Abstract

This document describes the design of a NetApp and Commvault solution for SAP HANA, which includes Commvault IntelliSnap snapshot management technology and NetApp® Snapshot™ technology. The solution is based on NetApp storage and the Commvault data protection suite.
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1 Overview

Companies today require continuous, uninterrupted availability for their SAP applications. They expect consistent performance levels in the face of ever-increasing volumes of data and the need for routine maintenance tasks such as system backups. 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, and the amount of data to be backed up is increasing. Therefore, it is difficult to find a time when backups can be performed with minimal effect on business processes. The time that is needed to restore and recover SAP systems is a 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 that you face in 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 that are placed on the database server, the storage system, and the storage network.

- **Shrinking backup windows.** Conventional backups can be made only 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, more backup disk space, and faster backup networks. You must also cover the ongoing expense of storing and managing these tape assets. Incremental or differential backups can help resolve these issues, but this arrangement results in a very slow, cumbersome, and complex restore process that is harder to verify. Such systems usually increase recovery time objective (RTO) and recovery point objective (RPO) times in ways that are unacceptable 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 requirement to restore and recover the SAP system. Therefore, the desired 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 that is available for the upgrade process. The decision to proceed is generally based on the amount of time that is required to restore and recover the database from the previously created backup. Rather than just restoring a system to its previous state, a rapid restore provides more time to solve problems that might occur during an upgrade.

1.1 The NetApp and Commvault Solution

Commvault IntelliSnap uses NetApp Snapshot technology to create database backups in minutes. Because Snapshot technology does not move or copy any physical data blocks on the storage platform, the time that is needed to create a Snapshot copy is independent of the size of the database. Snapshot technology also does not move or copy data blocks when data in the active file system is changed, so the use of Snapshot technology has no performance effect on the live SAP system. You can therefore schedule the creation of Snapshot copies without having to consider peak dialog or batch activity periods. SAP and NetApp customers typically schedule multiple online Snapshot copies during the day; for example, every 4 hours is common. These Snapshot copies are usually kept for 3 to 5 days on the primary storage system before they are removed.

Commvault software acts as an orchestration layer on top of the Snapshot technology, so it can manage the creation and deletion of Snapshot copies, as well as NetApp SnapMirror® and SnapVault® relationships. The software enables you to set retention policies on Snapshot copies as if they were normal backups, so you do not need to manually delete them or to script their deletion.
It also provides the possibility of a GUI-based restore in which the end user only has to specify the system that must be restored and up to what point in time. Commvault software then uses its recovery catalog to determine which Snapshot copy must be used. Commvault software can make this determination regardless of whether or not the Snapshot copy has been vaulted by using SnapVault. When the initial Snapshot copy has been reverted to the active file system, Commvault software applies the required log backups to complete the database recovery to the specified point in time. These log backups are restored from streaming backups that Commvault catalogs along with the database Snapshot copy to enable either full or point-in-time hands-free recovery.

Snapshot copies also provide key advantages for restore and recovery operations. Commvault IntelliSnap uses NetApp SnapRestore® data recovery software. SnapRestore enables the restore of an entire database or a portion of a database to any point in time, based on the available Snapshot copies. Such restore processes finish in a few minutes, independent of the size of the database. Because several online Snapshot copies are created during the day, the time that is needed for the recovery process is significantly reduced relative to a traditional backup approach. And because a restore operation can be performed with a Snapshot copy that is only a few hours old (rather than up to 24 hours), fewer transaction logs must be applied. Therefore, the mean time to recover, which is the time that is needed for restore and recovery operations, is reduced to several minutes rather than the several hours that conventional single-cycle tape backups require.

SnapVault software offers significant advantages over traditional backups. After an initial data transfer, in which all data has been transferred from the source to the destination, all subsequent backups copy only the changed blocks to the secondary storage. Therefore, the load on the primary storage system and the time that is needed for a full backup are significantly reduced. Because SnapVault software stores only the changed blocks at the destination, a full database backup requires less disk space.

Backing up data to tape as a long-term backup might still be required. This backup could be, for example, a weekly backup that is kept for a year. In that case, the tape infrastructure can be directly connected to the secondary storage, and data can be written to tape by using NDMP. Figure 1 shows an overview of the NetApp and Commvault backup solution. In addition, Commvault software offers native tape library support within the Commvault platform.
1.2 Run Time of Snapshot Copy Backups

Figure 2 shows SAP HANA Studio running SAP HANA on NetApp storage. Snapshot copies are used to back up the SAP HANA database. This figure shows that the SAP HANA database is backed up in 24 seconds by using Commvault IntelliSnap for Snapshot backup technology.
Further analysis of more than 11,000 backup runs demonstrated that more than 80% of the backups that used Snapshot technology finished in less than 20 seconds. All the backups were finished in less than a minute. See Figure 3.

Figure 3) Backup run-time analysis.
1.3 Recovery Time Objective Comparison

This section provides an RTO comparison of file-based backups and storage-based Snapshot copy backups. The RTO is defined by the sum of the time that is needed to restore the database and the time that is needed to start and to recover the database.

Time Needed to Restore the Database

With a file-based backup, the restore time depends on the size of the database and backup infrastructure, which defines the restore speed in megabytes per second (MBps). For example, if the infrastructure supports a restore operation at a speed of 250MBps, it takes approximately 1 hour and 10 minutes to restore a database that is 1TB in size.

With storage-based Snapshot copy backups, the restore time is independent of the size of the database and is in the range of a couple of seconds when the restore can be performed from primary storage. A restore from secondary storage is required only in the case of a disaster when the primary storage is no longer available.

Time Needed to Start the Database

The database start time depends on the size of the row and column store. For the column store, the start time also depends on how much data is preloaded during the database start. In the following examples, we assume that the start time is 30 minutes. The start time is the same for a file-based restore and recovery and for a restore and recovery that are based on a Snapshot copy.

Time Needed to Recover the Database

The recovery time depends on the number of logs that must be applied after the restore operation. This number is determined by the frequency at which data backups are performed.

With file-based data backups, the backup schedule is typically once per day. A higher backup frequency is normally not possible, because the backup degrades production performance. Therefore, in the worst case, all the logs that were written during the day must be applied during forward recovery.

Storage Snapshot copy data backups are typically scheduled with a higher frequency because they do not affect the performance of the SAP HANA database. For example, if Snapshot copy backups are scheduled every 6 hours, the recovery time would be, in the worst case, one-fourth of the recovery time for a file-based backup (6 hours/24 hours = 1/4).

Figure 4 shows an RTO example for a 2TB database when file-based data backups are used. In this example, a backup is performed once per day. The RTO differs depending on when the restore and recovery operations were performed. If the restore and recovery operations were carried out immediately after a backup was performed, the RTO is primarily based on the restore time, which is 1 hour and 10 minutes in the example. The recovery time increased to 2 hours and 50 minutes when restore and recovery operations were carried out immediately before the next backup was performed, and the maximum RTO was 4 hours and 30 minutes.
Figure 4) RTO for a 2TB database with file-based backups.

Figure 5 shows an RTO example for a 2TB database when Snapshot copy backups are used. With storage-based Snapshot copy backups, the RTO depends only on the database start time and on the forward recovery time. The restore operation is completed in a few seconds, independent of the size of the database. The forward recovery time also increases depending on when the restore and recovery operations are performed. However, because of the higher frequency of backups (every 6 hours in this example), the forward recovery time is 43 minutes at most. In this example, the maximum RTO is 1 hour and 13 minutes.

Figure 5) RTO for a 2TB database with Snapshot copy backups.

Figure 6 shows an RTO comparison of file-based and storage-based Snapshot copy backups for different database sizes and different frequencies of Snapshot copy backups. The green bar shows the file-based backup. The other bars show Snapshot copy backups with different backup frequencies.

With a single Snapshot copy data backup per day, the RTO is already reduced by 40% when compared with a file-based data backup. The reduction increases to 70% when four Snapshot copy backups are taken per day. Figure 6 also shows that the time saved starts to level off if you increase the Snapshot
copy backup frequency to more than four to six Snapshot copy backups per day. Therefore, customers typically configure four to six Snapshot copy backups per day.

Figure 6) RTO comparison: file-based backup versus Snapshot copy backup.

<table>
<thead>
<tr>
<th>RTO [hour]</th>
<th>500GB</th>
<th>1TB</th>
<th>2TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>File</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>5 Snapshot copy per day</td>
<td>8</td>
<td>12</td>
<td>24</td>
</tr>
</tbody>
</table>

Assumptions: Restore from file with 250MBps; database start with 400MBps; log files per day, 50% of database size; and forward recovery with 250MBps

Note: The graph shows the SAP HANA server RAM size. The database size in memory is calculated to be half of the server RAM size.

Note: The restore and recovery time is calculated based on the following assumptions. The database can be restored at 250MBps. The number of log files per day is 50% of the database size. For example, a 1TB database creates 500MB of log files per day. A recovery can be performed at 100MBps.

2 NetApp and Commvault SAP HANA Backup Solution

2.1 Solution Component Overview

Figure 7 shows an overview of the NetApp and Commvault components of the SAP HANA backup solution.
Where:
CS = CommServe
MA = MediaAgent
IDA= Intelligent Data Agent

CommServe
A group of systems that use one Commvault license or account number is called a CommCell. This group is operated by a central management component called CommServe. CommServe coordinates and executes all CommCell operations, maintaining Microsoft SQL Server databases that contain all configuration, security, and operational history for the CommCell environment. There can be only one CommServe host in a CommCell environment. The CommServe software can be installed in physical, virtual, and clustered environments. For more information about the CommServe host, see CommServe Server Overview.

SAP HANA Database Hosts
The SAP HANA client Intelligent Data Agent and MediaAgent software are installed on the SAP HANA database hosts. These two components enable Commvault IntelliSnap to automate the creation of application-aware NetApp Snapshot copies. They also enable IntelliSnap to catalog Snapshot data to simplify the recovery of individual files or databases without the need for a collection of scripts and disparate Snapshot copy, backup, and recovery tools. IntelliSnap technology also supports the transfer of Snapshot copy-based backups to another NetApp storage system that is stored at a different location by using NetApp SnapVault and SnapMirror technologies.
In addition, long-term Snapshot copy backups can be moved to commodity disk, cloud, or tape to eliminate legacy backup solutions.

To protect large databases in an on-premises environment, the use of Snapshot copies that are managed by Commvault is an excellent choice. It has a minimal impact on the SAP HANA database during a backup, and it greatly reduces RTO in case of a restore and recover operation.

NetApp Storage System

NetApp AFF systems are certified for use with SAP HANA. AFF systems provide the foundation for the backup solution, Snapshot copies, and replication that is based on SnapVault and SnapMirror technologies.

In addition, AFF systems are built with innovative inline data reduction technologies such as inline compression, inline deduplication, and inline compaction.

Storage Library

The NetApp and Commvault backup solution uses a NetApp AFF or FAS system as a storage library for the SAP HANA log backups, database integrity checks, and nondatabase file backups. In addition, this storage system is used as a SnapVault or a SnapMirror replication target of the primary storage system. As with the primary storage system, to provide space savings, innovative data reduction technologies such as compression and deduplication are also available at the secondary storage system.

2.2 Solution Components

The NetApp and Commvault backup solution for SAP HANA provides the following features:

- SAP HANA data file backup with storage-based Snapshot copies:
  - Backup scheduling
  - Replication to an off-site backup or disaster recovery location
  - Retention management
  - GUI-based simplified restore and recovery
- SAP HANA streaming data file backup by using the SAP HANA Backint interface:
  - Database block integrity check
  - Backup scheduling
  - Retention management
  - Deduplication-aware secondary (DASH) copy to disaster recovery location
- SAP HANA nondata volume backup with storage-based Snapshot copies:
  - Backup scheduling
  - Replication to an off-site backup or disaster recovery location
  - Retention management
- SAP HANA log file backup by using the SAP HANA Backint interface:
  - Retention management
  - DASH copy to disaster recovery location
  - Automatic application of transaction logs during recovery operations

Database data file backups are executed by Commvault by using the SAP HANA Intelligent Data Agent and MediaAgent, which leverage an SAP HANA database backup save point. The Snapshot copies, which are created on the primary storage system, are therefore based on a consistent image of the SAP HANA database.
Commvault software enables the replication of consistent database images to an off-site backup or disaster recovery location by using SnapVault or SnapMirror technologies. Typically, different retention policies are defined for backups at primary and off-site backup storage. Commvault orchestrates and manages the retention at both sites by using NetApp functionality that is built into the storage platform.

Commvault software also enables you to back up all SAP HANA data volumes by using the SAP HANA Backint interface, which is intended for streaming backups. To enable individual retention and protection policies and to collect all required information for SAP HANA disaster recovery, backup of SAP HANA nondata volumes must be scheduled independently from the database data backups.

The SAP HANA database can automatically execute log backups. These log backups are written to Commvault through the Backint interface as streaming backups. Commvault software can mirror or DASH copy these backups to a secondary site (and if necessary, to a tertiary site) for disaster recovery purposes. The software catalogs the backups so that roll-forward can be performed afterward; for example, restore of a data volume from a Snapshot copy backup.

SAP recommends that you combine storage-based Snapshot copy backups with a weekly streaming-based backup to execute a block integrity check. Based on your configurable retention policies, Commvault manages the housekeeping of streaming and Snapshot copy-based data file backups at the primary storage, streaming log file backups, and the SAP HANA backup catalog.

Figure 8 shows an overview of the database and log backup configuration, where the log backups are written to an NFS mount of the off-site backup storage.

Figure 8) Database and log backup configuration overview.

When executing a storage-based Snapshot copy backup of nondata volumes, Commvault software performs a streaming backup that stores the data in a storage library, which is defined within the used storage policy. This stored data can in turn be mirrored to a secondary site.

When executing a storage-based Snapshot copy backup of the SAP HANA database, Commvault software performs the following tasks:

1. Creates an SAP HANA backup save point to create a consistent image on the persistence layer.
2. Creates a storage Snapshot copy of the data volume.
3. Registers the storage Snapshot copy backup in the SAP HANA backup catalog.
4. Releases the SAP HANA backup save point.
5. Executes a SnapVault or SnapMirror update for the data volume, if configured.
6. Deletes storage Snapshot copies from the primary storage and from SnapVault or SnapMirror based on the defined retention policy.
   
   **Note:** Both the primary and secondary Snapshot copies can be assigned individual retention times based on Commvault’s Storage Policy concept.

7. Whenever a backup is deleted based on the retention policy or is manually deleted, Commvault deletes all log backups that are older than the oldest data backup. Log backups are deleted from the backup device and in the Commvault backup catalog.
   
   **Note:** The deletion of storage Snapshot copies at the off-site backup storage is executed by NetApp ONTAP® data management software. The deletion is based on the defined retention in the ONTAP protection relationship configuration.

### 2.3 Supported SAP HANA Releases and Configurations

Commvault V11 supports SAP HANA single-host and multiple-host configurations that use NFS- or FC-attached NetApp storage systems (FAS and AFF) by using streaming-based backups. V11 also supports single-host systems by using both streaming and Snapshot copies. Commvault V11 supports the following SAP HANA releases:

- SAP HANA single container:
  - SAP HANA 1.0 SPS7 and later
  - SAP HANA 2.0 up to SPS0

- SAP HANA Multitenant Database Container (MDC) single tenant:
  - SAP HANA 2.0 SPS1 and later

  **Note:** Storage-based Snapshot copy backups for SAP HANA MDC with more than one tenant are not supported by SAP.

### 2.4 Capacity Requirements for Snapshot Copy Backups

You must consider the higher block change rate on the storage layer relative to the change rate with traditional databases. Due to the table merge process of the column store, much more data other than just the block changes is written to disk. Data from typical customers shows a daily change rate between 10% and 50%.

### 3 Installation and Configuration Overview

#### 3.1 Commvault Installation

Perform the base Commvault software installation as instructed in the Commvault installation documentation.

#### 3.2 Configuration Steps

After the base Commvault software installation process is complete, configure the following settings:

1. Set up a storage library for streaming backup data.
2. Set up NetApp storage virtual machines (SVMs) for NetApp Snapshot copy management.
3. Set up a storage policy.
4. Set up agents on the client systems.

The rest of this section provides details about each of these settings.

**Set Up a Storage Library for Streaming Backup Data**

You must set up a Commvault disk storage library for streaming backup data. A disk library is a virtual library that is associated with one or more mount paths. In this solution, a volume in the NetApp storage system is mounted by using NFS to the SAP HANA host where the Commvault MediaAgent is installed. Streaming backup data is used for SAP HANA log backup, and full data backup is used as a database consistency check once per week.

**Set Up NetApp SVMs for Snapshot Copy Management**

For Commvault to communicate with a NetApp storage system, it must be able to communicate with the SVMs. For this purpose, the SVMs must be defined in Commvault Array Management, as shown in Figure 9. When you use NetApp SnapMirror or SnapVault technology, you must define both the primary and secondary arrays.

![Figure 9) Commvault Array Management.](image)

Figure 10 shows the end result after you have defined the NetApp systems in Commvault.

![Figure 10) Commvault Array Management completed.](image)
Set Up a Storage Policy

To set up and configure a storage policy, you must define a data protection strategy as described in section 3.3, Data Protection Strategy.

For Snapshot copy-based backups, use either of the following options to configure replication of Snapshot copy-based backups on NetApp storage systems:

- **NetApp OnCommand® Unified Manager**: When you use OnCommand Unified Manager, it creates and manages the SnapMirror or SnapVault relationships for you after you define the provision pools and the replication target of the source SVM. Within provision pools, aggregates are defined, which can be used for automatic provisioning of volumes—in this case, for volumes that are used as the replication target.
  - To use this option, specify the OnCommand Unified Manager server name or IP address when you create the storage policy.

- **Open Systems data protection**: In the storage policy, enter the NetApp SVM host name or IP address + user name and password directly.
  
  **Note:** This option requires you to manually manage the SnapMirror or SnapVault relationships. For details, see the Commvault documentation.

For details, see the Commvault documentation.

Set Up Agents on the Client Systems

This setting is a two-step process:

1. Push the Commvault software to the client system.
2. Define the SAP HANA instance by creating a pseudo client.

After you complete these steps, configure the Commvault SAP on HANA agent as described in the Commvault SAP HANA Best Practices Guide.

3.3 Data Protection Strategy

Before you configure a Commvault storage policy to back up SAP HANA systems, you must define the data protection strategy based on the RTO and RPO requirements of the various SAP systems.

A common approach is to define system types such as production, development, test, or sandbox systems. All SAP systems of the same system type typically have the same data protection parameters.

The parameters that you must define are as follows:

- How often should a Snapshot copy backup be executed?
- How long should Snapshot copy backups be kept on the primary storage system?
- How often should a block integrity check be executed?
- Should the primary backups be replicated to an off-site backup location?
- How long should the backups be kept at the off-site backup storage?

Table 1 shows an example of data protection parameters for the system types of production, development, and test. For the production and development systems, a high backup frequency has been defined, and the backups are replicated to an off-site backup location once per day. The test systems have lower requirements and no replication of the backups.
Table 1) Data protection parameters.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Production Systems</th>
<th>Development Systems</th>
<th>Test Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup frequency</td>
<td>Every 4 hours</td>
<td>Every 4 hours</td>
<td>Every 4 hours</td>
</tr>
<tr>
<td>Primary retention</td>
<td>2 days</td>
<td>2 days</td>
<td>2 days</td>
</tr>
<tr>
<td>Block integrity check</td>
<td>Once per week</td>
<td>Once per week</td>
<td>No</td>
</tr>
<tr>
<td>Replication to off-site backup site</td>
<td>Once per day</td>
<td>Once per day</td>
<td>No</td>
</tr>
<tr>
<td>Off-site backup retention</td>
<td>2 weeks</td>
<td>2 weeks</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2 shows the policies that must be configured for the data protection parameters.

Table 2) Policies based on data protection parameters.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Policy LocalSnap</th>
<th>Policy LocalSnapAndSnapVault</th>
<th>Policy Streaming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backup type</td>
<td>Snapshot copy-based</td>
<td>Snapshot copy-based</td>
<td>File-based</td>
</tr>
<tr>
<td>Schedule frequency</td>
<td>Hourly</td>
<td>Daily</td>
<td>Weekly</td>
</tr>
<tr>
<td>Primary retention</td>
<td>Count = 12</td>
<td>Count = 2</td>
<td>Count = 1</td>
</tr>
<tr>
<td>SnapVault replication</td>
<td>No</td>
<td>Yes</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The policy LocalSnap is used for the production, development, and test systems to cover the local Snapshot copy backups with a retention of 2 days.

In the resource configuration, the schedule is defined for the system types:

- Production: Schedule every 4 hours.
- Development: Schedule every 4 hours.
- Test: Schedule every 4 hours.

The policy LocalSnapAndSnapVault is used for the production and development systems to cover the daily replication to the off-site backup storage.

In the resource configuration, the schedule is defined for production and development:

- Production: Schedule every day.
- Development: Schedule every day.

The policy Streaming is used for the production and development systems to cover the weekly block integrity check by using a file-based backup.

In the resource configuration, the schedule is defined for production and development:

- Production: Schedule every week.
- Development: Schedule every week.

For each individual SAP HANA database that uses the off-site backup policy, a protection relationship must be configured on the storage layer. The protection relationship defines which volumes are replicated and the retention of backups at the off-site backup storage.

With our example, for each production and development system, a retention of 2 weeks is defined at the off-site backup storage.
Note: In our example, protection policies and retention for SAP HANA database resources and nondata volume resources are not different.

### 3.4 Backup Retention Management and Housekeeping of Log Backups

In Commvault, data retention is managed through storage policies that define where a backup is stored and for how long, as shown in the example in Figure 11. This procedure can handle Snapshot copy, SnapVault, and streaming-based backups in the same way. The deletion of expired backups is a fully automated background process.

Figure 11) Storage policy example.

#### 4 Conclusion

The NetApp and Commvault backup solution for SAP HANA is changing today’s backup and recovery landscape. Commvault IntelliSnap software together with NetApp storage software combines simplified manageability, power, and flexibility for the SAP HANA landscape, including virtual environments. Commvault IntelliSnap for NetApp integrates with NetApp Snapshot technology in a virtually seamless way for fast and efficient backup operations. It also integrates with NetApp SnapVault and SnapMirror software to support content cataloging and data movement to tape-based media.

Commvault IntelliSnap for NetApp offers single-interface management for backup and recovery workflows for NetApp ONTAP and much more. Because it centralizes all these functions and offers policy-based management and granular recovery across all supported workloads, Commvault IntelliSnap for NetApp is a compelling enterprise backup and recovery solution.

#### Where to Find Additional Information

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

- TR-4018: Integrating NetApp ONTAP Systems with SAP Landscape Management  
- TR-4646: SAP HANA Disaster Recovery with Asynchronous Storage Replication  
- NetApp Product Documentation
  http://docs.netapp.com
- Commvault General Documentation
- Commvault Best Practices for Protecting SAP HANA
- SAP Support Portal

**Version History**

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Document Version History</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1.0</td>
<td>August 2018</td>
<td>Initial release.</td>
</tr>
</tbody>
</table>
Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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