



Technical Report

Messaging and Collaboration on NetApp Storage from Private Cloud to Hybrid Cloud

Niyaz Mohamed, NetApp
May 2016 | TR-4509

Abstract

NetApp for Messaging and Collaboration Private Cloud is a reference architecture that describes how to integrate NetApp® clustered Data ONTAP® storage operating system (OS) and NetApp FAS systems with Microsoft private cloud technologies. This solution features Microsoft Windows Server 2012 R2 with Hyper-V and System Center 2012 R2.

Note: For VMware deployments, see the [FlexPod Datacenter with Microsoft Exchange 2013 solution](#) and the [FlexPod Datacenter with Microsoft SharePoint 2013 solution](#).

TABLE OF CONTENTS

1	Overview	4
2	Audience.....	4
3	Messaging and Collaboration as a Service in Private Cloud	4
4	Use Case Summary	5
4.1	Why Private Cloud?	5
4.2	Automating Microsoft Application Installation and Storage Provisioning.....	5
5	Solution Components	6
5.1	Network Configuration	7
5.2	Storage Configuration	8
5.3	Microsoft Windows Server Configuration	8
6	Solution Architecture	8
6.1	Microsoft Exchange 2013.....	9
6.2	Microsoft SharePoint 2013.....	9
6.3	Microsoft Skype for Business.....	10
6.4	Consolidated Architecture.....	10
7	Sizing and Layout Planning.....	11
7.1	Data Gathering.....	12
7.2	Compute Requirements	13
7.3	Storage Requirements	15
7.4	Detailed Application Sizing.....	15
7.5	Data Layout.....	19
7.6	Efficiency.....	21
8	Performance Validation	21
8.1	Microsoft Exchange 2013.....	22
8.2	VM Disk I/O Latency	22
8.3	VM CPU and Memory Utilization.....	22
8.4	NetApp Storage Utilization Summary.....	22
9	Deployment Steps for Production	24
9.1	Microsoft Exchange 2013.....	24
9.2	Microsoft SharePoint 2013.....	24
9.3	Microsoft Lync 2013.....	25
10	Backup and Recovery	25

11 Disaster Recovery and High Availability	26
11.1 Availability	26
11.2 Disaster Recovery	26
11.3 High Availability	26
11.4 DR Deployment Phases	28
11.5 DR Preparation	29
11.6 Other DR Options	31
11.7 DR Considerations	31
12 Conclusion	32
References	33

LIST OF TABLES

Table 1) Software versions used throughout this document	7
Table 2) VM resources for Exchange Server	14
Table 3) VM resources for SharePoint Server	14
Table 4) VM resources for Lync Server	14
Table 5) Microsoft Exchange database and logs placement	19
Table 6) Microsoft SharePoint database and logs placement	19
Table 7) Microsoft Lync database placement	20
Table 8) I/O and average latency across all databases on mailbox 1	22
Table 9) I/O and average latency across all databases on mailbox 2	22
Table 10) I/O and average latency across all databases on mailbox 3	22
Table 11) SharePoint performance results	23

LIST OF FIGURES

Figure 1) Microsoft Exchange 2013	9
Figure 2) Microsoft SharePoint 2013	10
Figure 3) Microsoft Lync Server	10
Figure 4) Consolidated solution architecture	11
Figure 5) Role requirements results pane: log, disk space, and I/O requirements from Microsoft storage calculator	16
Figure 6) IOPS and throughput requirements from the Microsoft storage calculator	16
Figure 7) SharePoint sizer	17
Figure 8) Lync Server design requirements	18
Figure 9) Sample storage layout	21
Figure 10) Architectural diagram	28

1 Overview

The current industry trend in data center design is toward shared infrastructure and a private cloud model. By using virtualization along with prevalidated IT platforms, enterprise customers have embarked on the journey to the cloud. Customers are moving away from application silos and toward a shared infrastructure that can be quickly deployed, thereby increasing agility and reducing costs. NetApp delivers a unique and solid platform for private cloud, which uses best-of-class a FAS controller that can be clubbed with a best-of-class server, and network components to serve as the foundation for a variety of workloads, enabling efficient architectural designs that can be deployed quickly and confidently.

2 Audience

This document describes the architecture and deployment procedures of an infrastructure composed of NetApp and Microsoft virtualization that uses iSCSI-based storage for messaging and collaboration workloads. The intended audience for this document includes, but is not limited to, sales engineers, field consultants, professional services, IT managers, partner engineering, and customers who want to deploy the core Microsoft private Cloud architecture with NetApp clustered Data ONTAP for Microsoft Exchange, SharePoint, and Lync.

3 Messaging and Collaboration as a Service in Private Cloud

Cloud is a buzzword in the IT industry today. Cloud-style designs offer critical reductions in business expenses and build business assurance. Nonetheless, these frameworks are intricate and hard to introduce and arrange. This report is intended to decrease deployment and plan time for NetApp customers and associates by giving particular direction to making a Microsoft Private Cloud in light of a NetApp storage infrastructure for messaging and collaboration workloads.

Messaging and collaboration tools drive efficiency and productivity and always act as the backbone of a business's ability to effectively improve the availability and agility of the content, document management, and e-mail messaging environments. An effective messaging and collaboration suite help reduce overall costs through better application integration and helps people in an enterprise perform more effectively, sharing information and collaborating whenever and wherever they need to. Industry trends indicate a vast data center transformation toward shared infrastructure and cloud computing, sometimes referred to as software-defined computing. Enterprise customers are moving away from isolated centers of IT operation toward more cost-effective virtualized environments. The objectives of the move toward virtualization, and eventually to software-defined cloud computing, are to increase agility and reduce cost.

Accomplishing this change can appear to be overwhelming and complex, particularly in light of the fact that organizations must deliver imperviousness to change in both their hierarchical and their specialized IT demonstrations. To quicken the procedure and streamline the advancement to a shared cloud, software-defined infrastructure, NetApp has developed a solution called NetApp for Microsoft Private Cloud. This document provides guidance about how to design and architect a scalable private cloud and run a messaging and collaboration workload solution using NetApp unified storage and Microsoft Windows Server 2012 R2 Hyper-V.

Note: Recent research performed by third parties shows that in a messaging and collaboration deployment for any user base beyond 5,000 users in a private cloud option is the least expensive for the enterprises.

4 Use Case Summary

4.1 Why Private Cloud?

Private cloud is a computing model that uses resources that are dedicated to an organization. A private cloud shares many of the characteristics of public cloud computing including resource pooling, self-service, elasticity, and pay by use. It is delivered in a standardized manner with the additional control and customization available from dedicated resources.

Microsoft private cloud offerings can help customers and service providers build dedicated infrastructure-as-a-service (IaaS) environments that transform the way they deliver IT services. Such a solution provides a streamlined approach to delivering scalable, preconfigured, and validated infrastructure platforms for on-premises private cloud implementations. With local control over data and operations, IT can dynamically pool, allocate, secure, and manage resources for agile IaaS and offer SaaS/Office365-like messaging and collaboration services to its end users. Likewise, departments can deploy applications with speed and consistency using self-provisioning (and decommissioning) and automated data center services in a virtualized environment. More organizations are deploying private clouds instead of the public cloud so that they can provide the public cloud functionality without compromising data security and compliance.

4.2 Automating Microsoft Application Installation and Storage Provisioning

Automating and virtualizing Microsoft applications on NetApp storage in a private cloud delivers significant benefits, including:

- Server and storage hardware cost reduction
- Space and power savings
- Improved server use
- Simplified management
- Repeatable, proven process to deploy the infrastructure
- Reduced human error as a result of fewer manual processes
- Advanced storage management, provisioning, backup, and data recovery features
- Shared virtual infrastructure that supports multiple platforms and applications
- Automated application and storage provisioning
- Reduced storage provisioning roundtrip time
- Empowerment of application administrators to provision application and storage based on their expertise
- Ability to make sure that best practices are followed
- Ability to provision application and storage for disaster recovery (DR) and data archival based on recovery point objective (RPO) and recovery time objective (RTO)

For more information, see [TR-4438: IT as a Service: Simplifying Application and Storage Provisioning Using NetApp OnCommand Workflow Automation and System Center Orchestrator 2012 R2](#).

The overall solution has the following key benefits:

- **Increase agility.** Allows IT and storage administrators to respond more quickly at reduced cost to changing needs with nondisruptive operations.
- **Improve efficiency.** Automate management tasks using Microsoft System Center 2012 R2 integrated with NetApp data management software for comprehensive infrastructure management offering.
- **Reduce total cost of ownership.** Increase utilization, decrease administrative burden on IT staff, and leverage existing investments.

- **Improve performance, security, and control.** Deliver greater bandwidth, lower latency, and a more consistent experience worldwide.
- **Utilize a proven platform.** The proven ability of NetApp technology solutions along with Cisco or any other server/networking vendor and expertise helps to jump-start a Microsoft private cloud deployment.

The following primary Microsoft applications are discussed in this document:

- [Microsoft Exchange Server 2013](#)
- [Microsoft SharePoint Server 2013](#)
- [Microsoft Lync Server 2013](#)

The key highlights of this solution are:

- Microsoft applications virtualization with Hyper-V
- Storage efficiency with NetApp primary storage deduplication and thin provisioning without any negative tradeoffs
- Scalability and ease of management with NetApp efficiency parameters such as deduplication, compression, and so on
- Efficient, deduplication-aware, application-consistent backup and recovery with NetApp SnapManager® for Hyper-V (SMHV), SnapManager for Exchange (SME), and SnapManager for SharePoint (SMSP)

Note: This report assumes [NetApp for Microsoft Private Cloud Deployment Guide](#) is followed in the customer environments.

For more information about the best practices followed in this architecture, see the following guides:

- [Microsoft Exchange Server 2013 and SnapManager for Exchange Best Practices Guide for Clustered Data ONTAP](#)
- [Best Practice Guide for Microsoft SQL Server and SnapManager 7.0 for SQL Server with Clustered Data ONTAP](#)
- [Microsoft SharePoint and SnapManager 8.0 for SharePoint with Clustered Data ONTAP: Best Practices Guide](#)
- [IT as a Service: Simplifying Application and Storage Provisioning Using NetApp OnCommand Workflow Automation and System Center Orchestrator 2012 R2](#)
- [FlexPod Datacenter with Microsoft Private Cloud Fast Track v4: Clustered Data ONTAP Deployment Guide](#)
- [NetApp for Microsoft Private Cloud Deployment Guide](#)

5 Solution Components

The NetApp for Messaging and Collaboration Private Cloud showcases building Microsoft private cloud and virtualizing Microsoft messaging and collaboration suite applications using Hyper-V and NetApp unified storage based on the technical report. Results of the testing demonstrate that the performance of Microsoft applications on Microsoft Hyper-V and NetApp storage in this solution is suitable for production environments and is well within Microsoft and NetApp best practice recommendations.

Table 1 lists the software versions used throughout this document.

Table 1) Software versions used throughout this document.

Layer	Component	Version	Details
Computing	Any server (depending on the design)	N/A	N/A
Network	Any network switch	N/A	N/A
Storage	NetApp FAS8XXX	8.2.2 and later	NetApp Data ONTAP software
Software	Microsoft Windows Server 2012R2 Hyper-V	2012 R2	Virtualization hypervisor
Software	System Center Virtual Machine Manager	2012 R2	Virtualization management
	NetApp Data ONTAP SMI-S Agent	5.2	SMI-S agent
	NetApp Windows Host Utilities Kit	6.0.2	NetApp plug-in for Windows
	NetApp SnapDrive® for Windows	7.1.2 and later	LUN provisioning and Snapshot® management
	NetApp SnapManager for Hyper-V	2.1	NetApp plug-in for Hyper-V
	Microsoft Exchange Server 2013	2013 SP1	Exchange Server Enterprise Edition
	Microsoft SQL Server 2014	2014 SP1	Database Server using SQL Server 2014 Enterprise Edition
	Microsoft SharePoint Server 2013	2013 SP1	Application Server SharePoint 2013 Enterprise Edition
	Microsoft Lync Server 2013	2013	Lync Enterprise Edition
	NetApp SnapManager for Exchange	7.2	SnapDrive for Windows
	NetApp SnapManager for SharePoint	8.2	SnapManager for Microsoft SharePoint
	NetApp SnapManager for SQL Server	7.1	SnapManager for Microsoft SQL Server
	NetApp Single Mailbox Recovery	7.1	Single item recovery tool

Assumptions

- We assume that [NetApp for Microsoft Private Cloud Deployment Guide](#) and [FlexPod Datacenter with Microsoft Private Cloud Fast Track v4: Clustered Data ONTAP Deployment Guide](#) are followed for setting up Microsoft Private Cloud before implementing messaging and collaboration workload.
- The validation described in this report is performed using iSCSI guest initiators. The other deployment models supported are Pass-through disks and VHDx. Contact your NetApp consulting engineer for appropriate sizing and deployment options.

5.1 Network Configuration

Many network architectures include a tiered design with three or more tiers, such as core, distribution, and access. Designs are driven by the port bandwidth and quantity required at the edge, as well as the ability of the distribution and core tiers to provide higher speed uplinks to aggregate traffic. Additional

considerations include Ethernet broadcast boundaries and limitations, spanning tree, and other loop-avoidance technologies.

A dedicated management network is a common feature of advanced data center virtualization solutions. Most virtualization vendors recommend managing hosts through a dedicated network to avoid competition with guests' traffic needs and to provide a degree of separation for security and ease of management. This typically means dedicating a network interface card (NIC) for each host and a port per network device in the management network.

With advanced data center virtualization, a frequent use case is to provide isolated networks in which different owners, such as particular departments or applications, are provided with their own dedicated networks. Multitenant networking refers to using technologies such as virtual LANs (VLANs) or Internet Protocol Security (IPsec) isolation techniques to provide dedicated networks that use a single network infrastructure or wire.

For step-by-step network segregation and configuration information, see section 5 of [NetApp for Microsoft Private Cloud Deployment Guide](#)

5.2 Storage Configuration

Building a private cloud with NetApp clustered Data ONTAP provides greater IT flexibility, efficiency and cost savings. NetApp clustered Data ONTAP software is the foundation of the Data Fabric and thus provides a clear path to any cloud.

For instructions about the physical installation of FAS80xx controllers, follow the procedures in the FAS80xx Series documentation on the NetApp Support site. When planning the physical location of the storage systems, refer to the following sections in the Site Requirements Guide:

- Site Preparation
- System Connectivity Requirements
- Circuit Breaker, Power Outlet Balancing, System Cabinet Power Cord Plugs, and Console Pinout Requirements
- 80xx Series Systems

For step-by-step storage configuration, see section 6 of [NetApp for Microsoft Private Cloud Deployment Guide](#) and [FlexPod Datacenter with Microsoft Private Cloud Fast Track v4 Cloud Fast Track v4 Clustered Data ONTAP Deployment Guide](#)

5.3 Microsoft Windows Server Configuration

With the built-in virtualization capabilities of Windows Server, best-in-class features and performance can be achieved. When System Center capabilities are added, the private cloud can provide elasticity and scalability into the datacenter using automation, resource pooling, and dynamic provisioning.

For prerequisites and configuration information, refer to section 7 and later of [NetApp for Microsoft Private Cloud Deployment Guide](#) and [FlexPod Datacenter with Microsoft Private Cloud Fast Track v4 Cloud Fast Track v4 Clustered Data ONTAP Deployment Guide](#).

6 Solution Architecture

The NetApp for Messaging and Collaboration Private Cloud solution showcases virtualization of Microsoft applications on Microsoft Hyper-V infrastructure and NetApp unified storage in the private cloud model, achieving significant storage efficiency; performance; operational agility; and efficient, application-consistent, deduplication-aware data protection. Test results of this solution demonstrate that the performance of Microsoft applications on Microsoft Hyper-V platform and NetApp storage is suitable for production-ready environments and is well within Microsoft and NetApp best practice recommendations.

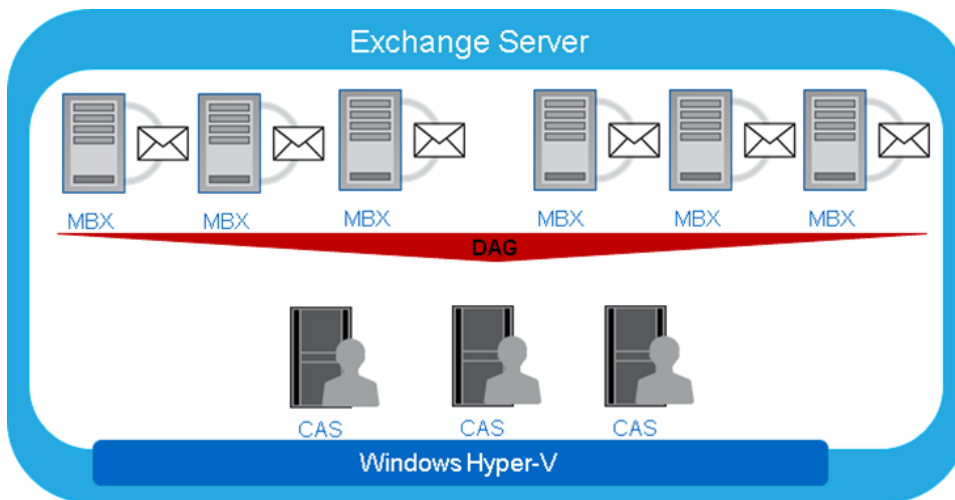
The workload virtualized in this solution is as follows:

- **Microsoft Exchange 2013.** 10,000 users with 2GB mailbox per user and 0.084 IOPS per user
- **Microsoft SharePoint 2013.** 10,000 users with 100 documents per user with an average document size of 200KB.
- **Microsoft Lync Server 2013 (now Skype for Business).** 10,000 users with high availability (HA) (N+1)

6.1 Microsoft Exchange 2013

Microsoft Exchange is a messaging platform that provides e-mail, scheduling capabilities, and tools for custom collaboration and messaging service applications. The Exchange platform allows users to create and manage all of their communications in the workplace and on their mobile devices, as illustrated in Figure 1.

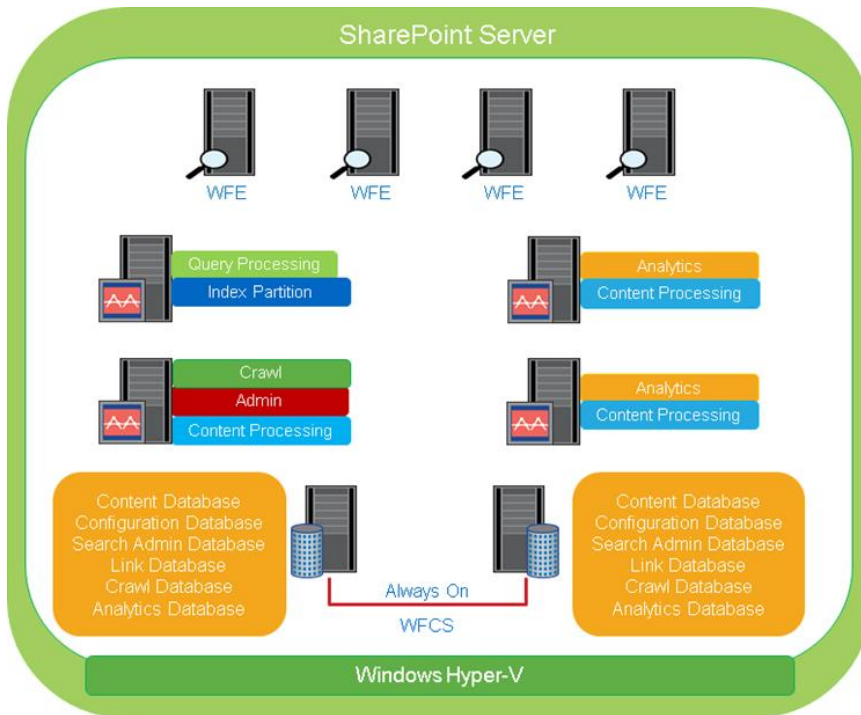
Figure 1) Microsoft Exchange 2013.



6.2 Microsoft SharePoint 2013

Microsoft SharePoint is a web application platform that helps a user organize information, people, and projects. The SharePoint platform allows a user to connect with employees across the enterprise, share ideas, and reinvent the way people work together. This platform makes it easy to find answers, discover insights, and connect with experts. Figure 2 shows the architecture for a Microsoft SharePoint farm.

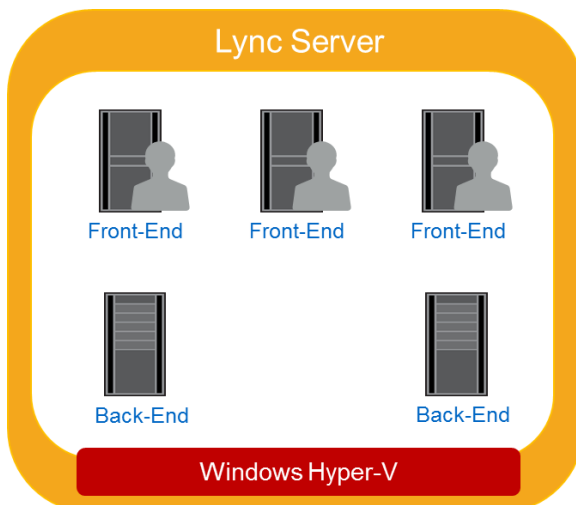
Figure 2) Microsoft SharePoint 2013.



6.3 Microsoft Skype for Business

Microsoft Skype for Business 2013 (formerly known as Lync) is a communications and collaboration platform that combines the client experience inspired by Skype with the enterprise-grade security, compliance, and control of Lync. Skype for Business offers features that include presence, IM, voice and video calls, and online meetings. Figure 3 shows the Lync architecture.

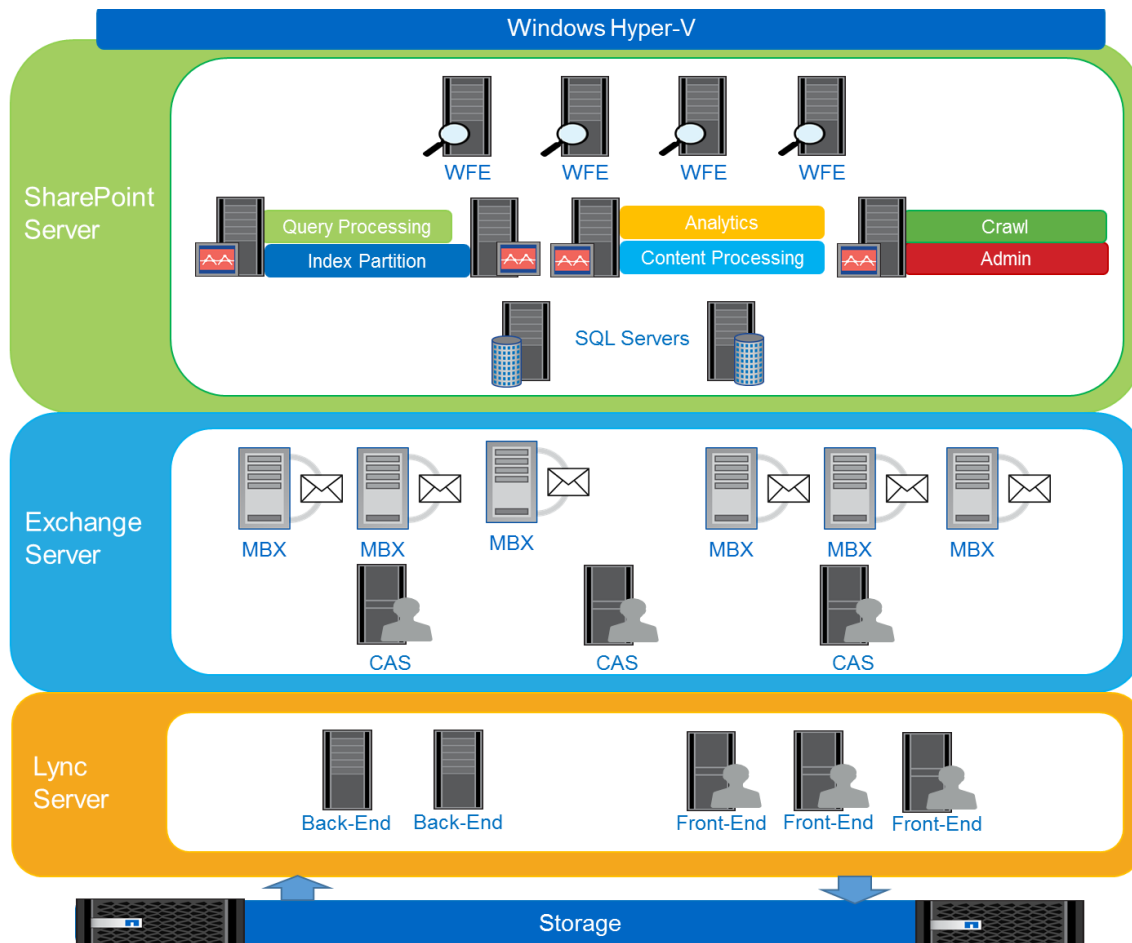
Figure 3) Microsoft Lync Server.



6.4 Consolidated Architecture

Figure 4 is an illustration of the consolidated solution architecture.

Figure 4) Consolidated solution architecture.



7 Sizing and Layout Planning

In general, cloud computing enables customers to efficiently provision on-demand resources in a self-service model. Resources such as CPU, memory, storage capacity, and performance are optimized in the cloud through resource pooling. Resource pooling allows physical and virtual resources to be dynamically reassigned according to the customer's current and future requirements.

A private cloud infrastructure is operated solely by an organization. It can be managed by the organization or by a third party, and it can exist on or off site. Although private cloud infrastructures can be agnostic in terms of hardware and software, NetApp storage efficiency technologies can be used to increase performance. NetApp refers to each instance of hardware as a pod, and each pod is designed to be fully self-contained, if necessary. Although each customer's environment configuration can vary, after the private cloud infrastructure is built, it is easily scalable if requirements and demands change. This scalability includes vertical scaling (adding additional resources within a pod), as well as horizontal scaling (adding additional pods). Examples of vertical scaling include:

- Deploying additional or different rack-mount servers, blades, and chassis to increase compute capacity
- Deploying additional disk shelves to improve input/output (I/O) capacity and throughput
- Adding special hardware or software to introduce new features

The [NetApp Private Cloud Infrastructure Capacity Planning Guide](#) provides a blueprint for a successful private cloud deployment by aligning sizing and provisioning models into one consolidated, easy-to-use methodology.

The following sections discuss in detail the parameters and factors that must be considered for each application sizing.

7.1 Data Gathering

The process of sizing Microsoft applications involves various phases. Whether evolving an existing infrastructure or designing a new one from scratch, you must define the baseline and the assumptions for the new architecture. Start the process by understanding the available guidance about each application and then gather any available data about the existing deployment. For new solutions, estimate the user profile and organizational requirements.

Microsoft Exchange

Gather the following data before configuring and deploying Microsoft Exchange:

- Total number of Exchange Servers
- Latency on the network link
- Windows version and service pack level
- Number of database availability groups (DAGs) deployed in the environment
- Number of active mailboxes
- Number of mailbox servers
- Number of databases
- Available database cache for mailbox
- Number of database copies
- Backup requirements
- Backup frequency
- Current backup schedule times
- Retention policy on the Exchange backups

Microsoft SharePoint

One of the main components of the SharePoint architecture is a content database. Content databases store all content for a site collection. This includes site documents or files in document libraries, list data, web part properties, audit logs, sandboxed solutions, and user names and rights. All of the files that are stored for a specific site collection are located in one content database on only one server. A content database can be associated with more than one site collection.

The following information is required for a detailed and accurate sizing design for any content database:

- Workload
- Number of users
- User concurrency
- Requests per second
- Number of documents
- Average size or type of documents
- Number of versions of each document stored
- Which service applications will be used?

- Number of content databases
- Web application and site collection design

Gather the following additional data before configuring and deploying Microsoft SharePoint:

- Number of SharePoint Servers
- Number of SharePoint farms in your organization
- Number of Microsoft SQL Servers
- OS version for SharePoint and SQL Servers
- Desired protocol (FCP/iSCSI/CIFS)
- Total amount of transaction log data generated per day
- Number and size of the SharePoint databases
- Rate of change in the SharePoint databases
- Are any of the servers used in the SharePoint farms virtualized?
- Number of users for each SharePoint farm
- Number of active (concurrent) users that might be using the SharePoint environment at any time (such as 10% of the total users)
- Physical file size of your SharePoint and SQL Server databases

Microsoft Lync

Gather the following data before configuring and deploying Microsoft Skype for Business (formerly known as Lync):

- Number of front-end servers being deployed
- SQL Server edition for the back-end servers
- Number of edge servers and mediation servers
- Type of hardware load balancer being used
- Number, size, and location of PSTN gateways
- Will there be any clustered hosts? If so, what clustering is to be used?

7.2 Compute Requirements

Placing virtual machines (VMs) over physical hosts is an important activity and vital component in all private cloud deployments and its related management framework. Profile-oriented storage allows a user to easily select the appropriate storage layer on which to deploy VMs. While provisioning resources to VMs, a cloud provider should maximize resource utilization by placing VMs over a minimal set of physical hosts.

A good design should never plan to run servers at 100% of CPU capacity. In general, 80% CPU utilization in a failure scenario is a reasonable target for most customers. The VMs must be spread across different hosts in order to avoid a host failure from affecting multiple VMs. This rule also applies to domain controllers. However, a domain controller VM and an application VM can run on the same host.

Note: The VMs should always be placed in a separate SAS disk aggregate from the workload aggregates. Based on the RAM requirements, the solution was tested with 4 Hyper-V hosts with 256GB RAM each. The aggregate contained 24 900GB SAS drives.

Note: The VMs can be classified as Platinum, Gold, Silver, and Bronze, depending up on the number of vCPU, RAM, OS disk capacity, IOPS, RPO, and RTO requirements.

Microsoft Exchange

To calculate memory per server, you need to know the per-server user count (active and passive users) and determine whether to run the mailbox role in isolation or deploy multirole servers (Mailbox+CAS). To accurately size the server and memory requirements, follow the steps detailed on the [Exchange Team Blog](#) site.

Note: Although this deployment considers mailbox/client access server role isolation, size your environment based on your design requirements and assumptions.

Table 2 lists the VM resource requirements for Exchange Server.

Table 2) VM resources for Exchange Server.

Hardware Profile	Number	Description
Exchange Server 2013 (mailbox role)	6	6 VMs with 12 vCPUs and 64GB RAM each and 200GB OS volume
Exchange Server 2013 (CAS role)	3	3 VMs with 8 vCPUs and 24GB RAM each and 100GB OS volume
Active Directory (AD) servers	2	2 VMs with 4 vCPUs and 16GB RAM each and 60GB OS volume

For more information, see the [Exchange 2013 System Requirements](#) on the Microsoft TechNet site.

Microsoft SharePoint

Table 3 lists the VM resource requirements for SharePoint Server.

Table 3) VM resources for SharePoint Server.

Hardware Profile	Number	Description
SharePoint Server 2013 web role	4	4 VMs with 4 vCPUs and 8GB RAM each and 80GB OS volume
Application role	4	4 VMs with 4 vCPUs and 8GB RAM each and 80GB OS volume
Database	2	2 VMs with 12 vCPUs and 16GB RAM each and 80GB OS volume

For more details and to plan the VMs accordingly, see the [Hardware and Software Requirements for SharePoint 2013](#) on the Microsoft TechNet site.

Microsoft Lync

Table 4 lists the VM resource requirements for Lync Server.

Table 4) VM resources for Lync Server.

Hardware Profile	Number	Description
Lync Server 2013 front-end	3	3 VMs with 12 vCPUs and 32GB RAM each and 80GB OS volume
Lync Server 2013 back-end server	2	2 VM with 12 vCPUs and 32GB RAM each and 80GB OS volume

Hardware Profile	Number	Description

For more details and to plan the VMs accordingly, see the [Server Hardware Platforms for Lync Server 2013](#) on the Microsoft TechNet site.

7.3 Storage Requirements

When planning content storage for messaging and collaboration applications, you must choose a suitable storage architecture. The following section contains details about storage sizing. The aggregate sizing is based on the storage requirements for all applications to meet the storage capacity, performance, and Snapshot backup requirement of an assumed workload.

The aggregate contains all of the physical disks for a workload. All flexible volumes that are created inside a 64-bit aggregate span across all of the data drives in the aggregate to provide more disk spindles for the I/O activity on the flexible volumes.

NetApp recommends at least 10% available space in an aggregate that is hosting application data to allow optimal performance of the storage system.

A volume is generally sized at 90% of the aggregate size, housing both the actual LUNs and the Snapshot copies of those LUNs. This sizing takes into account the content database, the transaction logs, the growth factor, and 20% of free disk space.

When sizing for your environment, consult with your NetApp SE about the exact storage configuration based on your individual requirements.

7.4 Detailed Application Sizing

Microsoft Exchange

Microsoft Exchange is a highly redundant application that allows mailboxes to move between mailbox servers within a DAG without interruption to the user accessing the mailbox.

A DAG is the base component of the mailbox server HA and site resilience framework built into Microsoft Exchange Server 2013. A DAG is a group of up to 16 mailbox servers that host a set of databases and provide database-level recovery from failures that affect individual servers or databases.

The Exchange 2013 mailbox solution test environment included the following components:

- 10,000 mailboxes
- 1 DAG
- 6 mailbox servers
- 833 mailboxes per database
- 2048MB mailbox size
- 0.07 IOPS per user (additional 20% buffer)
- Four databases per server
- 12 active databases total for 10,000 active mailboxes
- 12 passive databases total, with the passive databases on separate volume groups and on a separate but identical storage controller node
- 2 copies of the database

Microsoft Exchange Sizer is an excellent tool that assists in accurately determining the size of the Exchange mailbox servers. This sizer, when used in conjunction with the NetApp internal sizer, offers an

accurate estimate of the NetApp storage resources required to meet workload capacity and I/O requirements.

After gathering the required information for sizing, use the Microsoft storage calculator to design the mailbox server as per the requirements. The calculator provides the following information, which is used as the input in the NetApp sizer for Exchange 2013:

- Disk space requirements
- Transaction log requirements
- Host I/O and throughput requirements

Figure 5 and Figure 6 show the requirements from the Microsoft storage calculator.

Figure 5) Role requirements results pane: log, disk space, and I/O requirements from Microsoft storage calculator.

Transaction Log Requirements	/ Database	/ Server	/ DAG	/ Environment
User Transaction Logs Generated / Day	16667	33333	200000	200000
Average Move Mailbox Transaction Logs Generated / Day	2671	5343	32057	32057
Average Transaction Logs Generated / Day	19338	38676	232057	232057
Disk Space Requirements	/ Database	/ Server	/ DAG	/ Environment
Transport Database Space Required	--	257 GB	1545 GB	1545 GB
Database Space Required	1826 GB	7305 GB	43828 GB	43828 GB
Log Space Required	116 GB	464 GB	2782 GB	2782 GB
Database Volume Space Required	--	12783 GB	76699 GB	76699 GB
Log Volume Space Required	--	580 GB	3478 GB	3478 GB
Restore Volume Space Required	--	2428 GB	14566 GB	14566 GB
Host IO and Throughput Requirements	/ Database	/ Server	/ DAG	/ Environment
Total Database Required IOPS	67	268	1608	1608
Total Log Required IOPS	15	58	346	346
Database Read I/O Percentage	60%	--	--	--
Background Database Maintenance Throughput Requirements	1.0 MB/s	4 MB/s	24 MB/s	24 MB/s

Figure 6) IOPS and throughput requirements from the Microsoft storage calculator.

Host IO and Throughput Requirements	/ Database	/ Server	/ DAG	/ Environment
Total Database Required IOPS	67	268	1608	1608
Total Log Required IOPS	15	58	346	346
Database Read I/O Percentage	60%	--	--	--
Background Database Maintenance Throughput Requirements	1.0 MB/s	4 MB/s	24 MB/s	24 MB/s

Based on the sizing, the following storage resources were tested for Microsoft Exchange 2013 in this solution:

- 72 * 2TB 7.2k RPM and 2TB FC card
- 2 aggregates
- 2 RAID groups (18) in each aggregate

Microsoft SharePoint

Capacity and performance sizing is vital for a successful SharePoint deployment on NetApp storage. Start your design by gathering some basic workload characteristics such as total number of users, average daily concurrent users, and total number of requests per day. Also, try to estimate the workload distribution across different SharePoint capabilities such as search crawl, team site activities, and Office web apps. Estimate the database size, number of web apps, site collections, number of lists, libraries, and number of items. A key decision point in the planning process for content storage on Microsoft SharePoint 2013 is how to choose a suitable storage architecture. Microsoft SharePoint 2013 content storage has a significant dependency on the underlying database; therefore, database and SQL Server requirements must drive storage choices.

SharePoint stores data in SQL Server and indexes in the file systems on the search and index management servers. In general, the most important characteristics for determining the amount of

storage space required are the total size of the documents stored on the portal site and the total size of the documents included in the portal site index.

With regard to SharePoint, the term farm is used to describe a collection of one or more SharePoint Servers and one or more SQL Servers. These servers together provide a set of basic SharePoint services bound together by a single configuration database in SQL Server. A farm in SharePoint marks the highest level of SharePoint administrative boundary. Microsoft SharePoint 2013 can be configured as a small, medium, or large farm deployment. The topology service provides you with an almost limitless amount of flexibility, so you can tailor the topology of your farm to meet the specific needs of multiple tenants.

Approximating SharePoint data sizes can be broken down into three different sections:

- Content database
- SharePoint index
- SharePoint search

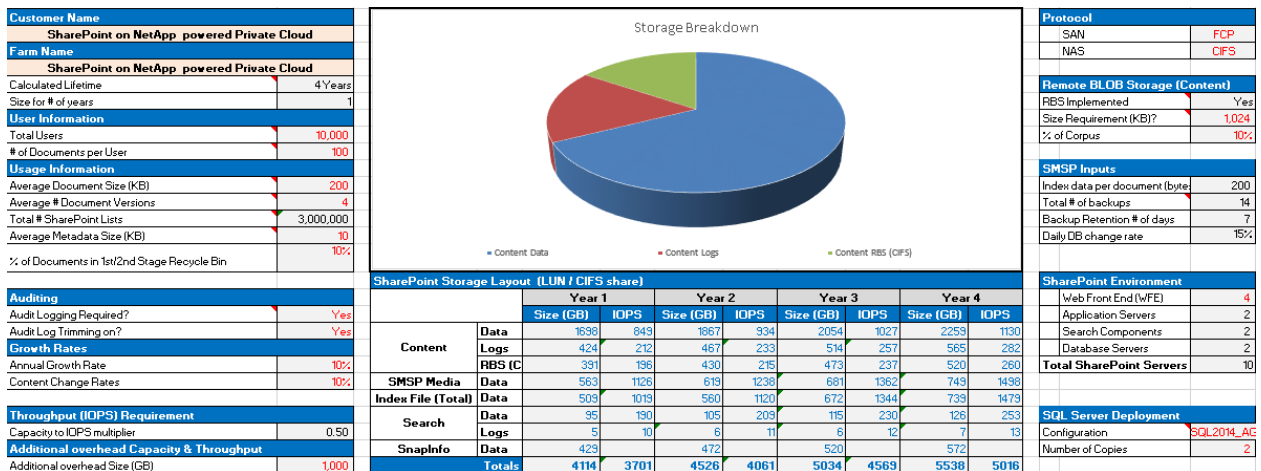
Use the new NetApp storage calculator for SharePoint for SharePoint sizing and estimation. This sizing tool contains Microsoft and NetApp sizing best practices for properly sizing and configuring storage for SharePoint Servers.

The SharePoint 2013 solution test environment included the following components:

- Total number of users: 10,000
- Concurrency rate: 10%
- Initial farm size: 1000GB
- Number of SharePoint farms: 1
- Purpose of SharePoint web application: document management
- Do you reply heavily on SharePoint's search function?: Yes

Figure 7 illustrates the SharePoint sizer.

Figure 7) SharePoint sizer.



Note: Consult with your NetApp sales engineer (SE) to access the NetApp SharePoint storage calculator and calculate the exact storage configuration for your organization.

Based on the sizing, the following storage resources were tested for Microsoft SharePoint 2013 in this solution:

- 24 * 900GB 10k RPM SAS disks and 2TB FC card
- 2 aggregates

- 1 RAID group (14) in each aggregate

Microsoft Lync 2013

The placement of Lync Server roles is very important for achieving an HA solution in a Lync Server 2013, now called Skype for Business. Lync Server uses Windows fabric for HA which has internal intelligence to sustain server and service failures. External factors influencing this HA intelligence should be avoided if possible.

There are two key requirements that must be identified that drive the server design and ultimately determine the Lync Server 2013 Edition and total amount of servers: user count and HA. It is important for an organization to understand each server and the role that it provides. As the environments grow from SMB to large enterprise, the design requirements for the Lync Server architecture begin to scale up, as shown in Figure 8:

- Total number of users: 10,000
- HA plus 100% workload
- No persistent chat
- Archiving enabled

Figure 8) Lync Server design requirements.

Modality/Workload		Workload	Number of users	Front End	Network in	Memory in GB
IM/P	Users enabled for instant messaging (IM) and presence	100.0%	10000	23%	31	17.25
	Average number of contacts in Contacts list	80	NA			
Enterprise Voice	Users enabled for Enterprise Voice	60.0%	6000			
	Average number of calls per user per hour (peak)	4	NA			
	Percentage of calls that use media bypass	65.0%	NA			
	Percentage of voice users enabled for UC-PSTN calls	60.0%	3600	18%	40	1.37
	Percentage of voice users enabled for UC-UC calls	40.0%	2400	4%	4	0.94
Conferencing	Percentage of users in concurrent conferences	5.0%	500			
	Percentage of conferences with group IM only (no voice)	10.0%	275	3%	6	0.11
	Percentage of users using dial-in conferencing	15.0%	75	5%	2	0.38
	Percentage of conferences using voice	90.0%	450	10%	60	0.91
	Including video (No Multi View)	<input type="checkbox"/>	0	0%	0	-
	Including Multi View	<input checked="" type="checkbox"/>	75	1%	41	0.59
	Including application sharing	<input checked="" type="checkbox"/>	187.5	4%	118	2.02
	Including web conferencing	<input checked="" type="checkbox"/>	75	2%	36	0.13
Mobility	Percentage of users enabled for Mobility	40.0%	4000	12%	0.29	1.99

Recommendations	Physical			
	Servers*	Average CPU Load	Network in Mbps	Memory in GB
Total Front End Servers Required	2	45%	169	21
Edge Servers (based on 30% external)	1	NA	NA	NA
Archiving/Call Detail Recording/Quality of Experience s	1	NA	NA	NA
Back End Database Server Required (Pools Required)	1	NA	NA	NA

Based on the sizing, the following storage resources were tested for Microsoft Lync 2013 in this solution:

- 12 * 600GB 10k RPM SAS disks
- 1 aggregate
- 1 RAID group (14) in the aggregate

7.5 Data Layout

Exchange 2013 Database and Log LUNs

NetApp recommends placing active and passive database copies on separate aggregates to provide higher redundancy in addition to DAG functionality. Storage for the Microsoft Exchange Server 2013 database is provisioned on separate LUNs for databases and logs. Disks are configured with NetApp RAID DP® data protection technology, and database EDB and log files are placed on separate LUNs. iSCSI is used as the transport protocol for the storage subsystem. Table 5 shows the Microsoft Exchange database and logs placement.

Table 5) Microsoft Exchange database and logs placement.

Aggregate	Storage Virtual Machine	Server Role	Databases	Volumes and LUNs	Size (GB)
Aggr_Exch1 (RAID-DP)	Exch1_SVM	Exch-MBX1	DB1-DB4	4	1900GB
			Log1-Log4	4	120GB
		Exch-MBX2	DB5-DB8	4	1900GB
			Log5-Log8	4	120GB
		Exch-MBX3	DB9-DB12	4	1900GB
			Log9-Log12	4	120GB
Aggr_Exch2 (RAID-DP)	Exch2_SVM	Exch-MBX4	DB13-DB16	4	1900GB
			Log13-Log16	4	120GB
		Exch-MBX5	DB17-DB20	4	1900GB
			Log17-Log20	4	120GB
		Exch-MBX6	DB21-DB24	4	1900GB
			Log21-Log24	4	120GB

SharePoint 2013 Database and Log LUNs

Storage for the Microsoft SharePoint 2013 database is provisioned on separate LUNs for databases and logs. Disks are configured with RAID DP, and database .mdf and .ldf files are placed on separate LUNs. Microsoft SharePoint application server (search) index files are provisioned on a separate LUN and separate drive. iSCSI is used as the transport protocol for the storage subsystem. Table 6 shows the Microsoft SharePoint database and logs placement.

Table 6) Microsoft SharePoint database and logs placement.

Aggregate	SVM	Server Role	Databases	Volumes and LUNs	Size
		Application server			
			Index DB		
			Data	SearchIndex_VOL	500GB
				SearchIndex_LUN	300GB

Aggregate	SVM	Server Role	Databases	Volumes and LUNs	Size
				Index LUNs	2000GB
Aggr_SP01	SP1_SVM	SQL AG Node1	Search DB		
			Data	SearchDB_VOL	120GB
				SearchDB_LUN	60GB
			Log	SearchLog_VOL	20GB
				SearchLog_LUN	10GB
			Content DB		
			Data	ContentDB_VOL	2000GB
				ContentDB_LUN	1000GB
			Log	ContentLog_VOL	420GB
				ContentLog_LUN	210GB
Aggr_SP02	SP2_SVM	SQL AG Node2	Search DB		
			Data	SearchDB_VOL	120GB
				SearchDB_LUN	60GB
			Log	SearchLog_VOL	20GB
				SearchLog_LUN	10GB
			Content DB		
			Data	ContentDB_VOL	2000GB
				ContentDB_LUN	1000GB
			Log	ContentLog_VOL	420GB
				ContentLog_LUN	210GB

Lync 2013 Database and Log LUNs

A single aggregate was provisioned in the NetApp lab environment. Separate FlexVol® volumes were created for each SQL Server instance.

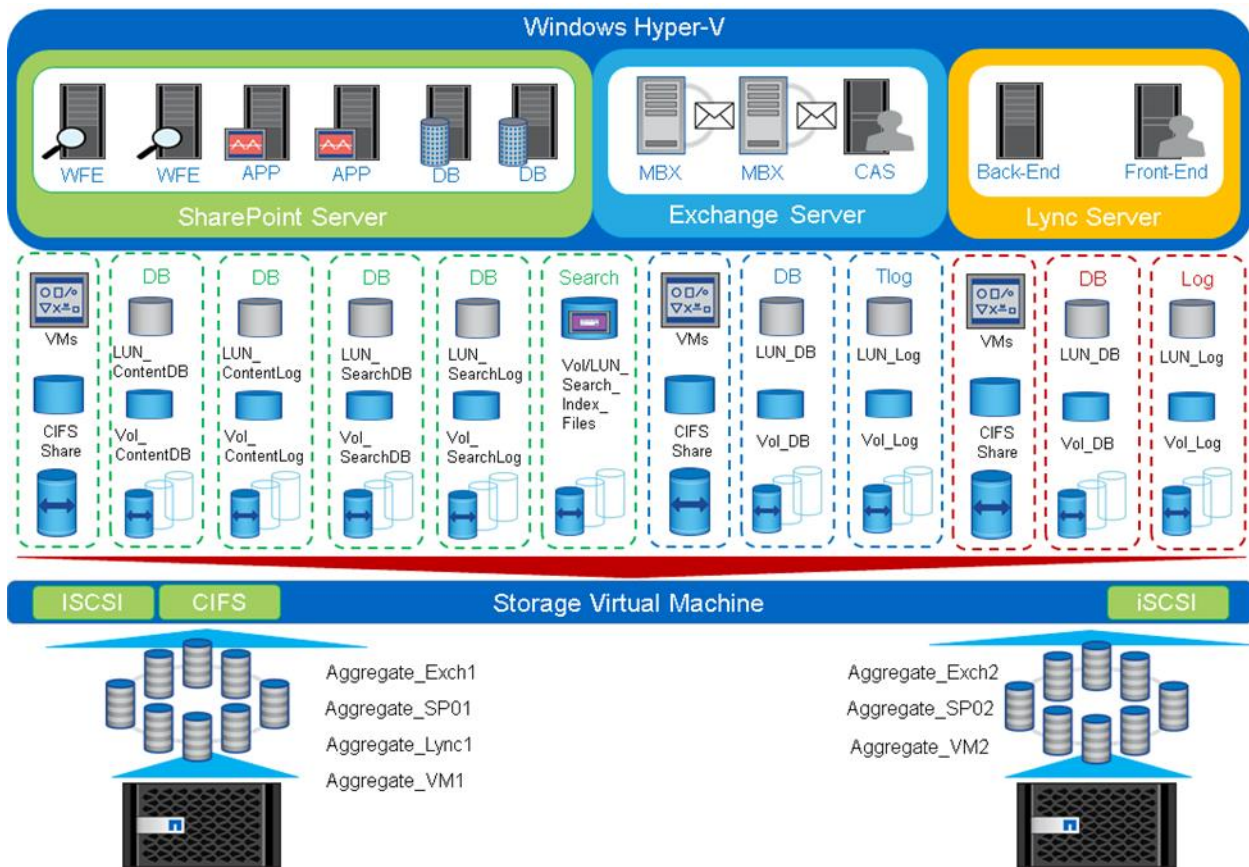
Place all data files and log files in a different FlexVol volume to separate the random data file I/O of the data files from the sequential I/O to the log files. Table 7 shows the Microsoft Lync database placement.

Table 7) Microsoft Lync database placement.

Aggregate	SVM	Server Role	Database	Size
Aggr_Lync1	Lync_SVM	Front-end server	Application database	248GB
		Back-end server	SQL/CMS database	1168GB

Figure 9 illustrates a sample storage layout.

Figure 9) Sample storage layout.



7.6 Efficiency

NetApp thin provisioning, deduplication, and compression capabilities were enabled on the volumes hosting VMs. The deduplication schedule was set to run once every night. As you scale out with hundreds to thousands of VMs, the storage efficiency yields better results.

Note: NetApp intelligent caching capabilities (built natively in Data ONTAP and Flash Cache™ cards) strongly complement NetApp storage efficiency capabilities.

8 Performance Validation

The storage configuration described in this document was validated by configuring the environment and conducting performance tests using the application-specific tools described in this section. The tests were performed individually for Microsoft Exchange, SharePoint, and Lync and also by running all these applications at the same time. The test results discussed in this section validate that the architecture is capable of handling the mixed workload described earlier.

Note: Based on the test results, with appropriate sizing and planning, this solution can be easily scaled to 3-4x users or more. Additional workloads can also be added as required based on proper sizing.

8.1 Microsoft Exchange 2013

The Microsoft Exchange JetStress Tool was used to simulate the 10,000-user environment with 2048MB per mailbox. Several two-, four-, and eight-hour duration load tests were performed, both with and without NetApp deduplication enabled on the VM C: drives hosting the OS and Exchange binaries.

8.2 VM Disk I/O Latency

For all test cycles, the read and write latencies were well within the Microsoft recommendations mentioned on the [Exchange 2013 Performance Counters](#) page of the Microsoft TechNet site.

8.3 VM CPU and Memory Utilization

For the entire test cycle, there were no CPU or memory bottlenecks on the VMs or the Hyper-V host.

8.4 NetApp Storage Utilization Summary

For the entire test cycle, the NetApp FAS8060 storage controller had more than enough capability to handle the workload for the 10,000-user Exchange environment that was tested. Also, there were no I/O bottlenecks on the storage array. Table 8 through Table 10 list the I/O and average latency for mailbox servers 1, 2, and 3.

Table 8) I/O and average latency across all databases on mailbox 1.

Type of Operation	Amount
Achieved transactional I/O per second	742.656
Target transactional I/O per second	269
Average database disk read latency (ms)	10.256
Average database disk write latency (ms)	3.058

Table 9) I/O and average latency across all databases on mailbox 2.

Type of Operation	Amount
Achieved transactional I/O per second	719.175
Target transactional I/O per second	269
Average database disk read latency (ms)	10.654
Average database disk write latency (ms)	3.061

Table 10) I/O and average latency across all databases on mailbox 3.

Type of Operation	Amount
Achieved transactional I/O per second	702.656
Target transactional I/O per second	269
Average database disk read latency (ms)	10.768
Average database disk write latency (ms)	3.065

For information about installing and running JetStress, see the [JetStress 2013 Field Guide](#).

Microsoft SharePoint 2013

AvePoint SharePoint Test Environment Creator and Microsoft Visual Studio Team System (VSTS) tools were used to populate and stress test the SharePoint environment described earlier in this document. The content database that was created was 1TB. The user workload that was tested was 70% browsing, 6% upload, 12% search, and 12% open. Several two-hour load tests were performed with 10% of the users online at any time. Tests were conducted with and without data deduplication enabled on the VM C: drives hosting the OS SQL and SharePoint Server binaries.

VM Disk I/O Latency

For all the tests, the read and write latencies for the database files were well within the Microsoft recommendations.

VM CPU and Memory Utilization

For the entire duration of the test cycles, there were no CPU or memory bottlenecks on any of the VMs.

NetApp Storage Utilization Summary

For the entire duration of the test cycles, the NetApp FAS8060 storage controller had sufficient capability to handle the test workload for the SharePoint environment. The response time for browsing, upload, search and open user load was well within 1-2 seconds. Also, there were no I/O bottlenecks on the storage array. Table 11 lists the SharePoint performance results.

Table 11) SharePoint performance results.

Type of Operation	Amount
Requests per second	33.33
Response time	<1 second
Throughput	60 requests/user/hour

Microsoft Lync 2013

The Lync Server 2013 Stress and Performance Tool with the default load settings was used to populate and simulate the 10,000-user environment described earlier in this document. Tests were conducted with and without data deduplication enabled on the VM C: drives hosting the OS and Lync Server binaries.

Note: This characterization didn't consider all types of Lync Server 2013 workloads. Additional workloads impact the sizing and performance requirements.

VM Disk I/O Latency

For all of the tests, the read and write latencies for the database files were well within the Microsoft recommendations.

VM CPU and Memory Utilization

For the entire duration of the test cycles, there were no CPU or memory bottlenecks on any of the VMs.

NetApp Storage Utilization Summary

For the entire duration of the test cycles, the NetApp FAS8060 storage controller had sufficient capability to handle the test workload for the Lync environment. Also, there were no I/O bottlenecks on the storage array.

The Lync front-end server performed within the recommended thresholds. The test results show that the Lync 2013 environment successfully handled the user load within acceptable values when compared with [key health indicators](#) in Lync Server 2013.

As mentioned earlier in this document, the load tests for different applications were also conducted all at the same time. There were no performance bottlenecks on the storage controllers, network, Hyper-V hosts, or VMs.

Note: Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting sizing and proof-of-concept testing for acceptable results in a nonproduction, isolated test environment that otherwise matches your production environment before your production implementation of this solution.

9 Deployment Steps for Production

This section provides guidance for implementing and configuring Microsoft Exchange and SharePoint in a production environment based on the test validation criteria described earlier in this document. Make sure that the servers, storage controllers, and disks are validated before moving into production.

Note: Consult with your NetApp SE to access the NetApp SharePoint storage calculator and calculate the exact storage configuration for your organization.

9.1 Microsoft Exchange 2013

To deploy Microsoft Exchange 2013 solutions using best practices that meet specific business requirements, see [TR-4280: Microsoft Exchange Server and SnapManager for Exchange Deployment Guide](#). This guide is based on the experiences of existing NetApp customers, real-world simulations, and NetApp engineering lab validations. It helps customers through the entire project lifecycle, including requirement assessment, solution design, installation, and administration along with the backup methodologies and validation steps.

Archive Mailbox

When an archive mailbox is considered for archiving and longer term retention, NetApp recommends that you isolate the archive mailboxes into separate databases. The personal archive mailbox does not add transactional IOPS, and it requires the Microsoft Enterprise Client Access License (CAL). Many NetApp customers isolate archive mailboxes into dedicated databases and reduce both the number of database copies to one per site and the Snapshot copies per day to one. The database changes only at night, when the message records management process moves mails over the archive threshold from the primary to the archive mailbox.

9.2 Microsoft SharePoint 2013

To deploy Microsoft SharePoint 2013 solutions using best practices that meet specific business requirements, see [TR-4297: Microsoft SharePoint Server and SnapManager for SharePoint Deployment Guide](#). This guide is based on the experiences of existing NetApp customers, real-world simulations, and NetApp engineering lab validations. It helps customers through the entire project lifecycle, including requirement assessment, solution design, installation, and administration.

OneDrive for Business

OneDrive for Business can be set up in a SharePoint Server 2013 on-premises environment, providing the business users with the sync and storage features provided by OneDrive for Business, but keeping all

of the data within on-premises environment. To install and configure OneDrive for Business, see the [Set Up OneDrive for Business in a SharePoint Server 2013 On-Premises Environment](#) webpage.

Yammer

Yammer provides a richer enterprise social experience. Yammer functionality can be added to a SharePoint environment by adding it to the navigation bar to embed a Yammer feed in a site. To integrate Yammer with a SharePoint Server 2013 on-premises environment, follow the guidelines on the [Integrate Yammer with On-Premises SharePoint 2013 Environments](#) webpage.

9.3 Microsoft Lync 2013

To deploy Microsoft Lync Server 2013, follow the steps provided on the Microsoft TechNet [Deploying Lync Server 2013](#) webpage.

Note: Use OnCommand Workflow Automation (WFA) to install and customize application deployments by following the guidelines in [TR-4438: IT as a Service: Simplifying Application and Storage Provisioning Using NetApp OnCommand Workflow Automation and System Center Orchestrator 2012 R2](#).

Note: Hybrid is another deployment option for which on-premises deployment can co-exist with Microsoft Office365. There are various options for hybrid deployments, so NetApp strongly recommends that customers perform total cost of ownership (TCO) calculations before making a decision. As mentioned earlier in this document, TCO calculations for on-premises deployments are the least expensive.

10 Backup and Recovery

For obtaining application-consistent backups for Microsoft Exchange, SQL Server, SharePoint, and VMs, NetApp SnapManager for Exchange, SQL Server, SharePoint, and Hyper-V were leveraged to perform scheduled backups of the transaction logs and databases and to initiate SnapMirror® updates (if required per the design). The SnapManager products also make sure of granular recovery for these Microsoft applications. The backup and recovery solution component includes application-consistent point-in-time NetApp Snapshot copies with NetApp SME, SMSQL, SMSP, and SMHV.

NetApp Snapshot copies are different from competing solutions because NetApp does not use copy-on-write methodology. Such backups encounter performance degradation even after just a handful of backups. The NetApp Snapshot solution quickly updates pointers (seconds to minutes) and can handle over 250 Snapshot copies per volume.

Snapshot copies are easily replicated to another site with SnapMirror and FlexClone® (read/write Snapshot copy) technology to another environment for testing or data mining, and archived to a small controller with large capacity disks for long-term retention. The RTO to recover a database that is corrupt, is missing, or requires a full reseed is just a few minutes.

For detailed information about setting up a SnapManager backup, see the following SnapManager documents:

- [TR-4221: Microsoft Exchange Server 2016/2013 and SnapManager for Exchange Best Practices Guide for Clustered Data ONTAP](#)
- [TR-4225: Best Practice Guide for Microsoft SQL Server and SnapManager 7.0 for SQL Server with Clustered Data ONTAP](#)
- [TR-4243: Microsoft SharePoint and SnapManager 8.0 for SharePoint with Clustered Data ONTAP: Best Practices Guide](#)
- [SnapManager 7.1 for Microsoft Exchange Server Installation and Setup Guide](#)
- [SnapManager for Microsoft SharePoint](#) on the NetApp Support site

11 Disaster Recovery and High Availability

DR requires commitment and investment from the enterprise on a secondary site for the continued operation of Microsoft application when the primary production site is temporarily or permanently unusable.

To appropriately architect a solution for HA and business continuity, you should be familiar with the terms defined in this section.

11.1 Availability

Availability is the degree to which a system, subsystem, service, or equipment is in an operable state for a proportion of time in a functional condition. It refers to the ability of the user community to access and use the system.

11.2 Disaster Recovery

DR is the process of regaining access to the data, hardware, and software necessary to resume critical business operations after a disaster. A DR plan should include methods or plans for copying necessary mission-critical data to a recovery site, as well as procedures to regain access to this mission-critical data after a disaster.

11.3 High Availability

HA is a system design protocol that confirms a certain absolute degree of operational continuity of a system, service, or equipment during a given measurement period. HA planning should include strategies to prevent single points of failure, which could potentially disrupt the availability of mission-critical business operations. It is important to have a clear understanding of business drivers and recovery needs, which can help measure the impact and set recovery goals in terms of how long it will take to resume operations and how much time latency is remaining in the last transaction that has been recovered.

With traditional DR solutions, businesses had to figure out what their budget could support and make tough decisions about the recovery plans. This process has been simplified with the evolution of virtualization and services through private and public clouds. DR solutions are now both easy to manage and affordable, allowing for increased DR protection for all applications:

- Private cloud-based DR
- Hybrid cloud-based DR, blending on-premises private cloud and near-to-the-cloud environments

Private Cloud-Based DR

Most companies believe it is a best practice to keep mission-critical data center applications in a private cloud model so that the IT administrators have the most control over them. Compliance issues come into play, as do application concerns; however, it might simply come down to what an organization's decision makers are comfortable with. For companies that use a private cloud or are planning to build a private cloud based on the guidance in this technical report, NetApp offers a portfolio of products that includes replication and DR orchestration to further simplify and reduce the costs of implementing a DR solution.

See the following technical reports for step-by-step guidance about how to deploy a robust DR plan in a private cloud deployment model:

- [Disaster Recovery Solution for Microsoft Exchange on Clustered Data ONTAP](#)
- [NetApp SnapManager for Microsoft SharePoint Server–Disaster Recovery Guide](#)

Hybrid Cloud–Based DR: Blending On-Premises Private Cloud and Near-to-Cloud Environment

Hybrid clouds can increase flexibility and provide access to nearly unlimited compute power. However, concerns about data security continue to inhibit broader adoption. Private storage solutions that provide a direct connection to one or more hyperscalar clouds can address security concerns and enable hybrid cloud configurations for a DR use case. Hybrid clouds provide the cost benefits and flexibility of cloud computing with at least some of the same controls afforded by an on-premises infrastructure. An organization can improve its IT service delivery with a hybrid approach. To maximize return on investment (ROI), issues such as governance and authentication must be carefully considered. To help NetApp customers select the most appropriate solutions for their IT infrastructure, NetApp provides NetApp Private Storage (NPS) using IaaS and ExpressRoute/direct connect offerings from Microsoft Azure or Amazon Web Services (AWS). NPS offers excellent performance and enterprise-class storage features. When DR is completely outsourced, a company has no direct control over what is happening, and the decisions are left up to whoever the outsourcer is. When you use co-location, the data center is essentially in a different location; therefore, a company would still have control over the hardware, software, and most of the communications.

Note: The VMs can be used from Microsoft Azure IaaS, or they can be hosted in the same rack where storage controllers are hosted.

Note: The same use case can be extended to deploying production workloads similar to hosted offerings provided by various vendors.

Note: Before you start migrating data and applications, consider how best to design a hybrid architecture that meets your needs and provides the right mix of cloud and data center resources.

A hybrid solution uses a topology that provides cross-cloud redundancy. For example, the NPS for a Microsoft Azure solution is a hybrid cloud architecture that allows enterprises to build an agile cloud infrastructure that combines the scalability and flexibility of the Microsoft Azure cloud with the control and performance of NetApp storage. NetApp storage is deployed at an Equinix colocation facility and is connected to Microsoft Azure computing resources through the Equinix Cloud Exchange and the Microsoft Azure ExpressRoute service.

The following environments can be deployed in two locations (this model provides benefits similar to those provided by deploying to a second on-premises data center):

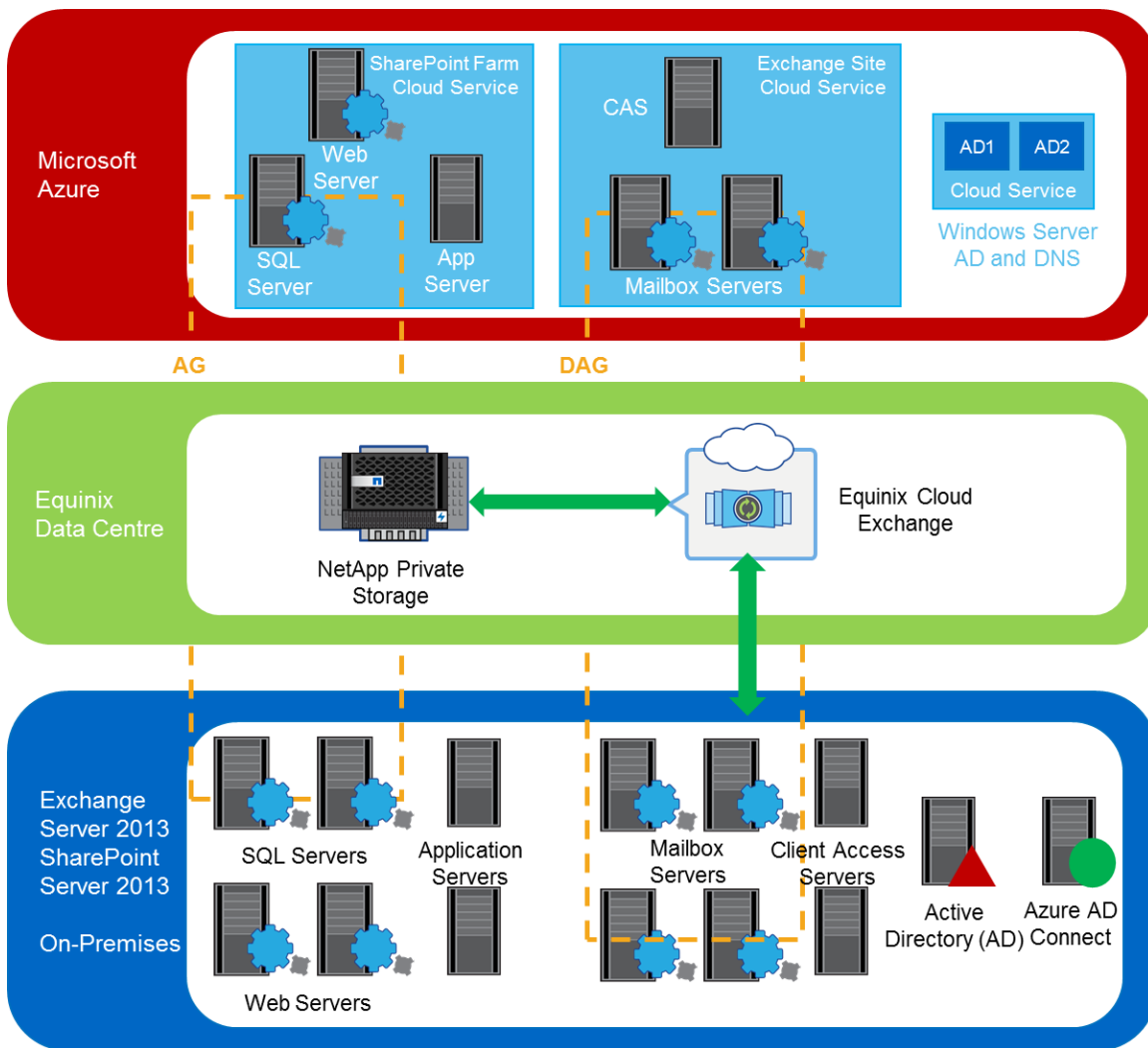
- An on-premises private cloud running in a data center, for example, on the west coast.
- A recovery environment deployed using an IaaS on hyperscalar provider and storage residing next to the data center leveraging ExpressRoute. For example, this environment would be hosted in a data center on the eastern coast and is set up as a warm standby recovery environment.

For detailed information about deploying NPS for Microsoft Azure solution, refer to [NetApp Private Storage for Microsoft Azure Solution Architecture and Deployment Guide](#).

For detailed information about deploying NPS for Amazon solution, refer to [NetApp Private Storage for Amazon Web Services \(AWS\) Solution Architecture and Deployment Guide](#).

Figure 10 is an illustration of the architectural diagram.

Figure 10) Architectural diagram.



11.4 DR Deployment Phases

The end-to-end configuration of the production and DR workload consists of the following phases:

- Phase 1: Configure on-premises private cloud environment. Configure switches, network, servers, NetApp storage and applications as mentioned in the preceding sections based on the design requirements (for example, build active directory and create Exchange DAG, SQL Server availability group, and SharePoint farms based on the design layout).
- Phase 2: Sign up for Microsoft Azure subscription. Create ExpressRoute circuit and enable Microsoft Azure ExpressRoute circuit in Equinix cloud Exchange and connect the Microsoft Azure virtual network to ExpressRoute. Configure NetApp storage and associated network connectivity to ExpressRoute.
- Phase 3: Configure on-premises Active Directory sites and subnets. Register DNS in Windows Azure. Provision and configure replica Active Directory Domain Services (AD DS) domain controllers.
- Phase 4: Configure SQL Server, SharePoint, and Exchange infrastructure in the recovery site. Create and configure the virtual machines based on the CPU and RAM requirements; prepare them for use with SQL Server, SharePoint, and Exchange; and create the cluster.

- Phase 5: Configure Exchange Servers and provision the required storage from NPS through ExpressRoute based on the storage layout.
- Phase 6: Configure SharePoint Servers and provision the required storage from NPS through ExpressRoute based on the storage layout.
- Phase 7: Create the replica copies and add the appropriate databases to the correct path.
- Phase 8: Complete the DR environment configuration.

The solution uses Exchange DAG and SQL Server AlwaysOn Availability Groups as an end-to-end solution that provides HA and disaster failover recovery. In addition to providing HA in a production environment, Exchange DAG and SQL Server AlwaysOn improve RTO because the Exchange and the SQL Server instances for SharePoint next to the cloud data center contain a replica of the databases from the primary data center.

Note: The number of resources depends on your DR environment: cold standby, warm standby, or hot standby. In the event of a disaster, with cloud resources, you can easily scale out the recovery environment to meet the load requirements and scale in the recovery when you no longer need the resources.

Note: You can also deploy a cold standby recovery environment based on the design and leveraging NetApp SnapMirror technology to replicate the content from an on-premises environment to NPS (another compelling scenario). After the data is replicated across sites using SnapMirror technology, in the event of a disaster, the Microsoft application data is recovered on the DR site that is leveraging the NPS and IaaS VMs by DAG or AG level recovery mechanism or by using standalone server for recovery.

11.5 DR Preparation

Exchange Server

To prepare the Exchange Server for DR, complete the following steps:

1. Create two VMs for the multi-Exchange role in cloud from the gallery image Windows Server 2012 R2, under the appropriate cloud service and storage account where Microsoft Azure DC resides (apply Microsoft guidelines to determine CPU and memory requirements). Considerations include the number of mailboxes, mailbox profile, number of servers in the DAG, number of passive database copies, and several other custom parameters.
Note: For the Exchange Server role, add HTTPS (TCP/443) and SMTP (TCP/25) to the endpoint list.
2. Patch the VMs with the required hotfixes.
3. Join the VMs to the domain.
4. Install prerequisites for the Exchange Server roles.
Note: The same VM can hold multiple roles.
5. Install Exchange Server 2013 mailbox/client access role on the VMs.
6. Add the mailbox servers to the DAG (this can be IP-less DAG or a DAG with a static IP).
Note: You can use a single network interface. A single network interface is also supported for production environments.
7. Add database copies on the mailbox servers on which the copy should be created.
8. Test failover to and from the mailbox server on Microsoft Azure VM.

In the event of a disaster, complete the following steps:

1. Terminate a partially running data center.
2. Validate and confirm the prerequisites for the second data center.

3. Activate the mailbox servers.

Note: If the servers in the standby data center have an activation blocked setting, the system won't perform an automatic failover from the primary data center to the standby data center of any database. If there are no failover restrictions for any of the database copies in the standby data center, the system activates copies in the second data center, assuming they are healthy.

4. Activate the client access servers.

Note: Activating client access servers involves changing the mapping of the DNS records for these service endpoints from IP addresses in the primary data center to the IP addresses in the second data center that are configured as the new service endpoints. Depending on the DNS configuration, the DNS records that need to be modified might or might not be in the same DNS zone.

5. After appropriate configuration changes have been completed, the second data center functions in the same way as in the primary data center.

For detailed steps, see [Datacenter Switchovers](#) on Microsoft's TechNet site.

SharePoint Server

To prepare the SharePoint Server for DR, complete the following steps:

1. Create the VMs for SQL Server nodes in the cloud from gallery image Windows Server 2012 R2, under the same cloud service and storage account where Microsoft Azure DC resides.
2. Provision the VMs for the SharePoint Servers.
3. Patch the VMs with the required hotfixes.
4. Add these two nodes to the Microsoft Azure DR data center connected to the NPS that stretches the on-premises failover cluster.
5. Install failover clustering on the SQL Server nodes.
6. Install SQL Server 2014 as a standalone default instance and enable SQL Server Always ON.
7. Add an unused IP address from Microsoft Azure VLAN subnet to the existing AG listener.
8. Test failover to and from the SQL Server node on the Microsoft Azure VM.
9. Install and configure SharePoint Server to create the recovery farm.
10. Add nodes as replicas for existing availability groups and make sure that the replicas in the recovery farm are configured as readable secondary replicas.

Note: Group the DR recovery requirements.

11. Test the connection to the availability group listener name.

In the event of a disaster, complete the following steps:

1. Perform a failover of the cluster and the availability groups.
2. Mount any additional SharePoint content databases that were not part of the original farm configuration. Additional content databases were probably created since the initial deployment and added to an availability group.
3. Verify that the service applications are accessible.
4. Start the user profile synchronization service on one server in the DR farm.
5. Perform a full import of the user profiles.
6. Update DNS for web applications and site collections and also for the application domain.
7. Perform test cases in your environment to make sure that the recovery is as expected.
8. After the primary site is operational again, plan to fall back to the on-premises farm.

Note: For detailed steps, see [Plan for SQL Server AlwaysOn and Microsoft Azure for SharePoint Server 2013 Disaster Recovery](#) on Microsoft's TechNet site.

11.6 Other DR Options

DR Using SnapMirror Technology

SnapMirror can be used to support DR. In this scenario, prior to the disaster, the volumes containing all of the database copies, both active and passive/secondary, are replicated to the DR site using NetApp SnapMirror technology.

Depending on the DR requirements of the application being deployed, SnapMirror can be implemented in the following ways:

- The SnapMirror replication can occur over site-to-site virtual private network (VPN) links between an on-site location and the Equinix colocation facility. To support this replication, network security equipment that can support a site-to-site VPN must be deployed in both the primary and the secondary locations, and an Internet connection must exist between both of the locations.
- The SnapMirror replication can occur over a Multiprotocol Label Switching (MPLS) dedicated network connection (that is, dark fiber) between an on-site location and the Equinix colocation facility.
- To support this replication, network equipment that can support this connection must be deployed in both the primary and the secondary locations.

In the event of a disaster, complete the following steps:

1. Rebuild the application using the reserved instances from the IaaS resources.
2. Install NetApp Windows host utilities, SDW, and SnapManager products on the designated VMs.
3. Determine whether the servers are connected properly using an appropriate protocol to the SnapMirror destination storage.
4. Use SDW to connect to the LUNs in the SnapMirror destination. Use the same drive letters or mount points as the original servers. SDW will automatically break the SnapMirror relationship.
5. Use SME/SMSP capabilities to recover from the most recent backups.

DR Using Azure Site Recovery

Another DR option is to use Azure Site Recovery (ASR) to migrate on-premises VMs to Azure. Both Microsoft Hyper-V and VMware VMs can be migrated to Azure with ASR. Microsoft System Center Virtual Machine Manager (VMM) integrates with the NetApp storage SMI-S 5.2 provider to manage NetApp storage and SnapMirror replication as part of VM and data protection groups. ASR relies on the Hyper-V replica service to perform block-level replication of VMs to Azure VMs. In the case of DR, VMs and the storage in the primary location are offline. System Center VMM running in Azure or in the NPS colocation facility does the following:

1. Issue commands to the NetApp SMI-S provider to break SnapMirror replication.
2. Brings the Azure VMs online.
3. Creates iSCSI sessions to NPS.
4. Maps the LUNs on NPS to the Azure VMs.

11.7 DR Considerations

Take the following considerations into account when planning for DR:

- Customers with a single data center should consider stretching their workload into a hyperscaler cloud leveraging NPS (it provides benefits similar to those from deploying to a second on-premises data center).

- Sizing is critical; consider network impacts (strongly consider ExpressRoute as a better network solution).
- At a minimum, a Microsoft Azure subscription is required to create the services in cloud.
- Select and use appropriate VM series (for example, DS series VMs) for the appropriate workload.
- Determine the quantity of cloud services for the DR scenario.
- Microsoft Azure VMs by default have 1 1Gb vNIC. It is possible to have more than 1 vNIC per VM, but this is only possible at the time of creation. It is not currently possible to retrofit additional vNICs to an existing VM.
- All VMs in a vNET must be multi-NIC. You cannot have some VMs that are single vNIC and some that are multi-NIC.
- Each VM type has a maximum number of vNICs. If more vNICs are required, increase the VM size to cater the requirement.
- It is a common practice to have the servers in the recovery environment on a separate subnet. This practice must be taken into account when configuring Windows Server Failover Clustering (WSFC).
- It is important to monitor the latency of replaying log buffers to the DR environment during testing. Plan for and test network latency between the on-premises farm and the recovery environment. The latency between replicas has an impact on RPO.
- Windows PowerShell Azure cmdlets can help automate tasks in the environment.

NetApp has a long history of providing high-performance, feature-rich storage systems. NPS extends this legacy to Microsoft Azure/AWS. With the advent of NPS, NetApp continues to develop leading-edge storage solutions that provide the agility and mobility that current and future NetApp customers desire. Our testing shows that NPS, when combined with Microsoft Azure/AWS EC2, delivers performance comparable to that of on-premises environments when running comparable workloads. NPS allows customers to benefit from the elasticity and economics of the cloud combined with the control, availability, and performance of NetApp storage.

NetApp has delivery partners who specialize in deploying NPS solutions. These partners are experienced and can help make your NPS for Microsoft Azure deployment a success. For more information about NPS delivery partners, contact your NetApp account representative.

12 Conclusion

The NetApp for Messaging and Collaboration Private Cloud solution enables the following Microsoft applications on-demand provisioning and management in a private cloud and extends the DR capabilities to the public cloud:

- Exchange
- SharePoint
- Lync

With this solution, application administrators can deploy applications on appropriate storage tiers to optimize the performance needs of the applications. This solution has a very compelling TCO when compared to competing JBOD and RAID 10 solutions; many customers are sensitive to operating costs. This solution typically consumes less rack space and requires fewer physical disks, which results in power and cooling savings. When meeting a customer's SLA, fewer database copies require fewer Exchange mailbox servers, which also saves rack space, power and cooling costs, server acquisition costs, and server operating costs.

In today's tight fiscal environment, many enterprise customers are evaluating the costs of an entire package, not just the up-front purchase price. NetApp's strength is in reducing complexity and increasing efficiency and availability, while providing the best solution. This approach lowers both RPOs and RTOs beyond what Exchange and SharePoint natively provide in the box. The NetApp storage platform runs the

same OS on all storage models. Expansion is easy; just add more shelves or replace the storage controller. NetApp Unified Controller delivers data access by using NFS, CIFS, iSCSI, and FCoE protocols concurrently over a shared network port using the NetApp unified target adapter. SnapMirror replication provides flexible site resiliency and easy expansion into the private cloud. Storage efficiency features such as deduplication and thin provisioning increase the enterprise efficiency and can greatly reduce the cost per user with services such as Exchange, SharePoint, and Virtual Desktop.

References

The following references were used in this document:

- TR-4221: Microsoft Exchange Server 2016/2013 and SnapManager for Exchange Best Practices Guide for Clustered Data ONTAP
<http://www.netapp.com/us/media/tr-4221.pdf>
- TR-4225: Best Practice Guide for Microsoft SQL Server and SnapManager 7.0 for SQL Server with Clustered Data ONTAP
<http://www.netapp.com/us/media/tr-4225.pdf>
- TR-4243: Microsoft SharePoint and SnapManager 8.0 for SharePoint with Clustered Data ONTAP: Best Practices Guide
<http://www.netapp.com/us/media/tr-4243.pdf>
- TR-4438: IT as a Service: Simplifying Application and Storage Provisioning Using NetApp OnCommand Workflow Automation and System Center Orchestrator 2012 R2
<http://www.netapp.com/us/media/tr-4438.pdf>
- TR-4094: FlexPod Datacenter with Microsoft Private Cloud Fast Track v4: Clustered Data ONTAP Deployment Guide
<http://www.netapp.com/us/media/tr-4094.pdf>
- TR-4356: NetApp for Microsoft Private Cloud Deployment Guide
<http://www.netapp.com/us/media/tr-4356.pdf>
- Microsoft TechNet: Exchange 2013 System Requirements
[http://technet.microsoft.com/en-us/library/aa996719\(v=exchg.150\).aspx](http://technet.microsoft.com/en-us/library/aa996719(v=exchg.150).aspx)
- NetApp Support: Clustered Data ONTAP 8.2 Logical Storage Management Guide
<http://support.netapp.com/documentation/docweb/index.html?productID=61651>
- Volume Shadow Copy Service Overview
[http://msdn.microsoft.com/en-us/library/aa384649\(v=VS.85\).aspx](http://msdn.microsoft.com/en-us/library/aa384649(v=VS.85).aspx)
- Exchange Server Role Requirements Calculator
<http://gallery.technet.microsoft.com/office/Exchange-2013-Server-Role-f8a61780>
- NetApp Support: Data ONTAP Documentation
<http://now.netapp.com/NOW/knowledge/docs/docs.cgi>

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.

Copyright Information

Copyright © 1994–2016 NetApp, Inc. All rights reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

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

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

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

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

RESTRICTED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.277-7103 (October 1988) and FAR 52-227-19 (June 1987).

Trademark Information

NetApp, the NetApp logo, Go Further, Faster, AltaVault, ASUP, AutoSupport, Campaign Express, Cloud ONTAP, Clustered Data ONTAP, Customer Fitness, Data ONTAP, DataMotion, Flash Accel, Flash Cache, Flash Pool, FlashRay, FlexArray, FlexCache, FlexClone, FlexPod, FlexScale, FlexShare, FlexVol, FPolicy, GetSuccessful, LockVault, Manage ONTAP, Mars, MetroCluster, MultiStore, NetApp Fitness, NetApp Insight, OnCommand, ONTAP, ONTAPI, RAID DP, RAID-TEC, SANshare, SANtricity, SecureShare, Simplicity, Simulate ONTAP, SnapCenter, SnapCopy, Snap Creator, SnapDrive, SnapIntegrator, SnapLock, SnapManager, SnapMirror, SnapMover, SnapProtect, SnapRestore, Snapshot, SnapValidator, SnapVault, SolidFire, StorageGRID, Tech OnTap, Unbound Cloud, WAFL, and other names are trademarks or registered trademarks of NetApp Inc., in the United States and/or other countries. All other brands or products are trademarks or registered trademarks of their respective holders and should be treated as such. A current list of NetApp trademarks is available on the web at <http://www.netapp.com/us/legal/netapptmlist.aspx>. TR-4509-0516