VULTR

Multi-Region NetApp ONTAP with NetApp FlexCache for Accelerating AI and Analytics on Vultr Cloud

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Introduction

Organizations can now seamlessly extend their On-Premises NetApp ONTAP environments into Vultr Cloud, enabling AI and analytics workloads to run with dramatically lower data-access latency. Using NetApp FlexCache, customers present their existing datasets in Vultr as secure, read/write volumes - without migrating or duplicating data. This approach places business-critical data closer to GPU compute resources, accelerating AI initiatives, reducing infrastructure costs, and enabling rapid experimentation across regions and teams.

NetApp FlexCache creates lightweight, high-performance cache volumes in Vultr Cloud that automatically fetch frequently accessed data from On-Premises ONTAP systems while synchronizing all writes to the source. This ensures consistent, real-time access to enterprise datasets across sites and clouds, without the overhead of replicating full datasets. The result is a unified hybrid-cloud architecture that supports high-performance AI, ML, and analytics workloads, while preserving data governance, security, and operational simplicity.

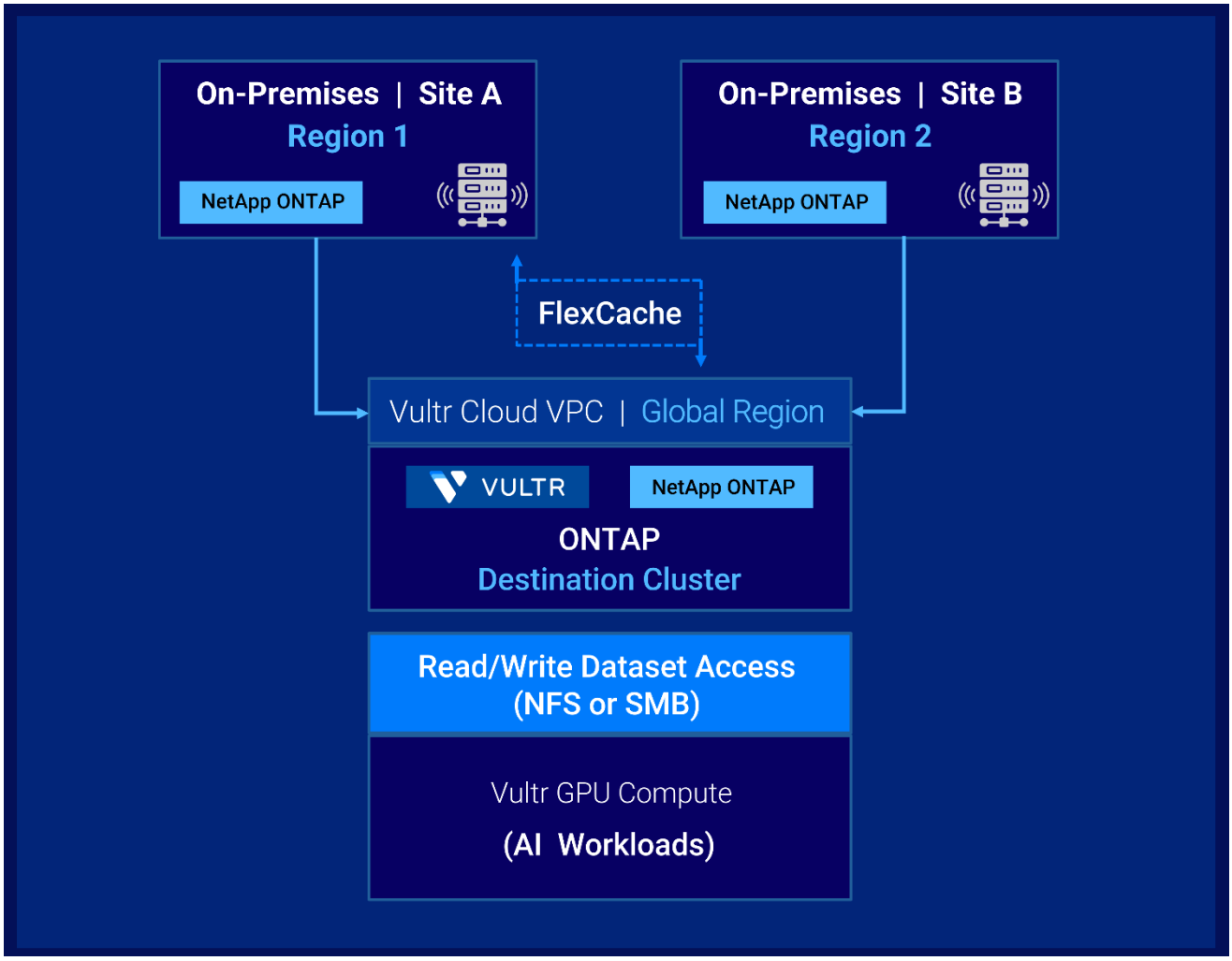


Figure 1: Architecture for Multi-Region NetApp FlexCache into Vultr Cloud

This hybrid-cloud design extends On-Premises NetApp ONTAP data into Vultr Cloud using NetApp FlexCache, giving GPU workloads fast, local access to enterprise datasets without migrating full volumes. The result is a unified, low-latency data layer optimized for AI and analytics.

Hybrid Multi-Region Data Consolidation

- NetApp FlexCache fan-in brings data from multiple ONTAP sites into a single ONTAP instance on Vultr.
- Standard NFS/SMB access lets Vultr compute mount datasets immediately.
- Supports ONTAP, CVO, and AFF/FAS.

NetApp FlexCache Performance & Efficiency

- Low-latency access near Vultr GPU nodes.
- Automatic caching of hot data.
- Real-time coherency with On-Prem origin volumes.
- Small cloud footprint since only active data is cached.
- Scales easily to many sites.

Enterprise-Ready Hybrid Cloud Design

- Aligned with NetApp best practices.
- Optimized for AI/ML by placing data close to compute.

This solution consolidates data from multiple On-Premises ONTAP environments into a unified hybrid-cloud platform on Vultr. Each site exposes its active data as a NetApp FlexCache volume, giving compute and GPU workloads consistent, region-wide access without shifting primary datasets off-premises.

NetApp FlexCache further enhances performance by positioning lightweight cache volumes near consuming applications. Hot data is fetched on demand, writes are synchronized back to the origin, and full replication is avoided - resulting in a low-latency, efficient, and highly scalable data layer for multi-region AI and enterprise workloads.

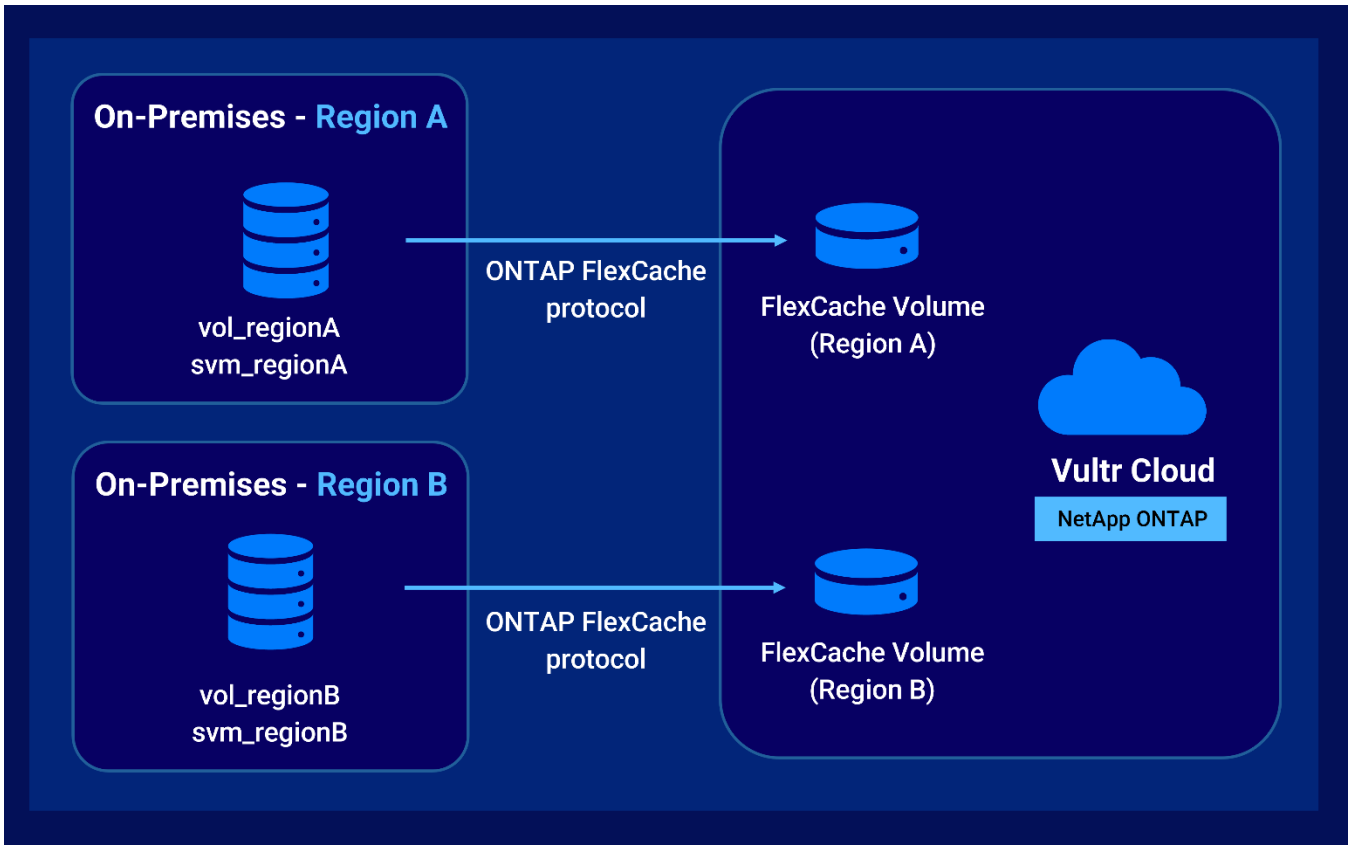


Figure 2: Hybrid Multi-Region NetApp FlexCache Deployment Using NetApp ONTAP and Vultr Cloud

Prerequisites

The prerequisites below ensure that the environment is properly configured for a multi-region NetApp FlexCache setup using NetApp ONTAP on Vultr Cloud as the destination.

ONTAP

- ONTAP 9.8+ on all source and destination clusters
- NetApp ONTAP requires matching major ONTAP version on both source and destination
- NetApp FlexCache license on both origin and cache clusters
- Intercluster LIFs configured on each node
- DNS, routing, and firewall rules in place
- Source SVMs and volumes ready for replication

ONTAP on VMware ESXi (in Vultr Cloud)

- Vultr-provided ESXi 8.x or ESXi 9.0 host with vCenter access to deploy given ONTAP ova file, create/assign datastores, and create port groups / networks
- ONTAP license available to be deployed on ESXi in Vultr Cloud
- Adequate CPU/RAM and attached block storage
- Management, inter-cluster, and data LIFs configured.

Networking

- IPSec VPN or secure tunnel between sites and Vultr
- Connectivity between intercluster LIFs (ping + TCP 11104/11105/10000)
- NFS/SMB ports allowed for compute access
- DNS resolution across environments

Security & Access

- Admin access to all ONTAP clusters
- Vultr console/API access
- Firewall rules permitting cluster/SVM peering for NetApp FlexCache

Storage & Configuration

- Destination aggregates created on NetApp ONTAP
- SVMs defined for replication/caching and data access boundaries

> ⓘ **Note on Example IP Addresses**
>
> - This guide uses RFC 5737 documentation-reserved IP addresses (e.g., 192.0.2.XX and 198.51.100.XX) throughout all examples and command output. These are non-routable addresses designated by IANA specifically for use in documentation.
> - Replace them with your actual infrastructure IPs before deployment.

Step 1 | Prepare Networking & Environment Prep

A secure, stable network foundation is required before configuring NetApp Flexcache. That includes creating the VPC, deploying a VPN tunnel, setting up DNS and routing, and deploying NetApp ONTAP in Vultr Cloud. NetApp FlexCache depends on encrypted TCP connectivity between intercluster LIFs - provided by the VPN - so correct resource provisioning and network configuration are critical to ensure all downstream steps work smoothly without impacting production.

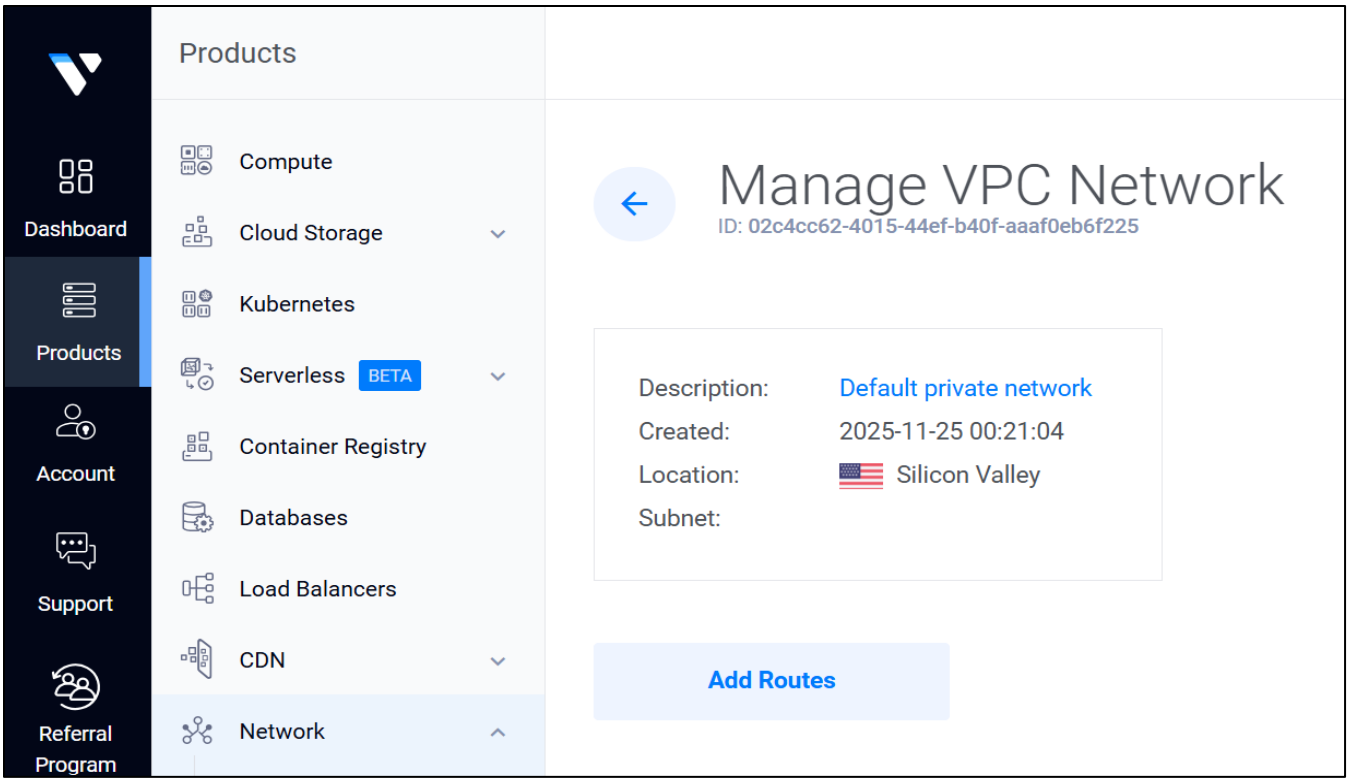
This section covers

- Create and validate Vultr Cloud account
- Create Vultr VPC and required compute instances
- Set up IPSec VPN between On-Prem ONTAP and Vultr Cloud
- Validate routing using ICMP, NFS ports, and NetApp FlexCache ports (TCP 11104/11105/10000)
- Deploy ONTAP image in Vultr
- Create ONTAP SVM (vserver) and configure DNS, routing, and firewall rules

Create Vultr VPC

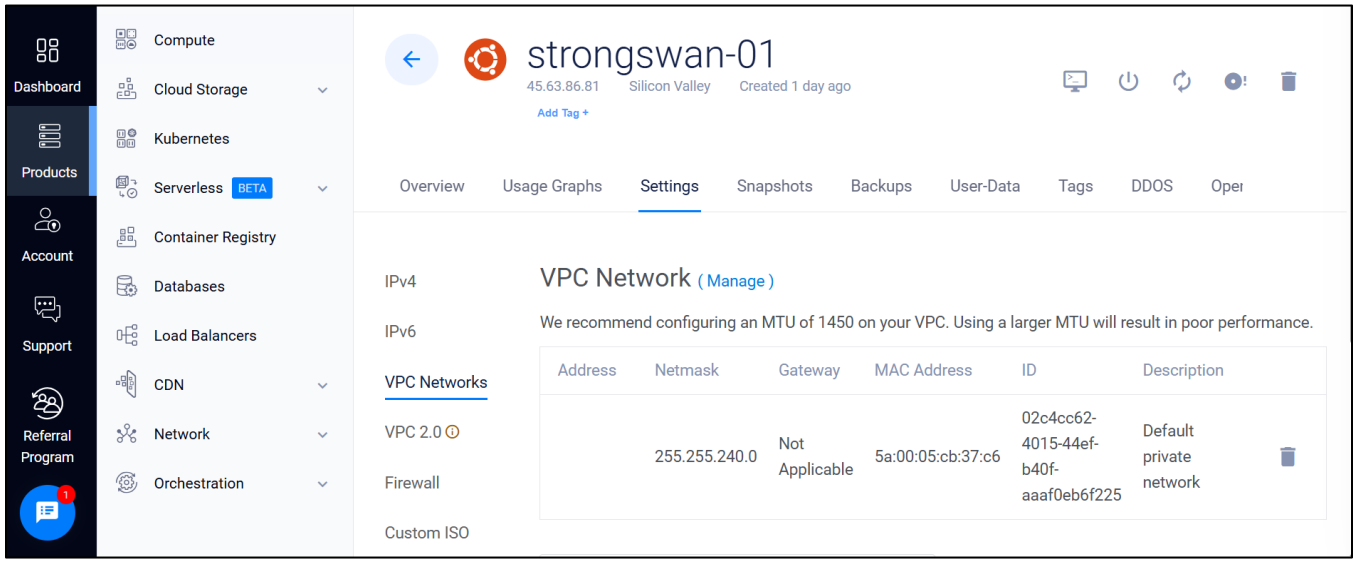
A Vultr VPC is a logically isolated virtual network that provides private IP addressing and controlled routing for cloud resources. It is needed to securely host ONTAP and compute nodes in an isolated environment, ensuring predictable connectivity and a dedicated path for NetApp FlexCache traffic.

Provision a VPC to provide network isolation and private IP space for ONTAP and compute nodes.



Expected Output:

- The VPC should display the correct subnet 192.0.2.0/20 and region.
- This confirms the VPC was created and provides the private network required for ONTAP and NetApp FlexCache traffic.



Expected Output:

- The StrongSwan VM should have a private VPC IP address (e.g., 192.0.2.6).
- This confirms the VM is attached to the correct Vultr VPC and can communicate with ONTAP.

Deploy ONTAP on VMware ESXi

Deploy the ONTAP VM that will serve as the NetApp FlexCache destination. This ONTAP instance provides full ONTAP capabilities in Vultr Cloud, enabling FlexCache and exposing NFS/SMB volumes to Vultr compute nodes.

- Log in to your VMware ESXi host.
- Go to Networking » Virtual Switches.
- Create a new virtual switch named vSwitch1 and click Add. This switch will be used for the VPC connection.
- Select Port Groups » Add Port Group.
- Enter a Port Group Name, choose vSwitch1 as the virtual switch, and click Add.
- In the left pane, select Virtual Machines and click Create / Register VM.
- Choose Deploy a virtual machine from an OVA file, then click Next.
- Provide a VM Name, select the OVA file, and click Next.
- On the Storage Options page, click Next to continue.
- Under Deployment Options, select your VM Network, then click Next.
- On Additional Settings, enter the admin password and network configuration details, then click Next » Finish.
- The deployment may take 4–5 minutes, depending on your network speed.
- Once the login screen appears in the VM console, open a browser and navigate to the configured IP address to access the ONTAP Deploy Dashboard

Deploy ONTAP System Manager Cluster

- Log in to the ONTAP Deploy Dashboard.
- Upload your license file.
- Under Add Host to Inventory, choose Hypervisor Type » ESX, enter your VMware ESXi credentials, and click Add.
- Under Create a Cluster, provide a Cluster Name, select a Cluster Size, and choose the appropriate Network Configuration, then click Done.
- In Hypervisor and Network, configure:
    - Node settings
    - VMware hosts
    - Required networks

- In Storage, select Software RAID. Under Storage Pool, ensure all disks are the same size for optimal stability. Using mismatched disks can cause configuration failures, VM restarts, or cluster instability.
- Click Done to proceed.
- Set the admin password for ONTAP System Manager and click Create Cluster.
- The cluster deployment will take about 4–5 minutes.
- Return to the VMware ESXi panel and wait for the cluster VM to finish deploying.
- When the login page appears on the cluster VM console, go back to the ONTAP Deploy Dashboard. Under Clusters, select your cluster and click Launch System Manager.
- Log in with your credentials to access and manage storage through the System Manager interface.

Create LIF on NetApp ONTAP

An Inter-cluster LIF on NetApp ONTAP is a dedicated logical network interface assigned a private IP inside the VPN/VPC subnet and bound to a specific node and port. It serves as the endpoint for all cluster-to-cluster communication, including SnapMirror replication, NetApp FlexCache and cluster peering. ONTAP does not create these automatically, so defining at least one inter-cluster LIF per node is essential - without it, the cluster cannot establish peering or replicate data, even if the VPN tunnel is fully functional.

Check the available ports

```
net port show
```

```
ONTAPSelectCluster::> net port show
(network port show)

Node: ONTAPSelectCluster-01

Port   IPspace   Broadcast Domain  Link  MTU   Speed(Mbps)  Health
                                           Admin/Oper    Status
----- -------  ---------------  ----  ----  ----------- --------
e0a    Default   Default           up    1500  auto/auto   healthy
e0b    Default   Default           up    1500  auto/auto   healthy
e0c    Default   Default           up    1500  auto/auto   healthy
3 entries were displayed.

ONTAPSelectCluster::>
```

Use e0a which is the default, stable, and recommended data-capable port available on ONTAP for intercluster/LIF traffic in most deployments.

```
net int create -vserver ONTAPSelectCluster -lif ic1 -address 192.0.2.51 -netmask 255.255.240.0 -
home-node ONTAPSelectCluster-01 -home-port e0a -role intercluster
```

```
ONTAPSelectCluster::> net int create -vserver ONTAPSelectCluster -lif ic1 -address 192.0.2.51
-netmask 255.255.240.0 -home-node ONTAPSelectCluster-01 -home-port e0a -role intercluster
```

CLI Validation | Check LIF state:

```
network interface show
```

```
ONTAPSelectCluster::> network interface show

                 Logical        Status     Network            Current            Current Is
Vserver          Interface      Admin/Oper Address/Mask       Node               Port    Home
------------------------ ------------    ---------- ------------------ ------------------ ------ -
ONTAPSelectCluster
                ONTAPSelectCluster-01_mgmt1 up/up 192.0.2.61/20 ONTAPSelectCluster-01 e0a    true
                cluster_mgmt    up/up     192.0.2.60/20    ONTAPSelectCluster-01 e0a    true
                icl             up/up     192.0.2.51/20    ONTAPSelectCluster-01 e0a    true
SVM_Dataflex
                SVM_Dataflex_data_01    up/up 192.0.2.53/20    ONTAPSelectCluster-01 e0b    true
SVM_data
                SVM_data_Cifs           up/up 192.0.2.52/20    ONTAPSelectCluster-01 e0c    true

5 entries were displayed.
```

```
net int show -role intercluster -fields role,address,status-oper, status-admin,lif,home-port,
home-node
```

```
ONTAPSelectCluster::> net int show -role intercluster -fields role,address,status-oper,
status-admin,lif,home-port,home-node

(network interface show)

vserver          lif   role       address      home-node   home-port   status-oper  status-admin

---------------- ---- ------- ------------- --------------------- --------- -------- --------

ONTAPSelectCluster   ic1  intercluster   192.0.2.51     ONTAPSelectCluster-01  e0a   up   up
```

Expected Output:

- lif: ic1
- Address: 192.0.2.51
- Home Node: ONTAPSelectCluster-01
- Current Node: ONTAPSelectCluster-01 (unless it has failed over)
- Home Port: e0a
- Operational Status: up
- Administrative Status: up

Enable NFS on ONTAP

Enable NFS using the following command on NetApp ONTAP

```
vserver nfs create -vserver <vservername> -v3 enabled -v4.0 enabled
```

CLI Validation (Region A)

```
vserver nfs create -vserver SVM_data -v3 enabled -v4.0 enabled
```

Verify NFS server creating with:

```
nfs show
```

```
ONTAPSelectCluster::> vserver nfs create -vserver SVM_data -v3 enabled -v4.0 enabled
```

```
ONTAPSelectCluster::> nfs show
Vserver: SVM_data
        General Access:  true
                    v3:  enabled
                  v4.0:  enabled
                   4.1:  enabled
                   UDP:  enabled
                   TCP:  enabled
                  RDMA:  enabled
    Default Windows User:  -
   Default Windows Group:  -
```

CLI Validation (Region B)

```
nfs create -vserver SVM_Dataflex -v3 enabled -v4.0 enabled
```

Verify NFS server creating with:

```
nfs show
```

```
ONTAPSelectCluster::> nfs show
Vserver: SVM_data
        General Access:  true
                    v3:  enabled
                  v4.0:  enabled
                   4.1:  enabled
                   UDP:  enabled
                   TCP:  enabled
                  RDMA:  enabled
    Default Windows User:  -
   Default Windows Group:  -
```

Set Up VPN/IPSec

NetApp FlexCache replication requires secure, encrypted TCP connectivity between intercluster LIFs. A VPN/IPSec tunnel provides that secure transport path across public networks. Set up a secure IPSec tunnel between On-Prem ONTAP and Vultr Cloud.

The VPN tunnel provides a secure transport path between the On-Prem and Vultr environments. Without it, your ONTAP VM inside Vultr has no route to the On-Prem gateway or DNS for name resolution or reachability tests.

StrongSwan was deployed on the Vultr compute node to serve as the VPN end-point for this build guide.


```
ipsec statusall
```

Expected Output:

- Both IPSec tunnels should show Status: UP.

This confirms On-prem has successfully established Phase-1 and Phase-2 security associations with the StrongSwan gateway in Vultr.

Configure DNS & Routing

After the VPN is active, you can safely set default and inter-cluster routes so ONTAP can:

- Resolve hostnames across sites
- Reach on-prem inter-cluster LIFs over the new encrypted tunnel

Steps:

- Add DNS servers
- Add a default route pointing through the VPN gateway
- Add inter-cluster routes for the on-prem CIDRs

Set DNS Servers and Create Default/Inter-cluster Routes

Add local host entries for peer clusters

- 192.0.2.51 » Vultr ONTAP intercluster LIF IP
- 198.51.100.201 » On-Prem ONTAP inter-cluster LIF IP

These private IPs inside the VPN tunnel are the internal intercluster LIF addresses used exclusively for SnapMirror replication and NetApp FlexCache. ONTAP relies on these dedicated logical interfaces for all replication traffic.

Note: They are not the public IPs of StrongSwan or bastion hosts. They are the internal cluster communication IPs used for NetApp FlexCache replication.

Each ONTAP (On-Prem and Vultr) must be able to:

- Resolve the peer cluster's intercluster LIF hostname
- Reach that IP across the VPN (on TCP ports 11104 and 11105)

CLI on Vultr ONTAP

```
vserver services name-service dns hosts create -vserver ONTAPSelectCluster -address 198.51.100.201
-hostname inter_1
```

Verify

```
vserver services name-service dns show
```

```
ONTAPSelectCluster::> vserver services name-service dns hosts show
Vserver             Address              Hostname      Aliases
------------        --------------       ------------  -----------
ONTAPSelectCluster
                    198.51.100.201       inter_1           -
```

CLI on On-Prem ONTAP

```
vserver services name-service dns hosts create -vserver sx -address 192.0.2.51 -hostname ic1
```

Verify

```
vserver services name-service dns hosts show
sxId0edb1927eae795ba7::> vserver services name-service dns hosts show
Vserver      Address        Hostname      Aliases
------------ -----------    ------------  ----------------
sx           192.0.2.51     ic1
```

Create Route

This is the Vultr ONTAP VPC subnet: 192.0.2.0/20

- ONTAP intercluster LIF: 192.0.2.51
- StrongSWAN LAN IP (VPN gateway in Vultr): 192.0.2.6

On-Premise ONTAP VPC subnet: 198.51.100.0/16

- On-Prem ONTAP Intercluster LIF: 198.51.100.201
- On-Prem local subnet gateway: 198.51.100.1

Note: The routes are shown for the IPs above. This would change as per setup.

Route to be added on Vultr ONTAP (to reach on-prem equivalent)

To reach anything in the On-Prem ONTAP VPC (198.51.100.0/16), send traffic to the StrongSWAN LAN IP (192.0.2.6), which is the VPN gateway on the Vultr side.

```
network route create -vserver ONTAPSelectCluster -destination 198.51.100.0/16 -gateway 192.0.2.6
```

CLI Validation

```
network route show
```

```
ONTAPSelectCluster::> network route show
Vserver             Destination          Gateway              Metric
-----------------   ------------------   --------------       --------
ONTAPSelectCluster
                    0.0.0.0/0            192.0.2.1            10
                    198.51.100.0/16      192.0.2.6            20
2 entries were displayed.

ONTAPSelectCluster::>
```

Expected Output:

- A default route exists
- Specific route(s) to on-prem network appear
- No overlapping or incorrect routes

Route to be added on On-Prem ONTAP (to reach Vultr ONTAP)

To reach the Vultr ONTAP subnet (192.0.2.0/20), send traffic to On-Prem local VPC subnet gateway (198.51.100.1)

```
network route create -vserver sx  -destination 192.0.2.0/20 -gateway 198.51.100.1
```

CLI Validation

```
network route show
```

```
sxId0edb1927eae795ba7::*> network route show
Vserver             Destination          Gateway              Metric
-----------------   ------------------   ---------------      --------
sx
                    0.0.0.0/0            198.51.100.1         20
                    192.0.2.0/20         198.51.100.1         20
2 entries were displayed.
```

Validate Connectivity

To validate that the VPN tunnel and routing are correctly configured for NetApp FlexCache, both sites must be able to reach each other's intercluster LIFs. ONTAP provides a built-in way to test this using network ping from the LIF itself, ensuring that the test follows the correct broadcast domain, routing table, and VPN path.

CLI Validation | Test From On-Prem » ONTAP (Cloud)

```
network ping -lif inter_1 -vserver sxId0edb1927eae795ba7 -destination <Cloud_IC_LIF_IP>

network ping -lif inter_2 -vserver sxId0edb1927eae795ba7 -destination <Cloud_IC_LIF_IP>
```

Use IP address and not ic1.**ic1** is the name of a LIF object inside ONTAP, not a DNS hostname, so ONTAP cannot resolve it unless we explicitly create a DNS/hosts entry with that name.

```
sxId0edb1927eae795ba7::> network ping -lif inter_1 -vserver sxId0edb1927eae795ba7 -destination
192.0.2.51

192.0.2.51 is alive
```

```
sxId0edb1927eae795ba7::> network ping -lif inter_2 -vserver sxId0edb1927eae795ba7 -destination
192.0.2.51

192.0.2.51 is alive
```

Test From ONTAP (Cloud) » On-Prem

```
network ping -lif ic1 -vserver ONTAPSelectCluster -destination <ONprem_IC_LIF_1>
```

```
ONTAPSelectCluster::> network ping -lif ic1 -vserver ONTAPSelectCluster -destination
198.51.100.201

198.51.100.201 is alive
```

```
network ping -lif ic1 -vserver ONTAPSelectCluster -destination <ONprem_IC_LIF_2>
```

```
ONTAPSelectCluster::> network ping -lif ic1 -vserver ONTAPSelectCluster -destination
198.51.100.104

198.51.100.104 is alive
```

Expected Output:

- <OnPrem_IP> is alive
- Symmetric reachability
- No routing errors (e.g., “Network unreachable”)

This validates that the ONTAP Vultr Cloud intercluster LIF can return traffic back to the on-prem intercluster LIFs.

NetApp FlexCache Firewall Ports

The following TCP ports must be enabled bidirectionally on your firewall between the Inter-cluster LIFs of your ONTAP clusters (On-Prem and Vultr ONTAP) before cluster peering can be established.

TCP Port 11104 (SnapMirror and NetApp FlexCache Control)

- Purpose: Mandatory for establishing and maintaining cluster peering.
- Function: Used for the secure control channel, authentication, and metadata exchange (the peering handshake).

TCP Port 10000 (Data Transfer Primarily for SnapMirror)

- Purpose: Mandatory for all SnapMirror data transfer operations.
- Function: Used for the actual block-level data transfer during replication.

CLI run on On-Prem

```
nc -zv 192.0.2.51 11104
nc -zv 192.0.2.51 11105
```

```
ubuntu@ip-198.51.100-99:~$ nc -zv 192.0.2.51 11104
Connection to 192.0.2.51 11104 port [tcp/*] succeeded!
ubuntu@ip-198.51.100-99:~$ nc -zv 192.0.2.51 11105
Connection to 192.0.2.51 11105 port [tcp/*] succeeded!
ubuntu@ip-198.51.100-99:~$ nc -zv 192.0.2.51 10000
Connection to 192.0.2.51 10000 port [tcp/webmin] succeeded!
```

CLI run on ONTAP

```
nc -zv 198.51.100.201 11104
nc -zv 198.51.100.201 11105
```

```
root@strongswan-01:~# nc -zv 198.51.100.201 11104
Connection to 198.51.100.201 11104 port [tcp/*] succeeded!
root@strongswan-01:~# nc -zv 198.51.100.201 11105
Connection to 198.51.100.201 11105 port [tcp/*] succeeded!
root@strongswan-01:~# nc -zv 198.51.100.201 10000
Connection to 198.51.100.201 10000 port [tcp/webmin] succeeded!
```

Expected Output:

- Connection to ... port [tcp/*] succeeded!
- Zero connection timeouts or refusals.
- Confirms bidirectional traffic flow on critical ports.

Essential NFS Access Ports

These ports are necessary for your Vultr Compute/GPU Nodes to successfully mount and access the read-only datasets from the NetApp ONTAP system. They must be opened on the firewall governing traffic between the compute nodes and the ONTAP Data LIFs.

TCP/UDP Port 111

- Purpose: Mandatory for initial client-server communication and service discovery.
- Function: Used by the NFS client (Vultr Compute Nodes) to find the dynamic port numbers of other necessary NFS services, such as Mountd.

TCP/UPD Port 2049

- Purpose: Mandatory for all NFS data access and transfer operations.
- Function: The primary port used for the core NFS protocol, enabling clients to read and write file data across the network (Note: For NFSv4.x, this port often handles all functions).

CLI run on ONTAP

To check if a Vultr Compute Node can reach the NetApp ONTAP Data LIF (192.0.2.52) on the main NFS port (2049):

Get NetApp ONTAP Data LIF

```
network interface show -role data
```

```
ONTAPSelectCluster::*> net int show -role data
(network interface show)
Vserver      Logical       Status        Network          Current       Current      Is
             Interface     Admin/Oper    Address/Mask     Node          Port         Home
----------   ------------  ------------  ------------   ---------      ----------   -------
SVM_Dataflex
             SVM_Dataflex_data_01 up/up 192.0.2.53/20     ONTAPSelectCluster-01 e0b true
SVM_data
             SVM_data_Cifs up/up        192.0.2.52/20     ONTAPSelectCluster-01 e0c true

2 entries were displayed.
```

Use the above ONTAP Data LIF to run the netcat command.

```
nc -zv 192.0.2.52 2049
nc -zv 192.0.2.52 111
```

```
root@strongswan-01:~# nc -zv 192.0.2.52 2049
Connection to 192.0.2.52 2049 port [tcp/nfs] succeeded!
root@strongswan-01:~# nc -zv 192.0.2.52 111
Connection to 192.0.2.52 111 port [tcp/sunrpc] succeeded!
```

```
nc -zv 192.0.2.53 2049
nc -zv 192.0.2.53 111
```

```
root@strongswan-01:~# nc -zv 192.0.2.53 2049
Connection to 192.0.2.53 2049 port [tcp/nfs] succeeded!
root@strongswan-01:~# nc -zv 192.0.2.53 111
Connection to 192.0.2.53 111 port [tcp/sunrpc] succeeded!
```

Step 2 | Configure ONTAP Cluster Peering

Cluster and SVM peering establish the trust required for NetApp FlexCache relationships across On-Premises and Vultr ONTAP environments. Peering allows the systems to communicate securely over intercluster LIFs and authorizes the cache to access the origin volume. Without proper peering in place, a NetApp FlexCache volume cannot be created or connected to its source.

This section covers

- Create intercluster LIFs on both on-prem ONTAP and Vultr NetApp ONTAP
- Configure cluster peering (bidirectional trust)
- Configure SVM peering (data SVM to data SVM authorization)
- Validate encrypted intercluster connectivity

Cluster Peering

Cluster peering is essential for enabling NetApp FlexCache. It establishes a secure trust relationship between source and destination ONTAP clusters, allowing them to authenticate and exchange replication metadata. This process relies entirely on Inter-cluster LIFs, which are dedicated network interfaces used solely for managing the ONTAP-to-ONTAP traffic required for peering and data transfer.

Note: Always run the 'cluster peer create' command first on the destination side – the side that will RECEIVE the peer request.

On NetApp ONTAP on Vultr Cloud

```
network interface show -role intercluster
```

```
ONTAPSelectCluster::> network interface show  -role intercluster

                 Logical        Status     Network            Current            Current Is
Vserver          Interface      Admin/Oper Address/Mask       Node               Port    Home
------------------------ ----------    ---------- ------------------ ------------------ ------ -
ONTAPSelectCluster
                 icl            up/up     192.0.2.51/20   ONTAPSelectCluster-01 e0a    true
```

On On-Prem ONTAP

```
sxId0edb1927eae795ba7::> network interface show  -role intercluster

               Logical      Status     Network            Current            Current Is
Vserver        Interface    Admin/Oper Address/Mask       Node               Port    Home
------------------------ ----------    ---------- ------------------ ------------------ ------ -
sxId0edb1927eae795ba7
                inter_1      up/up     198.51.100.201/20   sxId0edb1927eae795ba7-01 e0a    true
                inter_2      up/up     198.51.100.104/20   sxId0edb1927eae795ba7-02 e0a    true

2 entries were displayed
```

Expected Output:

- status-admin = up, status-oper = up
- Correct IPs assigned
- Home-node and home-port match the configuration

CLI for cluster peering to be run on Vultr Cloud NetApp ONTAP

```
cluster peer create -peer-addrs <peer-intercluster-LIF-IP of ON-PREM> -generate-passphrase true
```

```
ONTAPSelectCluster::*> cluster peer show
This table is currently empty.
```

```
ONTAPSelectCluster::*> cluster peer create -peer-addrs 198.51.100.104 -generate-passphrase true

Notice:

      Passphrase: xxxxxxxxxx
      Expiration Time: 12/3/2025 06:37:24 +00:00
      Initial Allowed Vserver Peers: -
      Intercluster LIF IP: 192.0.2.51
      Peer Cluster Name: sxId0edb1927eae795ba7

Warning: make a note of the passphrase - it cannot be displayed again.
```

Note: Copy the Passphrase which will be needed in the next command.

CLI for cluster peering to be run on On-Prem NetApp ONTAP

Here, don't pass '-generate-passphrase true', as we need to use the generated passphrase from NetApp ONTAP [Destination].

- Passphrase is generated only once — on the destination cluster that initiates the peering (Destination NetApp ONTAP).
- The on-prem source must **reuse** that same passphrase when replying to complete the peering.

```
cluster peer create -peer-addrs <peer-intercluster-LIF-IP of ON-PREM>
```

```
sxId0edb1927eae795ba7::> cluster peer create -address-family ipv4 -peer-addrs 192.0.2.51

Notice: Use a generated passphrase or choose a passphrase of 8 or more characters. To ensure the
authenticity of the peering relationship, use a phrase or sequence of characters that would be
hard to guess.

Enter the passphrase:
Confirm the passphrase:
```

Validation

```
cluster peer show
```

```
ONTAPSelectCluster::*> cluster peer show
Peer Cluster Name         Cluster Serial Number   Availability   Authentication
---------------------     ---------------------   ------------   --------------
sxId0edb1927eae795ba7     1-80-000011             Available      ok
```

```
sxId0edb1927eae795ba7::> cluster peer show
Peer Cluster Name         Cluster Serial Number   Availability   Authentication
---------------------     ---------------------   ------------   --------------
ONTAPSelectCluster        1-80-000011             Available      ok
```

Expected Output:

- Availability = Available
- Authentication = ok
- Remote cluster name displayed
- No timeout or "unreachable" errors

SVM Peering

SVM (vserver) peering links the data SVMs on each cluster so NetApp FlexCache can access the origin volume and establish a cache relationship. Because FlexCache authorization is defined at the SVM level, this step is required. Even if the clusters are peered, FlexCache cannot operate unless the source and destination SVMs are explicitly permitted to communicate.

Since the Vultr Cloud ONTAP system will act as the FlexCache destination, it is the appropriate place to initiate the 'vserver peer create' command. The On-Premises ONTAP system will then receive and accept the peering request.

CLI run on NetApp ONTAP (Vultr Cloud)

Run the following command on the ONTAP cluster (the destination). This command creates a pending peering relationship.

```
vserver peer create -vserver <dst_svm_ontap_select> -peer-vserver <src_svm_ onprem> –applications
flexcache,snapmirror –peer-cluster <onprem-cluster-name>
```

```
ONTAPSelectCluster::*> vserver peer create -vserver SVM_data -peer-vserver sx -applications
flexcache,snapmirror -peer-cluster sxId0edb1927eae795ba7
Info: [Job 52] 'vserver peer create' job queued
```

CLI run on On-prem NetApp ONTAP [Source]

Immediately after the create command, run the following command on the corresponding On-Prem cluster (the source) to accept the peering request and finalize the relationship.

```
vserver peer accept -vserver <src_svm_onprem> -peer-vserver <dst_svm_ontap_select>
```

```
sxId0edb1927eae795ba7::> vserver peer accept -vserver sx -peer-vserver SVM_data
Info: [Job 82] 'vserver peer accept' job queued
```

Validation from both NetApp ONTAP (Destination) and On-prem ONTAP (Source)

```
vserver peer show
```

```
ONTAPSelectCluster:: *> vserver peer show

            Peer          Peer                            Peering              Remote
Vserver     Vserver       State         Peer Cluster      Applications         Vserver
----------------------    ----------------------      ---------------      ---------------
SVM_data    sx            peered        sxId0edb1927eae795ba7    flexcache, snapmirror
```

```
sxId0edb1927eae795ba7::> vserver peer show

            Peer          Peer                            Peering              Remote
Vserver     Vserver       State         Peer Cluster      Applications         Vserver
----------------------    ----------------------      ---------------      ---------------
Sx          SVM_data      peered        ONTAPSelectCluster       flexcache, snapmirror
                                                                                SVM data
```

Expected Output:

- Peer state = peered
- Applications = FlexCache, snapmirror
- No “initial” or “pending” states
- No peer conflicts

Step 3 | Setup Destination Volumes & NetApp FlexCache

NetApp FlexCache enables low-latency, read-optimized access to shared datasets by creating cache volumes close to applications and users while maintaining a single authoritative origin volume. In this workflow, FlexCache volumes are created on the destination ONTAP system to locally serve read traffic, and appropriate NFS/SMB export and security policies are applied to ensure controlled, transparent access for clients. Together, these steps allow applications to consume cached data seamlessly without modifying existing access patterns or duplicating full datasets.

This section covers

- Network Test-Path (NetApp FlexCache Connectivity Validation)
- Prepare destination aggregates
- Configure volume export/security settings (NFS/SMB)
- Create destination NetApp FlexCache volume
- Test mounts on Vultr compute nodes

Network Test-Path (NetApp FlexCache Connectivity Validation)

The network test-path command is a specialized NetApp ONTAP utility used to proactively validate the entire network path necessary for NetApp FlexCache and cluster peering operations. It is the most robust way to verify your network is ready. This command should be run after Cluster Peering and vserver peering is set up but before you attempt to set up NetApp FlexCache.

This tests the following:

- **Connectivity & Routing:** Confirms that a dedicated SnapMirror and NetApp FlexCache connection can be established between the source and destination cluster nodes over the correct Intercluster LIFs.
- **Firewall Status:** Verifies that the firewall allows traffic for both the SnapMirror and NetApp FlexCache control channel (TCP 11104) and the data transfer channel (TCP 10000).
- **LIF Configuration:** Ensures the Intercluster LIFs on both the source and destination are properly configured, up, and listening for SnapMirror and NetApp FlexCache traffic.

Run this from both ONTAP and On-prem ONTAP.

```
network test-path -source-node <Source_Node_Name> -destination-cluster <Destination_ Cluster_Name>
-destination-node <Destination_Node_Name>
```

```
sxId0edb1927eae795ba7::*> network test-path -source-node sxId0edb1927eae795ba7-01
-destination-cluster ONTAPSelectCluster -destination-node ONTAPSelectCluster-01

Warning: This operation will generate large amount of cluster traffic and can cause temporary
cluster traffic slowness.

Do you want to continue? {y|n}: y

Initiating path test. It can take up to 120 seconds for results to be displayed.

      Test Duration: 14.25 secs
      Send Throughput: 27.97 MB/sec
      Receive Throughput: 27.97 MB/sec
      MB Sent: 398.62
      MB Received: 398.62
      Avg Latency: 5157.99 ms
```

```
sxId0edb1927eae795ba7::*> network test-path -source-node sxId0edb1927eae795ba7-02
-destination-cluster ONTAPSelectCluster -destination-node ONTAPSelectCluster-01

Warning: This operation will generate large amount of cluster traffic and can cause temporary
cluster traffic slowness.

Do you want to continue? {y|n}: y
      Test Duration: 14.26 secs
      Send Throughput: 29.64 MB/sec
      Receive Throughput: 29.64 MB/sec
      MB Sent: 422.56
      MB Received: 422.56
      Avg Latency: 4797.68 ms
```

```
ONTAPSelectCluster::*> network test-path -source-node ONTAPSelectCluster-01
-destination-cluster sxId0edb1927eae795ba7 -destination-node sxId0edb1927eae795ba7-01

Warning: This operation will generate large amount of cluster traffic and can cause temporary
cluster traffic slowness.

Do you want to continue? {y|n}: y

Initiating path test. It can take up to 120 seconds for results to be displayed.
```

```
      Test Duration: 14.23 secs
      Send Throughput: 20.71 MB/sec
      Receive Throughput: 20.71 MB/sec
      MB Sent: 294.69
      MB Received: 294.69
      Avg Latency: 5387.71 ms
```

Expected Output:

- Confirms network connectivity between source and destination nodes
- Shows source node and destination node/cluster
- Displays status of the path (e.g., success or failure)
- Provides latency or response time details (if applicable)
- Indicates any issues such as packet loss or unreachable network

Prepare Destination Aggregates

Aggregates are storage pools, and FlexVols are the ONTAP volumes that will receive replicated NetApp FlexCache data. NetApp FlexCache volumes will be created during the FlexCache creation on destination NetApp ONTAP.

CLI | Create aggregate

```
storage aggregate create -aggregate <aggr_vultr> -disklist <connected-disk> -node <node>
```

```
ONTAPSelectCluster::> aggr create -aggregate aggr_data -disklist NET-1.1 -ha-policy sfo -node
ONTAPSelectCluster-01

Info: The layout for aggregate "aggr_data" on node "ONTAPSelectCluster-01" would be:
      First Plex

          RAID Group rg0, 1 disks (advanced_zoned checksum, raid0)
                                                    Usable Physical
             Position      Disk          Type          Size          Size
             ----------    ------------  ------------  ------------  ----------
             data          NET-1.1       SSD           3.44TB        3.50TB


      Aggregate capacity available for volume use would be 3.10TB.

      3.50TB would be used from capacity license.

Do you want to continue? {y|n}: y
[Job 40] Job succeeded: DONE
ONTAPSelectCluster::>
```

Validation

```
aggregate show
```

```
ONTAPSelectCluster::> aggr show
Aggregate     Size    Available      Used%      State      #Vols      Nodes       RAID Status
---------     ------ ----------     ------ ---------      -----   ---------      -----------------
aggr0_ONTAPSelectCluster_01
           60.22GB   2.92GB         95%        online       1     ONTAPSelectCluster-01 raid0,normal
aggr_data  3.10TB    3.10GB          0%        online       0     ONTAPSelectCluster-01 raid0,normal
2 entries were displayed.
```

Expected Output:

- Aggregate aggr_data created successfully
- Shows associated node (ONTAPSelectCluster-01) and disks (NET-1.1)
- Aggregate status is online and ready to host volumes
- Displays total size and available space of the aggregate

Configure volume export/security settings (NFS/SMB)

Export policies define which compute nodes can mount the FlexCache volume via NFS or SMB. Vultr compute instances must be explicitly granted both read-write access to the destination volumes. We will be configuring the following:

- **export-policy create –** Creates an export policy that defines the overall access framework for NFS clients on the SVM.
- **export-policy rule create –** Adds specific access rules (read-only/read-write, security type, client conditions) to the policy so ONTAP knows what permissions to enforce.
- **volume modify -policy <policy-name> –** Applies the export policy to a specific volume, enabling ONTAP to enforce those access rules when the volume is mounted.
- **volume mount -junction-path <path> –** Mounts the volume into the SVM's namespace, making it visible and accessible for NFS clients to mount.

```
vserver export-policy create -vserver dst_svm -policyname <policy-name>
```

```
ONTAPSelectCluster::> export-policy create -policyname Test_Expolicy -vserver SVM_data
```


Validate

```
export-policy show
```

```
ONTAPSelectCluster::> export-policy show
Vserver      Policy Name
------------------------------
SVM_data     Test_Expolicy
SVM_data     default
2 entries were displayed.
```

Expected Output:

- Export policy Test_Expolicy created successfully
- Associated with the Vserver SVM_data
- Status indicates the policy is active and ready to be configured with rules
- Confirms policy is ready to control NFS/CIFS access for volumes under the Vserver

Add rule

After creating the policy, associate the required hosts with the policy and assign the appropriate permission levels.

```
vserver export-policy rule create -vserver dst_svm -policyname <policy-name>-clientmatch
<nfs_node_on_vultr> -rorule any -rwrule any -protocol nfs3 –superuser any
```

```
ONTAPSelectCluster::*> export-policy rule create -policyname Test_Expolicy -clientmatch 192.0.2.7
-rorule any -rwrule any -vserver SVM_data -protocol nfs3 -superuser any
```

Validate

```
export-policy rule show -policyname Test_Expolicy -clientmatch 192.0.2.7
```

```
ONTAPSelectCluster::> export-policy rule show -policyname Test_Expolicy -clientmatch 192.0.2.7
Vserver      Policy Name           Rule Index    Access Protocol    Client Match  RO Rule
---------    ------------------    ------------  --------------     ------------  ------
SVM_data     Test_Expolicy           3           nfs3               192.0.2.7    any
```

```
export-policy rule show -policyname Test_Expolicy -fields rorule, rwrule
```

```
ONTAPSelectCluster::> export-policy rule show -policyname Test_Expolicy -fields rorule, rwrule

vserver      policyname            ruleindex     rorule         rwrule
---------    ------------------    ------------  ------         ---------
SVM_data     Test_Expolicy           3            any           any
```

Expected Output:

- Rule added successfully to export policy Test_Expolicy
- Shows client match: 192.0.2.7
- Read-only (rorule) and read-write (rwrule) permissions set (any)
- Protocol applied: NFSv3
- Superuser access: any
- Confirms the rule is active and ready to allow NFS access for the client

Create Destination NetApp FlexCache Volume

A NetApp FlexCache volume stores hot (frequently accessed) data close to users or applications, while the origin volume remains the authoritative source. FlexCache automatically manages cache coherency, metadata synchronization, and write-forward behavior, ensuring consistent access across sites without administrative overhead.

FlexCache volumes do not need to match the size of the origin volume. Because they store only hot data, metadata, and recently accessed blocks, **they can be provisioned significantly smaller - typically 5 - 20% of the origin volume's capacity - making them highly storage-efficient**.

CLI | Create a NetApp FlexCache volume

The FlexCache volume is created on the destination cluster/SVM and linked to the source volume. Only metadata and frequently accessed data are cached, reducing latency and WAN traffic.

```
volume flexcache create -vserver <cache_svm> -volume <cache_volume_name> -aggr-list <aggregate> -
size 1TB -origin-volume <origin_vol> -origin-vserver <origin_svm>
```

```
ONTAPSelectCluster::> volume flexcache create -volume Flex_Test_DES01 -vserver SVM_data -aggr-list
aggr_data -size 6GB -origin-volume Flex_Test_S10 -origin-vserver sx -junction-path
/Flex_Test_DES01

[Job 95] Job succeeded: Successful.
```

- **volume flexcache create**

  Initiates the creation of a FlexCache volume on the destination (cache) cluster.

- **-vserver <cache_svm>**

  Specifies the Storage Virtual Machine (SVM) where the FlexCache volume will be created.

- **-volume <cache_volume>**

  Defines the name of the FlexCache volume on the cache SVM.

- **-origin-vserver <source_svm>**

Identifies the source SVM that hosts the original (origin) volume.

- -origin-volume <source_volume>

  Specifies the source volume whose data will be cached in the FlexCache volume.

- -size <size>

  Sets the size of the FlexCache volume (used for metadata and cached data blocks).

Validate from Destination cluster

Confirms the cache is correctly associated with the origin volume.

```
volume flexcache show
```

```
ONTAPSelectCluster::> volume flexcache show
Vserver Volume       Size         Origin-Vserver          Origin-Volume         Origin-Cluster
---------------      --------     ---------------         ---------------       -------------------
SVM_data Flex_Test_DES01 6GB        sx                    Flex_Test_S10       sxId0edb1927eae795ba7
```

Validate from Source origin NetApp ONTAP cluster

Validate origin and cache relationship health.

```
volume flexcache origin show
```

```
sxId0edb1927eae795ba7::> volume flexcache origin show
Origin-Vserver       Origin-Volume      Cache-Vserver     Cache-Volume      Cache-Cluster
---------------      --------------     --------------    --------------    -------------
sx                   Flex_Test_S10      SVM_data          Flex_Test_DES01    ONTAPSelectCluster
```

Expected Output:

- FlexCache volume Flex_Test_DES01 created successfully
- Associated with Vserver SVM_data
- Linked to aggregate aggr_data and sized 6GB
- Origin volume: Flex_Test_S10 on Vserver sx
- Caching relationship with origin volume established and ready to serve cached data to clients

Mount the NetApp FlexCache Volume with Junction Path

The volume mount command attaches the volume to the SVM's namespace at a junction path, making it visible and mountable by NFS clients. Without a junction path, the volume exists internally but cannot be accessed over NFS.

```
volume mount -vserver <dest_svm> -volume <cache_vol1> -junction-path /Junction-path
```

```
ONTAPSelectCluster::> vol mount -volume Flex_Test_DES01 -junction-path /Flex_Test_DES01
-vserver SVM_data
```

Validation

```
Volume show -volume <volumename> -fields junction-path
```

```
ONTAPSelectCluster::> vol show -volume Flex_Test_DES01 -fields junction-path

vserver             volume               junction-path
------------------------------------------------------------
SVM_data            Flex_Test_DES01      /Flex_Test_DES01
```

Expected Output:

- Volume Flex_Test_DES01 mounted successfully
- Mounted on Vserver SVM_data
- Junction path set to /Flex_Test_DES01
- Volume status is online and accessible to clients
- Confirms the volume is ready for read/write operations

Modify the volume with export-policy

The volume modifies command assigns an export policy to the volume, enabling ONTAP to apply the correct access rules when clients attempt to mount it. Without an export policy bound to the volume, ONTAP will not allow any NFS access.

Validate policy before modifying

```
ONTAPSelectCluster::> vol show Flex_Test_DES01 -fields policy
vserver volume             policy

-----------------------------------

SVM_data Flex_Test_DES01    default
```

Modify the policy

```
volume modify -vserver dst_svm –volume <vol> -policy <policy-name>
```

```
ONTAPSelectCluster::> vol modify -volume Flex_Test_DES01 -vserver SVM_data -policy Test_Expolicy

[Job 104] Job succeeded: volume modify succeeded
```

Validate policy after modifying

```
volume show –volume <volume> -fields policy
```

```
ONTAPSelectCluster::> vol show -volume Flex_Test_DES01 -vserver SVM_data -fields policy

vserver        volume             policy
------------   ------------       --------------
SVM_data       Flex_Test_DES01    Test_Expolicy
```

Expected Output:

- Volume Flex_Test_DES01 updated successfully
- Associated with Vserver SVM_data
- Export policy changed/applied to Test_Expolicy
- Confirms the volume is online and the new policy is active
- Volume is ready for client access under the updated export policy

Check Export Policy access

The export-policy check-access command in NetApp ONTAP is used to verify whether a specific client is allowed to access an NFS export and what level of access it will receive. It simulates an NFS access request and evaluates the export policy rules without mounting the volume. The command checks the client IP or hostname against the export policy rules, determines whether access is permitted or denied, and reports the effective permissions such as read-only, read-write, superuser access, and protocol version. This is mainly used for troubleshooting NFS permission issues, helping administrators quickly confirm if export policies are correctly configured for a given client.

```
export-policy check-access -vserver SVM_data -volume Flex_Test_DES01 -client-ip 192.0.2.7
-authentication-method sys -protocol nfs3 -access-type read-write
```

If access is denied, add clientmatch into the root volume export policy as below:

```
ONTAPSelectCluster::> export-policy rule create -policyname default -vserver SVM_Data -clientmatch
192.0.2.7 -rorule any -rwrule any -protocol nfs3 -superuser any
```

Validate

```
ONTAPSelectCluster::> export-policy check-access -vserver SVM_data -volume Flex_Test_DES01 -
client-ip 192.0.2.7 -authentication-method sys -protocol nfs3 -access-type read-write
                                Policy         Policy         Rule        Access    Security
Path                Policy      Owner          Owner Type     Index                 Style
                    ----------- ----------     -----------    -------     --------  -------------
/                   default     SVM_data_root  volume           2         read          unix
/Flex_Test_DES01    Test_Expolicy Flex_Test_DES01 volume         3         read-write    unix

2 entries were displayed.
```

Expected Output:

- Checks access for client IP 192.0.2.7 on volume Flex_Test_DES01
- Shows Vserver: SVM_data
- Authentication method: sys
- Protocol: NFSv3
- Access type tested: read-write
- Output indicates whether access is allowed or denied
- Confirms which export policy rule permits or blocks the access

Test Mount on Vultr Compute

Verification that Vultr compute nodes can access the replicated dataset over NFS. Ensures the end-to-end path - from **On-Prem » NetApp FlexCache » NetApp ONTAP(Destination) » Vultr compute** - is fully operational.

When we mount an NFS export from NetApp ONTAP(Destination) in Vultr:

- We are mounting the active filesystem of the destination NetApp FlexCache Volume
- NetApp FlexCache maintains a local cache of hot (frequently accessed) data from the source volume. Clients can perform read and write operations on the NetApp FlexCache volume - reads are served locally from the cache, while all writes are sent directly to the origin (source) volume, which remains the authoritative data source.

CLI (from compute instance on Vultr Cloud)

```
mount -t nfs <ontap_select_ip>:/<junction-path> <compute node mount point>
```

```
root@compute-01: /mnt# sudo mount -t nfs 192.0.2.52:/Flex_Test_DES01 /mnt/Flexcache_Test
```

Testing Read Access

Once the FlexCache volume is mounted, we can verify that the end user is able to successfully access and read the cached data from the cache volume.

```
cat /mnt/Flexcache_Test/<file>
```

```
root@compute-01:/mnt/Flexcache_Test# cat logs_pfsense.txt
Last 500 IPsec Log Entries. (Maximum 500)

Nov 28 09:08:55 14[CFG]     remote_port = 500
Nov 28 09:08:55 14[CFG]     send_certreq = 1
Nov 28 09:08:55 14[CFG]     send_cert = CERT_SEND_IF_ASKED
Nov 28 09:08:55 14[CFG]     ppk_id = (null)
Nov 28 09:08:55 14[CFG]     ppk_required = 0
Nov 28 09:08:55 14[CFG]     mobike = 0
Nov 28 09:08:55 14[CFG]     aggressive = 0
Nov 28 09:08:55 14[CFG]     dscp = 0x00
Nov 28 09:08:55 14[CFG]     encap = 0
```

Testing Write Access (Destination NetApp ONTAP)

The following commands demonstrate the testing of FlexCache write functionality. A file named Testing_for_FlexCache_Write was successfully created from the cache volume, and the same file is now available and visible on the source NFS host, confirming that write operations are correctly redirected to the source volume.

```
root@compute-01: ~# cd /mnt/Flexcache_Test
root@compute-01:/mnt/Flexcache_Test# touch testing_for_Flexcache_Write
root@compute-01:/mnt/Flexcache_Test# ll
total 2000744
drwxr-xr-x 2 root root      4096 Feb 4 07:53 ./
drwxr-xr-x 4 root root      4096 Feb 4 07:42 ../
-rw------- 1 root root 790716416 Dec 11 07:44 1GB_testfile.img
-rw-r--r-- 1 root root 681090009 Dec 11 07:42 ‘Create Cluster.mkv’
-rw-r--r-- 1 root root 567048214 Dec 11 07:42 ‘Create VM for OTS Deploy.mkv’
-rw-r--r-- 1 root root      1599 Dec 5 10:34      file2.txt
-rw-r--r-- 1 root root      27476 Dec 11 07:43 logs_pfsense.txt
-rw-r--r-- 1 root root      1803092 Dec 11 07:42 ‘Multi-Region NetApp SnapMirror to ONTAP Select in
Vultr Cloud_v1.1.docx’
-rw-r--r-- 1 root root      203 Dec 5 10:06       Test_file.txt
-rw-r--r-- 1 root root      0 Dec 11 07:56 testing_for_Flexcache_Write
-rw-r--r-- 1 root root      0 Dec 11 07:48 tst11
root@compute-01:/mnt/Flexcache_Test#
```

Testing Write Through to Origin (Source NetApp ONTAP)

ONTAP FlexCache uses write-through semantics, where all writes are forwarded directly to the origin volume, preserving a single authoritative source of truth. A write or update issued at the FlexCache mount is forwarded to the origin volume.

```
ubuntu@ip-198.51.100-99:/mnt/Test_Flex$ ll
total 2000744
drwxr-xr-x 2 root root      4096 Dec 11 07:53 ./
drwxr-xr-x 5 root root      4096 Dec 11 09:50 ../
-rw------- 1 root root 790716416 Dec 11 07:44 1GB_testfile.img
-rw-r--r-- 1 root root 681090009 Dec 11 07:42 'Create Cluster.mkv'
-rw-r--r-- 1 root root 567048214 Dec 11 07:42 'Create VM for OTS Deploy.mkv'
-rw-r--r-- 1 root root      1803092 Dec 11 07:42 'Multi-Region NetApp SnapMirror to ONTAP Select in
Vultr Cloud_v1.1.docx'
-rw-r--r-- 1 root root      203 Dec 11 10:06      Test_file.txt
-rw-r--r-- 1 root root      1599 Dec 11 10:34     file2.txt
-rw-r--r-- 1 root root      27476 Dec 11 07:43 logs_pfsense.txt
-rw-r--r-- 1 root root      0 Dec 11 07:56 testing_for_Flexcache_Write
-rw-r--r-- 1 root root      0 Dec 11 07:48 tst11
ubuntu@ip-198.51.100-99:/mnt/Test_Flex$
```

Expected Output:

- Mount is successful
- Read and Write operations success

Validate Throughput and Performance

A performance test using read workloads to ensure ONTAP meets expected throughput for AI/analytics. Confirms the system can sustain the I/O patterns required by downstream GPU/compute pipelines.

The dd test is run twice to demonstrate FlexCache behavior: the first run reads data from the origin across the WAN, while the second run reads the same data locally from the FlexCache, delivering higher throughput.

CLI (compute-side example)

```
dd if=/mnt/Flexcache_Test/<bigfile> of=/dev/null bs=1M status=progress
```

```
root@compute-01:/mnt/Flexcache_Test# dd if=Create\ cluster.mkv of=/dev/null bs=1M status=progress
664797184 bytes (665 MB, 634 MiB) copied, 21 s, 31.6 MB/s
649+1 records in
649+1 records out
681090009 bytes (681 MB, 650 MiB) copied, 21.425 s, 31.8 MB/s
```


Expected Output (from across the WAN):

- Stable read throughput (e.g., 20–200 MB/s depending on network access to the source over the WAN)
- No read stalls or NFS timeout messages

Now clear linux cache (so test doesn't take data from memory but from FlexCache).

```
echo 3 > /proc/sys/vm/drop_caches
```

```
root@compute-01:/mnt/Flexcache_Test# dd if=Create\ cluster.mkv of=/dev/null bs=1M status=progress
580911104 bytes (581 MB, 554 MiB) copied, 2 s, 290 MB/s
649+1 records in
649+1 records out
681090009 bytes (681 MB, 650 MiB) copied, 2.31956 s, 294 MB/s
```

Expected Output (from FlexCache):

- Stable read throughput (e.g., 200–400 MB/s)
- No read stalls or NFS timeout messages

Observation: Higher Performance Gains with FlexCache

Accessing data through ONTAP FlexCache can deliver significantly higher throughput than reading directly from the origin volume over the WAN, because frequently accessed (hot) data is served from the FlexCache volume that is mounted within the same region or site as the client. Although FlexCache is accessed over the network, it avoids WAN round trips by servicing read requests from a nearby cache, reducing latency and offloading read traffic from the origin volume. This enables near–local-storage performance for repeated read operations while preserving a single authoritative source of truth at the origin.

Step 4 | Configure Second Region (Region B) for FlexCache on Vultr Cloud

Configure ONTAP Cluster Peering

This section assumes that Region B is already configured as part of the same VPN and that cluster peering has been successfully established, like the setup completed for Region A. The following steps describe the procedure to mount a volume from Region B.

This section covers:

- Configure cluster peering (bidirectional trust)
- Configure SVM peering (data SVM to data SVM authorization)
- Network Test-Path (NetApp FlexCache connectivity validation)
- Prepare destination aggregate
- Configure volume export/security settings (NFS/SMB)
- Create destination NetApp FlexCache Volume
- Test mounts on Vultr Compute

Cluster Peering

Cluster peering for Region B is configured in the same manner as Region A.

Run the 'cluster peer create' command first on the destination side - the side that will RECEIVE the peer request.

On NetApp ONTAP on Vultr Cloud

```
network interface show -role intercluster
```

```
ONTAPSelectCluster::> network interface show -role intercluster
             Logical      Status       Network           Current       Current  Is
 Vserver     Interface    Admin/Oper   Address/Mask      Node          Port     Home
 ----------  ----------   ----------   --------------    ---------     -------  ----
 ONTAPSelectCluster
              ic1          up/up        192.0.2.51/20   ONTAPSelectCluster-01   e0e     true
```

On On-Prem ONTAP

```
sxId0edb1927eae795ba7::> network interface show -role intercluster
             Logical      Status       Network           Current       Current  Is
 Vserver     Interface    Admin/Oper   Address/Mask      Node          Port     Home
 ----------  ----------   ----------   --------------    ---------     -------  ----
 sxId0edb1927eae795ba7
              inter_1      up/up       198.51.100.201/20  sxId0edb1927eae795ba7-01   e0e     true
              inter_2      up/up       198.51.100.104/20  sxId0edb1927eae795ba7-02   e0e     true
 2 entries were displayed.
```

Expected Output:

- status-admin = up, status-oper = up
- Correct IPs assigned
- Home-node and home-port match the configuration

CLI for cluster peering to be run on Vultr Cloud NetApp ONTAP

```
cluster peer create -peer-addrs <peer-intercluster-LIF-IP of On-Prem> -generate-passphrase true
```

```
ONTAPSelectCluster::*> cluster peer show

This table is currently empty.
```

```
ONTAPSelectCluster::*> cluster peer create -peer-addrs 198.51.100.104 -generate-passphrase true

Notice:

      Passphrase: xxxxxxxxx
      Expiration Time: 12/3/2025 06:37:24 +00:00
      Initial Allowed Vserver Peers: -
      Intercluster LIF IP: 192.0.2.51
      Peer Cluster Name: sxId0edb1927eae795ba7

Warning: make a note of the passphrase - it cannot be displayed again.
```

Note: Copy the Passphrase which will be needed in the next command

CLI for cluster peering to be run on On-Prem NetApp ONTAP

Here, don't pass '-generate-passphrase true', as we need to use the generated passphrase from NetApp ONTAP[Destination]

- Passphrase is generated only once - on the destination cluster that initiates the peering (Destination NetApp ONTAP).
- The On-Prem source must reuse that same passphrase when replying to complete the peering.

```
cluster peer create -peer-addrs <peer-intercluster-LIF-IP of On-Prem>
```

```
sxId0edb1927eae795ba7::> cluster peer create -address-family ipv4 -peer-addrs 192.0.2.51

Notice: Use a generated passphrase or choose a passphrase of 8 or more characters. To ensure the
authenticity of the peering relationship, use a phrase or sequence of characters that would be
hard to guess.

Enter the passphrase:
Confirm the passphrase:
```

Validation

```
cluster peer show
```

```
ONTAPSelectCluster::*> cluster peer show

Peer Cluster Name         Cluster Serial Number Availability   Authentication

------------------------- --------------------- -------------- --------------

sxId0edb1927eae795ba7     1-80-000011           Available      ok
```

```
sxId0edb1927eae795ba7::> cluster peer show

Peer Cluster Name         Cluster Serial Number Availability   Authentication

------------------------- --------------------- -------------- --------------

ONTAPSelectCluster        1-80-000011           Available      ok
```

Expected Output:

- Availability = Available
- Authentication = ok
- Remote cluster name displayed
- No timeout or “unreachable” errors

SVM Peering

Since the Vultr Cloud ONTAP system will act as the FlexCache destination, it is the appropriate place to initiate the ‘vserver peer create’ command. The On-Premises ONTAP system will then receive and accept the peering request.

Before creating the vserver peering, ensure the required vserver and data LIFs are created and configured to support client access and peering operations.

Create a vserver

```
ONTAPSelectCluster :: > vserver create -vserver SVM_Dataflex -aggregate aggr_data -subtype default
-rootvolume SVM_Dataflex_root -root volume-security-style mixed -language C.UTF-8 -snapshot-policy
default -data-services data-iscsi, data-nfs, data-cifs, data-flexcache,data-nvme-tcp
[Job 123] Job succeeded:
Vserver creation completed.
```

Validate

```
ONTAPSelectCluster::> vserver show

Vserver  Type  Subtype   Admin State   Operational State   Root Volume   Aggregate
-----    -----  -------- ------------ ------------------ ------------- ------------

ONTAPSelectCluster admin    -      -         -                 -             -
ONTAPSelectCluster-01 node  -      -         -                 -             -
SVM_Dataflex data  default  running       running       SVM_Dataflex_root     aggr_data
SVM_data     data  default  running       running       SVM_data_root         aggr_data
4 entries were displayed.
```

Data LIF creation

```
ONTAPSelectCluster::> network interface create -vserver SVM_Dataflex -lif SVM_Dataflex_data_01 -
data-protocol fcache,nfs,cifs -address 192.0.2.53 -netmask 255.255.240.0 -home-node
ONTAPSelectCluster-01 -home-port e0b
```

Validate

```
ONTAPSelectCluster::> net int show SVM_Dataflex_data_01
      (network interface show)
             Logical      Status       Network           Current       Current  Is
 Vserver     Interface    Admin/Oper   Address/Mask      Node          Port     Home
 ----------  ----------   ----------   --------------    ---------     -------  ----
 SVM_Dataflex
       SVM_Dataflex_data_01 up/up      192.0.2.53/20   ONTAPSelectCluster-01   e0b     true
```

CLI run on NetApp ONTAP (Vultr Cloud - Destination)

Run the following command on the ONTAP cluster (the destination). This command creates the pending peering relationship.

```
ONTAPSelectCluster::*> vserver peer create -vserver SVM_Dataflex -peer-vserver SVM_Flexdata
-applications snapmirror,flexcache -peer-cluster sxId0edb1927eae795ba7

Info: [Job 125] ‘vserver peer create’ job queued
```

CLI run on On-Prem NetApp ONTAP [Source]

Immediately after the create command, run the following command on the corresponding On-Prem cluster (the source) to accept the peering request and finalize the relationship.

```
sxId0edb1927eae795ba7::*> vserver peer accept -vserver SVM_Flexdata -peer-vserver SVM_Dataflex
Info: [Job 245] 'vserver peer accept' job queued
```

Validation from both ONTAP (Destination) and On-Prem ONTAP (Source)

```
vserver peer show
```

Validation | CLI (Source)

```
ONTAPSelectCluster::*> vserver peer show
            Peer        Peer                           Peering        Remote
Vserver     Vserver     State        Peer Cluster      Applications   Vserver
----------- ----------- ------------ ----------------- -------------- ---------
SVM_Dataflex SVM_Flexdata peered     sxId0edb1927eae795ba7 snapmirror, flexcache SVM_Flexdata
SVM_data     sx           peered     sxId0edb1927eae795ba7 flexcache, snapmirror sx
2 entries were displayed.
```

CLI (Destination)

```
sxId0edb1927eae795ba7::> vserver peer show
            Peer        Peer                           Peering        Remote
Vserver     Vserver     State        Peer Cluster      Applications   Vserver
----------- ----------- ------------ ----------------- -------------- ---------
SVM_Flexdata SVM_Dataflex peered     ONTAPSelectCluster snapmirror, flexcache SVM_Dataflex
sx         SVM_data       peered     ONTAPSelectCluster flexcache, snapmirror SVM_data
2 entries were displayed.
```

Expected Output:

- Peer state = peered
- Applications = FlexCache, snapmirror
- No "initial" or "pending" states
- No peer conflicts

Network Test-Path

The network test-path command is a specialized NetApp ONTAP utility used to proactively validate the entire network path necessary for NetApp FlexCache and cluster peering operations. It is the most robust way to verify your network is ready.

This command should be run after Cluster Peering and vserver peering is set up but before you attempt to set up NetApp FlexCache.

This tests the following:

- Connectivity & Routing: Confirms that a dedicated SnapMirror and NetApp FlexCache connection can be established between the source and destination cluster nodes over the correct Intercluster LIFs.
- Firewall Status: Verifies that the firewall allows traffic for both the SnapMirror and NetApp FlexCache control channel (TCP 11104) and the data transfer channel (TCP 10000).
- LIF Configuration: Ensures the Intercluster LIFs on both the source and destination are properly configured, up, and listening for SnapMirror and NetApp FlexCache traffic.

Run this from both ONTAP and On-Prem ONTAP

```
network test-path -source-node <Source_Node_Name> -destination-cluster
<Destination_Cluster_Name> -destination-node <Destination_Node_Name>
```

```
sxId0edb1927eae795ba7::*> network test-path -source-node sxId0edb1927eae795ba7-01 -destination
-cluster ONTAPSelectCluster -destination-node ONTAPSelectCluster-01

Warning: This operation will generate large amount of cluster traffic and can cause temporary
cluster traffic slowness.

Do you want to continue? {y|n}: y

Initiating path test. It can take up to 120 seconds for results to be displayed.
      Test Duration: 14.25 secs
   Send Throughput: 27.97 MB/sec
Receive Throughput: 27.97 MB/sec
           MB Sent: 398.62
       MB Received: 398.62
       Avg Latency: 5157.99 ms
```

```
sxId0edb1927eae795ba7::*> network test-path -source-node sxId0edb1927eae795ba7-02 -destination-
cluster ONTAPSelectCluster -destination-node ONTAPSelectCluster-01

Warning: This operation will generate large amount of cluster traffic and can cause temporary
cluster traffic slowness.

Do you want to continue? {y|n}: y

     Test Duration: 14.26 secs
   Send Throughput: 29.64 MB/sec
Receive Throughput: 29.64 MB/sec
           MB Sent: 422.56
```

```
       MB Received: 422.56
       Avg Latency: 4797.68 ms
```

```
ONTAPSelectCluster::*> network test-path -source-node ONTAPSelectCluster-01 -destination-cluster
sxId0edb1927eae795ba7 -destination-node sxId0edb1927eae795ba7-01

Warning: This operation will generate large amount of cluster traffic and can cause temporary
cluster traffic slowness.

Do you want to continue? {y|n}: y

Initiating path test. It can take up to 120 seconds for results to be displayed.
     Test Duration: 14.23 secs
   Send Throughput: 20.71 MB/sec
Receive Throughput: 20.71 MB/sec
           MB Sent: 294.69
       MB Received: 294.69
       Avg Latency: 5387.71 ms
```

Expected Output:

- Confirms network connectivity between source and destination nodes
- Shows source node and destination node/cluster
- Displays status of the path (e.g., success or failure)
- Provides latency or response time details (if applicable)
- Indicates any issues such as packet loss or unreachable network

Prepare Destination Aggregate

Aggregates are storage pools, and FlexVols are the ONTAP volumes that will receive replicated NetApp FlexCache data.

NetApp FlexCache volumes will be created during the FlexCache creation on destination NetApp ONTAP.

CLI | Create aggregate

```
storage aggregate create -aggregate <aggr_vultr> -disklist <connected-disk> -node <node>
```

```
ONTAPSelectCluster::> aggr create -aggregate aggr_data -disklist NET-1.1 -ha-policy sfo -node
ONTAPSelectCluster-01
Info: The layout for aggregate "aggr_data" on node "ONTAPSelectCluster-01" would be:
      First Plex
        RAID Group rg0, 1 disks (advanced_zoned checksum, raid0)
                                                          Usable Physical
          Position   Disk                      Type           Size     Size
          ---------- ------------------------- ---------- -------- --------
          data       NET-1.1                   SSD          3.44TB   3.50TB
      Aggregate capacity available for volume use would be 3.10TB.
      3.50TB would be used from capacity license.
Do you want to continue? {y|n}: y
```

```
[Job 40] Job succeeded: DONE
```

Validation

```
aggregate show
```

```
ONTAPSelectCluster::> aggr show
Aggregate     Size    Available     Used%   State    #Vols    Nodes             RAID Status
----------    -----   -----------   -----   ------ -------    ----------        ---------------
aggr0_ONTAPSelectCluster_01
              60.22GB  2.92GB       95%     online     1    ONTAPSelectCluster-01 raid0, normal
aggr_data
              3.10TB   3.10TB       0%      online     0    ONTAPSelectCluster-01 raid0, normal
```

Expected Output:

- Aggregate aggr_data created successfully
- Shows associated node (ONTAPSelectCluster-01) and disks (NET-1.1)
- Aggregate status is online and ready to host volumes
- Displays total size and available space of the aggregate

Configure volume export/security settings (NFS/SMB)

Export policies define which compute nodes can mount the FlexCache volume via NFS or SMB. Vultr compute instances must be explicitly granted read-write access to the destination volumes. We will be configuring the following:

- **export-policy create –** Creates an export policy that defines the overall access framework for NFS clients on the SVM.
- **export-policy rule create –** Adds specific access rules (read-only/read-write, security type, client conditions) to the policy so ONTAP knows what permissions to enforce.
- **volume modify -policy <policy-name> –** Applies the export policy to a specific volume, enabling ONTAP to enforce those access rules when the volume is mounted.
- **volume mount -junction-path <path> –** Mounts the volume into the SVM's namespace, making it visible and accessible for NFS clients to mount.

```
vserver export-policy create -vserver dst_svm -policyname <policy-name>
```

```
ONTAPSelectCluster::*> export-policy create -policyname Test_dest_flexpolicy -vserver SVM_Dataflex
```

Validate

```
Export-policy show –policyname  <policy-name>

ONTAPSelectCluster::*> export-policy show -policyname Test_dest_flexpolicy

Vserver             Policy Name
-------------       ------------------
SVM_Dataflex        Test_dest_flexpolicy
```

Expected Output:

- Export policy Test_dest_flexpolicy created successfully
- Associated with the Vserver SVM_Dataflex
- Status indicates the policy is active and ready to be configured with rules
- Confirms policy is ready to control NFS/CIFS access for volumes under the Vserver

Add rule

After creating the policy, associate the required hosts with the policy and assign the appropriate permission levels.

```
ONTAPSelectCluster::*> vserver export-policy rule create -policyname Test_dest_flexpolicy -vserver
SVM_Dataflex -clientmatch 192.0.2.7 -rorule any -rwrule any -superuser any
```

Validate

```
export-policy rule show -policyname <policy-name>
```

```
ONTAPSelectCluster::> export-policy rule show -policyname Test_dest_flexpolicy -clientmatch
192.0.2.7

             Policy          Rule    Access   Client                RO
Vserver      Name            Index   Protocol Match                 Rule

------------ --------------- ------  -------- --------------------- ---------

SVM_Dataflex Test_dest_flexpolicy 1  any      192.0.2.7             any
```

Expected Output:

- Rule added successfully to export policy Test_dest_flexpolicy
- Shows client match: 192.0.2.7
- Read-only (rorule) and read-write (rwrule) permissions set (any)
- Protocol applied: NFSv3
- Superuser access: any
- Confirms the rule is active and ready to allow NFS access for the client

Create Destination NetApp FlexCache Volume

FlexCache volumes do not need to match the size of the origin volume. Because they store only hot data, metadata, and recently accessed blocks, they can be provisioned significantly smaller - **typically 5 - 20% of the origin volume's capacity - making them highly storage-efficient**.

CLI | Create a NetApp FlexCache volume

The FlexCache volume is created on the destination cluster/SVM and linked to the source volume. Only metadata and frequently accessed data are cached, reducing latency and WAN traffic.

```
volume flexcache create  -vserver <cache_svm>  -volume <cache_volume_name>  -aggr-list <aggregate>
-size 1TB  -origin-volume <origin_vol>  -origin-vserver <origin_svm>
```

```
ONTAPSelectCluster::*> flexcache create -vserver SVM_Dataflex -volume Flex_vol_Test01 -size 7GB -
aggr-list aggr_data -origin-volume  Flex_Vol_S20 -origin-vserver SVM_Flexdata

  (volume flexcache create)

[Job 128] Job succeeded: Successful.
```

- **volume flexcache create**

  Initiates the creation of a FlexCache volume on the destination (cache) cluster.

- **-vserver <cache_svm>**

  Specifies the Storage Virtual Machine (SVM) where the FlexCache volume will be created.

- **-volume <cache_volume>**

  Defines the name of the FlexCache volume on the cache SVM.

- **-origin-vserver <source_svm>**

  Identifies the source SVM that hosts the original (origin) volume.

- **-origin-volume <source_volume>**

  Specifies the source volume whose data will be cached in the FlexCache volume.

- **-size <size>**

  Sets the size of the FlexCache volume (used for metadata and cached data blocks).

Validate from Destination cluster

Confirms the cache is correctly associated with the origin volume.

```
volume flexcache show
```

```
ONTAPSelectCluster::*> flexcache show
  (volume flexcache show)
Vserver Volume      Size       Origin-Vserver Origin-Volume Origin-Cluster
------- ----------- ---------- -------------- ------------- --------------
SVM_Dataflex Flex_vol_Test01 7GB SVM_Flexdata Flex_Vol_S20  sxId0edb1927eae795ba7
SVM_data Flex_Test_DES01 6GB   sx            Flex_Test_S10 sxId0edb1927eae795ba7
2 entries were displayed.
```

Validate from Source origin NetApp ONTAP cluster

Validate origin and cache relationship health.

```
volume flexcache origin show
```

```
sxId0edb1927eae795ba7::*> volume flexcache origin show
Origin-Vserver Origin-Volume  Cache-Vserver  Cache-Volume  Cache-Cluster
-------------- -------------- -------------- ------------- --------------
SVM_Flexdata   Flex_Vol_S20   SVM_Dataflex   Flex_vol_Test01 ONTAPSelectCluster
sx             Flex_Test_S10  SVM_data       Flex_Test_DES01 ONTAPSelectCluster
2 entries were displayed.
```

Expected Output:

- FlexCache volume Flex_vol_Test01 created successfully
- Associated with Vserver SVM_dataflex
- Linked to aggregate aggr_data and sized 7GB
- Origin volume: Flex_vol_Test01 on Vserver SVM_Flexdata
- Junction path set: /Flex_vol_Test01
- Volume status is online and caching relationship with origin volume established and ready to serve cached data to clients

Mount the NetApp FlexCache Volume with Junction Path

The volume mount command attaches the volume to the SVM's namespace at a junction path, making it visible and mountable by NFS clients. Without a junction path, the volume exists internally but cannot be accessed over NFS.

```
volume mount -vserver dest_svm  -volume cache_vol1  -junction-path /Junction-path
```

```
ONTAPSelectCluster::*> vol mount -volume Flex_vol_Test01 -vserver SVM_Dataflex -junction-path
/Flex_vol_Test01
```

Validate

```
Volume show -volume volumename -fields junction-path
```

```
ONTAPSelectCluster::*> vol show -volume Flex_vol_Test01 -fields junction-path
vserver      volume          junction-path
------------ --------------- ----------------
SVM_Dataflex Flex_vol_Test01 /Flex_vol_Test01
```

Expected Output:

- Volume Flex_vol_Test01 mounted successfully
- Mounted on Vserver SVM_dataflex
- Junction path set to /Flex_vol_Test01
- Volume status is online and accessible to clients
- Confirms the volume is ready for read/write operations

Modify the volume with export-policy

The volume modifies command assigns an export policy to the volume, enabling ONTAP to apply the correct access rules when clients attempt to mount it. Without an export policy bound to the volume, ONTAP will not allow any NFS access.

Validate policy before modifying

```
ONTAPSelectCluster::*> vol show -volume Flex_vol_Test01 -fields policy
vserver      volume          policy
------------ --------------- -------
SVM_Dataflex Flex_vol_Test01 default
```

Modify the volume

```
volume modify -vserver dst_svm -volume <vol> -policy <policy-name>
```

```
ONTAPSelectCluster::*> vol modify -volume Flex_vol_Test01 -policy Test_dest_flexpolicy -vserver
SVM_Dataflex

[Job 133] Job succeeded: volume modify succeeded
```

Validation after modifying

```
volume show –volume <volume> -fields policy
```

```
ONTAPSelectCluster::*> vol show -volume Flex_vol_Test01 -vserver SVM_Dataflex -fields policy

vserver      volume          policy
------------ --------------- --------------------
SVM_Dataflex Flex_vol_Test01 Test_dest_flexpolicy
```

Expected Output:

- Volume Flex_vol_Test01 updated successfully
- Associated with Vserver SVM_dataflex
- Export policy changed/applied to Test_dest_flexpolicy
- Confirms the volume is online and the new policy is active
- Volume is ready for client access under the updated export policy

Check Export Policy access

The export-policy check-access command in NetApp ONTAP is used to verify whether a specific client is allowed to access an NFS export and what level of access it will receive. It simulates an NFS access request and evaluates the export policy rules without actually mounting the volume. The command checks the client IP or hostname against the export policy rules, determines whether access is permitted or denied, and reports the effective permissions such as read-only, read-write, superuser access, and protocol version. This is mainly used for troubleshooting NFS permission issues, helping administrators quickly confirm if export policies are correctly configured for a given client.

```
export-policy check-access -vserver SVM_Dataflex -volume Flex_vol_Test01 -client-ip 192.0.2.7 -
authentication-method sys -protocol nfs3 -access-type read-write
```

If access is denied, add clientmatch into the root volume export policy as below:

```
ONTAPSelectCluster::*> export-policy rule create -policyname default -vserver SVM_Dataflex -
clientmatch 192.0.2.7 -rorule any -rwrule any -superuser any
```

Validate

```
ONTAPSelectCluster::> export-policy check-access -vserver SVM_Dataflex -volume Flex_vol_Test01 -
client-ip 192.0.2.7 -authentication-method sys -protocol nfs3 -access-type read-write

                                Policy    Policy     Rule            Security
Path                Policy      Owner     Owner Type Index Access    Style

------------------- ---------- --------- ---------- ---- ---------- ----------

/                   default     SVM_Dataflex_root volume 1 read      mixed

/Flex_vol_Test01    Test_dest_flexpolicy Flex_vol_Test01 volume 1 read-write mixed

2 entries were displayed.
```

Expected Output:

- Checks access for client IP 192.0.2.7 on volume Flex_vol_Test01
- Shows Vserver: SVM_dataflex
- Authentication method: sys
- Protocol: NFSv3
- Access type tested: read-write
- Output indicates whether access is allowed or denied
- Confirms which export policy rule permits or blocks the access

Test Mount on Vultr Compute

Verification that Vultr compute nodes can access the replicated dataset over NFS. Ensures the end-to-end path - from **On-Prem » NetApp FlexCache » NetApp ONTAP(Destination) » Vultr compute** - is fully operational.

When we mount an NFS export from NetApp ONTAP(Destination) in Vultr:

- We are mounting the active filesystem of the destination NetApp FlexCache Volume
- NetApp FlexCache maintains a local cache of hot (frequently accessed) data from the source volume. Clients can perform read and write operations on the NetApp FlexCache volume - reads are served locally from the cache, while all writes are sent directly to the origin (source) volume, which remains the authoritative data source.

CLI (from compute instance on Vultr Cloud)

```
mount -t nfs <ontap_select_ip>:/<junction-path> <compute node mount point>
```

```
root@compute-01:~# sudo mount -t nfs 192.0.2.53:/Flex_vol_Test01 /mnt/Flexcache_Site2
```

```
ls /mnt/Flexcache_Site2/
```

```
root@compute-01:~# ls /mnt/Flexcache_Site2/
'Create Cluster.mkv'    logs_pfsense.txt  'Multi-Region NetApp SnapMirror to ONTAP Select in Vultr
Cloud_v1.1.docx'

root@compute-01:~#
```

Testing Read Access

Once the FlexCache volume is mounted, we can verify that the end user is able to successfully access and read the cached data from the cache volume.

```
cat /mnt/Flexcache_Test/<file>
```

```
root@compute-01:~# cat /mnt/Flexcache_Test/logs_pfsense.txt

Last 500 IPsec Log Entries. (Maximum 500)

Nov 28 09:08:55 14[CFG]         remote_port = 500
Nov 28 09:08:55 14[CFG]         send_certreq = 1
Nov 28 09:08:55 14[CFG]         send_cert = CERT_SEND_IF_ASKED
Nov 28 09:08:55 14[CFG]         ppk_id = (null)
Nov 28 09:08:55 14[CFG]         ppk_required = 0
Nov 28 09:08:55 14[CFG]         mobike = 0
Nov 28 09:08:55 14[CFG]         aggressive = 0
Nov 28 09:08:55 14[CFG]         dscp = 0x00
Nov 28 09:08:55 14[CFG]         encap = 0
Nov 28 09:08:55 14[CFG]         dpd_delay = 10
Nov 28 09:08:55 14[CFG]         dpd_timeout = 60
Nov 28 09:08:55 14[CFG]         fragmentation = 2
```

Testing Write Access (Destination NetApp ONTAP)

The following commands demonstrate the testing of FlexCache write functionality. A file named Testing_for_FlexCache_Write was successfully created from the cache volume, and the same file is now available and visible on the source NFS host, confirming that write operations are correctly redirected to the source volume.

```
root@compute-01:~# cd /mnt/Flexcache_Site2
```

```
root@compute-01:/mnt/Flexcache_Site2# touch Test_for_site_Multi_flext

root@compute-01:/mnt/Flexcache_Site2#

root@compute-01:/mnt/Flexcache_Site2# ll
```

```
total 669564
drwxr-xr-x 2 nobody nogroup      4096 Dec 15 11:23  ./
drwxr-xr-x 5 root   root         4096 Dec 15 11:14  ../
-rw-r--r-- 1 nobody nogroup 681090009 Dec 15 09:59 'Create Cluster.mkv'
-rw-r--r-- 1 nobody nogroup     27476 Dec 15 10:00  logs_pfsense.txt
-rw-r--r-- 1 nobody nogroup   1803092 Dec 15 10:00 'Multi-Region NetApp SnapMirror to ONTAP Select
in Vultr Cloud_v1.1.docx'
-rw-r--r-- 1 nobody nogroup         0 Dec 15 11:23  Test_for_site_Multi_flext
root@compute-01:/mnt/Flexcache_Site2#
```

Testing Write Through to Origin (Source NetApp ONTAP)

ONTAP FlexCache uses write-through semantics, where all writes are forwarded directly to the origin volume, preserving a single authoritative source of truth. A write or update issued at the FlexCache mount is forwarded to the origin volume.

```
ubuntu@ip-198.51.100-99:~$ cd /mnt/Flex_Vol_S20$
ubuntu@ip-198.51.100-99:/mnt/Flex_Vol_S20$ ll
total 669564
drwxr-xr-x 2 root  root      4096 Dec 15 11:23  ./
drwxr-xr-x 6 root  root      4096 Dec 15 09:50  ../
-rw-r--r-- 1 root root 681090009 Dec 15 09:59 'Create Cluster.mkv'
-rw-r--r-- 1 root root   1803092 Dec 15 10:00 'Multi-Region NetApp SnapMirror to ONTAP Select in
Vultr Cloud_v1.1.docx'
-rw-r--r-- 1 root root         0 Dec 15 11:23  Test_for_site_Multi_flext
-rw-r--r-- 1 root root     27476 Dec 15 10:00  logs_pfsense.txt
ubuntu@ip-198.51.100-99:/mnt/Flex_Vol_S20$
```

Expected Output:

- Mount is successful
- Read and Write operations success

Validate Throughput and Performance

A performance test using read workloads to ensure ONTAP meets expected throughput for AI/analytics. Confirms the system can sustain the I/O patterns required by downstream GPU/compute pipelines.

The dd test is run twice to demonstrate FlexCache behavior: the first run reads data from the origin across the WAN, while the second run reads the same data locally from the FlexCache, delivering higher throughput.

CLI (compute-side example)

```
dd if=/mnt/Flexcache_Site2/<bigfile> of=/dev/null bs=1M status=progress
```

```
root@compute-01:/mnt/Flexcache_Site2# dd if=Create\ cluster1.mkv of=/dev/null bs=1M
status=progress

651165696 bytes (651 MB, 621 MiB) copied, 12 s, 54.2 MB/s
649+1 records in
649+1 records out
681090009 bytes (681 MB, 650 MiB) copied, 12.3586 s, 55.1 MB/s
```

Expected Output (from across the WAN):

- Stable read throughput (e.g., 20–200 MB/s depending on network access to the source over the WAN)
- No read stalls or NFS timeout messages

Now clear linux cache (so test doesn't take data from memory but from FlexCache)

```
echo 3 > /proc/sys/vm/drop_caches
```

```
root@compute-01:/mnt/Flexcache_Site2# dd if=Create\ cluster.mkv of=/dev/null bs=1M status=progress
386924544 bytes (387 MB, 369 MiB) copied, 1 s, 386 MB/s
649+1 records in
649+1 records out
681090009 bytes (681 MB, 650 MiB) copied, 1.904 s, 358 MB/s
```

Expected Output (from FlexCache):

- Stable read throughput (e.g., 200–400 MB/s)
- No read stalls or NFS timeout messages

Observation: Higher Performance Gains with FlexCache

Accessing data through ONTAP FlexCache can deliver significantly higher throughput than reading directly from the origin volume over the WAN, because frequently accessed (hot) data is served from the FlexCache volume that is mounted within the same region or site as the client. Although FlexCache is accessed over the network, it avoids WAN round trips by servicing read requests from a nearby cache, reducing latency and offloading read traffic from the origin volume. This enables near–local-storage performance for repeated read operations while preserving a single authoritative source of truth at the origin.

Troubleshooting

A structured approach to isolate problems across networking, routing, NetApp FlexCache, and export access.

This section covers

- Peering problems, including failed intercluster or SVM peer relationships
- NetApp FlexCache transfer failures caused by policy, scheduling, permissions, or connectivity issues
- Routing or firewall misconfigurations that block NetApp FlexCache ports or intercluster LIF communication
- ONTAP connectivity issues related to VPC, VPN, or LIF configuration errors
- NFS/SMB export issues impacting read-only mount access from compute nodes

Validate Intercluster LIF Connectivity

From source cluster

```
network ping -lif <source_intercluster_lif> -vserver <src_svm> -destination
<dest_intercluster_lif>
```

Expected:

- Successful ICMP replies
- Low latency for smooth transfers

Validate SVM and Cluster Peering

Cluster peering

```
cluster peer show
```

Look for:

- Availability = Available
- Authentication Status = ok

SVM peering

```
vserver peer show
```

Look for:

- Peer state = peered

Expected:

- Peer state = peered
- Applications = snapmirror , flexcache
- No conflicts or pending states

Detailed peer status

```
cluster peer show -instance
```

Expected:

- No blocked ports
- No authentication failures
- Connection status = operational

Routing or Firewall Misconfiguration

Ping intercluster LIFs

```
network ping -lif <src_ic_lif> -vserver <src_svm> -destination <dst_ic_lif>
```

Expected:

- Successful ping replies
- Low latency (single digit ms ideal)

Routing table

```
network route show
```

Expected:

- Route exists to destination intercluster network
- Gateway reachable
- No incorrect or overlapping routes

Firewall policy check

```
system services firewall policy show
```

Expected:

- FlexCache service allowed
- No deny rules blocking intercluster traffic
- Relevant policies applied to the correct LIFs

Verify NetApp FlexCache ports

```
network connections active show  -service fcache
```

Expected:

- Active connections visible on ports 11104 and 11105
- State = Established

ONTAP Connectivity (VPC/VPN/LIF)

List all LIFs

```
network interface show
```

Expected:

- All LIFs in up/up state
- Correct roles: data / intercluster / mgmt

Home-node and home-port correctness

```
network interface show -fields home-node,home-port,is-home
```

Expected:

- is-home = true (unless failover active)

Cluster internal connectivity

```
cluster ping-cluster -node *
```

Expected:

- All nodes reachable
- No packet loss

Test VPN reachability

```
network ping -vserver <svm> -destination <onprem_vpn_gateway_ip>
```

Expected:

- Ping successful
- Round-trip latency consistent

NFS Export Issues

Export policies

```
vserver export-policy rule show
```

Expected:

- Client IP or subnet allowed
- Read-only permissions granted
- NFS version allowed (e.g., v3/v4)

Volume export path

```
volume show -fields junction-path,export-policy
```

Expected:

- Junction path = valid (e.g., /vol1)
- Export policy assigned correctly

List CIFS shares

```
vserver cifs share show
```

Expected:

- Share listed (if SMB used)
- Correct permissions

Check client access

```
export-policy check-access -vserver <svm> -volume <vol> -client-ip <compute_ip> -authentication-
method sys
```

Expected:

- Access = read or read-only
- No “Access denied”

NFS service status

```
vserver nfs status
```

Expected:

- NFS enabled = true
- Active NFS versions listed

FlexCache Volume Issues

Volume Status

```
volume show -volume <cache_volume>
```

Expected :

- Displays details of the specified FlexCache volume
- Shows volume name and associated Vserver (SVM)
- Indicates volume state (e.g., online)
- Displays volume size and available space
- Shows junction path (if mounted)
- Confirms the volume is a FlexCache type and linked to an origin volume

FlexVolume status

```
volume flexcache show
```

Expected:

- Lists all FlexCache volumes in the cluster
- Displays cache volume name and Vserver
- Shows associated origin volume and origin Vserver
- Indicates cache status as available/online
- Displays cache size and usage
- Confirms FlexCache relationship is healthy

Origin Volume status

```
volume flexcache origin show
```

Expected :

- Displays origin volumes enabled for FlexCache
- Shows origin Vserver and volume name
- Lists associated cache volumes
- Confirms FlexCache origin status
- Indicates active cache relationships