa can provide multiple parameters when calling the script.

In addition to the custom parameters, PARAM_ClonePostFix, PROP_ClonePostFix, PARAM_ClonePostFix, and PROP_ClonePostFix, many others can be handed over, as is shown in the SAP LaMa Documentation.

```
root@sap-jump:~# cat /usr/sap/hostctrl/exe/operations.d/netapp_clone.conf
Name: netapp_clone
Username: sapuser
Description: NetApp Clone for Custom Provisioning
Command: /usr/sap/scripts/netapp_clone.sh
--HookOperationName=$[HookOperationName] --SAPSYSTEMNAME=$[SAPSYSTEMNAME]
--SAPSYSTEM=$[SAPSYSTEM] --MOUNT_XML_PATH=$[MOUNT_XML_PATH]
--PARAM_ClonePostFix=$[PARAM-ClonePostFix] --PARAM_SnapPostFix=$[PARAM
-SnapPostFix] --PROP_ClonePostFix=$[PROP-ClonePostFix]
--PROP_SnapPostFix=$[PROP-SnapPostFix]
--SAP_LVM_SRC_SID=$[SAP_LVM_SRC_SID]
--SAP_LVM_TARGET_SID=$[SAP_LVM_TARGET_SID]
ResulConverter: hook
Platform: Unix
```

Provider script netapp_clone.sh

The provider script must be stored in /usr/sap/scripts as configured in the provider configuration file.

Variables

The following variables are hard coded in the script and must be adapted accordingly.

- PRIMARY_CLUSTER=<hostname of netapp cluster>
- PRIMARY_SVM=<SVM name where source system volumes are stored>

The certificate files PRIMARY_KEYFILE=/usr/sap/scripts/ansible/certs/ontap.key and PRIMARY_CERTFILE=/usr/sap/scripts/ansible/certs/ontap.pem must be provided as described in NetApp Ansible modules - Prepare ONTAP.



If different clusters or SVMs are required for different SAP systems, these variables can be added as parameters in the SAP LaMa provider definition.

Function: create inventory file

To make Ansible playbook execution more dynamic, an inventory. yml file is created on the fly. Some static values are configured in the variable section and some are dynamically created during execution.

Function: run Ansible playbook

This function is used to execute the Ansible playbook together with the dynamically created inventory.yml file. The naming convention for the playbooks is netapp_lama_\${HookOperationName}.yml. The values for \${HookOperationName} is dependent on the LaMa operation and handed over by LaMa as a command line parameter.

Section Main

This section contains the main execution plan. The variable \${HookOperationName} contains the name of the LaMa replacement step and is provided by LaMa when the script is called.

- Values with the system clone and system copy provisioning workflow:
 - · CloneVolumes
 - PostCloneVolumes
- · Value with the system destroy workflow:
 - ServiceConfigRemoval
- Value with the system refresh workflow:
 - ClearMountConfig

HookOperationName = CloneVolumes

With this step, the Ansible playbook is executed, which triggers the Snapshot copy and cloning operation. The volume names and mount configuration are handed over by SAP LaMa through an XML file defined in the variable \$MOUNT_XML_PATH. This file is saved because it is used later in the step FinalizeCloneVolumes to create the new mount-point configuration. The volume names are extracted from the XML file and the Ansible cloning playbook is executed for each volume.



In this example, the AS instance and the central services share the same volume. Therefore, volume cloning is only executed when the SAP instance number (\$SAPSYSTEM) is not 01. This might differ in other environments and must be changed accordingly.

HookOperationName = PostCloneVolumes

During this step, the custom properties ClonePostFix and SnapPostFix and the mount point configuration for the target system are maintained.

The custom properties are used later as input when the system is decommissioned during the ServiceConfigRemoval or ClearMountConfig phase. The system is designed to preserve the settings of the custom parameters that were specified during the system provisioning workflow.

The values used in this example are ClonePostFix=_clone_20221115 and

SnapPostFix=_snap_20221115.

For the volume HN9_sap, the dynamically created Ansible file includes the following values: datavolumename: HN9_sap, snapshotpostfix: _snap_20221115, and clonepostfix: _clone_20221115.

Which leads into the snapshot name on the volume HN9_sap HN9_sap_snap_20221115 and the created volume clone name HN9_sap_clone_20221115.



Custom properties could be used in any way to preserve parameters used during the provisioning process.

The mount point configuration is extracted from the XML file that has been handed over by LaMa in the CloneVolume step. The ClonePostFix is added to the volume names and send back to LaMa through the default script output. The functionality is described in SAP Note 1889590.



In this example, qtrees on the storage system are used as a common way to place different data on a single volume. For example, HN9_sap holds the mount points for /usr/sap/HN9, /sapmnt/HN9, and /home/hn9adm. Subdirectories work in the same way. This might differ in other environments and must be changed accordingly.

HookOperationName = ServiceConfigRemoval

In this step, the Ansible playbook that is responsible for the deletion of the volume clones is running.

The volume names are handed over by SAP LaMa through the mount configuration file, and the custom properties ClonePostFix and SnapPostFix are used to hand over the values of the parameters originally specified during the system provisioning workflow (see the note at HookOperationName = PostCloneVolumes).

The volume names are extracted from the xml file, and the Ansible cloning playbook is executed for each volume.



In this example, the AS instance and the central services share the same volume. Therefore, the volume deletion is only executed when the SAP instance number (\$SAPSYSTEM) is not 01. This might differ in other environments and must be changed accordingly.

HookOperationName = ClearMountConfig

In this step, the Ansible playbook that is responsible for the deletion of the volume clones during a system refresh workflow is running.

The volume names are handed over by SAP LaMa through the mount configuration file, and the custom properties ClonePostFix and SnapPostFix are used to hand over the values of the parameters originally specified during the system provisioning workflow.

The volume names are extracted from the XML file and the Ansible cloning playbook is executed for each volume.



In this example, the AS instance and the central services share the same volume. Therefore, volume deletion is only executed when the SAP instance number (\$SAPSYSTEM) is not 01. This might differ in other environments and must be changed accordingly.

```
root@sap-jump:~# cat /usr/sap/scripts/netapp clone.sh
#!/bin/bash
#Section - Variables
VERSION="Version 0.9"
#Path for ansible play-books
ANSIBLE PATH=/usr/sap/scripts/ansible
#Values for Ansible Inventory File
PRIMARY CLUSTER=grenada
PRIMARY SVM=svm-sap01
PRIMARY KEYFILE=/usr/sap/scripts/ansible/certs/ontap.key
PRIMARY CERTFILE=/usr/sap/scripts/ansible/certs/ontap.pem
#Default Variable if PARAM ClonePostFix / SnapPostFix is not maintained in
LaMa
DefaultPostFix= clone 1
#TMP Files - used during execution
YAML TMP=/tmp/inventory ansible clone tmp $$.yml
TMPFILE=/tmp/tmpfile.$$
MY NAME="`basename $0`"
BASE SCRIPT DIR="`dirname $0`"
#Sendig Script Version and run options to LaMa Log
echo "[DEBUG]: Running Script $MY NAME $VERSION"
echo "[DEBUG]: $MY NAME $@"
#Command declared in the netapp clone.conf Provider definition
#Command: /usr/sap/scripts/netapp clone.sh
--HookOperationName=$[HookOperationName] --SAPSYSTEMNAME=$[SAPSYSTEMNAME]
--SAPSYSTEM=$[SAPSYSTEM] --MOUNT XML PATH=$[MOUNT XML PATH]
--PARAM ClonePostFix=$[PARAM-ClonePostFix] --PARAM SnapPostFix=$[PARAM
-SnapPostFix] --PROP ClonePostFix=$[PROP-ClonePostFix]
--PROP SnapPostFix=$[PROP-SnapPostFix]
--SAP LVM SRC SID=$[SAP LVM SRC SID]
--SAP LVM TARGET SID=$[SAP LVM TARGET SID]
#Reading Input Variables hand over by LaMa
for i in "$@"
do
case $i in
--HookOperationName=*)
HookOperationName="${i#*=}";shift;;
--SAPSYSTEMNAME=*)
SAPSYSTEMNAME="${i#*=}";shift;;
--SAPSYSTEM=*)
SAPSYSTEM="${i#*=}";shift;;
--MOUNT XML PATH=*)
MOUNT XML PATH="${i#*=}";shift;;
--PARAM ClonePostFix=*)
```

```
PARAM ClonePostFix="${i#*=}";shift;;
--PARAM SnapPostFix=*)
PARAM SnapPostFix="${i#*=}";shift;;
--PROP ClonePostFix=*)
PROP ClonePostFix="${i#*=}";shift;;
--PROP SnapPostFix=*)
PROP SnapPostFix="${i#*=}";shift;;
--SAP LVM SRC SID=*)
SAP LVM SRC SID="${i#*=}";shift;;
--SAP LVM TARGET SID=*)
SAP LVM TARGET SID="${i#*=}";shift;;
*)
# unknown option
;;
esac
done
#If Parameters not provided by the User - defaulting to DefaultPostFix
if [ -z $PARAM ClonePostFix ]; then PARAM ClonePostFix=$DefaultPostFix;fi
if [ -z $PARAM SnapPostFix ]; then PARAM SnapPostFix=$DefaultPostFix;fi
#Section - Functions
#Function Create (Inventory) YML File
****
create yml file()
{
echo "ontapservers:">$YAML TMP
echo " hosts:">>$YAML TMP
echo " ${PRIMARY CLUSTER}:">>$YAML TMP
echo " ansible host: "'"'$PRIMARY CLUSTER'"'>>$YAML TMP
echo " keyfile: "'"'$PRIMARY KEYFILE'"'>>$YAML TMP
echo " certfile: "'"'$PRIMARY CERTFILE'"'>>$YAML TMP
echo " svmname: "'"'$PRIMARY SVM'"'>>$YAML TMP
echo " datavolumename: "'"'$datavolumename'"'>>$YAML_TMP
echo " snapshotpostfix: "'"'$snapshotpostfix'"'>>$YAML_TMP
echo " clonepostfix: "'"'$clonepostfix'"'>>$YAML TMP
}
#Function run ansible-playbook
run ansible playbook()
{
echo "[DEBUG]: Running ansible playbook
netapp lama ${HookOperationName}.yml on Volume $datavolumename"
ansible-playbook -i $YAML TMP
$ANSIBLE PATH/netapp lama ${HookOperationName}.yml
}
#Section - Main
```

```
#HookOperationName - CloneVolumes
if [ $HookOperationName = CloneVolumes ] ;then
#save mount xml for later usage - used in Section FinalizeCloneVolues to
generate the mountpoints
echo "[DEBUG]: saving mount config...."
cp $MOUNT XML PATH /tmp/mount config ${SAPSYSTEMNAME} ${SAPSYSTEM}.xml
#Instance 00 + 01 share the same volumes - clone needs to be done once
if [ $SAPSYSTEM != 01 ]; then
#generating Volume List - assuming usage of gtrees - "IP-
Adress:/VolumeName/qtree"
xmlFile=/tmp/mount config ${SAPSYSTEMNAME} ${SAPSYSTEM}.xml
if [ -e $TMPFILE ];then rm $TMPFILE;fi
numMounts=`xml grep --count "/mountconfig/mount" $xmlFile | grep "total: "
| awk '{ print $2 }'`
i=1
while [ $i -le $numMounts ]; do
    xmllint --xpath "/mountconfig/mount[$i]/exportpath/text()" $xmlFile
|awk -F"/" '{print $2}' >>$TMPFILE
i=$((i + 1))
done
DATAVOLUMES=`cat $TMPFILE |sort -u`
#Create yml file and rund playbook for each volume
for I in $DATAVOLUMES; do
datavolumename="$I"
snapshotpostfix="$PARAM SnapPostFix"
clonepostfix="$PARAM ClonePostFix"
create yml file
run ansible playbook
done
else
echo "[DEBUG]: Doing nothing .... Volume cloned in different Task"
fi
fi
#HookOperationName - PostCloneVolumes
if [ $HookOperationName = PostCloneVolumes] ;then
#Reporting Properties back to LaMa Config for Cloned System
echo "[RESULT]:Property:ClonePostFix=$PARAM ClonePostFix"
echo "[RESULT]:Property:SnapPostFix=$PARAM SnapPostFix"
#Create MountPoint Config for Cloned Instances and report back to LaMa
according to SAP Note: https://launchpad.support.sap.com/#/notes/1889590
echo "MountDataBegin"
echo '<?xml version="1.0" encoding="UTF-8"?>'
echo "<mountconfig>"
```

```
xmlFile=/tmp/mount config ${SAPSYSTEMNAME} ${SAPSYSTEM}.xml
numMounts=`xml grep --count "/mountconfig/mount" $xmlFile | grep "total: "
| awk '{ print $2 }'`
i=1
while [ $i -le $numMounts ]; do
MOUNTPOINT=`xmllint --xpath "/mountconfig/mount[$i]/mountpoint/text()"
$xmlFile`;
        EXPORTPATH=`xmllint --xpath
"/mountconfig/mount[$i]/exportpath/text()" $xmlFile`;
        OPTIONS=`xmllint --xpath "/mountconfig/mount[$i]/options/text()"
$xmlFile`;
#Adopt Exportpath and add Clonepostfix - assuming usage of gtrees - "IP-
Adress:/VolumeName/gtree"
TMPFIELD1=`echo $EXPORTPATH|awk -F":/" '{print $1}'`
TMPFIELD2=`echo $EXPORTPATH|awk -F"/" '{print $2}'`
TMPFIELD3=`echo $EXPORTPATH|awk -F"/" '{print $3}'`
EXPORTPATH=$TMPFIELD1":/"${TMPFIELD2}$PARAM ClonePostFix"/"$TMPFIELD3
echo -e '\t<mount fstype="nfs" storagetype="NETFS">'
echo -e "\t\t<mountpoint>${MOUNTPOINT}</mountpoint>"
echo -e "\t\t<exportpath>${EXPORTPATH}</exportpath>"
echo -e "\t\t<options>${OPTIONS}</options>"
echo -e "\t</mount>"
i=$((i + 1))
done
echo "</mountconfig>"
echo "MountDataEnd"
#Finished MountPoint Config
#Cleanup Temporary Files
rm $xmlFile
fi
#HookOperationName - ServiceConfigRemoval
if [ $HookOperationName = ServiceConfigRemoval ] ;then
#Assure that Properties ClonePostFix and SnapPostfix has been configured
through the provisioning process
if [ -z $PROP ClonePostFix ]; then echo "[ERROR]: Propertiy ClonePostFix
is not handed over - please investigate"; exit 5; fi
if [ -z $PROP SnapPostFix ]; then echo "[ERROR]: Propertiy SnapPostFix is
not handed over - please investigate";exit 5;fi
#Instance 00 + 01 share the same volumes - clone delete needs to be done
once
if [ $SAPSYSTEM != 01 ]; then
#generating Volume List - assuming usage of qtrees - "IP-
Adress:/VolumeName/qtree"
xmlFile=$MOUNT XML PATH
if [ -e $TMPFILE ]; then rm $TMPFILE; fi
```

```
numMounts=`xml grep --count "/mountconfig/mount" $xmlFile | grep "total: "
| awk '{ print $2 }'`
i=1
while [ $i -le $numMounts ]; do
     xmllint --xpath "/mountconfig/mount[$i]/exportpath/text()" $xmlFile
|awk -F"/" '{print $2}' >>$TMPFILE
i=$((i + 1))
done
DATAVOLUMES=`cat $TMPFILE |sort -u| awk -F $PROP ClonePostFix '{ print $1
}'`
#Create yml file and rund playbook for each volume
for I in $DATAVOLUMES; do
datavolumename="$I"
snapshotpostfix="$PROP SnapPostFix"
clonepostfix="$PROP ClonePostFix"
create yml file
run ansible playbook
done
else
echo "[DEBUG]: Doing nothing .... Volume deleted in different Task"
fi
#Cleanup Temporary Files
rm $xmlFile
fi
#HookOperationName - ClearMountConfig
****
if [ $HookOperationName = ClearMountConfig ] ;then
        #Assure that Properties ClonePostFix and SnapPostfix has been
configured through the provisioning process
        if [ -z $PROP ClonePostFix ]; then echo "[ERROR]: Propertiy
ClonePostFix is not handed over - please investigate"; exit 5; fi
        if [ -z $PROP SnapPostFix ]; then echo "[ERROR]: Propertiy
SnapPostFix is not handed over - please investigate";exit 5;fi
        #Instance 00 + 01 share the same volumes - clone delete needs to
be done once
        if [ $SAPSYSTEM != 01 ]; then
               #generating Volume List - assuming usage of gtrees - "IP-
Adress:/VolumeName/qtree"
               xmlFile=$MOUNT XML PATH
               if [ -e $TMPFILE ];then rm $TMPFILE;fi
               numMounts=`xml grep --count "/mountconfig/mount" $xmlFile
| grep "total: " | awk '{ print $2 }'`
               i=1
               while [ $i -le $numMounts ]; do
                      xmllint --xpath
"/mountconfig/mount[$i]/exportpath/text()" $xmlFile |awk -F"/" '{print
```

```
$2}' >>$TMPFILE
                       i=$((i + 1))
               done
               DATAVOLUMES=`cat $TMPFILE |sort -u| awk -F
$PROP ClonePostFix '{ print $1 }'`
               #Create yml file and rund playbook for each volume
               for I in $DATAVOLUMES; do
                       datavolumename="$I"
                       snapshotpostfix="$PROP SnapPostFix"
                       clonepostfix="$PROP ClonePostFix"
                       create yml file
                       run ansible playbook
               done
       else
               echo "[DEBUG]: Doing nothing .... Volume deleted in
different Task"
       fi
       #Cleanup Temporary Files
       rm $xmlFile
fi
#Cleanup
****
#Cleanup Temporary Files
if [ -e $TMPFILE ];then rm $TMPFILE;fi
if [ -e $YAML TMP ]; then rm $YAML TMP; fi
exit 0
```

Ansible Playbook netapp_lama_CloneVolumes.yml

The playbook that is executed during the CloneVolumes step of the LaMa system clone workflow is a combination of create_snapshot.yml and create_clone.yml (see NetApp Ansible modules - YAML files). This playbook can be easily extended to cover additional use cases like cloning from secondary and clone split operations.

```
root@sap-jump:~# cat /usr/sap/scripts/ansible/netapp lama CloneVolumes.yml
- hosts: ontapservers
 connection: local
 collections:
   - netapp.ontap
 gather facts: false
 name: netapp lama CloneVolumes
 tasks:
 - name: Create SnapShot
   na ontap snapshot:
     state: present
     snapshot: "{{ datavolumename }}{{ snapshotpostfix }}"
     use rest: always
     volume: "{{ datavolumename }}"
     vserver: "{{ svmname }}"
     hostname: "{{ inventory hostname }}"
     cert filepath: "{{ certfile }}"
     key filepath: "{{ keyfile }}"
     https: true
     validate certs: false
 - name: Clone Volume
   na ontap volume clone:
     state: present
     name: "{{ datavolumename }}{{ clonepostfix }}"
     use rest: always
     vserver: "{{ svmname }}"
     junction path: '/{{ datavolumename }}{{ clonepostfix }}'
     parent volume: "{{ datavolumename }}"
     parent snapshot: "{{ datavolumename }}{{ snapshotpostfix }}"
     hostname: "{{ inventory hostname }}"
     cert filepath: "{{ certfile }}"
     key filepath: "{{ keyfile }}"
     https: true
     validate certs: false
```

Ansible Playbook netapp_lama_ServiceConfigRemoval.yml

The playbook that is executed during the ServiceConfigRemoval phase of the LaMa system destroy workflow is combination of delete_clone.yml and delete_snapshot.yml (see NetApp Ansible modules - YAML files). It must be aligned to the execution steps of the netapp_lama_CloneVolumes playbook.

```
root@sap-jump:~# cat
/usr/sap/scripts/ansible/netapp lama ServiceConfigRemoval.yml
- hosts: ontapservers
 connection: local
 collections:
    - netapp.ontap
 gather facts: false
 name: netapp lama ServiceConfigRemoval
 tasks:
  - name: Delete Clone
   na ontap volume:
      state: absent
      name: "{{ datavolumename }}{{ clonepostfix }}"
      use rest: always
      vserver: "{{ svmname }}"
      wait for completion: True
      hostname: "{{ inventory hostname }}"
      cert filepath: "{{ certfile }}"
      key_filepath: "{{ keyfile }}"
      https: true
      validate certs: false
  - name: Delete SnapShot
    na ontap snapshot:
      state: absent
      snapshot: "{{ datavolumename }}{{ snapshotpostfix }}"
      use rest: always
      volume: "{{ datavolumename }}"
      vserver: "{{ svmname }}"
      hostname: "{{ inventory hostname }}"
      cert filepath: "{{ certfile }}"
      key filepath: "{{ keyfile }}"
      https: true
      validate certs: false
root@sap-jump:~#
```

Ansible Playbook netapp_lama_ClearMountConfig.yml

The playbook, which is executed during the netapp_lama_ClearMountConfig phase of the LaMa system refresh workflow is combination of delete_clone.yml and delete_snapshot.yml (see NetApp Ansible
modules - YAML files). It must be aligned to the execution steps of the netapp_lama_CloneVolumes
playbook.

```
root@sap-jump:~# cat
/usr/sap/scripts/ansible/netapp lama ServiceConfigRemoval.yml
- hosts: ontapservers
 connection: local
 collections:
   - netapp.ontap
 gather facts: false
 name: netapp lama ServiceConfigRemoval
 tasks:
  - name: Delete Clone
   na_ontap_volume:
     state: absent
     name: "{{ datavolumename }}{{ clonepostfix }}"
      use rest: always
     vserver: "{{ svmname }}"
      wait for completion: True
      hostname: "{{ inventory hostname }}"
      cert filepath: "{{ certfile }}"
      key filepath: "{{ keyfile }}"
      https: true
      validate certs: false
  - name: Delete SnapShot
   na ontap snapshot:
      state: absent
      snapshot: "{{ datavolumename }}{{ snapshotpostfix }}"
      use rest: always
      volume: "{{ datavolumename }}"
      vserver: "{{ svmname }}"
      hostname: "{{ inventory hostname }}"
      cert filepath: "{{ certfile }}"
      key filepath: "{{ keyfile }}"
      https: true
      validate certs: false
root@sap-jump:~#
```

Sample Ansible inventory.yml

This inventory file is dynamically built during workflow execution, and it is only shown here for illustration.

```
ontapservers:
hosts:
grenada:
ansible_host: "grenada"
keyfile: "/usr/sap/scripts/ansible/certs/ontap.key"
certfile: "/usr/sap/scripts/ansible/certs/ontap.pem"
svmname: "svm-sap01"
datavolumename: "HN9_sap"
snapshotpostfix: "_snap_20221115"
clonepostfix: "_clone_20221115"
```

Conclusion

The integration of a modern automation framework like Ansible into SAP LaMa provisioning workflows gives customers a flexible solution to address standard or more complex infrastructure requirements.

Where to find additional information

To learn more about the information that is described in this document, review the following documents and/or websites:

· Collections in the NetApp Namespace

https://docs.ansible.com/ansible/latest/collections/netapp/index.html

• Documentation about Ansible Integration and Sample Ansible Playbooks

https://github.com/sap-linuxlab/demo.netapp_ontap

General Ansible and NetApp Integration

https://www.ansible.com/integrations/infrastructure/netapp

· Blog on integrating SAP LaMa with Ansible

https://blogs.sap.com/2020/06/08/outgoing-api-calls-from-sap-landscape-management-lama-with-automation-studio/

• SAP Landscape Management 3.0, Enterprise Edition Documentation

https://help.sap.com/doc/700f9a7e52c7497cad37f7c46023b7ff/3.0.11.0/en-US/4df88a8f418c5059e10000000a42189c.html#loio4df88a8f418c5059e10000000a42189c

• SAP LaMa Documentation – Provider Definitions

https://help.sap.com/doc/700f9a7e52c7497cad37f7c46023b7ff/3.0.11.0/en-US/bf6b3e43340a4cbcb0c0f3089715c068.html

· SAP LaMa Documentation - Custom Hooks

https://help.sap.com/doc/700f9a7e52c7497cad37f7c46023b7ff/3.0.11.0/en-US/139eca2f925e48738a20dbf0b56674c5.html

• SAP LaMa Documentation - Configuring SAP Host Agent Registered Scripts

https://help.sap.com/doc/700f9a7e52c7497cad37f7c46023b7ff/3.0.11.0/en-US/250dfc5eef4047a38bab466c295d3a49.html

• SAP LaMa Documentation - Parameters for Custom Operations and Custom Hooks

https://help.sap.com/doc/700f9a7e52c7497cad37f7c46023b7ff/3.0.11.0/en-US/0148e495174943de8c1c3ee1b7c9cc65.html

SAP LaMa Documentation - Adaptive Design

https://help.sap.com/doc/700f9a7e52c7497cad37f7c46023b7ff/3.0.11.0/en-US/737a99e86f8743bdb8d1f6cf4b862c79.html

NetApp Product Documentation

https://www.netapp.com/support-and-training/documentation/

Version history

Version	Date	Document version history			
Version 1.0	January 2023	Initial release			

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