Technical Report

Best Practices for Domino on NetApp

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Executive Summary

IBM Lotus Domino provides enterprise-grade e-mail, collaboration capabilities, a custom application platform, Web-serving capabilities, and an integrated database system. Domino can be set up and configured in a multitude of ways, and it is not likely that this guide will fit every production scenario. This document is limited in scope to the best practices that pertain to the storage layout of the Domino environment, and there are many additional Domino-server specific best practices. This technical report is not intended to be a definitive implementation or solution guide. Expertise might be required to solve specific deployments.

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1 Introduction

IBM Lotus Domino is an IBM server product that provides enterprise-grade e-mail, collaboration capabilities, and a custom application platform. IBM supports a wide variety of configurations for Domino deployments. For optimal performance and smooth operation, it is important to follow design considerations and best practices. This document offers insights related to design considerations and best practices when implementing an IBM Lotus Domino solution in a NetApp® storage environment.

1.1 Intended Audience and Scope

This document offers guidance in planning and deploying IBM Lotus Domino on NetApp storage. It assumes familiarity with the basic concepts of IBM Lotus Domino, NetApp storage systems, NetApp Data ONTAP® operating system, network protocols, and disk types.

The recommendations and best practices described in this document are based on experiences with NetApp customers, real-world simulations, NetApp Engineering Lab validations, and standard recommendation for NetApp storage. The scope of this document is limited to technical discussions of design considerations. This document does not describe an end-to-end solution implementation.

The best practices for IBM Lotus Domino presented in this document focus primarily on Lotus Domino 8.5.2 and NetApp Data ONTAP 8.0. The information presented in this document is applicable to a wide variety of configurations.

1.2 IBM Statement of Support for Domino on SAN and NAS Environments

IBM has a full statement of support for running Domino in storage area network (SAN) and network-attached storage (NAS) environments. Essentially, the statement reads that both SAN (FCP and iSCSI) and NAS (NFS and CIFS) devices are supported with IBM Lotus Domino. Read the full statement of support on the IBM Web site: https://www-304.ibm.com/support/docview.wss?uid=swg27002613.

2 Recipe for Success

For end users, performance is essential. Domino environment performance depends on various factors, but when it comes to storage, the number of disk spindles makes a huge difference. The system I/O is driven by the number of disks in the Domino environment. Although invisible to the end user, the key to a successful storage implementation is to think about the disks, not only the amount of space is needed to store the data. Many of the complaints about SAN and NAS in Domino have to do with poor performance, often because the environment is sized for capacity, not for I/O.

2.1 Storage Layout Best Practices

Best Practice
RAID structure, aggregates, and flexible volumes are the key logical elements of the NetApp storage system. When architecting a Domino environment on NetApp storage, the layout of aggregates and volumes must be thoroughly considered.

Disk Drives

When considering the storage layout, proper consideration of the type of disks = to use for the Domino environment is crucial. Certain disk drive types provide advantages in capacity or I/O:

- **FC.** Fibre Channel (FC) disk drives are beneficial for high read/write speed, and they have the ability to handle high I/O loads. This type of disk is more expensive compared with other types of disks. FC disks are ideally suited to handle the I/O requirements of Lotus Domino server deployments. FC disks run at either 10K or 15K RPM.

- **SATA.** Serial ATA (SATA) is a viable solution in Domino environments with appropriate sizing for I/O. Although the SATA disks might be a good fit for performance and capacity, NetApp recommends that SATA disks in a Domino environment should be used in a DS4243 disk shelf. A PAM card should be used in solutions involving SATA drives to account for periods of increased I/O. SATA disks run at either 5.4K RPM or, when SAS connected, 7.2K RPM.
- **SAS.** Serial attached SCSI (SAS) disks provide capacity as well as throughput speeds that make them an excellent choice for Domino server workloads. SAS disks run at 15K RPM.
- **SSD.** Solid-state disks (SSDs) are flash-memory-based devices that provide higher IOPS and faster response time than rotating media can provide. SSDs demonstrate latencies that are at least 10 times lower than the fastest hard disk drives (HDDs), often enabling response times more than 10 times faster. For random read workloads, SSDs might deliver the I/O throughput of 30 or more HDDs while consuming significantly less power per disk. For details, see NetApp WP-7061: Flash Memory Technology in Enterprise Storage.

RAID-DP

NetApp RAID-DP® is an advanced RAID technology that is provided as the default RAID level on all FAS systems. RAID-DP offers dramatic improvements in data protection that address the challenges to RAID implementation brought on by the rapid growth in size of modern disks, and it protects against the simultaneous loss of two drives in a single RAID group. These improvements are provided by NetApp at no cost to the customer. This level of resiliency and storage efficiency makes data residing on RAID-DP safer than data stored on RAID 5 and more cost effective than RAID 10. NetApp recommends using RAID-DP on all RAID groups that store IBM Lotus Domino data.

For in-depth information about RAID-DP, see TR-3298-RAID-DP: NetApp Implementation of Double-Parity RAID for Data Protection.

Aggregate Recommendations

An *aggregate* is NetApp's virtualization layer that abstracts physical disks from logical datasets, referred to as *flexible volumes.* Aggregates are the means by which the total IOPS available to all of the physical disks are pooled as a resource. This design is well suited to meet the needs of an unpredictable and mixed workload. NetApp recommends configuring the storage environment with a small number of large aggregates. On smaller FAS arrays, it might not be practical to have more than a single aggregate, due to the restricted number of disk drives on the system. In these cases, it is acceptable to have only a single aggregate.

Table 1 describes deploying Domino on a single aggregate versus multiple aggregates. Most configurations are likely to use only a single aggregate for Domino (or a single large shared aggregate for the whole storage system), but high-I/O, large-scale Domino environments can benefit by having multiple aggregates to service different disk types. An example of a multiple aggregate layout would be hosting Domino logs and data on one large aggregate with SAS drives, while a smaller aggregate composed of SATA drives hosts Domino data from the Domino Attachment and Object Service (DAOS).

Table 1) Aggregate configurations.

Use Case	Aggregate Layout	Benefits
Shared storage, small storage controller deployments	Single aggregate for Domino	• Easier to manage and configure • Larger aggregates have better performance in lab testing

Use Case	Aggregate Layout	Benefits
Large storage controller deployments, specific disks for specific purposes	Multiple aggregates for Domino (separate aggregates for Domino data, Domino logs, and potentially DAOS shares)	• Specific aggregates for specific purposes • Potential for better storage tiering: Use fast disk for high-I/O activities (log and data volumes) and slower disk for low-I/O activities (DAOS)

Best Practice

NetApp recommends having at least 10% free space available in an aggregate that is hosting Domino data. This allows the storage system to perform optimally.

Volume Planning

NetApp FlexVol® volumes enable you to create virtual volumes that you can manage and move independently from physical storage. A FlexVol volume can share its containing aggregate with other FlexVol volumes.

Data ONTAP enables the creation of flexible volumes for managing data without the need to assign physical disks to the volumes. This results in the following additional benefits for Lotus Domino environments:

- A large number of volumes can be created, all with independent Snapshot™ copy schedules, mirroring policies, and so on.
- All volumes can be managed independently while receiving the maximum I/O benefit of a much larger pool of disks.

Volume layout is critical in creating and sustaining a highly available Domino environment. Careful consideration of various backup groups, disaster recovery scenarios, and archiving solutions helps determine the placement of volumes onto aggregates and the corresponding LUNs onto those volumes.

Best Practices

- Place Domino data, Domino transactional logs, and DAOS stores in separate volumes.
- NetApp recommends separating database and transaction logs from different servers into separate volumes to prevent a potential “busy” Snapshot copy problem. Because there are separate volumes for each server, there is no concern about Snapshot schedules overlapping different servers.
- NetApp recommends having at least 10% free space available in a volume that is hosting Lotus Domino data.

SAN Deployment

If you need to use LUNs in your environment, NetApp recommends separating Domino data, Domino transaction logs, and DAOS stores into their own LUNs. This in is line with other best practices and allows greater flexibility for backup and restore procedures and data protection strategies.

Choosing a Protocol for Domino

Protocol selection for your Domino environment is driven by your business requirements. IBM supports Domino on multiple protocols: FCP, iSCSI, and NFS. NetApp supports these same protocols, and does not recommend one protocol over the other.

Best Practice
Use the same protocol (FCP, iSCSI, or NFS) for both Domino data and Domino transactional logs.

2.2 NetApp Flash Cache

NetApp Flash Cache is an intelligent cache that combines software and hardware in NetApp storage controllers to increase system performance without increasing the disk drive count. Flash Cache is implemented with software features in Data ONTAP and PCIe-based modules with either 16GB of RAM or 256GB or 512GB of Flash memory per module. Multiple modules can be combined in a single system and presented as a single unit. This technology allows submillisecond access to data that would previously have been served from disk at an average of 10 milliseconds or more.

The random read I/O patterns of Lotus Domino work very well with Flash Cache, and it is estimated that adding Flash Cache to your environment can double IOPS without increasing disk count.

For full information and best practices about Flash Cache, see TR-3832: Flash Cache Best Practices Guide.

Best Practice
Use Flash Cache.

2.3 Domino Layout Best Practices

A typical IBM Lotus Domino environment has at least two Domino volumes, one for Domino data and one for Domino transactional logs. Many environments also have a volume for Domino DAOS if enabled.

Many environments can benefit from having a volume for view rebuilds. When Domino rebuilds views—for example, when a user opens a view whose index has been deleted or when `updall -R` is run—temporary files may be generated to sort the data to rapidly rebuild views. By default, these temporary files are located in the system's temporary folder or in the Domino data folder. IBM recommends changing the location of the temporary files to a different drive to distribute disk I/O and make sure of adequate space to rebuild views. To change the temporary folder used for view rebuilds, add the `View_Rebuild_Dir` setting to the `notes.ini` file.

Considering this information, Figure 1 shows an example of an optimal layout for the Domino environment. Depending on the protocol used, the volumes might contain LUNs, but in the interest of making this example widely applicable, the LUNs are not referred to directly.

Figure 1) Domino layout.

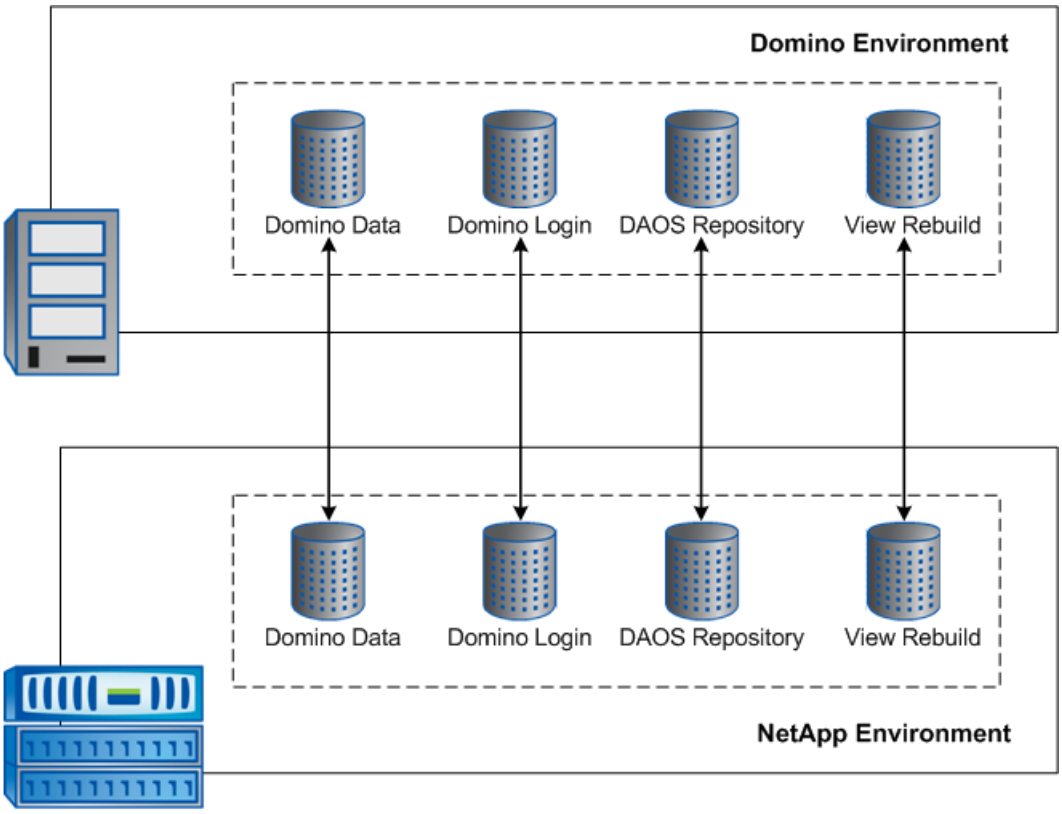


Table 2 shows the best practice recommendations for the volume layout.

Table 2) Preferred volume layout.

Volume	Purpose	Description	Notes
Volume 1	Domino data	Volume contains Domino data	FC, SAS, or SSD drives preferred
Volume 2	Domino transactional logs	Volume contains Domino transactional logs	FC, SAS, or SSD drives preferred
Volume 3	View rebuild	Stores temp files created during index updates	Use notes.ini variable: View_Rebuild_Dir to set (default is system temp directory) Can use RAM disk
Volume 4	DAOS repository	Volume contains .dlo files from DAOS	Low I/O requirements; good candidate for SATA drives

Best Practice

Maintain separate volumes for Domino data, Domino transactional logs, Domino DAOS, and view rebuild.

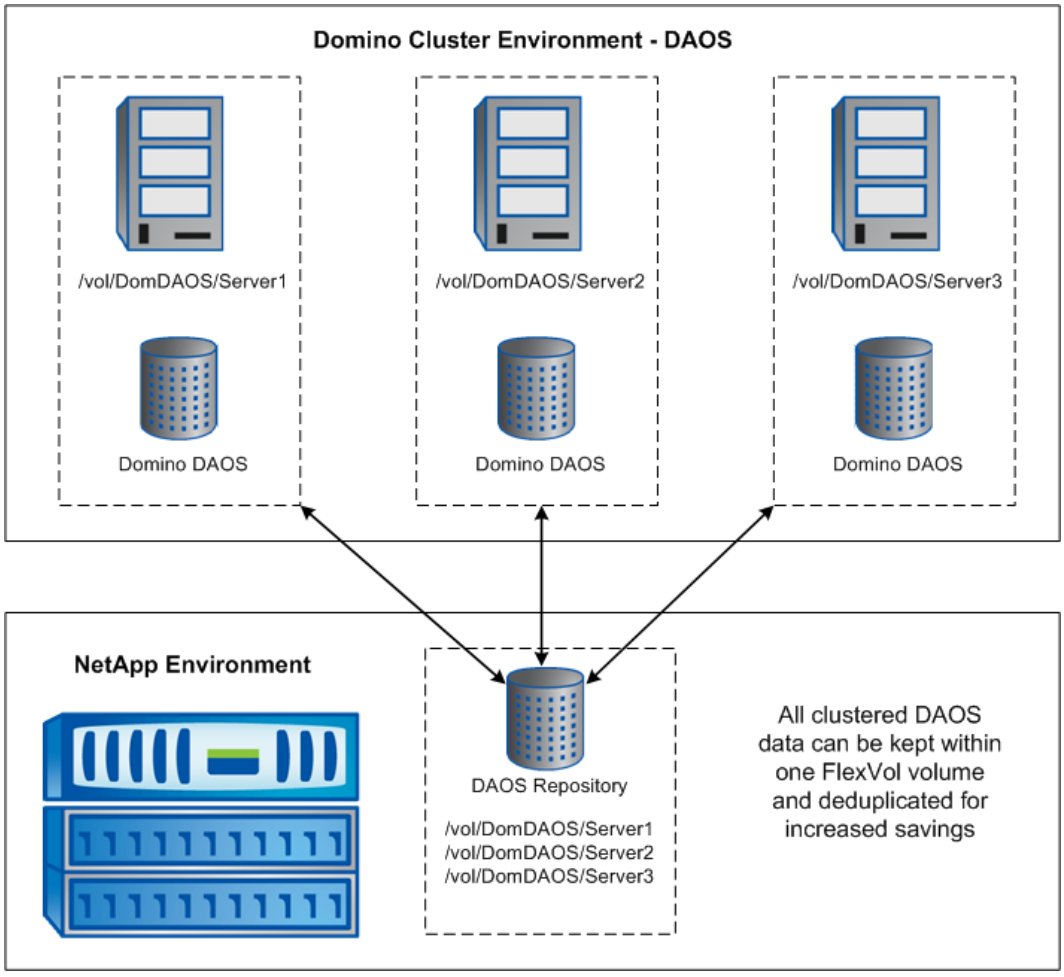
2.4 Layout Planning with DAOS

Domino Attachment and Object Service (DAOS), released in Domino 8.5, uses a repository to store attachments rather than keeping a copy in every database. DAOS has proven to work very well and provides excellent space savings for Domino. DAOS is enabled per server, and the DAOS repositories are not shared within a cluster. NetApp deduplication technology can be used to take storage savings to the next level. To take advantage of additional storage saving, follow these steps:

1. By default, DAOS employs encryption to safeguard the repository; this is a separate setting from encryption settings that apply to a document or NSF. Disable encryption to deduplicate data in the DAOS repository. This is done by setting the `notes.ini` variable: `DAOS_ENCRYPT_NLO=0`.
2. When the DAOS encryption is disabled, use a single volume for all of your DAOS repositories. Deduplicating this volume potentially significantly increases storage utilization in the Domino cluster.

Figure 2 illustrates a Domino DAOS cluster.

Figure 2) Domino DAOS cluster.



2.5 Sizing and Capacity Planning

The Domino environment is very important for optimal performance and operation sizing. Sizing a Domino environment can be difficult, but tools and utilities available from both IBM and NetApp can help you to make sure that your environment is sized appropriately.

An IBM sizing guide, *System X for Lotus Domino 8.5,* is available at www.ibm.com/partnerworld/wps/sizing/sizingguide/guide_redirect.jsp?guide_id=sgq27334812140609002&ssoId=unauthenticated.

When using Domino with any SAN or NAS device, it is important to size the storage environment for I/O, not for capacity. NetApp internal database sizing tools can be used to size a Domino environment. Contact a NetApp sales representative for information.

Best Practice
Size Domino environments for I/O, not for capacity.

3 NetApp Storage Efficiency Technologies for Domino

3.1 NetApp Snapshot and Domino

NetApp Snapshot is at the core of NetApp data protection solutions. A Snapshot copy is a locally retained point-in-time image of data that is typically created in a matter of seconds. A Snapshot copy can be used to create online backups of Domino databases, and the same Snapshot backup image can be used to restore the database.

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. The NetApp Snap Creator™ framework with the Domino plug-in uses the Domino APIs for application consistency.

The preferred solution if you are running Domino on NetApp is the NetApp Snap Creator framework with the Domino plug-in. For details, see TR-4009: NetApp Snap Creator Framework with IBM Lotus Domino Plug-In Deployment and Configuration Guide.

If you are not using Snap Creator with the Domino plug-in, you might want to stop the Domino server before creating a Snapshot copy to make sure of application consistency. Stopping Domino affects availability, so you should do this only during off-peak hours or during a weekly maintenance window. When using this method, you 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 provides an excellent balance of availability and consistency for your Domino environment.

For more information about NetApp Snapshot, see the Data ONTAP 7.3 Data Protection Online Backup and Recovery Guide.

3.2 NetApp Snapshot with Domino Compact

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 to free up unused space. To execute the compact task, run the following command:

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

Where:

- `database` is the full name of the database 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. If no switch is used, the default behavior of compact is determined by whether transactional logging is enabled or disabled. This is detailed in the following section.

Execute the following command on the Domino console to run compact against all databases in the mail subdirectory by using the switches `-b` and `-S 10`.

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

There are three styles of compacting:

- **In-place compacting with space recovery.** Unused space is recovered, but the database size is not reduced. When compact is run without any options selected, this is the default style for databases that have transaction logging enabled.
- **In-place compacting with space recovery and reduction in file size.** Unused space is recovered in databases, and the file size is reduced. A new database instance ID (DBIID) is also assigned, meaning that new backups of databases should be taken. This is the default compacting style for databases that do not have transaction logging enabled.
- **Copy-style compacting.** Copies of databases are created, and the original database is deleted after compacting is complete. This means that an entirely new file is written with a new DBIID, and for a short time, two copies of a database exist. Therefore additional space is consumed on the disk. This style of compacting is required when applying structural changes to databases such as moving to a new on-disk structure (ODS).

IBM recommends compacting databases weekly or monthly as necessary.

For more information about the Domino compact task, refer to the “Compacting Databases” section of the IBM Lotus Domino 8.5 Administrator Guide. For a complete list of switches for the Domino compact task, refer to IBM Technote 1084388.

NetApp Snapshot and Domino Compact: Considerations

A NetApp Snapshot copy is a frozen copy of data block inodes. As long as the blocks remain unchanged in the active file system, the Snapshot copy consumes no space. If the block data is changed, the changed data is written to a new block and the old block is owned by the Snapshot copy. Therefore the Snapshot copy size depends on the changed blocks. Domino compact with certain switches causes data rearrangement, resulting in changed blocks. For example, if you run compact `-c`, which copies the database to a new location on disk, you touch every block in that database as it is copied to a new location. As a result, the Snapshot copy captures the changed blocks, which with a compact `-c` is every block. This means that the Snapshot copy is approximately the size of the database.

It’s important to be aware of the behavior of compact with NetApp Snapshot copies and to evaluate the use of compact in your environment.

NetApp Snapshot 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, compact behavior depends 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 therefore 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. If you are using the Domino compact feature, you should consider allocating appropriate storage space for Snapshot copies.

Additionally, compact usage should include the `-S` switch with 10% or 15% as a threshold. This reduces data churn by running compact only against databases with more than the specified percentage of white space.

Compact `-c` should be used only 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 to use compact `-c` to help resolve database corruption after the fact, but it should not be run regularly as a preventive measure.

Best Practices

- Assess how compact is being used today: What switches are being used and why?
- Use of compact `-b` is preferred.
- Use compact `-S`.
- Minimize the use of compact `-c`.

4 NetApp Deduplication and Domino

NetApp deduplication is a method of improving storage utilization by eliminating redundant data. In the deduplication process, one unique copy of the data is retained, while redundant data is replaced with a pointer to the unique copy.

NetApp deduplication, part of NetApp's storage efficiency offerings, provides block-level deduplication in an entire flexible volume on a NetApp storage system. Deduplication is supported on FAS and V-Series systems running Data ONTAP 7.2.5.1 operating in 7-Mode or later for customers running Data ONTAP 7.2 7-Mode, or Data ONTAP 7.3P1 operating in 7-Mode or later for customers running Data ONTAP 7.3 7-Mode.

For full details about deduplication, see TR-3505: NetApp Deduplication for FAS and V-Series Deployment and Implementation Guide.

The storage savings that you can expect vary widely with the type (e-mail, applications, and so on) and redundancy of data in your environment. NetApp customers using Domino have reported anywhere from 6% to 88% savings in their Domino environment; the mean is around 27%.

Domino Encryption and NetApp Deduplication

NetApp deduplication is not effective on databases where encryption is enabled. As mentioned earlier, this is also true for the DAOS repository.

Domino and NetApp Deduplication with DAOS

NetApp deduplication is still effective when DAOS is enabled, but the reported space savings from NetApp will be lower because DAOS has already performed much of the work. The overall space savings should be greater because of the use of two complementary technologies to deduplicate the dataset. As mentioned in section 2.4, "Layout Planning with DAOS," when using DAOS in a cluster, it is possible to architect your storage layout to place DAOS shares from a cluster on the same volume and enable deduplication for additional storage savings.

Domino Quotas and NetApp Deduplication

Domino quotas are not affected by deduplication. A mailbox with a limit of 1GB cannot store more than 1GB of data in a deduplicated volume, even if the data consumes less than 1GB of physical space on the storage system.

5 Virtualization and Domino

Lotus Domino virtualizes very well, and an entire world of best practices surrounds Domino and virtualization. Rather than reference all of the virtualization-specific information in this report, the following links point to pertinent information.

- Virtualizing IBM Lotus Domino 8.5.1 on VMware vSphere 4: www.vmware.com/files/pdf/techpaper/IBM_Lotus_Domino_on_vSphere_V1.pdf

  This document describes testing that was conducted jointly by VMware, IBM, and NetApp to characterize the performance and functionality of IBM Lotus Domino 8.5.1 running on VMware® vSphere® 4.0. In addition, the paper provides guidance on sizing and best practices that can be used by customers considering similar deployments.
- NetApp and VMware vSphere Storage Best Practices: http://media.netapp.com/documents/tr-3749.pdf

  This technical report reviews the best practices for implementing VMware vSphere with NetApp unified storage arrays.
- NetApp Storage Best Practices for Microsoft Virtualization and NetApp SnapManager for Hyper-V: http://media.netapp.com/documents/tr-3702.pdf

  This technical report provides guidelines and best practices for integrated architecture and implementations of Microsoft® Hyper-V™ with NetApp storage solutions.

6 Conclusion

This guide can help you achieve the best experience with IBM Lotus Domino in a NetApp storage environment. However, Domino can be set up and configured in a multitude of ways, and it is not likely that this guide will fit every production scenario. This document is limited in scope to the best practices that pertain to the storage layout of the Domino environment, and there are many additional Domino server-specific best practices. Contact your NetApp representative for additional information.

Best Practices for IBM Lotus Domino

Best Practices

Storage Layout: Aggregate

- NetApp recommends having at least 10% free space available in an aggregate that is hosting Domino data. This allows the storage system to perform optimally.

Storage Layout: Volume Planning

- Place Domino data, Domino transactional logs, and DAOS stores in separate volumes.
- NetApp recommends separating database and transaction logs from different servers into separate volumes to prevent a potential "busy" Snapshot copy problem. Because there are separate volumes for each server, there is no concern about Snapshot schedules overlapping different servers.
- NetApp recommends having at least 10% free space available in a volume that is hosting Lotus Domino data.

Storage Layout: Protocol Selection

- Use the same protocol (FCP, iSCSI, or NFS) for both Domino data and Domino transactional logs.

Storage Layout: NetApp Flash Cache

- Use Flash Cache.

Domino Layout: Recommended Configuration

- Maintain separate volumes for Domino data, Domino transactional logs, Domino DAOS, and view rebuild.

Domino Layout: Sizing and Capacity Planning

- Size Domino environments for I/O, not for capacity.

NetApp Snapshot with Domino Compact

- Assess how compact is being used today: What switches are being used and why?
- Compact `-b` is preferred.
- Use compact `-S`.
- Minimize the use of compact `-c`.

References

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- TR-3832: Flash Cache and PAM Best Practice Guide
  http://media.netapp.com/documents/tr-3832.pdf

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Version	Date	Document Version History
Version 1.0	August 2011	Initial release.
Version 1.0.1	September 2012	Updated this report with links to IBM content on Domino compact and minor revisions.

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

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