

Module 7

Data access

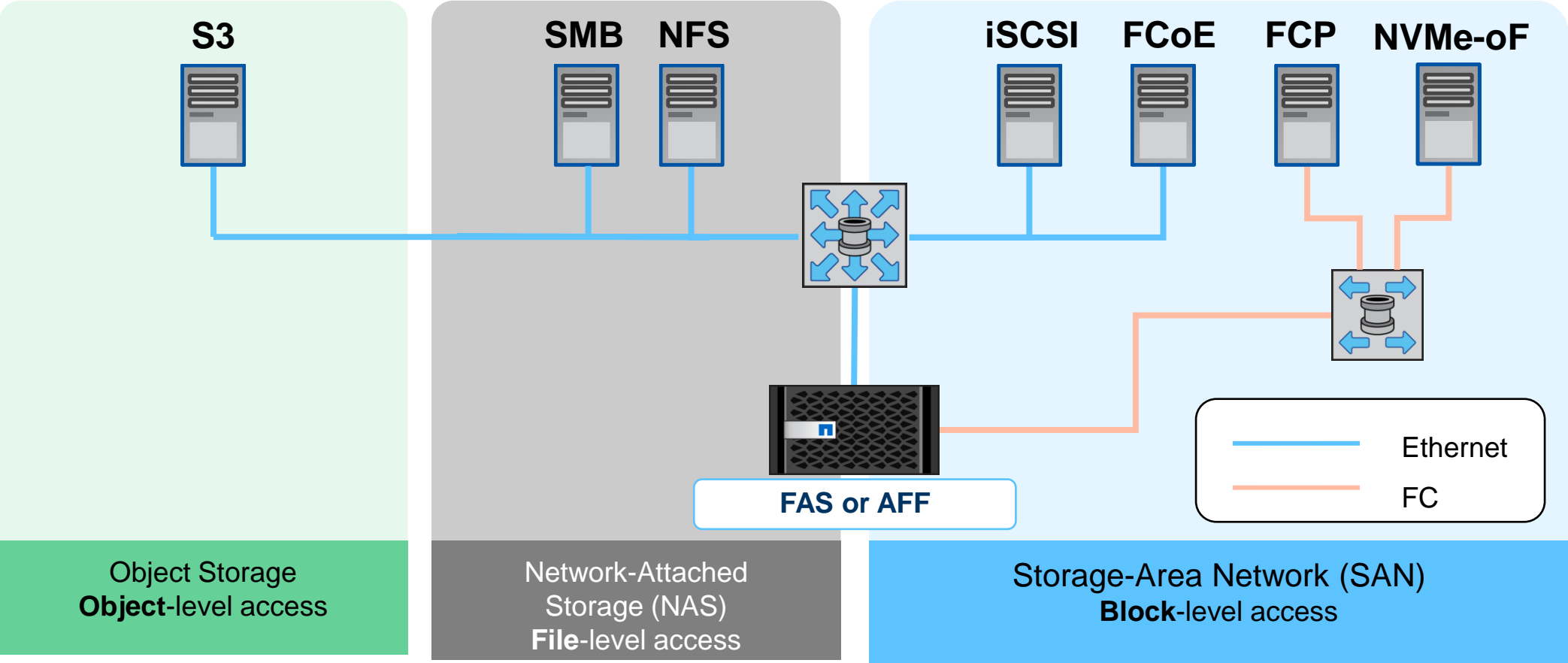
About this module

This module focuses on enabling you to do the following:


- Use NAS protocols to access data
- Use SAN protocols to access data
- Use object protocols to access data

Unified storage

Review



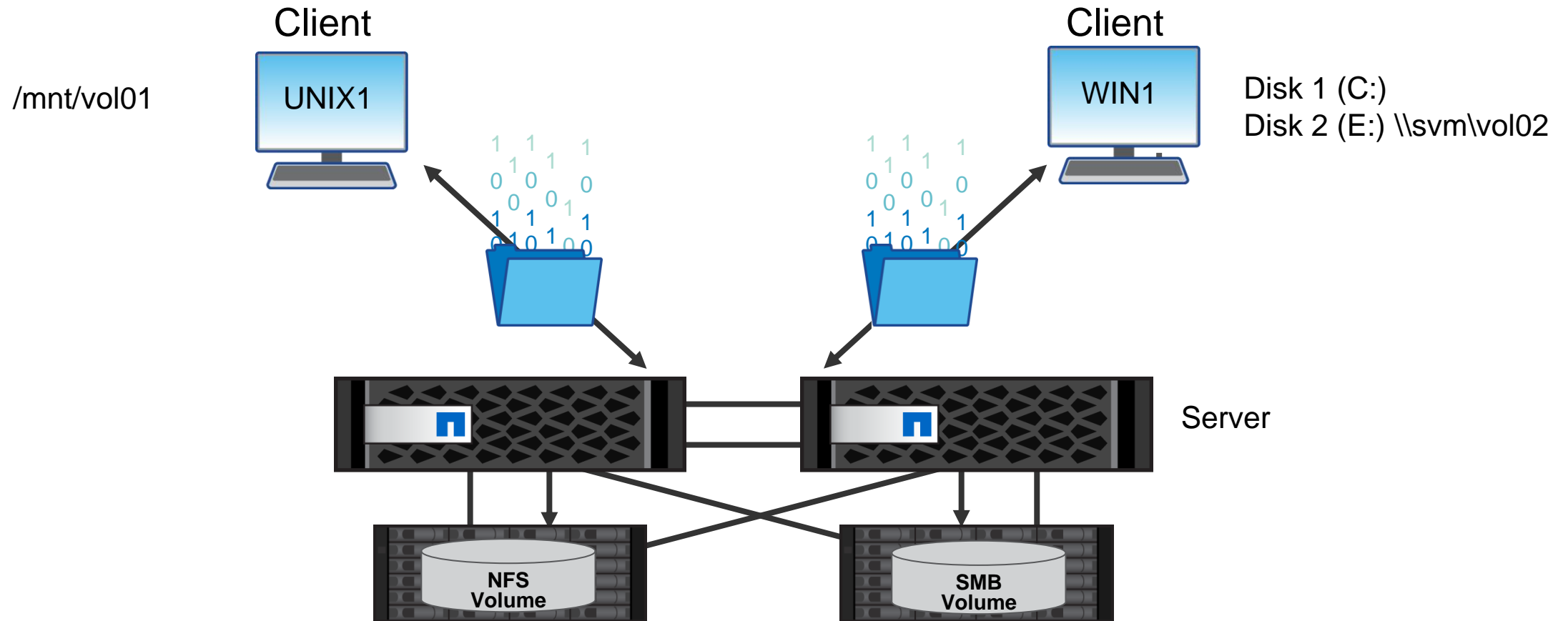
S3 = Simple Storage Service NVMe-oF = NVMe over Fabrics



Lesson 1

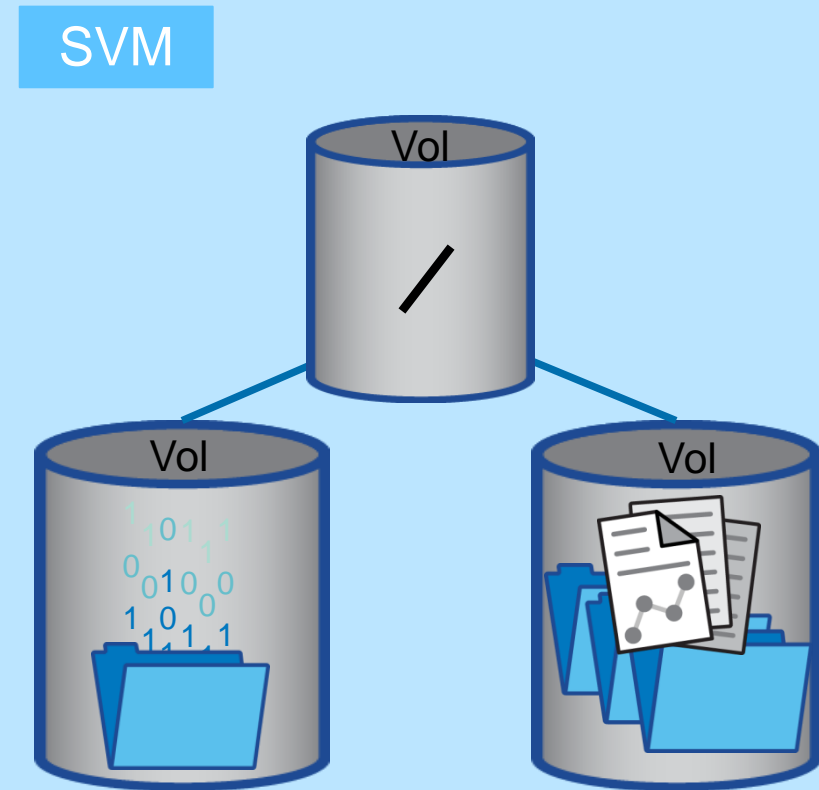
Use NAS protocols to access data

The NAS file system



Storage system resources

- FlexVol volume
 - Data container to manage data in a storage VM (storage virtual machine, also known as SVM)
 - Exportable by mounting to a namespace junction
- Qtree
 - Volume partition created on a storage system
 - Exportable by mounting to a namespace junction
- Directory
 - Volume partition created on the NAS client
 - Not exportable



Namespace and junction paths

Create a projects volume under the SVM root:

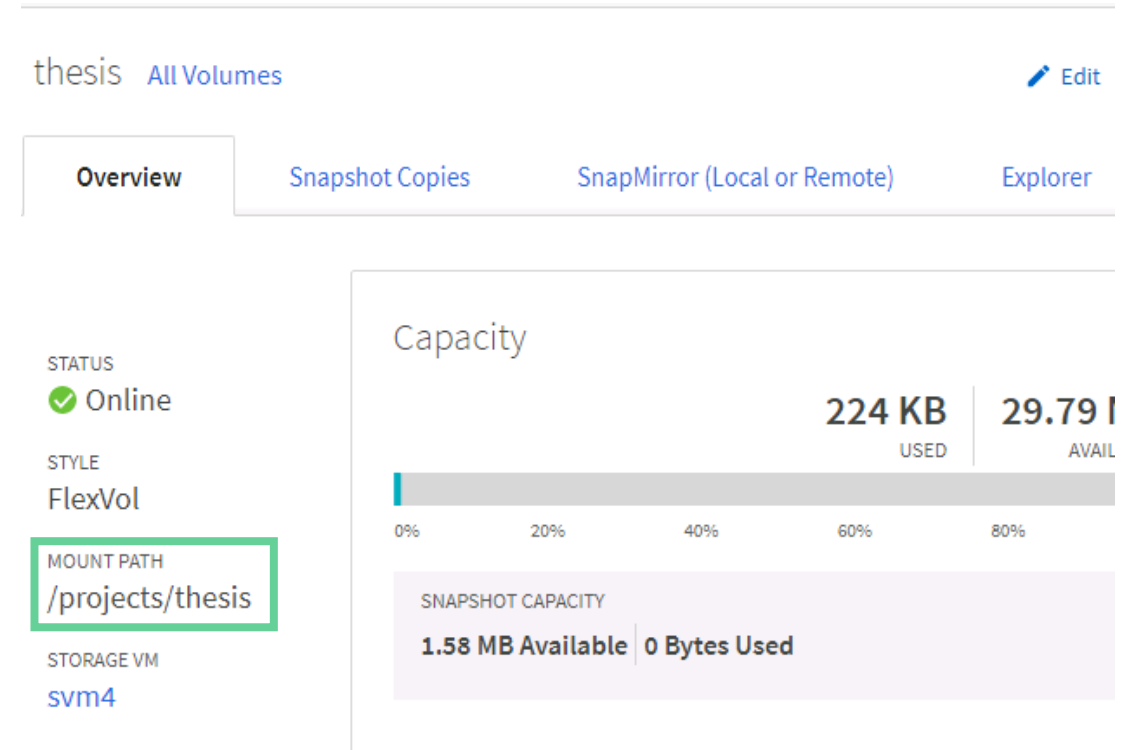
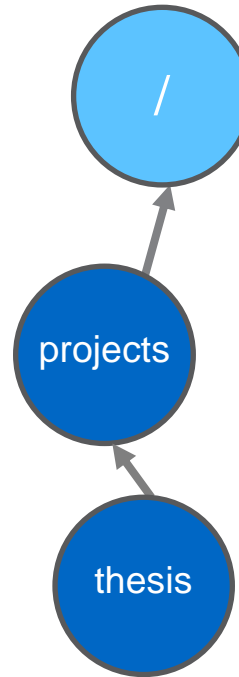
```
::> volume create -vserver svm4  
-aggregate sas_data_23 -volume projects  
-size 5GB -junction-path /projects
```

– THEN –

- Create a second named project volume:

```
::> volume create -vserver svm4  
-aggregate sas_data_18 -volume thesis  
-size 10GB
```
- Mount the second volume under /projects:

```
::> volume mount -vserver svm4 -volume thesis  
-junction-path /projects/thesis
```



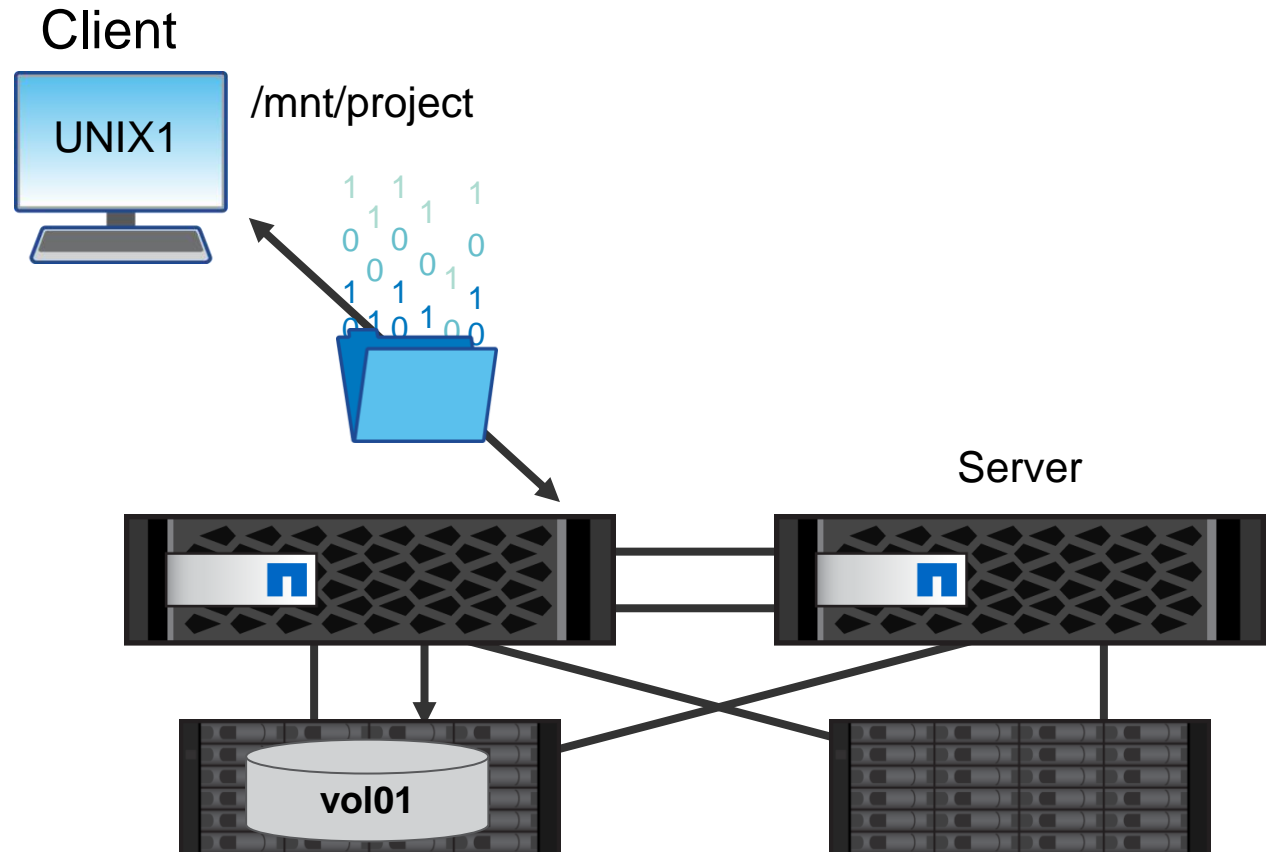


Topic for discussion

How do NFS and SMB clients see junctions in a namespace?

NFS

- vol01 is *exported* to UNIX1 with read/write permission.
- UNIX1 *mounts* vol01 to /mnt/project with read/write permission.



NFS implementation steps

1. Verify or add the NFS protocol license.
2. Enable NFS functionality on the SVM.
3. Create or identify the necessary resources.
4. Export the available resources.
5. Configure NFS authentication.
6. Authorize the user.
7. Mount the exported resources.



SVM creation: NFS

SVM basic details

ONTAP System Manager

Search actions, objects, and pages

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+ Add

Create

<input type="checkbox"/>	Name	State	Subtype
<input type="checkbox"/>	svm1	running	default
<input type="checkbox"/>	svm2	running	default
<input type="checkbox"/>	svm3	running	default

Add Storage VM

STORAGE VM NAME

svm5

Access Protocol

☒ SMB/CIFS, NFS

☐ Enable SMB/CIFS

☒ Enable NFS

☐ Allow NFS client access

Add at least one rule to allow NFS clients to access volumes in this storage VM.

EXPORT POLICY

Default

Protocols

NetApp

11

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Allow NFS client access

Add export rule

Cancel Save

SVM creation: NFS

Configure network interfaces

ONTAP System Manager

Search actions, objects, and pages

<>

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NETWORK

NETWORK INTERFACE

Use multiple network interfaces when client traffic is high.

cluster1-01

IP ADDRESS

192.168.0.133

SUBNET MASK

24

GATEWAY

Add optional gateway

☒ Use the same subnet mask and gateway for all of the following interfaces

cluster1-02

IP ADDRESS

192.168.0.134

SVM creation: NFS

SVM administrator details

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Search actions, objects, and pages

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Overview

Settings

Storage VM Administration

☒ Manage administrator account

USER NAME

vsadmin

PASSWORD

CONFIRM PASSWORD

☐ Add a network interface for storage VM management.

Save

Cancel

Optionally, create an SVM administrator account.

Optionally, create an SVM management LIF.

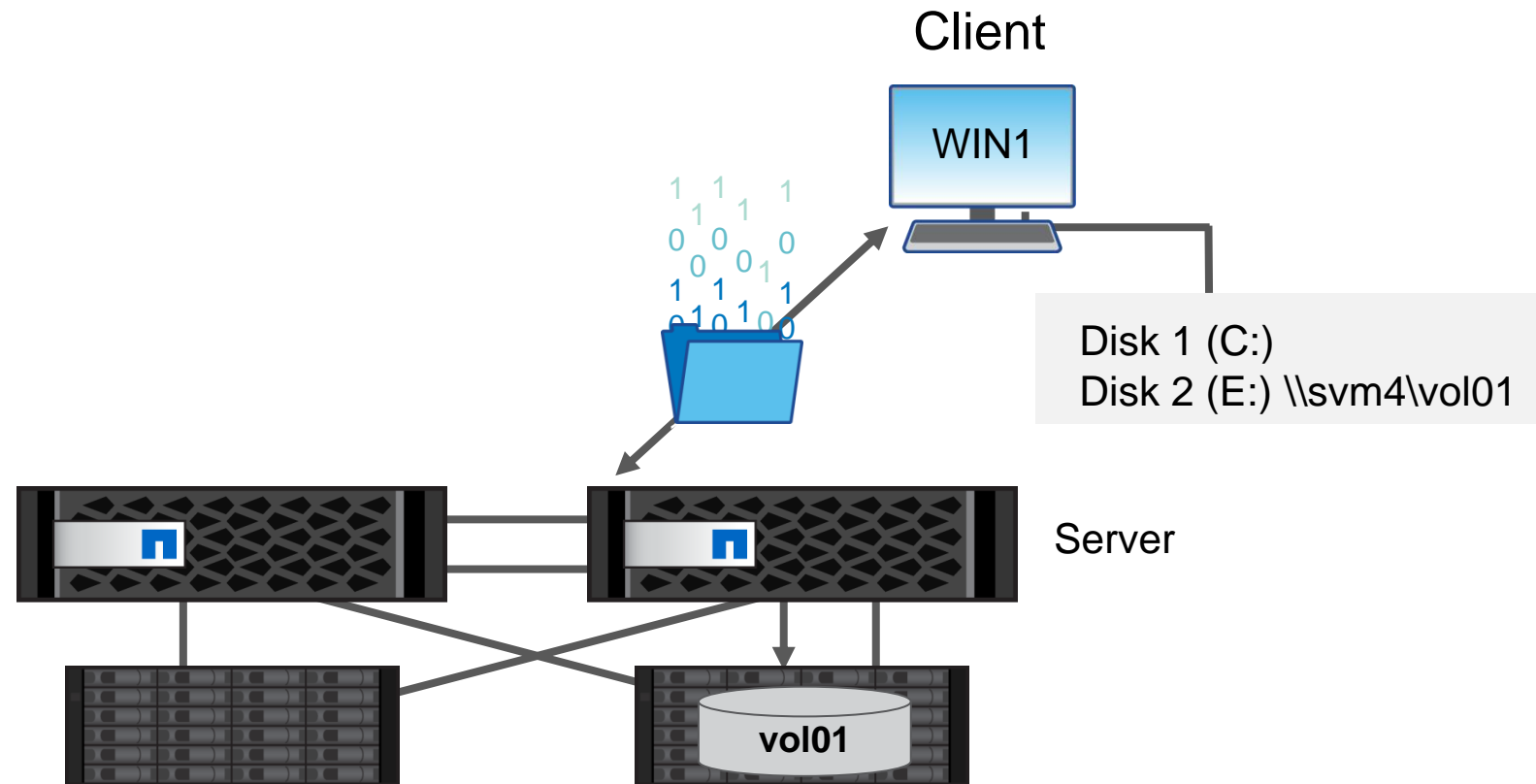
NFS client mounts

Use the UNIX `mount` command on the client to mount an exported NFS resource from the storage system.

```
unix1# mkdir /mnt/project1
```

```
unix1# mount <SVM LIF IP>:/project/pro1 /mnt/project1
```

SMB



SMB implementation steps

1. Verify or add the CIFS protocol license.
2. Enable SMB functionality on the SVM.
3. Create or identify the necessary resources.
4. Share the available resources.
5. Configure SMB authentication.
6. Authorize the user.
7. Map the shared resources.



SVM creation: SMB

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Storage VMs

+ Add

Create

<input type="checkbox"/>	Name	State	Subtype
	svm1	running	default
	svm2	running	default
	svm3	running	default
	svm4	running	default
	svm5	running	default

Add Storage VM

STORAGE VM NAME

svm_SMB

Access Protocol

SMB/CIFS, NFS

☒ Enable SMB/CIFS

☐ Enable NFS

SVM creation: SMB

Configure the CIFS protocol

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Access Protocol

SMB/CIFS, NFS

Enable SMB/CIFS

ADMINISTRATOR NAME

administrator

PASSWORD

.....

SERVER NAME

svm_SMB

ACTIVE DIRECTORY DOMAIN

demo.netapp.com

Information to create a machine record in Active Directory

Enable SMB/CIFS

ADMINISTRATOR NAME

administrator

PASSWORD

.....

SERVER NAME

svm_SMB

ACTIVE DIRECTORY DOMAIN

demo.netapp.com

Encrypts data while accessing the shares in the storage VM.

DNS DETAILS

DOMAINS

DEMO.NETAPP.COM

+ Add

NAME SERVERS

192.168.0.253

+ Add

DNS settings from Admin SVM

SVM creation: SMB

Configure network interfaces

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NETWORK INTERFACE

Use multiple network interfaces when client traffic is high.

cluster1-01

IP ADDRESS

192.168.0.125

SUBNET MASK

24

GATEWAY

192.168.0.1

☐ Use the same subnet mask and gateway for all of the following interfaces

cluster1-02

IP ADDRESS

192.168.0.126

SUBNET MASK

24

GATEWAY

192.168.0.1

Multiple LIFs can improve I/O

SVM creation: SMB

SVM administrator details

ONTAP System Manager

Search actions, objects, and pages

Storage VM Administration

☒ Manage administrator account

USER NAME

vsadmin

PASSWORD

CONFIRM PASSWORD

☐ Add a network interface for storage VM management.

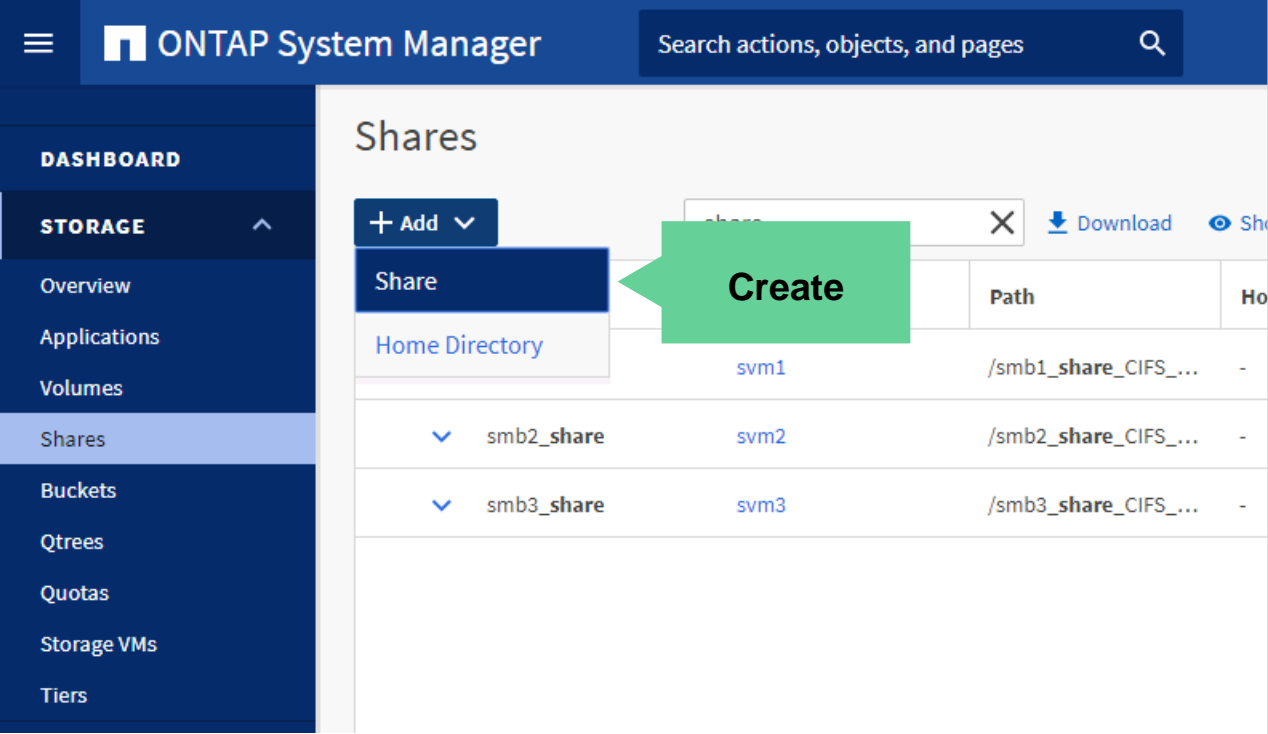
Save Cancel

Optionally, create an SVM administrator account.

Optionally, create an SVM management LIF.

In an exercise for this module, you create an SVM to serve both NFS and SMB.

Create an SMB share



Add Share

SHARE NAME

SMB_share

STORAGE VM

svm_SMB

FOLDER NAME

/

Browse

DESCRIPTION

Entire SVM namespace

ACCESS PERMISSION

User/Group	User Type	Access Permission
Everyone	Windows	Full Control

+ Add

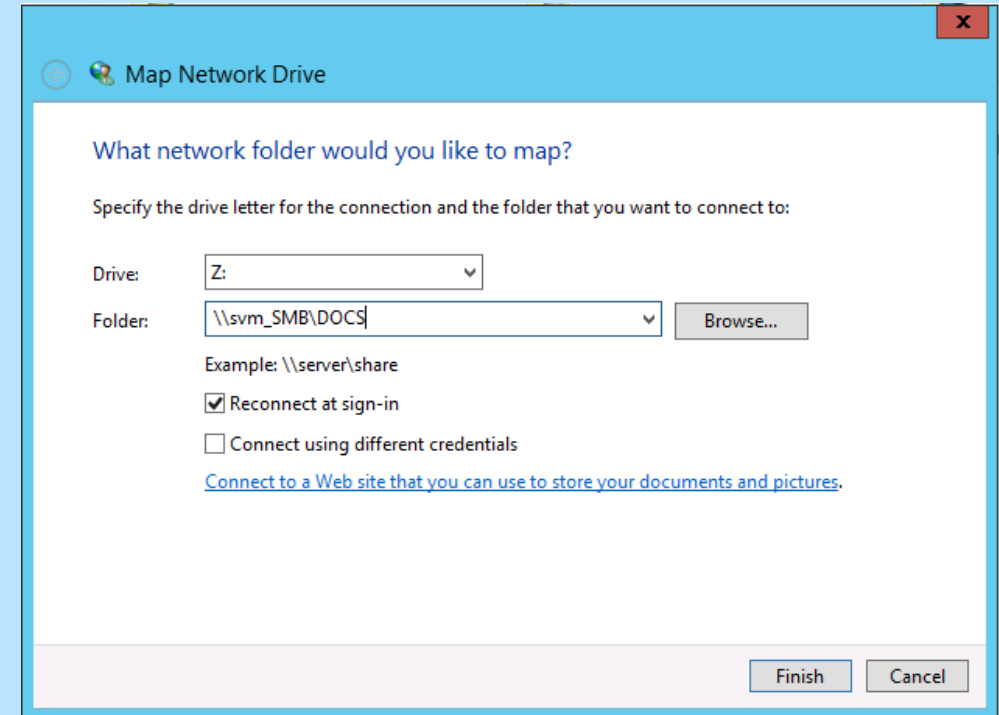
☐ Encrypt data while accessing this share
Encrypts data using SMB 3.0 to prevent unauthorized file access on this share.

Save

Cancel

Mapping a share to a client

- CLI:
 - C:\> `net view \\svm_SMB`
 - C:\> `net use e: \\svm_SMB\DOCS /user:marketing\jdoe`
- UI:
 - Use Windows File Explorer.
 - Map a network drive.
`\\svm_SMB\DOCS`



NetApp ONTAP File System Analytics

Explore a FlexVol volume

Visualization through ONTAP System Manager

- Collects hierarchical subdirectory granular metadata to provide visibility into the following:
 - Capacity usage and trend
 - Files and directories count
 - File activity and age histogram
- Supports REST APIs for application integration

The screenshot displays the 'Explorer' tab for the volume 'smb2_share_CIFS_volume'. The interface includes tabs for 'Overview', 'Snapshot Copies', 'SnapMirror (Local or Remote)', and 'Explorer'. A 'Last Refreshed' timestamp of 'Apr 10, 2021, 10:48:56 PM' and an 'Enable Analytics' link are visible. A directory tree on the left shows a root directory with subdirectories: 'portfolio', 'tools', and 'profiles'. The main table displays columns for 'Directory Name', 'Used', 'Modify History', and 'Access History'. The 'Used', 'Modify History', and 'Access History' columns for the 'portfolio' directory show 'No Data' with information icons. A dialog box titled 'File analytics were not enabled.' is overlaid on the table, with the message 'Enable analysis on this volume to gather access history. Check back after some time.' and buttons for 'Cancel' and 'Enable'.

smb2_share_CIFS_volume All Volumes Edit More

Overview Snapshot Copies SnapMirror (Local or Remote) Explorer

Last Refreshed: Apr 10, 2021, 10:48:56 PM Enable Analytics

Files Show / Hide

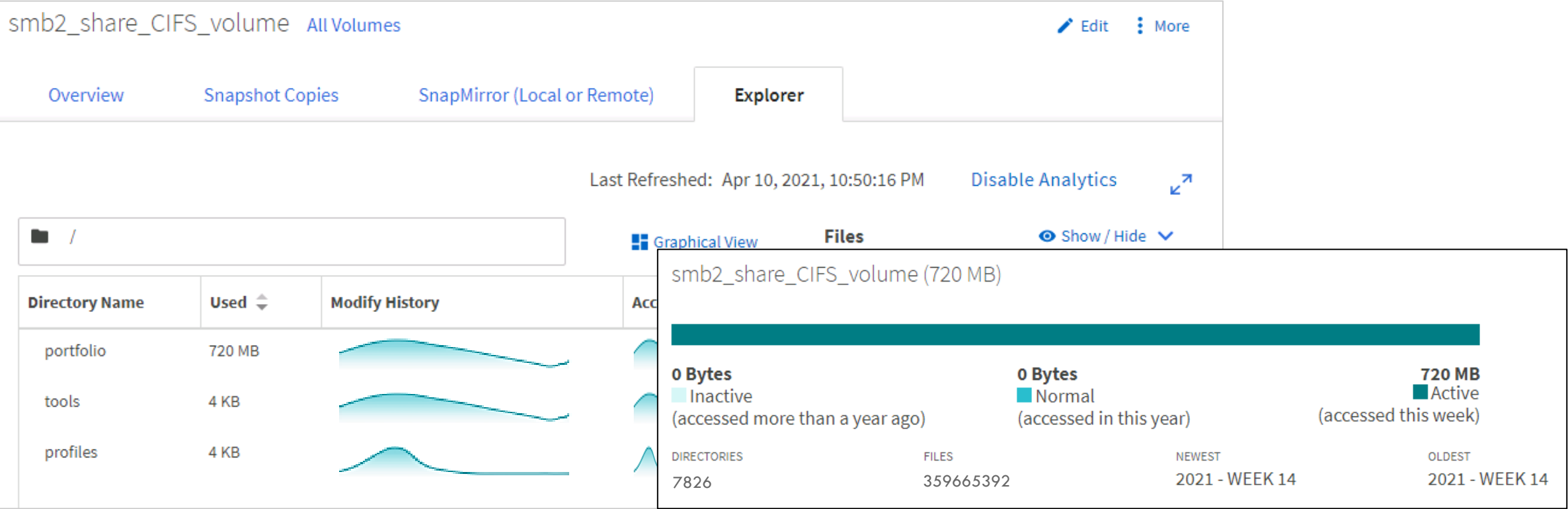
Directory Name	Used	Modify History	Access History
> portfolio	No Data	No Data	No Data
> tools			
> profiles			

File analytics were not enabled. X

Enable analysis on this volume to gather access history.
Check back after some time.

Cancel Enable

ONTAP File System Analytics



Additional NAS learning

Where can I learn about advanced topics like the following?

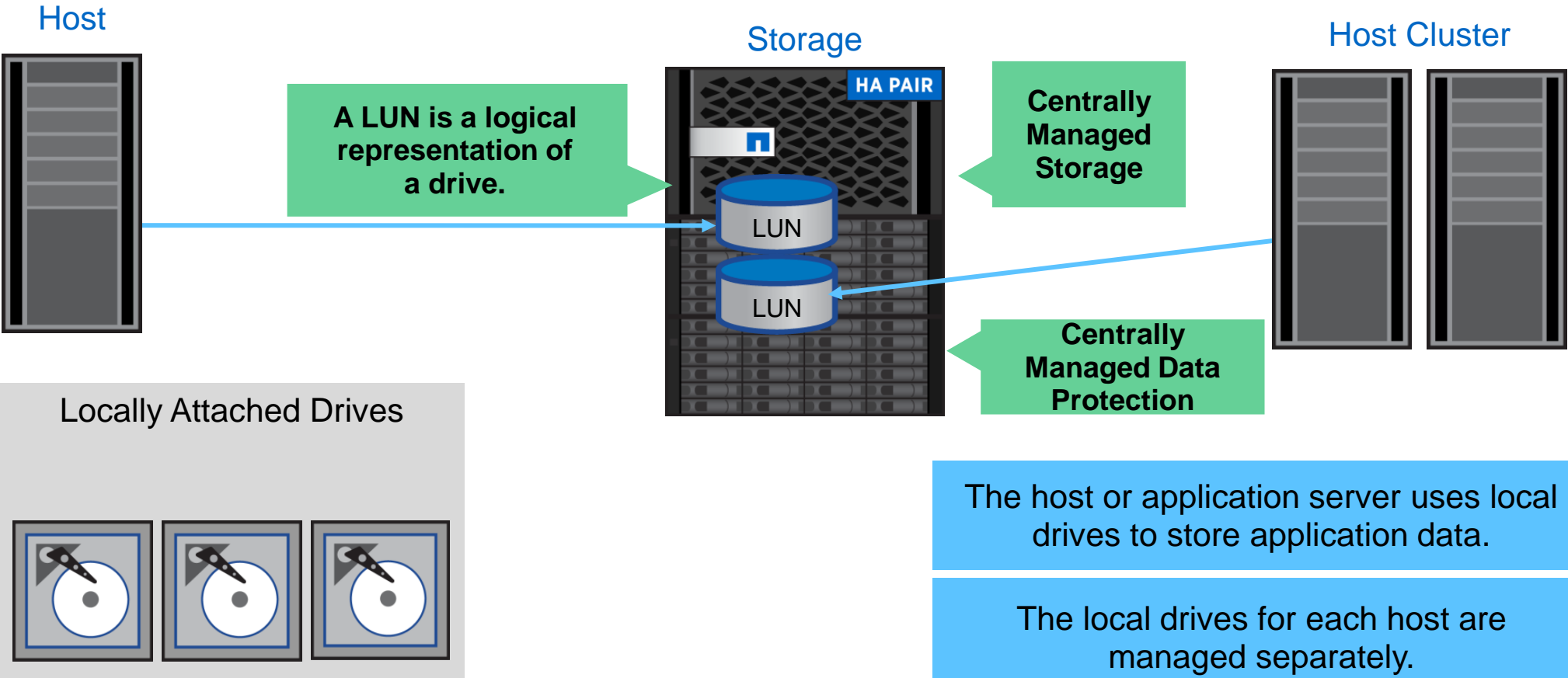
- Protocol versions and features
- Export policies and rules
- Shares
- Authentication
- Permissions
- Using multiple protocols
- Managing scalable NAS containers
- *ONTAP NAS Fundamentals*
(online course)
- *ONTAP NFS Administration*
(virtual/instructor-led course)
- *ONTAP SMB Administration*
(virtual/instructor-led course)



Lesson 2

Use SAN protocols to access data

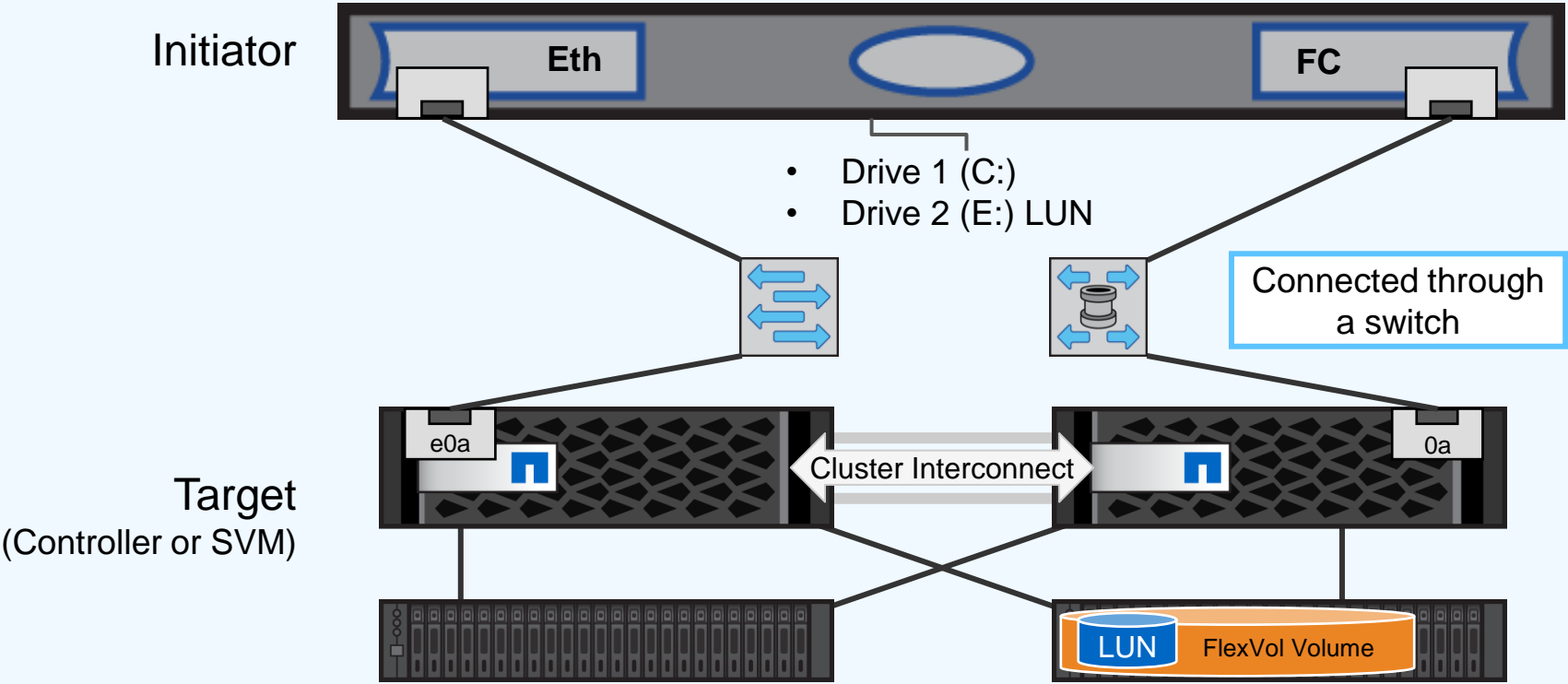
SAN



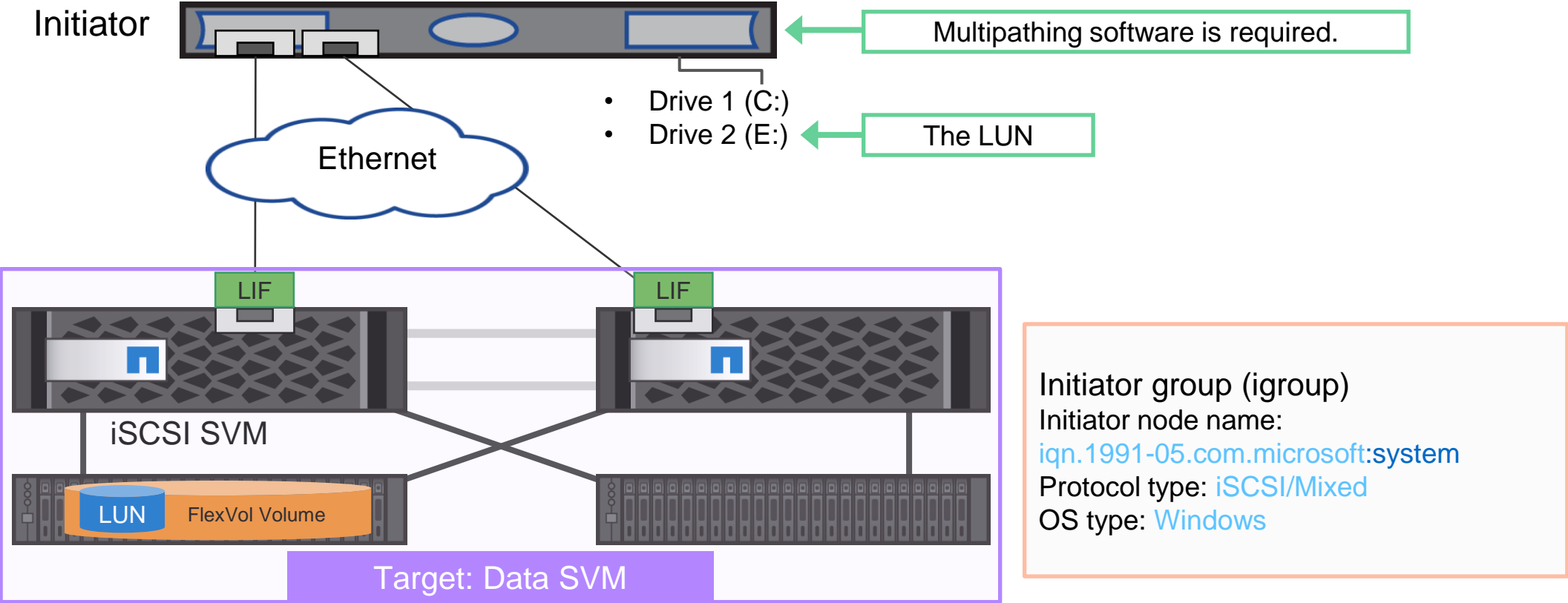
HA = high-availability

Connecting initiator to target

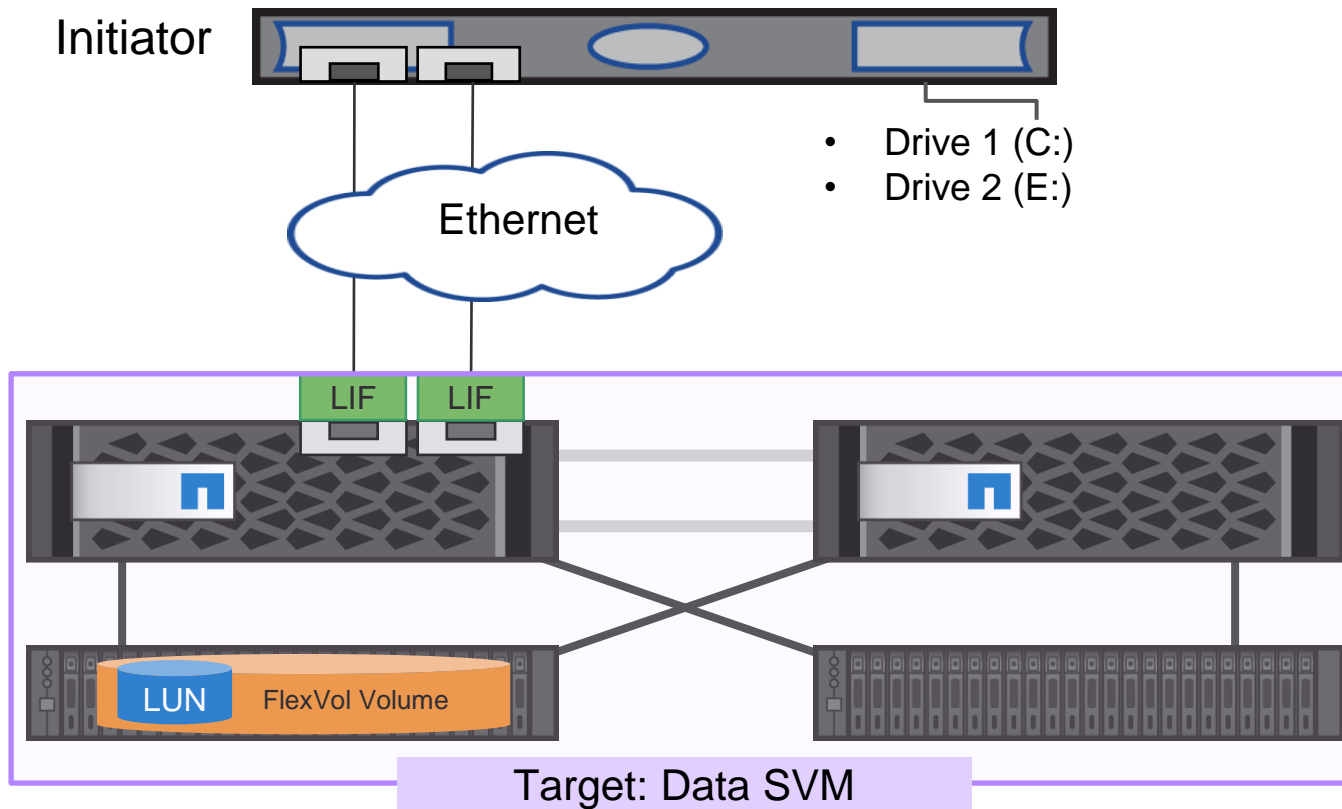
How can you connect an initiator to a target?



iSCSI architecture



iSCSI node names



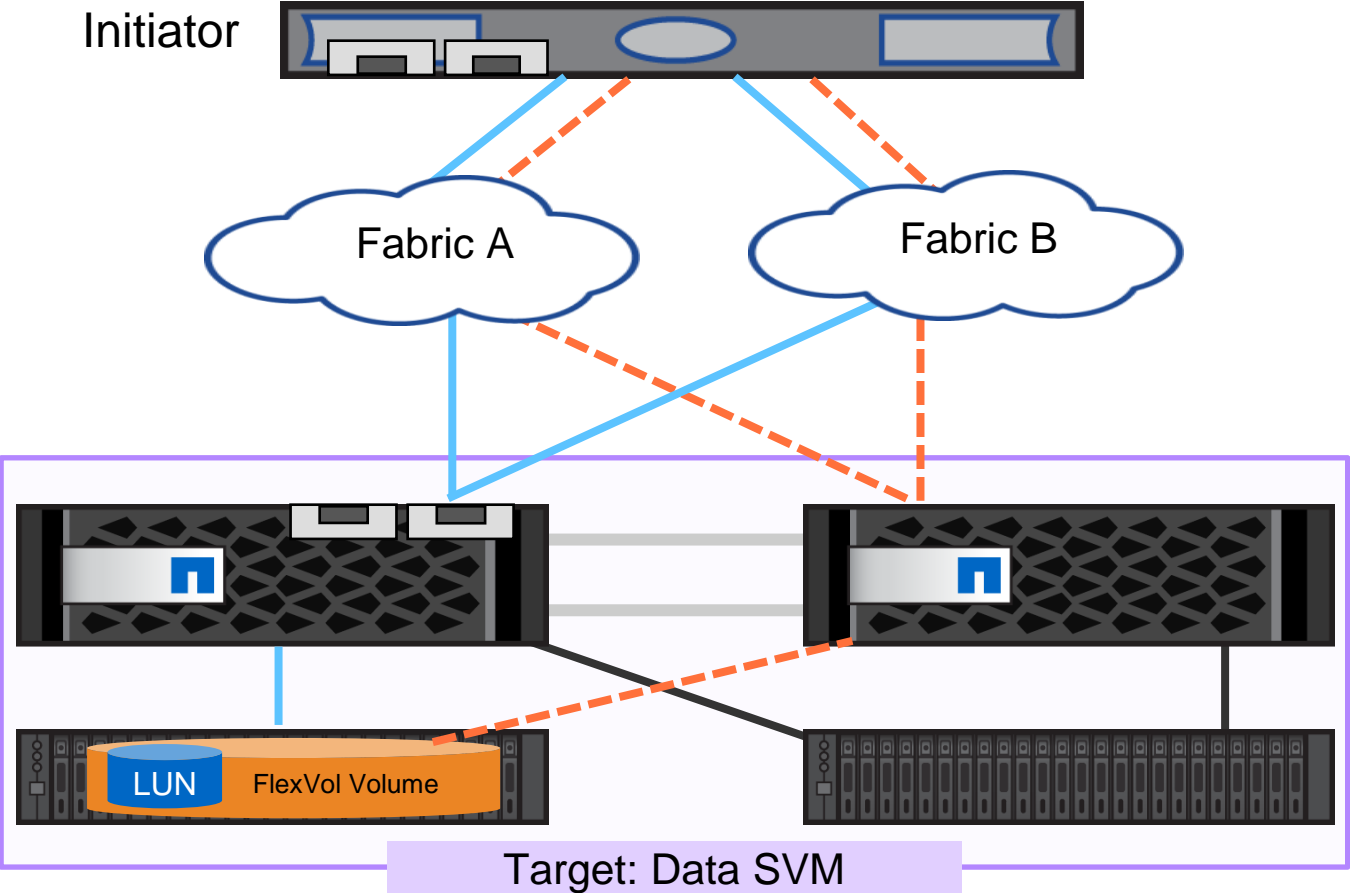
Each node has a unique iSCSI Qualified Name (IQN).

iqn.1991-05.com.microsoft:system

All data SVMs with iSCSI enabled have unique IQNs.

iqn.1992-08.com.netapp:sn.000...:vs

SAN Multipath



Multiple pathways from the initiator to the target LUN through separate SAN fabrics is recommended.

ONTAP uses asymmetric logical unit access (ALUA) to advertise the available and optimal paths

Multipathing software on the host identifies paths and manages path failure and recovery

NetApp Unified Host Utilities provide easy connection from a Windows or Linux host computer to NetApp storage systems

Legend

Active Optimized

Inactive path

iSCSI implementation steps

1. Verify or add the iSCSI protocol license.
2. Enable iSCSI functionality on the SVM.
3. Create or identify the necessary resources.
4. Map the LUN to the appropriate igroup.
5. Locate the LUN on the host computer and prepare the drive.



SVM creation: iSCSI

SVM basic details

≡

ONTAP System Manager

Search actions, objects,

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Storage VMs

+ Add

<input type="checkbox"/>	Name	State	Subtype
<input type="checkbox"/>	svm1	running	default
<input type="checkbox"/>	svm2	running	default
<input type="checkbox"/>	svm3	running	default
<input type="checkbox"/>	svm4	running	default
<input type="checkbox"/>	svm5	running	default

Configure iSCSI LIFs

Add Storage VM

STORAGE VM NAME

svm_iSCSI

Access Protocol

SMB/CIFS, NFS

☒ iSCSI

☒ Enable iSCSI

NETWORK INTERFACE

cluster2-01

IP ADDRESS

192.168.0.181

SUBNET MASK

24

GATEWAY

Add optional gateway

☐ Use the same subnet mask and gateway for all of the following interfaces

IP ADDRESS

192.168.0.182

SUBNET MASK

24

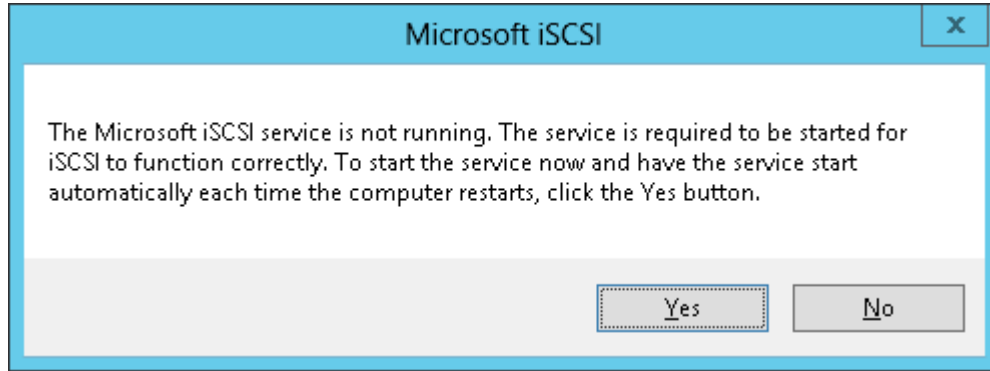
GATEWAY

Add optional gateway

Licensed protocols

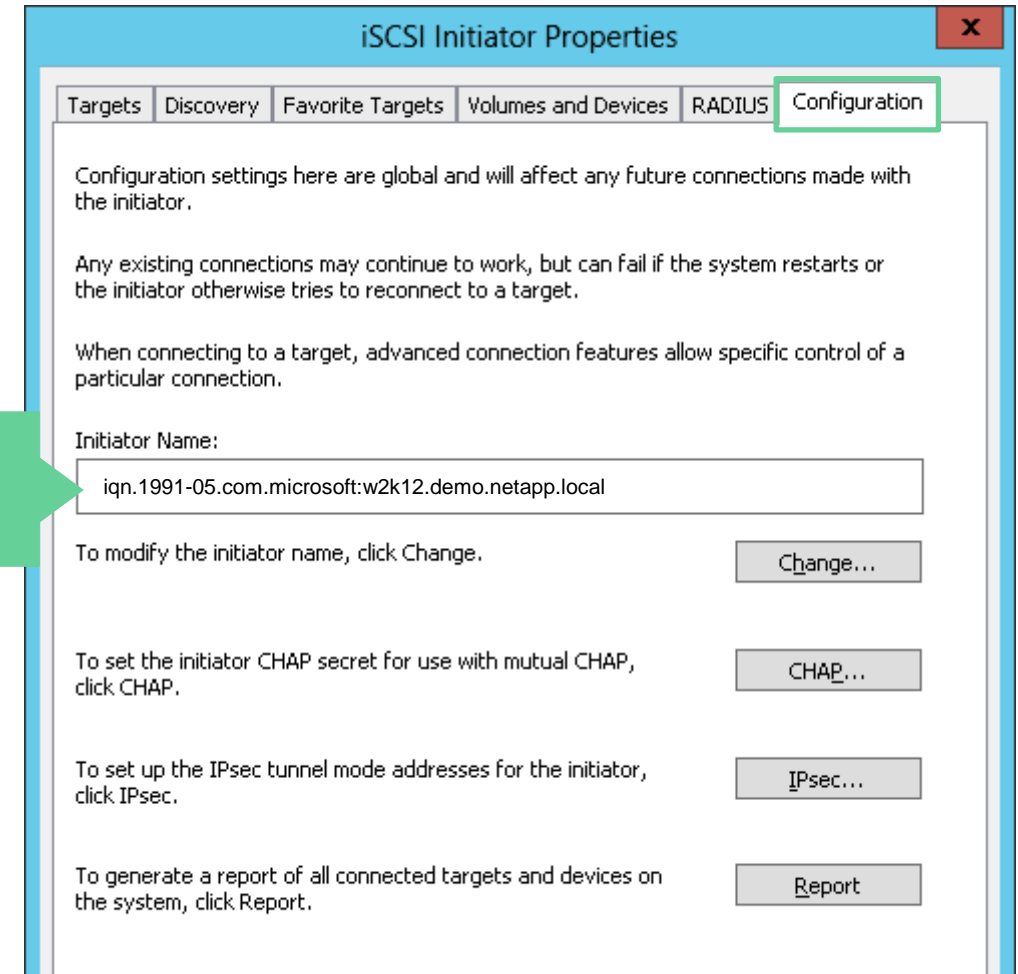
Windows iSCSI implementation

Identify the iSCSI node name



This prompt might appear the first time that you start the iSCSI initiator.

iSCSI Initiator Name



LUN creation

ONTAP System Manager

Search actions, objects, and

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LUNs

+ Add

Create

<input type="checkbox"/>	Name	Storage VM	Volume
No data wa			

Add LUNs

NAME PREFIX

SQL_prodA

NUMBER OF LUNS

CAPACITY PER LUN

4

16

GB

HOST OPERATING SYSTEM

LUN FORMAT

Windows

Windows 2008

HOST INITIATORS

iqn.1991-05.com.microsoft:jumphost.demo.netapp.com

More Options

Cancel

Save

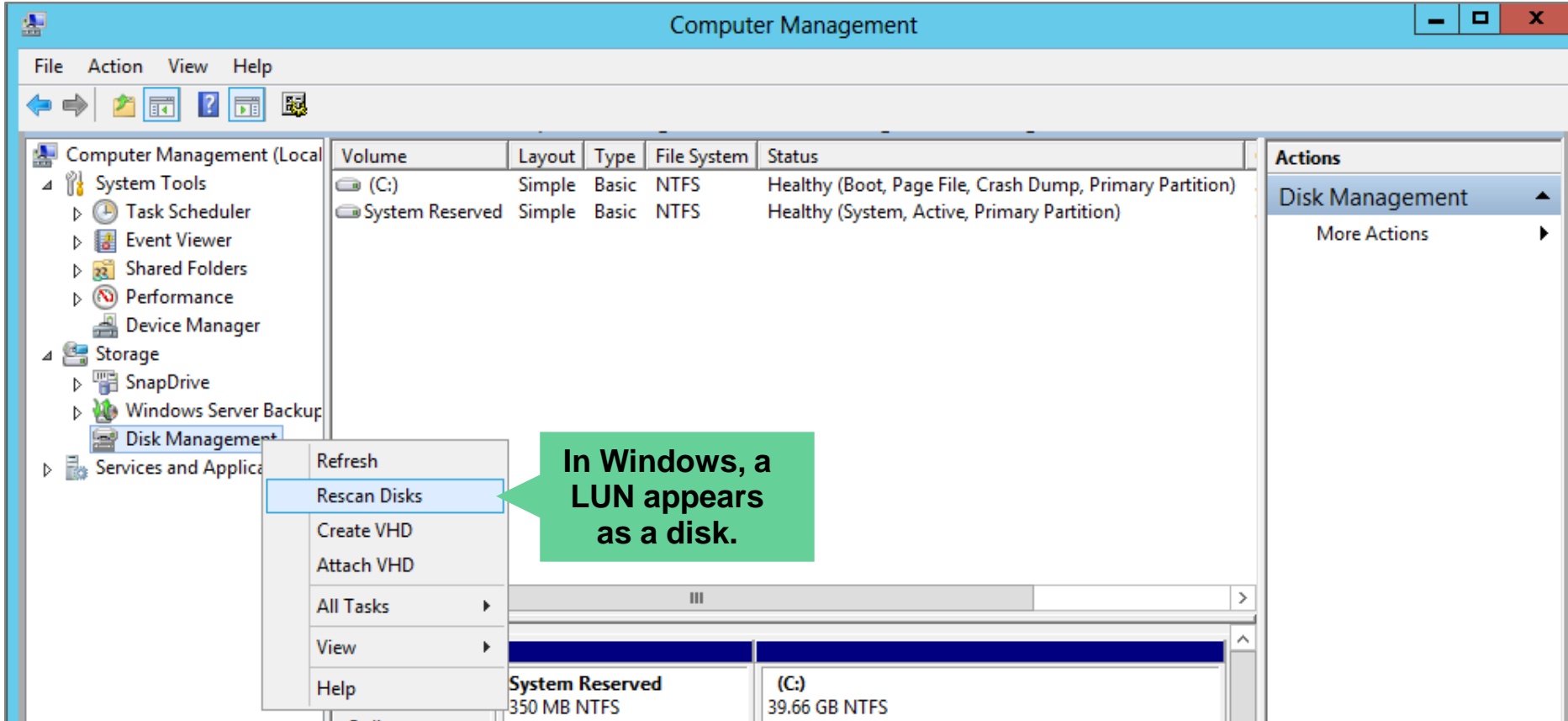
Select number and size of LUNs.

Select client OS type.

Enter client host IQNs.

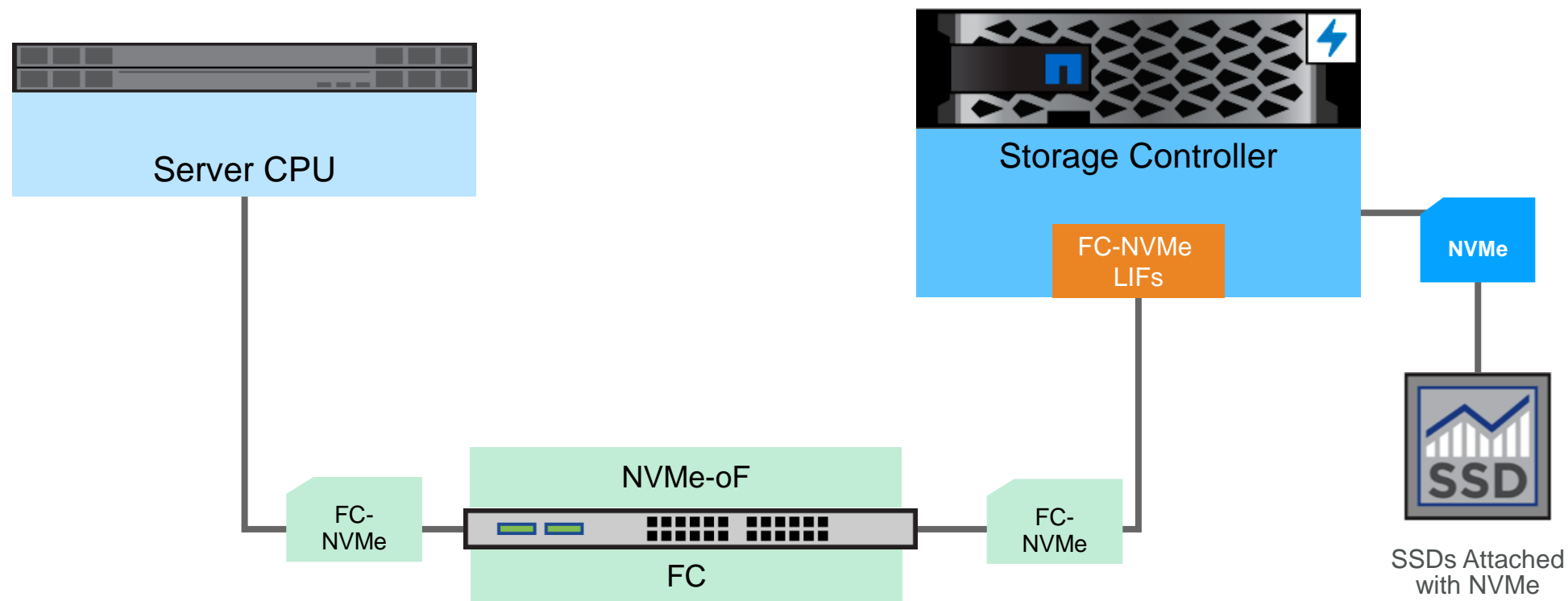
Windows LUN implementation

Discover the LUN



To configure the LUN with NTFS, first discover the LUN by selecting **Disk Management > Rescan Disks**.

NVMe over Fibre Channel

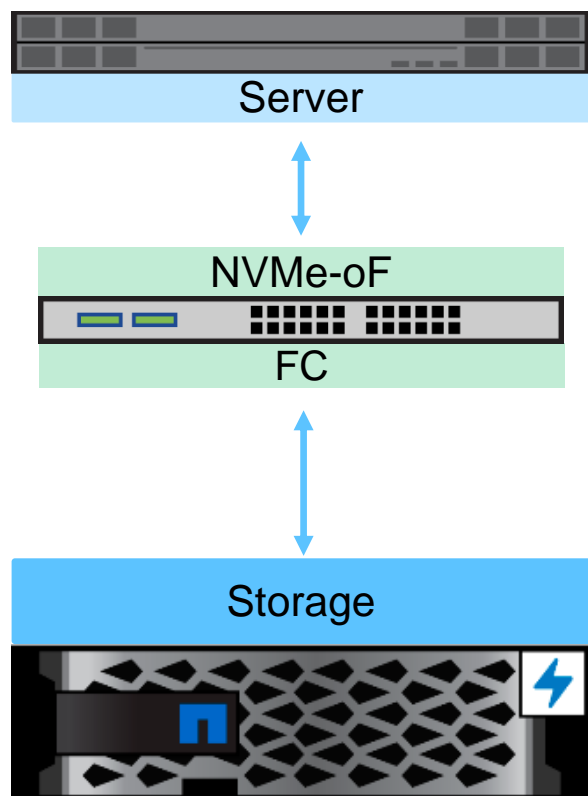


NVMe-oF = NVMe over Fabrics
FC-NVMe = NVMe over Fibre Channel (the ANSI standard)

More info in Addendum

NVMe over Fibre Channel

Supported features in ONTAP software



ONTAP 9.4

- Application-based high availability only
- No storage path failover
- Useful with applications that provide failover (for example, Oracle RAC, MongoDB, and Splunk)
- SUSE Enterprise Linux 12 SP3 support

ONTAP 9.5

- Multipath (storage path) failover with **asymmetric namespace access (ANA)**
 - ANA is like asymmetric logical unit access (ALUA) for FC.
 - ANA was supported first with SUSE Enterprise Linux 15
- Red Hat Enterprise Linux 7.6 support (without ANA)

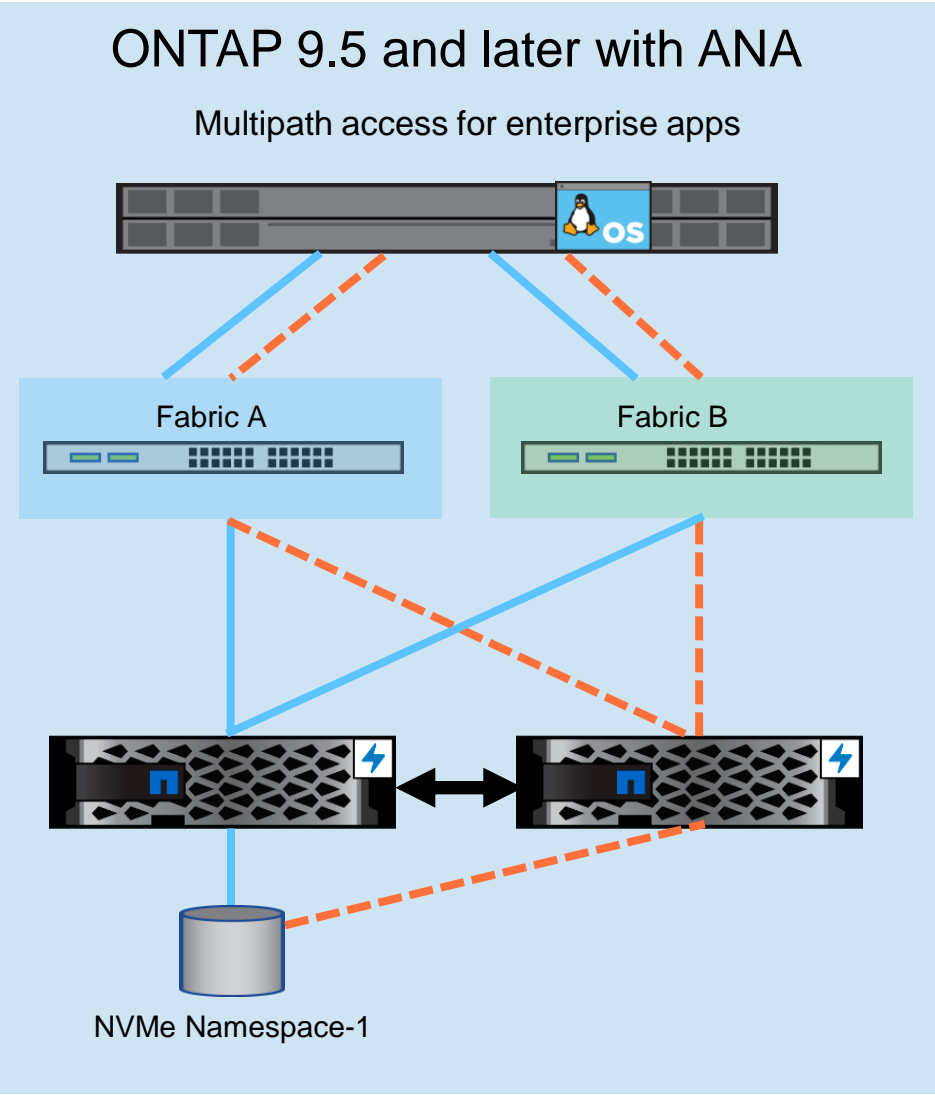
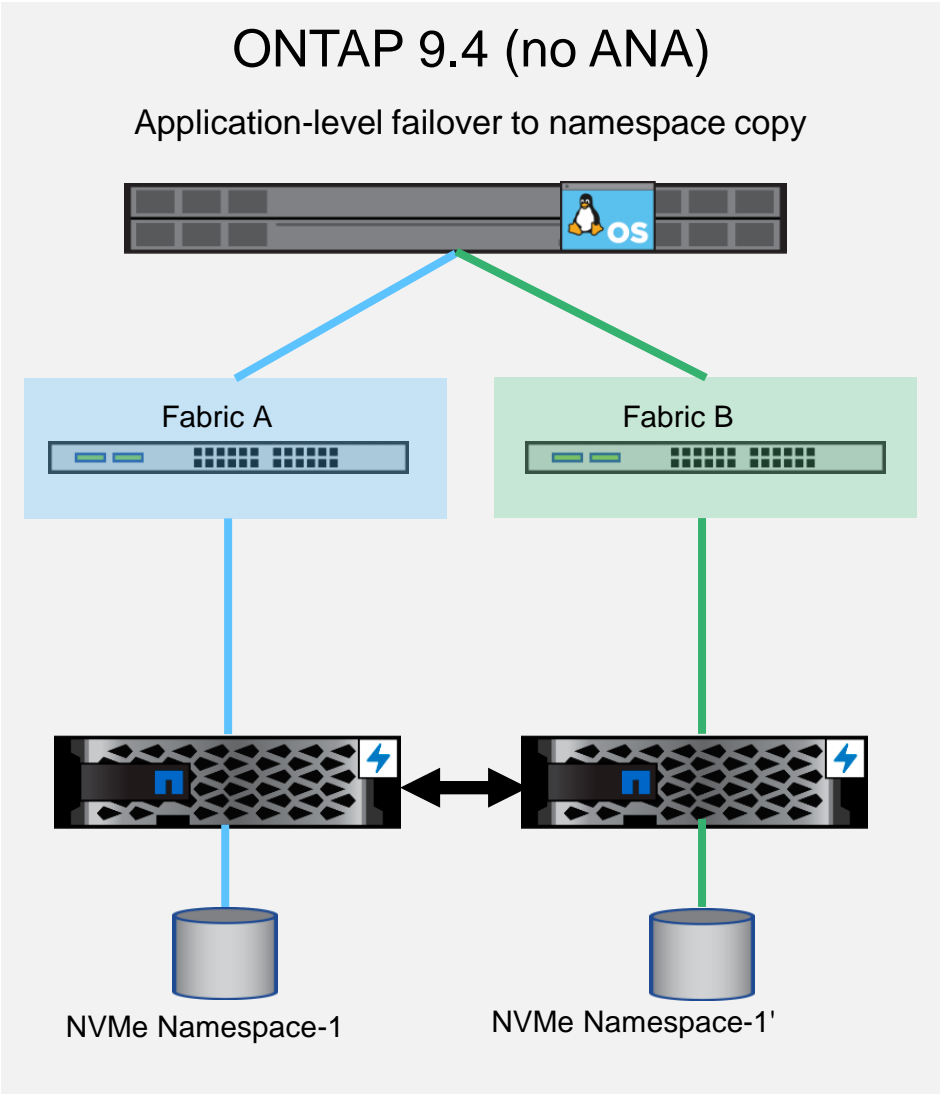
ONTAP 9.6+

- Multipath (storage path) failover with **asymmetric namespace access (ANA)**
 - SUSE Enterprise Linux 15
 - Red Hat Enterprise Linux 8.0
- Application-based high availability only (without ANA)
 - Microsoft Windows
 - VMware ESXi
 - Oracle Linux

See NetApp Interoperability Matrix Tool (IMT) for host bus adapter (HBA), switch, and host software support:

<https://mysupport.netapp.com/matrix/#welcome>

NVMe/FC with asymmetric namespace access



Additional SAN learning

Where can I learn about advanced topics like the following?

- FC and FCoE protocols
- Implementing Windows and Linux initiators
- LUN management and mobility enhancements
 - *ONTAP SAN Fundamentals*
(online course)
 - *ONTAP SAN Administration*
(virtual instructor-led course and instructor-led course)
 - *ONTAP SAN Implementation*
(virtual instructor-led course and instructor-led course)

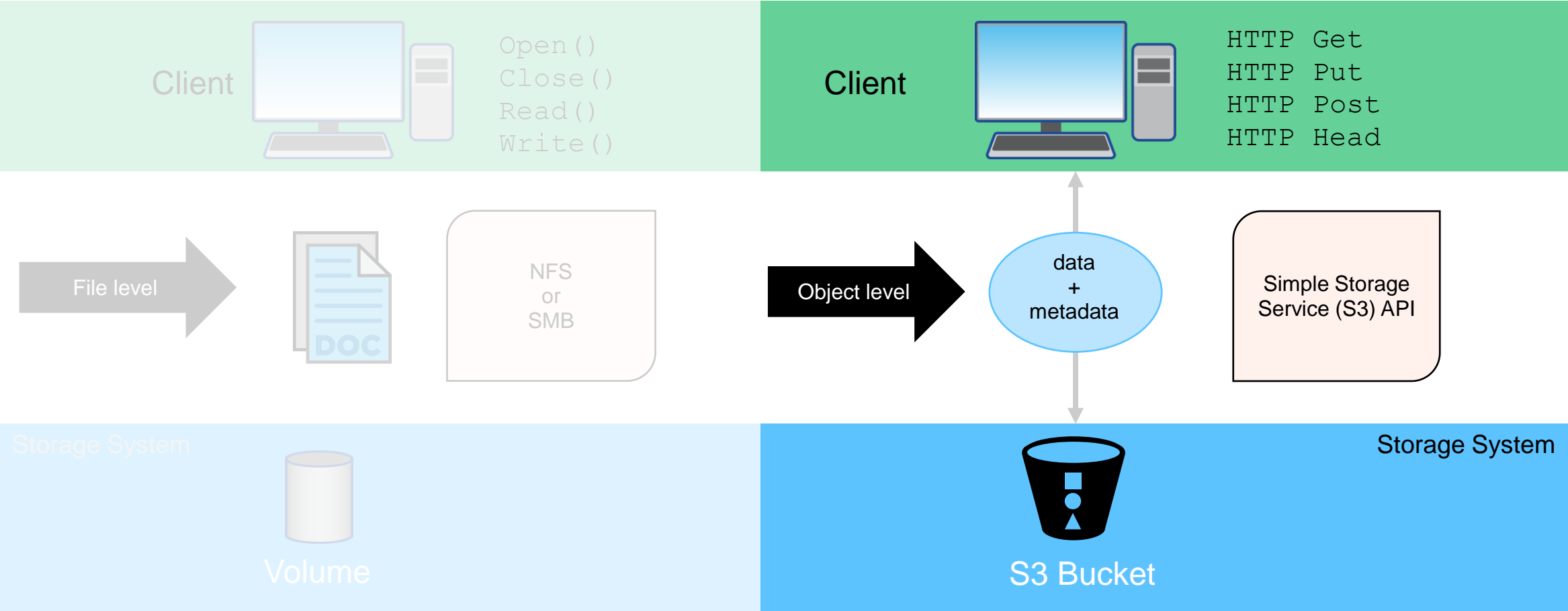


Lesson 3

Use object protocols to access data

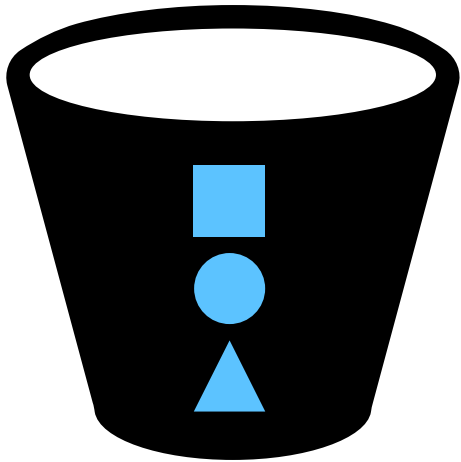
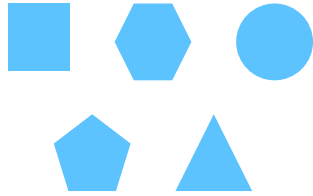
NAS and object

Overview



S3 objects and buckets

Basics

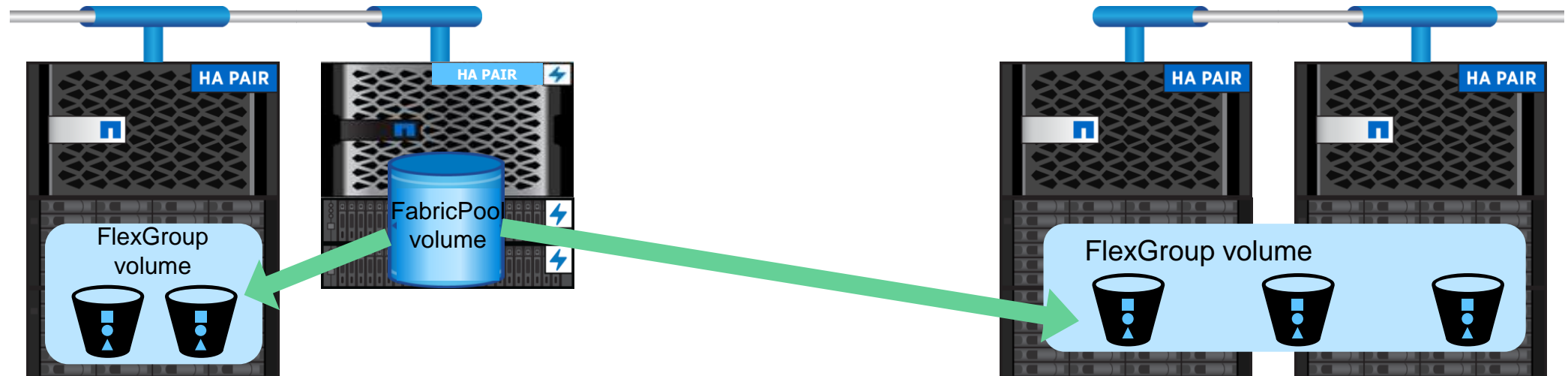


- Objects can contain any type of data, like files can.
- Objects are stored in buckets.
- Buckets are a flat namespace with no hierarchy
 - Objects are identified by a unique key ID.
 - Objects can be tagged with key=value pairs.
- NetApp ONTAP S3 buckets reside in FlexGroup volumes and can span multiple aggregates and storage nodes.

FabricPool use of S3

Use FabricPool technology to migrate cold data to a lower local storage tier.

Use FabricPool technology to migrate cold data to another ONTAP storage system.



Comparing ONTAP S3 to StorageGRID



Or



ONTAP S3

- Basic S3 protocol access
- Limited by ONTAP cluster size
- Suitable for FabricPool cloud tier and simple S3 client applications

StorageGRID

- Globally-dispersed object namespace design
- Full S3 command set
- Assumption of rich metadata
- Policy-engine driven data movement
- Integration with public cloud services

StorageGRID® is and will remain NetApp's industry-leading solution for object storage.

S3 implementation steps

1. Install the S3 license.
2. Create an S3 SVM.
3. Create a S3 user.
4. Obtain the user key and secret key.
5. Create a bucket.



SVM creation: S3

Create an S3-enabled storage VM

ONTAP System Manager

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Storage VMs

+ Add

<input type="checkbox"/>	Name
<input type="checkbox"/>	svm1
<input type="checkbox"/>	svm2
<input type="checkbox"/>	svm3
<input type="checkbox"/>	svm4
<input type="checkbox"/>	svm5

Add Storage VM

STORAGE VM NAME

svm_S3

Access Protocol

☒ S3

☐ Enable SMB/CIFS

☐ Enable NFS

☒ Enable S3

NETWORK INTERFACE

Use multiple network interfaces when client traffic is high.

cluster1-01

IP ADDRESS

192.168.0.195

SUBNET MASK

24

GATEWAY

Add optional gateway

☒ Use the same subnet mask and gateway for all of the following interfaces

cluster1-02

IP ADDRESS

192.168.0.196

Storage VM Administration

☒ Manage administrator account

USER NAME

vsadmin

PASSWORD

.....

CONFIRM PASSWORD

.....

☐ Add a network interface for storage VM management.

Save

Cancel

SVM creation: S3

Certificates

✓ SMB/CIFS, NFS, S3

FC

☐ Enable SMB/CIFS

☐ Enable NFS

☒ Enable S3

S3 SERVER NAME

s3.company.com

☒ Enable TLS

PORT

443

CERTIFICATE

☒ Use system-generated certificate ?

☐ Use external-CA signed certificate

☐ Use HTTP (Non-secure)

Added Storage VM

×

STORAGE VM

svm_S3

S3 SERVER NAME

S3.company.com

User Details

USER NAME

sm_s3_user

⚠ The secret key will not be displayed again. Save this key for future use.

ACCESS KEY

bBQ9qG0xu3AYD_G4WcHg9_1EDLPY0an53BDZvxj_cy1DG5Vzdj1_V1nx670Z9U0Chs43wa5sT0T
p63p_iT2AAF3XZmbH XF M_w_zuL0b1v8BTy3a5SU92M96jtA77p3qB

📋

SECRET KEY

[Show secret key](#)

Certificate

CERTIFICATE SERIAL NUMBER

167450A1CD634686

CERTIFICATE EXPIRATION DATE

Tuesday, Apr 4, 2023, 10:20 PM

CERTIFICATE DETAILS

-----BEGIN CERTIFICATE-----
MIIDZjCCAk6gAwIBAgIIFnRQoc1jRoYwDQYJKoZIhvcNAQELBQAwJTEWMBQGA1UE
AxQNU1ZNX1NZU01HUI9DQTELMakGA1UEBhMCVVMwHhcNMjEwNDA5MjlyMDIxWhcN
.....

📋

Download

Close

Create S3 user accounts

ONTAP System Manager

Search actions, objects, and pages

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svm5

☒ svm_S3

S3

☒ Enabled

Server

FQDN

S3.demo

TLS

Enabled

HTTP

Disabled

CERTIFICATE

System-

Add User

NAME

image_archiver

Cancel

Save

Added User

USERNAME

image_archiver

ACCESS KEY

7aC637qpD4_p_Q_wcc9p9_28a0Mqzg6y9FsY3jZv3KkP9zdNpfBQvn4h9ajpCzRDX7uXXY9Ifp9N
LdSs6mNiybXpsBA_3nt2Qo1sgNmTn6PrINR3BIQBIRd5qT6ohy9_

SECRET KEY

_0Zj3x_3Jc0p7_01rNU91qAdj1TqTotPpop45J4Ba3V2Vo4Z8l4SrC4a74_iK4SAch65AV47NO3J_
DSnXwbczSbdzc_2o_9_1Y_onO9_CS7PdczDE97AAb42i_uEHw4

Hide secret key

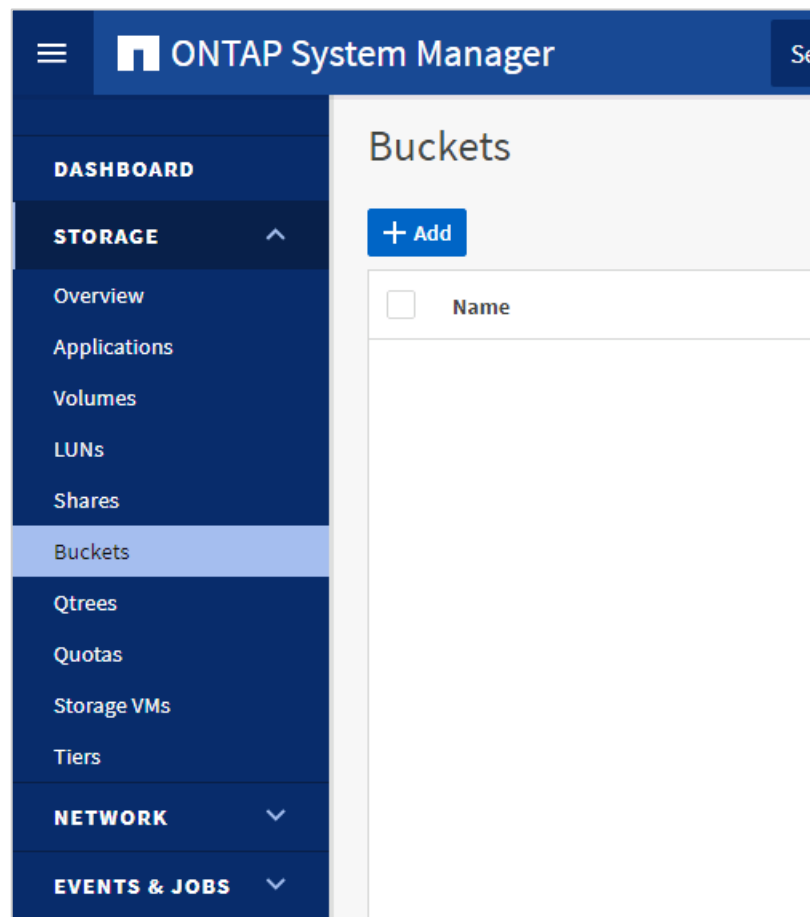
The secret key will not be displayed again. Save this key for future use.

Download

Close

Create an S3 bucket

Performance service levels



Add Bucket

NAME

archived-images

STORAGE VM

svm_S3

CAPACITY

500

TB

☐ Use for tiering

If you select this option, the system will try to select low-cost media with optimal performance

PERFORMANCE SERVICE LEVEL

Performance

Performance

Placement : Low latency | QoS Policy : performance-fixed | Limit : 30000 IOPS, 937 MB/s

Value

Placement : Low cost | QoS Policy : value-fixed | Limit : 15000 IOPS, 468 MB/s

Custom

Choose your preferred placement and quality of service (QoS).

Performance service levels represent the performance expectations of the clients or applications using the storage system. The performance service levels are defined based on the capabilities supported by the storage system on this cluster.

The selection of a performance service level indicates the location (placement) of the new storage in the cluster and the QoS policy assigned to the storage. The QoS ceiling will be set by default. To disable QoS, select "Custom" as the performance service level and then choose "none" as the QoS policy group.

- Extreme:** Used for applications that expect the lowest latency and highest performance.
- Performance:** Used for applications with modest performance needs and latency.
- Value:** Used for applications for which throughput and capacity are more important than latency.
- Custom:**
 - Placement
 - Low latency - Used for applications that expect the lowest latency and highest performance.
 - Mid-point - Used for applications with modest performance needs and latency.
 - Low cost - Used for applications for which throughput and capacity are more important than latency.
 - Assign QoS Policy Group
 - Specify a custom QoS policy or no QoS policy.

Create an S3 bucket

Controlling access

Permissions

☐ Copy access permissions from an existing bucket

Principal	Effect	Actions	Resources	Conditions
No data				

+ Add

Save

Cancel

New Permission

PRINCIPAL

image_archiver X

EFFECT

Allow

ACTIONS

GetObject X

PutObject X

DeleteObject X

ListBucket X

RESOURCES ?

archived-images,archived-images/*

Conditions ?

+ Add

Cancel

Save

An abstract graphic in the top right corner consisting of a cluster of teal-colored cubes of various sizes, arranged in a staggered, overlapping pattern that creates a sense of depth and three-dimensionality.

Knowledge check

Module 7: Data access

Knowledge check

A volume called svm1_vol2 is created on the aggr2 aggregate and mounted to the junction path /svm1/vol2. An administrator moves the volume to the aggr1 aggregate.

After the move, what is the path to the volume?

- a. /aggr1/svm1/svm1_vol2
- b. /svm1/vol2
- c. /vol/svm1_vol2
- d. /aggr1/svm1_vol2

Knowledge check

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- c. /vol/svm1_vol2
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Knowledge check

When you create an SVM to support SAN protocols, which configuration step does not need to be made?

- a. Configure a SAN LIF on each cluster node.
- b. Choose an IPspace for the SVM.
- c. Create an interface group.
- d. Create an SVM management LIF.

Knowledge check

When you create an SVM to support SAN protocols, which configuration step does not need to be made?

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References

- ONTAP 9 Documentation Center:
<http://docs.netapp.com/ontap-9/index.jsp>
 - *Logical Storage Management Guide*
 - *NFS Configuration Power Guide*
 - *SMB/CIFS Configuration Power Guide*
 - *SAN Configuration Guide*
 - *SAN Administration Guide*
- [TR-4080 Best Practices for Modern SAN](#)
- [TR-4684: Implementing and Configuring Modern SANs with NVMe/FC](#)

Module summary

This module focused on enabling you to do the following:

- Use NAS protocols to access data
- Use SAN protocols to access data
- Use object protocols to access data



Complete an exercise

Module 7
Data access

Configuring the NFS protocol in an SVM

Configuring the SMB protocol in an SVM

Configuring iSCSI in an SVM

Configuring the S3 protocol in an SVM

Managing NAS storage VMs

- Access your lab equipment.
- Open your Exercise Guide, Module 7.
- Complete Exercises 1 through 5.
- Share your results.

This exercise requires approximately
85 minutes.



Share your experiences

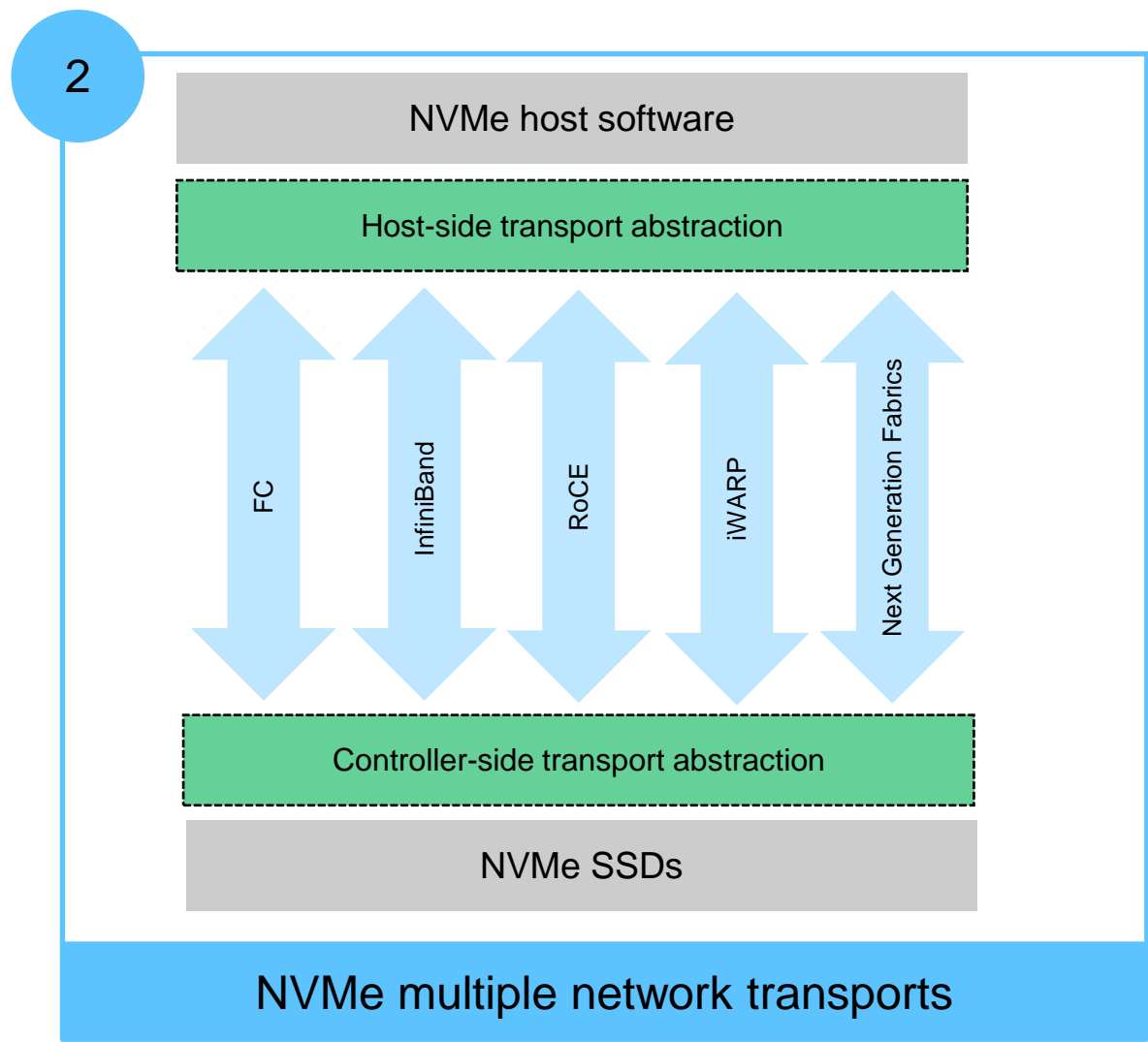
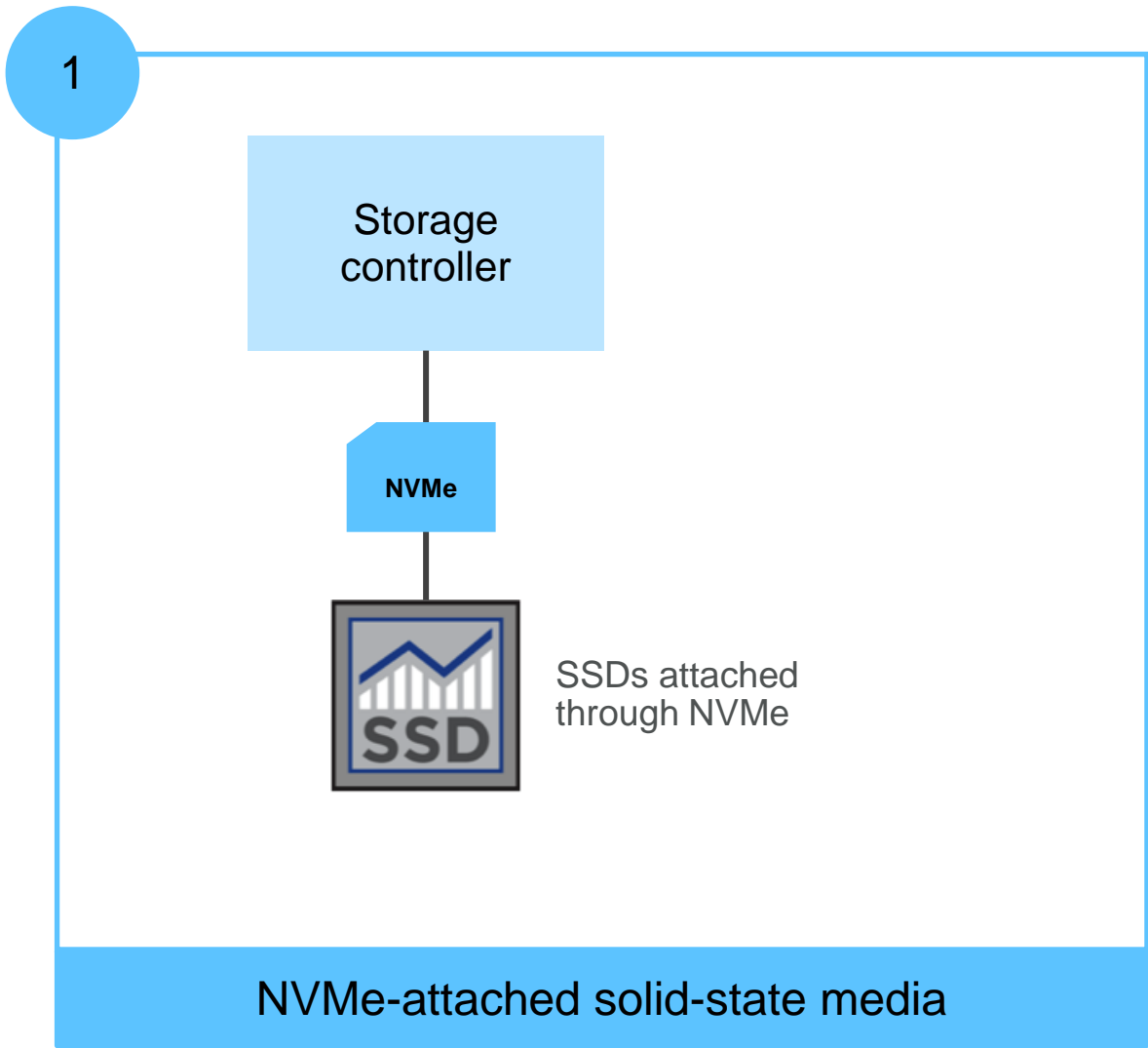
Roundtable discussion

- Were you able to use both the SMB and NFS protocols to access the same volume in the namespace?
- How does partitioning and formatting a LUN from the Windows host differ from partitioning and formatting a physical disk in Windows?
- Why do you need FlexVol volumes?

Addendum

NVMe and NVMe/FC

NVMe and modern SAN

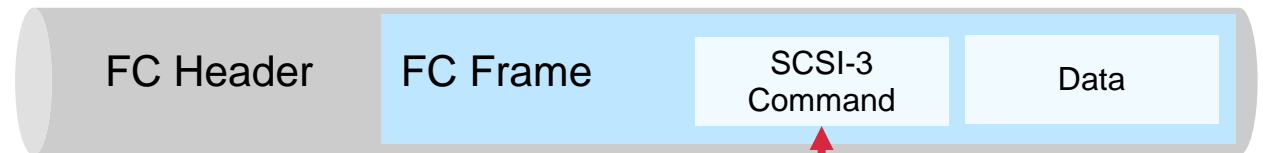


NVMe/FC and FC frames

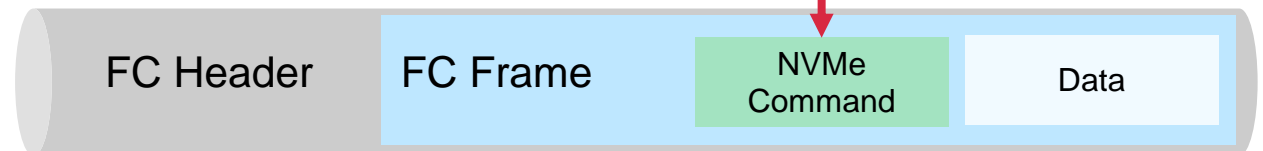
- Share hardware and fabric components
- Can coexist on the same optical fibers, ports, switches, and storage controllers

NVMe/FC and FCP look similar.

FCP: SCSI-3 command set encapsulated in an FC frame



Replaced



FC-NVMe: NVMe command set encapsulated in an FC frame

NVMe and FC naming

NVMe terminology

FC	NVMe/FC
Worldwide port name (WWPN)	NVMe qualified name (NQN)
LUN	Namespace
LUN mapping/LUN masking/igroup	Subsystem
Asymmetric logical unit access (ALUA)	Asymmetric namespace access (ANA)

Setting up NVMe

1. Install the NVMe_oF license.
2. Enable the NVMe protocol on a storage VM.
3. Create NVMe protocol data LIFs.
4. Create one or more NVMe namespaces.
5. Grant client hosts access to the namespaces.

Add Storage VM

STORAGE VM NAME

svm_NVMe

Access Protocol

SMB/CIFS, NFS, S3 ☒ NVMe/FC

☒ Enable NVMe/FC

CONFIGURE FC PORTS ?

Nodes	1a	1b
cluster1-01	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
cluster1-02	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Add NVMe Namespace

NAME PREFIX

nvme_lun

NUMBER OF NAMESPACES

2

CAPACITY PER NAMESPACE

100 GB

HOST OPERATING SYSTEM

Windows

HOST NQN

nqn.2001-08.com.demo:nvme:host1,nqn.2001-08.com.demo:nvme:host2

More Options Cancel Save

Addendum S3 deployments

S3 protocol in ONTAP 9.8 software

ONTAP 9.8 and later releases support S3 object storage in production environments.

Focus	Supported	Not supported	
Data protection	<ul style="list-style-type: none">• NetApp Cloud Sync service• System scheduled NetApp Snapshot copies• NetApp Volume Encryption (NVE)• NetApp Storage Encryption (NSE)	<ul style="list-style-type: none">• Erasure coding• MetroCluster software• NDMP• SnapLock software• SnapMirror software• The SyncMirror feature• Storage-Level Access Guard (SLAG)	<ul style="list-style-type: none">• Object versioning• SMTape• SVM disaster recovery• Transport Layer Security (TLS)• User-created Snapshot copies• WORM
Storage efficiency	<ul style="list-style-type: none">• Inline deduplication• Inline compression• Compaction	<ul style="list-style-type: none">• Aggregate-level efficiencies	
Additional features	<ul style="list-style-type: none">• QoS maximums (ceiling)• QoS minimums (floors)	<ul style="list-style-type: none">• Audit• FabricPool technology• NetApp FPolicy software	<ul style="list-style-type: none">• Qtrees• Quotas