# Plan

## ONTAP Select

NetApp
November 08, 2026

This PDF was generated from https://docs.netapp.com/us-en/ontap-select-9191/concept_workflow_deploy.html on November 08, 2026. Always check docs.netapp.com for the latest.

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# Plan

## ONTAP Select installation and deployment workflow

You can use the following workflow to deploy and administer an ONTAP Select cluster.

1. **Plan the deployment and prepare the environment**

Review the planning requirements for your ONTAP Select nodes, storage, networking, and hypervisor environment. Preparing your environment in advance helps you avoid deployment issues.

2. **Install the ONTAP Select Deploy administration utility**

Install the utility that you use to deploy and manage ONTAP Select clusters.

3. **Acquire the licenses required for a production deployment**

Purchase and apply the licenses needed for your production deployment. You can choose between the Capacity Tiers and Capacity Pools licensing models.

4. **Deploy an ONTAP Select cluster using the ONTAP Select Deploy administration utility**

Use the Deploy utility to create your ONTAP Select cluster:

- Deploy using the web UI
- Deploy using the CLI
- Deploy using the REST API

5. **Administer the ONTAP Select cluster using the standard NetApp management tools and interfaces**

Administer your ONTAP Select cluster using the same management tools and interfaces you use for other ONTAP clusters.

# ONTAP Select

## ONTAP Select requirements and planning considerations

There are several general requirements you should consider as part of planning an ONTAP Select deployment.

#### Required Linux knowledge and skills for KVM

Linux with the KVM hypervisor is a complex environment to work in. Before deploying ONTAP Select on KVM, you must have the necessary knowledge and skills.

**Linux server distribution**

You should have experience with the specific Linux distribution to be used for your ONTAP Select Deployment. Specifically, you should be able to perform the following tasks:

- Install the Linux distribution
- Configure the system using the CLI
- Add software packages as well as any dependencies

For more information on preparing your Linux server, including the required configuration and software packages, refer to the host configuration checklist. Refer to the hypervisor requirements for the currently supported Linux distributions.

**KVM deployment and administration**

You should be familiar with general virtualization concepts. In addition, there are several Linux CLI commands that you must use as part of installing and administering ONTAP Select in a KVM environment:

- `virt-install`
- `virsh`
- `lsblk`
- `lvs`
- `vgs`
- `pvs`

**Networking and Open vSwitch configuration**

You should be familiar with networking concepts and the configuration of network switches. In addition, you should have experience with Open vSwitch. You must use the following network commands a part of configuring the ONTAP Select network in a KVM environment:

- `ovs-vsctl`
- `ip`
- `ip link`
- `systemctl`

**Cluster size and related considerations**

There are several planning issues related to the cluster size that you should consider.

**Number of nodes in the cluster**

An ONTAP Select cluster is composed of one, two, four, six, eight, ten, or twelve nodes. You should determine the size of the cluster based on the application requirements. For example, if HA capability is needed for an enterprise deployment, then a multi-node cluster should be used.

**Dedicated versus collocated**

Based on the application type, you should determine if the deployment follows the dedicated or collocated model. Note that the collocated model can be more complex due to the workload diversity and tighter integration.

### Hypervisor host considerations

There are several planning issues related to the hypervisor host that you should consider.

> You should not directly modify the configuration of an ONTAP Select virtual machine unless directed to do so by NetApp support. A virtual machine should only be configured and modified through the Deploy administration utility. Making changes to an ONTAP Select virtual machine outside of the Deploy utility without assistance from NetApp support can cause the virtual machine to fail and render it unusable.

#### Hypervisor independent

Both ONTAP Select and the ONTAP Select Deploy administration utility are hypervisor-independent. The following hypervisors are supported for both.

- VMware ESXi
- Kernel-based Virtual Machine (KVM)

> Beginning with ONTAP Select 9.14.1, support for KVM hypervisor has been reinstated. Previously, support for deploying a new cluster on a KVM hypervisor was removed in ONTAP Select 9.10.1 and support for managing existing KVM clusters and hosts, except to take offline or delete, was removed in ONTAP Select 9.11.1.

Refer to the hypervisor-specific planning information and release notes for additional details regarding the supported platforms.

#### Hypervisor for ONTAP Select nodes and administration utility

Both the Deploy administration utility and ONTAP Select nodes run as virtual machines. The hypervisor you choose for the Deploy utility is independent of the hypervisor you choose for the ONTAP Select nodes. You have complete flexibility when pairing the two:

- Deploy utility running on VMware ESXi can create and manage ONTAP Select clusters on either VMware ESXi or KVM
- Deploy utility running on KVM can create and manage ONTAP Select clusters on either VMware ESXi or KVM

#### One or more instances of ONTAP Select node per host

Each ONTAP Select node runs as a dedicated virtual machine. You can create multiple nodes on the same hypervisor host, with the following restrictions:

- Multiple nodes from a single ONTAP Select cluster cannot run on the same host. All the nodes on a specific host must be from different ONTAP Select clusters.
- You must use external storage.
- If you use software RAID, you can only deploy one ONTAP Select node on the host.

#### Hypervisor consistency for the nodes within a cluster

All of the hosts within an ONTAP Select cluster must run on the same version and release of the hypervisor software.

#### Number of physical ports on each host

You must configure each host to use one, two, or four physical ports. Although you have flexibility when configuring the network ports, you should follow these recommendations where possible:

- A host in a single-node cluster should have two physical ports.
- Each host in a multi-node cluster should have four physical ports

**Integrating ONTAP Select with an ONTAP hardware-based cluster**

You cannot add an ONTAP Select node directly to an ONTAP hardware-based cluster. However, you can optionally establish a cluster peering relationship between an ONTAP Select cluster and a hardware-based ONTAP cluster.

### Storage considerations

There are several planning issues related to host storage that you should consider.

**RAID type**

When using direct-attached storage (DAS) on ESXi, you should decide whether to use a local hardware RAID controller or the software RAID feature included with ONTAP Select. If you use software RAID, see Storage and RAID considerations for more information.

**Local storage**

When using local storage managed by a RAID controller, you must decide the following:

- Whether to use one or more RAID groups
- Whether to use one or more LUNs

**External storage**

When using the ONTAP Select vNAS solution, you must decide where the remote datastores are located and how they are accessed. ONTAP Select vNAS supports the following configurations:

- VMware vSAN
- Generic external storage array

**Estimate for the storage needed**

You should determine how much storage is required for the ONTAP Select nodes. This information is required as part of acquiring the purchased licenses with storage capacity. Refer to Storage capacity restrictions for more information.

The ONTAP Select storage capacity corresponds to the total allowable size of the data disks attached to the ONTAP Select virtual machine.

**Licensing model for production deployment**

You must select the Capacity Tiers or Capacity Pools licensing model for each ONTAP Select cluster deployed in a production environment. Review the section *License* for more information.

### Authentication using the credential store

The ONTAP Select Deploy credential store is a data base holding account information. Deploy uses the account credentials to perform host authentication as part of cluster creation and management. You should be aware of how the credential store is used as part of planning an ONTAP Select deployment.

The account information is stored securely in the data base using the Advanced Encryption Standard (AES) encryption algorithm and SHA-256 hashing algorithm.

### Types of credentials

The following types of credentials are supported:

- host

  The **host** credential is used to authenticate a hypervisor host as part of deploying an ONTAP Select node directly to ESXi or KVM.

- vcenter

  The **vcenter** credential is used to authenticate a vCenter server as part of deploying an ONTAP Select node to ESXi when the host is managed by VMware vCenter.

### Access

The credential store is accessed internally as part of performing normal administrative tasks using Deploy, such as adding a hypervisor host. You can also manage the credential store directly through the Deploy web user interface and CLI.

### Related information

- Storage and RAID considerations

## ONTAP Select VMware hypervisor and hardware considerations

There are several hardware requirements and planning issues you should consider related to the VMware environment.

### Hypervisor requirements

There are several requirements related to the hypervisor where ONTAP Select runs.

> ⓘ You should review the ONTAP Select Release Notes for any additional known restrictions or limitations.

#### VMware licensing

To deploy an ONTAP Select cluster, your organization must have a valid VMware vSphere license for the hypervisor hosts where ONTAP Select runs. You should use the licenses that are appropriate for your deployment.

#### Software compatibility

You can deploy ONTAP Select on KVM and ESXi hypervisors.

**KVM**

ONTAP Select supports the following KVM hypervisor versions:

- KVM on Red Hat Enterprise Linux (RHEL) 10.1, 10.0, 9.7, 9.6, 9.5, 9.4, 9.2, 9.1, 9.0, 8.8, 8.7, and 8.6
- KVM on Rocky Linux 10.1, 10.0, 9.7, 9.6, 9.5, 9.4, 9.3, 9.2, 9.1, 9.0, 8.9, 8.8, 8.7, and 8.6

**ESXi**

ONTAP Select supports the following ESXi hypervisor versions:

- VMware ESXi 9.0
- VMware ESXi 8.0 U3
- VMware ESXi 8.0 U2
- VMware ESXi 8.0 U1 (build 21495797)
- VMware ESXi 8.0 GA (build 20513097)

NetApp supports ONTAP Select on the identified versions of ESXi as long as VMware also continues to support the same versions.

ESXi 7.0 GA reached end of availability status. If you have ONTAP Select clusters with this version, you must upgrade to the supported versions as per the Interoperability Matrix Tool (IMT).

#### VMware vCenter and standalone ESXi hosts

If an ESXi hypervisor host is managed by a vCenter server, you must register the host to the Deploy administration utility using the vCenter credentials. You cannot register the host as a standalone host using the ESXi credentials.

### Core hardware requirements

The physical hypervisor host where you deploy ONTAP Select must meet several hardware requirements. You can choose any platform for the hypervisor host, as long as it meets the minimum hardware requirements. The following vendors provide supported hardware platforms: Cisco, Dell, HP, Fujitsu, Lenovo, and Supermicro.

ONTAP Select supports CPU models based on Intel Xeon Sandy Bridge and Advanced Micro Devices (AMD) processors.

Refer to the Interoperability Matrix Tool for more information.

#### Basic hardware requirements

There are several common hardware requirements that apply to all platforms regardless of the node instance type or license offering.

**Processor**

The supported microprocessors include Intel Xeon server processors and AMD processors.

Refer to Intel Xeon Processors and AMD EPYC Server CPUs for more information.

**Ethernet configuration**

There are several supported Ethernet configurations based on the cluster size.

| Cluster size | Minimum requirements | Recommended requirements |
|---|---|---|
| Single node cluster | 2 x 1GbE | 2 x 10GbE |
| Two-node cluster or MetroCluster SDS | 4 x 1GbE or 1 x 10GbE | 2 x 10GbE |

| Cluster size | Minimum requirements | Recommended requirements |
|---|---|---|
| Four, six, eight, ten, or twelve-node cluster | 2 x 10GbE | 4 x 10GbE or 2 x 25/40GbE |

#### Additional hardware requirements based on the instance type

There are several additional hardware requirements based on the node instance type.

| Node size | CPU cores | Memory | Required platform license offering |
|---|---|---|---|
| Small | Six physical cores or greater, with four reserved for ONTAP Select | 24GB or greater, with 16GB reserved for ONTAP Select | Standard, premium, or premium XL |
| Medium | Ten physical cores or greater, with eight reserved for ONTAP Select | 72GB or greater, with 64GB reserved for ONTAP Select | Premium or premium XL |
| Large | Eighteen physical cores or greater, with sixteen reserved for ONTAP Select | 136GB or greater, with 128GB reserved for ONTAP Select | Premium XL |

There are additional disk requirements based on the platform license. See Storage and RAID for more information.

#### Related information

Learn about the platform license offerings for ONTAP Select

## ONTAP Select storage and RAID considerations

There are several planning issues related to ONTAP Select host storage that you should consider.

External storage support information is outlined for ESXi and KVM hosts. For more information, refer to VMware ESXi requirements and KVM requirements.

#### Hardware RAID controller requirements

The RAID controller on the hypervisor host where you deploy ONTAP Select must meet several requirements.

A host where ONTAP Select runs requires local physical drives when using a hardware RAID controller or the software RAID capability provided with ONTAP Select. If you use the ONTAP Select vNAS solution to access external storage, a local RAID controller and software RAID capability are not used.

The minimum requirements for the RAID controller include:

- 12 Gbps throughput

- 512 MB internal battery-backed or flash (SuperCAP) cache
- Configured in write back mode:
  - Enable failback mode to “write through” (if supported)
  - Enable “always read ahead” policy (if supported)
- All local disks behind the RAID controller should be configured as a single RAID group; use multiple RAID controllers if needed:
  - Disable the local drive cache for RAID group, which is fundamental to preserving data integrity.
- Perform LUN configuration based on the following guidelines:
  - If the RAID group size exceeds the maximum LUN size of 64TB, configure multiple equal-sized LUNs consuming all the available storage within the RAID group.
  - If the RAID group size is smaller than the maximum LUN size of 64TB, configure one LUN consuming all available storage within the RAID group.

### Software RAID requirements

When deploying an ONTAP Select cluster on the hypervisor, you can use the software RAID capability provided by ONTAP Select instead of a local hardware RAID controller. Review the following requirements and restrictions before deploying a cluster using software RAID.

#### General requirements

The environment for a software RAID deployment must meet the following core requirements:

- VMware ESXi 8.0 GA (build 20513097) or later
- ONTAP Select premium license or higher
- Local SSD drives only
- Separation of system disks from the root and data aggregates
- No hardware RAID controller on the host



If a hardware RAID controller is present, refer to the Deep dive storage section for additional configuration requirements.

#### ESXi specific requirements

- VMware ESXi 8.0 GA (build 20513097) or later
- VMware VMotion, HA, and DRS are not supported
- You cannot use software RAID with a node that has been upgraded from ONTAP Select 9.4 or earlier. If this is the case, you need to create a new node for software RAID deployment.

#### KVM specific requirements

There are also specific software package configuration requirements. Refer to the preparation of the Linux server step for more information.

### Media expectations for KVM

The SSD flash storage devices used must meet the following additional requirements:

- The SSD devices must accurately and persistently report themselves to the Linux host through the following methods:
  - # cat /sys/block/<device>/queue/rotational

    The value reported for these commands must be '0'.
- It is expected that the devices are connected to an HBA or, in some cases, to a RAID controller configured to operate in JBOD mode. When using a RAID controller, the device function must be passed through the host without overlaying any RAID functionality. When using a RAID controller in JBOD mode, you should review the RAID documentation or contact the vendor as needed to make sure the device reports the rotational speed as '0'.
- There are two separate storage components:
  - Virtual machine storage

    This is an LVM pool (storage pool) containing the system data used to host the ONTAP Select virtual machine. The LVM pool must be backed by a high endurance flash device, and can be either SAS, SATA, or NVMe. An NVMe device is recommended for improved performance.
  - Data disks

    This is a set of SAS or SATA SSD drives used for data management. The SSD devices should be enterprise grade and durable. The NVMe interface is not supported.
- All devices must be formatted with 512BPS.

#### ONTAP Select node configuration

You must configure each ONTAP Select node and hypervisor host as follows to separate the system disks from the root and data aggregates:

- Create a system storage pool
  You must create a storage pool for the ONTAP Select system data. You must attach the storage pool as part of configuring the ONTAP Select node.
- Attach necessary physical disks
  The hypervisor host must have the required SSD disks attached and available for use by the ONTAP Select virtual machine. These drives hold the root and data aggregates. You must attach the storage disks as part of configuring the ONTAP Select node.

### Storage capacity restrictions

As part of planning an ONTAP Select deployment, you should be aware of the restrictions related to storage allocation and use.

The most important storage restrictions are presented below. You should also review the Interoperability Matrix Tool for more detailed information.



ONTAP Select enforces several restrictions related to storage allocation and use. Before you deploy an ONTAP Select cluster or purchase a license, you should be familiar with these restrictions. Refer to the License section for more information.

#### Calculate raw storage capacity

The ONTAP Select storage capacity corresponds to the total allowable size of the virtual data and root disks attached to the ONTAP Select virtual machine. You should consider this when allocating capacity.

##### Minimum storage capacity for a single-node cluster

The minimum size of the storage pool allocated for the node in a single-node cluster is:

- Evaluation: 500 GB
- Production: 1.0 TB

The minimum allocation for a production deployment consists of 1 TB for user data, plus approximately 266 GB used by various ONTAP Select internal processes, which is considered required overhead.

##### Minimum storage capacity for a multi-node cluster

The minimum size of the storage pool allocated for each node in a multi-node cluster is:

- Evaluation: 1.9 TB
- Production: 2.0 TB

The minimum allocation for a production deployment consists of 2 TB for user data, plus approximately 266 GB used by various ONTAP Select internal processes, which is considered required overhead.



Each node in an HA pair must have the same storage capacity.

When estimating the amount of storage for an HA pair, you must consider that all aggregates (root and data) are mirrored. As a result, each plex of the aggregate consumes an equal amount of storage.

For example, when a 2TB aggregate is created, it allocates 2TB to two plex instances (2TB for plex0 and 2TB for plex1) or 4TB of the total licensed amount of storage.

##### Storage capacity and multiple storage pools

You can configure each ONTAP Select node to use up to 400 TB of storage when using local direct-attached storage, VMware vSAN, or external storage arrays. However, a single storage pool has a maximum size of 64 TB when using direct-attached storage or external storage arrays. Therefore, if you plan to use more than 64 TB of storage in these situations, you must allocate multiple storage pools as follows:

- Assign the initial storage pool during the cluster creation process
- Increase the node storage by allocating one or more additional storage pools



A 2% buffer is left unused in each storage pool and does not require a capacity license. ONTAP Select does not use this storage unless you specify a capacity cap. If you specify a capacity cap, then ONTAP Select uses that amount of storage unless the amount specified falls in the 2% buffer zone. The buffer is needed to prevent occasional errors that occur when attempting to allocate all of the space in a storage pool.

##### Storage capacity and VMware vSAN

When using VMware vSAN, a datastore can be larger than 64 TB. However, you can only initially allocate up to

64 TB when creating the ONTAP Select cluster. After the cluster is created, you can allocate additional storage from the existing vSAN datastore. The vSAN datastore capacity that can be consumed by ONTAP Select is based on the VM storage policy set.

#### Best practices

You should consider the following recommendations regarding the hypervisor core hardware:

- All drives in a single ONTAP Select aggregate should be the same type. For example, you should not mix HDD and SSD drives in the same aggregate.

### Additional disk drive requirements based on the platform license

The drives you choose are limited based on the platform license offering.

> The disk drive requirements apply when using a local RAID controller and drives, as well as software RAID. These requirements do not apply to external storage accessed through the ONTAP Select vNAS solution.

**Standard**

- 8 to 60 internal HDD (NL-SAS, SATA, 10K SAS)

**Premium**

- 8 to 60 internal HDD (NL-SAS, SATA, 10K SAS)
- 4 to 60 internal SSD

**Premium XL**

- 8 to 60 internal HDD (NL-SAS, SATA, 10K SAS)
- 4 to 60 internal SSD
- 4 to 14 internal NVMe

> Software RAID with local DAS drives is supported with the premium license (SSD only) and premium XL license (SSD or NVMe).

### NVMe drives with software RAID

You can configure software RAID to use NVMe SSD drives. Your environment must meet the following requirements:

- ONTAP Select with a supported Deploy administration utility
- Premium XL platform license offering or a 90-day evaluation license
- VMware ESXi version 8.0 or later
- NVMe devices conforming to specification 1.0 or later

You need to manually configure the NVMe drives before using them. See Configure a host to use NVMe drives for more information.

## External storage requirements

### VMware ESXi external storage requirements for ONTAP Select

ONTAP Select vNAS is a solution allowing the ONTAP Select data stores to be external to the ESXi hypervisor host where the ONTAP Select virtual machine runs. These remote data stores can be accessed through VMware vSAN or a generic external storage array.

#### Basic requirements and restrictions

The ONTAP Select vNAS solution can be used with an ONTAP Select cluster of any size.

All related storage components, including hardware, software, and feature requirements, must adhere to the requirements described in the Interoperability Matrix Tool. In addition, ONTAP Select supports all external storage arrays described in the VMware Storage/SAN Compatibility documentation, including iSCSI, NAS (NFSv3), Fibre Channel, and Fibre Channel over Ethernet. External array support is limited by the ESXi version supported by ONTAP Select.

The following VMware features are supported when deploying a cluster with ONTAP Select vNAS:

- VMotion
- High Availability (HA)
- Distributed Resource Scheduler (DRS)

> These VMware features are supported with single-node and multi-node ONTAP Select clusters. When deploying a multi-node cluster, you should make sure that two or more nodes from the same cluster do not run on the same hypervisor host.

The following VMware features are not supported:

- Fault Tolerance (FT)
- Virtual datastore (VVOL)

#### Configuration requirements

If you plan to use a VMFS datastore on an external storage array (iSCSI, Fibre Channel, Fibre Channel over Ethernet), you must create a VMFS storage pool before configuring ONTAP Select to use the storage. If you use an NFS datastore, there is no need to create a separate VMFS datastore. All vSAN datastores must be defined within the same ESXi cluster.

> You must provide a capacity limit for every datastore on VMware vSAN or an external storage array when configuring a host or performing a storage add operation. The capacity you specify must be within the allowed storage limits of the external storage. An error will occur if you do not provide a capacity limit or the external storage runs out of space during the disk creation operation.

#### Best practices

Review the VMware documentation and follow the applicable best practices identified for ESXi hosts. In addition:

- Define dedicated network ports, bandwidth, and vSwitch configurations for the ONTAP Select networks and external storage (VMware vSAN and generic storage array traffic when using iSCSI or NFS)

- Configure the capacity option to restrict storage utilization (ONTAP Select cannot consume the entire capacity of an external vNAS datastore)
- Verify that all generic external storage arrays use the available redundancy and HA features where possible

#### KVM external storage requirements for ONTAP Select

You can configure ONTAP Select on the KVM hypervisor with an external storage array.

##### Basic requirements and restrictions

If you use an external array for the ONTAP Select storage pools, the following configuration restrictions apply:

- You must define as the logical pool type using CLVM.
- You must provide a storage capacity limit.
- The configuration only supports FC, Fibre Channel over Ethernet (FCoE), and iSCSI protocols.
- The configuration does not recognize thinly provisioned storage.

> The storage capacity you specify must be within the allowed storage limits of the external storage. An error occurs if you do not provide a capacity limit or the external storage runs out of space during the disk creation operation.

##### Best practices

You should follow these best practices:

- Define dedicated network ports, bandwidth, and vSwitch configurations for the ONTAP Select networks and external storage
- Configure the capacity option to restrict storage utilization (ONTAP Select cannot consume the entire capacity of an external storage pool)
- Verify that all external storage arrays use the available redundancy and high availability (HA) features where possible

## ONTAP Select networking requirements

You must configure the hypervisor network correctly before deploying ONTAP Select.

#### Virtual switch options

You must configure a virtual switch on each of the ONTAP Select hosts to support the external network and internal network (multi-node clusters only). As part of deploying a multi-node cluster, you should test the network connectivity on the internal cluster network.

> To learn more about how to configure a vSwitch on a hypervisor host and the high speed interface feature, refer to the Deep dive networking section.

#### Upgrade to VMXNET3 (ESXi only)

Beginning with ONTAP Select 9.5 using Deploy 2.10, VMXNET3 is the default network driver included with new cluster deployments on VMware ESXi. If you upgrade an older ONTAP Select node to version 9.5 or later, the

driver is not automatically upgraded.

#### Cluster MTU

A separate internal network is used to connect the ONTAP Select nodes in a multi-node cluster. Typically the MTU size for this network is 9000. However, there are situations where this MTU size is too large for the network connecting the ONTAP Select nodes. To accommodate the smaller frames, the MTU size used by ONTAP Select on the internal network can be in the range of 7500-9000 bytes.

The MTU size is displayed in the Cluster Details section of the cluster creation page. The value is determined by the Deploy administration utility as follows:

1. Initial default of 9000.
2. As you add the hosts and networks for the HA pairs, the MTU value is reduced as needed, based on the configuration of the vSwitches in the network.
3. The final cluster MTU value for the cluster is set after you have added all the HA pairs and are ready to create the cluster.



You can manually set the cluster MTU value if needed, based on the design of your network.

#### Two-NIC host with standard vSwitch (ESXi only)

In order to improve ONTAP Select performance in a two-NIC configuration, you should isolate the internal and external network traffic using two port groups. This recommendation applies to the following specific configuration:

- ONTAP Select multi-node cluster
- Two NICs (NIC1 and NIC2)
- Standard vSwitch

In this environment, you should configure the traffic using two port groups as follows:

**Port group 1**

- Internal network (cluster, RSM, HA-IC traffic)
- NIC1 is active
- NIC2 in standby

**Port group 2**

- External network (data and management traffic)
- NIC1 is standby
- NIC2 in active

Refer to the Deep dive networking section for more information about two-NIC deployments.

#### Four-NIC host with standard vSwitch (ESXi only)

In order to improve ONTAP Select performance in a four-NIC configuration, you should isolate the internal and external network traffic using four port groups. This recommendation applies to the following specific configuration:

- ONTAP Select multi-node cluster
- Four NICs (NIC1, NIC2, NIC3, and NIC4)
- Standard vSwitch

In this environment, you should configure the traffic using four port groups as follows:

**Port group 1**

- Internal network (cluster, RSM traffic)
- NIC1 is active
- NIC2, NIC3, NIC4 in standby

**Port group 2**

- Internal network (cluster, HA-IC traffic)
- NIC3 is active
- NIC1, NIC2, NIC4 in standby

**Port group 3**

- External network (data and management traffic)
- NIC2 is active
- NIC1, NIC3, NIC4 in standby

**Port group 4**

- External network (data traffic)
- NIC4 is active
- NIC1, NIC2, NIC3 in standby

Refer to the Deep dive networking section for more information about four-NIC deployments.

### Network traffic requirements

You must make sure that your firewalls are configured properly to allow the network traffic to flow among the various participants in an ONTAP Select deployment environment.

#### Participants

There are several participants or entities that exchange network traffic as part of an ONTAP Select deployment. These are introduced, and then used in the summary description of the network traffic requirements.

- Deploy
  ONTAP Select Deploy administration utility
- vSphere (ESXi only)
  Either a vSphere server or ESXi host, depending on how the host is managed in your cluster deployment
- Hypervisor server
  ESXi hypervisor host or Linux KVM host
- OTS node
  An ONTAP Select node

- OTS cluster
  An ONTAP Select cluster
- Admin WS
  Local administrative workstation

#### Summary of network traffic requirements

The following table describes the network traffic requirements for an ONTAP Select deployment.

| Protocol / Port | ESXi / KVM | Direction | Description |
|---|---|---|---|
| TLS (443) | ESXi | Deploy to vCenter server (managed) or ESXi (managed or unmanaged) | VMware VIX API |
| 902 | ESXi | Deploy to vCenter server (managed) or ESXi (unmanaged) | VMware VIX API |
| ICMP | ESXi or KVM | Deploy to hypervisor server | Ping |
| ICMP | ESXi or KVM | Deploy to each OTS node | Ping |
| SSH (22) | ESXi or KVM | Admin WS to each OTS node | Administration |
| SSH (22) | KVM | Deploy to hypervisor server nodes | Access hypervisor server |
| TLS (443) | ESXi or KVM | Deploy to OTS nodes and clusters | Access ONTAP |
| TLS (443) | ESXi or KVM | Each OTS node to Deploy | Access Deploy (Capacity Pools licensing) |
| iSCSI (3260) | ESXi or KVM | Each OTS node to Deploy | Mediator/Mailbox disk |

## ONTAP Select two-node clusters with HA

Deploying a two-node cluster with HA involves the same planning and configuration used with other cluster node configurations. However, there are several differences you should be aware of when creating a two-node cluster.

#### Target environment

The two-node cluster consists of one HA pair and has been specifically designed for remote office and branch office deployments.

While designed primarily for the remote and branch office environment, you can also deploy a two-node cluster in the data center if needed.

#### Licensing

You can deploy a two-node cluster using any VMware vSphere license. However, the VMware ROBO Standard and Advanced licenses are ideal for remote and branch office deployments.

#### Mediator service

When a cluster consists of two nodes, it is not possible to achieve the quorum required when a node fails or loses communication. To resolve these types of split-brain situations, every instance of the ONTAP Select Deploy utility includes a mediator service. This service connects to each node in the active two-node clusters to monitor the HA pairs and assist in managing failures. The mediator service maintains the HA state information at a dedicated iSCSI target associated with each two-node cluster.

If you have one or more active two-node clusters, the ONTAP Select Deploy virtual machine administering the clusters must be running at all times. If the ONTAP Select Deploy virtual machine is halted or fails, the mediator service is unavailable and HA capability is lost for the two-node clusters.

#### Location of the cluster and mediator service

Because the two-node clusters are typically deployed in a remote or branch office, they can be remote from the corporate data center and the ONTAP Select Deploy utility providing administrative support. With this configuration, the management traffic between the ONTAP Select Deploy utility and cluster flows over the WAN. Refer to the release notes for more information about limitations and restrictions.

#### Back up the Deploy configuration data

It is a best practice to back up the ONTAP Select Deploy configuration data on a regular basis, including after creating a cluster. This becomes particularly important with two-node clusters, because of the mediator configuration data included with the backup.

#### Static IP address assigned to Deploy

You must assign a static IP address to the ONTAP Select Deploy administration utility. This requirement applies to all ONTAP Select Deploy instances that manage one or more ONTAP Select two-node clusters.

## ONTAP Select remote and branch office deployments

You can deploy ONTAP Select in a remote office/branch office (ROBO) environment. As part of planning a ROBO deployment, you must select the configuration supporting your objectives.

There are two primary configurations available when deploying ONTAP Select in a ROBO environment.

You can use any VMware vSphere license when deploying ONTAP Select.

#### ONTAP Select two-node cluster with ONTAP HA

The ONTAP Select two-node cluster consists of one HA pair and is ideal for ROBO deployments.

#### ONTAP Select single-node cluster with VMware support

You can deploy an ONTAP Select single-node cluster in a ROBO environment. While a single node lacks native HA capability, you can deploy the cluster in one of the following ways to provide storage protection:

- Shared external storage using VMware HA
- VMware vSAN

If you use vSAN, you must have a VMware vSAN ROBO license.

## ONTAP Select MetroCluster SDS deployment requirements

MetroCluster SDS is a configuration option when creating a two-node ONTAP Select cluster. It is similar to a Remote Office/Branch Office (ROBO) deployment. This enhanced two-node deployment provides additional use case scenarios. You should be aware of the requirements and restrictions as part of preparing to deploy MetroCluster SDS.

Before deploying MetroCluster SDS, verify that the following requirements are met.

**Licensing**

Each node must have a premium or higher ONTAP Select license.

**Hypervisor platforms**

MetroCluster SDS can be deployed on the same VMware ESXi and KVM hypervisors as supported for a two-node cluster in a ROBO environment.

> Beginning with ONTAP Select 9.14.1, support for KVM hypervisor has been reinstated. Previously, support for deploying a new cluster on a KVM hypervisor was removed in ONTAP Select 9.10.1 and support for managing existing KVM clusters and hosts, except to take offline or delete, was removed in ONTAP Select 9.11.1.

**Network configuration**

Layer 2 connectivity is required between the participating sites. Both 10GbE and 1GbE are supported, including the following configurations:

- 1 x 10GbE
- 4 x 1GbE

> The data serving ports and interconnect ports must be connected to the same first switch.

**Latency between the nodes**

The network between the two nodes must support a mean latency of 5 ms with an additional 5 ms periodic jitter. Before deploying the cluster, you must test the network using the procedure described in the Deep dive networking section.

**Mediator service**

As with all two-node ONTAP Select clusters, there is a separate mediator service contained in the Deploy virtual machine that monitors the nodes and assists in managing failures. With the enhanced distance available with MetroCluster SDS, this creates three distinct sites in the network topology. Latency on the link between the mediator and a node should be 125 ms round-trip or less.

**Storage**

Direct-attached storage (DAS) is supported using either HDD and SSD disks. vNAS is also supported, including external storage arrays and vSAN in a VMware environment.

> When deploying MetroCluster SDS, you cannot use vSAN in a distributed or "stretched" topology.

**Static IP address assigned to Deploy**

You must assign a static IP address to the Deploy administration utility. This requirement applies to all Deploy instances that manage one or more ONTAP Select two-node clusters.

## ONTAP Select VMware vCenter server on ESXi

You must define a vCenter server account and associate it with a role containing the necessary administrative privileges.

You also need the fully qualified domain name or IP address of the vCenter server managing the ESXi hypervisor hosts where ONTAP Select is deployed.

### Administrative privileges

The minimum administrative privileges needed to create and manage an ONTAP Select cluster are presented below.

#### Datastore

- Allocate space
- Browse datastore
- Low level file operations
- Update virtual machine files
- Update virtual machine metadata

#### Host

**Configuration**

- Network configuration
- System management

**Local operations**

- Create virtual machine
- Delete virtual machine
- Reconfigure virtual machine

#### Network

- Assign network

#### Virtual machine

**Configuration**

All privileges in the category.

**Interaction**

All privileges in the category.

**Inventory**

All privileges in the category.

**Provisioning**

All privileges in the category.

#### vApp

All privileges in the category.

### Related information

Learn about VMware vSphere privileges for vSAN ESA in vCenter

# ONTAP Select Deploy

## ONTAP Select Deploy general requirements and planning

There are several general requirements that you should consider as part of planning to install the ONTAP Select Deploy administration utility.

### Pairing the Deploy utility with the ONTAP Select clusters

You have several options when pairing an instance of the Deploy utility with the ONTAP Select clusters.

> In all deployment scenarios, a single ONTAP Select cluster and the nodes in the cluster can be managed by only one instance of the Deploy administration utility. A cluster cannot be managed by two or more different instances of the Deploy utility.

#### One instance of the utility for each ONTAP Select cluster

You can deploy and manage each ONTAP Select cluster using a dedicated instance of the Deploy utility. With this one-to-one configuration, there is a clear separation between each of the utility-to-cluster pairings. This configuration provides a high level of isolation with smaller failure domains.

#### One instance of the utility for multiple ONTAP Select clusters

You can deploy and manage multiple ONTAP Select clusters in your organization using a single instance of the Deploy utility. With this one-to-many configuration, all processing and configuration data is managed by the same instance of the Deploy utility.

> One instance of the Deploy utility can administer up to 400 ONTAP Select nodes or 100 clusters.

### Requirements related to the KVM environment

Before installing the Deploy administration utility in a KVM hypervisor environment, you should review the basic requirements and prepare for the deployment.

#### Requirements and restrictions for a deployment

There are several requirements and restrictions that you should consider when installing the ONTAP Select Deploy utility in a KVM environment.

#### Linux KVM host server hardware requirements

There are several minimum resource requirements that your Linux KVM hypervisor host must meet. Verify that the hosts where ONTAP Select is deployed meet the following basic requirements:

- Linux server:
  - The hardware and software must be 64-bit
  - The server must adhere to the same supported versions as defined for an ONTAP Select node
- Virtual CPUs (2)
- Virtual memory (4GB)
- Storage (40GB)

- "Dynamic Host Configuration Protocol (DHCP) is enabled (you can also assign a static IP address)

**Network connectivity**

Verify that the Deploy virtual machine network interface is configured and can to connect to the ONTAP Select hosts that it manages.

**Support for IP version 4**

ONTAP Select Deploy only supports IP version 4 (IPv4). IP version 6 (IPv6) is not supported. This restriction affects ONTAP Select in the following ways:

- You must assign an IPv4 address to the management LIF of the Deploy VM.
- Deploy cannot create ONTAP Select nodes configured to use IPv6 on the ONTAP LIFs.

### Required configuration information

As part of your deployment planning, you should determine the required configuration information before installing the ONTAP Select Deploy administration utility.

**Name of the Deploy VM**

The name to use for the VM.

**Name of the Linux KVM host**

The Linux KVM host where the Deploy utility is installed.

**Name of the storage pool**

The storage pool holding the VM files (approximately 40GB is required).

**Network for the VM**

The network where the Deploy VM is connected.

### Optional network configuration information

The Deploy VM is configured using the DHCP by default. However, if needed, you can manually configure the network interface for the VM.

**Host name**

The name of the host.

**Host IP address**

The static IPv4 address.

**Subnet mask**

The subnetwork mask, which is based on the network that the VM is a part of.

**Gateway**

The default gateway or router.

**Primary DNS server**

The primary domain name server.

**Secondary DNS server**

The secondary domain name server.

#### Search domains

The search domains to use.

#### Authentication using the credential store

The ONTAP Select Deploy credential store is a data base holding account information. Deploy uses the account credentials to perform host authentication as part of cluster creation and management. You should be aware of how the credential store is used as part of planning an ONTAP Select deployment.

The account information is stored securely in the database using the AES encryption algorithm and SHA-256 hashing algorithm.

#### Types of credentials

The following types of credentials are supported:

- **Host**: Used to authenticate a hypervisor host as part of deploying an ONTAP Select node directly to VMware ESXi
- **vCenter**: Used to authenticate a vCenter server as part of deploying an ONTAP Select node to ESXi when the host is managed by VMware vCenter

#### Access

The credential store is accessed internally as part of performing normal administrative tasks using Deploy, such as adding a hypervisor host. You can also manage the credential store directly through the Deploy web user interface and CLI.

## ONTAP Select Deploy hypervisor host considerations

There are several planning issues related to the hypervisor host that you should consider.

You should not directly modify the configuration of an ONTAP Select virtual machine unless directed to do so by NetApp support. A virtual machine should only be configured and modified through the Deploy administration utility. Making changes to an ONTAP Select virtual machine outside of the Deploy utility without assistance from NetApp support can cause the virtual machine to fail and render it unusable.

#### Hypervisor independent

Both ONTAP Select and the ONTAP Select Deploy administration utility are hypervisor independent.

The following hypervisors are supported for both ONTAP Select and the ONTAP Select Deploy administration:

- VMware ESXi
- Kernel-based Virtual Machine (KVM)

Refer to the hypervisor-specific planning information and release notes for additional details regarding the supported platforms.

#### Hypervisor for ONTAP Select nodes and administration utility

Both the Deploy administration utility and the ONTAP Select nodes run as virtual machines. The hypervisor you choose for the Deploy utility is independent of the hypervisor you choose for the ONTAP Select nodes. You have complete flexibility when pairing the two:

- A Deploy utility running on VMware ESXi can create and manage ONTAP Select clusters on either VMware ESXi or KVM.
- A Deploy utility running on KVM can create and manage ONTAP Select clusters on either VMware ESXi or KVM.

**One or more instances of ONTAP Select node per host**

Each ONTAP Select node runs as a dedicated virtual machine. You can create multiple nodes on the same hypervisor host, with the following restrictions:

- Multiple nodes from a single ONTAP Select cluster cannot run on the same host. All the nodes on a specific host must be from different ONTAP Select clusters.
- You must use external storage.
- If you use software RAID, you can only deploy one ONTAP Select node on the host.

**Hypervisor consistency for the nodes within a cluster**

All of the hosts within an ONTAP Select cluster must run on the same version and release of the hypervisor software.

**Number of physical ports on each host**

You must configure each host to use one, two, or four physical ports. Although you have flexibility when configuring the network ports, you should follow these recommendations where possible:

- A host in a single-node cluster should have two physical ports.
- Each host in a multi-node cluster should have four physical ports

**Integrate ONTAP Select with an ONTAP hardware-based cluster**

You cannot add an ONTAP Select node directly to an ONTAP hardware-based cluster. However, you can optionally establish a cluster peering relationship between an ONTAP Select cluster and a hardware-based ONTAP cluster.

### VMware hypervisor environment

There are several requirements and restrictions specific to the VMware environment that you should consider before installing the ONTAP Select Deploy utility in a VMware environment.

**ESXi host server hardware requirements**

Your ESXi hypervisor host must meet several minimum resource requirements. Check that the hosts where ONTAP Select is deployed meet the following basic requirements:

- ESXi server:
  - Hardware and software must be 64-bit
  - Must adhere to the same supported versions as defined for an ONTAP Select node
- Virtual CPUs (2)
- Virtual memory (4 GB)
- Storage (40 GB)
- DHCP enabled (can also assign a static IP address)

**Network connectivity**

Check that the ONTAP Select Deploy virtual machine network interface is configured and has a single

management IP address. You can use DHCP to dynamically assign an IP address or manually configure a static IP address.

Depending on your deployment decisions, the Deploy VM must be able to connect to the vCenter server, ESXi hypervisor hosts, and ONTAP Select nodes it manages. You must configure your firewalls to allow the required traffic.

Deploy uses the VMware VIX API to communicate with the vCenter server and ESXi hosts. Initially, it establishes a connection using SOAP over SSL on TCP port 443. After this, a connection is opened using SSL on port 902. In addition, Deploy issues PING commands to verify that there is an ESXi host at the IP address you specify.

Additionally, Deploy must be able to communicate with the ONTAP Select node and cluster management IP addresses using the following protocols:

- PING command (ICMP)
- SSH (port 22)
- SSL (port 443)

#### Support for IP version 4

ONTAP Select Deploy only supports IP version 4 (IPv4). IP version 6 (IPv6) is not supported. This restriction affects ONTAP Select in the following ways:

- You must assign an IPv4 address to the management LIF of the Deploy virtual machine.
- Deploy cannot create ONTAP Select nodes configured to use IPv6 on the ONTAP LIFs.

### VMware vCenter server considerations

#### VMware vSphere privileges for ESA

To create and manage vSAN Express Storage Architecture (ESA) in vCenter, you need the following vSphere Content Library privileges:

> To access the Content Library privileges, an administrator needs to grant you access to Global Permissions in vCenter Server.

- Add library item
- Create local library
- Delete library item
- Delete local library
- Download files
- Read storage
- Update files
- Update library
- Update library item
- Update local library
- View configuration settings

# Summary of best practices for ONTAP Select deployment

There are best practices that you should consider as part of planning an ONTAP Select deployment.

## Storage

You should consider the following best practices for storage.

### All-Flash or Generic Flash arrays

ONTAP Select virtual NAS (vNAS) deployments using all-flash VSAN or generic flash arrays should follow the best practices for ONTAP Select with non-SSD DAS storage.

### External storage

You should adhere to the following recommendations:

- Define dedicated network ports, bandwidth, and vSwitch configurations for the ONTAP Select networks and external storage
- Configure the capacity option to restrict storage utilization (ONTAP Select cannot consume the entire capacity of an external storage pool)
- Verify that all external storage arrays use the available redundancy and HA features where possible

### Hypervisor core hardware

All of the drives in a single ONTAP Select aggregate should be the same type. For example, you should not mix HDD and SSD drives in the same aggregate.

### RAID controller

The server RAID controller should be configured to operate in writeback mode. If write workload performance issues are seen, check the controller settings and make sure that writethrough or writearound is not enabled.

If the physical server contains a single RAID controller managing all locally attached disks, NetApp recommends creating a separate LUN for the server OS and one or more LUNs for ONTAP Select. In the event of boot disk corruption, this best practice allows the administrator to recreate the OS LUN without affecting ONTAP Select.

The RAID controller cache is used to store all incoming block changes, not just those targeted toward the NVRAM partition. Therefore, when choosing a RAID controller, select one with the largest cache available. A larger cache allows less frequent disk flushing and an increase in performance for the ONTAP Select VM, the hypervisor, and any compute VMs collocated on the server.

### RAID groups

The optimal RAID-group size is eight to 12 drives. The maximum number of drives per RAID group is 24.

The maximum number of NVME drives supported per ONTAP Select node is 14.

A spare disk is optional, but recommended. NetApp also recommends using one spare per RAID group; however, global spares for all RAID groups can be used. For example, you can use two spares for every three RAID groups, with each RAID group consisting of eight to 12 drives.

ONTAP Select receives no performance benefits by increasing the number of LUNs within a RAID group. Multiple LUNs should only be used to follow best practices for SATA/NL-SAS configurations or to bypass hypervisor file system limitations.

#### VMware ESXi hosts

NetApp recommends using ESXi 8.0 or later and an NVMe disk for the datastore hosting the system disks. This configuration provides the best performance for the NVRAM partition.

> When installing on ESXi 8.0 or later, ONTAP Select uses the vNVMEe driver regardless of whether the system disk resides on an SSD or on an NVMe disk. This sets the VM hardware level to 13, which is compatible with ESXi 8.0 and later.

Define dedicated network ports, bandwidth, and vSwitch configurations for the ONTAP Select networks and external storage (VMware vSAN and generic storage array traffic when using iSCSI or NFS).

Configure the capacity option to restrict storage utilization (ONTAP Select cannot consume the entire capacity of an external vNAS datastore).

Assure that all generic external storage arrays use the available redundancy and HA features where possible.

#### VMware Storage vMotion

Available capacity on a new host is not the only factor when deciding whether to use VMware Storage vMotion with an ONTAP Select node. The underlying storage type, host configuration, and network capabilities should be able to sustain the same workload as the original host.

## Networking

You should consider the following best practices for networking.

#### Duplicate MAC addresses

To eliminate the possibility of having multiple Deploy instances assign duplicate MAC addresses, one Deploy instance per layer-2 network should be used to create or manage an ONTAP Select cluster or node.

#### EMS messages

The ONTAP Select two-node cluster should be carefully monitored for EMS messages indicating that storage failover is disabled. These messages indicate a loss of connectivity to the mediator service and should be rectified immediately.

#### Latency between nodes

The network between the two nodes must support a mean latency of 5 ms with an additional 5 ms periodic jitter. Before deploying the cluster, test the network using the procedure described in the ONTAP Select Product Architecture and Best Practices technical report.

#### Load balancing

To optimize load balancing across both the internal and the external ONTAP Select networks, use the Route Based on Originating Virtual Port load-balancing policy.

### Multiple layer-2 networks

If data traffic spans multiple layer-2 networks and the use of VLAN ports is required or when you are using multiple IPspaces, VGT should be used.

### Physical switch configuration

VMware recommends that STP be set to Portfast on the switch ports connected to the ESXi hosts. Not setting STP to Portfast on the switch ports can affect the ONTAP Select ability to tolerate uplink failures. When using LACP, the LACP timer should be set to fast (1 second). The load-balancing policy should be set to Route Based on IP Hash on the port group and Source and Destination IP Address and TCP/UDP port and VLAN on the LAG.

### Virtual switch options for KVM

You must configure a virtual switch on each of the ONTAP Select hosts to support the external network and internal network (multi-node clusters only). As part of deploying a multi-node cluster, you should test the network connectivity on the internal cluster network.

To learn more about how to configure an Open vSwitch on a hypervisor host, refer to the ONTAP Select on KVM Product Architecture and Best Practices technical report.

## HA

You should consider the following best practices for high availability.

### Deploy backups

It is a best practice to regularly back up the Deploy configuration data, including after creating a cluster. This becomes particularly important with two-node clusters, because the mediator configuration data is included with the backup.

After creating or deploying a cluster, you should back up the ONTAP Select Deploy configuration data.

### Mirrored aggregates

Although the existence of the mirrored aggregate is needed to provide an up-to-date (RPO 0) copy of the primary aggregate, take care that the primary aggregate does not run low on free space. A low-space condition in the primary aggregate might cause ONTAP to delete the common Snapshot copy used as the baseline for storage giveback. This works as designed to accommodate client writes. However, the lack of a common Snapshot copy on failback requires the ONTAP Select node to do a full baseline from the mirrored aggregate. This operation can take a significant amount of time in a shared-nothing environment.

NetApp recommends that you maintain at least 20% free space for mirrored aggregates for optimal storage performance and availability. Although the recommendation is 10% for non-mirrored aggregates, the filesystem can use the additional 10% of space to absorb incremental changes. Incremental changes increase space utilization for mirrored aggregates due to ONTAP's copy-on-write Snapshot-based architecture. Failure to adhere to these best practices might have a negative impact on performance. High availability takeover is only supported when data aggregates are configured as mirrored aggregates.

### NIC aggregation, teaming, and failover

ONTAP Select supports a single 10Gb link for two-node clusters; however, it is a NetApp best practice to have hardware redundancy through NIC aggregation or NIC teaming on both the internal and the external networks of the ONTAP Select cluster.

If a NIC has multiple application-specific integrated circuits (ASICs), select one network port from each ASIC when building network constructs through NIC teaming for the internal and external networks.

NetApp recommends that the LACP mode be active on both the ESXi and the physical switches. Furthermore, the LACP timer should be set to fast (1 second) on the physical switch, ports, port channel interfaces, and on the VMNICs.

When using a distributed vSwitch with LACP, NetApp recommends that you configure the load-balancing policy to Route Based on IP Hash on the port group, Source and Destination IP Address, TCP/UDP Port, and VLAN on the LAG.

### Two-node stretched HA (MetroCluster SDS) best practices

Before you create a MetroCluster SDS, use the ONTAP Deploy connectivity checker to make sure that the network latency between the two data centers falls within the acceptable range.

There is an extra caveat when using virtual guest tagging (VGT) and two-node clusters. In two-node cluster configurations, the node management IP address is used to establish early connectivity to the mediator before ONTAP is fully available. Therefore, only external switch tagging (EST) and virtual switch tagging (VST) tagging is supported on the port group mapped to the node management LIF (port e0a). Furthermore, if both the management and the data traffic are using the same port group, only EST and VST are supported for the entire two-node cluster.

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