Hewlett Packard Enterprise

Reference Architecture

HPE Reference Architecture for backup and recovery of SAP HANA database on HPE Superdome Flex Server (Scale-up configuration built with Intel Cascade Lake)

Using HPE StoreOnce, HPE D3710 enclosure, and Veritas NetBackup

CONTENTS

EXECUTIVE SUMMARY

SAP HANA®, short for "High-performance Analytic Appliance," is a data platform built for running in-memory transactional and analytical workloads. Unlike traditional databases that require these workloads to be separated, SAP HANA offers a faster and simplified architecture that consolidates both online analytic processing (OLAP) and online transaction processing (OLTP) landscapes into a single database.

In today's data growing environments, protecting mission-critical SAP HANA is becoming increasingly challenging. Most data protection technologies in use today have limitations, including incompatible technology silos, restricted scale and performance, untenable service-level agreements (SLAs), backup failures, and complex management.

The general challenges with backup and recovery faced by customers are:

- Exponential data growth in a complex IT environment
- Shrinking backup and recovery windows; backups that take longer with greater demands on application availability
- Data protection issues; insufficient backup frequency
- Increased administration effort required to manage the backup environments
- Not meeting the Service Level Agreements (SLAs) for Recovery Time Objectives (RTOs) and Recovery Point Objectives (RPOs)
- Inability to perform quick and reliable recovery

This Reference Architecture (RA) describes a solution for backup and recovery of SAP HANA databases running on the HPE Superdome Flex scale-up server with four Intel® Xeon®-Platinum 8280/8276/8280M/8276M/8280L/8276L processors, and the operating system choice of SUSE Linux® Enterprise Server (SLES) or Red Hat Enterprise Linux® (RHEL) using Veritas NetBackup®. Implementing SAP HANA data protection by integrating HPE StoreOnce with Veritas NetBackup, allows users to backup and restore the SAP HANA database in an efficient way.

This document lists the advantages of backup solution using Veritas NetBackup, HPE StoreOnce 5200, and the potential benefits in terms of efficiency. It also substantiates the various internal tests performed by Hewlett Packard Enterprise to ensure this solution is efficient and all the components are integrated well to work together seamlessly.

What's new?
This document briefly demonstrates the latest features of the components that are used in this solution:

- HPE Superdome Flex server supports the second-generation Intel Xeon Scalable processors with a choice of Gold or Platinum.
- HPE Superdome Flex server supports new 128 GB DDR4 DIMMs.
- HPE D3710 Enclosure is bundled with 600 GB, 1.2 TB, 1.8 TB SFF SAS drives and 1 TB, 2 TB SFF SAS Midline drives.
- HPE StoreOnce Catalyst OST plugin for Veritas NetBackup that supports the Content Awareness feature for SAP HANA.

Target audience: This RA is intended for IT professionals, Backup Administrators, and SAP BASIS consultants responsible for designing and implementing SAP HANA environments with a robust data protection solution. Readers of this paper should have a functional understanding of SAP HANA, HPE StoreOnce, and Veritas NetBackup concepts and technologies.

Document Purpose: The purpose of this RA is to describe a solution for backup and recovery of the SAP HANA database and highlights the benefits of integrating Veritas NetBackup and HPE StoreOnce to the technical audience.

This Reference Architecture describes solution testing performed in October 2019.

INTRODUCTION

The demand for backup and the associated data management activities are increasing rapidly in the IT industry. There are various reasons and factors to choose the best backup software and backup storage medium that suits the environment. Most of the companies run multiple software tools for backup, recovery, archiving, managing data, and storage resources. Most of these methodologies/technologies do not meet the requirements for today's environment with rapid data growth.

As an example, customers are managing the SAP HANA backups in their own ways, some of them backup the SAP HANA database into flat files on a Network-Attached Storage (NAS) share mounted on the HANA nodes and then backup these flat files using their existing backup solutions. Although this works, it is not an efficient backup and restore solution because it is slow and is a two-step process. The manual intervention required for managing the backups and restore of data and log files adds to administration overhead and writing backups to an NAS share is known to cause performance issues.

The main challenge for the customer is to choose the backup software, which is up to date, cost-effective, feature rich, and managed efficiently.

There are several SAP HANA TDI configurations available from multiple hardware vendors, but there are very few SAP HANA certified backup solutions available to backup a SAP HANA database.

To overcome such challenges, Hewlett Packard Enterprise has integrated HPE StoreOnce with Veritas NetBackup software for the data protection of the SAP HANA database. Veritas NetBackup has developed an SAP HANA Backup agent and OpenStorage Technology (OST) for its enterprise-class backup product. The OpenStorage Technology is an API that allows NetBackup software to take advantage of intelligent storage solutions such as HPE StoreOnce 5200. Hewlett Packard Enterprise has developed HPE StoreOnce Catalyst plug-in for Veritas NetBackup that delivers tight integration between HPE StoreOnce Systems and Veritas NetBackup software.

HPE StoreOnce with Veritas NetBackup technology has an efficient way to manage SAP HANA backup and restore that enables data protection which simplifies day to day IT operations.

The solution is built on the HPE Superdome Flex server along with the HPE StoreOnce system using Veritas NetBackup. There are strong and valid reasons to choose Hewlett Packard Enterprise hardware for the SAP HANA platform:

- Leader in SAP and SAP HANA market share
- Most scalable solution on Intel x86 Cascade Lake processors
- Mission-critical x86 platform with higher Reliability, Availability, and Serviceability (RAS)
- Based on open standards / x86 Intel processors
- Large range of solution offerings: Appliances, TDI, from entry-level to large scale
- Tightly integrated and tested infrastructure blocks
- Best support in the industry: SAP HANA Center of Excellence (CoE)

Does data growth leave you struggling with complex, distributed, and costly data protection? The solution here is to tackle the cost, risk, and complexity of data protection with HPE StoreOnce. HPE StoreOnce is a disk-based, de-duplicating, and cloud integrated system, providing backup, data recovery, and data retention for Hybrid IT.

The following are the key features which make the HPE StoreOnce 5200 the best fit for this solution:

- HPE StoreOnce single node systems are based on HPE ProLiant Gen10 technology. It supports a more scalable and flexible VSA structure. New flex I/O choices with 10/25GbE-SFP and 32Gb Fibre Channel.
- New HPE StoreOnce products move to an all-inclusive licensing structure. HPE StoreOnce Catalyst and replication are included with the product at no additional charge (encryption license, at a nominal charge).
- Improved GUI that includes Federated Management, which allows users to configure and monitor multiple HPE StoreOnce systems or VSAs in a single pane of glass.
- Role-Based Access Control (RBAC) which allows customers to assign different roles/permissions to users of their HPE StoreOnce system.

- Content Awareness feature of HPE StoreOnce Catalyst OpenStorage Technology (OST) Plug-in for Veritas NetBackup enables faster SAP HANA backup windows.

The cost implications of the storage, which is used for backup and recovery solutions, depends upon the actual consumption of the necessary resources. Customers are looking for the storage in their backup and recovery solutions which can fit into their budget without affecting the performance.

In order to facilitate the customer need, Hewlett Packard Enterprise has the best in class disk enclosure product called "HPE D3000 Enclosure series". The growing storage needs of small and midrange businesses can be managed by deploying the HPE D3000 Enclosures with the next generation 12Gb SAS low-cost, high capacity, tiered external storage system. The HPE D3000 Enclosures are ideal for your SAP application environments.

This backup solution has been built with HPE Superdome Flex server along with HPE D3710 Enclosure, HPE StoreOnce 5200, and Veritas NetBackup software.

SOLUTION OVERVIEW

Backint for SAP HANA is the backup approach that connects the SAP HANA landscape to the centralized backup environment. Hewlett Packard Enterprise uses the SAP preferred backint backup approach in this solution.

This solution addresses the effective way to backup and restore the SAP HANA database using Veritas NetBackup Enterprise software and HPE StoreOnce. Veritas NetBackup software provides a simplified end-to-end backup and recovery solution for single-node scale-up in SAP HANA environments. In a scale-up environment, all SAP HANA components are running on a single server and the persistent layer resides on internal SSD disks.

In case of any data loss, restoration of the backed-up data and the log files can be initiated directly from the media using SAP backint interface. SAP HANA's Backint is an API that helps third-party backup software vendors to connect their backup agents to the SAP HANA. In this solution, SAP HANA Studio and SAP HANA Cockpit software has been used to test the backup and recovery of SAP HANA databases. SAP HANA Studio is the common tool that is used to backup and restore the database and users can also opt for SAP HANA Cockpit in their environment.

Hewlett Packard Enterprise and SAP have teamed up to provide all the functionality, performance required to support today's complex IT infrastructure. HPE Superdome Flex server solutions for SAP HANA scale-up configurations built with the Intel Xeon Scalable Processors (Intel Cascade Lake) is a portfolio of optimally configured hardware appliances with preloaded software and a full range of included services – design, factory integration, on-site installation, and proactive support with a single point of contact.

Industries follow certain rules and conditions when it comes to backup and recovery of data. If these rules are not complied with, then the business will have issues. It is very important to adhere to all the required compliances. Hewlett Packard Enterprise has designed its disk-based storage "HPE D3000 Enclosure" which has a higher level of redundancy and reliability, reducing single-points-of-failure within the storage network. This modular platform provides investment protection by allowing purchases based on customers' current needs and future plans without hidden management fees. Customer can increase the data speed with enterprise-class, dual-port SAS drives as need and budget dictate.

Hewlett Packard Enterprise has a service-centered data protection approach for business in the modern world that requires uninterrupted service for users and customers. Data protection is no longer just about backing up and restoring data, but it's also about recovering business applications and restoring critical services for users. HPE StoreOnce is a highly scalable disk-based deduplication solution designed to lower the backup footprint while delivering backup and recovery speeds to meet or exceed SLAs.

In this solution, HPE StoreOnce 5200 systems are tightly integrated with Veritas NetBackup through the HPE StoreOnce Catalyst plugin to enable the movement of deduplicated data across the devices. HPE StoreOnce Catalyst store with low-bandwidth transfer mode allows the deduplication process to be off-loaded to the NetBackup media server which reduces network I/O load between NetBackup media server and HPE StoreOnce because only new data is transmitted.

Following are the key benefits of a backup and recovery solution using HPE StoreOnce and Veritas NetBackup:

- Increased SAP HANA database backup speed: Veritas NetBackup with HPE StoreOnce 5200 Catalyst deduplicates backup data for improved SAP HANA database backup throughput performance and reduces the capacity needed to store backups by writing only the unique data.
- Ability to move backup data offsite efficiently and cost-effectively: Use the HPE StoreOnce 5200 remote replication feature to replicate SAP HANA backups to an HPE StoreOnce Backup system in a remote facility seamlessly for simpler recovery in the event of a disaster.

- Efficient backups: Veritas NetBackup and HPE StoreOnce 5200 with HPE StoreOnce Catalyst utilizes the same deduplication algorithm and its content awareness feature identifies and intelligently process, stores the backup data from SAP HANA, and reduces backup time.

Figure 1 shows the SAP HANA scale-up backup environment that is tested in the lab.

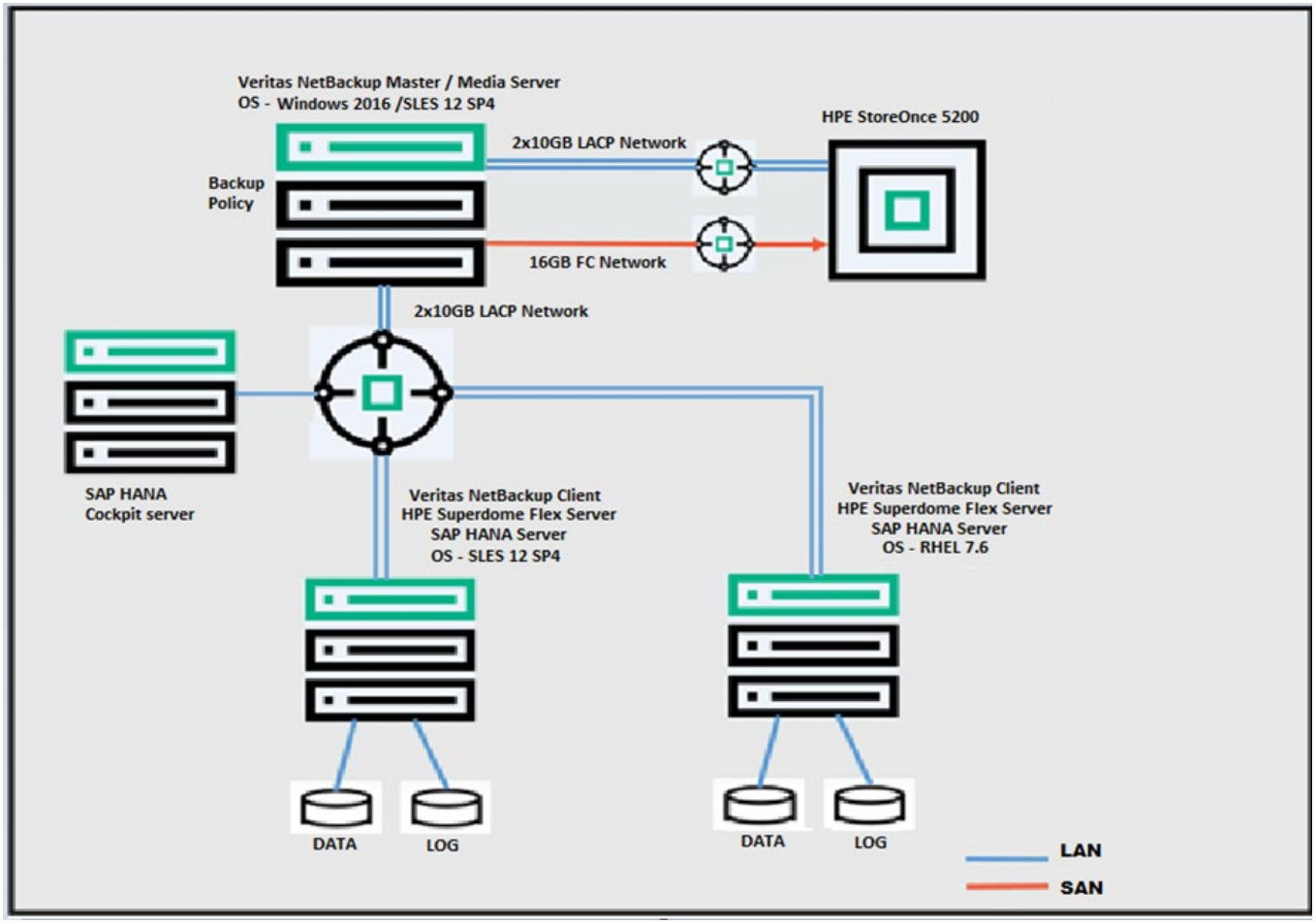

FIGURE 1. SAP HANA scale-up backup environment using Veritas NetBackup (tested lab configuration)

Figure 2 shows the HPE Superdome Flex server, HPE ProLiant DL380 Gen10, HPE D3710 Enclosure, HPE FlexFabric 5945 network switches, HPE FlexFabric 5900 network switches, HPE StoreFabric 6600B Fibre Channel switches, and HPE StoreOnce 5200 used in the lab environment. Each HPE Superdome Flex server is coupled with a dedicated HPE D3710 enclosure.

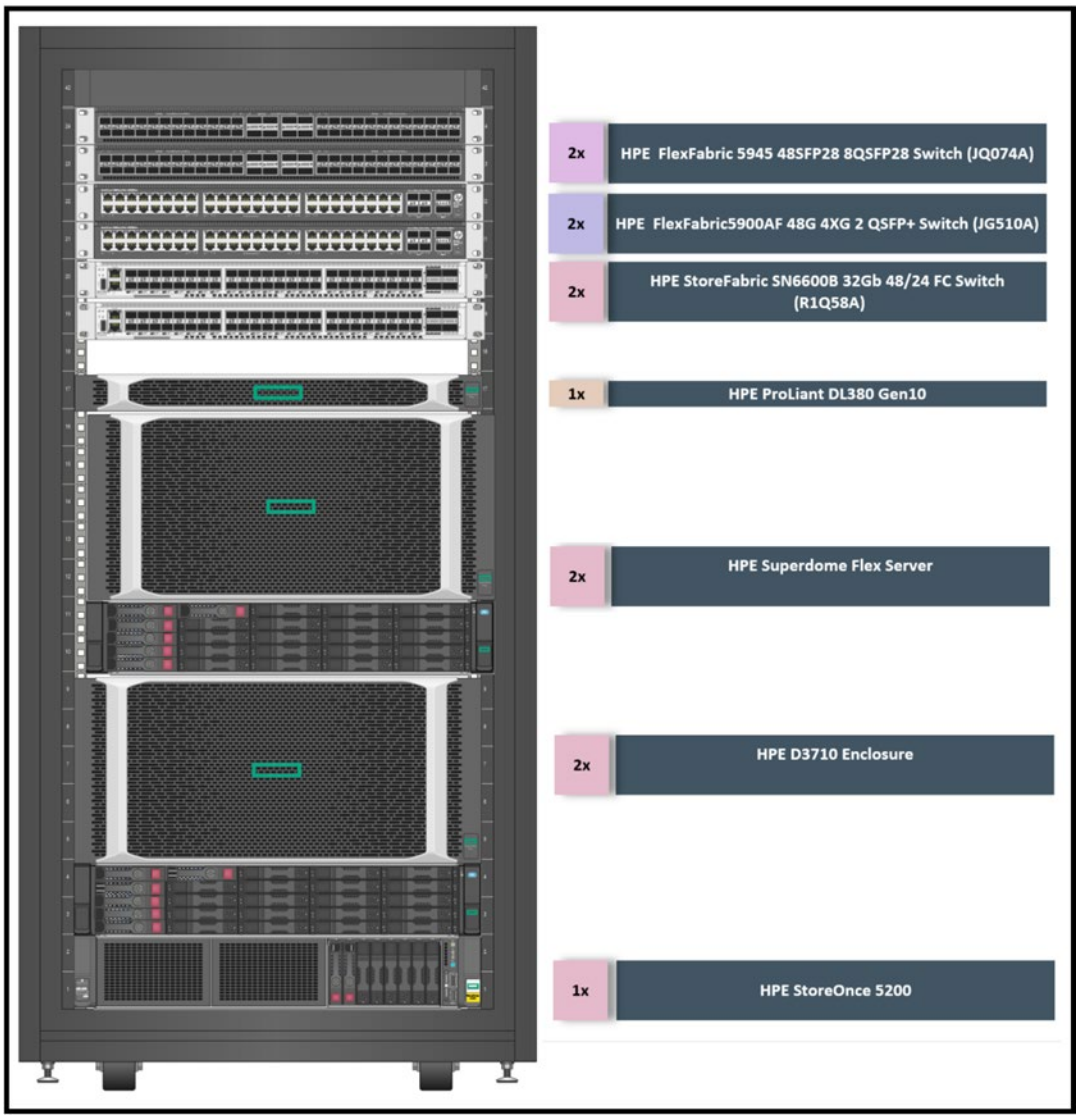

FIGURE 2. Front view of the hardware used in the lab (tested lab configuration)

SAP HANA backup and recovery

SAP HANA data is kept in memory to gain the best performance. However, SAP HANA uses persistent storage to provide a fallback in case of failures. In a standard database operation, the changed data is automatically saved from memory to disk at regular savepoints. In SAP HANA, the default savepoint happens every five minutes even during a backup operation. During a savepoint, the transactions would run as normal, and the new transactions can be started as normal.

Changes to data are recorded in the log segments in the redo log buffer. Once the database transaction is committed, these log segments are saved to disk. Additionally, if the redo log buffer gets filled up anytime, all data in the redo log buffer is written to disk eventually, even if there is no commit sent.

SAP HANA backup options for data and log backup

The following options are available for data and log backups:

- Backups to the file system.
- Backups using 3rd party backup tools with Backint for SAP HANA API support.
- Delta backups: Delta backups contain data that was changed since a complete data backup. Delta backups are of two types:
  - Differential backups – stores all the data changed since the last full data backup.
  - Incremental backups – stores the data changed since the last full data backup or the last delta backup (incremental or differential).
- Scheduling SAP HANA backups: SAP HANA Cockpit has a provision for scheduling full backups and delta backups at specific intervals.

SAP HANA **recovery** options

There are three ways to perform recovery of an SAP HANA database, based on the requirement.

- **Recover the database to its most recent state:** This option uses the last backup for restoring the database and then restores and replays all the applicable logs to restore the database to the most recent consistent state.
- **Recover the database to the following point in time:** This option restores the last database backup taken before the point in time specified and then replays the logs until the point in time is selected. This option is useful to roll back the database to a particular point in time or to a time when the database was in a known consistent state.
- **Recover the database to a specific data backup:** This option offers the user a list of available database backup images and the date-time when those backups were taken. The user has to select the backup that needs to be restored. No logs are replayed using this option.

This document describes the backup and recovery of SAP HANA databases using Veritas NetBackup 8.2 with Backint for SAP HANA support and explains the options and ways in which a customer can deploy Veritas NetBackup and HPE StoreOnce 5200 to backup SAP HANA database.

SOLUTION COMPONENTS

Hewlett Packard Enterprise solutions for SAP HANA backup and recovery have been designed keeping in mind the available memory on the server and the SAP HANA database size. The solution components include HPE Superdome Flex server, HPE ProLiant DL380 Gen10 server, HPE StoreOnce 5200, HPE FlexFabric 5945, and HPE FlexFabric 5900 Network Switches, HPE SN6600B Fibre Channel Switches, and HPE StoreOnce 5200.

Table 1 shows the list of components used in the solution.

TABLE 1. components used in the solution

Components	Operating system	Sid	Hardware	Comments
Database server	SLES 12 SP4	HN1	HPE Superdome Flex scale-up server (Cascade Lake Processor)	Database server SID – HN1. SAP HANA database 2.0 SPS04
Database server	RHEL 7.6	AB1	HPE Superdome Flex scale-up server (Cascade Lake Processor)	Database server SID – AB1. SAP HANA database 2.0 SPS04
Veritas NetBackup Server (Master /Media Server)	Microsoft® Windows Server® 2016 / SLES® 12 SP4	NA	HPE ProLiant DL380 Gen10 server	Veritas NetBackup Server (version 8.2) where backup and restore sessions can be configured and monitored. SAP HANA Studio is also configured in the same server.
HPE StoreOnce Catalyst Plugin for Veritas NetBackup	Microsoft® Windows Server® 2016/SLES® 12 SP4	NA	HPE ProLiant DL380 Gen10 server	Version 4.2.1
Storage	NA	NA	2x HPE D3710 Enclosure	Used for SAP HANA DATA, LOG, SHARED and USRSAP
Fibre Channel HBA	NA	NA	2x HPE SN1100E 16Gb 2P Fibre Channel HBA	Fibre Channel connection has been done between NetBackup media server and HPE StoreOnce 5200

Components	Operating system	Sid	Hardware	Comments
Fibre Channel Switch	NA	NA	2x HPE SN6600B Fibre Channel Switch	Zoning has been done between NetBackup media server and HPE StoreOnce 5200

HPE Superdome Flex Server for SAP HANA Scale-up (Cascade Lake)

HPE Superdome Flex Server utilizes a unique modular architecture that scales flexibly and seamlessly from 4- to 32- sockets in a single system. With up to 32 sockets/896 cores, customers have plenty of headroom to scale. HPE Superdome Flex Server for SAP HANA scale-up configurations is built with enhanced management, reliability, and security ecosystem. HPE Superdome Flex server featuring new Intel Xeon Scalable processors with choice of Gold or Platinum processor architecture, allow SAP customers to harness the power of in-memory computing with SAP HANA applications for real-time business results, delivered on a mission-critical, optimized, and high-performance infrastructure. HPE Superdome Flex server is ideal for critical SAP S/4HANA and SAP BW/4HANA workloads. The HPE Superdome Flex for SAP HANA scale-up is a pre-defined solution of hardware and software that integrates SAP HANA.

HPE ProLiant DL380 Gen10 server

HPE ProLiant servers are industry-leading servers in x86 architecture and are available in various forms such as rack mount, tower, and blade servers. These servers are available with one socket and two sockets. For the purpose of this solution, the HPE ProLiant DL380 Gen10 server was chosen as a management server. This server has been chosen considering the processor and memory requirements of Veritas NetBackup and the SAP HANA database size. For more information, see the HPE ProLiant DL380 Gen10 QuickSpecs document.

KEY POINTS

The HPE ProLiant DL380 Gen10 Server functions as a Veritas NetBackup Master and Media Server which is used for configuration of backup devices and monitoring the SAP HANA backup/restore operations.

HPE StoreOnce 5200

The HPE StoreOnce target backup system is a disk-based storage appliance for backing up multiple servers or PCs to target devices on the storage appliance. The total number of backup target devices provided by an HPE StoreOnce Backup system varies according to the model. These devices can be HPE StoreOnce Catalyst, Virtual Tape Library (VTL), Network Attached Storage (NAS), or any combination of Catalyst, NAS, and VTL devices. All HPE StoreOnce devices automatically make use of HPE StoreOnce deduplication, ensuring efficient and cost-effective use of disk space. The benefit of HPE StoreOnce Catalyst devices is that deduplication may be configured to occur on the Media Server (low bandwidth) or on the HPE StoreOnce Backup system (high bandwidth), allowing the user to decide what makes the most efficient use of available bandwidth.

HPE D3710 Enclosure

The HPE D3000 Enclosures give the flexibility to mix and match SAS, SATA, and Solid-State drives in the same enclosure and extend the benefit of tiered storage to your customers. With the HPE D3700 and the Gen10 branded HPE D3710 SFF, customers can increase to 200 drives or up to eight SFF enclosures from a single controller port. HPE D3710 enclosure has solid-state drive support for up to 25 drives per Smart Array Controllers on all HPE D3000 models. The HPE D3000 Enclosures support the HPE SmartDrive Carrier, enabling a single set of common drives for Gen8 and Gen9 ProLiant servers and D3000 Enclosures. The HPE D3000 Enclosures are compatible with selected HPE Smart Array SAS Controllers and HBAs. It requires little IT expertise to manage the enclosures. In this solution, all SSD configuration with HPE D3710 has been used to support large data volumes of SAP HANA database.

Veritas NetBackup

Veritas NetBackup architecture

Veritas NetBackup is a backup solution that is designed to provide fast and reliable backup and recovery solution for fast-growing business data. Veritas NetBackup has major features like:

- **Centralized and network backup operations** - NetBackup master server can be used to schedule database backups or start them manually for any client.
- **Parallel backup and restore operations** - NetBackup for SAP supports the parallel backup and restore capabilities of SAP Tools.

- **Graphical user interfaces** - NetBackup provides the following graphical user interfaces for client users and administrators. A database administrator or NetBackup administrator can start backup or restore operations for SAP from the NetBackup graphical user interface on the NetBackup master server.

Veritas NetBackup security feature

NetBackup uses security certificates to authenticate NetBackup clients. A master server acts as the Certificate Authority (CA) and issues digital certificates to clients. The authorization token is required for a NetBackup client to obtain a host-based certificate. The authorization token should be created in the NetBackup master Server (Refer to Appendix C). The administrator can then deploy the certificate after installing the NetBackup client software by obtaining the authorization token from the NetBackup master server.

- **Veritas NetBackup Client** - A host system becomes Veritas NetBackup client (i.e. SAP HANA database host) when the Veritas NetBackup client software components are installed on the system.
- **Master Server** - A server that provides a centralized administration and control for backup and restore of all clients.
- **Media Server** - A server that has physical connectivity to the storage devices that can be used for backups. The devices can be Storage Library, Tape Library, Optical storage, and Robotic devices.
- **Global Data Manager** - A Master of Master that can monitor and manage multiple Master Servers and multiple backup domains.

Figure 3 shows the Veritas NetBackup Architecture.

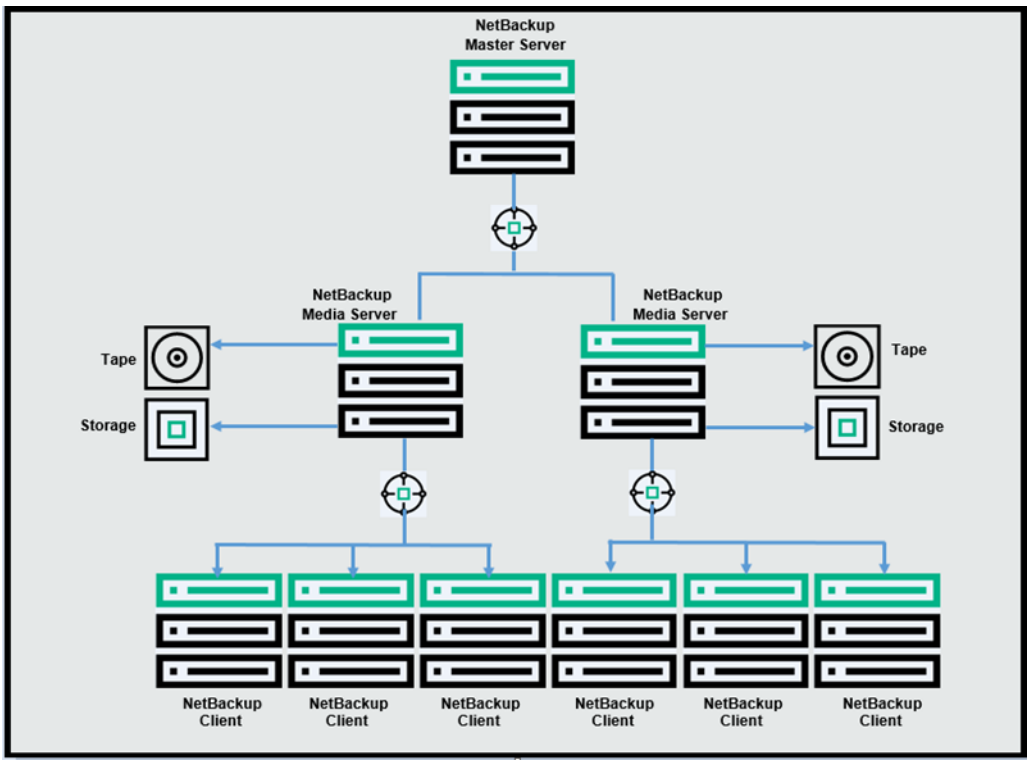

FIGURE 3. Veritas NetBackup Architecture

Veritas Netbackup SAP HANA agent

Veritas NetBackup has developed a backint agent for SAP HANA. The NetBackup for SAP HANA Agent integrates the backint interface of SAP HANA with the backup and the recovery management capabilities of NetBackup. Backup, restore, delete and inquiry operations are specified by the backint interface and it also manages parallel operations.

This agent interfaces with the SAP HANA Backint API to allow online backups of a SAP HANA database. Each server process on each SAP HANA node creates a Veritas NetBackup backup job. These backup jobs are managed by the Veritas NetBackup master server to control

resource requirements such as backup media, job schedule, job execution, and so on. The backup administrator can monitor the progress and status of these backup jobs from the Veritas NetBackup master server. The agent can also be configured to initiate automatic backup of SAP HANA logs at specified intervals. The automatic log backup ensures that the logs filesystem always has enough space available for database logs.

To backup SAP HANA profile and configuration files, configure an Application Backup schedule under a separate storage pool.

SAP HANA Studio

SAP HANA Studio is the front-end application that can be used for multiple purposes such as SAP HANA configuration, administration, development, and SQL client queries. Multiple SAP HANA database instances can be added to an SAP HANA Studio. SAP HANA Studio also allows administrators to configure, monitor, and initiate backups and restore.

BEST PRACTICES AND CONFIGURATION GUIDANCE

Enabling SAP HANA backup using Veritas NetBackup requires installing Veritas NetBackup software, configuration of HPE StoreOnce, configuring SAP HANA Studio, or SAP HANA Cockpit. The following sections briefly explain the configuration steps required in each of these components.

Veritas NetBackup Master/Media Server

Download and install the Veritas NetBackup master and media software on the HPE ProLiant DL380 Gen10 Server. Refer to the Veritas NetBackup 8.2 documentation for the installation process.

In the lab environment, Microsoft Windows Server 2016 and SLES 12 SP 4 were used as Veritas NetBackup Master and Media server.

NOTE

For Veritas NetBackup master server and media server Operating System compatibility matrix. Refer to the Veritas software compatibility list.

Installing HPE StoreOnce Catalyst OST plugin on Veritas NetBackup master and media server

After the Veritas NetBackup master and media software installation, stop all NetBackup services on the Veritas NetBackup master and media server. Install the HPE StoreOnce Catalyst (OST[1]) Plugin software version 4.2.1 or later and start the NetBackup services.

The latest HPE StoreOnce catalyst plugin can be downloaded[2] at https://myenterpriselicense.hpe.com/cwp-ui/software.

[1] Open Storage Technology
[2] HPE login credentials are required

The Content-Aware Feature of the HPE StoreOnce Catalyst plugin can be enabled during the installation of the plugin as shown in Figure 4.

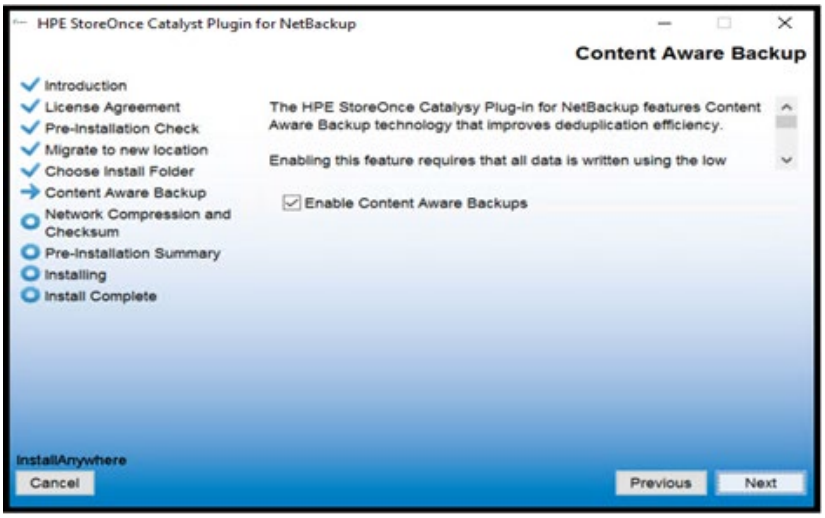

FIGURE 4. HPE StoreOnce Catalyst Plugin for NetBackup installation wizard

The Content Awareness can also be enabled by uncommenting "CATALYST_CONTENT_AWARE_BACKUPS: ENABLE" line in the following file after plugin installation.

For Windows NetBackup media server:

```
%ProgramFiles%\Hewlett Packard Enterprise\StoreOnce\isvsupport\OST\config\plugin.conf
```

For Linux NetBackup media server:

```
/usr/openv/hpe/ost/config/plugin.conf
```

WARNING

Enabling Content-Aware Backups with existing logical storage units that contain old backups can lead to a reduction in deduplication ratios and a drop in backup throughput performance. Hence enable Content Awareness only in the new NetBackup media server. Any changes to plugin.conf become effective without restarting NetBackup services.
Content-Aware backup works only with Catalyst Store with Low Bandwidth Transfer mode.

HPE StoreOnce Catalyst Store

To backup SAP HANA Database, the target storage device has to be configured. Login to the HPE StoreOnce 5200. In the System Dashboard, click **Catalyst Stores > Create Store** to create a new "Catalyst Store".

Figure 5 shows the Catalyst Stores that are created on HPE StoreOnce 5200.

The two Catalyst Stores were used for Fibre Channel-based backup configuration and the other two used for IP based backup configuration.

NOTE
A dedicated Link Aggregation (10 GB+10 GB) network has been configured between Veritas NetBackup clients, media server, and HPE StoreOnce 5200 System. An additional 16 GB Fibre Channel network has been configured between the Veritas NetBackup media server and HPE StoreOnce 5200 System.

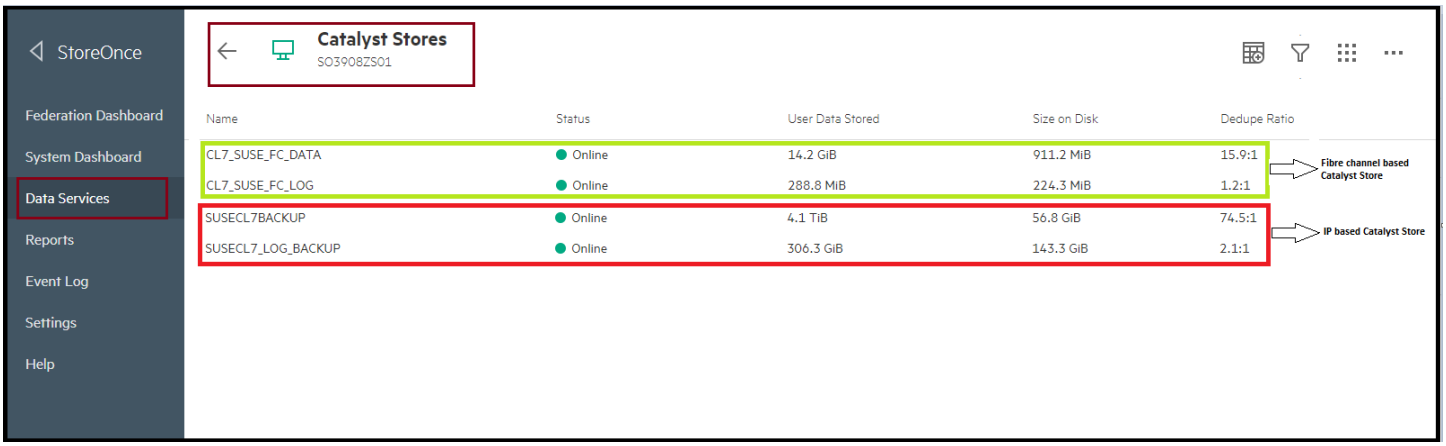

FIGURE 5. HPE StoreOnce Catalyst Stores wizard

Disk Storage Server configuration

To configure the Disk Storage Servers:

1. On the NetBackup Administration console GUI, go to Master Server, Configure Disk Storage Servers.
2. Select **Open Storage** as disk storage type.
3. Provide the Media Server IP, Storage server type as **hpe-StoreOnceCatalyst**, HPE StoreOnce 5200 IP address in the “Storage server name” field and enter the credentials of the HPE StoreOnce 5200. In case of Fibre Channel, provide the COFC identifier instead of HPE StoreOnce IP address to access the Catalyst Stores.
4. Select the storage server volume and provide a disk pool name.

Figure 6. shows the NetBackup Disk Storage server configuration

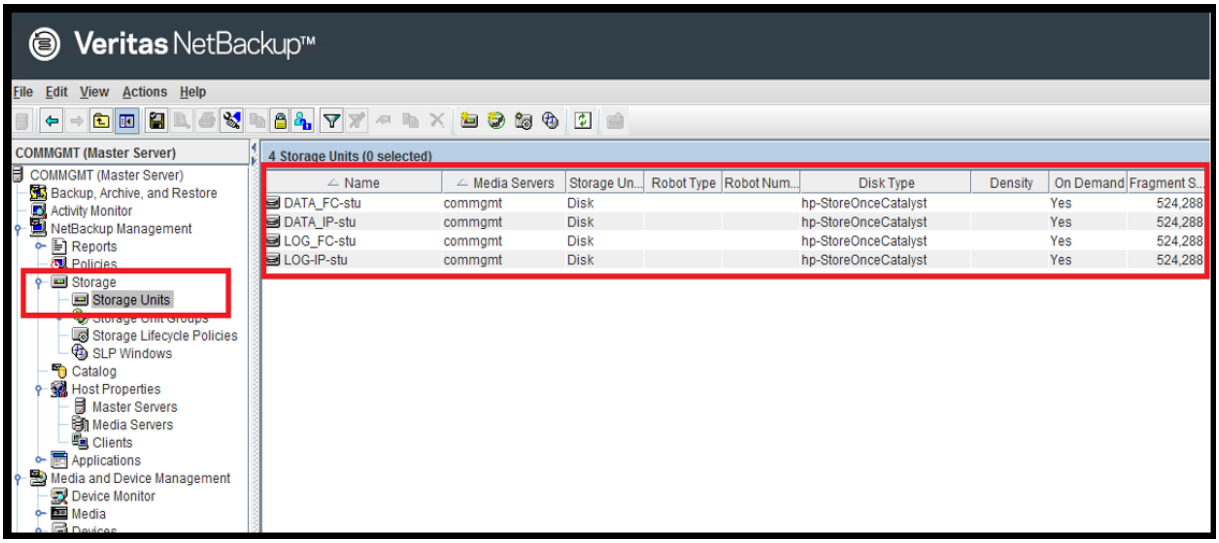

FIGURE 6. NetBackup Disk Storage server configuration

Creating NetBackup backup policy and adding client

To create a new policy and add the client under the policy:

1. Select the **Policies** under the **NetBackup Management** on the left pane as shown in Figure 7. Right-click to create a new Policy on the right pane.
2. Provide the following on the policy:
   - On the **Attribute** tab, select policy type as **SAP**, provide the configured disk pool storage on the Policy storage.
   - On the **Schedules** tab, the default is backup type is **Application backup**.
   - On the **Clients** tab, add the SAP HANA database client which has to be backed up.
   - On the **Backup Selections** tab, do not select anything (Application backup doesn't require any selection).

Figure 7 shows the policies created on the Veritas NetBackup Master Server.

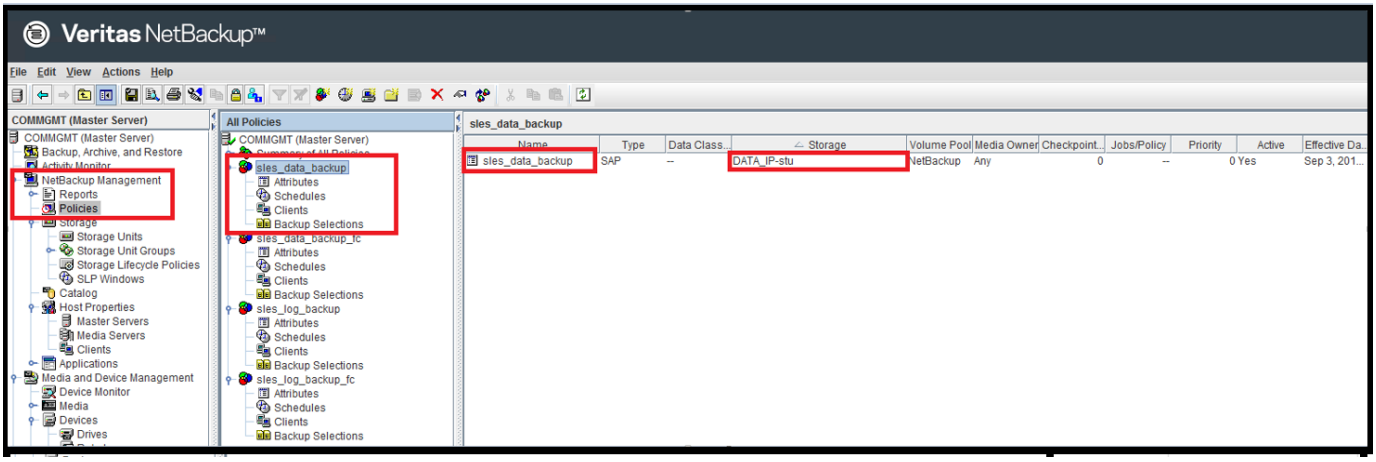

FIGURE 7. Veritas NetBackup backup policy configuration

Veritas NetBackup configuration for SAP HANA database node

Since the Veritas NetBackup client software gets installed on the SAP HANA node, we have to configure the policy parameter values on the SAP HANA node. It is a best practice to have the database backed up to one HPE StoreOnce Catalyst store and the logs backed up to a separate HPE Catalyst store.

Steps to configure the SAP HANA database compute node include:

1. Install Veritas NetBackup client software on SAP HANA database node (SLES 12 SP4/RHEL 7.6).
2. Create a soft link from SAP HANA's hdbbackint to hdbbackint_script script instead of NetBackup's hdbbackint binary as shown below. Login as "<SID>adm" and create a softlink as shown below.

```
ln -s /usr/openv/netbackup/bin/hdbbackint_script /usr/sap/<SID>/SYS/global/hdb/opt/hdbbackint
```

3. A default `initSAP.utl`[3] file is provided with Veritas NetBackup is located at /usr/openv/netbackup/ext/db_ext/sap/scripts/sap_oracle/initSAP.utl. Take a copy of the initSAP.utl file and create a new file named as init<SID>.utl. In the new init<SID>.utl file, uncomment the policy keyword and provide policy name that was created in NetBackup master server to take an SAP HANA backup.
4. The "utl" files can be created for DATA and LOG individually. Individual Storage server also can be configured for DATA and LOG policy.
5. Manually create a "node_names.txt" file under "/usr/openv/netbackup/ext/db_ext/sap". The file should contain one client name per line.
6. Ensure that the HPE StoreOnce 5200 node IP address and hostname exist in the "/etc/hosts" file.
7. Ensure the backup interface IP address is added in the "/etc/hosts" file of SAP HANA database node as well as Veritas NetBackup master node.
8. bp.conf file can be found at "/usr/open/netbackup" directory. The file contains the entry of the master server name, client name, and connect_options.

NOTE

The testing was performed on HPE Superdome Flex server for SAP HANA scale-up (3TB system memory) with SAP HANA database version: 2.00.040.00.1553674765

As a best practice ensure SAP HANA database node, NetBackup Master Server, NetBackup Media Server, and HPE StoreOnce are in the same network.

SAP HANA Studio configuration for backup and recovery

The integration of the SAP HANA database and NetBackup for backup is configured in the SAP HANA Studio. The parameter files are used to specify the NetBackup policy for backing up DATA and LOG. If the target storage unit for data files is different from log files, specify a different parameter file containing a different NetBackup policy for log backups.

1. Choose **Backup** from the expanded menu on the left. (See Figure 8)
2. The parameter file "init<SID>.utl" must be specified for data in the SAP HANA database instance configuration. To specify the parameter file, go to **Instance > Configuration > global.ini > data_backup_parameter_file**.

```
/usr/openv/netbackup/ext/db_ext/sap/scripts/sap_oracle/init<SID>_data.utl
```

3. The parameter file "init<SID>.utl" must be specified for log in the SAP HANA database instance configuration. To specify the parameter file, go to **Instance > Configuration > global.ini > log_backup_parameter_file**.

```
/usr/openv/netbackup/ext/db_ext/sap/scripts/sap_oracle/init<SID>_log.utl
```

4. To specify backup using the backint file for log, go to **Instance > Configuration > global.ini > log_backup_using_backint > SYSTEM = true**.

[3] The initSAP.utl is a text file that contains comments, parameters (required and optional), and parameter values. These parameters determine the backup and restore procedure between Veritas NetBackup and the SAP tools.

5. Click on the floppy disk icon at the top right-hand side in the backup window of SAP HANA Studio to save the changes in configuration.

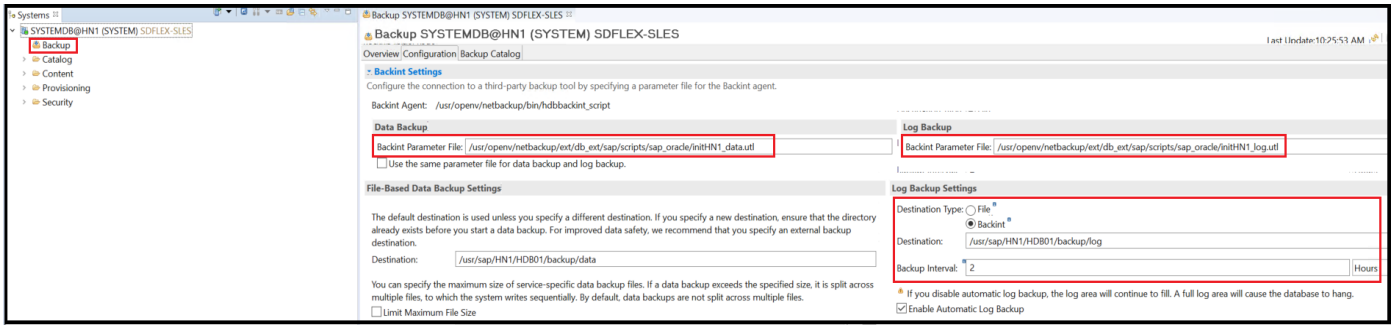

FIGURE 8. Backint parameter file settings on SAP HANA Studio

Figure 9. shows the SAP HANA backup and restore options for system and tenant database.

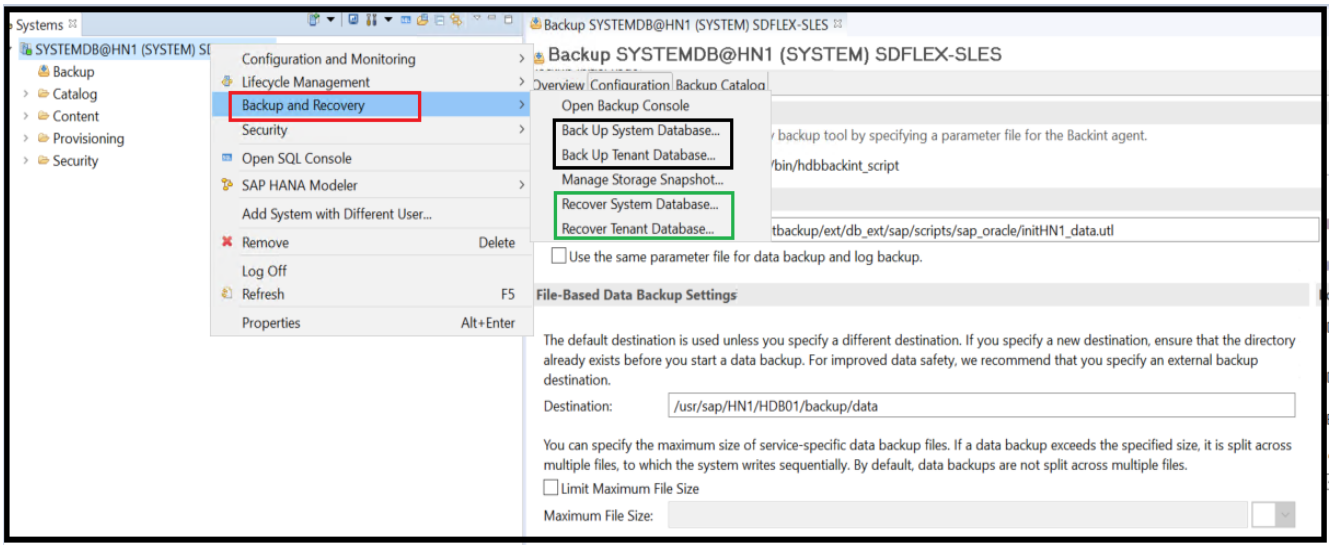

FIGURE 9. SAP HANA backup and restore options for system and tenant database

Figure 10 shows the backup parameter for data and log. Catalog_backup_parameter_file should have the same parameter file that was used for data and log backup configuration. Catalog_backup_using_backint should be set to "TRUE". If the above parameters are not set, the backint restoration will fail.

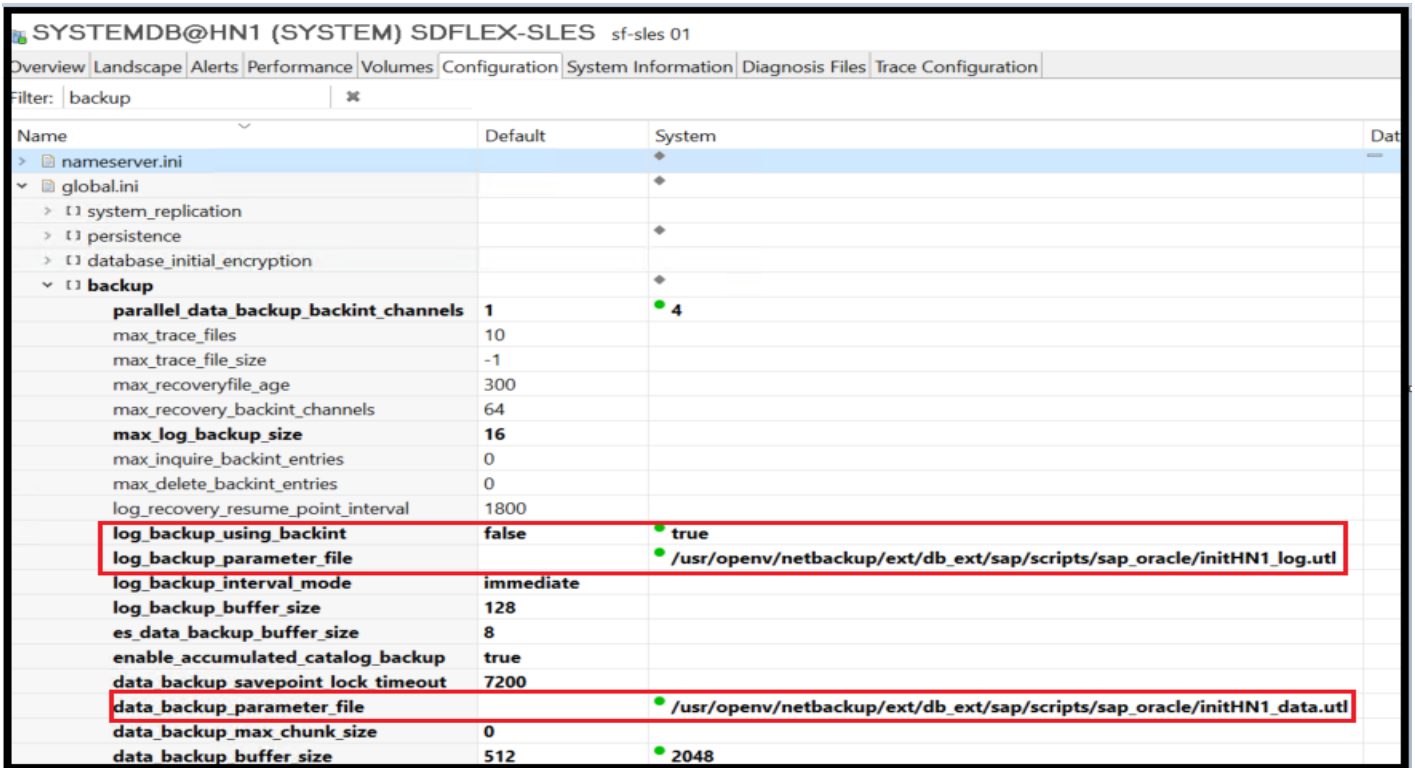

FIGURE 10. SAP HANA backup configuration parameter wizard

Delta backup

Delta backup can be initiated from the SAP HANA Studio.

To initiate delta backup:

1. In SAP HANA Studio, right-click System.
2. Select **Backup and Recovery > Backup System**.
3. In the Backup of System wizard, in the Backup Type drop-down, you can select **Complete Data Backup**, **Differential Data Backup**, or **Incremental Data Backup** as shown in Figure 11.

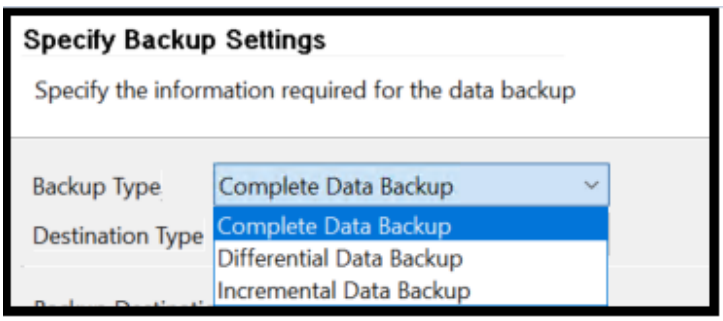

FIGURE 11. Delta backup settings in SAP HANA Studio backup wizard

Multistreaming data backups

By default, SAP HANA uses a single backint channel for data backups. SAP HANA has a provision to increase the number of channels up to 32 to write the backup data in parallel. However multiple parallel data streams improve the performance of backup and restore, increasing number of channels has an impact on NetBackup media server CPU and memory consumption.

In our tests we have used four parallel backint channels, ensuring it does not have any negative impact on CPU and memory of single-socket HPE ProLiant DL380 Gen10 NetBackup media server that is used in the lab environment.

To configure SAP HANA multistreaming channels, change "parallel_data_backup_backint_channels" ini file parameter in the following method.

1. In SAP HANA Studio, go to the configuration tab, expand global.ini > backup. Search for parallel_data_backup_backint_channels parameter and change the desired value. The default value is 1. The maximum number of channels permitted is 32 for each service. Multistreaming channels can be used with data backup services size larger than 128 GB. In the lab tested environment, the value of "parallel_data_backup_backint_channels" is 4 as shown in Figure 12.
2. Each multistreaming channel requires an IO buffer of 512 MB. This buffer size can be configured using the "data_backup_buffer_size" ini file parameter. Make sure increasing the buffer size does not affect the memory consumption of the server. In the lab tested environment, the value of "data_backup_buffer_size" is 2048 used for 4 parallel channels as shown in Figure 12.

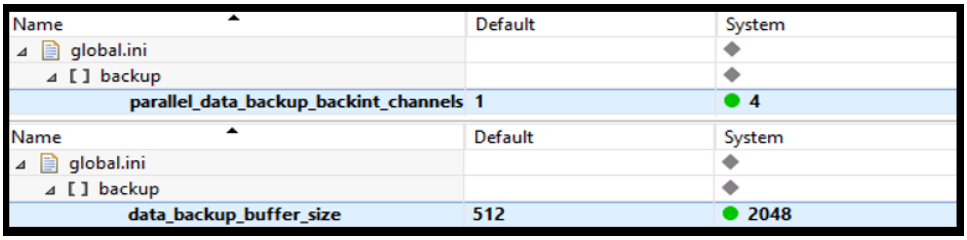

FIGURE 12. Backup parameter (parallel channels) configuration wizard

Figure 13. shows the Backup operation wizard

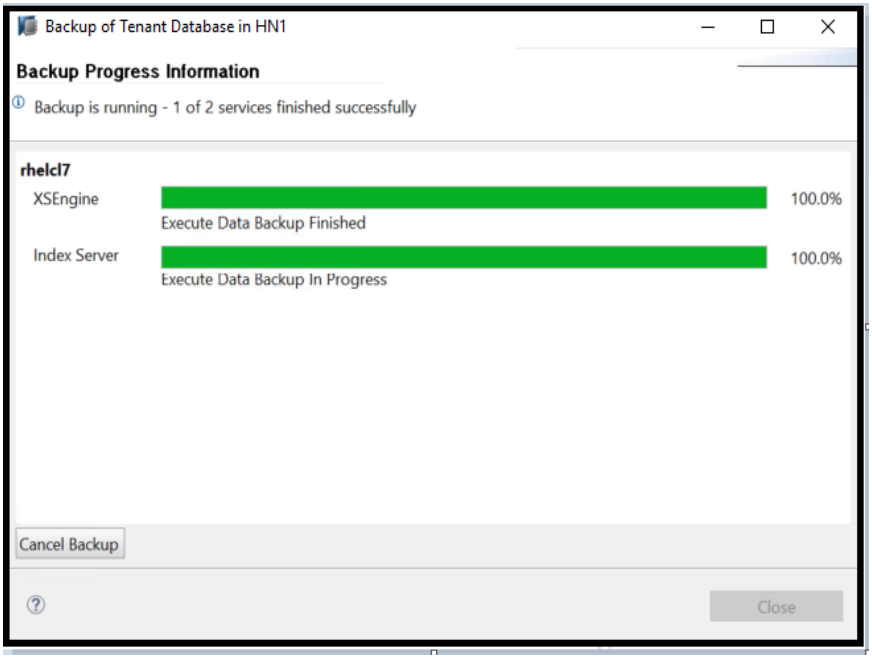

FIGURE 13. Backup operation wizard

SAP HANA database restore

To configure the SAP HANA database, restore, select the option **Search for the backup catalog in the file system only** that shows the file-based and backint based backups. Figure 14 shows the restoration of the SAP HANA database with options.

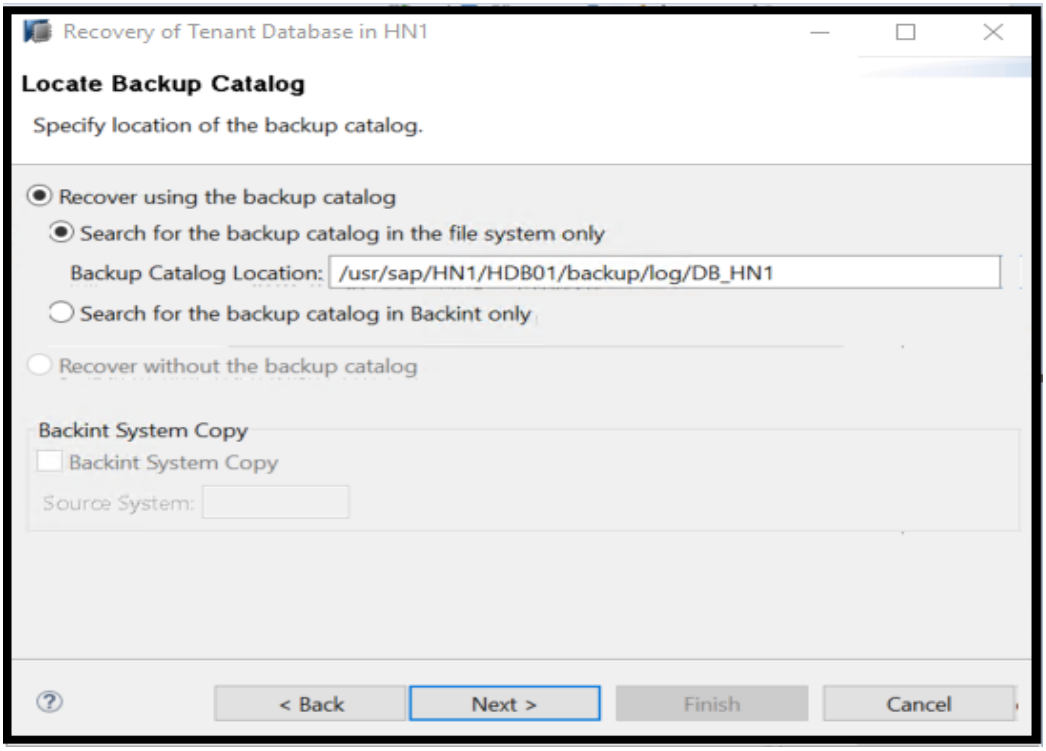

FIGURE 14. Recovery of SAP HANA database operations wizard

Figure 15 shows the SAP HANA restoration progress.

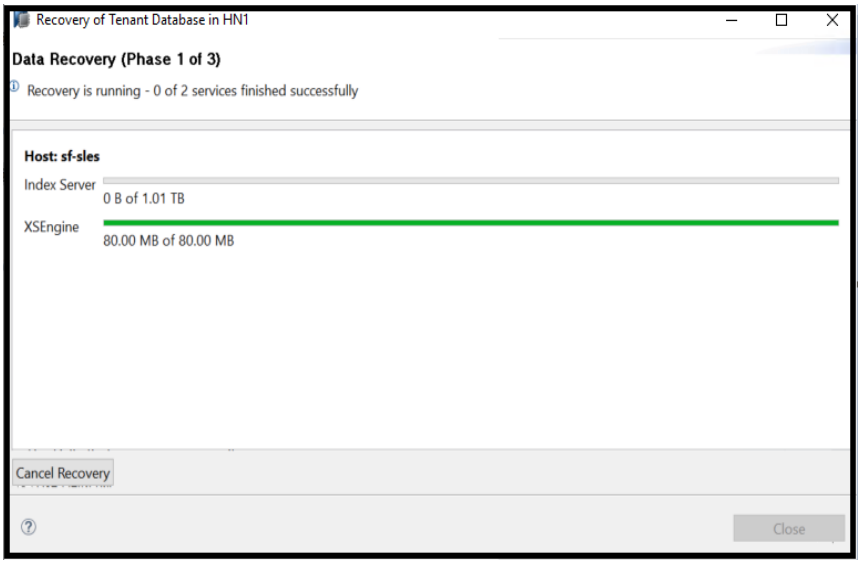

FIGURE 15. Recovery progress of SAP HANA database

Figure 16 shows SAP HANA recovery completion.

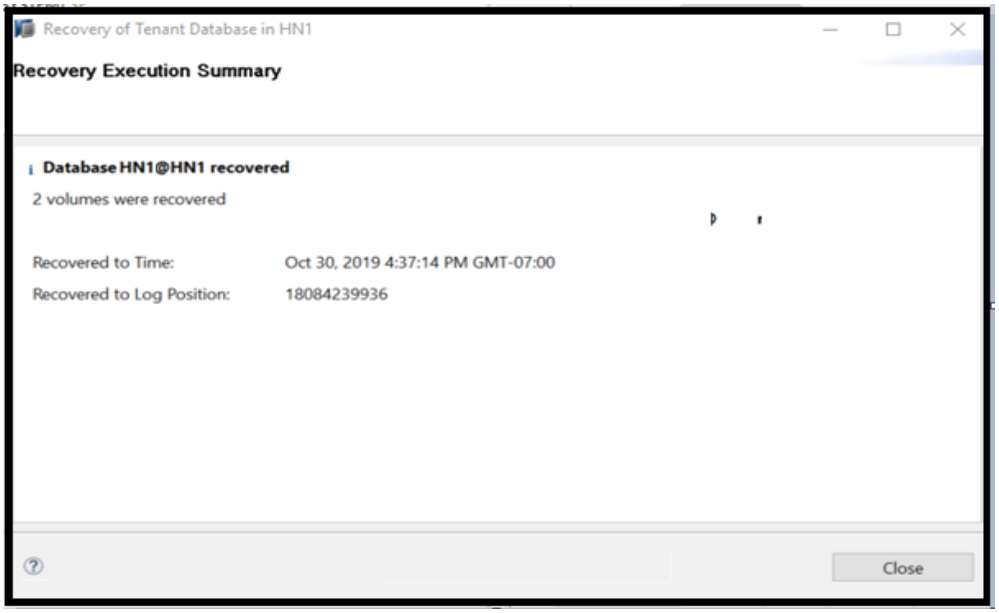

FIGURE 16. Recovery completion of SAP HANA database

SAP HANA Cockpit configuration

SAP HANA Cockpit supports scheduling of data backups and delta backups (incremental/decremental). The following section provides the configuration guidance for SAP HANA Cockpit backup and restore.

SAP HANA Cockpit prerequisites

As a best practice, create a backup user using SAP HANA Studio and assign the following granted roles and system privilege:

Granted roles

- sap. hana. backup. roles: Administrator
- sap. hana. backup. roles: Operator
- sap. hana. backup. roles: Scheduler
- sap. hana.xs. admin. roles: Jobadministrator
- sap. hana.xs. admin. roles: HTTPDestAdministrator
- sap. hana.xs. admin. roles: JobSchedullerAdministrator

System privilege

- BACKUP OPERATOR

NOTE

Scheduling backups using SAP HANA Cockpit also requires XS Job Scheduler to be active.

Steps to create a backup schedule using SAP HANA Cockpit

1. In SAP HANA Cockpit, click on the Resource directory that will show the running databases.

2. Select the SYSTEMDB database and click on manage databases.
3. Click on manage schedules, in the schedule settings window, add a new schedule.
4. Provide the schedule name, recurrence pattern, and recurrence details.
5. Click **Save**.

Figure 17 shows the Scheduling backup with SAP HANA Cockpit.

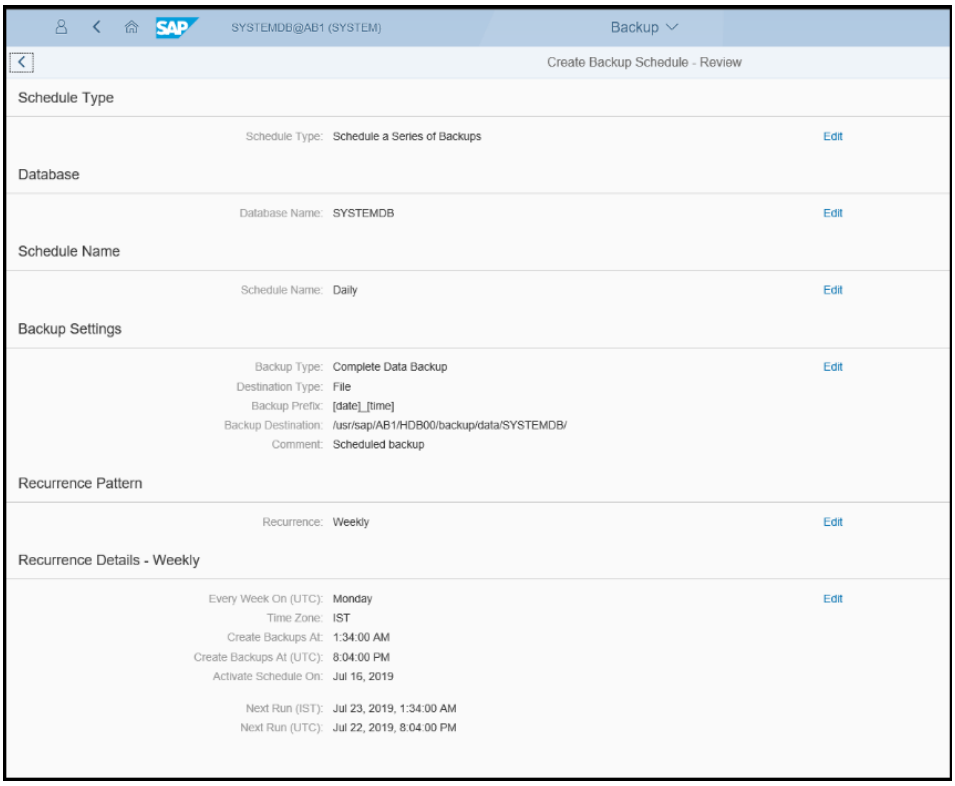

FIGURE 17. Scheduling backup with SAP HANA Cockpit

SAP HANA database backup using SAP HANA Cockpit

To configure the SAP HANA database backup using SAP HANA Cockpit:

1. In SAP HANA Cockpit, click on the Resource directory that will show the running databases.
2. Select the Tenant DB database and click on manage database backups.
3. Click on create a backup, select the backup type, destination type, and proceed with “backup”.

The backup progress of tenant database backup appears as shown in Figure 18.

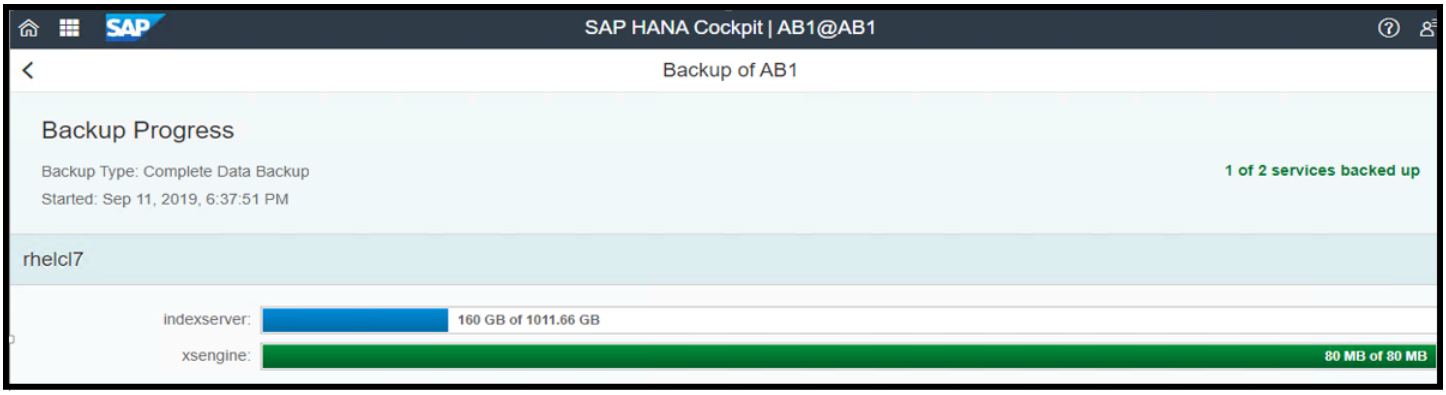

FIGURE 18. SAP HANA database backup using SAP HANA Cockpit

SAP HANA database recovery using SAP HANA Cockpit

To configure the SAP HANA database recovery using SAP HANA Cockpit:

Select the SYSTEMDB@<SID> under System Overview and click **Manage databases > Stop Tenant**. Once the tenant database is stopped, the recover tenant database option will be visible. On the successful tenant database recovery, the database starts as shown in Figure 19.

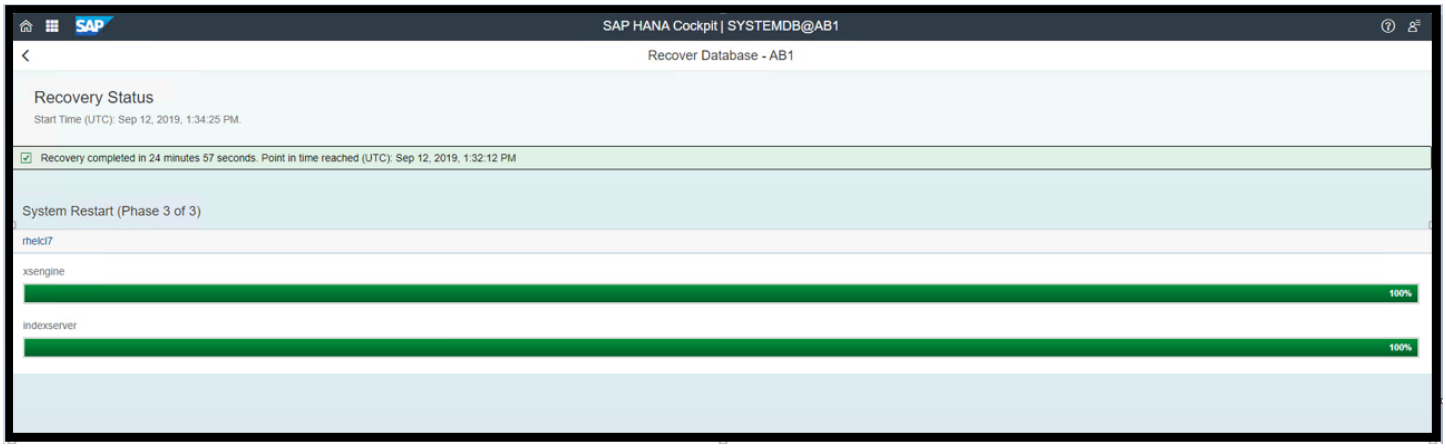

FIGURE 19. SAP HANA database recovery using SAP HANA Cockpit

Veritas NetBackup backup/restore job monitoring

The database backup operation can be seen on the NetBackup Master Server. Once the backup is initiated, the activity monitor displays the status of the backup job as shown in Figure 20.

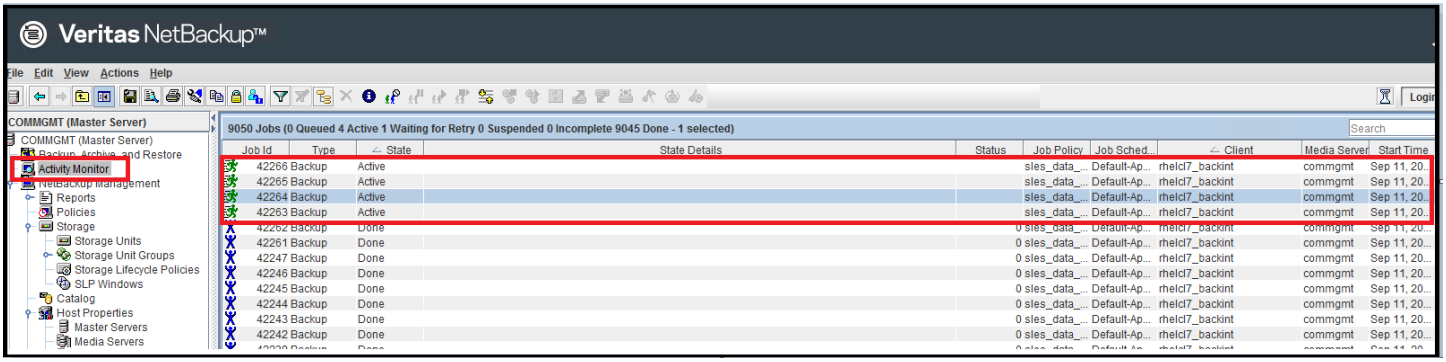

FIGURE 20. Veritas NetBackup Activity Monitor window

SAP HANA database restore operation can be seen on Veritas NetBackup server, by selecting the task on the home page and select the **Restore History** as shown in Figure 21.

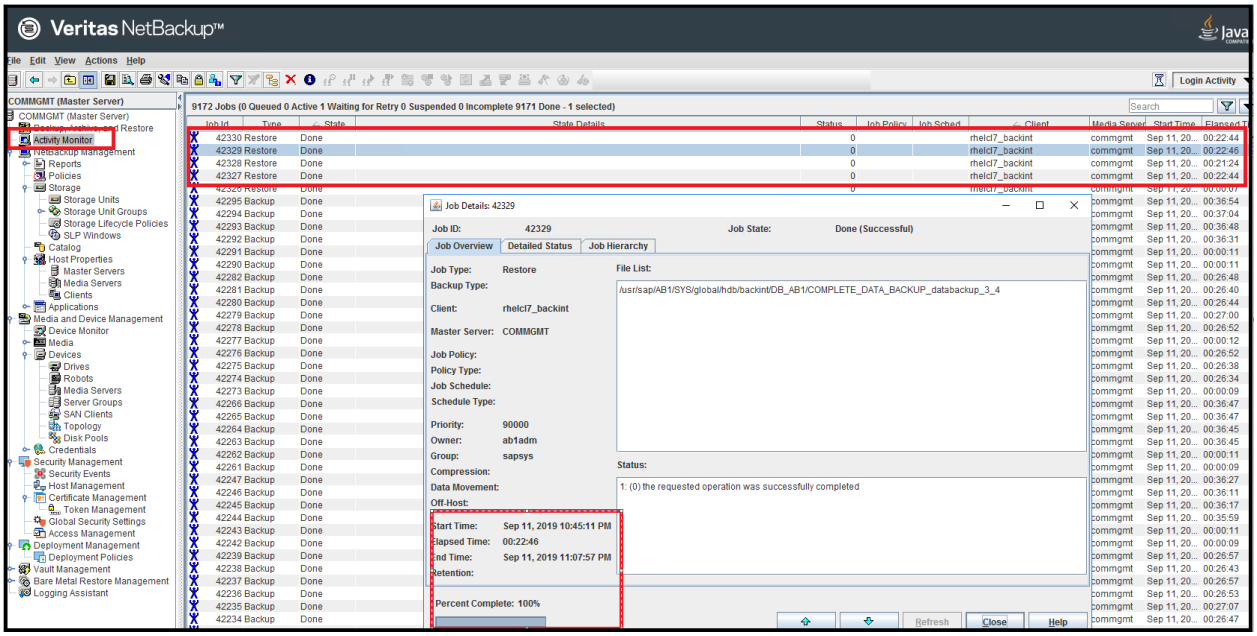

FIGURE 21. Veritas NetBackup restoration job status

CAPACITY AND SIZING

Planning the capacity for backups is a complex process that is not just limited to the availability of physical storage for storing backups, it also involves defining the CPU/memory requirements on the media server and sizing the Ethernet links. For databases in general and SAP HANA in particular, backups are very critical for the uptime of the database. These backups are important not just for recovery in case of a failure, but if database logs are not backed up in a timely manner, they could fill up the logs filesystem and potentially bring down the database. Proper capacity planning for SAP HANA backups is very important.

The considerations for arriving at the backup capacity required for a predefined solution using HPE Superdome Flex server for SAP HANA are the SAP HANA database size, the backup frequency, and the change (delta) that a database is witnessing. In traditional backup devices, the sizing would be a simple calculation of the space required for each backup and the number of backups to be retained. Today's advanced backup technology can share, compress, encrypt, multiplex, and deduplicate the data that is going to a backup media.

As stated earlier a customer may have a higher backup frequency if they have a lower recovery time objective and vice-versa. What is presented below is a generic example; therefore, each customer's actual storage requirements will differ accordingly. Another assumption taken in this example is a Deduplication ratio of 10:1 (actual data size: size on disk).

Table 2 shows the storage capacity calculation for HPE StoreOnce Backup.

TABLE 2. SAP HANA database backup and restore from the target backup device

Disk backups	Scale-up
Daily Backup Size (data)	1 TB Per Backup
Daily backup size (logs)	50 GB (This assumes 100 MB every five minutes for 24 hours. 288 log files will be generated, which adds up to 28,800 MB or approximately 30 GB. 50 GB is taken to be on the safer side.)
Maximum number of data backups on the HPE StoreOnce device at any point in time	7 daily, 5 weekly, 12 monthly, 7 yearly, 7 special
	38 backups convert to 38 TB
Maximum number of log backups on the HPE StoreOnce device at any point in time	50 GB * 14 (Assuming two weeks' worth of logs are kept on the disk)
	700 GB
Total backup capacity required	38.7 TB
Total backup capacity required on disk assuming a deduplication ratio of 10:1	~4 TB
Available raw capacity	288 TB (HPE StoreOnce 5200)
Available usable capacity	216 TB

Table 3 shows the suggested backup strategy.

TABLE 3. Suggested backup strategy

Backup policy	Disk-based backup using Catalyst store	Retention
DATA_IP_POLICY	Daily (Mon-Sun)	7 days
LOG_IP_POLICY	Every 15 minutes (as default)	14 days, point in time restores have a dependency on logs having retention of 14 days means that we can restore a database to a point in time in the last 14 days.
DATA_IP_POLICY	Weekly (Sat)	4 weeks
DATA_IP_POLICY	Monthly	12 months

The information available in Table 2 clearly shows that the HPE StoreOnce 5200 is well suited for all HPE Superdome Flex for SAP HANA that is in the range of 1.5 TB and 9 TB of memory. A requirement of ~9 TB seems too less versus the actual usable space available; however, customers should consider all their SAP HANA instances and calculate their total capacity required, this additional capacity would be useful for any future growth and any other applications that could share this HPE StoreOnce unit. Even for customers that have a higher backup frequency and need more backup space, the HPE StoreOnce 5200 has ample scope for expansion and can be scaled up to 288 TB (raw) and 216 TB (usable). It should be noted here that the above calculation is for one production SAP HANA instance, for non-production instances such as QA and development and testing, additional capacity needs to be calculated and procured.

Workload description

Hewlett Packard Enterprise has performed extensive testing to arrive at the achievable backup and restore solution of using Veritas NetBackup backup software in an SAP HANA database environment using HPE StoreOnce 5200. Figure 1 shows the Hewlett Packard Enterprise lab test

setup. The Ethernet links from the SAP HANA server to Veritas Master/Media Server and the HPE StoreOnce 5200 are running at 2x10Gbps Link Aggregation. Multiple tests were performed in each environment. The SAP HANA database instances HN1 and AB1 were built to a size of approximately 1TB on SLES 12 SP4 and RHEL 7.6 respectively.

Workload

Backups and backup speed are an important factor and that should be able to complete in a reasonable amount of time. It is also very important that the restore of the database is quick and smooth. Hewlett Packard Enterprise tested the backup and restoration of an SAP HANA database using the SAP Backint API. The backup and restore for an SAP HANA instance can be initiated from SAP HANA Studio/SAP HANA Cockpit. A restore can be from flat file backups or from a Backint backup. Except for the SAP HANA Index server, all other jobs are very small and complete in a few minutes. The Index server takes time depending upon the volume of data in the database.

Key Challenges

To design the backup solution is to get the best performance and making sure the backup and restore happens flawlessly. To achieve the best performance requires tunables in Veritas NetBackup software and SAP HANA databases.

Analysis and recommendations

- SAP HANA database can only be recovered as a whole, and it is not possible to recover a table or an object. The recovery process requires the database to be down.
- SAP recommends that in addition to the data and logs there should also be a backup of the configuration files on the SAP HANA nodes. These files should be backed up before and after an upgrade of the SAP HANA database or any system changes are executed.
- Enable the log backups to initiate automatically rather than manually, this will ensure the logs space is always available and prevent the database from going down due to filesystem full condition.
- While successful backup is very important, it is also very important to ensure that the backup images are expiring in a timely manner, this ensures that there is sufficient capacity available on the backup device for routine future backups.
- In a multitenant database container environment, it is recommended to backup the system and all the tenant databases regularly. While recovering the system databases, the whole system (system database and all the tenant databases) need to be shut down.
- Configure the SAP HANA data backups with multistreaming channel values up to twenty for maximum throughput on HPE Superdome Flex server for SAP HANA scale-up 3TB configuration.
- Configure SAP HANA node, Veritas NetBackup Media server, and HPE StoreOnce with network Link Aggregation (IEEE802.3ad) with load balancing hash “xmit_hash_policy=layer3+4” for backup traffic (Refer Appendix G).
- Enable Content-Aware backup in HPE StoreOnce OST Catalyst plugin for Veritas NetBackup.
- Configure HPE StoreOnce Catalyst with low-bandwidth transfer mode. It allows the deduplication process to be off-loaded to the NetBackup Media server which reduces network I/O load between Veritas NetBackup media server and HPE StoreOnce because only new data is transmitted.

SUMMARY

To summarize, the common expectations across the industries are that data protection is simple, reliable, and cost-effective.

It is always important to have a good backup management strategy that helps to manage the exponential data growth in the customer environment. This backup solution is a compelling solution for challenging data protection environment. It enables the efficient backup, and data protection for SAP HANA databases.

HPE hardware, i.e. HPE Superdome Flex server and HPE StoreOnce 5200 systems along with Veritas NetBackup, provides an easier and more economical backup and recovery solution for organizations.

SAP HANA is a high-speed in-memory database (IMDB) commonly used for mission-critical enterprise applications, and therefore customers need an SAP-certified backup solution for SAP HANA databases. Customers demand the highest efficiency and performance in their SAP HANA environment while minimizing the risk of data loss. SAP customers need an enterprise-class backup solution, like Veritas NetBackup that they can trust on to perform reliable backup and restore of SAP HANA databases.

This tested solution resulting in the following benefits:

- Reduced backup footprint
- Reduced infrastructure equipment
- Agent-based backup with de-duplication
- Simple, reliable, and cost-effective
- Great performance

This Hewlett Packard Enterprise backup solution for SAP HANA has been built and tested using the best in class components. The workload data/results section substantiates that using Veritas NetBackup for SAP HANA solution will enable customers to meet strict SLAs with demanding Recovery Time Objectives (RTO) and Recovery Point Objectives (RPO).

By reading this document, users can deploy this backup and recovery solution in an SAP HANA environment using the HPE Superdome Flex server, HPE StoreOnce 5200, and Veritas NetBackup software. As discussed throughout this document all these components work together seamlessly to provide an HPE backup solution for SAP HANA to deliver return on investment and add to profitability.

Hewlett Packard Enterprise always delivers a solution that excels in reliability and performance while minimizing the costs which makes this as the most recommended backup and recovery solution in the market.

Implementing a proof-of-concept

As a matter of best practice for all deployments, Hewlett Packard Enterprise recommends implementing a proof-of-concept using a test environment that matches as closely as possible to the planned production environment. In this way, appropriate performance and scalability characterizations can be obtained. For help with a proof-of-concept, contact a Hewlett Packard Enterprise Services representative (hpe.com/us/en/services/consulting.html) or your Hewlett Packard Enterprise partner.

APPENDIX A: BILL OF MATERIALS

NOTE

Part numbers are at the time of publication/testing and subject to change. The bill of materials does not include complete support options or other rack and power requirements. If you have questions regarding ordering, please consult with your Hewlett Packard Enterprise Reseller or Hewlett Packard Enterprise Sales Representative. For more details, see https://www.hpe.com/us/en/services/consulting.html.

TABLE A1. Bill of materials (Lab tested environment)

QTY	COMPONENTS
1	HPE Superdome Flex server with Cascade Lake processor
1	SLES 12 SP4 for SAP
1	RHEL 7.6 for SAP
1	Microsoft Windows 2016
1	HPE StoreOnce 5200
2	HPE D3710 Enclosure
1	HPE ProLiant DL380 Gen10
2	HPE Flex Fabric 5945 network switches
2	HPE Flex Fabric 5900 network switches
1	Veritas NetBackup software
1	SAP HANA 2.0 SPS 04

APPENDIX B: VERITAS NETBACKUP RECOMMENDATIONS

To avoid errors related to storage resource, perform the following tuning on the NetBackup Master Server.

1. Go to **Veritas NetBackup Administration Console > Host Properties > Master Servers**.
2. Select the Master Server (right-click for properties), Global Attributes, and change the Maximum jobs per client value from **1** to **99**. The default value is **1**.

   Figure B1. shows the Veritas NetBackup Maximum jobs per client settings.

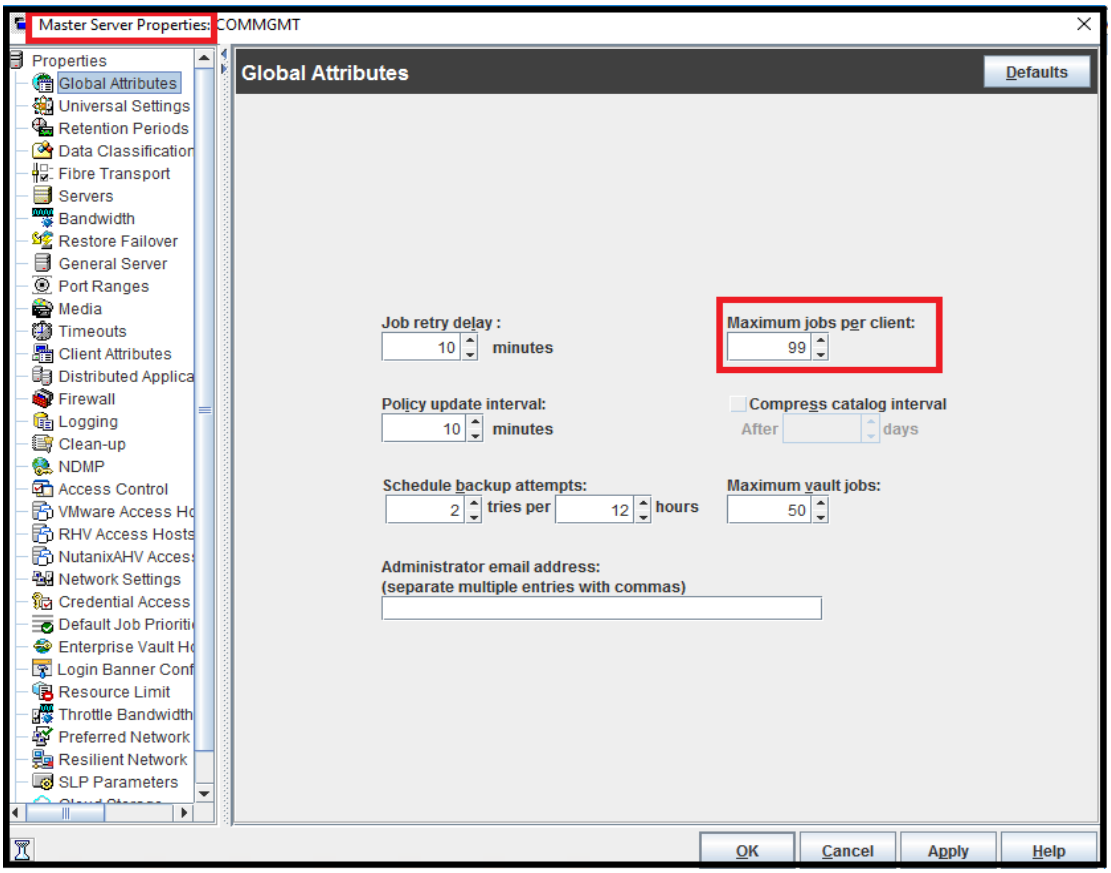

FIGURE B1. Veritas NetBackup Maximum jobs per client settings

To avoid errors related to client read timeout value, perform the following tuning on the NetBackup Master Server.

3. Go to **Veritas NetBackup Administration Console > Host Properties > Master Servers**.
4. Select the **Master Server (right-click for properties) > Timeouts**. Change the Client read timeout value from **300** to **3000**. The default value is **300**.

Figure B2. shows the Veritas NetBackup client timeout settings.

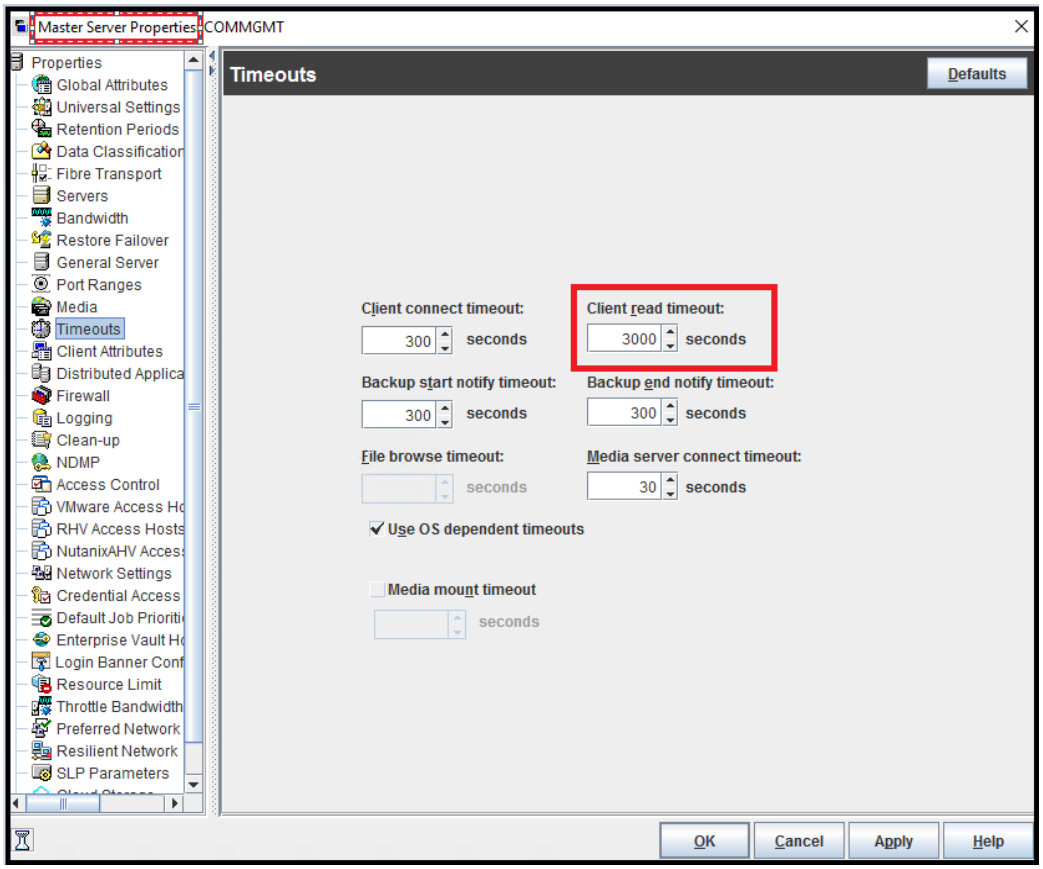

FIGURE B2. Veritas NetBackup client timeout settings

Veritas NetBackup policy can be scheduled as shown in Figure B3. Customers can change the backup policy schedule as required.

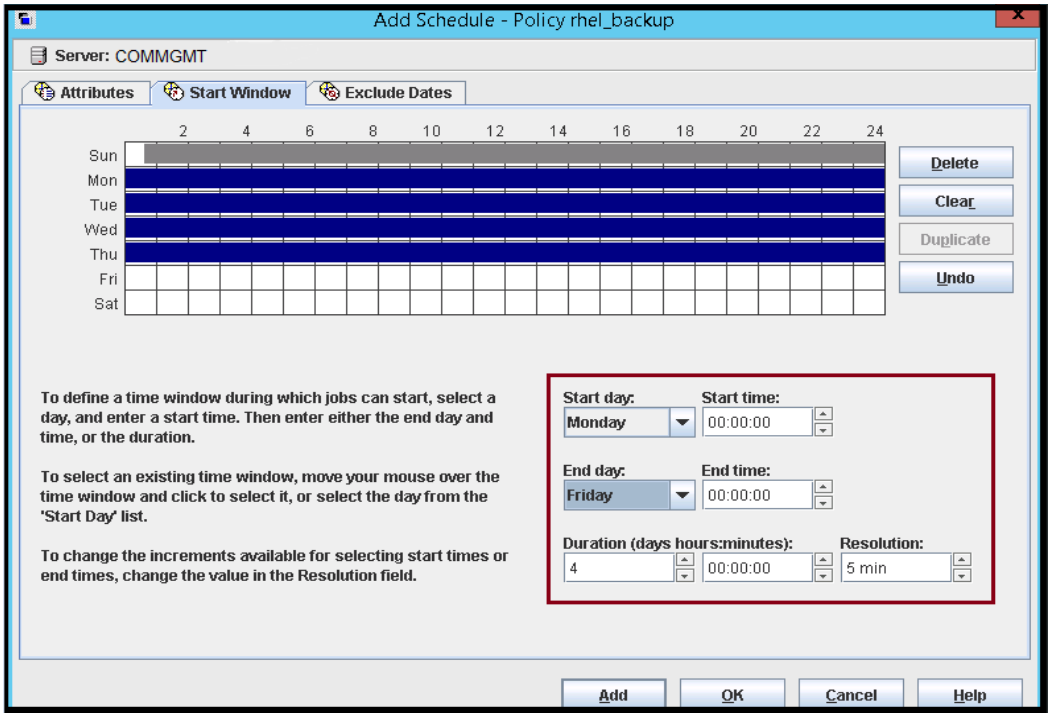

FIGURE B3. Veritas NetBackup policy schedule settings

APPENDIX C: VERITAS NETBACKUP AUTHORIZATION TOKEN MANAGEMENT

To create an authorization token in the Veritas NetBackup Master Server, the following procedure is required as shown in Figure C1.

NetBackup Master Server configuration

1. Select Security Management in the Veritas NetBackup Master Server.

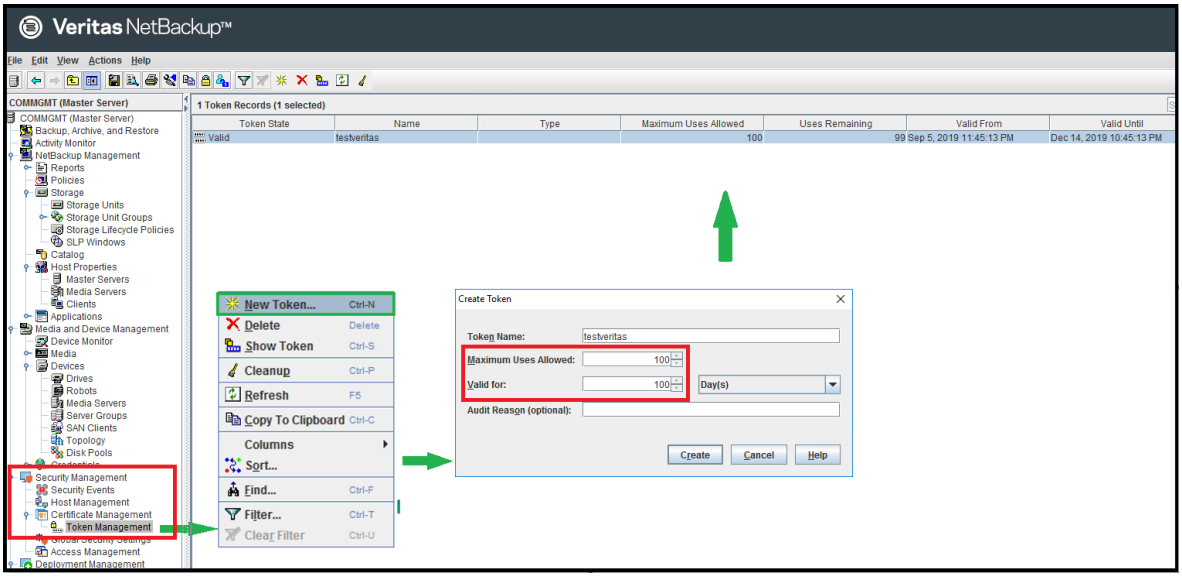

FIGURE C1. NetBackup Master Server Authorization token management

2. Select the **Token Management** and right-click on the right pane. Click on **Net Token** to create a new Token.
3. Provide the name of the Token, Maximum uses allowed, and no of days' validity, and click on create.

NetBackup Client configuration

Perform the following procedure in the NetBackup Client to communicate to the Master server:

1. Extract the NetBackup client software on the Client (Linux).
2. Run the installer and provide the NetBackup Master Server name.

   The client shows the fingerprint of the Master Server
3. Press **Y** to continue.
4. Go to the NetBackup Master Server and click on the Token Management.
5. Right-click on the token **testveritas** as shown in Figure C2.
6. Click on **Show Token** option and select **Copy** from the window that appears.

   This will allow you to copy the 16-digit token. Paste the same token in the client and continue and complete the installation.

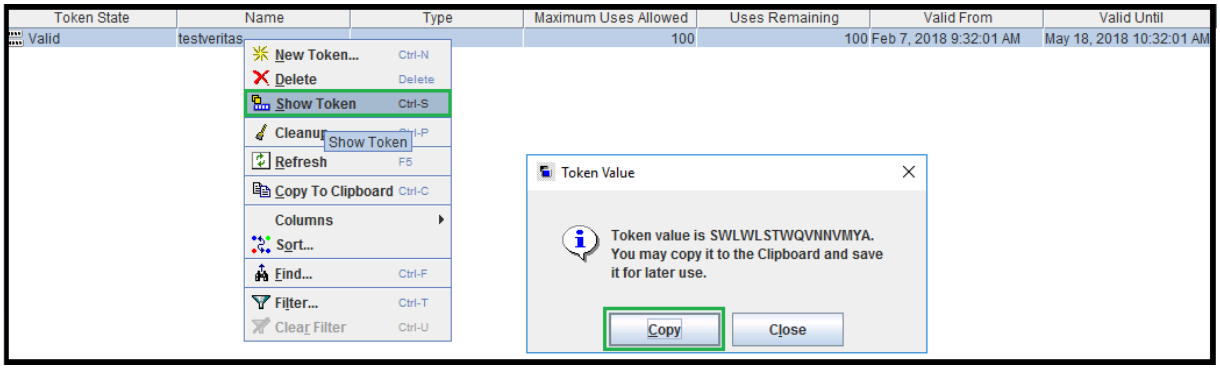

FIGURE C2. Copying the NetBackup Master Server Authorization token

For more information on Authorization code, refer to https://www.veritas.com/content/support/en_US/doc/21733320-127424841-0/v120724188-127424841.

APPENDIX D: SAP HANA BACKINT BACKUP PERFORMANCE RECOMMENDATIONS

SAP HANA backint performance can be improved by setting the following parameters. The parameters shown in Figure D1 were used in the Hewlett Packard Enterprise lab test environment.

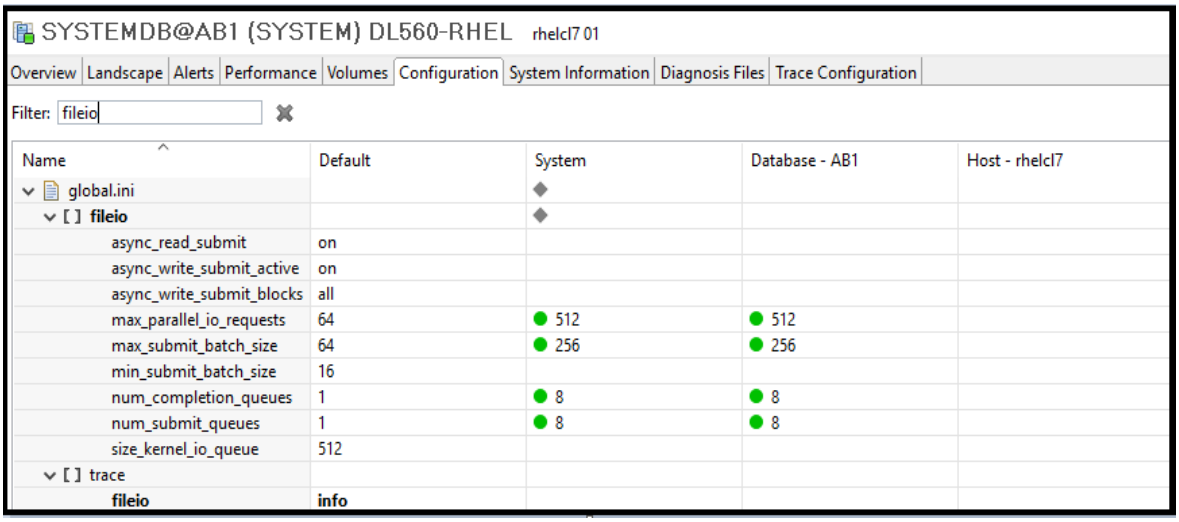

FIGURE D1. SAP HANA database parameters for backint backup

After setting the above parameters in the global.ini file, restart the database to make the changes effective.

APPENDIX E: HPE STOREONCE RECOMMENDATIONS

HPE StoreOnce 5200 delivers cost-effective, scalable disk-based backup with deduplication for longer-term on-site data retention and off-site disaster recovery for larger data centers or regional offices. It also provides a replication target device for up to 50 remote or branch offices.

KEY POINTS

The obvious benefit of in-line deduplication for SAP HANA backups is the opportunity to save on actual storage consumption.

HPE StoreOnce – models for SAP HANA

HPE StoreOnce has been designed to cater to the needs of all types of customers from entry-level to large scale enterprises. HPE StoreOnce Backup systems deliver scale-out capacity and performance to keep pace with shrinking backup windows, reliable disaster recovery, simplified protection of remote offices, and rapid file restore to meet today's SLAs. It provides flexibility for future growth/changes. Table E1 lists the features of the HPE StoreOnce 5200 model that is recommended for backing up SAP HANA.

TABLE E1. HPE StoreOnce Backup model for SAP HANA

PRODUCT DESCRIPTION	HPE STOREONCE 5200
Form factor	4U Scalable Rack
Total capacity	Up to 288 TB (raw), Up to 216 TB (usable)
Device interface	16Gb and 32Gb Fibre Channel Ports 10GbE and 25GbE Ethernet Ports 1 Gb Ethernet Ports
Max fan-in/backup Target	32
Maximum Write performance	17 TB/hour
Maximum Catalyst write performance	33 TB/hour

KEY POINTS

HPE StoreOnce Backup systems are built using HPE ProLiant servers, hence they share common management tools with Hewlett Packard Enterprise server products (for example, HPE Systems Insight Manager (SIM) and HPE Integrated Lights-Out (iLO)) reducing the time and energy it takes to manage the IT infrastructure. For more information about the HPE StoreOnce 5200 system, refer to the HPE StoreOnce 5200 System overview.

APPENDIX F: HPE D3710 ENCLOSURE RECOMMENDATIONS

HPE D3710 Enclosure features an affordable storage for capacity on-demand, flexible, and scalable with room to expand.

For more information, refer to the HPE D3710 Enclosure overview.

APPENDIX G: NETWORK BONDING CONFIGURATION RECOMMENDATIONS

Edit the bonding configuration file /etc/sysconfig/network/ifcfg-bondX in SLES or /etc/sysconfig/network-scripts/ifcfg-bondX file in RHEL with "xmit_hash_policy=layer3+4" in the BONDING_MODULE_OPTS line as follows:

```
BONDING_MODULE_OPTS='mode=802.3ad miimon=100 xmit_hash_policy=layer3+4'
```

RESOURCES AND ADDITIONAL LINKS

HPE Reference Architectures, hpe.com/info/ra

HPE Servers, hpe.com/servers

HPE Storage, hpe.com/storage

HPE Networking, hpe.com/networking

Veritas NetBackup documentation, https://www.veritas.com/support/en_US/article.100040135

Veritas NetBackup compatibility matrix, https://www.veritas.com/support/en_US/article.100040093

HPE GreenLake Advisory and Professional Services, https://www.hpe.com/us/en/services/consulting.html

To help us improve our documents, please provide feedback at hpe.com/contact/feedback.

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