Deploy virtual grid nodes

StorageGRID software

NetApp
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Table of Contents

Deploy virtual grid nodes

Collect information about your deployment environment (VMware)

Before deploying grid nodes, you must collect information about your network configuration and VMware environment.

> It is more efficient to perform one single installation of all the nodes, rather than installing some nodes now and some nodes later.

VMware information

You must access the deployment environment and collect information about the VMware environment; the networks that were created for the Grid, Admin, and Client Networks; and the storage volume types you plan to use for Storage Nodes.

You must collect information about your VMware environment, including the following:

- The username and password for a VMware vSphere account that has appropriate permissions to complete the deployment.
- Host, datastore, and network configuration information for each StorageGRID node virtual machine.

> VMware live vMotion causes the virtual machine clock time to jump and is not supported for grid nodes of any type. Though rare, incorrect clock times can result in loss of data or configuration updates.

Grid Network information

You must collect information about the VMware network created for the StorageGRID Grid Network (required), including:

- The network name.
- The method used to assign IP addresses, either static or DHCP.
  - If you are using static IP addresses, the required networking details for each grid node (IP address, gateway, network mask).
  - If you are using DHCP, the IP address of the primary Admin Node on the Grid Network. See How grid nodes discover the primary Admin Node for more information.

Admin Network information

For nodes that will be connected to the optional StorageGRID Admin Network, you must collect information about the VMware network created for this network, including:

- The network name.
- The method used to assign IP addresses, either static or DHCP.
  - If you are using static IP addresses, the required networking details for each grid node (IP address, gateway, network mask).

    - If you are using DHCP, the IP address of the primary Admin Node on the Grid Network. See How grid nodes discover the primary Admin Node for more information.
- The external subnet list (ESL) for the Admin Network.

Client Network information

For nodes that will be connected to the optional StorageGRID Client Network, you must collect information about the VMware network created for this network, including:

- The network name.
- The method used to assign IP addresses, either static or DHCP.
- If you are using static IP addresses, the required networking details for each grid node (IP address, gateway, network mask).

Information about additional interfaces

You can optionally add trunk or access interfaces to the VM in vCenter after you install the node. For example, you might want to add a trunk interface to an Admin or Gateway Node, so you can use VLAN interfaces to segregate the traffic belonging to different applications or tenants. Or, you might want to add an access interface to use in a high availability (HA) group.

The interfaces you add are displayed on the VLAN interfaces page and on the HA groups page in the Grid Manager.

- If you add a trunk interface, configure one or more VLAN interfaces for each new parent interface. See configure VLAN interfaces.
- If you add an access interface, you must add it directly to HA groups. See configure high availability groups.

Storage volumes for virtual Storage Nodes

You must collect the following information for virtual machine-based Storage Nodes:

- The number and size of storage volumes (storage LUNs) you plan to add. See Storage and performance requirements.

Grid configuration information

You must collect information to configure your grid:

- Grid license
- Network Time Protocol (NTP) server IP addresses
- DNS server IP addresses

Create node configuration files for Linux deployments

Node configuration files are small text files that provide the information the StorageGRID host service needs to start a node and connect it to the appropriate network and block storage resources. Node configuration files are used for virtual nodes and aren't used for

appliance nodes.

> "Linux" refers to a RHEL, Ubuntu, or Debian deployment. For a list of supported versions, see the NetApp Interoperability Matrix Tool (IMT).

Location for node configuration files

Place the configuration file for each StorageGRID node in the `/etc/storagegrid/nodes` directory on the host where the node will run. For example, if you plan to run one Admin Node, one Gateway Node, and one Storage Node on HostA, you must place three node configuration files in `/etc/storagegrid/nodes` on HostA.

You can create the configuration files directly on each host using a text editor, such as vim or nano, or you can create them elsewhere and move them to each host.

Naming of node configuration files

The names of the configuration files are significant. The format is `node-name.conf`, where `node-name` is a name you assign to the node. This name appears in the StorageGRID Installer and is used for node maintenance operations, such as node migration.

Node names must follow these rules:

- Must be unique
- Must start with a letter
- Can contain the characters A through Z and a through z
- Can contain the numbers 0 through 9
- Can contain one or more hyphens (-)
- Must be no more than 32 characters, not including the `.conf` extension

Any files in `/etc/storagegrid/nodes` that don't follow these naming conventions will not be parsed by the host service.

If you have a multi-site topology planned for your grid, a typical node naming scheme might be:

```
site-nodetype-nodenumber.conf
```

For example, you might use `dc1-adm1.conf` for the first Admin Node in Data Center 1, and `dc2-sn3.conf` for the third Storage Node in Data Center 2. However, you can use any scheme you like, as long as all node names follow the naming rules.

Contents of a node configuration file

A configuration file contains key/value pairs, with one key and one value per line. For each key/value pair, follow these rules:

- The key and the value must be separated by an equal sign (=) and optional whitespace.
- The keys can contain no spaces.
- The values can contain embedded spaces.

- Any leading or trailing whitespace is ignored.

The following table defines the values for all supported keys. Each key has one of the following designations:

- **Required**: Required for every node or for the specified node types
- **Best practice**: Optional, although recommended
- **Optional**: Optional for all nodes

Admin Network keys

ADMIN_IP

Value	Designation
Grid Network IPv4 address of the Admin Node you want to use to install the Linux-based node. For recovery, use the IP of the primary Admin Node if available; otherwise, use the IP of a non-primary Admin node. If you omit this parameter, the node attempts to discover a primary Admin Node using mDNS. How grid nodes discover the primary Admin Node **Note**: This value is ignored, and might be prohibited, on the primary Admin Node.	Best practice

ADMIN_NETWORK_CONFIG

Value	Designation
DHCP, STATIC, or DISABLED	Optional

ADMIN_NETWORK_ESL

Value	Designation
Comma-separated list of subnets in CIDR notation to which this node should communicate using the Admin Network gateway. Example: `172.16.0.0/21,172.17.0.0/21`	Optional

ADMIN_NETWORK_GATEWAY

Value	Designation

IPv4 address of the local Admin Network gateway for this node. Must be on the subnet defined by ADMIN_NETWORK_IP and ADMIN_NETWORK_MASK. This value is ignored for DHCP-configured networks.
 	
Examples:
 	
`1.1.1.1`
 	
`10.224.4.81`
	Required if `ADMIN_NETWORK_ESL` is specified. Optional otherwise.

ADMIN_NETWORK_IP

Value	Designation

IPv4 address of this node on the Admin Network. This key is only required when ADMIN_NETWORK_CONFIG = STATIC; don't specify it for other values.
 	
Examples:
 	
`1.1.1.1`
 	
`10.224.4.81`
	Required when ADMIN_NETWORK_CONFIG = STATIC.
	
	Optional otherwise.

ADMIN_NETWORK_MAC

Value	Designation
The MAC address for the Admin Network interface in the container. This field is optional. If omitted, a MAC address will be generated automatically. Must be 6 pairs of hexadecimal digits separated by colons. Example: `b2:9c:02:c2:27:10`	Optional

ADMIN_NETWORK_MASK

Value	Designation

IPv4 netmask for this node, on the Admin Network. Specify this key when ADMIN_NETWORK_CONFIG = STATIC; don’t specify it for other values.
 	
Examples:
 	
`255.255.255.0`
 	
`255.255.248.0`
	Required if ADMIN_NETWORK_IP is specified and ADMIN_NETWORK_CONFIG = STATIC.
	
	Optional otherwise.

ADMIN_NETWORK_MTU

Value	Designation

The maximum transmission unit (MTU) for this node on the Admin Network. Don’t specify if ADMIN_NETWORK_CONFIG = DHCP. If specified, the value must be between 1280 and 9216. If omitted, 1500 is used.
 	
If you want to use jumbo frames, set the MTU to a value suitable for jumbo frames, such as 9000. Otherwise, keep the default value.
 	
IMPORTANT: The MTU value of the network must match the value configured on the switch port the node is connected to. Otherwise, network performance issues or packet loss might occur.
 	
Examples:
 	
`1500`
 	
`8192`
	Optional

ADMIN_NETWORK_TARGET

Value	Designation

Name of the host device that you will use for Admin Network access by the StorageGRID node. Only network interface names are supported. Typically, you use a different interface name than what was specified for GRID_NETWORK_TARGET or CLIENT_NETWORK_TARGET.
 	
Note: Don't use bond or bridge devices as the network target. Either configure a VLAN (or other virtual interface) on top of the bond device, or use a bridge and virtual Ethernet (veth) pair.
 	
Best practice:Specify a value even if this node will not initially have an Admin Network IP address. Then you can add an Admin Network IP address later, without having to reconfigure the node on the host.
 	
Examples:
 	
`bond0.1002`
 	
`ens256`
	Best practice

ADMIN_NETWORK_TARGET_TYPE

Value	Designation
Interface (This is the only supported value.)	Optional

ADMIN_NETWORK_TARGET_TYPE_INTERFACE_CLONE_MAC

Value	Designation
True or False Set the key to "true" to cause the StorageGRID container use the MAC address of the host host target interface on the Admin Network. **Best practice:** In networks where promiscuous mode would be required, use the ADMIN_NETWORK_TARGET_TYPE_INTERFACE_CLONE_MAC key instead. For more details on MAC cloning for Linux, see Considerations and recommendations for MAC address cloning	Best practice

ADMIN_ROLE

Value	Designation
Primary or non-primary This key is only required when NODE_TYPE = VM_Admin_Node; don't specify it for other node types.	Required when NODE_TYPE = VM_Admin_Node Optional otherwise.

Block device keys

BLOCK_DEVICE_AUDIT_LOGS

Value	Designation

Path and name of the block device special file this node will use for persistent storage of audit logs.
 	
Examples:
 	
`/dev/disk/by-path/pci-0000:03:00.0-scsi-0:0:0:0`
 	
`/dev/disk/by-id/wwn-0x600a09800059d6df000060d757b475fd`
 	
`/dev/mapper/sgws-adm1-audit-logs`
	Required for nodes with NODE_TYPE = VM_Admin_Node. Don't specify it for other node types.

BLOCK_DEVICE_RANGEDB_nnn

Value	Designation

Path and name of the block device special file this node will use for persistent object storage. This key is only required for nodes with NODE_TYPE = VM_Storage_Node; don't specify it for other node types.
 	
Only BLOCK_DEVICE_RANGEDB_000 is required; the rest are optional. The block device specified for BLOCK_DEVICE_RANGEDB_000 must be at least 4 TB; the others can be smaller.
 	
Don't leave gaps. If you specify BLOCK_DEVICE_RANGEDB_005, you must also specify BLOCK_DEVICE_RANGEDB_004.
 	
Note: For compatibility with existing deployments, two-digit keys are supported for upgraded nodes.
 	
Examples:
 	
`/dev/disk/by-path/pci-0000:03:00.0-scsi-0:0:0:0`
 	
`/dev/disk/by-id/wwn-0x600a09800059d6df000060d757b475fd`
 	
`/dev/mapper/sgws-sn1-rangedb-000`
	Required:
	
	BLOCK_DEVICE_RANGEDB_000
	
	Optional:
	
	BLOCK_DEVICE_RANGEDB_001
	
	BLOCK_DEVICE_RANGEDB_002
	
	BLOCK_DEVICE_RANGEDB_003
	
	BLOCK_DEVICE_RANGEDB_004
	
	BLOCK_DEVICE_RANGEDB_005
	
	BLOCK_DEVICE_RANGEDB_006
	
	BLOCK_DEVICE_RANGEDB_007
	
	BLOCK_DEVICE_RANGEDB_008
	
	BLOCK_DEVICE_RANGEDB_009
	
	BLOCK_DEVICE_RANGEDB_010
	
	BLOCK_DEVICE_RANGEDB_011
	
	BLOCK_DEVICE_RANGEDB_012
	
	BLOCK_DEVICE_RANGEDB_013
	
	BLOCK_DEVICE_RANGEDB_014
	
	BLOCK_DEVICE_RANGEDB_015

BLOCK_DEVICE_TABLES

Value	Designation

Path and name of the block device special file this node will use for persistent storage of database tables. This key is only required for nodes with NODE_TYPE = VM_Admin_Node; don't specify it for other node types.
 	
Examples:
 	
`/dev/disk/by-path/pci-0000:03:00.0-scsi-0:0:0:0`
 	
`/dev/disk/by-id/wwn-0x600a09800059d6df000060d757b475fd`
 	
`/dev/mapper/sgws-adm1-tables`
	Required

BLOCK_DEVICE_VAR_LOCAL

Value	Designation

Path and name of the block device special file this node will use for its `/var/local` persistent storage.
 	
Examples:
 	
`/dev/disk/by-path/pci-0000:03:00.0-scsi-0:0:0:0`
 	
`/dev/disk/by-id/wwn-0x600a09800059d6df000060d757b475fd`
 	
`/dev/mapper/sgws-sn1-var-local`
	Required

Client Network keys

CLIENT_NETWORK_CONFIG

Value	Designation
DHCP, STATIC, or DISABLED	Optional

CLIENT_NETWORK_GATEWAY

Value	Designation

IPv4 address of the local Client Network gateway for this node, which must be on the subnet defined by CLIENT_NETWORK_IP and CLIENT_NETWORK_MASK. This value is ignored for DHCP-configured networks.
 	
Examples:
 	
`1.1.1.1`
 	
`10.224.4.81`
	Optional

CLIENT_NETWORK_IP

Value	Designation

IPv4 address of this node on the Client Network.
 	
This key is only required when CLIENT_NETWORK_CONFIG = STATIC; don't specify it for other values.
 	
Examples:
 	
`1.1.1.1`
 	
`10.224.4.81`
	Required when CLIENT_NETWORK_CONFIG = STATIC
	
	Optional otherwise.

CLIENT_NETWORK_MAC

Value	Designation
The MAC address for the Client Network interface in the container. This field is optional. If omitted, a MAC address will be generated automatically. Must be 6 pairs of hexadecimal digits separated by colons. Example: `b2:9c:02:c2:27:20`	Optional

CLIENT_NETWORK_MASK

Value	Designation

IPv4 netmask for this node on the Client Network.
 	
Specify this key when CLIENT_NETWORK_CONFIG = STATIC; don't specify it for other values.
 	
Examples:
 	
`255.255.255.0`
 	
`255.255.248.0`
	Required if CLIENT_NETWORK_IP is specified and CLIENT_NETWORK_CONFIG = STATIC
	
	Optional otherwise.

CLIENT_NETWORK_MTU

Value	Designation

The maximum transmission unit (MTU) for this node on the Client Network. Don't specify if CLIENT_NETWORK_CONFIG = DHCP. If specified, the value must be between 1280 and 9216. If omitted, 1500 is used.
 	
If you want to use jumbo frames, set the MTU to a value suitable for jumbo frames, such as 9000. Otherwise, keep the default value.
 	
IMPORTANT: The MTU value of the network must match the value configured on the switch port the node is connected to. Otherwise, network performance issues or packet loss might occur.
 	
Examples:
 	
`1500`
 	
`8192`
	Optional

CLIENT_NETWORK_TARGET

Value	Designation

Name of the host device that you will use for Client Network access by the StorageGRID node. Only network interface names are supported. Typically, you use a different interface name than what was specified for GRID_NETWORK_TARGET or ADMIN_NETWORK_TARGET.
 	
Note: Don't use bond or bridge devices as the network target. Either configure a VLAN (or other virtual interface) on top of the bond device, or use a bridge and virtual Ethernet (veth) pair.
 	
Best practice: Specify a value even if this node will not initially have a Client Network IP address. Then you can add a Client Network IP address later, without having to reconfigure the node on the host.
 	
Examples:
 	
`bond0.1003`
 	
`ens423`
	Best practice

CLIENT_NETWORK_TARGET_TYPE

Value	Designation
Interface (This is only supported value.)	Optional

CLIENT_NETWORK_TARGET_TYPE_INTERFACE_CLONE_MAC

Value	Designation
True or False Set the key to "true" to cause the StorageGRID container to use the MAC address of the host target interface on the Client Network. **Best practice:** In networks where promiscuous mode would be required, use the CLIENT_NETWORK_TARGET_TYPE_INTERFACE_CLONE_MAC key instead. For more details on MAC cloning for Linux, see Considerations and recommendations for MAC address cloning	Best practice

Grid Network keys

GRID_NETWORK_CONFIG

Value	Designation
STATIC or DHCP Defaults to STATIC if not specified.	Best practice

GRID_NETWORK_GATEWAY

Value	Designation
IPv4 address of the local Grid Network gateway for this node, which must be on the subnet defined by GRID_NETWORK_IP and GRID_NETWORK_MASK. This value is ignored for DHCP-configured networks. If the Grid Network is a single subnet with no gateway, use either the standard gateway address for the subnet (X.Y.Z.1) or this node's GRID_NETWORK_IP value; either value will simplify potential future Grid Network expansions.	Required

GRID_NETWORK_IP

Value	Designation

IPv4 address of this node on the Grid Network. This key is only required when GRID_NETWORK_CONFIG = STATIC; don't specify it for other values.
 	
Examples:
 	
`1.1.1.1`
 	
`10.224.4.81`
	Required when GRID_NETWORK_CONFIG = STATIC
	
	Optional otherwise.

GRID_NETWORK_MAC

Value	Designation
The MAC address for the Grid Network interface in the container. Must be 6 pairs of hexadecimal digits separated by colons. Example: `b2:9c:02:c2:27:30`	Optional If omitted, a MAC address will be generated automatically.

GRID_NETWORK_MASK

Value	Designation

IPv4 netmask for this node on the Grid Network. Specify this key when GRID_NETWORK_CONFIG = STATIC; don't specify it for other values.
 	
Examples:
 	
`255.255.255.0`
 	
`255.255.248.0`
	Required when GRID_NETWORK_IP is specified and GRID_NETWORK_CONFIG = STATIC.
	
	Optional otherwise.

GRID_NETWORK_MTU

Value	Designation

The maximum transmission unit (MTU) for this node on the Grid Network. Don't specify if GRID_NETWORK_CONFIG = DHCP. If specified, the value must be between 1280 and 9216. If omitted, 1500 is used.
 	
If you want to use jumbo frames, set the MTU to a value suitable for jumbo frames, such as 9000. Otherwise, keep the default value.
 	
IMPORTANT: The MTU value of the network must match the value configured on the switch port the node is connected to. Otherwise, network performance issues or packet loss might occur.
 	
IMPORTANT: For the best network performance, all nodes should be configured with similar MTU values on their Grid Network interfaces. The **Grid Network MTU mismatch** alert is triggered if there is a significant difference in MTU settings for the Grid Network on individual nodes. The MTU values don't have to be the same for all network types.
 	
Examples:
 	
`1500`
 	
`8192`
	Optional

GRID_NETWORK_TARGET

Value	Designation

Name of the host device that you will use for Grid Network access by the StorageGRID node. Only network interface names are supported. Typically, you use a different interface name than what was specified for ADMIN_NETWORK_TARGET or CLIENT_NETWORK_TARGET.
 	
Note: Don't use bond or bridge devices as the network target. Either configure a VLAN (or other virtual interface) on top of the bond device, or use a bridge and virtual Ethernet (veth) pair.
 	
Examples:
 	
`bond0.1001`
 	
`ens192`
	Required

GRID_NETWORK_TARGET_TYPE

Value	Designation
Interface (This is the only supported value.)	Optional

GRID_NETWORK_TARGET_TYPE_INTERFACE_CLONE_MAC

Value	Designation
True or False Set the value of the key to "true" to cause the StorageGRID container to use the MAC address of the host target interface on the Grid Network. **Best practice:** In networks where promiscuous mode would be required, use the GRID_NETWORK_TARGET_TYPE_INTERFACE_CLONE_MAC key instead. For more details on MAC cloning for Linux, see Considerations and recommendations for MAC address cloning	Best practice

Installation password key (temporary)

CUSTOM_TEMPORARY_PASSWORD_HASH

Value	Designation
For the primary Admin Node, set a default temporary password for the StorageGRID Installation API during installation. **Note**: Set an installation password on the primary Admin Node only. If you attempt to set a password on another node type, validation of the node configuration file will fail. Setting this value has no effect when installation has completed. If this key is omitted, by default no temporary password is set. Alternatively, you can set a temporary password using the StorageGRID Installation API. Must be a `crypt()` SHA-512 password hash with format `$6$<salt>$<password hash>` for a password of at least 8 and no more than 32 characters. This hash can be generated using CLI tools, such as the `openssl passwd` command in SHA-512 mode.	Best practice

Interfaces key

INTERFACE_TARGET_nnnn

Value	Designation
Name and optional description for an extra interface you want to add to this node. You can add multiple extra interfaces to each node. For *nnnn*, specify a unique number for each INTERFACE_TARGET entry you are adding. For the value, specify the name of the physical interface on the bare-metal host. Then, optionally, add a comma and provide a description of the interface, which is displayed on the VLAN interfaces page and the HA groups page. Example: `INTERFACE_TARGET_0001=ens256, Trunk` If you add a trunk interface, you must configure a VLAN interface in StorageGRID. If you add an access interface, you can add the interface directly to an HA group; you don’t need to configure a VLAN interface.	Optional

Maximum RAM key

MAXIMUM_RAM

Value	Designation

The maximum amount of RAM that this node is allowed to consume. If this key is omitted, the node has no memory restrictions. When setting this field for a production-level node, specify a value that is at least 24 GB and 16 to 32 GB less than the total system RAM.
 	
Note: The RAM value affects a node's actual metadata reserved space. See the description of what Metadata Reserved Space is.
 	
The format for this field is *numberunit*, where *unit* can be `b`, `k`, `m`, or `g`.
 	
Examples:
 	
`24g`
 	
`38654705664b`
 	
Note: If you want to use this option, you must enable kernel support for memory cgroups.
	Optional

Node type keys

NODE_TYPE

Value	Designation
Type of node: • VM_Admin_Node • VM_Storage_Node • VM_Archive_Node • VM_API_Gateway	Required

STORAGE_TYPE

Value	Designation
Defines the type of objects a Storage Node contains. For more information, see Types of Storage Nodes. This key is only required for nodes with NODE_TYPE = VM_Storage_Node; don't specify it for other node types. Storage types: • combined • data • metadata **Note**: If the STORAGE_TYPE is not specified, the Storage Node type is set to combined (data and metadata) by default.	Optional

Port remap keys

Support for port remapping is deprecated and will be removed in a future release. To remove remapped ports, refer to Remove port remaps on bare metal hosts.

PORT_REMAP

Value	Designation
Remaps any port used by a node for internal grid node communications or external communications. Remapping ports is necessary if enterprise networking policies restrict one or more ports used by StorageGRID, as described in Internal grid node communications or External communications. **IMPORTANT**: Don't remap the ports you are planning to use to configure load balancer endpoints. **Note**: If only PORT_REMAP is set, the mapping that you specify is used for both inbound and outbound communications. If PORT_REMAP_INBOUND is also specified, PORT_REMAP applies only to outbound communications. The format used is: *`network type/protocol/default port used by grid node/new port`*, where *`network type`* is grid, admin, or client, and *`protocol`* is tcp or udp. Example: `PORT_REMAP = client/tcp/18082/443` You can also remap multiple ports using a comma-separated list. Example: `PORT_REMAP = client/tcp/18082/443, client/tcp/18083/80`	Optional

PORT_REMAP_INBOUND

Value	Designation
Remaps inbound communications to the specified port. If you specify PORT_REMAP_INBOUND but don't specify a value for PORT_REMAP, outbound communications for the port are unchanged. **IMPORTANT**: Don't remap the ports you are planning to use to configure load balancer endpoints. The format used is: *network type/protocol/remapped port /default port used by grid node*, where *network type* is grid, admin, or client, and *protocol* is tcp or udp. Example: `PORT_REMAP_INBOUND = grid/tcp/3022/22` You can also remap multiple inbound ports using a comma-separated list. Example: `PORT_REMAP_INBOUND = grid/tcp/3022/22, admin/tcp/3022/22`	Optional

How grid nodes discover the primary Admin Node

Grid nodes communicate with the primary Admin Node for configuration and management. Each grid node must know the IP address of the primary Admin Node on the Grid Network.

To ensure that a grid node can access the primary Admin Node, you can do either of the following when deploying the node:

- You can use the ADMIN_IP parameter to enter the primary Admin Node's IP address manually.
- You can omit the ADMIN_IP parameter to have the grid node discover the value automatically. Automatic discovery is especially useful when the Grid Network uses DHCP to assign the IP address to the primary Admin Node.

Automatic discovery of the primary Admin Node is accomplished using a multicast domain name system (mDNS). When the primary Admin Node first starts up, it publishes its IP address using mDNS. Other nodes on the same subnet can then query for the IP address and acquire it automatically. However, because multicast IP traffic is not normally routable across subnets, nodes on other subnets can't acquire the primary Admin Node's IP address directly.

If you use automatic discovery:

- You must include the ADMIN_IP setting for at least one grid node on any subnets that the primary Admin Node is not directly attached to. This grid node will then publish the primary Admin Node's IP address for other nodes on the subnet to discover with mDNS.
- Ensure that your network infrastructure supports passing multi-cast IP traffic within a subnet.

Deploy a StorageGRID node as a virtual machine (VMware)

You use VMware vSphere Web Client to deploy each grid node as a virtual machine. During deployment, each grid node is created and connected to one or more StorageGRID networks.

If you need to deploy any StorageGRID appliance Storage Nodes, see Deploy appliance Storage Node.

Optionally, you can remap node ports or increase CPU or memory settings for the node before powering it on.

Before you begin

- You have reviewed how to plan and prepare for installation, and you understand the requirements for software, CPU and RAM, and storage and performance.
- You are familiar with VMware vSphere Hypervisor and have experience deploying virtual machines in this environment.

> The `open-vm-tools` package, an open-source implementation similar to VMware Tools, is included with the StorageGRID virtual machine. You don't need to install VMware Tools manually.

- You have downloaded and extracted the correct version of the StorageGRID installation archive for VMware.

> If you are deploying the new node as part of an expansion or recovery operation, you must use the version of StorageGRID that is currently running on the grid.

- You have the StorageGRID Virtual Machine Disk (`.vmdk`) file:

```
NetApp-SG-version-SHA.vmdk
```

- You have the `.ovf` and `.mf` files for each type of grid node you are deploying:

Filename	Description

`vsphere-primary-admin.ovf`
 	
`vsphere-primary-admin.mf`
	The template file and manifest file for the primary Admin Node.

`vsphere-non-primary-admin.ovf`
 	
`vsphere-non-primary-admin.mf`
	The template file and manifest file for a non-primary Admin Node.

`vsphere-storage.ovf`
 	
`vsphere-storage.mf`
	The template file and manifest file for a Storage Node.

`vsphere-gateway.ovf`
 	
`vsphere-gateway.mf`
	The template file and manifest file for a Gateway Node.

- The `.vdmk`, `.ovf`, and `.mf` files are all in the same directory.

- You have a plan to minimize failure domains. For example, you should not deploy all Gateway Nodes on a single vSphere ESXi host.

> In a production deployment, don't run more than one Storage Node on a single virtual machine. Do not run multiple virtual machines on the same ESXi host if that would create an unacceptable failure-domain issue.

- If you are deploying a node as part of an expansion or recovery operation, you have the instructions for expanding a StorageGRID system or the recovery and maintenance instructions.
- If you are deploying a StorageGRID node as a virtual machine with storage assigned from a NetApp ONTAP system, you have confirmed that the volume does not have a FabricPool tiering policy enabled. For example, if a StorageGRID node is running as an virtual machine on a VMware host, ensure the volume backing the datastore for the node does not have a FabricPool tiering policy enabled. Disabling FabricPool tiering for volumes used with StorageGRID nodes simplifies troubleshooting and storage operations.

> Never use FabricPool to tier any data related to StorageGRID back to StorageGRID itself. Tiering StorageGRID data back to StorageGRID increases troubleshooting and operational complexity.

About this task

Follow these instructions to initially deploy VMware nodes, add a new VMware node in an expansion, or replace a VMware node as part of a recovery operation. Except as noted in the steps, the node deployment procedure is the same for all node types, including Admin Nodes, Storage Nodes, and Gateway Nodes.

If you are installing a new StorageGRID system:

- You can deploy nodes in any order.
- You must ensure that each virtual machine can connect to the primary Admin Node over the Grid Network.
- You must deploy all grid nodes before configuring the grid.

If you are performing an expansion or recovery operation:

- You must ensure that the new virtual machine can connect to all other nodes over the Grid Network.

If you need to remap any of the node's ports, don't power on the new node until the port remap configuration is complete.

> Support for port remapping is deprecated and will be removed in a future release. To remove remapped ports, refer to Remove port remaps on bare metal hosts.

Steps

1. Using VCenter, deploy an OVF template.

   If you specify a URL, point to a folder containing the following files. Otherwise, select each of these files from a local directory.

   ```
   NetApp-SG-version-SHA.vmdk
   vsphere-node.ovf
   vsphere-node.mf
   ```

For example, if this is the first node you are deploying, use these files to deploy the primary Admin Node for your StorageGRID system:

```
NetApp-SG-version-SHA.vmdk
vsphere-primary-admin.ovf
vsphere-primary-admin.mf
```

2. Provide a name for the virtual machine.

   The standard practice is to use the same name for both the virtual machine and the grid node.

3. Place the virtual machine in the appropriate vApp or resource pool.
4. If you are deploying the primary Admin Node, read and accept the End User License Agreement.

   Depending on your version of vCenter, the order of the steps will vary for accepting the End User License Agreement, specifying the name of the virtual machine, and selecting a datastore.

5. Select storage for the virtual machine.

   If you are deploying a node as part of recovery operation, perform the instructions in the storage recovery step to add new virtual disks, reattach virtual hard disks from the failed grid node, or both.

   When deploying a Storage Node, use 3 or more storage volumes, with each storage volume being 4 TB or larger. You must assign at least 4 TB to volume 0.

   > The Storage Node .ovf file defines several VMDKs for storage. Unless these VMDKs meet your storage requirements, you should remove them and assign appropriate VMDKs or RDMs for storage before powering up the node. VMDKs are more commonly used in VMware environments and are easier to manage, while RDMs might provide better performance for workloads that use larger object sizes (for example, greater than 100 MB).

   > Some StorageGRID installations might use larger, more active storage volumes than typical virtualized workloads. You might need to tune some hypervisor parameters, such as `MaxAddressableSpaceTB`, to achieve optimal performance. If you encounter poor performance, contact your virtualization support resource to determine whether your environment could benefit from workload-specific configuration tuning.

6. Select networks.

   Determine which StorageGRID networks the node will use by selecting a destination network for each source network.

   - The Grid Network is required. You must select a destination network in the vSphere environment. + The Grid Network is used for all internal StorageGRID traffic. It provides connectivity among all nodes in the grid, across all sites and subnets. All nodes on the Grid Network must be able to communicate with all other nodes.
   - If you use the Admin Network, select a different destination network in the vSphere environment. If you don’t use the Admin Network, select the same destination you selected for the Grid Network.
   - If you use the Client Network, select a different destination network in the vSphere environment. If you don’t use the Client Network, select the same destination you selected for the Grid Network.

- If you use an Admin or Client network, nodes do not have to be on the same Admin or Client networks.

7. For **Customize Template**, configure the required StorageGRID node properties.
   a. Enter the **Node name**.

      If you are recovering a grid node, you must enter the name of the node you are recovering.

   b. Use the **Temporary installation password** drop-down to specify a temporary installation password, so that you can access the VM console or the StorageGRID Installation API, or use SSH, before the new node joins the grid.

      The temporary installation password is only used during node installation. After a node has been added to the grid, you can access it using the node console password, which is listed in the `Passwords.txt` file in the Recovery Package.

      - **Use node name**: The value you provided for the **Node name** field is used as the temporary installation password.
      - **Use custom password**: A custom password is used as the temporary installation password.
      - **Disable password**: No temporary installation password will be used. If you need to access the VM to debug installation issues, see Troubleshoot installation issues.

   c. If you selected **Use custom password**, specify the temporary installation password you want to use in the **Custom password** field.
   d. In the **Grid Network (eth0)** section, select STATIC or DHCP for the **Grid network IP configuration**.
      - If you select STATIC, enter the **Grid network IP**, **Grid network mask**, **Grid network gateway**, and **Grid network MTU**.
      - If you select DHCP, the **Grid network IP**, **Grid network mask**, and **Grid network gateway** are automatically assigned.
   e. In the **Primary Admin IP** field, enter the IP address of the primary Admin Node for the Grid Network.

      This step does not apply if the node you are deploying is the primary Admin Node.

      If you omit the primary Admin Node IP address, the IP address will be automatically discovered if the primary Admin Node, or at least one other grid node with ADMIN_IP configured, is present on the same subnet. However, it is recommended to set the primary Admin Node IP address here.

   f. In the **Admin Network (eth1)** section, select STATIC, DHCP, or DISABLED for the **Admin network IP configuration**.
      - If you don't want to use the Admin Network, select DISABLED and enter **0.0.0.0** for the Admin Network IP. You can leave the other fields blank.
      - If you select STATIC, enter the **Admin network IP**, **Admin network mask**, **Admin network gateway**, and **Admin network MTU**.
      - If you select STATIC, enter the **Admin network external subnet list**. You must also configure a gateway.
      - If you select DHCP, the **Admin network IP**, **Admin network mask**, and **Admin network gateway** are automatically assigned.
   g. In the **Client Network (eth2)** section, select STATIC, DHCP, or DISABLED for the **Client network IP**

configuration.

- If you don't want to use the Client Network, select DISABLED and enter **0.0.0.0** for the Client Network IP. You can leave the other fields blank.
- If you select STATIC, enter the **Client network IP**, **Client network mask**, **Client network gateway**, and **Client network MTU**.
- If you select DHCP, the **Client network IP**, **Client network mask**, and **Client network gateway** are automatically assigned.

8. Review the virtual machine configuration and make any changes necessary.
9. When you are ready to complete, select **Finish** to start the upload of the virtual machine.
10. If you deployed this node as part of recovery operation and this is not a full-node recovery, perform these steps after deployment is complete:
    a. Right-click the virtual machine, and select **Edit Settings**.
    b. Select each default virtual hard disk that has been designated for storage, and select **Remove**.
    c. Depending on your data recovery circumstances, add new virtual disks according to your storage requirements, reattach any virtual hard disks preserved from the previously removed failed grid node, or both.

       Note the following important guidelines:

       - If you are adding new disks you should use the same type of storage device that was in use before node recovery.
       - The Storage Node .ovf file defines several VMDKs for storage. Unless these VMDKs meet your storage requirements, you should remove them and assign appropriate VMDKs or RDMs for storage before powering up the node. VMDKs are more commonly used in VMware environments and are easier to manage, while RDMs might provide better performance for workloads that use larger object sizes (for example, greater than 100 MB).
11. If you need to remap the ports used by this node, follow these steps.

    You might need to remap a port if your enterprise networking policies restrict access to one or more ports that are used by StorageGRID. See the networking guidelines for the ports used by StorageGRID.

    Don't remap the ports used in load balancer endpoints.

    a. Select the new VM.
    b. From the Configure tab, select **Settings** > **vApp Options**. The location of **vApp Options** depends on the version of vCenter.
    c. In the **Properties** table, locate PORT_REMAP_INBOUND and PORT_REMAP.
    d. To symmetrically map both inbound and outbound communications for a port, select **PORT_REMAP**.

    Support for port remapping is deprecated and will be removed in a future release. To remove remapped ports, refer to Remove port remaps on bare metal hosts.

    If only PORT_REMAP is set, the mapping that you specify applies to both inbound and outbound communications. If PORT_REMAP_INBOUND is also specified, PORT_REMAP applies only to outbound communications.

i. Select **Set Value**.

ii. Enter the port mapping:

`<network type>/<protocol>/<default port used by grid node>/<new port>`

`<network type>` is grid, admin, or client, and `<protocol>` is tcp or udp.

For example, to remap ssh traffic from port 22 to port 3022, enter:

```
client/tcp/22/3022
```

You can remap multiple ports using a comma-separated list.

For example:

```
client/tcp/18082/443, client/tcp/18083/80
```

iii. Select **OK**.

e. To specify the port used for inbound communications to the node, select **PORT_REMAP_INBOUND**.

> If you specify PORT_REMAP_INBOUND and don't specify a value for PORT_REMAP, outbound communications for the port are unchanged.

i. Select **Set Value**.

ii. Enter the port mapping:

`<network type>/<protocol>/<remapped inbound port>/<default inbound port used by grid node>`

`<network type>` is grid, admin, or client, and `<protocol>` is tcp or udp.

For example, to remap inbound SSH traffic that is sent to port 3022 so that it is received at port 22 by the grid node, enter the following:

```
client/tcp/3022/22
```

You can remap multiple inbound ports using a comma-separated list.

For example:

```
grid/tcp/3022/22, admin/tcp/3022/22
```

iii. Select **OK**

12. If you want to increase the CPU or memory for the node from the default settings:

a. Right-click the virtual machine, and select **Edit Settings**.

b. Change the number of CPUs or the amount of memory as required.

Set the **Memory Reservation** to the same size as the **Memory** allocated to the virtual machine.

c. Select **OK**.

13. Power on the virtual machine.

After you finish

If you deployed this node as part of an expansion or recovery procedure, return to those instructions to complete the procedure.

Example node configuration files (Linux)

You can use the example node configuration files to help set up the node configuration files for your StorageGRID system. The examples show node configuration files for all types of grid nodes.

> "Linux" refers to a RHEL, Ubuntu, or Debian deployment. For a list of supported versions, see the NetApp Interoperability Matrix Tool (IMT).

For most nodes, you can add Admin and Client Network addressing information (IP, mask, gateway, and so on) when you configure the grid using the Grid Manager or the Installation API. The exception is the primary Admin Node. If you want to browse to the Admin Network IP of the primary Admin Node to complete grid configuration (because the Grid Network is not routed, for example), you must configure the Admin Network connection for the primary Admin Node in its node configuration file. This is shown in the example.

> In the examples, the Client Network target has been configured as a best practice, even though the Client Network is disabled by default.

Example for primary Admin Node

Example file name: `/etc/storagegrid/nodes/dc1-adm1.conf`

Example file contents:

```
NODE_TYPE = VM_Admin_Node
ADMIN_ROLE = Primary
TEMPORARY_PASSWORD_TYPE = Use custom password
CUSTOM_TEMPORARY_PASSWORD = Passw0rd
BLOCK_DEVICE_VAR_LOCAL = /dev/mapper/dc1-adm1-var-local
BLOCK_DEVICE_AUDIT_LOGS = /dev/mapper/dc1-adm1-audit-logs
BLOCK_DEVICE_TABLES = /dev/mapper/dc1-adm1-tables
GRID_NETWORK_TARGET = bond0.1001
ADMIN_NETWORK_TARGET = bond0.1002
CLIENT_NETWORK_TARGET = bond0.1003

GRID_NETWORK_IP = 10.1.0.2
GRID_NETWORK_MASK = 255.255.255.0
GRID_NETWORK_GATEWAY = 10.1.0.1

ADMIN_NETWORK_CONFIG = STATIC
ADMIN_NETWORK_IP = 192.168.100.2
ADMIN_NETWORK_MASK = 255.255.248.0
ADMIN_NETWORK_GATEWAY = 192.168.100.1
ADMIN_NETWORK_ESL = 192.168.100.0/21,172.16.0.0/21,172.17.0.0/21
```

Example for Storage Node

Example file name: `/etc/storagegrid/nodes/dc1-sn1.conf`

Example file contents:

```
NODE_TYPE = VM_Storage_Node
ADMIN_IP = 10.1.0.2
BLOCK_DEVICE_VAR_LOCAL = /dev/mapper/dc1-sn1-var-local
BLOCK_DEVICE_RANGEDB_00 = /dev/mapper/dc1-sn1-rangedb-0
BLOCK_DEVICE_RANGEDB_01 = /dev/mapper/dc1-sn1-rangedb-1
BLOCK_DEVICE_RANGEDB_02 = /dev/mapper/dc1-sn1-rangedb-2
BLOCK_DEVICE_RANGEDB_03 = /dev/mapper/dc1-sn1-rangedb-3
GRID_NETWORK_TARGET = bond0.1001
ADMIN_NETWORK_TARGET = bond0.1002
CLIENT_NETWORK_TARGET = bond0.1003

GRID_NETWORK_IP = 10.1.0.3
GRID_NETWORK_MASK = 255.255.255.0
GRID_NETWORK_GATEWAY = 10.1.0.1
```

Example for Gateway Node

Example file name: `/etc/storagegrid/nodes/dc1-gw1.conf`

Example file contents:

```
NODE_TYPE = VM_API_Gateway
ADMIN_IP = 10.1.0.2
BLOCK_DEVICE_VAR_LOCAL = /dev/mapper/dc1-gw1-var-local
GRID_NETWORK_TARGET = bond0.1001
ADMIN_NETWORK_TARGET = bond0.1002
CLIENT_NETWORK_TARGET = bond0.1003
GRID_NETWORK_IP = 10.1.0.5
GRID_NETWORK_MASK = 255.255.255.0
GRID_NETWORK_GATEWAY = 10.1.0.1
```

Example for a non-primary Admin Node

Example file name: `/etc/storagegrid/nodes/dc1-adm2.conf`

Example file contents:

```
NODE_TYPE = VM_Admin_Node
ADMIN_ROLE = Non-Primary
ADMIN_IP = 10.1.0.2
BLOCK_DEVICE_VAR_LOCAL = /dev/mapper/dc1-adm2-var-local
BLOCK_DEVICE_AUDIT_LOGS = /dev/mapper/dc1-adm2-audit-logs
BLOCK_DEVICE_TABLES = /dev/mapper/dc1-adm2-tables
GRID_NETWORK_TARGET = bond0.1001
ADMIN_NETWORK_TARGET = bond0.1002
CLIENT_NETWORK_TARGET = bond0.1003

GRID_NETWORK_IP = 10.1.0.6
GRID_NETWORK_MASK = 255.255.255.0
GRID_NETWORK_GATEWAY = 10.1.0.1
```

Validate the StorageGRID configuration (Linux)

After creating configuration files in `/etc/storagegrid/nodes` for each of your StorageGRID nodes, you must validate the contents of those files.

"Linux" refers to a RHEL, Ubuntu, or Debian deployment. For a list of supported versions, see the NetApp Interoperability Matrix Tool (IMT).

To validate the contents of the configuration files, run the following command on each host:

```
sudo storagegrid node validate all
```

If the files are correct, the output shows **PASSED** for each configuration file, as shown in the example.

When using only one LUN on metadata-only nodes, you might receive a warning message that can be ignored.

```
Checking for misnamed node configuration files… PASSED
Checking configuration file for node dc1-adm1… PASSED
Checking configuration file for node dc1-gw1… PASSED
Checking configuration file for node dc1-sn1… PASSED
Checking configuration file for node dc1-sn2… PASSED
Checking configuration file for node dc1-sn3… PASSED
Checking for duplication of unique values between nodes… PASSED
```

For an automated installation, you can suppress this output by using the `-q` or `--quiet` options in the `storagegrid` command (for example, `storagegrid --quiet…`). If you suppress the output, the command will have a non-zero exit value if any configuration warnings or errors were detected.

If the configuration files are incorrect, the issues are shown as **WARNING** and **ERROR**, as shown in the example. If any configuration errors are found, you must correct them before you continue with the installation.

```
Checking for misnamed node configuration files…
  WARNING: ignoring /etc/storagegrid/nodes/dc1-adm1
  WARNING: ignoring /etc/storagegrid/nodes/dc1-sn2.conf.keep
  WARNING: ignoring /etc/storagegrid/nodes/my-file.txt
Checking configuration file for node dc1-adm1…
  ERROR: NODE_TYPE = VM_Foo_Node
         VM_Foo_Node is not a valid node type.  See *.conf.sample
  ERROR: ADMIN_ROLE = Foo
         Foo is not a valid admin role.  See *.conf.sample
  ERROR: BLOCK_DEVICE_VAR_LOCAL = /dev/mapper/sgws-gw1-var-local
         /dev/mapper/sgws-gw1-var-local is not a valid block device
Checking configuration file for node dc1-gw1…
  ERROR: GRID_NETWORK_TARGET = bond0.1001
         bond0.1001 is not a valid interface.  See `ip link show`
  ERROR: GRID_NETWORK_IP = 10.1.3
         10.1.3 is not a valid IPv4 address
  ERROR: GRID_NETWORK_MASK = 255.248.255.0
         255.248.255.0 is not a valid IPv4 subnet mask
Checking configuration file for node dc1-sn1…
  ERROR: GRID_NETWORK_GATEWAY = 10.2.0.1
         10.2.0.1 is not on the local subnet
  ERROR: ADMIN_NETWORK_ESL = 192.168.100.0/21,172.16.0foo
         Could not parse subnet list
Checking configuration file for node dc1-sn2… PASSED
Checking configuration file for node dc1-sn3… PASSED
Checking for duplication of unique values between nodes…
  ERROR: GRID_NETWORK_IP = 10.1.0.4
         dc1-sn2 and dc1-sn3 have the same GRID_NETWORK_IP
  ERROR: BLOCK_DEVICE_VAR_LOCAL = /dev/mapper/sgws-sn2-var-local
         dc1-sn2 and dc1-sn3 have the same BLOCK_DEVICE_VAR_LOCAL
  ERROR: BLOCK_DEVICE_RANGEDB_00 = /dev/mapper/sgws-sn2-rangedb-0
         dc1-sn2 and dc1-sn3 have the same BLOCK_DEVICE_RANGEDB_00
```

Start the StorageGRID host service (Linux)

To start your StorageGRID nodes, and ensure they restart after a host reboot, you must enable and start the StorageGRID host service.

"Linux" refers to a RHEL, Ubuntu, or Debian deployment. For a list of supported versions, see the NetApp Interoperability Matrix Tool (IMT).

Steps

1. Run the following commands on each host:

```
sudo systemctl enable storagegrid
sudo systemctl start storagegrid
```

2. Run the following command to ensure the deployment is proceeding:

```
sudo storagegrid node status node-name
```

3. If any node returns a status of "Not Running" or "Stopped," run the following command:

```
sudo storagegrid node start node-name
```

4. If you have previously enabled and started the StorageGRID host service (or if you are unsure if the service has been enabled and started), also run the following command:

```
sudo systemctl reload-or-restart storagegrid
```

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