



Technical Report

Domino Backup and Restore Solutions Using NetApp Technology

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NETAPP SOLUTIONS FOR LOTUS DOMINO

Backup and restore for Domino databases can be a very time- and resource-consuming operation. Storage technology innovations such as NetApp[®] Snapshot[®] copies have simplified Domino backup and restore operations. This technical report discusses the different solutions offered by NetApp to back up and restore Lotus Domino software using a NetApp storage system.

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1 EXECUTIVE SUMMARY

This technical report addresses the three most common methods of backing up and restoring Domino data on NetApp storage. SnapManager[®] for Domino (SMD) is the best solution for customers running Domino on Microsoft[®] Windows[®] due to advanced API integration, but there are additional requirements to using SMD. NetApp Snap Creator Framework and the Domino plug-in have superior integration with NetApp storage efficiencies and work with multiple operating systems. Finally, custom scripting is available for customers that have specific needs that cannot be met with other tools.

2 INTRODUCTION

Today, businesses have operations across the globe, and they are required to keep their mission-critical applications running 24x7. They also expect the application performance to be maintained during routine maintenance such as backup and recovery, regardless of the data growth rate, which can sometimes be very high. Since backup windows are shrinking and the amount of the data that needs to be backed up is ever increasing, it is a complex task to define a point in time at which a backup can be created with minimal impact on system performance and availability.

The following factors make traditional backup and recovery methods very challenging:

- **System performance impact.** Backup operations typically have a significant impact on the performance of a production system because they place a high load on the Domino or database server, the storage system, and the underlying network during the backup process.
- **Shrinking backup windows.** Enterprises expect maximum availability of their applications. Defining an appropriate window for creating backup images can present a challenge when the database needs to be accessible 24x7.
- **Rapid data growth.** Enterprise data is growing exponentially. That means longer windows are needed to backup the data. Organizations that can no longer afford an extended window for backups are forced to do heavy investment in the backup infrastructure to keep the backup window short. Growing databases also require more tape media or disk storage space for backup images. Incremental backups can address these issues, but longer restore times make them unacceptable.
- **Decreasing mean time to recover (MTTR).** The mean time to recover is the time needed to recover from a database failure. The MTTR can be divided in two parts: the time that is necessary to restore the database from a backup image and the time that is necessary to perform roll-forward recovery of the database. The roll-forward recovery time depends on the number of archive and active logs that need to be reapplied to the database after it has been restored.

NetApp Snapshot technology and SnapRestore[®] technology offer unique features to address the challenges presented by traditional backup and recovery methods.

2.1 REQUIREMENTS AND ASSUMPTIONS

This report assumes that the reader is familiar with the basic operations of Lotus Domino, the operation of the host operating system that Domino is installed on, and NetApp storage systems, including Data ONTAP[®]. It is also assumed that your Domino server is already configured and working with its data stored on NetApp volumes, meaning that all appropriate licenses are installed on your NetApp storage systems and all aggregates and volumes have already been created as needed. The following technical reports will help you set up your Domino environment on NetApp:

- [TR-3588: Integrating Lotus Domino 8.5 for Windows 2008 with a NetApp Storage System](#)
- [TR-3723: Deploying Lotus Domino 8.0.2 Server on AIX with NetApp](#)
- [TR-3691: Integrating Lotus Domino 7.0 for Linux with a NetApp Storage System](#)

2.2 PURPOSE AND SCOPE

This report describes how NetApp Snapshot technology and SnapRestore technology can be used to back up and restore a Lotus Domino server. Specifically, this report covers the following:

- Key advantages of NetApp Snapshot technology
- Choosing a solution to back up and restore your Domino environment
- Snapshot copies and Domino Compact
- Backup and restore using SnapManager for Domino
- Backup and restore using NetApp Snap Creator Framework and the Domino plug-in
- Backup and restore using custom scripting

3 NETAPP TECHNOLOGY

3.1 SNAPSHOT AND SNAPRESTORE TECHNOLOGY

The core of the NetApp approach to database backup and recovery is the use of Snapshot technology. NetApp Snapshot technology is a feature of the WAFL[®] (Write Anywhere File Layout) storage virtualization technology that is a part of Data ONTAP, the microkernel that ships with every NetApp storage system. A Snapshot copy is a locally retained point-in-time “frozen” image of a WAFL volume that provides easy access to old versions of files, directory hierarchies, or logical unit numbers (LUNs). The high performance of NetApp Snapshot copies makes them highly scalable. A Snapshot copy takes only a few seconds to create, regardless of the size of the volume or the level of activity on the NetApp storage system. After a Snapshot copy has been created, changes to data objects are reflected in updates to the current version of the objects, as if the Snapshot copy did not exist. Meanwhile, the Snapshot versions of the data remain completely stable. Therefore, Snapshot copies incur no performance overhead; users can comfortably store up to 255 Snapshot copies per WAFL volume, all of which can be accessible as read-only online versions of the data.

NetApp Snapshot technology can be used to create a backup of all your Domino databases in seconds. The time needed to create a Snapshot copy is independent of the size of the database because Snapshot technology does not move data blocks, Snapshot copies vastly improve the frequency and reliability of backups because they incur virtually no performance overhead and can be safely created while a database is up and running. Customers running Lotus Domino on a NetApp storage system typically create several Snapshot copies throughout the day.

NetApp Snapshot technology also provides key advantages for the database recovery operation. The NetApp SnapRestore feature of Data ONTAP provides a way to restore the entire database to the state it was in at the point in time when any available Snapshot copy was created. Because no copying of data is involved, an incredible amount of time is saved as the file system is returned to its earlier state. The restore process can be done in a few minutes, regardless of the size of the database. In addition, when low-impact Snapshot backups have been created frequently throughout the day, fewer transaction logs need to be reapplied as part of the recovery process, resulting in a dramatic reduction in recovery time.

3.2 KEY ADVANTAGES

Snapshot technology offers various features for Lotus Domino customers, including fast backup and restore, high availability and reliability, better performance, and maximum storage efficiency.

- **Fast backup.** A Snapshot copy of a database can be created in a matter of seconds, regardless of the size of the database or the level of activity on the NetApp storage system. This dramatically reduces the database backup window from hours to seconds and helps Domino administrators to schedule frequent low-impact database backups.
- **Quick recovery.** The Data ONTAP SnapRestore command restores an entire database in a matter of seconds from a Snapshot backup. Because no data copying is involved, a lot of time is saved when a database is returned to the state it was in at the time the Snapshot copy was created. Additionally, because Snapshot copies can be created quickly and a large number of Snapshot copies can be retained, the amount of time needed to perform a roll-forward recovery operation against a database is greatly reduced.
- **High availability.** Companies cannot tolerate scheduled downtime, nor can they afford extended periods of slow system response that is often caused by traditional database backup methods. Snapshot copies, in contrast, can be created in a matter of seconds without any impact on system response time. This makes sure of high availability and uninterrupted system response.
- **High reliability.** The RAID architecture used for NetApp storage systems is unique and provides greater reliability than direct-attached storage. If a RAID member disk fails, it is automatically reconstructed (using parity disk data) without any user intervention. NetApp supports single parity as well as double parity RAID. Double parity RAID, known as RAID-DP[®], is considered approximately 10,000 times more reliable than traditional RAID and is the default on NetApp storage systems. For more detail on RAID-DP, refer to [TR-3298: Double-Parity RAID for Enhanced Data Protection with RAID-DP](#).
- **Uninterrupted system response.** Because a Snapshot copy is just a “frozen” image of the file system at a specific point in time, the process of creating a database backup with a Snapshot copy does not require copying of data; therefore, it has virtually no impact on system response time.
- **Minimum storage required for backup images.** Two Snapshot copies created in sequence differ from one another by the blocks added or changed in the time interval between the two. This block-incremental behavior minimizes the amount of storage space consumed.
- **Storage savings with NetApp FlexClone.** NetApp FlexClone[®] is another feature that is based on Snapshot technology that can offer Domino customers enormous storage savings in test/dev and virtualized environments. Using FlexClone technology, customers can create a full database clone in a matter of minutes without requiring additional storage. For more on FlexClone, refer to [TR-3347: A Thorough Introduction to FlexClone Volumes](#).

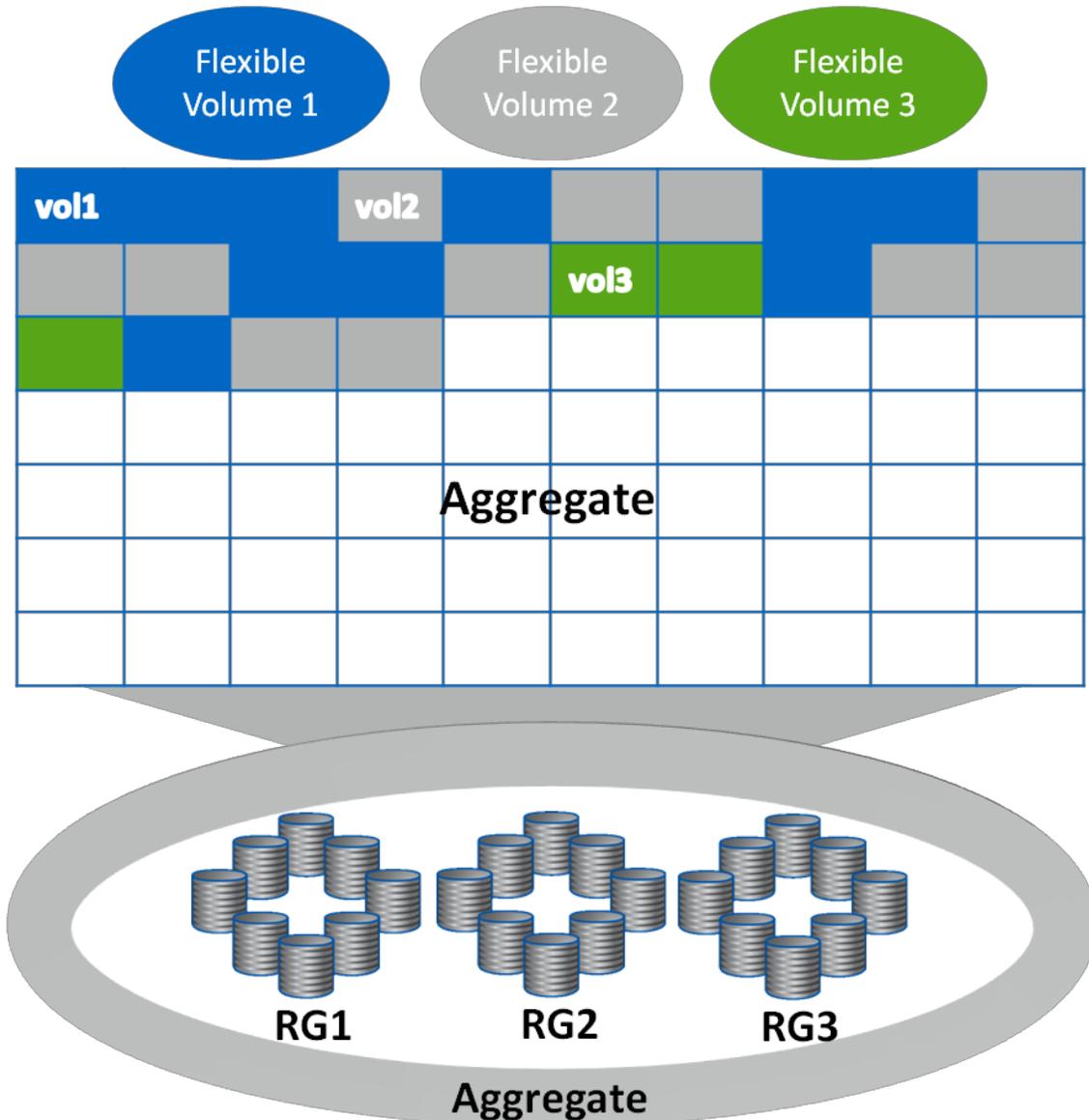
Snapshot backups are stored on the same NetApp storage system as the database. Therefore, NetApp recommends using Snapshot backups as a supplement, not a replacement, for backups to a second location, whether backing up to disk or to tape. Although backups to a second location are still necessary, there is only a slight probability that these backups will be needed for a restore and recovery. Most restore and recovery actions can be handled by using SnapRestore. Restores from a second location (disk or tape) are necessary only in situations where the primary storage system holding the Snapshot copies is damaged or there is a need to restore a database from a backup that is no longer available in the form of a Snapshot copy (for example, a two-month-old backup).

For further information on the Snapshot and SnapRestore features, visit the NOW™ (NetApp on the Web) Web site at now.netapp.com. Also see [WP-3002: File System Design for an NFS File Server Appliance](#) by Dave Hitz, James Lau, and Michael Malcolm and [Data Protection Online Backup and Recovery Guide](#).

3.3 STORAGE LAYERS

Data ONTAP 7G and later versions support aggregates, flexible volumes, and LUNs as logical storage layers. An aggregate is a RAID-level physical pool of storage and possesses its own RAID configuration, plex structure, and set of assigned disks. Within each aggregate, you can create one or more flexible volumes, which are the logical file systems that share the physical storage resources, RAID configuration, and plex structure of that common containing aggregate. Figure 1 illustrates the logical relationship aggregate, volume, and disk.

Figure 1) The logical relationship between aggregate, volumes, and disks.



An aggregate can be created by executing the following command on a NetApp storage system:

```
aggr create [AggrName] -f -t [raid4 | raid_dp] -r [RaidSize] [nDisk]@[DiskSize] | -d <disk1, disk2,...,diskn>
```

Where:

- `AggrName` identifies the name assigned to the aggregate.
- `RaidSize` identifies the size of the RAID group that will be created by the command implicitly.
- `nDisk` identifies the number of disks for the aggregate.
- `DiskSize` identifies the size of the disks used for the aggregate.

Note: Parameters shown in angle brackets (< >) are optional; parameters or options shown in square brackets ([]) are required and must be provided; a comma followed by ellipses (...) indicates that the preceding parameter can be repeated multiple times.

For example, to create an aggregate named `dbaggr1` that has 10 disks, each 300GB in size, you would execute the following command on the NetApp storage system:

```
aggr create dbaggr1 -f -t raid_dp -r 10 10@300
```

A FlexVol[®] volume, also known as a flexible volume, is a logical storage container. A FlexVol volume resides inside an aggregate and delivers high performance by using all disk spindles available to the aggregate. A FlexVol volume can be as small as a few megabytes and as large as the aggregate itself.

A FlexVol volume can be created by executing the following command on a NetApp storage system:

```
vol create [VolName] [AggrName] [VolSize]
```

Where:

- `VolName` identifies the name of the FlexVol volume.
- `AggrName` identifies the name of the aggregate.
- `VolSize` identifies the size of the volume in terms of MB, GB, TB, and so on.

For example, to create a FlexVol volume named `dbdata` that is 10GB in size and resides in an aggregate named `dbaggr1`, execute the following command on the NetApp storage system:

```
vol create dbdata dbaggr1 10G
```

One or more LUNs can be created within a volume. LUNs are used to map NetApp storage in SAN environments. A LUN is created by executing the following command on a NetApp storage system:

```
lun create -s [LunSize] -t [OSType] [LunPath]
```

Where:

- `LunSize` identifies the size of the LUN.
- `OSType` identifies the type of operating system the LUN is created for.
- `LunPath` identifies the path for LUN.

For example, to create a LUN named `/vol/dbdata/lun1` that is 50GB in size and resides in a FlexVol volume named `dbdata`, execute the following command on the NetApp storage system:

```
lun create -s 50G -t linux /vol/dbdata/lun1
```

It is important to note that the LUN created in the example above will be accessed by a Linux[®] host.

4 CHOOSING A SOLUTION FOR DOMINO WITH NETAPP

Choosing which solution to deploy in your Domino environment is driven by your business requirements and your choice of host operating system. Customers deploying Domino on NetApp have three backup and restore solutions to choose from:

- SnapManager for Domino
- NetApp Snap Creator Framework
- Custom scripts

For deployments based on Windows, SnapManager for Domino (SMD) is the preferred solution. SMD has integration with the Domino APIs to make sure of application consistency and is available for Microsoft Windows 2003 or 2008 server. SnapManager for Domino has additional requirements that are discussed in detail in section 7.

NetApp Snap Creator Framework is a flexible framework that has a built-in Domino plug-in. It offers advanced-level backup, restore, replication, cloning, and deep integration with NetApp products and is available for most popular operating systems. Snap Creator is discussed in detail in section 8.

Customers can also write custom scripts to take advantage of NetApp Snapshot technology for Domino server backup and restore. Section 9 of this report elaborates on a custom scripting approach.

Table 1) Choosing a NetApp solution for your Domino environment.

Solution	Windows	Linux	AIX	Solaris	Other	Notes
SnapManager for Domino	X					Domino API Integration requires Domino transaction logs in archive style
NetApp Snap Creator Framework	X	X	X	X		Superior integration with NetApp products and storage efficiencies
Custom scripting	X	X	X	X	X	Full customization requires the most work and testing

5 SNAPSHOT TECHNOLOGY FOR DOMINO DATABASES

Snapshot technology is a function of the storage system and can be used to create a Snapshot copy while I/O operations are occurring. NetApp recommends creating a Snapshot copy after pausing I/O operation momentarily or making sure of application consistency for the Domino database. Domino APIs allow pausing I/O to disk to achieve application consistency. SnapManager for Domino utilizes the Domino APIs for application consistency. Customers using other solutions, such as NetApp Snap Creator Framework and the Domino plug-in or custom scripting, might want to stop the Domino server before creating a Snapshot copy to make sure of application consistency. Since stopping Domino affects availability, you will likely want to do this only during off-peak hours or weekly maintenance window.

Customers can create a balance between consistency and availability by creating multiple Snapshot copies during the day while the Domino server is running, and creating nightly and weekly Snapshot copies during the evening maintenance window while the Domino server is stopped. This scenario works well for many customers and provides an excellent balance of availability and consistency for your Domino environment. This solution can be customized using NetApp Snap Creator Framework or scripted as shown in Appendix 10.4, "Sample Scripts."

For further information on Snapshot technology, refer to the [Data ONTAP 7.3 Data Protection Online Backup and Recovery Guide](#).

Note: In order to get access to NetApp Data ONTAP manuals and reference guides, you need a username and password, which can be easily obtained at no charge by registering on the NetApp Web site at now.netapp.com.

6 DOMINO COMPACT BEST PRACTICES FOR NETAPP ENVIRONMENT

6.1 LOTUS DOMINO COMPACT OVERVIEW

Lotus Domino contains several server tasks, including one for database compaction, or Compact. When documents and attachments are deleted from databases, Lotus Domino tries to reuse the unused space rather than reducing the size of the file on disk. Compact reorganizes the disk usage by each database in order to free up unused space.

The Compact task can be invoked with the following command:

```
load compact [database] - [optional switches]
```

Where:

- `database` is the full name of the database that you want to compact. You can also run the command against a directory with the Domino data folder.
- `optional switches` is one or more of the switches used to control Compact. A full list of these switches can be found in [Domino Compact Switches](#). If no switch is used, then the default behavior of Compact is determined by whether transactional logging is enabled or disabled. This is detailed in the three styles of Compact that follow.

Executing the following command on your Domino console will run Compact against all databases in the mail subdirectory using the switches `-b` and `-S 10`. Additional information about these switches can be found in [Domino Compact Switches](#).

```
load compact mail\ -b -S 10
```

There are three styles of compacting:

- In-place compacting with space recovery
- In-place compacting with space recovery and reduction in file size
- Copy-style compacting

IN-PLACE COMPACTING WITH SPACE RECOVERY

This style of compacting recovers unused space in a database but doesn't reduce the size of the database on disk. Databases retain the same database instance IDs (DBIIDs), so the relationship between the compacted databases and the transaction log remains intact. Users and servers can continue to access and edit databases during compacting.

When you run Compact without specifying options, Domino uses this style of compacting on all databases enabled for transaction logging. Domino also uses this style of compacting when you use the `-b` option (case sensitive) to compact any databases.

IN-PLACE COMPACTING WITH SPACE RECOVERY AND REDUCTION IN FILE SIZE

This style of compacting reduces the file size of databases as well as recovers unused space in databases. This style of compacting is somewhat slower than in-place compacting with space recovery only. This style of compacting assigns new DBIIDs to databases, so if you use this on databases with transactional logging enabled, you should perform full backups of the databases shortly after compacting is complete. This style of compacting allows users and servers to continue to access and edit databases during compacting.

When you run Compact without specifying options, Domino uses this style of compacting on databases that aren't enabled for transactional logging. Domino also uses this style of compacting when you use the `-B` option.

COPY-STYLE COMPACTING

Copy-style compacting creates copies of databases and then deletes the original databases after compacting completes, so extra disk space is required to make the database copies. This style of compacting creates a new database with a new database ID. If you use copy-style compacting on databases with transactional logging enabled as part of the database compaction process, then a new DBIID will be assigned. As a result, you should perform full backups of your databases shortly after compacting completes. When you use copy-style compacting, users and servers can't edit databases during compacting, and they can only read databases if the `-L` option is used.

When you use an option with Compact to enable a database property that requires a structural change to a database or when a structural change is pending, Domino uses copy-style compacting. Examples of pending structural changes are enabling or disabling the database properties "Document table bitmap optimization" and "Don't support specialized response hierarchy."

Table 2) The three styles of Domino Compact.

Characteristics	In-Place Space Recovery	In-Place Space Recovery with File Size Reduction	Copy Style
Databases that use it when Compact runs without options	Logged databases with no pending structural changes	Unlogged databases with no pending structural changes	Databases with pending structural changes
Databases you can use it on	Current release	Current release	Current release (need <code>-c</code>)
Relative speed	Fastest	Medium	Slowest
Users can read databases during compacting	Yes	Yes	No (unless <code>-L</code> option is used)
Users can edit databases during compacting	Yes	Yes	No
Reduction in file size	No	Yes	Yes
Extra disk space required	No	No	Yes

In addition to reducing file size, Compact is also used to:

- Enable or disable specific database properties
- Run the document archiving tool on server databases configured for document deletion and archiving
- Fix up corrupted databases

6.2 SNAPSHOT COPIES AND DOMINO COMPACT CONSIDERATIONS

A NetApp Snapshot copy is a frozen copy of data blocks. As long as the blocks remain unchanged in the active file system, the Snapshot copy consumes no space. If the block data is changed, then the changed data is written to a new block, and the old block is owned by the Snapshot copy. Hence, the Snapshot copy size depends on the number of changed blocks.

Domino Compact, with certain switches, causes data rearrangement, resulting in potentially large numbers of changed blocks. For example, if you run Compact -c, which will copy the database to a new location on disk, then you will rewrite every block in that database as it is copied to a new location. As a result, the Snapshot copy will capture the changed blocks, which with a Compact -c is every block. This means that your Snapshot copy is the size of the database.

It is very important to be aware of the behavior of Compact with NetApp Snapshot copies and evaluate your usage of Compact in your environment.

6.3 SNAPSHOT COPIES AND DOMINO COMPACT RECOMMENDATIONS

The most important step is to evaluate the way that Compact is currently being used in your environment. Document what switches you are using with Compact and determine why you are using them.

If you are using the default settings, your Compact behavior is dependent on whether Domino transactional logging is enabled or disabled. With transactional logs enabled, Compact's default behavior is -b, which does not reduce file size and as a result does not appear to have a measurable impact on Snapshot copy size. With transactional logging disabled, Compact's default behavior is -B, which performs in-place file size reduction, resulting in changed data blocks and causing larger than normal Snapshot copies as database space is reclaimed.

NetApp recommends that, for most environments, Compact should not be run more frequently than weekly. Customers using the Domino Compact feature should consider allocating appropriate storage space for Snapshot copies.

Additionally, any Compact usage should include the -s switch with 10% or 15% as a threshold. This will reduce data churn by only running Compact against databases with more than the specified percentage of whitespace.

Compact -c should only be utilized when implementing a new on-disk structure (ODS) or certain features that a new ODS makes available, such as DAOS or data document compression. It is possible that Compact -c could also be used to help resolve database corruption after the fact, but it should not be run regularly as a preventative measure.

7 SNAPMANAGER FOR DOMINO

SnapManager for Domino (SMD) is a comprehensive data management solution that streamlines storage management while simplifying configuration, backup, and restore operations for Lotus Domino databases. Deployed in combination with NetApp storage systems, SMD provides near-instantaneous hot backups and rapid restores to deliver an industry-leading combination of availability, scalability, performance, and reliability for Domino environments.

SMD uses the Domino APIs for application-consistent Snapshot copies of your Domino environment.

SnapManager for Domino requirements:

- All IBM-supported versions of Lotus Domino are supported on SMD
- Lotus Domino must be running on Microsoft Windows 2003 or 2008
- NetApp SnapDrive® for Windows 6.0 or greater must be installed
- Lotus Domino transactional logging must be enabled in the archive style.
- Lotus Domino must be configured with separate volumes for data and logs.

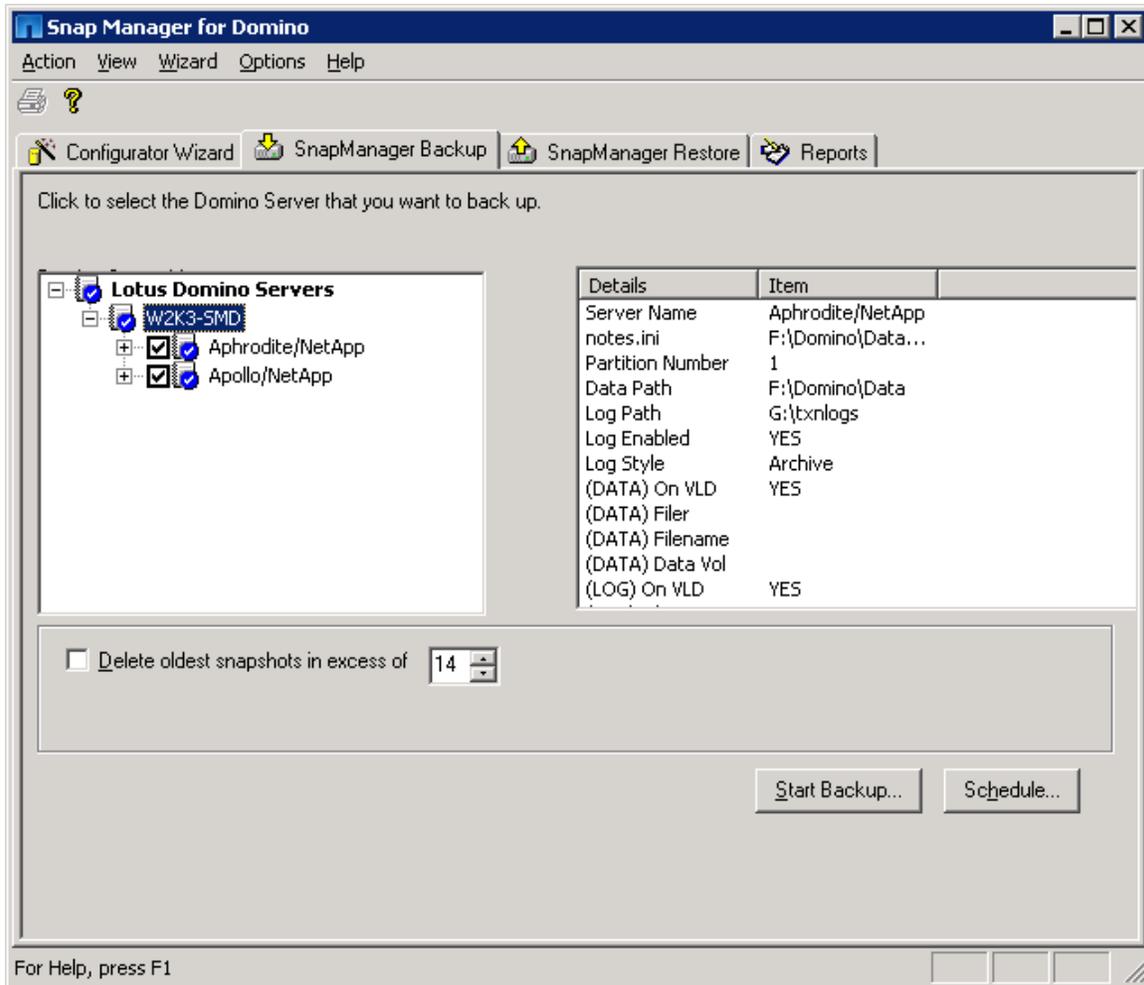
7.1 BACKUP WITH SNAPMANAGER FOR DOMINO

Backups through SnapManager for Domino use the Domino APIs to quiesce the Domino databases for application-consistent backups.

SnapManager for Domino uses an intuitive GUI with wizards as well as tabs for backup, restore, and reports. Figure 2 shows an example of SMD's backup tab, which gives you the option to automatically delete Snapshot copies in excess of a given number, schedule a backup, or back up now.

It is highly suggested that you go through the backup tab shown below or the wizard and schedule your backups to occur automatically in the future.

Figure 2) SnapManager for Domino backup tab example.

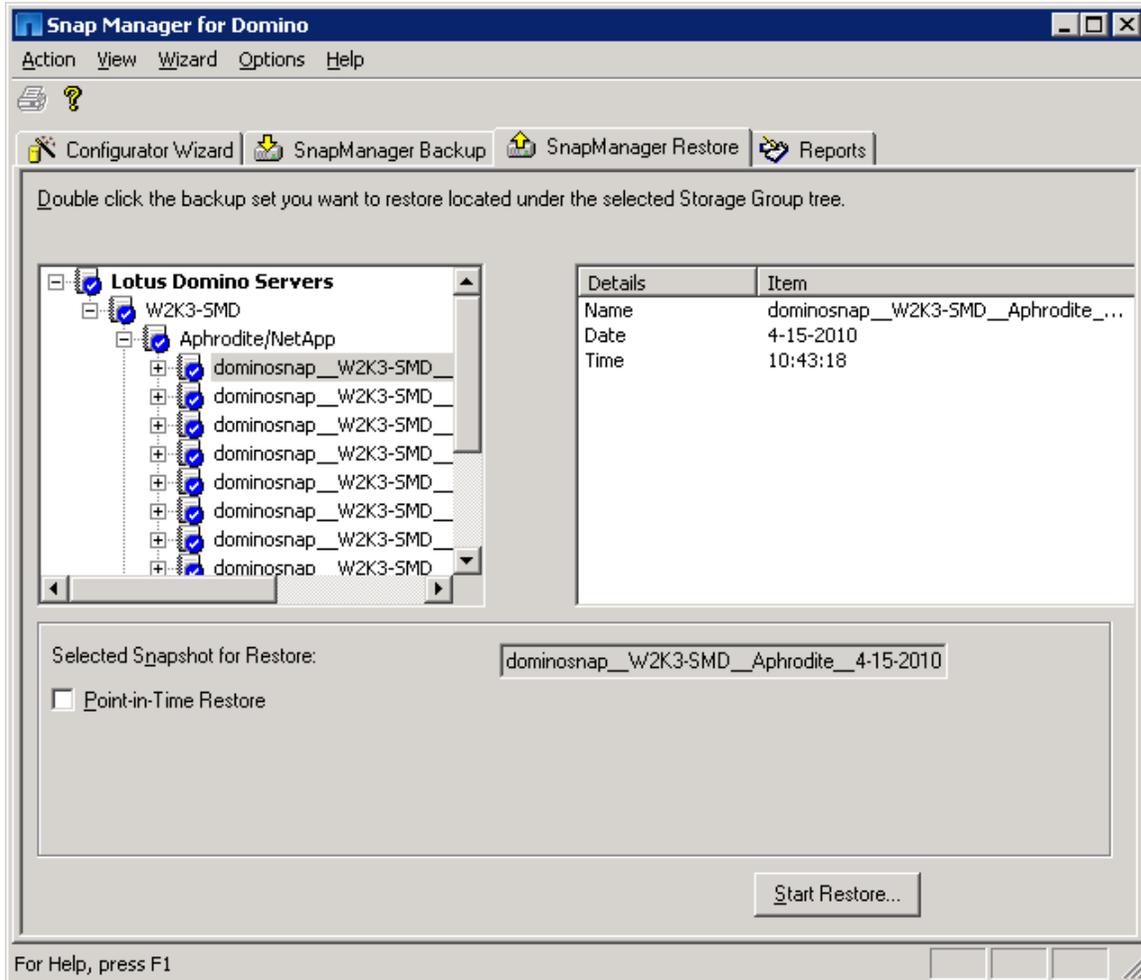


7.2 RESTORE WITH SNAPMANAGER FOR DOMINO

For restoring your Domino environment, SMD offers an intuitive wizard or tab-based restore feature. It is important to note that the restore operation using SMD is a volume-level operation and requires the Domino server to be stopped before attempting a restore. If you are using Domino partitioning, then all partitions on the physical server must be stopped even if you are only restoring one partition.

As Figure 3 shows, you will expand the Domino server that you want to restore to see a list of all the available Snapshot copies for that server. You will have the option to select a point-in-time restore; the default behavior is an up-to-the-minute restore that utilizes the Domino transactional logs to play forward all of the transactions that have occurred since the Snapshot copy was created.

Figure 3) SnapManager for Domino restore tab example.



7.3 SINGLE DATABASE RESTORE WITH SNAPMANAGER FOR DOMINO

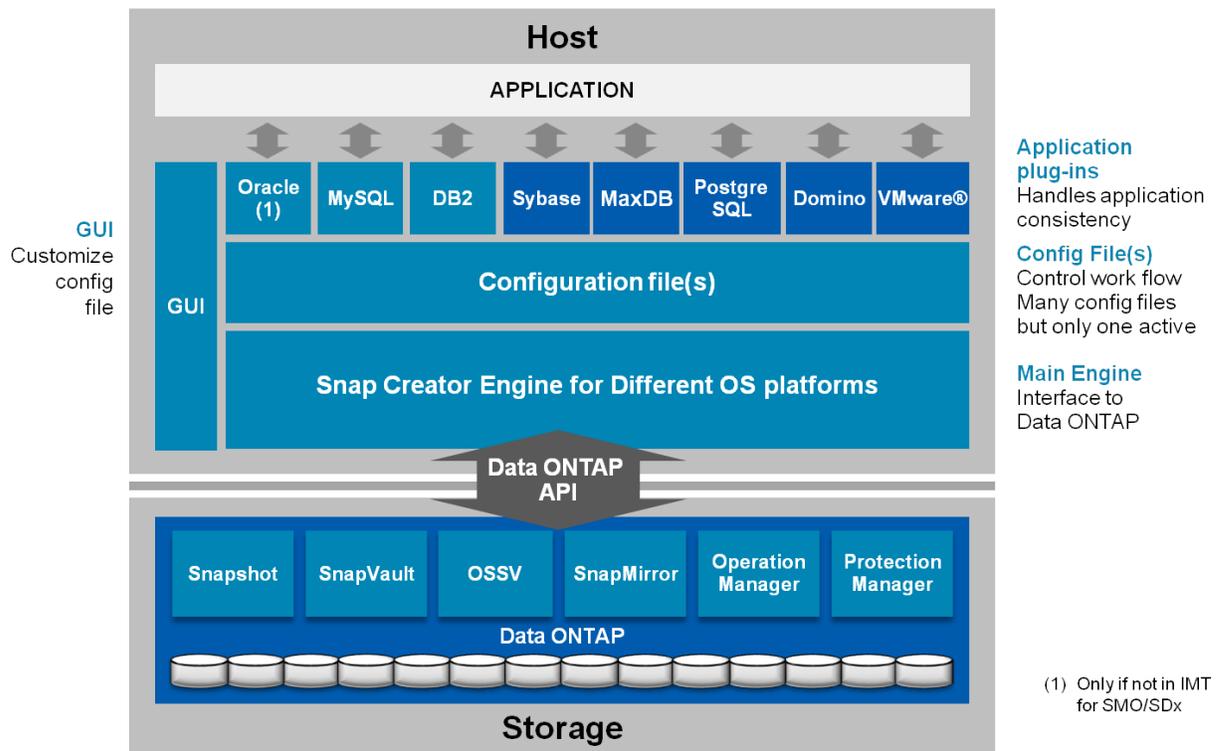
SnapManager for Domino uses a volume-based restore process, but most restores that are needed in the Domino environment are single database restores. Using the built-in functionality of NetApp SnapDrive, it is easy to mount a Snapshot backup copy of Domino server to a drive in your Microsoft Windows environment that will let you browse your Domino environment from an alternative mountpoint. See [Using SnapDrive to Restore a Single Domino Database](#) to walk through this process step by step. It is important to note that you are accessing your Domino data from an alternative path from a point-in-time Snapshot copy. This process does not use the Domino transactional logs as it exists outside of the SnapManager for Domino software.

8 NETAPP SNAP CREATOR FRAMEWORK AND THE DOMINO PLUG-IN

8.1 SNAP CREATOR OVERVIEW

NetApp Snap Creator Framework is software that exposes NetApp data protection technologies to integrate multiple applications on multiple operating systems. Snap Creator Framework is flexible, letting customers choose a particular application solution and evolve it over time. Currently, there are application plug-ins available for Oracle®, MaxDB, MySQL, Lotus Domino, DB2, PostgreSQL, and Sybase with more on the way. Snap Creator handles communicating with NetApp storage and performs various tasks, which include policy-based Snapshot management (using API or SnapDrive), an optional LUN or volume clone, seamless integration with SnapMirror® or SnapVault®, and integration with Operations Manager or Protection Manager.

Figure 4) Snap Creator architecture.



Snap Creator is composed of three components:

- **Snap Creator engine.** The Snap Creator engine is the main component of Snap Creator. It can run in server mode on a central backup server or as an agent on the Domino server where the database is installed. You can also integrate Snap Creator with an existing backup architecture. Snap Creator is easy to install, flexible, and platform independent. Snap Creator communicates with a NetApp storage system using Data ONTAP API calls and does policy-based Snapshot copy management. Snap Creator has a robust error-handling process, and it can send alerts by email or directly to external monitoring systems.
- **Snap Creator configuration.** The Snap Creator configuration file controls what Snap Creator does and can be customized based on your needs. The Snap Creator distribution comes with a default configuration file that can be used as a template to create the configuration file for the database. More than one config file per database is supported, but only one can be active at time.

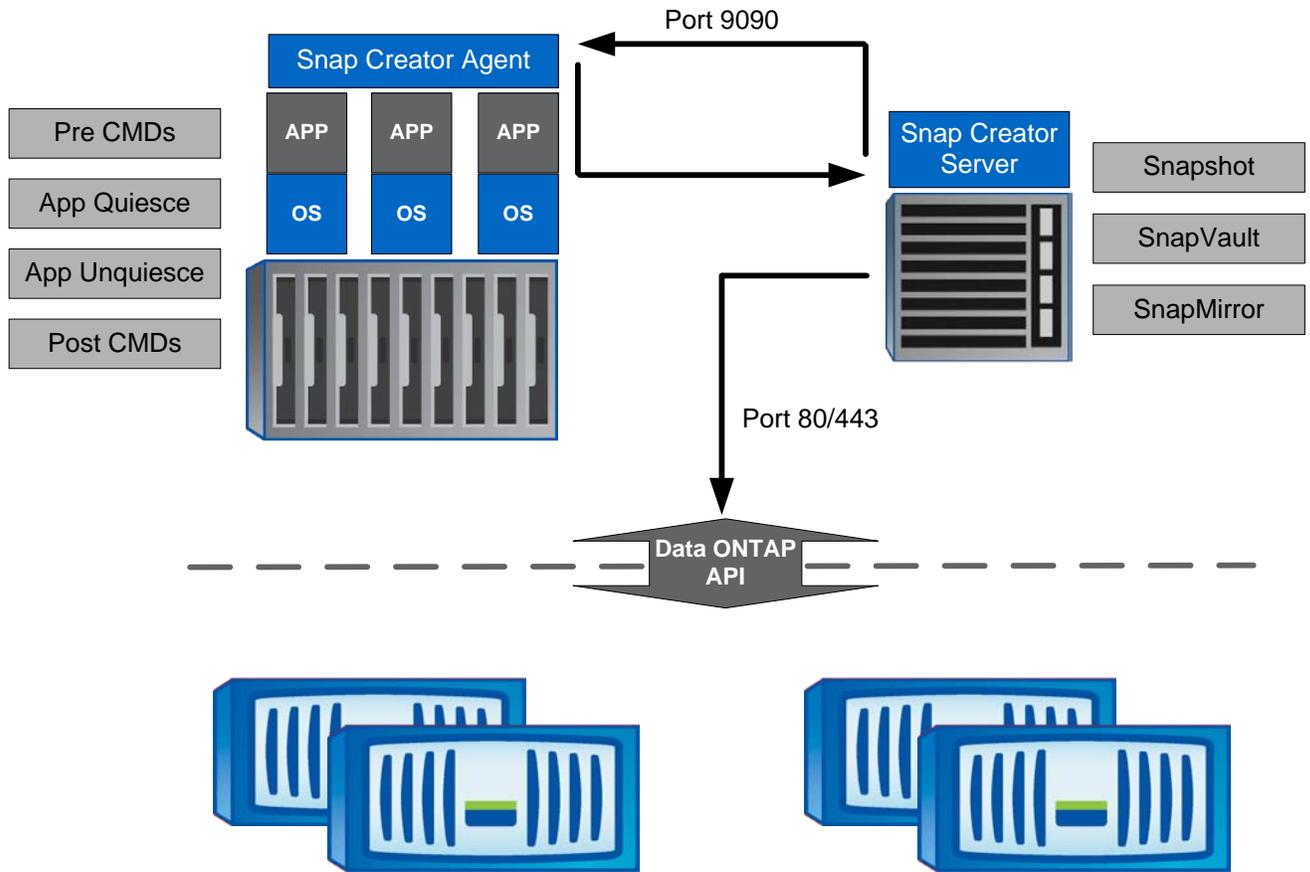
- Application plug-in.** The application plug-in is responsible for making sure that your Snapshot copy is crash consistent by putting the databases in an I/O suspend mode or reduced I/O mode during the Snapshot copy operation. After the Snapshot copy is done, the plug-in will put the database back into the normal mode if applicable. Optionally, you can use a customized script or commands to put the database on I/O suspend and resume modes.

Complete information about Snap Creator can be found in the NetApp Snap Creator Framework Installation and Administration Guide.

8.2 SNAP CREATOR SERVER-AGENT ARCHITECTURE

Snap Creator gives you the option to run as server-agent architecture so that you can centrally manage your backups. This means that all of your Snap Creator configuration files are stored, and all of your backup jobs are scheduled on a single system. Figure 5 depicts the architecture when using the server-agent method.

Figure 5) Snap Creator server-agent architecture.



Snap Creator's agent runs as a daemon running by default on port 9090, but any port can be chosen. SOAP over HTTP is used for communication. All application plug-ins are built into the agent, so all applications supported by Snap Creator are also supported by the agent. The agent also has an access file (agent.conf) to allow additional commands to be run in PRE, POST, or APP areas of the configuration file. By default, the agent.conf file denies everything so that only the Snap Creator built-in plug-ins are allowed.

8.3 SNAP CREATOR'S DOMINO PLUG-IN

The Domino plug-in for Snap Creator uses Domino CLI commands as opposed to Domino API calls. Since the Domino API calls are not utilized, Snapshot copies created while the Domino server is running do not guarantee application consistency. Any Snapshot copy created while Domino is running will result in databases being marked as being in the “unknown” status, which means that a consistency check will be run on databases as part of a restore operation and typical Domino maintenance tasks such as “fixup” and “updall” might need to be run.

Since the Domino plug-in is based on CLI commands, we recommend that you take a hybrid approach to backup by creating two configuration files: online and offline.

- The online configuration will be used to back up the database while Domino is online. The CLI commands will flush the database cache before creating a Snapshot copy.
- The offline configuration will be used during maintenance windows when Domino is offline, perhaps nightly or weekly depending on your corporate SLAs. The offline configuration will stop the Domino server, make sure that it is completely shut down with no Domino tasks running, create a consistent Snapshot copy, and then start the Domino server, returning it to normal operation.

For customers running Domino on Linux, UNIX[®], or AIX, Domino cannot be run as root, so a Domino administrator account should be created. When you create the Domino administrator account, be sure to set the home directory as the Domino data path, or an error will be generated.

8.4 INSTALLATION AND SETUP OF SNAP CREATOR FOR DOMINO

Refer to the Snap Creator installation guide for the installation and basic setup of Snap Creator. The following section will guide you through how to set up the Domino server to use Snap Creator.

Creating the Snap Creator configuration file: In order to do the backup or recovery of the Domino server, a configuration file is required, and the following fields must be configured. The Snap Creator configuration file has different sections, and the following example shows the minimum required fields for each section that have been changed from the default values.

BASIC CONFIGURATION

- `SNAME=[name]`

This is where you define the prefix for your Snapshot copy; the naming convention should be unique. Snapshot copies on a NetApp storage system will be deleted according to the naming convention and retention policy used. As a best practice, we recommend the `SNAME` field to be configured as the database name, which is online in this case.

- `VOLUMES=[Filer]:[Data_Vol],[Log_Vol]`

These are the volumes used by the Domino server. Snap Creator will allow you to configure more than one volume or storage controller and will make sure the Snapshot copy is consistent across the volumes and storage controllers. The usage for configuring the volumes is
`filer1:vol1,vol2,vol3;filer2:vol1;filer3:vol2,vol3.`

- `NTAP_USERS=[Filer]:[User]/[Password]`

In order to create a Snapshot copy or do a SnapRestore operation on the NetApp storage system, you create a user on the NetApp storage system with the necessary privileges. Refer to the installation document to set up the user on the storage system. The `NTAP_USERS` field is configured as the list of storage systems and their corresponding usernames/passwords, that is,
`filer1:joe/password1;filer2:bob/password2;filer3:ken/password3.` For this setup, since we have only one storage system, it is configured as just described. Snap Creator supports password encryption. For password encryption, refer to the Snap Creator installation guide.

NETAPP OPTIONS

- `NTAP_SNAPSHOT_RETENTIONS=daily:7,weekly:4,monthly:1`

This setting specifies the number of NetApp Snapshot copies to retain for a given policy. The setting above will keep at least seven daily backups, four weekly backups, and one monthly backup.

This is the policy that you will call when running Snap Creator. The example above shows that you have a daily, weekly, or monthly policy that you can use.

- `NTAP_SNAPSHOT_RETENTION_AGE=7`

This setting allows you to define a retention age for Snapshot copies in days. If this is configured, Snapshot copies will only be deleted if there are more Snapshot copies than defined in the `NTAP_SNAPSHOT_RETENTIONS` field and if they are older than the `NTAP_SNAPSHOT_RETENTION_AGE` field (days). Even though this is an optional field, setting this field is recommended, especially when you have an RPO requirement in a production environment.

PRE COMMANDS

- `PRE_NTAP_CMD01=`

This field is optional and can be configured if you want to run a command before the backup process begins. This setting can be configured to stop your Domino server when creating an offline configuration file. Make sure to stop the Domino server at the `PRE_NTAP` command, not at the `APP_QUIESCE` command, because the Domino server must be running when the module sends commands to it. Otherwise, the module command will fail. What you enter on this line depends on several things, especially on which operating system you are running Domino.

For example, when running Domino on Windows, you can enter the following command to stop the Domino server, running as a service named Lotus Domino server (FDominodata):

```
PRE_NTAP_CMD01=net stop "Lotus Domino Server (FDominodata)"
```

For running Domino on a Linux server with the Nashcom start/stop script, you might enter:

```
PRE_NTAP_CMD01=/etc/init.d/rc_domino stop
```

POST COMMANDS

- `POST_APP_UNQUIESCE_CMD01=`

This field is optional and can be configured if you want to run a command after the backup process ends. When using an offline configuration file, you can set this command to start your Domino server. Like the `PRE_NTAP` command, what you put in this field depends on the host operating system.

Returning to our previous examples, when running Domino on Windows, you can enter the following command to start the Domino server:

```
POST_APP_QUIESCE_CMD01=net start "Lotus Domino Server (FDominodata)"
```

For running Domino on a Linux server with the Nashcom start/stop script, you might enter:

```
POST_APP_QUIESCE_CMD01=/etc/init.d/rc_domino start
```

ADDITIONAL PLUG-INS

- `APP_IGNORE_ERROR=Y`

For Domino, set the `APP_IGNORE_ERROR` to "Y." Domino does not use typical error codes to indicate a successful completion. If this is set to "N," the Snap Creator process will receive a nonzero error code from Domino, believe that an error has occurred, and stop the Snap Creator process.

- `APP_NAME=NOTES`

As of Snap Creator version 3.3, the Domino module is a community-supported module and will need to be downloaded from the NetApp community site.

The module NOTES.pm needs to be placed in a directory with the same name as the module NOTES in the /plugins/directory.

For example, if your Snap Creator directory is in the /scServer directory, then your notes module will need to be placed in /scServer/plugins/NOTES/NOTES.pm.

The value of APP_NAME needs to be identical to the name of the folder containing the plug-in, so in the example above, APP_NAME=NOTES.

LOTUS NOTES SETTINGS

- OS_WINDOWS=
Set this value to either “Y” or “N” to identify whether the host operating system is Microsoft Windows.
- DOM_ADMIN=
Enter the name of the Domino server administrator (UNIX only). The Domino plug-in will run as this user. It is important that the user defined in DOM_ADMIN have the home directory set to the DOMINO_DATA_PATH (below). If this is not set properly, an error will be generated.
- SERVER_CMD=
This specifies the path to the notes server command. In UNIX, this is the server executable (for example, /opt/ibm/lotus/bin/server). In Windows, this is nserver.exe (for example, “C:\Program Files\IBM\Lotus\Domino\nservice.exe”). If your Domino server is installed in “Program Files” or another directory in Windows that includes a space, be sure to surround the path with quotation marks.
- LOTUS=
The specifies the path to the Lotus bin directory where “server” or “nservice” is located, which might be /opt/ibm/lotus/bin/server in UNIX or “C:\Program Files\IBM\Lotus\Domino\” in Windows. If your Domino server is installed in “Program Files” or another directory in Windows that includes a space, be sure to surround the path with quotation marks.
- DOMINO_DATA_PATH=
This is the path to your Domino Data directory.
- DOMINO_SERVICE_NAME=
This is the name of the service of the Domino server in Microsoft Windows (Windows only).
- RC_DOMINO_CMD=
This is the path to the script used to start and stop Domino (UNIX only). NetApp suggests the use of the [Nashcom start/stop script](#) for Domino on Linux.

8.5 BACKUP WITH SNAP CREATOR AND THE DOMINO PLUG-IN

After you create your configuration file, you can create a backup on the NetApp storage system using Snap Creator. When the snapcreator command is executed with the snap action, the following operations happen in the background:

1. Snap Creator calls the Domino plug-in using the Snap Creator configuration file and executes a drop all and a flush dbcache command on the Domino console.
2. Snap Creator does an inventory of all the configured volumes by using ZAPI calls on the NetApp storage system.
3. Snap Creator creates Snapshot copies for all configured volumes. It also checks that Snapshot copies for all volumes are done successfully.
4. Snap Creator applies the Snapshot management policies and deletes the expired Snapshot copies from the NetApp storage system.
5. Snap Creator sends alerts, if configured in the config file, showing the status of the backup operation.

To use Snap Creator to create the backup of the database, do the following:

```
snapcreator --profile [profile_name] --action [action_type] --policy [ policy name] --  
config [config_file] --verbose
```

Where:

- `Profile_name` is the name of your profile or folder that contains your config file.
- `action_type` is the operation you want to perform.
 - `snap` creates a Snapshot copy.
 - `snaplist` lists all Snapshot copies created by Snap Creator.
 - `restore` enters an interactive restore mode.
 - `delete` enters an interactive menu to delete Snapshot copies.
- `policy_name` is the name of the backup policy defined in your config file. The `policy_name` value is determined by the value of `NTAP_SNAPSHOT_RETENTIONS`.
- `config_name` is the name of the configuration file that you want to run. This field is needed if you have multiple configuration files in the profile directory.
- `verbose` shows the Snap Creator operation on the console and is optional. Snap Creator will save the output to the logs regardless of whether you specify this option.

In order to create a crash-consistent Snapshot copy for a profile named “domino” using Snap Creator with the policy “daily” and a config file named “online,” you would run the following command:

```
snapcreator --profile domino --action snap --policy daily -config online --verbose
```

The output of the Snap Creator backup operation of the Domino server is available for reference in [Snap Creator Backup Output](#).

After the Snapshot copy is created on the NetApp storage system, you can list or view it using Snap Creator. In order to list the Snapshot copy you have created now on the NetApp storage system for the profile “domino,” you would run the following command:

```
snapcreator --profile domino --action snaplist --policy daily
```

The Snap Creator Snapshot list will help you see what Snapshot copies are associated with the production database for the configured volumes. See [Snap Creator SnapList Output](#) for sample output of the action `snaplist`.

8.6 RESTORE WITH SNAP CREATOR AND THE DOMINO PLUG-IN

Any production database is subject to data corruption by either a malicious process or a user error. In order to go back to a point in time prior to data corruption, you will need to restore the database using the latest available good Snapshot copy. Snap Creator can be used to restore the Domino server using the Snapshot copies from the NetApp storage system. The Snap Creator restore process is an interactive process that requires user input. The restore process will only list the Snapshot copies for individual volumes that are created through Snap Creator. This means any other Snapshot copies either created manually or through some other process on the NetApp storage system will be ignored.

The following will happen during a restore operation through Snap Creator:

1. Snap Creator interactive restore menu will prompt with the restore of the configured volumes.
We recommend that you use the Volume Restore option. When you have finished restoring all volumes be sure to select “c” to continue as “q” to quit will immediately exit Snap Creator without processing any postrestore commands that you might have configured.

2. After you are in the correct volume, Snap Creator will list the Snapshot copies on the NetApp storage system, and the user can select the appropriate Snapshot copy to restore the configured volumes.
3. After all the volumes are restored, Snap Creator will call the POST commands to restart the database.

In order to restore the profile named “domino” with the config file “online” using an earlier Snapshot copy created through Snap Creator, you would run the following command:

```
snapcreator --profile domino --action restore -config online --policy daily
```

See [Snap Creator Restore Output](#) for a snippet from the output of the `snapcreator` command with `restore` option.

8.7 SINGLE DATABASE RESTORE WITH SNAP CREATOR

Single database restore with Snap Creator is similar to the approach taken by SnapManager for Domino in section 7. If you are using a block-based protocol such as FCP or iSCSI, you need to install SnapDrive to access single databases within a Snapshot copy. After SnapDrive is installed, you can go through the steps in Appendix 10.2 to restore a single database.

If you are running Domino on a file-based protocol such as NFS, then accessing a Snapshot copy for single file restore is even easier. Each NetApp volume contains a Snapshot directory called `.snapshot`, which has a list of Snapshot copy names. Browsing this directory allows you to access the point-in-time files created during the Snapshot copy.

For example, if you browsed to the `/mnt/domdata` volume mapped to the Linux server, you can browse to the `.snapshot` directory and execute an `ls` command, which might return the following:

```
[root@viper01 .snapshot]# pwd
/mnt/domdata/.snapshot
[root@viper01 .snapshot]# ls
domino-online-daily_20100521130210  domino-online-daily_20100719134218
domino-online-daily_20100719122528  domino-online-daily_20100719134410
domino-online-daily_20100719122554  domino-online-daily_20100802132706
domino-online-daily_20100719122636
[root@viper01 .snapshot]#
```

Each of the listed subdirectories is a read-only point-in-time Snapshot copy, which can be browsed with NFS just like a file system. Because the files are read only, you might need to copy the file to an alternate location if you need to change any data. To access the needed file, you can browse the file system at this point as if it is the production file system.

9 CUSTOM SCRIPTING FOR DOMINO BACKUP AND RESTORE

Custom scripting for any application requires testing and reusing common elements. The commands in the following sections are not meant to be a comprehensive list of all possible commands. Instead, they are a listing of the most frequently used actions when creating a custom script. More advanced scripting is possible using additional commands. Refer to the Installation and Administration Guide for each product used for additional information.

9.1 SCRIPTING ASSUMPTIONS

To use the scripting section effectively, we made the following assumptions:

- Your Domino environments use NetApp storage and are already configured and fully operational. To prevent access issues, the user accounts on both the server and the storage systems are configured identically.
- To execute the commands, RSH (remote shell) or SSH (secure shell) must be enabled and configured for the storage system. For the purposes of this report, RSH was used. Depending on your organization's policy, it might be preferred that you use SSH.

To enable the `rsh` command on the storage, you must perform the following two steps:

1. Set RSH options on the storage by executing the following command on the NetApp storage system:

```
options rsh.enable on
```

2. Add an entry in the `/etc/hosts.equiv` file found on the NetApp storage system for the database host and the user. Entries in the `/etc/hosts.equiv` file should look similar to this:

```
[HostName] [UserName]
```

Where:

- `HostName` identifies the name of the database host from which the `rsh` command is executed.
- `UserName` identifies the name of the user who wants to execute the `rsh` command.

For example, to create an entry for a Domino server named `Tampico` and a user named `domadmin`, you would add the following line to the `/etc/hosts.equiv` file on the NetApp storage system:

```
Tampico domadmin
```

After the appropriate entry has been added to the `/etc/hosts.equiv` file, a user can execute Data ONTAP commands directly from the host. The format used to execute Data ONTAP commands from the host looks something like this:

```
rsh -l [UserName]:[Password] [StorageSystemName] [DOTCommand]
```

Where:

- `UserName` identifies the name of the user who wants to execute the `rsh` command.
- `Password` identifies the password of the user who wants to execute the `rsh` command.
- `StorageSystemName` identifies the name of the storage system.
- `DOTCommand` identifies the Data ONTAP command.

For example, to test `rsh` for a NetApp storage named `Iceman`, you would enter the command:

```
rsh iceman version
```

Which returns: `NetApp Release 7.3.2: Thu Oct 15 04:17:39 PDT 2009.`

9.2 DOMINO COMMANDS FOR SCRIPTING

There are a few Domino-specific commands that are used to prepare the Domino environment for NetApp Snapshot technology. These commands need to be called from their binary location. For the purpose of this report, NetApp assumes that the Domino program files were installed at the default location.

DEFAULT INSTALL LOCATION FOR UNIX/LINUX

In UNIX, Linux, and AIX the default location is `/opt/ibm/lotus/bin`.

For UNIX, Linux, and AIX the name of domino executable file is `server`.

Thus, in a UNIX environment you need to execute:

```
/opt/ibm/lotus/bin/server -c [command]
```

Where `command` is the Domino server command that you want to process. Because the command is being passed to the Domino server, it must be contained in quotes to make sure the entire command is received.

DEFAULT INSTALL LOCATION FOR WINDOWS

In Windows the default location is `C:\Program Files\IBM\Lotus\Domino`.

For Windows the name of the Domino executable file is `nserver.exe`.

Windows users must use the Windows path and `nserver.exe` so that the command is formatted like this:

```
C:\Program Files\IBM\Lotus\Domino\nserver -c ["command"]
```

Where: `command` is the Domino server command that you want to process.

The following list contains the Domino commands that you are likely to use in preparing Domino for a Snapshot copy backup. For further details on these commands, refer to the [Domino user manual and reference guide](#). Both Linux and Windows examples are provided.

- `drop`

Use this command to close user sessions for all users or for specific users. This drop is generally transparent to the user because the Lotus Notes client automatically handles the reconnect.

Usage:

```
/opt/ibm/lotus/bin/server -c "drop all"  
C:\Program Files\IBM\Lotus\Domino\nserver -c "drop all"
```

- `dbcache flush`

Domino uses the database cache to keep the most recently used databases open for performance reasons. In order to create a NetApp Snapshot copy, you must flush the `dbcache` to make sure that no databases are open when the Snapshot copy is created. Flushing the `dbcache` helps to make sure that the Snapshot copies are consistent.

Usage:

```
/opt/ibm/lotus/bin/server -c "dbcache flush"  
C:\Program Files\IBM\Lotus\Domino\nserver -c "dbcache flush"
```

- `nsd -kill`

Use this command to stop activity of any Domino-related tasks. This command is normally run after the `Quit` command has been issued and completed. This stops any additional tasks that did not cleanly exit after issuing the `Quit` command.

Usage:

```
/opt/ibm/lotus/bin/nsd -kill
```

```
C:\Program Files\IBM\Lotus\Domino\nsd -kill
```

- `quit`

`Quit` does exactly what you think—it quits the Domino server. You would most likely use the `Quit` command if you wanted to create a Snapshot copy with the highest level of consistency. This process might take several minutes.

Usage:

```
/opt/ibm/lotus/bin/server -c "quit"  
C:\Program Files\IBM\Lotus\Domino\nserver -c "quit"
```

Additionally, you can run the same command with which you start the server, but with the `-q` option.

Usage:

```
/opt/ibm/lotus/bin/server -q  
C:\Program Files\IBM\Lotus\Domino\nserver -q
```

- `restart`

This command restarts the Domino server. The shutdown process might take several minutes. After shutdown, the system waits 10 seconds and then restarts the Domino server, which again might take several minutes. The `restart` command can also be used to restart tasks or add-ins on the Domino server, so you must specify `restart server`.

Usage:

```
/opt/ibm/lotus/bin/server -c "restart server"  
C:\Program Files\IBM\Lotus\Domino\nserver -c "restart server"
```

Even though you can use the `restart` command to stop the Domino server, NetApp recommends that you use the `Quit` command instead and use the script to start Domino server.

- `server/nserver`

This command starts the Domino server. There are a few different options for doing so, depending on how you want the server to operate. Running `nserver` or `nserver &` in Windows presents you with a GUI prompt asking if you want to start Domino as a service (background) or as an application. If you have selected the “do not show this again” checkbox, your preferred action is selected automatically.

Start the server in the foreground. This is the traditional way to start Domino.

```
server
```

Start the server in the background. This keeps your server running without taking over your shell window in Linux.

```
server &
```

Generally, NetApp recommends that you start the Domino server in the background.

Server: The Java® console allows the administrator to send commands to one or multiple servers from a console based on Java. The Java console is composed of three parts: the Domino server, the Domino controller, and the Domino console. The Domino controller runs on the server and listens for connection requests from the console. All data between the Java console and the Java controller is encrypted using SSL. The Java console can be started or stopped at any time without affecting the operational status of the Domino server.

Start the server in the foreground with the Java console.

```
server -jc  
C:\Program Files\IBM\Lotus\Domino\nserver -jc
```

Start the server in the background with the Java console.

```
server -jc &
```

- Windows Service commands
- When running Domino in a Windows environment, it is common for Domino to be installed and running as a service. Using Windows commands, you can start and stop the services from a script. In order to use the commands, it's most important to identify the service name that Domino is using. To do this, look at the services page in Windows by clicking Start → Run → services.msc. This opens the Services console. This page lists the services installed on the Windows server, typically in alphabetical order. Scroll down the page until you find the Lotus Domino server. The service name is often followed in parentheses by the drive letter that your Domino data directory is using and "Dominodata." In my environment, the Domino data is installed to the F drive, so the service name is Lotus Domino Server (FDominodata). Double-clicking this service opens the properties box. The first field under the general tab is the service name. In most cases this is the same as the display name.

- net start

This command starts a service.

```
net start "Lotus Domino Server (FDominodata)"
```

- net stop

This command stops a service.

```
net stop "Lotus Domino Server (FDominodata)"
```

9.3 NETAPP STORAGE SYSTEM COMMANDS FOR SCRIPTING

NetApp storage systems run a proprietary operating system called Data ONTAP. There are two options for executing Data ONTAP commands: directly on the storage system and using rsh/ssh. For scripting purposes, you use rsh/ssh from the local server to the remote NetApp storage system to call Data ONTAP commands. For further information on Data ONTAP commands, refer to [Data ONTAP Command: Manual Page Reference volume 1](#), which is available on the NetApp Web site.

For the purposes of this article, rsh is used.

The syntax for rsh is:

```
rsh -l [UserName]:[Password] [StorageSystemName] [DOTCommand]
```

Where:

- `UserName` identifies the name of the user who wants to execute the rsh command.
- `Password` identifies the password of the user who wants to execute the rsh command.
- `StorageSystemName` identifies the name of the storage system.
- `DOTCommand` identifies the Data ONTAP command.

COMMON COMMANDS

- snap create

Use this command to create a new Snapshot copy on your storage system.

Usage:

```
snap create [vol_name] [name]
```

Where:

- `vol_name` is the name of the volume where you are creating a Snapshot copy.
- `name` is the name of the Snapshot copy that you are creating.

For example, execute the following command to create a Snapshot copy named Daily1 on the volume lotusdata.

```
snap create lotusdata Daily1
```

- **snap delete**

Use this command to delete Snapshot copies. Generally, this command is used to keep only a specific number of Snapshot copies on your storage system.

Usage:

```
snap delete [vol_name] [name]
```

Where:

- `vol_name` is the name of the volume where you are deleting a Snapshot copy.
- `name` is the name of the Snapshot copy that you are deleting.

For example, execute the following command to delete a Snapshot copy named Daily6 on the volume lotusdata.

```
snap delete lotusdata Daily6
```

- **snap rename**

Use this command to give an existing Snapshot copy a new name. Generally, this is used to rotate Snapshot copies.

Usage:

```
snap rename [vol_name] [old-snapshot-name] [new-snapshot-name]
```

Where:

- `vol_name` is the name of the volume where you are renaming a Snapshot copy.
- `old-snapshot-name` is the name of the existing Snapshot copy.
- `new-snapshot-name` is the new name for your Snapshot copy.

For example, execute the following command to rename a Snapshot copy named Daily1 to the new Snapshot copy name of Daily2 on volume lotusdata.

```
snap rename lotusdata Daily1 Daily2
```

- **snap restore**

Use this command to revert a volume back to a specified Snapshot copy.

The `snap restore` command is available only if your storage system has the SnapRestore license. If you do not specify a Snapshot copy, the storage system prompts you for the Snapshot copy.

Usage:

```
snap restore -s [snapshot-name] [vol-name]
```

Where:

- `snapshot-name` is the name of the Snapshot copy you are making active.
- `vol_name` is the name of the volume you want to restore.

For example, execute the following command to restore a Snapshot copy named Nightly4 on the volume lotusdata.

```
snap restore -s Nightly4 lotusdata
```

9.4 SNAPDRIVE FOR WINDOWS COMMANDS FOR SCRIPTING

SnapDrive software for Windows integrates with Windows Volume Manager so that storage systems can serve as virtual storage devices for application data in Windows Server 2003 and 2008 environments. SnapDrive for Windows manages LUNs on a storage system, making these LUNs available as local disks on Windows hosts. This allows Windows hosts to interact with the LUNs just as if they were directly attached. This report does not address installation or best practices for SnapDrive. For more information about SnapDrive for Windows, see the documentation available in the [Storage System Client Software Information Library](#) section of the NetApp [NOW](#) site.

SnapDrive for Windows contains a command line utility that enables you to perform many of the tasks available in the SnapDrive MMC. This command line utility is `sdcli.exe`.

The `sdcli` commands consist of three input parameters that must be specified in the correct order, followed by one or more command line switches, which are case sensitive. All of the command examples in this section are written as if they are being run on the local machine. There are `sdcli` commands to run these commands remotely, but they are not addressed in this report.

When using `sdcli` on Windows 2008 be aware that you must be logged in as administrator or a user with administrative rights.

The default install location for SnapDrive for Windows is: `C:\Program Files\NetApp\SnapDrive\`

To run `sdcli` via a script you should pass the install path and the `sdcli.exe` then the parameters, so the command will be formatted like this:

```
C:\Program Files\NetApp\SnapDrive\sdcli.exe [command]
```

Where `command` is the Data ONTAP command(s) that you want to process.

COMMON COMMANDS

- `sdcli snap create`

Use this command to create a Snapshot copy through SnapDrive for Windows.

Usage:

```
sdcli snap create -s [snapshot-name] -D [mountpoint-list] [-x]
```

Where:

- `snapshot-name` is the name of the Snapshot copy you want to create.
- `mountpoint-list` is the name of the mounted volumes where you are creating a Snapshot copy.
- `-x` causes data to be flushed and consistent Snapshot copies to be created only for the drives and mountpoints specified by the `-D` switch, or the `[mountpoint-list]` above.

For example, execute the following command to create a Snapshot copy named `Jan_30_10` for the specified drives `F:` and `G:`.

```
sdcli snap create -s Jan_30_10 -D f g
```

- `sdcli snap delete`

Use this command to delete a Snapshot copy through SnapDrive for Windows.

Usage:

```
sdcli snap delete -D [mountpoint-list] -s [snapshot-name]
```

Where:

- `mountpoint-list` is the name of the mounted volumes where you are deleting Snapshot copies.
- `snapshot-name` is the name of the Snapshot copy you want to delete.

For example, execute the following command to delete a Snapshot copy named `Jan_30_10` for drive `F:`:

```
sdcli snap delete -D f -s Jan_30_10
```

- `sdcli snap rename`

This command changes the name of an existing Snapshot copy on the specified mountpoint.

Usage:

```
sdcli snap rename -d [mountpoint] -o [old-snapshot-name] -n [new-snapshot-name]
```

Where:

- `mountpoint` is the name of the mounted volume where you are renaming a Snapshot copy.
- `old-snapshot-name` is the existing Snapshot copy name that you want to rename.
- `new-snapshot-name` is the new name you are assigning to the Snapshot copy.

For example, execute the following command to rename a Snapshot copy named `Jan_30_10` to the new name of `Jan_EOM` on drive `F:`:

```
sdcli snap rename -d f -o Jan_31_10 -n Jan_EOM
```

- `sdcli snap mount`

Use this command to mount a Snapshot copy of a LUN. This can be used to access a point-in-time copy of a database from an alternate location. This is very useful when you want to perform single database recovery.

Usage:

```
sdcli snap mount -k [livemountpoint] -s [snapshot-name] -d [mountpoint]
```

Where:

- `livemountpoint` is the name of the volume that you took the Snapshot copy on.
- `snapshot-name` is the name of the Snapshot copy you want to mount to a new mountpoint.
- `mountpoint` is the new mountpoint where you are mounting the Snapshot copy.

For example, execute the following command to mount a Snapshot copy named `Jan_30_10` from drive `F:` to drive `S:` on the local host.

```
sdcli snap mount -k f -s Jan_30_10 -d s
```

- `sdcli snap unmount`

This command unmounts a Snapshot copy of a LUN that is currently mounted. After you finish using your mounted Snapshot copy for temporary use you will want to unmount it. It is best to do this regularly to keep from having extraneous copies of your data mounted on your server.

Usage:

```
sdcli snap unmount -d [mountpoint]
```

Where `mountpoint` is the mountpoint you want to disconnect.

For example, execute the following command to unmount the drive `S:` from a domino server.

```
sdcli snap unmount -d s
```

- `sdcli snap restore`

This command restores the current LUN image in the active file system with the point-in-time image captured by the specified Snapshot copy. Note that in a Domino environment you should be sure to stop the Domino server before restoring data.

Usage:

```
sdcli snap restore -d [mountpoint] -s [snapshot-name]
```

Where:

- `mountpoint` is the mountpoint where you are restoring the Snapshot copy.
- `snapshot-name` is the existing Snapshot copy name that you are restoring.

For example, execute the following command to restore a Snapshot copy named `Jan_30_10` on drive `F:`.

```
sdcli snap restore -d f -s Jan_30_10
```

9.5 SNAPDRIVE FOR UNIX COMMANDS FOR SCRIPTING

SnapDrive for UNIX simplifies data management in UNIX and Linux environments and increases the availability and reliability of application data through simplified storage provisioning and file system consistent Snapshot copies. It simplifies the complexity of storage management by enabling a flexible provisioning of storage resources and provides storage features that enable you to manage the entire storage hierarchy. The installation and configuration are beyond the scope of this report. For more information about SnapDrive for UNIX see the documentation available in the [Storage System Client Software Information Library](#) section of the NetApp [NOW](#) site.

COMMON COMMANDS

- `snapdrive snap create`

Use this command to create a Snapshot copy of your file system. This exact command creates a Snapshot copy on a file system (`-fs`), but depending on your configuration, you might need to create on a LUN (`-lun`), volume group (`-vg`), or disk group (`-dg`). The commands for each are similar, but check the [SnapDrive for UNIX Installation and Administration Guide](#) for complete details.

Usage:

```
snapdrive snap create -fs [mount_dir] -snapname [snapshot-name]
```

Where:

- `-fs` indicates a file system. Other options are `-lun` (LUN), `-dg` (disk group), `-vg` (volume group), `-hostvol` (host volume), `-lvol` (logical volume).
- `mount_dir` is the mountpoint where you are creating the Snapshot copy.
- `snapshot-name` is the name of the Snapshot copy that you are creating.

For example, execute the following command to create a Snapshot copy named `Jan_30_10` for `/mnt/domdata`.

```
snapdrive snap create -fs /mnt/domdata -snapname Jan_30_10
```

- `snapdrive snap delete`

This command is used to delete a Snapshot copy on the specified volume.

Usage:

```
snapdrive snap delete -snapname [storage_system]:[volume]:[snapshot-name]
```

Where:

- `storage_system` is the name of the storage system that contains the Snapshot copy you are deleting.
- `volume` is the name of the volume that contains the Snapshot copy you are deleting.
- `snapshot-name` is the name of the Snapshot copy that you are deleting.

For example, execute the following command to delete a Snapshot copy named `Jan_30_10` for the storage system `mystique:/volume /vol/DomData`.

```
snapdrive snap delete -snapname mystique:/vol/DomData:Jan_30_10
```

- `snapdrive snap rename`

This command renames a Snapshot copy on the storage system to a new Snapshot copy name. This command is often used when rotating Snapshot copies.

Usage:

```
snapdrive snap rename -snapname [storage_system]:[volume]:[old-snapshot-name]
[new-snapshot-name]
```

Where:

- `storage_system` is the name of the storage system that contains the Snapshot copy you are renaming.
- `volume` is the name of the volume that contains the Snapshot copy you are renaming.
- `old-snapshot-name` is the name of the existing Snapshot copy that you are renaming.
- `new-snapshot-name` is the new name of the Snapshot copy that you are renaming.

For example, execute the command to rename a Snapshot copy named `Jan_31_10` on `mystique:/volume /vol/DomData` to a new name of `Jan_EOM`.

```
snapdrive snap rename -snapname mystique:/vol/DomData:Jan_31_10 Jan_EOM
```

- `snapdrive snap connect`

This command is used to connect to an existing Snapshot copy. This exact command mounts a file system (`-fs`), but depending on your configuration, you might need to mount a LUN (`-lun`), volume group (`-vg`), or disk group (`-dg`). The commands for each are similar, but check the [SnapDrive for UNIX Installation and Administration Guide](#) for complete details.

Usage:

```
snapdrive snap connect -fs [source_mnt] [destination_mnt] -snapname [snapshot-
name]
```

Where:

- `-fs` indicates a file system. Other options are `-lun` (LUN), `-dg` (disk group), `-vg` (volume group), `-hostvol` (host volume), `-lvol` (logical volume).
- `source_mnt` is the mount location of the volume that holds the Snapshot copy you want to mount.
- `destination_mnt` is the new mountpoint where you are mounting the Snapshot copy.
- `snapshot-name` is the name of the Snapshot copy that you are mounting.

For example, execute the following command to mount the file system at `/mnt/domdata` to `domtemp` from the Snapshot copy named `Jan_30_10` on `mystique:/vol/Domdata`.

```
snapdrive snap connect -fs /mnt/domdata domtemp -snapname
mystique:/vol/DomData:Jan_30_10
```

- `snapdrive snap disconnect`

Use this command to disconnect a mounted Snapshot copy. This exact command mounts a file system (-fs), but depending on your configuration, you might need to mount a LUN (-lun) or a disk group (-dg). The commands for each are similar, but check the [SnapDrive for UNIX Installation and Administration Guide](#) for complete details.

Usage:

```
snapdrive snap disconnect -fs [mount_dir]
```

Where:

- `-fs` indicates a file system. Other options are `-lun` (LUN), `-dg` (disk group), `-vg` (volume group), `-hostvol` (host volume), `-lvol` (logical volume).
- `mount_dir` is the mount location of the Snapshot copy you want to disconnect.

For example, execute the following command to disconnect the Snapshot copy mounted at `/mnt/domtemp`.

```
snapdrive snap disconnect -fs /mnt/domtemp
```

- `snapdrive snap restore`

This command is used to restore a Snapshot copy. This exact command is referencing a file system (-fs) but depending on your configuration, you may need to reference a LUN (-lun), or disk group (-dg). The commands for each are similar, but check the [SnapDrive for UNIX Installation and Administration Guide](#) for complete details.

Usage:

```
snapdrive snap restore -fs [mount_dir] -snapname [snapshot-name]
```

Where:

- `-fs` indicates a file system. Other options are `-lun` (LUN), `-dg` (disk group), `-vg` (volume group), `-hostvol` (host volume), `-lvol` (logical volume).
- `mount_dir` is the mount location of the Snapshot copy you want to disconnect.
- `snapshot-name` – is the name of the Snapshot copy you want to use as a restore point.

Note: You need to stop the Domino server before attempting to restore a Snapshot copy. The restore command using the `-fs` switch attempts to unmount the file system so you must stop all associated processes that are using that mountpoint.

For example, execute the following command to restore the Snapshot copy named `Jan_29_10` to `/mnt/domdata`.

```
snapdrive snap restore -fs /mnt/domdata -snapname Jan_29_10
```

See [10.4: Sample Scripts](#) for sample scripts that should be useful in crafting a custom script for your environment.

10 APPENDIXES

10.1 DOMINO COMPACT SWITCHES

Table 3) Domino compact switches.

Switch	Purpose	Impact on Snapshot Copies
-S nn	Compacts database if unused space estimate is greater than nn% free space.	Low
-S nnnK	Compacts database if unused space estimate is greater than nnn kB.	Low
-S nnnM	Compacts database if unused space estimate is greater than nnn MB.	Low
-daos on	Enables Domino Attachment and Object Service (Domino 8.5 and later).	
-daos off	Disables Domino Attachment and Object Service (Domino 8.5 and later).	
-*	Include *.ntf and *.box when processing a directory (Domino 8.5 and later).	
-b	In-place database compaction without file-size reduction. The only switch that does not change the DBIID is -b.	Low
-B	In-place database compaction with file-size reduction.	Medium
-c or -C	Copy-style compaction, used to solve database corruption problems or enable features.	High
-L or -l	Copy-style compaction, allows access while compacting (if database is edited, Compact is cancelled).	High
-i	Use with -c or -L. Enables compacting to continue even if errors are encountered.	High
-o or -O	Use with in-place compaction. o checks for overlapping objects and switches to copy style if any are found.	
-e or -E	Does not execute Compact but validates syntax.	Low
-F	Enables "Document table bitmap optimization" database property. Performs copy-style compaction.	High
-f	Disables "Document table bitmap optimization" database property. Performs copy-style compaction.	High
-H	Enables the "Don't support specialized response hierarchy" database property. Performs copy-style compaction.	High
-h	Disables the "Don't support specialized response hierarchy" database property. Performs copy-style compaction.	High
-T	Enables transactional logging.	Low
-t	Disables transactional logging.	Low
-U	Enables the "Don't maintain unread marks" database property.	

Switch	Purpose	Impact on Snapshot Copies
-u	Disables the “Don’t maintain unread marks” database property.	
-K	Allows for a larger UNK table in a database past 64K.	
-k	Removes large UNK table in database.	
-V	Disables the “Compress document data” database property. Usually used with <code>-c</code> to enable or disable on existing data.	
-v	Enables the “Compress document data” database property. Usually used with <code>-c</code> to enable or disable on existing data.	
-ZU	Converts document attachments using compression type Huffman to LZ1. Note: The database property “Use LZ1 compression for attachments” must be enabled for this switch to be effective.	
-ZD	Converts document attachments using compression type LZ1 to Huffman.	
-N	Uncompress data (Domino 8 and later).	
-n	Compresses data (Domino 8 and later).	
-A	Archives and deletes documents from a database without compacting the database.	
-a	Archives and deletes documents from a database and then compacts the database.	
-j	Deletes documents from a database and then compacts the database.	
-Y	Recurse through subdirectories (default) (Domino 8.5 and later).	
-y	Do not recurse through subdirectories (Domino 8.5 and later).	
-0	Process NSFDB2 databases only. This ignores NSF databases and is to be used with other switches (Domino 8.5 and later).	
-D	Compacts databases and deletes any built view indexes.	
-R	Compacts databases and changes the ODS version to the previous release file format.	

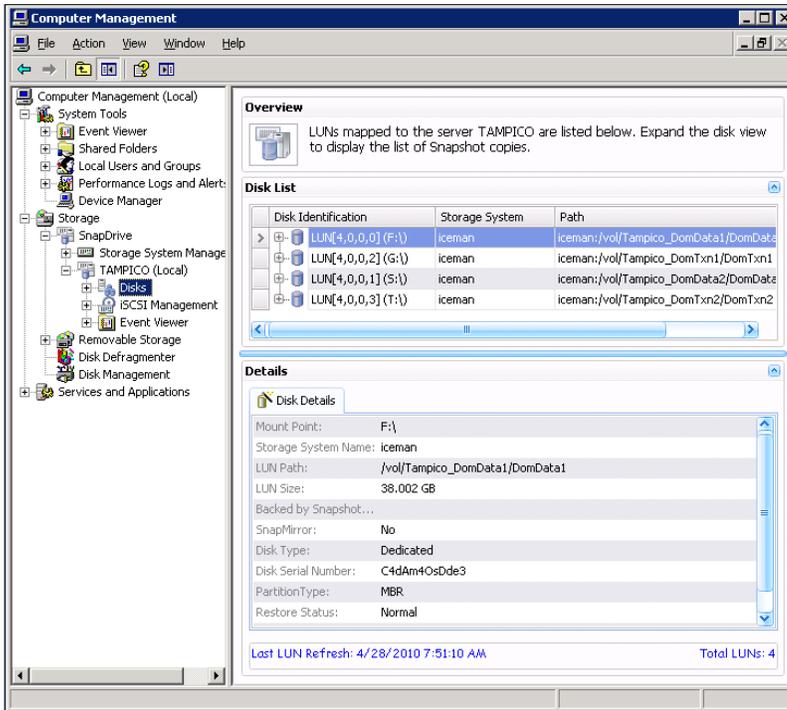
10.2 USING SNAPDRIVE TO RESTORE A SINGLE DOMINO DATABASE

It’s easy to restore a single Domino database or even a single e-mail from a LUN by using the built-in functionality of SnapDrive.

In this example, we mount a Snapshot copy contained in a LUN connected by iSCSI.

In Domino, each mail file or application is its own database, using the `.nsf` extension. You can use SnapDrive to browse the Snapshot copy directory and mount the Snapshot copy as a read-only file system. You can then copy a Domino database from the Snapshot copy onto a local workstation or even into the production file system, possibly overwriting a corrupt database with a Snapshot copy.

1. Open Computer Management (Start > Settings > Control Panel > Administrative Tools > Computer Management).
2. Under Storage, expand SnapDrive and expand the physical server name (Tampico in the example below), and then expand Disks.



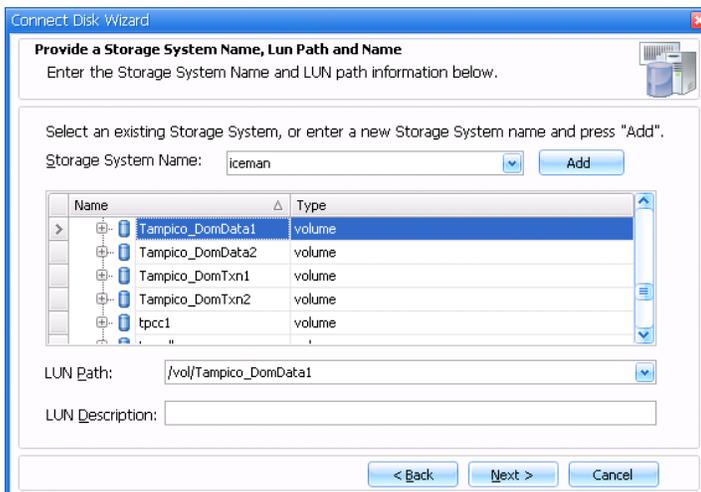
3. Right-click Disks and select Connect Disk.



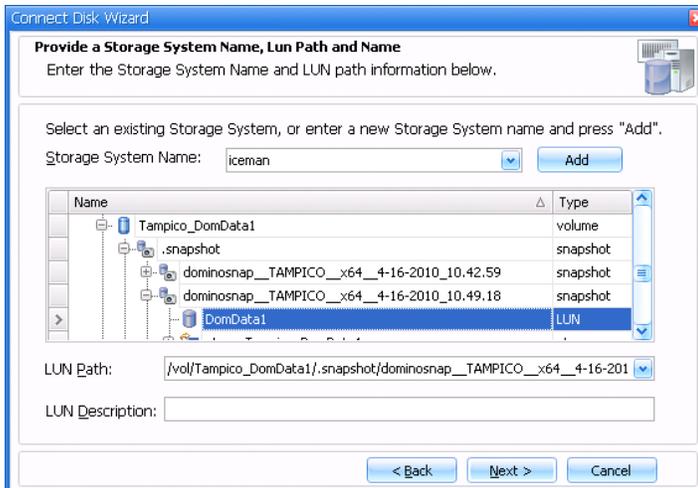
4. The Connect Disk Wizard opens.



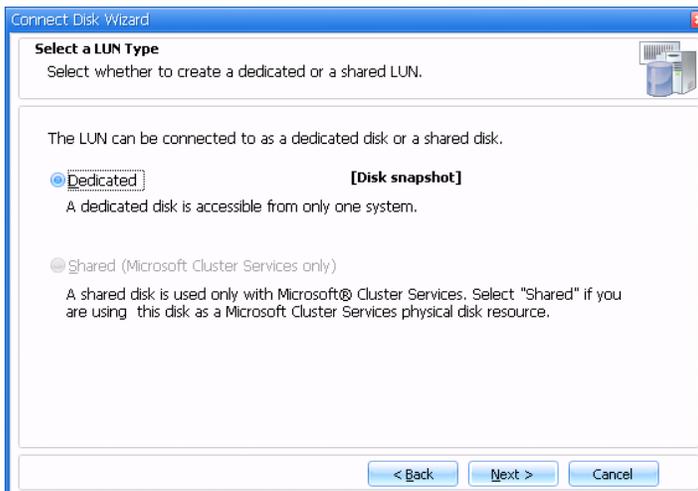
5. Click Next to continue.
6. Select your storage system from the drop down box or type your storage system name. Then locate the volume for which you want to access the Snapshot copy. In the following example, we are accessing a Snapshot copy on the volume Tampico_DomData1.



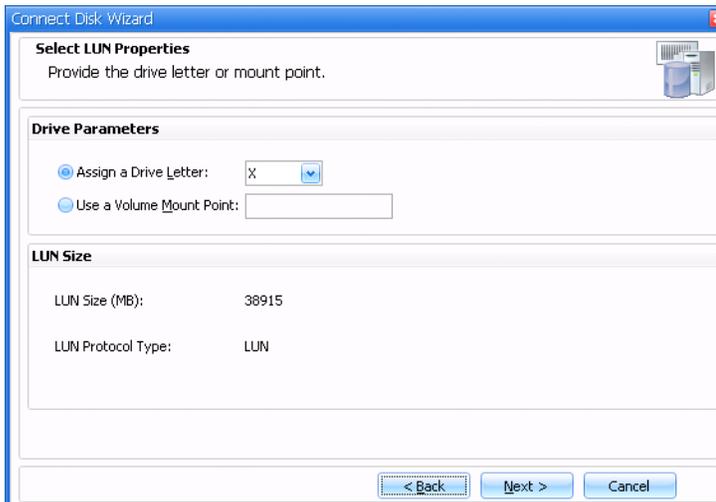
7. Expand the volume, then expand the .snapshot directory. Locate the Snapshot copy from which you want to access a database (in the following example, we are accessing dominosnap_TAMPICO_x64_4-16-2010_10.49.18). Then expand the Snapshot copy to select the LUN below it (DomData1 in the example).



8. Click Next to continue.
9. Select your LUN type. In this case, select Dedicated (your only option for a Snapshot copy).

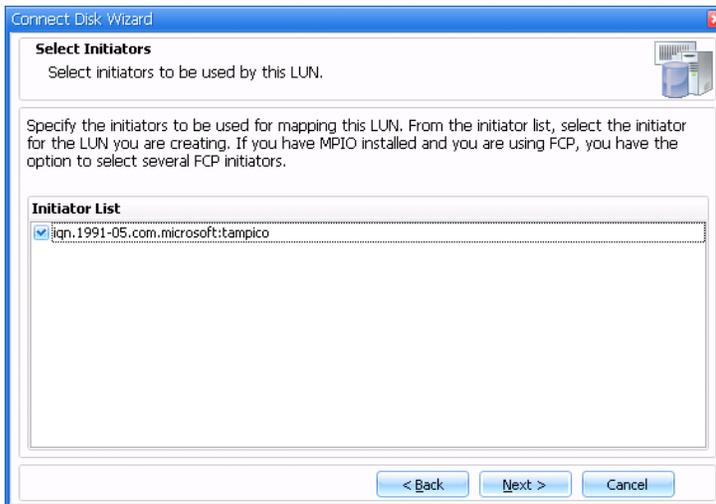


10. Click Next to continue.
11. Select a mountpoint for your Snapshot copy (in this example, X).



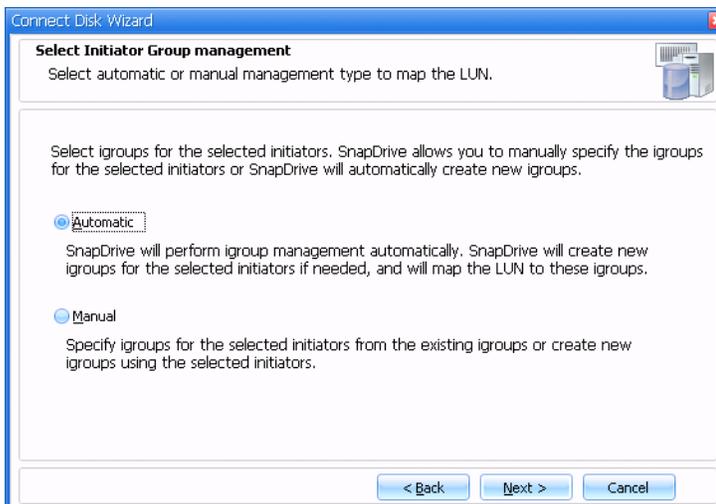
12. Click Next to continue.

13. We are using iSCSI in this example, so select an iSCSI initiator to continue.

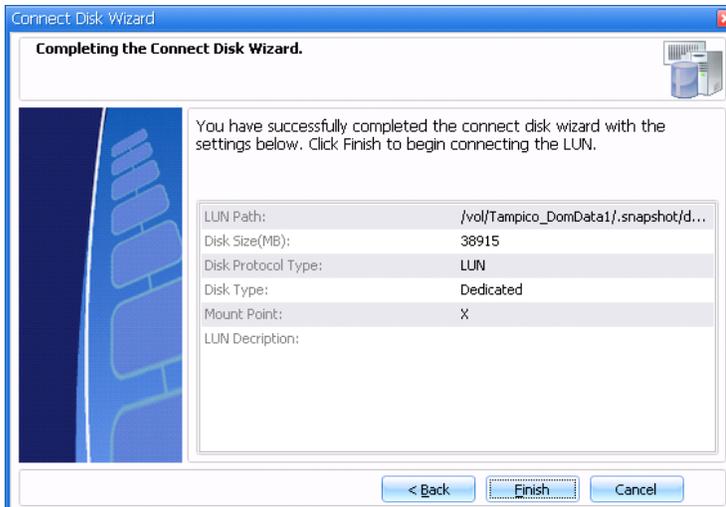


14. Click Next to continue.

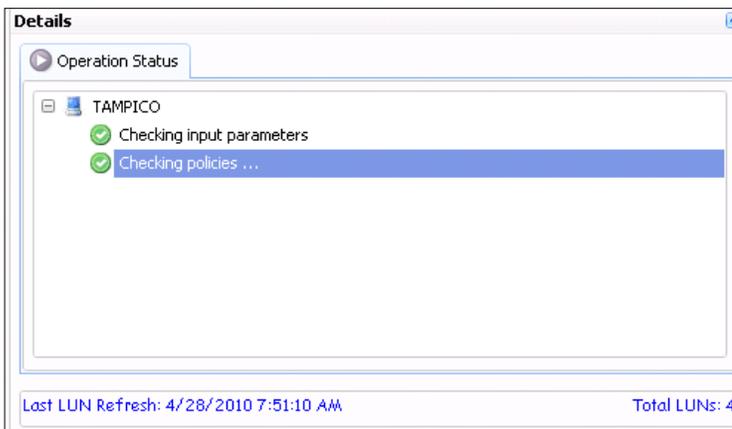
15. With iSCSI, you must also select initiator group management. Choose Automatic and click Next to continue.



16. Complete the Connect Disk Wizard. Review your settings and click Finish to continue.

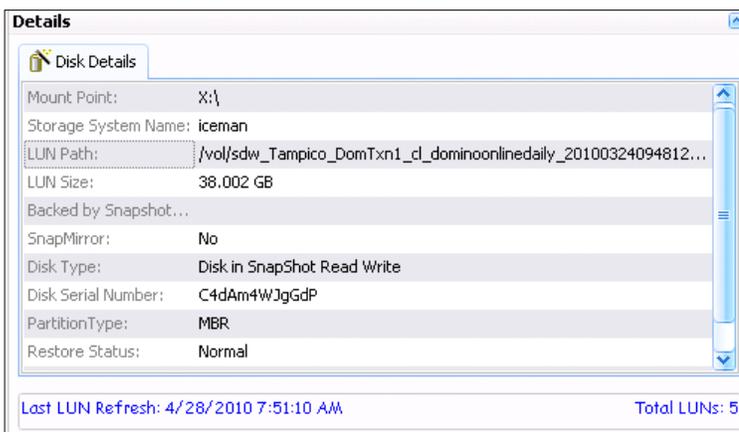


The details section updates you on the connection process.



When the process is completed, the details section reflects information about the mounted Snapshot copy.

The disk is now ready for use.



17. Open Windows Explorer to browse your Snapshot copy file system.

18. Locate the database to restore and copy it to your workstation or to the active file system.

Note: To restore to an active file system, you probably need to flush the database cache first by using the Domino CLI command `dbcache flush`.

A Domino administrator can open the restored database and copy a single e-mail from it into a user's production database.

19. When you have copied the database that you want to restore, remember to disconnect your Snapshot drive. To do this, highlight the drive in Computer Management, right-click, and select Disconnect Disk.

10.3 SNAP CREATOR COMMAND OUTPUT

SNAP CREATOR BACKUP OUTPUT

```
C:\scServer_v3.2.2\scServer_v3.2.2>snapcreator --profile domino --action snap --policy daily --config online --verbose
```

```
##### PRE APPLICATION QUIESCE COMMANDS #####
[Wed Jul 28 10:55:17 2010] INFO: No commands defined

##### PRE APPLICATION QUIESCE COMMANDS FINISHED SUCCESSFULLY #####

##### Application quiesce #####
[Wed Jul 28 10:55:17 2010] INFO: Starting Lotus Domino backup
[Wed Jul 28 10:55:18 2010] INFO: Dropping inactive connections
[Wed Jul 28 10:55:18 2010] INFO: Flushing DBCache
[Wed Jul 28 10:55:18 2010] INFO: Lotus Domino backup started successfully

##### POST APPLICATION QUIESCE COMMANDS #####
[Wed Jul 28 10:55:18 2010] INFO: No commands defined

##### POST APPLICATION QUIESCE COMMANDS FINISHED SUCCESSFULLY #####

##### PRE NETAPP COMMANDS #####
[Wed Jul 28 10:55:19 2010] INFO: No commands defined

##### PRE NETAPP COMMANDS FINISHED SUCCESSFULLY #####

##### Generating Info ASUP on iceman #####
[Wed Jul 28 10:55:19 2010] INFO: NetApp ASUP create on iceman finished successfully

##### Gathering Information for iceman:Tampico_DomData1 #####
[Wed Jul 28 10:55:19 2010] INFO: Performing NetApp Snapshot Inventory for
Tampico_DomData1 on iceman
[Wed Jul 28 10:55:19 2010] INFO: NetApp Snapshot Inventory of Tampico_DomData1 on
iceman completed Successfully

##### Gathering Information for iceman:Tampico_DomTxn1 #####
[Wed Jul 28 10:55:19 2010] INFO: Performing NetApp Snapshot Inventory for
Tampico_DomTxn1 on iceman
[Wed Jul 28 10:55:19 2010] INFO: NetApp Snapshot Inventory of Tampico_DomTxn1 on
iceman completed Successfully

##### Running NetApp Snapshot Rename on Primary iceman #####

##### Taking Snapshot on Primary iceman:Tampico_DomData1 #####
[Wed Jul 28 10:55:19 2010] INFO: Creating NetApp Snapshot for Tampico_DomData1 on
iceman
[Wed Jul 28 10:55:20 2010] INFO: NetApp Snapshot Create of domino-online-
daily_20100728105517 on iceman:Tampico_DomData1 Completed Successfully

##### Taking Snapshot on Primary iceman:Tampico_DomTxn1 #####
[Wed Jul 28 10:55:20 2010] INFO: Creating NetApp Snapshot for Tampico_DomTxn1 on
iceman
[Wed Jul 28 10:55:21 2010] INFO: NetApp Snapshot Create of domino-online-
daily_20100728105517 on iceman:Tampico_DomTxn1 Completed Successfully
```

```

##### PRE APPLICATION UNQUIESCE COMMANDS #####
[Wed Jul 28 10:55:21 2010] INFO: No commands defined

##### PRE APPLICATION UNQUIESCE COMMANDS FINISHED SUCCESSFULLY #####

##### Application unquiesce #####
[Wed Jul 28 10:55:21 2010] INFO: For online backups there is no need to do anything
for the unquiesce

##### POST APPLICATION UNQUIESCE COMMANDS #####
[Wed Jul 28 10:55:21 2010] INFO: No commands defined

##### POST APPLICATION UNQUIESCE COMMANDS FINISHED SUCCESSFULLY #####

##### ARCHIVE COMMANDS #####
[Wed Jul 28 10:55:21 2010] INFO: No commands defined

##### ARCHIVE COMMANDS FINISHED SUCCESSFULLY #####

##### Generating Info ASUP on iceman #####
[Wed Jul 28 10:55:21 2010] INFO: NetApp ASUP create on iceman finished successfully

##### POST NETAPP DATA TRANSFER COMMANDS #####
[Wed Jul 28 10:55:21 2010] INFO: No commands defined

##### POST NETAPP DATA TRANSFER COMMANDS FINISHED SUCCESSFULLY #####

##### Running NetApp Snapshot Delete on Primary iceman #####
[Wed Jul 28 10:55:21 2010] WARN: More than 7 NetApp snapshots exist, older snapshots
of iceman:Tampico_DomData1 will be automatically deleted!
[Wed Jul 28 10:55:21 2010] WARN: Deleting NetApp Snapshot domino-online-
daily_20100728104353 on iceman:Tampico_DomData1
[Wed Jul 28 10:55:22 2010] INFO: NetApp Snapshot Delete of domino-online-
daily_20100728104353 on iceman:Tampico_DomData1 completed Successfully
[Wed Jul 28 10:55:22 2010] WARN: More than 7 NetApp snapshots exist, older snapshots
of iceman:Tampico_DomTxn1 will be automatically deleted!
[Wed Jul 28 10:55:22 2010] WARN: Deleting NetApp Snapshot domino-online-
daily_20100728104353 on iceman:Tampico_DomTxn1
[Wed Jul 28 10:55:23 2010] INFO: NetApp Snapshot Delete of domino-online-
daily_20100728104353 on iceman:Tampico_DomTxn1 completed Successfully

##### POST NETAPP COMMANDS #####
[Wed Jul 28 10:55:23 2010] INFO: No commands defined

##### POST NETAPP COMMANDS FINISHED SUCCESSFULLY #####

##### SnapCreator finished successfully #####
[Wed Jul 28 10:55:23 2010] INFO: INFO: SnapCreator Backup for domino-online ACTION:
snap POLICY: daily finished successfully

C:\scServer_v3.2.2\scServer_v3.2.2>

```

SNAP CREATOR SNAPLIST OUTPUT

```

C:\scServer_v3.2.2\scServer_v3.2.2>snapcreator --profile domino --action snaplist --
config online

##### SnapCreator Snapshot (Primary) List for iceman:Tampico_DomData1 #####

### Snapshot Name ###                ### Snapshot Timestamp ###
domino-online-daily_20100728104421    Jul 28 2010 10:45:24
domino-online-daily_20100728104630    Jul 28 2010 10:47:33

```

```

domino-online-daily_20100728104900      Jul 28 2010 10:50:04
domino-online-daily_20100728104952      Jul 28 2010 10:50:56
domino-online-daily_20100728105050      Jul 28 2010 10:51:54
domino-online-daily_20100728105232      Jul 28 2010 10:53:36
domino-online-daily_20100728105517      Jul 28 2010 10:56:21

```

```

##### SnapCreator Snapshot (Primary) List for iceman:Tampico_DomTxnl #####

```

```

### Snapshot Name ###                ### Snapshot Timestamp ###
domino-online-daily_20100728104421      Jul 28 2010 10:45:25
domino-online-daily_20100728104630      Jul 28 2010 10:47:34
domino-online-daily_20100728104900      Jul 28 2010 10:50:05
domino-online-daily_20100728104952      Jul 28 2010 10:50:57
domino-online-daily_20100728105050      Jul 28 2010 10:52:04
domino-online-daily_20100728105232      Jul 28 2010 10:53:37
domino-online-daily_20100728105517      Jul 28 2010 10:56:21

```

```

C:\scServer_v3.2.2\scServer_v3.2.2>

```

SNAP CREATOR RESTORE OUTPUT

```

C:\scServer_v3.2.2\scServer_v3.2.2>snapcreator --profile domino --action restore --
policy daily --config online --verbose

```

```

##### PRE RESTORE COMMANDS #####
[Wed Jul 28 12:57:26 2010] INFO: No commands defined

```

```

##### PRE RESTORE COMMANDS FINISHED SUCCESSFULLY #####

```

```

### You have chosen to do a snap restore on one or more volumes for the Config:
online Policy: daily ###
Are you sure you want to continue (y|n)? y

```

```

### Volume Menu for iceman ###

```

01. Tampico_DomData1
02. Tampico_DomTxnl

```

Select a volume for snapshot restore (enter a number, "n" for next filer, "c" to
continue, or "q" to quit): 01

```

```

##### Gathering Information for iceman:Tampico_DomData1 #####
[Wed Jul 28 12:57:51 2010] INFO: Performing NetApp Snapshot Inventory for
Tampico_DomData1 on iceman
[Wed Jul 28 12:57:51 2010] INFO: NetApp Snapshot Inventory of Tampico_DomData1 on
iceman completed Successfully

```

```

### Snapshot Menu for iceman:Tampico_DomData1 ###

```

01. domino-online-daily_20100728105517 (Jul 28 2010 10:56:21)
 02. domino-online-daily_20100728105232 (Jul 28 2010 10:53:36)
 03. domino-online-daily_20100728105050 (Jul 28 2010 10:51:54)
 04. domino-online-daily_20100728104952 (Jul 28 2010 10:50:56)
 05. domino-online-daily_20100728104900 (Jul 28 2010 10:50:04)
 06. domino-online-daily_20100728104630 (Jul 28 2010 10:47:33)
 07. domino-online-daily_20100728104421 (Jul 28 2010 10:45:24)
- ```

Select a snapshot for restore (enter a number or "q" to quit): 03

```

```

Restore Menu for iceman:Tampico_DomData1 snapshot domino-online-
daily_20100728105050 ###

```

01. Volume Restore
02. File Restore

```

Select a restore type (enter a number, or "q" to quit): 01

```

```

WARN: You have selected to do a volume restore, All data in iceman:Tampico_DomData1
will be reverted to snapshot domino-online-daily_20100728105050
WARN: All data in iceman:Tampico_DomData1 from Jul 28 2010 10:51:54 to Jul 28 2010
12:58:09 will be lost!!!
Are you sure you want to continue with the restore (y|n)?y

[Wed Jul 28 12:58:20 2010] INFO: NetApp Snapshot Volume Restore of domino-online-
daily_20100728105050 on iceman:Tampico_DomData1 finished successfully

Volume Menu for iceman
01. Tampico_DomData1
02. Tampico_DomTxn1
Select a volume for snapshot restore (enter a number, "n" for next filer, "c" to
continue, or "q" to quit): 02

Gathering Information for iceman:Tampico_DomTxn1
[Wed Jul 28 12:58:35 2010] INFO: Performing NetApp Snapshot Inventory for
Tampico_DomTxn1 on iceman
[Wed Jul 28 12:58:35 2010] INFO: NetApp Snapshot Inventory of Tampico_DomTxn1 on
iceman completed Successfully

Snapshot Menu for iceman:Tampico_DomTxn1
01. domino-online-daily_20100728105517 (Jul 28 2010 10:56:21)
02. domino-online-daily_20100728105232 (Jul 28 2010 10:53:37)
03. domino-online-daily_20100728105050 (Jul 28 2010 10:52:04)
04. domino-online-daily_20100728104952 (Jul 28 2010 10:50:57)
05. domino-online-daily_20100728104900 (Jul 28 2010 10:50:05)
06. domino-online-daily_20100728104630 (Jul 28 2010 10:47:34)
07. domino-online-daily_20100728104421 (Jul 28 2010 10:45:25)
Select a snapshot for restore (enter a number or "q" to quit): 03

Restore Menu for iceman:Tampico_DomTxn1 snapshot domino-online-
daily_20100728105050 ###
01. Volume Restore
02. File Restore
Select a restore type (enter a number, or "q" to quit): 01

WARN: You have selected to do a volume restore, All data in iceman:Tampico_DomTxn1
will be reverted to snapshot domino-online-daily_20100728105050
WARN: All data in iceman:Tampico_DomTxn1 from Jul 28 2010 10:52:04 to Jul 28 2010
12:58:44 will be lost!!!
Are you sure you want to continue with the restore (y|n)?y

[Wed Jul 28 12:58:50 2010] INFO: NetApp Snapshot Volume Restore of domino-online-
daily_20100728105050 on iceman:Tampico_DomTxn1 finished successfully

Volume Menu for iceman
01. Tampico_DomData1
02. Tampico_DomTxn1
Select a volume for snapshot restore (enter a number, "n" for next filer, "c" to
continue, or "q" to quit): c

INFO: Completing restore and running an post-restore commands that may be defined

POST RESTORE COMMANDS
[Wed Jul 28 12:58:54 2010] INFO: No commands defined

POST RESTORE COMMANDS FINISHED SUCCESSFULLY
C:\scServer_v3.2.2\scServer_v3.2.2>

```

## 10.4 SAMPLE SCRIPTS

You can use the sample scripts in this section as basic examples of scripting for a NetApp and Domino environment. To use a script, just copy and paste it, and adjust the variables.

### SCENARIO

Company X wants to create a series of Snapshot copies. It has the following requirements for Snapshot copies:

- Create three daily Snapshot copies, keeping only one day's worth (three Snapshot copies maximum).
- Create one nightly Snapshot copy, keeping one week's worth of Snapshot copies (six Snapshot copies maximum).
- Create one weekly Snapshot copy, keeping one month's worth of Snapshot copies (four Snapshot copies maximum).

### ADDITIONAL REQUIREMENTS

Create daily Snapshot copies while the server is running, but stop the server during nightly and weekly Snapshot copy creation to achieve consistency.

The easiest way to approach this is to create three scripts: a daily script, a nightly script, and a weekly script.

### VARIABLES

- [host]: Replace with the host name or the IP address of your storage system.
- [vol\_name]: Replace with the volume name.
- [user]: Replace with your user name.
- [snapshot\_name]: Snapshot copy name; this is used in the restore script.

### UNIX BACKUP SCRIPTS

UNIX daily Snapshot script:

```
#!/bin/sh
echo "Begin Daily Snapshot Code"
#This code was written for Linux
#The purpose of this script is to create a Daily snapshot, keeping a maximum of 3
Daily snapshots
#This code assumes that your Domino binary files are in the default location
#Domino default binary location = /opt/ibm/lotus/bin
#This code also assumes that your Domino data directory is mounted at /mnt/domdata
#The snapshot names are: DAILY1, DAILY2, DAILY3
echo "Rotate Snapshots"
rsh [host] -l [user] -n snap delete [vol_name] DAILY3
rsh [host] -l [user] -n snap rename [vol_name] DAILY2 DAILY3
rsh [host] -l [user] -n snap rename [vol_name] DAILY1 DAILY2
echo "Change to Domino Data Directory"
cd /mnt/domdata
echo "Drop Domino Connections"
/opt/ibm/lotus/bin/server -c "drop all"
echo "Flush Database Cache"
/opt/ibm/lotus/bin/server -c "dbcache flush"
echo "Take Snapshot"
rsh [host] -l [user] -n snap create [vol_name] DAILY1
echo "End Daily Snapshot Code"
```

### UNIX nightly Snapshot script:

```
#!/bin/sh
echo "Begin Nightly Snapshot Code"
#This code was written for Linux
#The purpose of this script is to create a Nightly snapshot, keeping a maximum of 6
Nightly snapshots
#This code will completely stop the Domino server, ensuring that no activity is
occurring on the server
#This code assumes that your Domino binary files are in the default location
#Domino default binary location = /opt/ibm/lotus/bin
#This code also assumes that your Domino data directory is mounted at /mnt/domdata
#The snapshot names are: Nightly1, Nightly2, Nightly3, Nightly4, Nightly5, Nightly6
echo "Rotate Snapshots"
rsh [host]-1 [user] -n snap delete [vol_name] Nightly6
rsh [host]-1 [user] -n snap rename [vol_name] Nightly5 Nightly6
rsh [host]-1 [user] -n snap rename [vol_name] Nightly4 Nightly5
rsh [host]-1 [user] -n snap rename [vol_name] Nightly3 Nightly4
rsh [host]-1 [user] -n snap rename [vol_name] Nightly2 Nightly3
rsh [host]-1 [user] -n snap rename [vol_name] Nightly1 Nightly2
echo "Change to Domino Data Directory"
cd /mnt/domdata
echo "Drop Domino Connections"
/opt/ibm/lotus/bin/server -c "drop all"
echo "Flush Database Cache"
/opt/ibm/lotus/bin/server -c "dbcache flush"
echo "Stop the Domino Server"
/opt/ibm/lotus/bin/server -q
echo "Run NSD Kill to ensure that no Domino related tasks are running"
/opt/ibm/lotus/bin/nsd -kill
echo "Take Snapshot"
rsh [host]-1 [user] -n snap create [vol_name] Nightly1
echo "Start Domino Server"
/opt/ibm/lotus/bin/server &
echo "End Daily Snapshot Code"
```

### UNIX weekly Snapshot script:

```
#!/bin/sh
echo "Begin Nightly Snapshot Code"
#This code was written for Linux
#The purpose of this script is to create a Weekly snapshot, keeping a maximum of 4
Weekly snapshots
#This code will completely stop the Domino server, ensuring that no activity is
occurring on the server
#This code assumes that your Domino binary files are in the default location
#Domino default binary location = /opt/ibm/lotus/bin
#This code also assumes that your Domino data directory is mounted at /mnt/domdata
#The snapshot names are: Weekly1, Weekly2, Weekly3, Weekly4
echo "Rotate Snapshots"
rsh [host]-1 [user] -n snap delete [vol_name] Weekly4
rsh [host]-1 [user] -n snap rename [vol_name] Weekly3 Weekly4
rsh [host]-1 [user] -n snap rename [vol_name] Weekly2 Weekly3
rsh [host]-1 [user] -n snap rename [vol_name] Weekly1 Weekly2
echo "Change to Domino Data Directory"
cd /mnt/domdata
echo "Drop Domino Connections"
/opt/ibm/lotus/bin/server -c "drop all"
echo "Flush Database Cache"
/opt/ibm/lotus/bin/server -c "dbcache flush"
echo "Stop the Domino Server"
/opt/ibm/lotus/bin/server -q
echo "Run NSD Kill to ensure that no Domino related tasks are running"
```

```

/opt/ibm/lotus/bin/nsd -kill
echo "Take Snapshot"
rsh [host]-l [user] -n snap create [vol_name] Weekly1
echo "Start Domino Server"
/opt/ibm/lotus/bin/server &
echo "End Daily Snapshot Code"

```

## UNIX SNAPSHOT RESTORE CODE

```

#!/bin/sh
echo "Begin Snapshot Restore Code"
#This code was written for Linux
#The purpose of this script is to restore the most recent Nightly Snapshot
#This code assumes that your Domino binary files are in the default location
#Domino default binary location = /opt/ibm/lotus/bin
#This code also assumes that your Domino data directory is mounted at /mnt/domdata
#The snapshot we are restoring is: Nightly4
echo "Change to Domino Data Directory"
cd /mnt/domdata
echo "Drop Domino Connections"
/opt/ibm/lotus/bin/server -c "drop all"
echo "Flush Database Cache"
/opt/ibm/lotus/bin/server -c "dbcache flush"
echo "Stop the Domino Server"
/opt/ibm/lotus/bin/server -q
echo "Run NSD Kill to ensure that no Domino related tasks are running"
/opt/ibm/lotus/bin/nsd -kill
echo "Restore Last Nightly Snapshot"
rsh [host] -l [user] -n snap restore -s [snapshot_name] [vol_name]
echo "End Snapshot Restore Code"

```

## WINDOWS BACKUP SCRIPTS

Windows daily Snapshot code:

```

@REM Begin Daily Snapshot Code
@REM -----
@REM This code was written for Windows
@REM This code assumes that your program files exist in C:\Lotus\Domino
@REM -----

@REM Change to Domino Program Directory - This must be done to ensure @REM NSD/NSERVER
commands run properly
cd C:\Lotus\Domino
@REM Rotate Snapshots
rsh [host]-l [user] -n snap delete [vol_name] DAILY3
rsh [host]-l [user] -n snap rename [vol_name] DAILY2 DAILY3
rsh [host]-l [user] -n snap rename [vol_name] DAILY1 DAILY2
@REM Drop Domino Connections
C:\Lotus\Domino\nserver -c "drop all"
@REM Flush Database Cache
C:\Lotus\Domino\nserver -c "dbcache flush"
@REM Take Snapshot
rsh [host] -l [user] -n snap create [vol_name] DAILY1
@REM End Daily Snapshot Code
exit

```

Windows nightly Snapshot code:

```

@REM Begin Nightly Snapshot Code
@REM -----
@REM This code was written for Windows

```

```

@REM This code assumes that your program files exist in C:\Lotus\Domino
@REM This code assumes that Domino starts as a service
@REM Please adjust according to your environment
@REM -----
@REM Change to Domino Program Directory - This must be done to ensure NSD/NSERVER
commands run properly
cd C:\Lotus\Domino
@REM Rotate Snapshots
@REM This rotates the Nightly log, keeping six days worth of logs
rsh [host] -l [user] -n snap delete [vol_name] Nightly6
rsh [host] -l [user] -n snap rename [vol_name] Nightly5 Nightly6
rsh [host] -l [user] -n snap rename [vol_name] Nightly4 Nightly5
rsh [host] -l [user] -n snap rename [vol_name] Nightly3 Nightly4
rsh [host] -l [user] -n snap rename [vol_name] Nightly2 Nightly3
rsh [host] -l [user] -n snap rename [vol_name] Nightly1 Nightly2
@REM Drop Domino Connections
C:\Lotus\Domino\nserver -c "drop all"
@REM Flush Database Cache
C:\Lotus\Domino\nserver -c "dbcache flush"
@REM Stop the Domino Service
NET STOP "Lotus Domino Server (LotusDominoData)"
@REM PAUSE 3 MINUTES TO GIVE TIME FOR THE DOMINO TASKS TO SHUTDOWN PROPERLY
TIMEOUT 180
@REM run nsd kill to terminate any tasks that haven't shut down
C:\Lotus\Domino\nsd.exe -kill
@REM Take Snapshot
rsh [host] -l [user] -n snap create [vol_name] Nightly1
@REM Start Domino Service
NET START "Lotus Domino Server (LotusDominoData)"
@REM End Daily Snapshot Code
exit

```

#### Windows weekly Snapshot code:

```

@REM Begin Weekly Snapshot Code
@REM -----
@REM This code was written for Windows
@REM This code assumes that your program files exist in C:\Lotus\Domino
@REM This code assumes that Domino starts as a service
@REM Please adjust according to your environment
@REM -----
@REM Change to Domino Program Directory - This must be done to ensure NSD/NSERVER
commands run properly
cd C:\Lotus\Domino
@REM Rotate Snapshots
@REM This rotates the Weekly log, keeping four weeks worth of logs
rsh [host] -l [user] -n snap delete [vol_name] Weekly4
rsh [host] -l [user] -n snap rename [vol_name] Weekly3 Weekly4
rsh [host] -l [user] -n snap rename [vol_name] Weekly2 Weekly3
rsh [host] -l [user] -n snap rename [vol_name] Weekly1 Weekly2
@REM Drop Domino Connections
C:\Lotus\Domino\nserver -c "drop all"
@REM Flush Database Cache
C:\Lotus\Domino\nserver -c "dbcache flush"
@REM Stop the Domino Service
NET STOP "Lotus Domino Server (LotusDominoData)"
@REM PAUSE 3 MINUTES TO GIVE TIME FOR THE DOMINO TASKS TO SHUTDOWN PROPERLY
TIMEOUT 180
@REM run nsd kill to terminate any tasks that haven't shut down
C:\Lotus\Domino\nsd.exe -kill
@REM Take Snapshot
rsh [host] -l [user] -n snap create [vol_name] Weekly1
@REM Start Domino Service

```

```

NET START "Lotus Domino Server (LotusDominoData)"
@REM End Daily Snapshot Code
Exit

```

## WINDOWS SNAPSHOT RESTORE CODE

```

@REM Begin Snapshot Restore Code
@REM -----
@REM This code was written for Windows
@REM This code assumes that your program files exist in C:\Lotus\Domino
@REM This code assumes that Domino starts as a service
@REM Please adjust according to your environment
@REM -----
@REM Change to Domino Program Directory - This must be done to ensure NSD/NSERVER
commands run properly
cd C:\Lotus\Domino
@REM Drop Domino Connections
C:\Lotus\Domino\nserver -c "drop all"
@REM Flush Database Cache
C:\Lotus\Domino\nserver -c "dbcache flush"
@REM Stop the Domino Service
NET STOP "Lotus Domino Server (LotusDominoData)"
@REM PAUSE 3 MINUTES TO GIVE TIME FOR THE DOMINO TASKS TO SHUTDOWN PROPERLY
TIMEOUT 180
@REM run nsd kill to terminate any tasks that haven't shut down
C:\Lotus\Domino\nsd.exe -kill
@REM Restore Snapshot
rsh [host] -l [user] -n snap restore -s [snapshot_name] [vol_name]
@REM PAUSE 1 MINUTE TO ENSURE RESTORE IS COMPLETE
TIMEOUT 60
@REM Start Domino Service
NET START "Lotus Domino Server (LotusDominoData)"
@REM End Snapshot Restore Code
Exit

```

## WINDOWS ISCSI DAILY SNAPSHOT WITH SNAPDRIVE

```

@REM Begin Daily Snapshot
@REM -----
@REM Change to SnapDrive directory
echo on
c:
cd "\"program files"\netapp\snapdrive
@REM Keep only 6 snapshots
sdcli snap delete -m %computername% -s snap6 -d k
sdcli snap rename -m %computername% -d k -o snap5 -n snap6
sdcli snap rename -m %computername% -d k -o snap4 -n snap5
sdcli snap rename -m %computername% -d k -o snap3 -n snap4
sdcli snap rename -m %computername% -d k -o snap2 -n snap3
sdcli snap rename -m %computername% -d k -o snap1 -n snap2
@REM Prepare Domino for snapshot
j:\notes\nserver -c "drop all"
j:\notes\nserver -c "dbcache flush"
@REM Take snapshot
sdcli snap create -m %computername% -s snap1 -D k
exit

```

## 11 REFERENCES

The following IBM Web pages are referenced in this document:

- [IBM Lotus Domino Home Page](#)
- [IBM Lotus Notes and Domino Wiki](#)
- [IBM Lotus Support – Information Center and Documentation](#)

The following NashCom Web site is referenced in this document:

- [NashCom Domino Start/Stop Script](#)

The following NetApp video, technical reports, and Web site are referenced in this paper:

- [SnapManager for Domino Video on Demand](#)
- [TR-3002: File System Design for an NFS File Server Appliance](#)
- [TR-3298: RAID-DP: NetApp Implementation of RAID Double Parity for Data Protection](#)
- [TR-3347: A Thorough Introduction to FlexClone Volumes](#)
- [TR-3588: Integrating Lotus Domino 8.5 for Windows 2008 with a NetApp Storage System](#)
- [TR-3691: Integrating Lotus Domino for Linux with a NetApp Storage System](#)
- [TR-3692: SnapManager for Domino Installation and Use](#)
- [TR-3723: Deploying Lotus Domino Server in an AIX and NetApp Storage System Environment Using NFS](#)
- [TR-3841: SnapCreator 3.2 Installation and Administration Guide](#)
- [TR-3843: Storage Savings with Domino and NetApp Deduplication](#)
- [www.netapp.com](http://www.netapp.com)

The following NOW documents are referenced in this paper:

**Note:** A NOW account is required to access these documents (<http://now.netapp.com>).

- [Data ONTAP 8.0 7-Mode Data Protection Online Backup and Recovery Guide](#)
- [Data ONTAP 8.0 7-Mode Documentation](#)
- [SnapDrive for UNIX Installation and Administration Guide](#)
- [SnapDrive 6.2 for Windows Installation and Administration Guide](#)
- [Storage System Client Software Information Library](#)

## 12 REVISION INFORMATION

Table 4) Revision history.

| Date          | Version | Comments                                                                                                                           |
|---------------|---------|------------------------------------------------------------------------------------------------------------------------------------|
| February 2009 | 1.0     | Original publication: Domino scripting TR                                                                                          |
| November 2010 | 2.0     | Revised TR to a Domino backup and restore TR: added information for SnapManager for Domino, Snap Creator, Domino Compact, and more |

## 13 ACKNOWLEDGEMENTS

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