



# **NDMP for FlexVol volumes**

## **ONTAP 9**

NetApp  
July 21, 2023

# Table of Contents

- NDMP for FlexVol volumes ..... 1
  - About NDMP for FlexVol volumes ..... 1
  - About NDMP modes of operation ..... 1
  - Considerations when using NDMP ..... 2
  - Environment variable ..... 3
  - Common NDMP tape backup topologies ..... 20
  - Supported NDMP authentication methods ..... 20
  - NDMP extensions supported by ONTAP ..... 21
  - NDMP restartable backup extension for a dump supported by ONTAP ..... 21
  - What enhanced DAR functionality is ..... 21
  - Scalability limits for NDMP sessions ..... 21

# NDMP for FlexVol volumes

## About NDMP for FlexVol volumes

The Network Data Management Protocol (NDMP) is a standardized protocol for controlling backup, recovery, and other types of data transfer between primary and secondary storage devices, such as storage systems and tape libraries.

By enabling NDMP support on a storage system, you enable that storage system to communicate with NDMP-enabled network-attached backup applications (also called *Data Management Applications* or *DMAs*), data servers, and tape servers participating in backup or recovery operations. All network communications occur over TCPIP or TCP/IPv6 network. NDMP also provides low-level control of tape drives and medium changers.

You can perform tape backup and restore operations in either node-scoped NDMP mode or storage virtual machine (SVM) scoped NDMP mode.

You must be aware of the considerations that you have to take into account while using NDMP, list of environment variables, and supported NDMP tape backup topologies. You can also enable or disable the enhanced DAR functionality. The two authentication methods supported by ONTAP for authenticating NDMP access to a storage system are: plaintext and challenge.

### Related information

[Environment variables supported by ONTAP](#)

## About NDMP modes of operation

You can choose to perform tape backup and restore operations either at the node level as you have been doing until now or at the storage virtual machine (SVM) level. To perform these operations successfully at the SVM level, NDMP service must be enabled on the SVM.

If you upgrade from Data ONTAP 8.2 to Data ONTAP 8.3, the NDMP mode of operation used in 8.2 will continue to be retained post the upgrade from 8.2 to 8.3.

If you install a new cluster with Data ONTAP 8.2 or later, NDMP is in the SVM-scoped NDMP mode by default. To perform tape backup and restore operations in the node-scoped NDMP mode, you must explicitly enable the node-scoped NDMP mode.

### Related information

[Commands for managing node-scoped NDMP mode](#)

[Managing node-scoped NDMP mode for FlexVol volumes](#)

[Managing SVM-scoped NDMP mode for FlexVol volumes](#)

## What node-scoped NDMP mode is

In the node-scoped NDMP mode, you can perform tape backup and restore operations at the node level. The NDMP mode of operation used in Data ONTAP 8.2 will continue to be retained post the upgrade from 8.2 to 8.3.

In the node-scoped NDMP mode, you can perform tape backup and restore operations on a node that owns the volume. To perform these operations, you must establish NDMP control connections on a LIF hosted on the node that owns the volume or tape devices.



This mode is deprecated and will be removed in a future major release.

#### Related information

[Managing node-scoped NDMP mode for FlexVol volumes](#)

## What SVM-scoped NDMP mode is

You can perform tape backup and restore operations at the storage virtual machine (SVM) level successfully if the NDMP service is enabled on the SVM. You can back up and restore all volumes hosted across different nodes in the SVM of a cluster if the backup application supports the CAB extension.

An NDMP control connection can be established on different LIF types. In the SVM-scoped NDMP mode, these LIFs belong to either the data SVM or admin SVM. The connection can be established on a LIF only if the NDMP service is enabled on the SVM that owns this LIF.

A data LIF belongs to the data SVM and the intercluster LIF, node-management LIF, and cluster-management LIF belong to the admin SVM.

In the SVM-scoped NDMP mode, the availability of volumes and tape devices for backup and restore operations depends on the LIF type on which the NDMP control connection is established and the status of the CAB extension. If your backup application supports the CAB extension and a volume and the tape device share the same affinity, then the backup application can perform a local backup or restore operation, instead of a three-way backup or restore operation.

#### Related information

[Managing SVM-scoped NDMP mode for FlexVol volumes](#)

## Considerations when using NDMP

You must take into account a number of considerations when starting the NDMP service on your storage system.

- Each node supports a maximum of 16 concurrent backups, restores, or combination of the two using connected tape drives.
- NDMP services can generate file history data at the request of NDMP backup applications.

File history is used by backup applications to enable optimized recovery of selected subsets of data from a backup image. File history generation and processing might be time-consuming and CPU-intensive for both the storage system and the backup application.



SM Tape does not support file history.

If your data protection is configured for disaster recovery—where the entire backup image will be recovered—you can disable file history generation to reduce backup time. See your backup application documentation to determine whether it is possible to disable NDMP file history generation.

- Firewall policy for NDMP is enabled by default on all LIF types.
- In node-scoped NDMP mode, backing up a FlexVol volume requires that you use the backup application to initiate a backup on a node that owns the volume.

However, you cannot back up a node root volume.

- You can perform NDMP backup from any LIF as permitted by the firewall policies.

If you use a data LIF, you must select a LIF that is not configured for failover. If a data LIF fails over during an NDMP operation, the NDMP operation fails and must be run again.

- In node-scoped NDMP mode and storage virtual machine (SVM) scoped NDMP mode with no CAB extension support, the NDMP data connection uses the same LIF as the NDMP control connection.
- During LIF migration, ongoing backup and restore operations are disrupted.

You must initiate the backup and restore operations after the LIF migration.

- The NDMP backup path is of the format `/vserver_name/volume_name/path_name`.

*path\_name* is optional, and specifies the path of the directory, file, or Snapshot copy.

- When a SnapMirror destination is backed up to tape by using the dump engine, only the data in the volume is backed up.

However, if a SnapMirror destination is backed up to tape using SMTape, then the metadata is also backed up. The SnapMirror relationships and the associated metadata are not backed up to tape. Therefore, during restore, only the data on that volume is restored, but the associated SnapMirror relationships are not restored.

## Related information

[What Cluster Aware Backup extension does](#)

[ONTAP concepts](#)

[System administration](#)

# Environment variable

## Environment variables overview

Environment variables are used to communicate information about a backup or restore operation between an NDMP-enabled backup application and a storage system.

For example, if a user specifies that a backup application should back up `/vserver1/vol1/dir1`, the backup application sets the FILESYSTEM environment variable to `/vserver1/vol1/dir1`. Similarly, if a user specifies that a backup should be a level 1 backup, the backup application sets the LEVEL environment variable to 1 (one).



The setting and examining of environment variables are typically transparent to backup administrators; that is, the backup application sets them automatically.

A backup administrator rarely specifies environment variables; however, you might want to change the value of an environment variable from that set by the backup application to characterize or work around a functional or performance problem. For example, an administrator might want to temporarily disable file history generation to determine if the backup application's processing of file history information is contributing to performance issues or functional problems.

Many backup applications provide a means to override or modify environment variables or to specify additional environment variables. For information, see your backup application documentation.

### Environment variables supported by ONTAP

Environment variables are used to communicate information about a backup or restore operation between an NDMP-enabled backup application and a storage system. ONTAP supports environment variables, which have an associated default value. However, you can manually modify these default values.

If you manually modify the values set by the backup application, the application might behave unpredictably. This is because the backup or restore operations might not be doing what the backup application expected them to do. But in some cases, judicious modification might help in identifying or working around problems.

The following tables list the environment variables whose behavior is common to dump and SMTape and those variables that are supported only for dump and SMTape. These tables also contain descriptions of how the environment variables that are supported by ONTAP work if they are used:



In most cases, variables that have the value, Y also accept T and N also accept F.

#### Environment variables supported for dump and SMTape

Environment variable	Valid values	Default	Description
DEBUG	Y or N	N	Specifies that debugging information is printed.
FILESYSTEM	string	none	Specifies the path name of the root of the data that is being backed up.

Environment variable	Valid values	Default	Description
NDMP_VERSION	return_only	none	<p>You should not modify the NDMP_VERSION variable. Created by the backup operation, the NDMP_VERSION variable returns the NDMP version.</p> <p>ONTAP sets the NDMP_VERSION variable during a backup for internal use and to pass to a backup application for informational purposes. The NDMP version of an NDMP session is not set with this variable.</p>
PATHNAME_SEPARATOR	return_value	none	<p>Specifies the path name separator character.</p> <p>This character depends on the file system being backed up. For ONTAP, the character "/" is assigned to this variable. The NDMP server sets this variable before starting a tape backup operation.</p>
TYPE	dump or smtape	dump	Specifies the type of backup supported to perform tape backup and restore operations.
VERBOSE	Y or N	N	Increases the log messages while performing a tape backup or restore operation.

#### Environment variables supported for dump

Environment variable	Valid values	Default	Description
ACL_START	return_only	none	<p>Created by the backup operation, the ACL_START variable is an offset value used by a direct access restore or restartable NDMP backup operation.</p> <p>The offset value is the byte offset in the dump file where the ACL data (Pass V) begins and is returned at the end of a backup. For a direct access restore operation to correctly restore backed-up data, the ACL_START value must be passed to the restore operation when it begins. An NDMP restartable backup operation uses the ACL_START value to communicate to the backup application where the nonrestartable portion of the backup stream begins.</p>
BASE_DATE	0, -1, or DUMP_DATE value	-1	<p>Specifies the start date for incremental backups.</p> <p>When set to -1, the BASE_DATE incremental specifier is disabled. When set to 0 on a level 0 backup, incremental backups are enabled. After the initial backup, the value of the DUMP_DATE variable from the previous incremental backup is assigned to the BASE_DATE variable.</p> <p>These variables are an alternative to the LEVEL/UPDATE based incremental backups.</p>



Environment variable	Valid values	Default	Description
DIRECT	Y or N	N	<p>Specifies that a restore should fast-forward directly to the location on the tape where the file data resides instead of scanning the entire tape.</p> <p>For direct access recovery to work, the backup application must provide positioning information. If this variable is set to Y, the backup application specifies the file or directory names and the positioning information.</p>
DMP_NAME	string	none	<p>Specifies the name for a multiple subtree backup.</p> <p>This variable is mandatory for multiple subtree backups.</p>
DUMP_DATE	return_value	none	<p>You do not change this variable directly. It is created by the backup if the BASE_DATE variable is set to a value other than -1.</p> <p>The DUMP_DATE variable is derived by prepending the 32-bit level value to a 32-bit time value computed by the dump software. The level is incremented from the last level value passed into the BASE_DATE variable. The resulting value is used as the BASE_DATE value on a subsequent incremental backup.</p>

Environment variable	Valid values	Default	Description
ENHANCED_DAR_ENABLED	Y or N	N	<p>Specifies whether enhanced DAR functionality is enabled. Enhanced DAR functionality supports directory DAR and DAR of files with NT Streams. It provides performance improvements.</p> <p>Enhanced DAR during restore is possible only if the following conditions are met:</p> <ul style="list-style-type: none"> <li>• ONTAP supports enhanced DAR.</li> <li>• File history is enabled (HIST=Y) during the backup.</li> <li>• The <code>ndmpd.offset_map.enable</code> option is set to on.</li> <li>• ENHANCED_DAR_ENABLED variable is set to Y during restore.</li> </ul>

Environment variable	Valid values	Default	Description
EXCLUDE	pattern_string	none	<p>Specifies files or directories that are excluded when backing up data.</p> <p>The exclude list is a comma-separated list of file or directory names. If the name of a file or directory matches one of the names in the list, it is excluded from the backup.</p> <p>The following rules apply while specifying names in the exclude list:</p> <ul style="list-style-type: none"> <li>• The exact name of the file or directory must be used.</li> <li>• The asterisk (*), a wildcard character, must be either the first or the last character of the string.</li> </ul> <p>Each string can have up to two asterisks.</p> <ul style="list-style-type: none"> <li>• A comma in a file or directory name must be preceded with a backslash.</li> <li>• The exclude list can contain up to 32 names.</li> </ul> <div>  <p>Files or directories specified to be excluded for backup are not excluded if you set NON_QUOTA_TREE to Y simultaneously.</p> </div>

Environment variable	Valid values	Default	Description
EXTRACT	Y, N, or E	N	<p>Specifies that subtrees of a backed-up data set are to be restored.</p> <p>The backup application specifies the names of the subtrees to be extracted. If a file specified matches a directory whose contents were backed up, the directory is recursively extracted.</p> <p>To rename a file, directory, or qtree during restore without using DAR, you must set the EXTRACT environment variable to E.</p>
EXTRACT_ACL	Y or N	Y	<p>Specifies that ACLs from the backed up file are restored on a restore operation.</p> <p>The default is to restore ACLs when restoring data, except for DARs (DIRECT=Y).</p>

Environment variable	Valid values	Default	Description
FORCE	Y or N	N	<p>Determines if the restore operation must check for volume space and inode availability on the destination volume.</p> <p>Setting this variable to Y causes the restore operation to skip checks for volume space and inode availability on the destination path.</p> <p>If enough volume space or inodes are not available on the destination volume, the restore operation recovers as much data allowed by the destination volume space and inode availability. The restore operation stops when volume space or inodes are not available.</p>
HIST	Y or N	N	<p>Specifies that file history information is sent to the backup application.</p> <p>Most commercial backup applications set the HIST variable to Y. If you want to increase the speed of a backup operation, or you want to troubleshoot a problem with the file history collection, you can set this variable to N.</p> <div>  <p>You should not set the HIST variable to Y if the backup application does not support file history.</p> </div>

Environment variable	Valid values	Default	Description
IGNORE_CTIME	Y or N	N	<p>Specifies that a file is not incrementally backed up if only its ctime value has changed since the previous incremental backup.</p> <p>Some applications, such as virus scanning software, change the ctime value of a file within the inode, even though the file or its attributes have not changed. As a result, an incremental backup might back up files that have not changed. The IGNORE_CTIME variable should be specified only if incremental backups are taking an unacceptable amount of time or space because the ctime value was modified.</p> <div>  <p>The NDMP dump command sets IGNORE_CTIME to false by default. Setting it to true can result in the following data loss:</p> <ol style="list-style-type: none"> <li>If IGNORE_CTIME is set to true with a volume level incremental ndmpcopy, it results in the deleting</li> </ol> </div>

Environment variable	Valid values	Default	Description
IGNORE_QTREES	Y or N	N	Specifies that the restore operation does not restore qtree information from backed-up qtrees.
LEVEL	0-31	0	<p>Specifies the backup level.</p> <p>Level 0 copies the entire data set. Incremental backup levels, specified by values above 0, copy all files (new or modified) since the last incremental backup. For example, a level 1 backs up new or modified files since the level 0 backup, a level 2 backs up new or modified files since the level 1 backup, and so on.</p>
LIST	Y or N	N	Lists the backed-up file names and inode numbers without actually restoring the data.
LIST_QTREES	Y or N	N	Lists the backed-up qtrees without actually restoring the data.
MULTI_SUBTREE_NAMES	string	none	<p>Specifies that the backup is a multiple subtree backup.</p> <p>Multiple subtrees are specified in the string, which is a newline-separated, null-terminated list of subtree names. Subtrees are specified by path names relative to their common root directory, which must be specified as the last element of the list.</p> <p>If you use this variable, you must also use the DMP_NAME variable.</p>

Environment variable	Valid values	Default	Description
NDMP_UNICODE_FH	Y or N	N	<p>Specifies that a Unicode name is included in addition to the NFS name of the file in the file history information.</p> <p>This option is not used by most backup applications and should not be set unless the backup application is designed to receive these additional file names. The HIST variable must also be set.</p>
NO_ACLS	Y or N	N	<p>Specifies that ACLs must not be copied when backing up data.</p>



Environment variable	Valid values	Default	Description
NON_QUOTA_TREE	Y or N	N	<p>Specifies that files and directories in qtrees must be ignored when backing up data.</p> <p>When set to Y, items in qtrees in the data set specified by the FILESYSTEM variable are not backed up. This variable has an effect only if the FILESYSTEM variable specifies an entire volume. The NON_QUOTA_TREE variable only works on a level 0 backup and does not work if the MULTI_SUBTREE_NAMES variable is specified.</p> <div>  <p>Files or directories specified to be excluded for backup are not excluded if you set NON_QUOTA_TREE to Y simultaneously.</p> </div>
NOWRITE	Y or N	N	<p>Specifies that the restore operation must not write data to the disk.</p> <p>This variable is used for debugging.</p>

Environment variable	Valid values	Default	Description
RECURSIVE	Y or N	Y	<p>Specifies that directory entries during a DAR restore be expanded.</p> <p>The DIRECT and ENHANCED_DAR_ENABLED environment variables must be enabled (set to Y) as well. If the RECURSIVE variable is disabled (set to N), only the permissions and ACLs for all the directories in the original source path are restored from tape, not the contents of the directories. If the RECURSIVE variable is set to N or the RECOVER_FULL_PATHS variable is set to Y, the recovery path must end with the original path.</p> <div>  <p>If the RECURSIVE variable is disabled and if there is more than one recovery path, all of the recovery paths must be contained within the longest of the recovery paths. Otherwise, an error message is displayed.</p> </div> <p>For example, the following are valid recovery paths because all of the recovery paths are within foo/dir1/deepdir/my file:</p>

Environment variable	Valid values	Default	Description
RECOVER_FULL_PATHS	Y or N	N	<p>Specifies that the full recovery path will have their permissions and ACLs restored after the DAR.</p> <p>DIRECT and ENHANCED_DAR_ENABLED must be enabled (set to Y) as well. If RECOVER_FULL_PATHS is set to Y, the recovery path must end with the original path. If directories already exist on the destination volume, their permissions and ACLs will not be restored from tape.</p>
UPDATE	Y or N	Y	Updates the metadata information to enable LEVEL based incremental backup.

#### Environment variables supported for SMTape

Environment variable	Valid values	Default	Description
BASE_DATE	DUMP_DATE	-1	<p>Specifies the start date for incremental backups.</p> <p>BASE_DATE is a string representation of the reference Snapshot identifiers. Using the BASE_DATE string, SMTape locates the reference Snapshot copy.</p> <p>BASE_DATE is not required for baseline backups. For an incremental backup, the value of the DUMP_DATE variable from the previous baseline or incremental backup is assigned to the BASE_DATE variable.</p> <p>The backup application assigns the DUMP_DATE value from a previous SMTape baseline or incremental backup.</p>
DUMP_DATE	return_value	none	<p>At the end of an SMTape backup, DUMP_DATE contains a string identifier that identifies the Snapshot copy used for that backup. This Snapshot copy could be used as the reference Snapshot copy for a subsequent incremental backup.</p> <p>The resulting value of DUMP_DATE is used as the BASE_DATE value for subsequent incremental backups.</p>

Environment variable	Valid values	Default	Description
SMTAPE_BACKUP_SET_ID	string	none	<p>Identifies the sequence of incremental backups associated with the baseline backup.</p> <p>Backup set ID is a 128-bit unique ID that is generated during a baseline backup. The backup application assigns this ID as the input to the SMTAPE_BACKUP_SET_ID variable during an incremental backup.</p>
SMTAPE_SNAPSHOT_NAME	Any valid Snapshot copy that is available in the volume	Invalid	<p>When the SMTAPE_SNAPSHOT_NAME variable is set to a Snapshot copy, that Snapshot copy and its older Snapshot copies are backed up to tape.</p> <p>For incremental backup, this variable specifies incremental Snapshot copy. The BASE_DATE variable provides the baseline Snapshot copy.</p>
SMTAPE_DELETE_SNAPSHOT	Y or N	N	<p>For a Snapshot copy created automatically by SMTape, when the SMTAPE_DELETE_SNAPSHOT variable is set to Y, then after the backup operation is complete, SMTape deletes this Snapshot copy. However, a Snapshot copy created by the backup application will not be deleted.</p>
SMTAPE_BREAK_MIRROR	Y or N	N	<p>When the SMTAPE_BREAK_MIRROR variable is set to Y, the volume of type DP is changed to a RW volume after a successful restore.</p>

# Common NDMP tape backup topologies

NDMP supports a number of topologies and configurations between backup applications and storage systems or other NDMP servers providing data (file systems) and tape services.

## Storage system-to-local-tape

In the simplest configuration, a backup application backs up data from a storage system to a tape subsystem attached to the storage system. The NDMP control connection exists across the network boundary. The NDMP data connection that exists within the storage system between the data and tape services is called an NDMP local configuration.

## Storage system-to-tape attached to another storage system

A backup application can also back up data from a storage system to a tape library (a medium changer with one or more tape drives) attached to another storage system. In this case, the NDMP data connection between the data and tape services is provided by a TCP or TCP/IPv6 network connection. This is called an NDMP three-way storage system-to-storage system configuration.

## Storage system-to-network-attached tape library

NDMP-enabled tape libraries provide a variation of the three-way configuration. In this case, the tape library attaches directly to the TCP/IP network and communicates with the backup application and the storage system through an internal NDMP server.

## Storage system-to-data server-to-tape or data server-to-storage system-to-tape

NDMP also supports storage system-to-data-server and data-server-to-storage system three-way configurations, although these variants are less widely deployed. Storage system-to-server allows storage system data to be backed up to a tape library attached to the backup application host or to another data server system. The server-to-storage system configuration allows server data to be backed up to a storage system-attached tape library.

# Supported NDMP authentication methods

You can specify an authentication method to allow NDMP connection requests. ONTAP supports two methods for authenticating NDMP access to a storage system: plaintext and challenge.

In node-scoped NDMP mode, both challenge and plaintext are enabled by default. However, you cannot disable challenge. You can enable and disable plaintext. In the plaintext authentication method, the login password is transmitted as clear text.

In the storage virtual machine (SVM)-scoped NDMP mode, by default the authentication method is challenge. Unlike the node-scoped NDMP mode, in this mode you can enable and disable both plaintext and challenge authentication methods.

## Related information

[User authentication in a node-scoped NDMP mode](#)

## NDMP extensions supported by ONTAP

NDMP v4 provides a mechanism for creating NDMP v4 protocol extensions without modifying the core NDMP v4 protocol. You should be aware of the NDMP v4 extensions that are supported by ONTAP.

The following NDMP v4 extensions are supported by ONTAP:

- Cluster Aware Backup (CAB)



This extension is supported only in the SVM-scoped NDMP mode.

- Connection Address Extension (CAE) for IPv6 support
- Extension class 0x2050

This extension supports restartable backup operations and Snapshot Management Extensions.



The `NDMP_SNAP_RECOVER` message, which is part of the Snapshot Management Extensions, is used to initiate a recovery operation and to transfer the recovered data from a local Snapshot copy to a local file system location. In ONTAP, this message allows the recovery of volumes and regular files only.

The `NDMP_SNAP_DIR_LIST` message enables you to browse through the Snapshot copies of a volume. If a nondisruptive operation takes place while a browsing operation is in progress, the backup application must reinitiate the browsing operation.

## NDMP restartable backup extension for a dump supported by ONTAP

You can use the NDMP restartable backup extension (RBE) functionality to restart a backup from a known checkpoint in the data stream before the failure.

## What enhanced DAR functionality is

You can use the enhanced direct access recovery (DAR) functionality for directory DAR and DAR of files and NT streams. By default, enhanced DAR functionality is enabled.

Enabling enhanced DAR functionality might impact the backup performance because an offset map has to be created and written onto tape. You can enable or disable enhanced DAR in both the node-scoped and storage virtual machine (SVM)-scoped NDMP modes.

## Scalability limits for NDMP sessions

You must be aware of the maximum number of NDMP sessions that can be established simultaneously on storage systems of different system memory capacities. This maximum

number depends on the system memory of a storage system.

The limits mentioned in the following table are for the NDMP server. The limits mentioned in the section “Scalability limits for dump backup and restore sessions” are for the dump and restore session.

#### Scalability limits for dump backup and restore sessions

System memory of a storage system	Maximum number of NDMP sessions
Less than 16 GB	8
Greater than or equal to 16 GB but less than 24 GB	20
Greater than or equal to 24 GB	36

You can obtain the system memory of your storage system by using the `sysconfig -a` command (available through the nodeshell). For more information about using this command, see the man pages.



## Copyright information

Copyright © 2023 NetApp, Inc. All Rights Reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP “AS IS” AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

LIMITED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (b)(3) of the Rights in Technical Data -Noncommercial Items at DFARS 252.227-7013 (FEB 2014) and FAR 52.227-19 (DEC 2007).

Data contained herein pertains to a commercial product and/or commercial service (as defined in FAR 2.101) and is proprietary to NetApp, Inc. All NetApp technical data and computer software provided under this Agreement is commercial in nature and developed solely at private expense. The U.S. Government has a non-exclusive, non-transferrable, nonsublicensable, worldwide, limited irrevocable license to use the Data only in connection with and in support of the U.S. Government contract under which the Data was delivered. Except as provided herein, the Data may not be used, disclosed, reproduced, modified, performed, or displayed without the prior written approval of NetApp, Inc. United States Government license rights for the Department of Defense are limited to those rights identified in DFARS clause 252.227-7015(b) (FEB 2014).

## Trademark information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.