White Paper
Snap Creator 4.3 for SAP HANA® in PRIMEFLEX® for SAP Landscapes

With digitalization on the rise, organizations are facing increasing complexity in terms of managing large data volumes across the business while ensuring data resilience and consistency. Therefore, Fujitsu and NetApp designed an innovative concept to encompass the orchestration of SAP environments and data protection.

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Management summary

Companies today require continuous, uninterrupted availability for their SAP® applications. They expect consistent performance levels, a uniform operational concept, and a high degree of automation and standardization in the face of ever-increasing volumes of data and the need for routine maintenance tasks such as system backups.

PRIMEFLEX for SAP Landscapes enables simplified, fast and secure implementation and operation of SAP applications and databases. The infrastructure solution is designed, delivered and supported as one product and supplemented by a broad services portfolio. The integrated FlexFrame® Orchestrator software offers consistent and standardized administration of infrastructure, databases, and applications. This makes operation more reliable and efficient and dramatically boosts responsiveness towards new business processes and requirements. Thus, PRIMEFLEX for SAP Landscapes helps to better exploit the capabilities of SAP solutions and bridges the gap between business and IT.

Data Protection is an important part of the operation of SAP databases, especially for SAP HANA. Performing backups of SAP databases is a critical task and can have a significant performance effect on the production SAP system. Backup windows are shrinking while the amount of data to be backed up is increasing. Therefore, it is difficult to find a time when backups can be performed with a minimal effect on business processes. The time needed to restore and recover SAP systems is of particular concern because downtime for SAP production and nonproduction systems must be minimized to reduce data loss and cost to the business. The following points summarize the challenges facing SAP backup and recovery:

- **Performance effects on production SAP systems.** Typically, traditional copy-based backups create a significant performance drain on production SAP systems because of the heavy loads placed on the database server, the storage system, and the storage network.
- **Shrinking backup windows.** Conventional backups can only be made when few dialog or batch activities are in process on the SAP system. The scheduling of backups becomes more difficult when SAP systems are in use around the clock.
- **Rapid data growth.** Rapid data growth and shrinking backup windows require ongoing investment in backup infrastructure. In other words, you must procure more tape drives, newer tape drive technology, and faster storage networks. You must also cover the ongoing expense of storing and managing these tape assets. Incremental or differential backups can address these issues, but this arrangement results in a very slow, cumbersome, and complex restore process that is harder to verify. Such systems usually increase RTO and RPO times in ways that are not acceptable to the business.
- **Increasing cost of downtime.** Unplanned downtime of an SAP system typically affects business finances. A significant part of any unplanned downtime is consumed by the need to restore and recover the SAP system. Therefore, the desired recovery time objective (RTO) dictates the design of the backup and recovery architecture.
- **Backup and recovery time for SAP upgrade projects.** The project plan for an SAP upgrade includes at least three backups of the SAP database. These backups significantly reduce the time available for the upgrade process. The decision to proceed is generally based on the amount of time required to restore and recover the database from the previously created backup. Rather than just restoring a system back to its previous state, a rapid restore provides more time to solve problems that might occur during an upgrade.

NetApp Snapshot technology can be used to create database backups within minutes. The time needed to create a Snapshot copy is independent of the size of the database because a Snapshot copy does not move any physical data blocks on the storage platform. In addition, the use of Snapshot technology has no performance effect on the live SAP system, again because the NetApp Snapshot technology does not move or copy data blocks when the Snapshot copy is created or when data in the active file system is changed. Therefore, the creation of Snapshot copies can be scheduled without considering peak dialog or batch activity periods. SAP and NetApp customers typically schedule multiple online Snapshot backups during the day; for example, every four hours is common. These Snapshot backups are typically kept for three to five days on the primary storage system before being removed.

Applications and database like SAP HANA require consistency on the application level in order to use NetApp Snapshot technology for fully functional backups. NetApp provides the Snap Creator framework together with a plugin for SAP HANA to provide this functionality. Snap Creator can be used to back up SAP HANA database files as well as non-database files. The configuration and workflows described in this document cover the database backup.
FUJITSU Integrated System PRIMEFLEX

The modern IT in a company has to fit three conflicting targets:

- **Maximum flexibility in order to respond quickly and effectively to ever changing business demands.** This requires adjustments to existing IT services and above all fast delivery of new services.

- **Optimum/increased efficiency in financial perspective.** This includes less complexity and lower costs, in addition to more cost transparency and predictability, minimized risks and full compliance with IT directives and legislation.

- **Highest service levels as a prerequisite for highest levels of productivity and satisfaction of the users.**

The traditional data center infrastructure building in a DIY (Do-It-Yourself) approach got extremely complex over the years. The main reason for this is the complexity of the infrastructure itself, which is composed of diverse components, such as servers, storage, networks, virtualization layers for all these components, databases and other middleware, as well as applications. In addition, a management layer is needed to keep these components under control.

![DC infrastructure stack](image)

**Figure 1: DC infrastructure stack**

This is exactly what Integrated Systems is about, a pre-defined, pre-integrated and pre-tested combination of data center components, such as servers, storage, network connectivity and software. While management software is mandatory, depending on the use case, software for virtualization, automation and orchestration, as well as databases and applications may be optionally included. Based on real-life project experience, an Integrated System is designed in a way that its components will work optimally together over the whole lifecycle.

Depending on which components are included in an Integrated System, we distinguish between

- Systems built for general purposes (applicable for various usage scenarios)
- Purpose-built systems (optimized for a specific use case)

It is worth mentioning that terminology, definitions and segmentation of Integrated Systems vary in the market in general. And what is more, they even change once in a while. With regard to terminology, there are a lot of synonyms used in the market as converged systems, fabric-based systems, unified infrastructures, engineered systems, and various others.

Under the PRIMEFLEX brand, Fujitsu offers Integrated Systems built for general purpose and purpose-built systems. In addition to the traditional converged type of integrated systems, the PRIMEFLEX line includes hyper-converged systems, enabling customers an easy path to a software-defined data center. Fujitsu supports both delivery options: ready-to-run systems and reference architectures. Fujitsu’s Integrated Systems are built from best-in-class components, either own technologies, as for instance the Fujitsu Server PRIMERGY or 3rd party technologies from leading technology partners who are recognized as leaders in the market as for example NetApp.

Fujitsu’s Integrated Systems are unmatched when it comes to best practices and extensive project experience, and have proved themselves in Fujitsu’s cloud operation. Attractive supplements and flexible service options, fulfilled by Fujitsu or its local partners, make Integrated Systems from Fujitsu even more appealing.

From Fujitsu’s perspective, it is an absolute must for reference architectures to be supported by detailed installation and configuration descriptions. For this reason, Fujitsu provides comprehensive guidelines as a standard.

On demand, Fujitsu supports customers and partners in custom-tailoring PRIMEFLEX reference architectures according to specific demands in order to let them fully exploit the potential possibilities. As an option, reference architectures or adjusted reference architectures can even be pre-installed, thus making the reference architecture even ready-to-run instantly, and accelerating time to production even more. Although most of the typical activities have been done by Fujitsu before project start, some activities still need to be done onsite. But even with these remaining activities, Fujitsu does not leave you out in the rain. Fujitsu provides deployment services for its Integrated Systems, either on demand or as an integral part of the PRIMEFLEX offering.
The often more challenging task is the integration into the existing production environment, which is covered by Fujitsu's Integration Services that customers may order optionally. Even if additional services are needed, for instance database migration or anything else, it makes sense to have a word with Fujitsu.

By the way, we should not ignore Fujitsu's Consulting Services, which often represent a ground-breaking element for organizations at the beginning of any IT journey. Examples include assessments, customer briefings, IT investment decision support, configuration and sizing support, and many others.

Depending on the region and the respective local capabilities, services are either delivered by local consultants from Fujitsu or its partners, or by Fujitsu's international delivery team.

**PRIMEFLEX for SAP Landscapes**

PRIMEFLEX for SAP Landscapes bridges the gap between business and IT. It enables enterprises to implement innovations from SAP much faster, making the operation of their SAP environments simpler, more efficient and less expensive. This also applies to SAP HANA. Enterprises can securely manage the in-memory database, which is a mission-critical factor. PRIMEFLEX for SAP Landscapes accomplishes this task through central and transparent management of the entire SAP platform.

**FlexFrame Orchestrator**

Powered by the FlexFrame Orchestrator software component PRIMEFLEX for SAP Landscapes facilitates the operation of SAP applications, SAP databases and the SAP HANA platform and makes it faster and more effective. The FlexFrame Orchestrator is an open SAP management platform that supports consistent and uniform management of all SAP software landscapes, including SAP HANA. It enables enterprises to implement innovations from SAP much faster, making the operation of their SAP environments simpler, more efficient, and less expensive.

![PRIMEFLEX for SAP Landscapes powered by the FlexFrame Orchestrator software](http://www.fujitsu.com/primeflex)

Figure 2: PRIMEFLEX for SAP Landscapes powered by the FlexFrame Orchestrator software

FlexFrame Orchestrator is based on the principle that all software components (operating system, applications, database systems) reside in a central storage. Software can thus be dynamically deployed across physical and virtual resources. The entire solution, from the hardware layer to the application layer, is consistently managed by an integrated management tool. This unique, holistic concept optimizes planning, operation and change management in SAP environments and minimizes overall infrastructure-related costs. Furthermore, FlexFrame Orchestrator supports every kind of provisioning model, in a company's own data center, as managed services, as a hosting service from a service provider, and as a private cloud service. Key features of FlexFrame Orchestrator are described subsequently.

**Shared OS**

In a traditional datacenter the operation system is individually installed on every server of the landscape. In FlexFrame Orchestrator’s landscape only one central image exists which is accessed for booting up all servers.
With this architecture, OS upgrades, security patches etc. can be easily applied to all the servers just by rebooting the server with the new OS image. Also, the preparation of a new OS image is efficient as the OS image is cloned, the changes are applied to the clone and a testing server is booted with this modified OS image. After passing the tests the old central OS image is exchanged by the modified one. For the roll-out of the new OS step by step - to keep the high availability of the running systems - all servers are rebooted with the new central OS.

Software and hardware virtualization

Virtualization concepts play a fundamental role regarding efficiency and flexibility in IT environments. FlexFrame Orchestrator ensures a highly virtualized approach for SAP software landscapes. In addition to the virtualization of the SAP software (ACC) and virtual IP addresses, FlexFrame includes the use of virtualized servers. All applications nodes can be based on leading virtualization technology with VMware ESX or Linux KVM. Consequently, each SAP application can be started on any virtual or physical server in the FlexFrame Orchestrator environment. SAP applications can be relocated from any virtual server to any physical server and vice versa at any time. As a result, the application can be moved to the system with the best suited resources without any additional installation work.
HA of IT and SAP services

The overall FlexFrame Orchestrator landscape bases on a concept without a single-point-of-failure, i.e. all hardware components are configured in high availability. In this way even multiple node failures can be covered.

In the previous section the focus of virtualization in FlexFrame Orchestrator was to ensure efficient provisioning of optimal performance. Here this functionality is used for increasing the SAP system availability. Basis for the application availability are the FlexFrame agents, which are designed to monitor the application processes. In case of a problem the FlexFrame agents initiate several levels of recovering the application.

On top of this, FlexFrame Orchestrator provides a unique high availability concept for infrastructures running SAP and SAP HANA. Fewer critical services may share one failover server whereas business-critical applications can be protected by several failover servers. Disaster resilient two site deployments can also be implemented without having to take additional steps, typically the implementation of a complex cluster technology.

Multi-tenancy

In SAP terminology a multi-tenancy environment grants multiple customers to share the same application. The distinction between the customers is achieved by the application design, i.e. the customers do not share or see each other's data.

In FlexFrame Orchestrator tenants are segregated with a pool concept. A pool comprises a number of dedicated application nodes connected over a specific VLAN. In this way it can access the common resources of FlexFrame Orchestrator, e.g. shared OS images or application SW (read only) and on the other hand access (read/write) individual data on a dedicated area of the common storage, e.g. Storage Virtual Machine (SVM). The NetApp network attached storage offers the needed features for the isolation of customer data from each other.

Figure 5: FlexFrame virtual LAN layout

The FlexFrame Orchestrator Control Center supervises all pools centrally and avoids the usage of multiple dedicated Control Nodes to administer the different tenant environments. This fits perfectly for SAP hosting and service partners. In private cloud environments this feature supports to the separation of critical in-house services as for example HR payroll which can be operated isolated from companywide accessible ERP services.

A different usage scenario of the pools is in the development cycle. With different pools for development, quality assurance, pre-production etc. systems can easily be cloned and used in the other pool(s) without any post-processing (SAP LaMa etc.). Pools are separated from each other and thus the same SID can run in different pools without any problems. A typical scenario could be running for testing purposes a cloned production SID in the test. FlexFrame Orchestrator therefore supports post-processing of cloned SIDs with e.g. PMS from LNW-Soft or SAP LaMa for traditional development cycles within one SAP landscape (=pool) too.

SAP Landscape Management (LaMa)

The SAP Landscape Management LaMa, formerly named as SAP Landscape Virtualization Management (LVM), is the successor product of the SAP NetWeaver Adaptive Computing Controller (ACC). It is positioned as a management tool for SAP basis administrators and inherits all ACC capabilities in addition to offering more advanced automation capabilities. The eminent features are:

- End-to-end automation for SAP system clone / copy / refresh operations
- Automatic capacity management of SAP systems
- Comprising landscape reporting and landscape visualization
- Automation of SAP HANA System Replication tasks
A high degree of automation in the FlexFrame Orchestrator GUI eases the administration significantly. Standard tasks can be done by a single click from the SAP Basis administrator. Beside the acceleration of SAP system provisioning it also reduces faults in the administration.

Automation of DC tasks
In the past sections we have seen several aspects of data center automation:

- Automation of the HW stack
- Application automation
- Data center task automation

In the following we will have a closer look into the last item, the DC task automation.

A traditional data center is silo-oriented, server – network – storage. The complexity of each silo needs experienced experts for dedicated administration. Solutions like SAP need resources of each silo which are also dependent from each other. Provisioning for a SAP system is a long sequence of tasks of different DC administrators which results in a long provisioning phase. During the lifecycle changes or even backup-restore need the interaction with different administrators with the same time consuming process. The holistic view of FlexFrame Orchestrator leads to a paradigm shift. FlexFrame can flexibly allocate/use/release the resources of the different HA layers/DC silos without the need of actions of the dedicated HA admins. To support the SAP basis admin and to avoid faults in the provisioning within FlexFrame Orchestrator the standard steps are fully automated. In case the needed resources would exceed the limits the appropriate DC admin for e.g. storage must extend the provided storage.

PRIMEFLEX for SAP HANA
SAP HANA is an innovative data platform optimized for performing real-time analytics and handling real-time transaction workloads. It is based on innovative in-memory technology which allows real-time access to massive amounts of data, by storing the whole data in main memory and a copy of these data on persistent storage (disk). The maturation of industry-standard technology is a basic enabler for in-memory technology, as it provides the necessary power and capacity at an affordable price.

PRIMEFLEX for SAP HANA fulfills the substantial technical prerequisites and is certified by SAP. The on-site services ensure a fast and non-disruptive implementation and operation at the customer site.

Central NetApp NAS
In the previous chapters the central Network Attached Storage systems with a connection based on the network file system protocol (NFS) was already mentioned. Here we will have a bit deeper look into the details of the storage.

In FlexFrame Orchestrator the standard central NAS storage is a FAS or AFF system from NetApp. The operating system of the Storage Controller is called ONTAP. The disks within the storage system are combined in aggregates and on top of the aggregates FlexVolumes are created. Such a FlexVolume contains a file system and is usable from NFS (UNIX) or CIFS (Windows) client systems. Data is stored using a Write Anywhere File Layout (WAFL) mechanism. The Storage Controller(s) are equipped with a Non-Volatile RAM (NVRAM) that buffers committed IO blocks. The contents of the NVRAM remains intact in case of power outages etc. The data in the NVRAM are flushed to the disks based on different triggers during normal operations or in case of a power failure if the power is back online.
The minimum FlexFrame environment has at least the following volumes:
- volFF (OS images of Application Nodes, SAP and database software, pool related files)
- sapdata (database files)
- saplog (database log files)

With ONTAP 8.0 NetApp introduced its new paradigm of Storage Virtual Machine (SVM) which is used by FlexFrame Orchestrator for the segregation of tenants. In addition the Clustered Data ONTAP (cDOT) is the basis for NetApp's scale-out architecture of storage systems without downtime.

Usage of multiple Storage Controllers as well as NetApp HA configurations - in contrast and additively to cDOT (Metro)cluster configurations - is possible for redundancy and reliability. In FlexFrame environments HA and MetroCluster configurations are highly recommended to avoid SPOFs. The switching from one storage system to its HA or (Metro)cluster counterpart is transparent to FlexFrame.

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**Snap Creator**

**Overview**

The NetApp Snap Creator Framework enables you to use pre-packaged and custom plug-ins that standardize and simplify data protection for a wide variety of third-party applications, databases, and hypervisors in Windows and UNIX, and Linux environments. By leveraging Snapshot, SnapVault, and SnapMirror functionalities, as well as FlexClones, Snap Creator provides the following:

- **Application-consistent data protection**
  - A centralized solution for backing up critical information, integrating with existing application architectures to ensure data consistency and reduce operating costs.

- **Extensibility**
  - Achieve fast integration using modular architecture and policy-based automation.

- **Cloud readiness**
  - Operating system-independent Snap Creator functionality supports physical and virtual platforms and interoperates with IT-as-a-service and cloud environments.

- **Cloning capability**
  - Space-efficient data cloning is supported for development and test purposes.

Snap Creator has a full-featured server and agent architecture, which consists of three main components: Snap Creator Server, Snap Creator Agent, and plug-ins.

**Backup solution components**

Snap Creator can be used to back up the SAP HANA database files as well as the non-database files like the /hana/shared file system. The backup of non-database files can either be included in the Snap Creator configuration for database backups or can be put in a separate Snap Creator configuration. The configuration and workflows described in this document are focused on the database backup and do not cover the backup of non-database files.
The Snap Creator backup solution for SAP HANA covers the following areas:

- SAP HANA data file backup using storage-based Snapshot copies
- Replication of data file backups to a secondary offsite backup location
- SAP HANA log file backup using the HANA database log backup functionality
- Database block integrity check using a file-based backup
- Housekeeping of data file, log file backups and the SAP HANA backup catalog

Database data file backups are executed by Snap Creator in combination with the plug-in for SAP HANA. The plug-in triggers a SAP HANA database backup save point so that the Snapshot copies, which are created on the primary storage system, are based on a consistent image of the SAP HANA database.

Snap Creator allows replicating the consistent database images to a secondary storage location using SnapVault. Typically, different retention policies are defined for the backups at the primary storage and the backups at the secondary storage. Snap Creator handles the retention at the primary as well as the secondary storage.

The log backup is executed automatically by the SAP HANA database. Depending on the recovery point objectives there are several options for the storage location of the log backups:

- The log backup is written to a storage system, which synchronously mirrors the data to a second location. (NetApp MetroCluster)
- The log backup destination could be configured on the same primary storage system and then replicated asynchronously to a secondary storage with SnapMirror.
- The log backup destination could be configured on the same secondary storage where the database backups get replicated with SnapVault. With this configuration, the secondary storage has availability requirements similar to those of the primary storage so that it is certain that the log backups can always be written to the secondary storage.

SAP recommends combining storage-based Snapshot backups with a weekly file-based backup to execute a block integrity check. The block integrity check can be executed from within the Snap Creator GUI or CLI. Based on configurable retention policies, Snap Creator manages the housekeeping of data file backups at the primary and secondary storage location, log file backups and the SAP HANA backup catalogue. Figure 8 shows an overview of the database and log backup configuration.

Figure 8: Database and log backup.
Required NetApp licenses and software packages
The primary storage controllers must have a SnapRestore license installed and optionally SnapVault or SnapMirror licenses. The secondary storage must have a SnapVault or SnapMirror license installed.

No license is required for Snap Creator and the Snap Creator SAP HANA plug-in. To install and configure the Snap Creator software, the following software package is required: NetApp_Snap_Creator_Framework4.3-Linux64.tar.gz. This can be downloaded from the NetApp support site (http://mysupport.netapp.com/NOW/download/software/snapcreator_framework/4.3/).

Capacity requirements for Snapshot Backups
A higher block change rate on the storage layer has to be considered compared to the change rate with traditional databases. Due to the table merge process of the column store of SAP HANA, much more data than just the block changes is written to disk. Until more customer data is available, the current estimate for the change rate is 20% to 50% per day.

Snap Creator plug-in for SAP HANA
The NetApp Snap Creator framework in combination with an application-specific plug-in for SAP HANA is used to implement a backup solution for SAP HANA based on storage-based Snapshot backups.

Snap Creator and the SAP HANA plug-in are supported with ONTAP with the SAP HANA database nodes attached to the storage controllers using either NFS or Fibre Channel. The SAP HANA database can run in a single or multi-node configuration. The required interfaces to the SAP HANA database are available for Service Pack Stack (SPS) 7 and later.

The Snap Creator framework communicates with the storage systems to create Snapshot copies and to replicate the data to a secondary storage using SnapVault. Snap Creator is also used to restore the data either with SnapRestore at the primary storage or with SnapVault restore from the secondary storage.

The Snap Creator plug-in for SAP HANA uses the SAP HANA hdbsql client to execute SQL commands for the following tasks:

- Provide database consistency to prepare a storage-based Snapshot backup
- Manage log file backup retention on file system level
- Manage the SAP HANA backup catalog for data file and log file backups
- Execute a file-based backup for block integrity check

Figure 9 shows an overview of the communication paths of Snap Creator with the storage and the SAP HANA database.
When executing a backup Snap Creator performs the following tasks:
- Create an SAP HANA backup save point to get a consistent image on the persistence layer.
- Create a storage Snapshot copy of data volume.
- Register the storage Snapshot backup within the SAP HANA backup catalog.
- Delete the SAP HANA backup save point.
- Execute a SnapVault update for the data volume.
- Delete storage Snapshot copies at the primary and/or secondary storage based on the defined retention policies for backups at the primary and secondary storage.
- Delete SAP HANA backup catalog entries if the backups do not exist anymore at the primary and the secondary storage.
- Delete all log backups, which are older than the oldest data backup on file system and within the SAP HANA backup catalog.

Installation
The following sections describe the required software components and their installation and configuration to integrate the Snap Creator for SAP HANA with an existing PRIMEFLEX for SAP Landscapes installation. The mentioned software and tool versions are examples used at the creation time of this document. For a specific implementation it should be checked if newer versions exist and if they are compatible with the other components.

Technical Environment
FlexFrame ORCHESTRATOR
- FlexFrame V1.2A Release 017
- NetApp FAS8040, ONTAP 8.3.2 clustered
- RX2540M1 for AN and HN, SLES 11 SP4
- Cisco C3750-X-24TS, IOS 15.2(44)SE5
- Cisco Nexus 5548UP, NX-OS 7.1
- Pool p1 networks:
  o Storage 192.168.12.0/24, vlan 12
  o Server 192.168.11.0/24, vlan 11
  o Client 10.1.5.0/24, vlan 10
  o Control 192.168.13.0/24, vlan 13

FlexFrame Tool-server
The FlexFrame Tool-server is located outside of the FlexFrame environment and intended as gateway for remote access to the FlexFrame environment. It additionally hosts optional 3rd party SW as for example backup SW. In this case it runs also the Snap Creator framework.
- RX1330M1, SLES 11 SP4

SAP System Landscape
- NWO  NetWeaver 7.4 SR1 ABAP, Oracle 11.2.0.3 pool p1
- HZ1  SAP HANA 1.0 SPS11

Snap Creator Framework
The Snap Creator Agent (SCA) runs on FlexFrame application nodes (AN). Due to the fact the Snap Creator Server (SCS) has to access multiple FlexFrame pools, these components will be installed on an external backup server. A secondary storage can be used for snapshot backups (refer to document Best Practice FlexFrame for SAP NetApp Snap Creator Integration V.07, June 2013). Any project setup should be discussed with your Fujitsu or/and NetApp consultant.
Setup of FlexFrame Tool Server

Site Preparation
To connect the Tool-Server to a FlexFrame Orchestrator environment we need to allocate switch ports and IP-addresses. Depending on the planned backup scenario 10GbE network interfaces are highly recommended.

Allocation of switch ports for DATA connection
There are two possibilities of adding those switch ports. The first one shown is optimum for static environments.

Add the switch ports for the external backup server to the FlexFrame LDAP configuration (in this example 2 port):

```
cn1:~ # ff_swport_adm.pl --op add --port 1:1:23 --lan \p1:server,adm:server,p1:storage,adm:storage --desc "Backup Server data NIC-1"
cn1:~ # ff_swport_adm.pl --op add --port 1:2:23 --lan \p1:server,adm:server,p1:storage,adm:storage --desc "Backup Server data NIC-2"
```

In case of a hosting environment we would recommend to use the following option, the benefit of choosing this option is that if new FlexFrame Pools are created the switch port configuration is automatically updated to reflect the VLANs of the newly created Pool.

```
cn1:~ # ff_swgroup_adm.pl --op add uplink --group 2 --uplinkportcnt 2 --uplinkportmedia 10GB --uplinkchanneltype UPLINK
```

Configure an iRMC port (optionally):
We recommend connecting the iRMC to an already existing Out-of-Band management network, which is independent from the FlexFrame infrastructure.

```
cn1:~ # ff_swport_adm.pl --op add --port 1:1:2 --lan '#:23' --native '#:23' --desc "Backup Server: mgmt NIC-1"
```

Allocate IP-Addresses for the Tool-Server
Especially in NetApp cDOT environments it is necessary to have also a connection into the Control-LAN to issue commands to the cDOT cluster respectively the SVM (Storage Virtual Machine).

For FlexFrame versions below 1.2A use the following command to allocate IP-Addresses:

```
cn1:~ # ff_hosts.sh --p p01 --a 192.168.13.250 --n toolsrv-st
```
```
cn1:~ # ff_hosts.sh --p p01 --a 192.168.11.250 --n toolsrv-se ...
```

For FlexFrame versions 1.2A or higher please use the following command:

```
cn1:~ # ff_xn_adm.pl --op add --name toolsrv --pool adm --network control,storage,server \ --host 250
For any additional pool the control network has to be omitted!!
cn1:~ # ff_xn_adm.pl --op add --name toolsrv-p01 --pool p01 --network storage,server \ --host 250
```
Maintaining /etc/hosts file for name resolution

For the further steps in his document need a proper configured Name resolution, therefore the best way is even in a hosting environment is to have these entries maintained in the /etc/hosts file on the Tool Server.

```
cn1:~ # vi /etc/hosts
---
#### ToolServer local IP-Addresses ####
192.168.202.250 gpstfftoolsrv.testlab.net gpstfftoolsrv
10.1.204.250 gpstfftoolsrv.testlab.net gpstfftoolsrv
10.2.204.250 gpsttoolsrv-adm-st gpsttoolsrv-adm-st
10.1.204.250 gpsttoolsrv-adm-se gpsttoolsrv-adm-se
10.1.205.250 gpsttoolsrv-p1-se gpsttoolsrv-p1-se
10.2.205.250 gpsttoolsrv-p1-st gpsttoolsrv-p1-st
10.1.207.250 gpsttoolsrv-p2-se gpsttoolsrv-p2-se
10.2.207.250 gpsttoolsrv-p2-st gpsttoolsrv-p2-st
10.1.212.250 gpsttoolsrv-p3-se gpsttoolsrv-p3-se
10.2.212.250 gpsttoolsrv-p3-st gpsttoolsrv-p3-st
10.1.206.250 gpsttoolsrv-p4-se gpsttoolsrv-p4-se
10.2.206.250 gpsttoolsrv-p4-st gpsttoolsrv-p4-st
#### ControlNodes IP-Addresses ####
192.168.204.11 cn1
192.168.204.12 cn2
#### NetApp SVM ControlLAN IP-Addresses ####
192.168.103.8 svmff-co
192.168.103.9 svmp1-01-co
192.168.103.10 svmp1-02-co
192.168.103.20 svmp2-01-co
192.168.103.21 svmp2-02-co
192.168.103.19 svmp3-01-co
192.168.103.18 svmp3-02-co
192.168.103.22 svmp4-01-co
192.168.103.23 svmp4-02-co
#### DATABASE Pool p1 ####
10.1.205.1 dba01-se.p1.gpst.com p1-dba01-se
10.1.205.14 dbcr-se.p1.gpst.com p1-dbcr-se
192.168.205.90 p1-hdb90hz1-001 hdb90hz1-001.p1.gpst.com p1-hdb90hz1-001.p1.gpst.com
192.168.205.90 p1-hdb90hz1-001-se hdb90hz1-001-se.p1.gpst.com p1-hdb90hz1-001-se.p1.gpst.com
dbhz1-se
10.1.205.87 dbhz9-se.p1.gpst.com p1-dbhz9-se.p1.gpst.com p1-dbhz9-se
10.1.205.8 dbnws-se.p1.gpst.com p1-dbns-se.p1.gpst.com p1-dbns-se
192.168.205.10 p1-hdb04hd2-001 hdb04hd2-001.p1.gpst.com p1-hdb04hd2-001.p1.gpst.com
192.168.205.17 p1-hdb04hd2-001-se hdb04hd2-001-se.p1.gpst.com p1-hdb04hd2-001-se.p1.gpst.com
dbnl1-se.p1.gpst.com p1-dbnl1-se.p1.gpst.com p1-dbnl1-se
192.168.205.85 p1-hdb85hz3-001 hdb85hz3-001.p1.gpst.com p1-hdb85hz3-001.p1.gpst.com
192.168.205.85 p1-hdb85hz3-001-se hdb85hz3-001-se.p1.gpst.com p1-hdb85hz3-001-se.p1.gpst.com
#### DATABASE Pool p2 ####
10.1.207.4 dbrep-se.ralf.com p2-dbrep-se
10.1.207.1 dbnws-se.ralf.com p2-dbnws-se.ralf.com p2-dbnws-se
192.168.207.90 p2-hdb90hz1-901 hdb90hz1-901.ralf.com p2-hdb90hz1-901.ralf.com
10.1.207.90 p2-hdb90hz1-901-se hdb90hz1-901-se.ralf.com p2-hdb90hz1-901-se.ralf.com
dbhz1-se
10.1.207.87 dbhz9-se.ralf.com p2-dbhz9-se.ralf.com p2-dbhz9-se
```

For each new Pool respectively for each new database that should be backed up with NetApp Snap Creator you HAVE TO update the /etc/hosts file manually.
**Snap Creator Server Installation on Tool-Server**

Refer to the NetApp Snap Creator Framework 4.3 Installation Guide.

```
rx201:/opt/NetApp # tar -xvf /mnt/NetApp_Snap_Creator_Framework4.3-Linux64.tar
rx201: /opt/NetApp # cd scServer4.3
rx201: /opt/NetApp/scServer4.3 # ./snapcreator --setup
```

Welcome to the NetApp Snap Creator Framework 4.3!

### Installation options ###

01. NetApp Snap Creator Framework 4.3 Server

02. NetApp Snap Creator Framework 4.3 Remote CLI

Select install option (enter a number or "q" to quit): **01**

Do you accept the End User License Agreement (y|n): **y**

Enter controller serial number (Recommended): **XXXXXXXX**

Enter Snap Creator server port [8443]:

Enable job monitor (Y|N): **Y**

Enter job monitor size, how many jobs to allow [100]: **1000**

Enter scServer Administrator Username: **root**

Enter password for root:

Confirm password for root:

INFO: Updated NetApp Snap Creator Framework 4.3
/usr/local/scServer4.3/engine/etc/snapcreator.properties

INFO: Updated NetApp Snap Creator Framework 4.3 /usr/local/scServer4.3/bin/scServer

INFO: To start scServer please do the following:

/usr/local/scServer4.3/bin/scServer start

INFO: To access NetApp Snap Creator Framework 4.3 GUI goto **https://hostname:8443/**

```
Edit the file `/usr/local/scAgent4.3/bin/scServer` and add SuSE-Linux specific entries in the script header:
```

```
#!/bin/sh

### BEGIN INIT INFO
# Provides: scServer
# Required-Start: $network portmap $remote_fs
# X-UnitedLinux-Should-Start: ypbind keyserv ldap
# Required-Stop:
# X-UnitedLinux-Should-Stop:
# Default-Start: 3 5 6
# Default-Stop: 0 1 2 6
# Description: Start the scServer daemon for SnapCreator
### END INIT INFO
```

```
rx201:/opt/NetApp/scAgent4.1.0/bin # cp scServer /etc/init.d/scServer
rx201:/opt/NetApp/scAgent4.1.0/bin # insserv /etc/init.d/scServer
```
Snap Creator Agent Installation on Tool-Server

For SAP HANA databases there is also an option to use a locally installed hdclient in combination with the SnapCreator Agent to perform SnapShot backups.

```bash
rx601:/opt/NetApp/ # tar -xvf ./NetApp_Snap_Creator_Framework4.3-Linux64.tar scAgent4.3
rx601:/opt/NetApp/ # cd /opt/NetApp/scAgent4.3
rx601:/opt/NetApp/scAgent4.3 # ./snapcreator -setup
```

Welcome to the NetApp Snap Creator Framework 4.3!

### Installation options ###

01. NetApp Snap Creator Framework 4.3 Agent

Select install option (enter a number or "q" to quit): 01

END USER LICENSE AGREEMENT

Version: 28 February 2013

Do you accept the End User License Agreement (y|n): y

Enter Agent Port [9090]:

INFO: Updated NetApp Snap Creator Framework 4.3
/addon/NetApp/scAgent4.3/etc/agent.properties

INFO: To start scAgent please do the following:

/addon/NetApp/scAgent4.3/bin/scAgent start

Edit the file `/usr/local/scAgent4.3/bin/scAgent` and add SuSE-Linux specific entries in the script header:

```bash
#!/bin/sh
### BEGIN INIT INFO
# Provides: scAgent
# Required-Start: $network portmap $remote_fs autosfs
# X-UnitedLinux-Should-Start: ypsbind keyserv ldap
# Required-Stop:
# X-UnitedLinux-Should-Stop:
# Default-Start: 3 5 6
# Default-Stop: 0 1 2 6
# Description: Start the scAgent daemon for SnapCreator
### END INIT INFO
```

Change the following entry in `/usr/local/scAgent4.1.0/bin/scAgent`:

```bash
SNAPCREATOR_PATH=/opt/NetApp/scAgent4.1.0
```

Copy the script to `/etc/init.d` and run `insserv` for Snap Creator to create the necessary start/stop scripts and the required start order:

```bash
rx601:/opt/NetApp/scAgent4.3/bin # cp scAgent /etc/init.d/scAgent
rx601:/opt/NetApp/scAgent4.3/bin # insserv /etc/init.d/scAgent
```
Installation of SAP HANA hdbql client software

If you plan to create snapshot based backups of a SAP HANA database without having the need of integrating the Snap Creator Agent into the FlexFrame OS Image, you must install the hdbclient software on the Tool-Server.

```
rx201:/sapcd/s4hana/client/DATA_UNITS/HDB_CLIENT_LINUX_X86_64 # ./hdbinst
SAP HANA Database Client installation kit detected.
SAP HANA Lifecycle Management - Client Installation 1.00.102.01.1444147999
**********************************************************
********
Enter Installation Path [/usr/sap/hdbclient]:
Checking installation...
Preparing package 'Python Runtime'...
Preparing package 'Product Manifest'...
Preparing package 'SQLDBC'...
Preparing package 'REPOTOOLS'...
Preparing package 'Python DB API'...
Preparing package 'ODBC'...
Preparing package 'JDBC'...
Preparing package 'HALM Client'...
Preparing package 'Client Installer'...
Installing SAP HANA Database Client to /usr/sap/hdbclient...
Installing package 'Python Runtime'...
Installing package 'Product Manifest'...
Installing package 'SQLDBC'...
Installing package 'REPOTOOLS'...
Installing package 'Python DB API'...
Installing package 'ODBC'...
Installing package 'JDBC'...
Installing package 'HALM Client'...
Installing package 'Client Installer'...
Installation done
Log file written to '/var/tmp/hdb_client_2016-05-24_07.35.11/hdbinst_client.log' on host 'rx201'
```

It is also helpful to extend the PATH variable for user root so that you do not have to type in the whole path, while calling commands e.g. hdbuserstore, hdbsql etc.
Snap Creator Agent Integration in FlexFrame OS Image

Create a FlexFrame maintenance image for the installation of additional software components. Assign the maintenance image to a free AN and boot it. Add the LDAP entries for the additional automounter mount points with the tool `ff_custom_mnt_adm.pl`. Prerequisites: a volume (e.g. `addon`) has to be created on the filer, a subdirectory or qtree has to exist (in our case `./NetApp`), the `/etc/exports` file entry on the filer has to be correct and the exports have to be re-exported. Add the custom mount points and directories on the AN.

```bash
rx601:/addon/ # tar -xvf ./NetApp_Snap_Creator_Framework4.3.0-Linux64.tar scAgent4.3
rx601:/addon/ # ln -s scAgent4.3 snapcreator
rx601:/addon/scAgent4.3 # ln -s /var/log/snapcreator logs
rx601:/addon/scAgent4.3 # ln -s /var/log/snapcreator/agent.watchdog agent.watchdog
rx601:/addon/scAgent4.3 # ln -s /var/log/snapcreator/agent.watchdog.ref agent.watchdog.ref
rx601:/us/local # ln -s /addon/NetApp/scAgent4.3.0
rx601:/addon/NetApp # cd /us/local/scAgent4.3
rx601:/us/local/scAgent4.1.0 # /snapcreator --setup
```

Welcome to the NetApp Snap Creator Framework 4.3!

### Installation options ###

01. NetApp Snap Creator Framework 4.3 Agent

Select install option (enter a number or "q" to quit): 01

END USER LICENSE AGREEMENT

... Version: 28 February 2013

Do you accept the End User License Agreement (y|n): y

Enter Agent Port [9090]:

INFO: Updated NetApp Snap Creator Framework 4.3

```
# addon/NetApp/scAgent4.3/etc/agent.properties
```

INFO: To start scAgent please do the following:
```
rx601:/addon/NetApp/scAgent4.3/bin/scAgent start
```

Edit the file `us/local/scAgent4.3/bin/scAgent` and add SuSE-Linux specific entries in the script header:

```bash
#!/bin/sh
### BEGIN INIT INFO
# Provides: scAgent
# Required-Start: network portmap $remote_fs autofs
# X-UnitedLinux-Should-Start: ypbind keyserv ldap
# Required-Stop:
# X-UnitedLinux-Should-Stop:
# Default-Start: 3 5 6
# Default-Stop: 0 1 2 6
# Description: Start the scAgent daemon for SnapCreator
### END INIT INFO
```

Change the following entry in `us/local/scAgent4.1.0/bin/scAgent`:

```
SNAPCREATOR_PATH=/us/local/scAgent4.1.0
```

Copy the script to `/etc/init.d` and run `inserv` for Snap Creator to create the necessary start/stop scripts and the required start order:

```bash
rx601:/us/local/scAgent4.1.0/bin # cp scAgent /etc/init.d/scAgent
rx601:/us/local/scAgent4.1.0/bin # inserv /etc/init.d/scAgent
```

Exit the maintenance mode and create a new AN image with the customized settings included. Shut down the maintenance image AN and revert the maintenance image to a base image. Assign the new AN image and boot the AN.
Snap Creator Configuration

**SAP HANA Backup User and Hdbuserstore Configuration**
NetApp recommends configuring a dedicated database user within the HANA database to run the backup operations with Snap Creator. In the second step, an SAP HANA user store key is configured for this backup user, and this user store key is used within the configuration of the Snap Creator SAP HANA plug-in.

The HANA database user can be created with HANA Studio and must have at least the following roles:
- `sap.hana.backup.roles::Administrator`
- `sap.hana.backup.roles::Operator`
- `DBA_COCKPIT` (optional)

After the creation of the user you MUST login with the user once to change the password.

Then you can create the entry in the user store for root on the tool server by using the following command:

```
rx201:/usr/sap/hdbclient # hdbuserstore set P01HZ1 p01-hdb90hzi-001:39015 DBBAC KUP xyz123456!
```

In addition, a dedicated user on each NetApp SVM should be present:

```
gpstcl01::> security login create -user-or-group-name scbackup -application ontapi -authmethod password -role vsadmin -vserver svmp1-01 -comment SnapCreator_User
```

**Backup profile configuration in Snap Creator**
To configure Snap Creator, complete the following steps:
- Connect to the Snap Creator GUI.
- Log in with the user and password that were configured during the installation. Click Sign In.
- Create a new profile, provide a profile name and click OK. In our example, `P01` is the system identifier (SID) of the database.

Enter the configuration name and click Next.

Select Application Plug-In.
Select SAP HANA as the application plug-in and click Next.

![Configuration diagram](image)

Enter the database SID, the hdbuserstore keys for each SAP HANA node, the path to the hdbsql executable, and the OSDB user. You can also enable automated LOG cleanup. Click Next.

![Configuration diagram](image)

Enter the file backup location and the file backup prefix and select if you want to enable file backup. Click Next.

![Configuration diagram](image)
Enter the temporary file backup location for the block integrity check operation and select Enable DB Integrity Check. Click Next.

Enter the agent configuration parameter. Click Next.
Enter the storage connection settings and click Next.
Select the data volumes that are stored on this SVM and click Save.
Enter the Snapshot policy and retention configuration. The retention of 3 daily and 12 hourly Snapshot copies is presented as an example. Your system can be configured differently depending on your requirements.

Note: A Snapshot copy label is not required and must not be configured to make sure that Snap Creator is able to control backup retention at the secondary storage. If you were to set a label, clustered Data ONTAP would also control backup retention and would delete backups based on the retention defined in the SnapMirror relationship.

Note: You must select the naming convention Timestamp. The naming convention Recent is not supported with the SAP HANA plug-in because the timestamp of the Snapshot copy is also used for SAP HANA backup catalog entries.

No changes are needed on the next screen. Click Next.
Select SnapVault and configure the SnapVault retention policies and the SnapVault wait time.

Click Add.

Select a source SVM from the list and click Next.
Select all volumes and click Save.

The next screen shows all volumes that are protected in our example configuration. Click Next.

Enter the credentials for the target SVM and click Next. In this example, the vsadmin user is used to access the SVM. Typically, a dedicated backup user is configured on the storage system and then used with Snap Creator.

Click Next on the DFM screen.
After the configuration is completed, click Finish.

For more details about the backup configuration wizard in Snap Creator for SAP HANA have a look at the NetApp TR-4313.

Backup
A database backup can be performed by using either the Snap Creator GUI or the command line. The built-in scheduler in the Snap Creator GUI or the command line in combination with an external scheduler can be used to schedule the backups.

Backup Workflow
When Snap Creator is backing up the database, it performs the following steps:

- It creates a global synchronized backup save point to create a consistent database image on the persistence layer.
- It creates storage Snapshot copies for all data volumes of the database. In our example of a single-node HANA database, there is only one data volume. With an SAP HANA scale-out database, there are multiple data volumes.
- It registers the storage Snapshot backup within the SAP HANA backup catalog.
- It deletes the SAP HANA backup save point.
- It starts a SnapVault update for all data volumes (if configured and enabled).
- It checks the SnapVault status and waits until it is finished or a configurable timeout has occurred.
- It deletes storage Snapshot copies and deletes backups in the SAP HANA backup catalog based on the defined retention policy for backups at the primary and secondary storage.
- It deletes all log backups that are older than the oldest data backup on the file system and within the SAP HANA backup catalog. This step is only executed if Log Backup Cleanup is enabled.
Database backup with Snap Creator GUI
Click the P01_database_backup configuration. From the Actions menu, select Backup.

Select the backup policy and click OK.

The action is started.

Snap Creator triggers the SnapVault update, and Snap Creator waits until the data is replicated to the secondary storage. The wait time is set during configuration and can be adapted in the SnapVault Settings tab. Snap Creator triggers the SnapVault updates in parallel for each volume on the same storage controller and in sequence for each storage controller.
Database backup with Snap Creator CLI

Using Snap Creator Agent locally installed on Tool-Server

To use this option it is necessary to have the HANA Client Software installed locally on the Tool-Server. It is also necessary to create for each HANA database an entry in the HANA User-Store to allow password less access to the HANA database.

To back up the database, run the following command:

```
stlrx300s8-1:~ # /opt/NetApp/SnapCreator/scServer4.3.0/snapcreator --server localhost --port 8443 --user admin --passwd Netapp123 --profile HANA_profile_P01 --config P01_database_backup --action backup --policy daily --verbose
```

```
[Tue Feb 9 04:46:42 2016] INFO: Validating policy: daily finished successfully

########## Detecting Data ONTAP mode for hana ##########


########## Agent validation ##########


########## Plugin validation ##########

[Tue Feb 9 04:46:43 2016] INFO: Plugin validation completed successfully for plugin hana


########## Running storage discovery ##########

Truncated

Backups in SAP HANA Studio

Figure 10 shows a list of backups within the Snap Creator GUI. The highlighted backup shows a Snapshot copy named Backup-P01-daily_20160209044642. This backup includes the Snapshot copy for the data volume of the SAP HANA system. This backup is also available at the secondary storage.

![List of backups within Snap Creator](image)

Figure 10: List of backups within Snap Creator.

The Snapshot copy name is used by Snap Creator as a backup ID when Snap Creator registers the storage Snapshot copy in the SAP HANA backup catalog. Within SAP HANA Studio, the storage Snapshot backup is visible in the backup catalog. The external backup ID (EBID) has the same value as the Snapshot copy name, as is shown in Figure 11.
With every backup run, Snap Creator deletes Snapshot backups at the primary storage and at the secondary storage based on the retention policies defined for the different schedules (hourly, daily, and so on). Snap Creator also deletes the backups within the SAP HANA backup catalog if the backup does not exist at either the primary storage or the secondary storage. Therefore the SAP HANA backup catalog always shows the complete list of backups that are available at the primary and/or the secondary storage.

**Restore and Recover**

To restore and recover an SAP HANA database by using SAP HANA Studio and Snap Creator, complete the following steps:

To prepare the restore and recovery process with SAP HANA Studio, complete the following steps:

- Select Recover System and confirm shutdown of the SAP HANA system.
  - Select the recovery type and the log backup location.
  - The list of data backups is shown. Select Backup to see the external backup ID.

- To perform the restore process with Snap Creator, complete the following steps:
  - Select Restore from primary or secondary storage (volume or file based).
  - Select the Snapshot backup that matches the external backup ID from SAP HANA Studio.
  - Start the restore process.

**Note:**

- If a volume-based restore from primary storage is chosen, the data volumes must be unmounted from all SAP HANA database hosts before the restore and mounted again when the restore process is finished.
- In an SAP HANA multi-node setup with Fibre Channel, the unmount and mount operation is executed by the SAP HANA name server as part of the shutdown and startup process of the database.
- The SnapVault relation must be deactivated if a volume-based restore from primary storage is chosen with clustered Data ONTAP and if you must restore a Snapshot copy that is older than the Snapshot copy currently used as the base Snapshot copy for SnapVault replication.

To run the recovery process with SAP HANA Studio, complete the following steps:

- Click Refresh from the backup list and select the available backup for recovery (green item).
- Start the recovery process. When the recovery process is finished, the SAP HANA system is started.
Restore and recovery from primary storage

To restore and recover from primary storage, complete the following steps:

Within SAP HANA Studio, select the Recover option for the SAP HANA system.

Click OK to shut down the SAP HANA database.
Select the recovery type and click Next.
Provide log backup locations and click Next.

**Locate Log Backups**

Specify location(s) of log backup files to be used to recover the database.

- **Locations:**
  - /mnt/log_backup/P01

**Backint System Copy**

- **Backint System Copy**
- **Source System:**
A list of available backups is shown based on the content of the backup catalog. Choose the required backup and write down the external backup ID.

Deactivate the SnapVault relationship with the following commands on the backup cluster console. This step is required only with clustered Data ONTAP and if you need to restore a Snapshot copy that is older than the Snapshot copy currently used as the base for SnapVault replication.

On each database node, unmount all data volumes. In our example, only one volume must be unmounted on the single database node.

```
srtlrx300s8-3:/ # umount /hana/data/P01/mnt00001
```
From the Snap Creator GUI, select the configuration of the SAP HANA system. Go to Actions and select Restore.

Click Next.
Select to restore from the primary storage.

Select the SVM, the volume name, and the Snapshot name. The Snapshot name correlates with the backup ID that has been selected within SAP HANA Studio.
Click Finish.

Select Yes to add more restore items; in our example, there is only one volume.
Note: In an SAP HANA multi-node setup, there are multiple volumes that must be selected for the restore process.
When all volumes are selected, click OK to start the restore process.

Wait until the restore process completes.

On each database node, mount all data volumes. With our example, only one volume must be remounted at the database node.

```
mount /hana/data/P01/mnt00001
```
Go to SAP HANA Studio and click Refresh to update the list of available backups. The backup that was restored with Snap Creator is shown with a green icon in the list of backups. Select the backup and click Next.
Select other settings as required. Deselect Use Delta Backups (Recommended). Click Next.

- **Other Settings**
  - **Check Availability of Delta and Log Backups**
    - You can have the system check whether all required delta and log backups are available at the beginning of the recovery process. If delta or log backups are missing, they will be listed and the recovery process will stop before any data is changed. If you choose not to perform this check now, it will still be performed but later. This may result in a significant loss of time if the complete recovery must be repeated.
    - Check the availability of delta and log backups:
      - [ ] File System
      - [ ] Third-Party Backup Tool (Backint)
  - **Initialize Log Area**
    - If you do not want to recover log segments residing in the log area, select this option. After the recovery, the log entries will be deleted from the log area.
      - [ ] Initialize Log Area
  - **Use Delta Backups**
    - Select this option if you want to perform a recovery using delta backups. If you choose to perform a recovery without delta backups, only log backups will be used.
      - [ ] Use Delta Backups (Recommended)
  - **Install New License Key**
    - If you recover the database from a different system, the old license key will no longer be valid.
      - You can:
      - Select a new license key to install now
      - Install a new license key manually after the database has been recovered
      - [ ] Install New License Key

[Continue with the setup process]
Click Finish.

Review Recovery Settings

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

System Information

<table>
<thead>
<tr>
<th>System</th>
<th>P01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host</td>
<td>10.63.168.55</td>
</tr>
<tr>
<td>Version</td>
<td>1.00.110.00.1447753075</td>
</tr>
</tbody>
</table>

Recovery Definition

| Recovery Type | Snapshot (Point-in-Time Recovery (Until Now)) |

Configuration File Handling

Caution

If you want to recover customer-specific configuration changes, you may need to make the changes manually in the target system.

If you are performing a recovery to a different system:

Note that the target system and the source system must have the same configuration. In particular, the number of database services with their own persistency must be the same in both systems.

More Information: SAP HANA Administration Guide

Show SQL Statement
The recovery process starts.

**Restart (Phase 3 of 3)**

1. Recovery is running - 1 of 3 services finished successfully

<table>
<thead>
<tr>
<th>Host: stlne300 avalanche-3 (Master)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name Server</td>
</tr>
<tr>
<td>Restart completed</td>
</tr>
<tr>
<td>Index Server</td>
</tr>
<tr>
<td>Restarting</td>
</tr>
<tr>
<td>XSEngine</td>
</tr>
<tr>
<td>Restarting</td>
</tr>
</tbody>
</table>
Recovery completes.

### Recovery Execution Summary

<table>
<thead>
<tr>
<th>System P01 recovered</th>
<th>3 volumes were recovered</th>
</tr>
</thead>
</table>

Recovered to Time: 09.02.2016 14:29:16 GMT+01:00
Recovered to Log Position: 001415616

Resume any SnapVault relationships, if needed.

**Additional Restore and Recovery Scenarios**
Depending on the actual failure additional restore and recovery scenarios exist, e.g. restore and recovery from secondary storage, restore after complete primary storage failure, etc. Please consult the NetApp TR-4313 technical report for more details on these scenarios.
White paper Snap Creator 4.3 for SAP HANA in PRIMEFLEX for SAP Landscapes

Glossary
ACC  SAP Adaptive Computing Controller
AN  FlexFrame application node
cDOT  Clustered Data ONTAP
CN  FlexFrame control node
DC  Data center
DIY  Do It Yourself
FC  Fibre Channel
FFO  FlexFrame Orchestrator
Filers  filer-1 .. filer-<n>
GUI  Graphical user interface
HN  FlexFrame Hypervisor node
HW  Hardware
LaMa  SAP Landscape Management
NAS  Network Attached Storage
NFS  Network File System
NVRAM  Non-Volatile RAM
OS  Operating system
SPS  (SAP HANA) Service Pack Stack
SVM  Storage Virtual Machine
SW  Software
Switches  sw1g1 .. sw4g1, sw1g2 .. sw4g2, ...
VLAN  Virtual LAN
WAFL  (NetApp) Write Anywhere File Layout

Related documentation
This document does not replace any NetApp or FlexFrame information. Please pay attention to the following documents:
- NetApp® Snap Creator™ Framework 4.3 Installation Guide
- NetApp® Snap Creator™ Framework 4.3 Administration Guide
- NetApp® Snap Creator ™ Framework 4.3 SAP HANA Plug-in Operation Guide
- FlexFrame® Orchestrator Version 1.2A Installation of a FlexFrame Environment (Document Version 1.0)
- FlexFrame® Orchestrator Version 1.2A Administration and Operation (Document Version 1.0)

For more details please also refer to the NetApp webpages:
http://mysupport.netapp.com [Login required]
And to the FlexFrame webpages:

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