Expand your grid

StorageGRID

NetApp
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Expand your grid

Expand your grid: Overview

Use these instructions to expand the capacity or capabilities of your StorageGRID system without interrupting system operations.

About these instructions

These instructions describe how to perform a StorageGRID expansion to add storage volumes to Storage Nodes, new grid nodes to an existing site, or an entire new site.

These instructions are for technical personnel who are responsible for configuring and supporting the StorageGRID system after it has been installed.

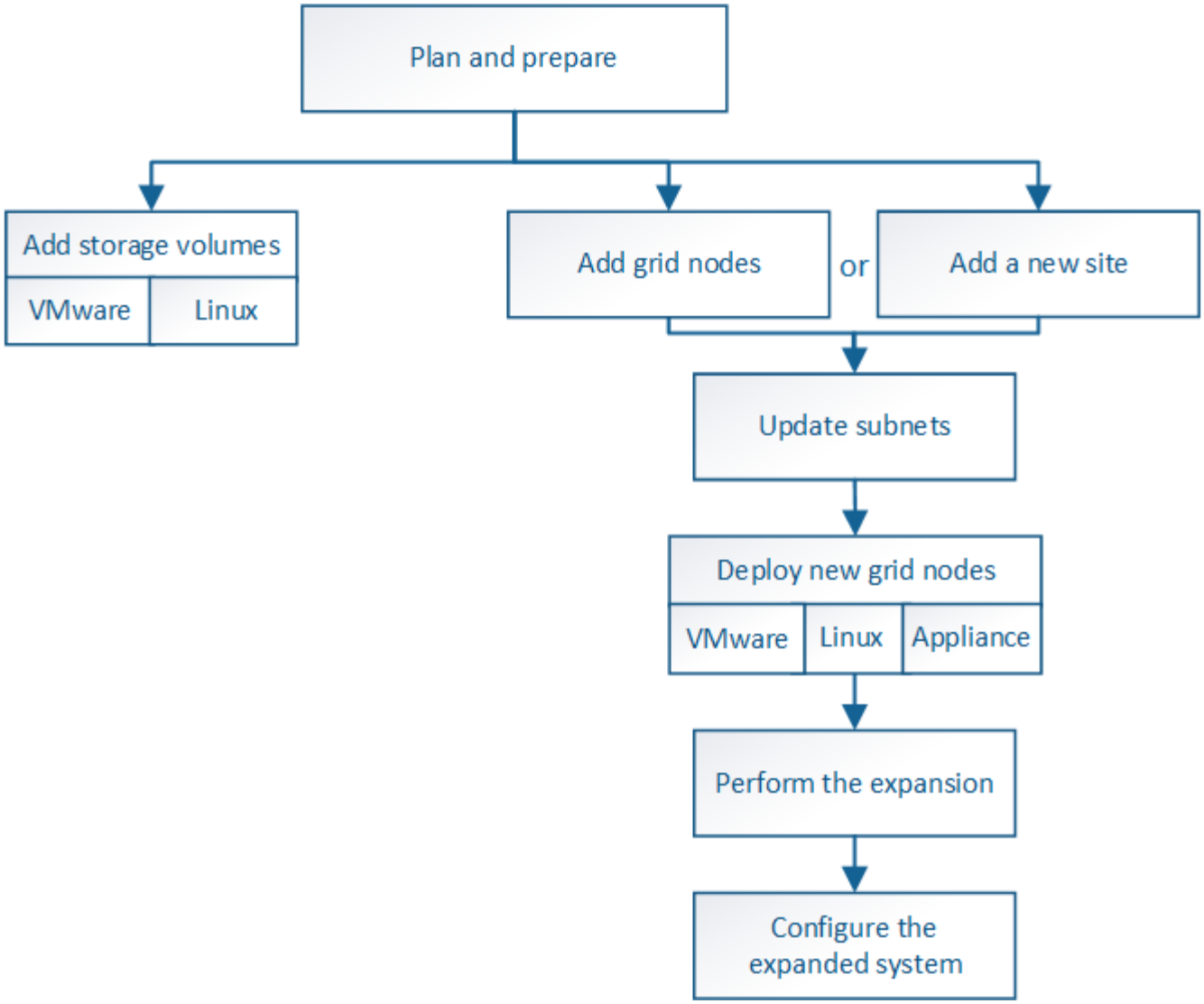
Overview of expansion procedure

The reason you are performing the expansion determines how many new nodes of each type you must add and the location of those new nodes. For example, there are different node requirements if you are performing an expansion to increase storage capacity, add metadata capacity, or add redundancy or new capabilities.

As shown in the workflow diagram, the steps for performing an expansion depend on whether you are adding storage volumes to a Storage Node, adding new nodes to an existing site, or adding a new site. In all cases, you can perform the expansion without interrupting the operation of your current system.

The steps for adding nodes also depend on whether you are adding StorageGRID appliances or hosts running VMware or Linux.

> “Linux” refers to a Red Hat® Enterprise Linux®, Ubuntu®, CentOS, or Debian® deployment. Use the NetApp Interoperability Matrix Tool (IMT) to get a list of supported versions.



Plan StorageGRID expansion

Add storage capacity

Guidelines for adding object capacity

You can expand the object storage capacity of your StorageGRID system by adding storage volumes to existing Storage Nodes or by adding new Storage Nodes to existing sites. You must add storage capacity in a way that meets the requirements of your information lifecycle management (ILM) policy.

Guidelines for adding storage volumes

Before adding storage volumes to existing Storage Nodes, review the following guidelines and limitations:

- You must examine your current ILM rules to determine where and when to add storage volumes to increase the storage available for replicated or erasure-coded objects. See the instructions for managing objects with information lifecycle management.
- You cannot increase the metadata capacity of your system by adding storage volumes because object

metadata is stored only on volume 0.

- Each software-based Storage Node can support a maximum of 16 storage volumes. If you need to add capacity beyond that, you must add new Storage Nodes.
- You can add one or two expansion shelves to each SG6060 appliance. Each expansion shelf adds 16 storage volumes. With both expansion shelves installed, the SG6060 can support a total of 48 storage volumes.
- You cannot add storage volumes to any other storage appliance.
- You cannot increase the size of an existing storage volume.
- You cannot add storage volumes to a Storage Node at the same time you are performing a system upgrade, recovery operation, or another expansion.

After you have decided to add storage volumes and have determined which Storage Nodes you must expand to satisfy your ILM policy, follow the instructions for your type of Storage Node:

- To add one or two expansion shelves to an SG6060 storage appliance, go to Add expansion shelf to deployed SG6060.
- For a software-based node, follow the instructions for adding storage volumes to Storage Nodes.

Guidelines for adding Storage Nodes

Before adding Storage Nodes to existing sites, review the following guidelines and limitations:

- You must examine your current ILM rules to determine where and when to add Storage Nodes to increase the storage available for replicated or erasure-coded objects. See the instructions for managing objects with information lifecycle management.
- You should not add more than 10 Storage Nodes in a single expansion procedure.
- You can add Storage Nodes to more than one site in a single expansion procedure.
- You can add Storage Nodes and other types of nodes in a single expansion procedure.
- Before starting the expansion procedure, you must confirm that all data-repair operations performed as part of a recovery are complete. See Check data repair jobs.
- If you need to remove Storage Nodes before or after performing an expansion, you should not decommission more than 10 Storage Nodes in a single Decommission Node procedure.

Guidelines for ADC service on Storage Nodes

When configuring the expansion, you must choose whether to include the Administrative Domain Controller (ADC) service on each new Storage Node. The ADC service keeps track of the location and availability of grid services.

- The StorageGRID system requires a quorum of ADC services to be available at each site and at all times.
- At least three Storage Nodes at each site must include the ADC service.
- Adding the ADC service to every Storage Node is not recommended. Including too many ADC services can cause slowdowns due to the increased amount of communication between nodes.
- A single grid should not have more than 48 Storage Nodes with the ADC service. This is equivalent to 16 sites with three ADC services at each site.
- In general, when you select the **ADC Service** setting for a new node, you should select **Automatic**. Select **Yes** only if the new node will replace another Storage Node that includes the ADC service. Because you cannot decommission a Storage Node if too few ADC services would remain, this ensures that a new ADC

service is available before the old service is removed.

- You cannot add the ADC service to a node after it is deployed.

Add storage capacity for replicated objects

If the information lifecycle management (ILM) policy for your deployment includes a rule that creates replicated copies of objects, you must consider how much storage to add and where to add the new storage volumes or Storage Nodes.

For guidance on where to add additional storage, examine the ILM rules that create replicated copies. If ILM rules create two or more object copies, plan to add storage in each location where object copies are made. As a simple example, if you have a two-site grid and an ILM rule that creates one object copy at each site, you must add storage to each site to increase the overall object capacity of the grid. See the instructions for managing objects with information lifecycle management.

For performance reasons, you should attempt to keep storage capacity and compute power balanced across sites. So, for this example, you should add the same number of Storage Nodes to each site or additional storage volumes at each site.

If you have a more complex ILM policy that includes rules that place objects in different locations based on criteria such as bucket name, or rules that change object locations over time, your analysis of where storage is required for the expansion will be similar, but more complex.

Charting how quickly overall storage capacity is being consumed can help you understand how much storage to add in the expansion, and when the additional storage space will be required. You can use the Grid Manager to monitor and chart storage capacity as described in the instructions for monitoring and troubleshooting StorageGRID.

When planning the timing of an expansion, remember to consider how long it might take to procure and install additional storage.

Add storage capacity for erasure-coded objects

If your ILM policy includes a rule that makes erasure-coded copies, you must plan where to add new storage and when to add new storage. The amount of storage you add and the timing of the addition can affect the grid's usable storage capacity.

The first step in planning a storage expansion is to examine the rules in your ILM policy that create erasure-coded objects. Because StorageGRID creates *k+m* fragments for every erasure-coded object and stores each fragment on a different Storage Node, you must ensure that at least *k+m* Storage Nodes have space for new erasure-coded data after the expansion. If the erasure-coding profile provides site-loss protection, you must add storage to each site. See Manage objects with ILM.

The number of nodes you need to add also depends on how full the existing nodes are when you perform the expansion.

General recommendation for adding storage capacity for erasure-coded objects

If you want to avoid detailed calculations, you can add two Storage Nodes per site when existing Storage Nodes reach 70% capacity.

This general recommendation provides reasonable results across a wide range of erasure-coding schemes for both single-site grids and for grids where erasure coding provides site-loss protection.

To better understand the factors that lead to this recommendation or to develop a more precise plan for your site, review the next section. For a custom recommendation optimized for your situation, contact your NetApp account representative.

Calculate number of expansion Storage Nodes to add for erasure-coded objects

To optimize how you expand a deployment that stores erasure-coded objects, you must consider many factors:

- Erasure-coding scheme in use
- Characteristics of the storage pool used for erasure coding, including the number of nodes at each site and the amount of free space on each node
- Whether the grid was previously expanded (because the amount of free space per Storage Node might not be approximately the same on all nodes)
- Exact nature of the ILM policy, such as whether ILM rules make both replicated and erasure-coded objects

The following examples can help you understand the impact of the erasure-coding scheme, the number of nodes in the storage pool, and the amount of free space on each node.

Similar considerations affect the calculations for an ILM policy that stores both replicated and erasure-coded data and the calculations for a grid that has been previously expanded.

> The examples in this section represent the best practices for adding storage capacity to a StorageGRID system. If you are unable to add the recommended number of nodes, you might need to run the EC rebalance procedure to allow additional erasure-coded objects to be stored. See Rebalance erasure-coded data.

Example 1: Expand one-site grid that uses 2+1 erasure coding

This example shows how to expand a simple grid that includes only three Storage Nodes.

> This example uses only three Storage Nodes for simplicity. However, using only three Storage Nodes is not recommended: an actual production grid should use a minimum of $k+m+1$ Storage Nodes for redundancy, which equals four Storage Nodes (2+1+1) for this example.

Assume the following:

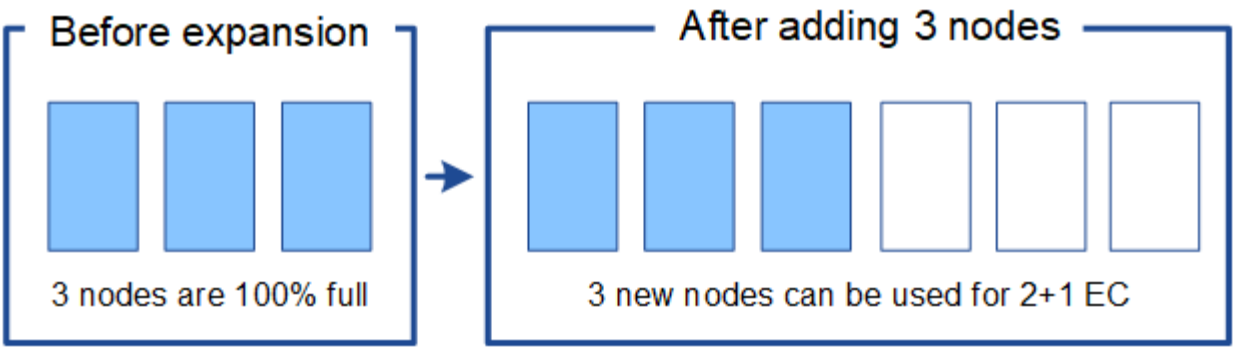
- All data is stored using the 2+1 erasure-coding scheme. With the 2+1 erasure coding scheme, every object is stored as three fragments, and each fragment is saved on a different Storage Node.
- You have one site with three Storage Nodes. Each Storage Node has a total capacity of 100 TB.
- You want to expand by adding new 100 TB Storage Nodes.
- You want to eventually balance erasure-coded data across the old and new nodes.

You have a number of options, based on how full the Storage Nodes are when you perform the expansion.

- **Add three 100 TB Storage Nodes when the existing nodes are 100% full**

  In this example, the existing nodes are 100% full. Because there is no free capacity, you must immediately add three nodes to continue 2+1 erasure coding.

  After the expansion is complete, when objects are erasure-coded, all fragments will be placed on the new nodes.

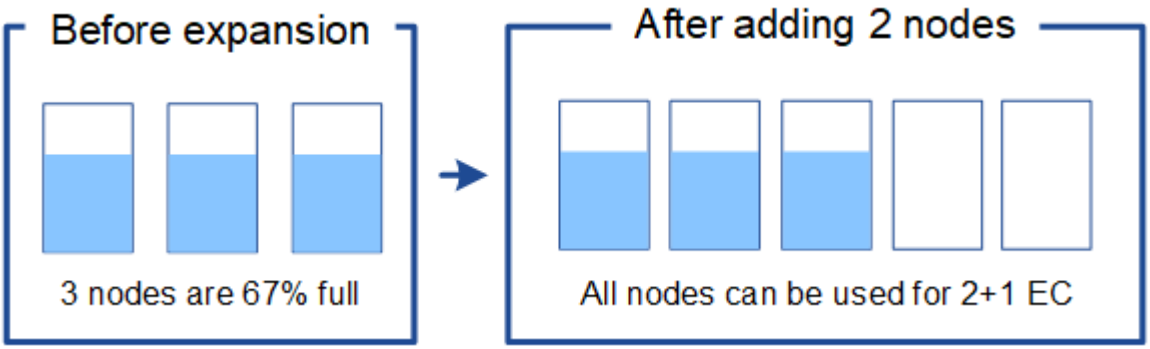


> This expansion adds *k+m* nodes. Adding four nodes is recommended for redundancy. If you add only *k+m* expansion Storage Nodes when existing nodes are 100% full, all new objects are stored on the expansion nodes. If any of the new nodes become unavailable, even temporarily, StorageGRID cannot meet ILM requirements.

- **Add two 100 TB Storage Nodes, when the existing Storage Nodes are 67% full**

  In this example, the existing nodes are 67% full. Because there are 100 TB of free capacity on the existing nodes (33 TB per node), you only need to add two nodes if you perform the expansion now.

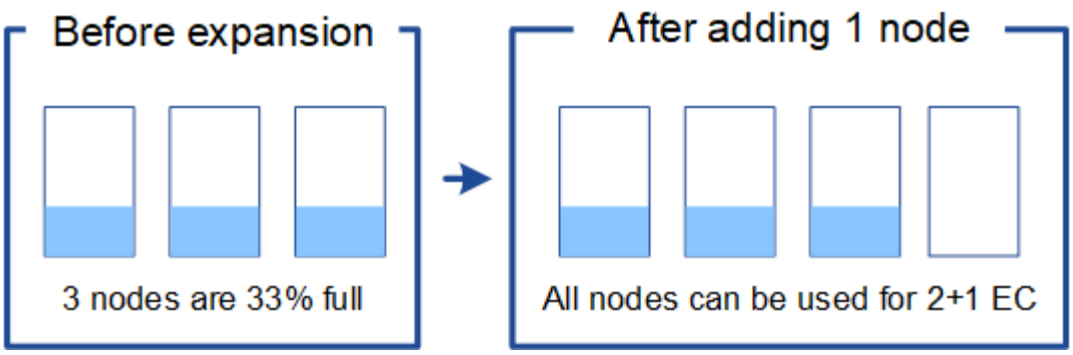
  Adding 200 TB of additional capacity will allow you to continue 2+1 erasure coding and to eventually balance erasure-coded data across all nodes.



- **Add one 100 TB Storage Node when the existing Storage Nodes are 33% full**

  In this example, the existing nodes are 33% full. Because there are 200 TB of free capacity on the existing nodes (67 TB per node), you only need to add one node if you perform the expansion now.

  Adding 100 TB of additional capacity will allow you to continue 2+1 erasure coding and to eventually balance erasure-coded data across all nodes.



Example 2: Expand three-site grid that uses 6+3 erasure coding

This example shows how to develop an expansion plan for a multi-site grid that has an erasure-coding scheme with a larger number of fragments. Despite the differences between these examples, the recommended expansion plan is very similar.

Assume the following:

- All data is stored using the 6+3 erasure coding scheme. With the 6+3 erasure coding scheme, every object is stored as 9 fragments, and each fragment is saved to a different Storage Node.
- You have three sites, and each site has four Storage Nodes (12 nodes in total). Each node has a total capacity of 100 TB.
- You want to expand by adding new 100 TB Storage Nodes.
- You want to eventually balance erasure-coded data across the old and new nodes.

You have a number of options, based on how full the Storage Nodes are when you perform the expansion.

- **Add nine 100 TB Storage Nodes (three per site), when existing nodes are 100% full**

  In this example, the 12 existing nodes are 100% full. Because there is no free capacity, you must immediately add nine nodes (900 TB of additional capacity) to continue 6+3 erasure coding.

  After the expansion is complete, when objects are erasure-coded, all fragments will be placed on the new nodes.

  > This expansion adds *k+m* nodes. Adding 12 nodes (four per site) is recommended for redundancy. If you add only *k+m* expansion Storage Nodes when existing nodes are 100% full, all new objects are stored on the expansion nodes. If any of the new nodes become unavailable, even temporarily, StorageGRID cannot meet ILM requirements.

- **Add six 100 TB Storage Nodes (two per site), when existing nodes are 75% full**

  In this example, the 12 existing nodes are 75% full. Because there are 300 TB of free capacity (25 TB per node), you only need to add six nodes if you perform the expansion now. You would add two nodes to each of the three sites.

  Adding 600 TB of storage capacity will allow you to continue 6+3 erasure coding and to eventually balance erasure-coded data across all nodes.

- **Add three 100 TB Storage Nodes (one per site), when existing nodes are 50% full**

In this example, the 12 existing nodes are 50% full. Because there are 600 TB of free capacity (50 TB per node), you only need to add three nodes if you perform the expansion now. You would add one node to each of the three sites.

Adding 300 TB of storage capacity will allow you to continue 6+3 erasure coding and to eventually balance erasure-coded data across all nodes.

Considerations for rebalancing erasure-coded data

If you are performing an expansion to add Storage Nodes and your ILM policy includes one or more ILM rules to erasure code data, you might need to perform the EC rebalance procedure after the expansion is complete.

For example, if you cannot add the recommended number of Storage Nodes for the erasure-coding scheme you are using, you might need to run the EC rebalance procedure to allow additional erasure-coded objects to be stored.

After reviewing these considerations, perform the expansion, and then go to Rebalance erasure-coded data after adding Storage Nodes to run the procedure.

What is EC rebalancing?

EC rebalancing is a StorageGRID procedure that might be required after a Storage Node expansion. The procedure is run as a command-line script from the primary Admin Node. When you run the EC rebalance procedure, StorageGRID redistributes erasure-coded fragments among the existing and the newly expanded Storage Nodes at a site.

The EC rebalance procedure:

- Only moves erasure-coded object data. It does not move replicated object data.
- Redistributes the data within a site. It does not move data between sites.
- Redistributes data among all Storage Nodes at a site. It does not redistribute data within storage volumes.
- Does not consider the replicated data usage on each Storage Node when determining where to move erasure-coded data

When the EC rebalance procedure is complete:

- Erasure-coded data is moved from Storage Nodes with less available space to Storage Nodes with more available space.
- Used (%) values might remain different between Storage Nodes because the EC rebalance procedure does not move replicated object copies.
- The data protection of erasure-coded objects will be unchanged.

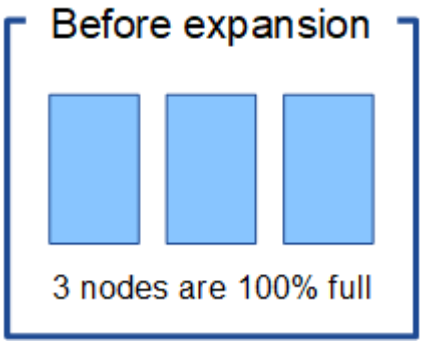
When the EC rebalance procedure is running, the performance of ILM operations and S3 and Swift client operations are likely to be impacted. For this reason, you should only perform this procedure in limited cases.

When not to perform EC rebalance

As an example of when you do not need to perform an EC rebalance, consider the following:

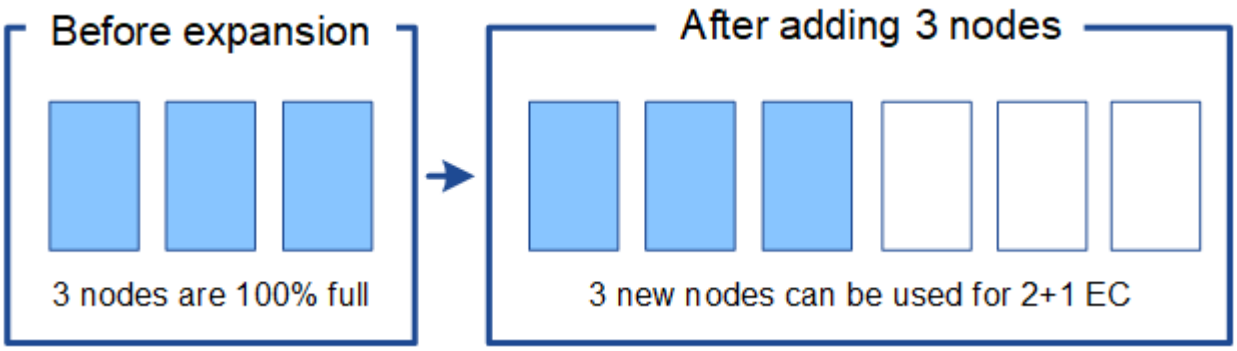
- StorageGRID is running at a single site, which contains three Storage Nodes.

- The ILM policy uses a 2+1 erasure-coding rule for all objects larger than 1.0 MB and a 2-copy replication rule for smaller objects.
- All Storage Nodes have become completely full, and the **Low Object Storage** alert has been triggered at the major severity level. The recommended action is to perform an expansion procedure to add Storage Nodes.



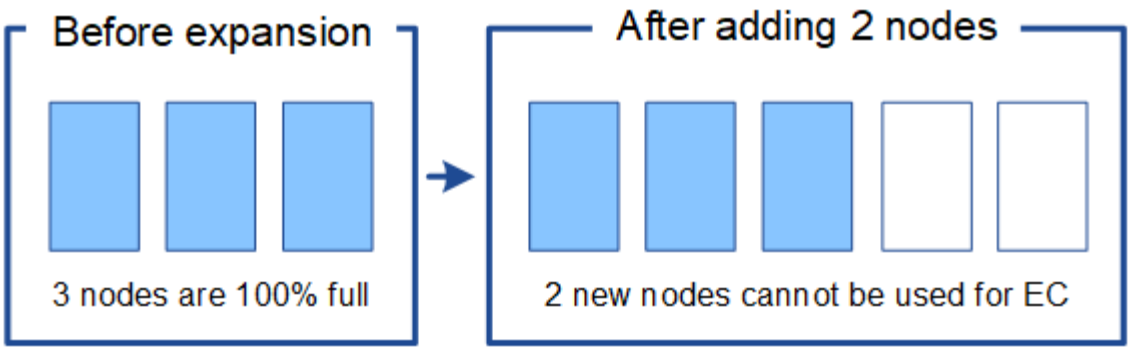
To expand the site in this example, it is recommended that you add three or more new Storage Nodes. StorageGRID requires three Storage Nodes for 2+1 erasure coding so that it can place the two data fragments and the one parity fragment on different nodes.

After you add the three Storage Nodes, the original Storage Nodes remain full, but objects can continue to be ingested into the 2+1 erasure coding scheme on the new nodes. Running the EC rebalance procedure is not recommended for this case: running the procedure will temporarily decrease performance, which might impact client operations.

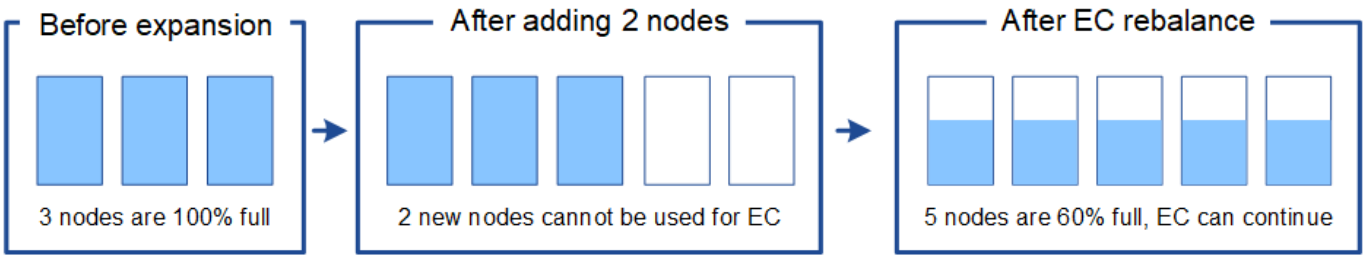


When to perform EC rebalance

As an example of when you should perform the EC rebalance procedure, consider the same example, but assume that you can only add two Storage Nodes. Because 2+1 erasure coding requires at least three Storage Nodes, the new nodes cannot be used for erasure-coded data.



To resolve this issue and make use of the new Storage Nodes, you can run the EC rebalance procedure. When this procedure runs, StorageGRID redistributes erasure-coded data and parity fragments among all Storage Nodes at the site. In this example, when the EC rebalance procedure is complete, all five nodes are now only 60% full, and objects can continue to be ingested into the 2+1 erasure coding scheme on all Storage Nodes.



Requirements for EC rebalancing

In general, you should only run the EC rebalance procedure in limited cases. Specifically, you should perform EC rebalancing only if all of the following statements are true:

- You use erasure coding for your object data.
- The **Low Object Storage** alert has been triggered for one or more Storage Nodes at a site, indicating that the nodes are 80% or more full.
- You are unable to add the recommended number of new Storage Nodes for the erasure-coding scheme in use. See Add storage capacity for erasure-coded objects.
- Your S3 and Swift clients can tolerate lower performance for their write and read operations while the EC rebalance procedure is running.

How EC rebalance procedure interacts with other maintenance tasks

You cannot perform certain maintenance procedures at the same time you are running the EC rebalance procedure.

Procedure	Allowed during EC rebalance procedure?
Additional EC rebalance procedures	No. You can only run one EC rebalance procedure at a time.

Procedure	Allowed during EC rebalance procedure?
Decommission procedure EC data repair job	No. • You are prevented from starting a decommission procedure or an EC data repair while the EC rebalance procedure is running. • You are prevented from starting the EC rebalance procedure while a Storage Node decommission procedure or an EC data repair is running.
Expansion procedure	No. If you need to add new Storage Nodes in an expansion, you should wait to run the EC rebalance procedure until after you have added all new nodes. If an EC rebalance procedure is in progress when you add new Storage Nodes, data will not be moved to those nodes.
Upgrade procedure	No. If you need to upgrade StorageGRID software, you should perform the upgrade procedure before or after running the EC rebalance procedure. As required, you can terminate the EC rebalance procedure to perform a software upgrade.
Appliance node clone procedure	No. If you need to clone an appliance Storage Node, you should wait to run the EC rebalance procedure until after you have added the new node. If an EC rebalance procedure is in progress when you add new Storage Nodes, data will not be moved to those nodes.
Hotfix procedure	Yes. You can apply a StorageGRID hotfix while the EC rebalance procedure is running.
Other maintenance procedures	No. You must terminate the EC rebalance procedure before running other maintenance procedures.

How EC rebalance procedure interacts with ILM

While the EC rebalance procedure is running, avoid making ILM changes that might change the location of existing erasure-coded objects. For example, do not start using an ILM rule that has a different Erasure Coding profile. If you need to make such ILM changes, you should abort the EC rebalance procedure.

Add metadata capacity

To ensure that adequate space is available for object metadata, you might need to perform an expansion procedure to add new Storage Nodes at each site.

StorageGRID reserves space for object metadata on volume 0 of each Storage Node. Three copies of all object metadata are maintained at each site, evenly distributed across all Storage Nodes.

You can use the Grid Manager to monitor the metadata capacity of Storage Nodes and to estimate how quickly metadata capacity is being consumed. In addition, the **Low metadata storage** alert is triggered for a Storage Node when the used metadata space reaches certain thresholds.

Note that a grid's object metadata capacity might be consumed faster than its object storage capacity, depending on how you use the grid. For example, if you typically ingest large numbers of small objects or add large quantities of user metadata or tags to objects, you might need to add Storage Nodes to increase metadata capacity even though sufficient object storage capacity remains.

For more information, see the following:

- Manage object metadata storage
- Monitor object metadata capacity for each Storage Node

Guidelines for increasing metadata capacity

Before adding Storage Nodes to increase metadata capacity, review the following guidelines and limitations:

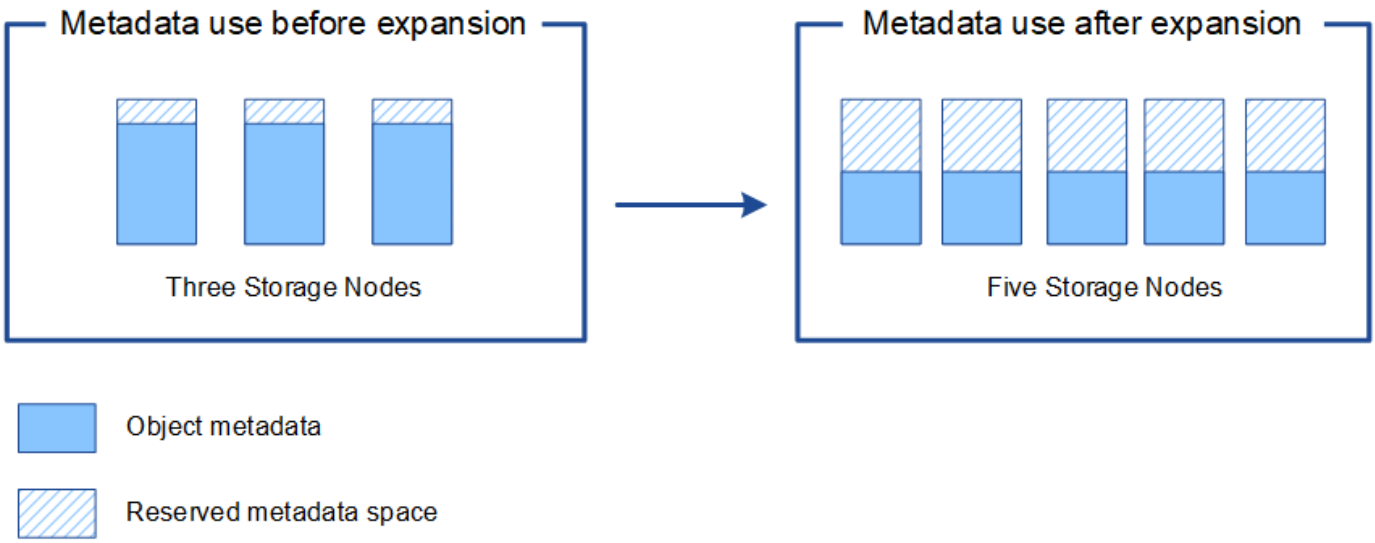
- Assuming sufficient object storage capacity is available, having more space available for object metadata increases the number of objects you can store in your StorageGRID system.
- You can increase a grid's metadata capacity by adding one or more Storage Nodes to each site.
- The actual space reserved for object metadata on any given Storage Node depends on the Metadata Reserved Space storage option (system-wide setting), the amount of RAM allocated to the node, and the size of the node's volume 0. See the instructions for administering StorageGRID.
- You cannot increase metadata capacity by adding storage volumes to existing Storage Nodes, because metadata is stored only on volume 0.
- You cannot increase metadata capacity by adding a new site.
- StorageGRID keeps three copies of all object metadata at every site. For this reason, the metadata capacity for your system is limited by the metadata capacity of your smallest site.
- When adding metadata capacity, you should add the same number of Storage Nodes to each site.

How metadata is redistributed when you add Storage Nodes

When you add Storage Nodes in an expansion, StorageGRID redistributes the existing object metadata to the new nodes at each site, which increases the overall metadata capacity of the grid. No user action is required.

The following figure shows how StorageGRID redistributes object metadata when you add Storage Nodes in an expansion. The left side of the figure represents volume 0 of three Storage Nodes before an expansion. Metadata is consuming a relatively large portion of each node's available metadata space, and the **Low metadata storage** alert has been triggered.

The right side of the figure shows how the existing metadata is redistributed after two Storage Nodes are added to the site. The amount of metadata on each node has decreased, the **Low metadata storage** alert is no longer triggered, and the space available for metadata has increased.



Add grid nodes to add capabilities to your system

You can add redundancy or additional capabilities to a StorageGRID system by adding new grid nodes to existing sites.

For example, you might choose to add additional Gateway Nodes to support the creation of High Availability groups of Gateway Nodes, or you might add an Admin Node at a remote site to permit monitoring using a local node.

You can add one or more of the following types of nodes to one or more existing sites in a single expansion operation:

- Non-primary Admin Nodes
- Storage Nodes
- Gateway Nodes
- Archive Nodes

When preparing to add grid nodes, be aware of the following limitations:

- The primary Admin Node is deployed during the initial installation. You cannot add a primary Admin Node during an expansion.
- You can add Storage Nodes and other types of nodes in the same expansion.
- When adding Storage Nodes, you must carefully plan the number and location of the new nodes. See Guidelines for adding object capacity.
- If you are adding Archive Nodes, note that each Archive Node only supports tape through Tivoli Storage Manager (TSM) middleware.
- If the **New Node Client Network Default** option is set to **Untrusted** on the Untrusted Client Networks page, client applications that connect to expansion nodes using the Client Network must connect using a load balancer endpoint port (**CONFIGURATION** > **Network** > **Untrusted Client Networks**). See the instructions for administering StorageGRID to change the setting for the new node and to configure load balancer endpoints.

Add a new site

You can expand your StorageGRID system by adding a new site.

Guidelines for adding a site

Before adding a site, review the following requirements and limitations:

- You can only add one site per expansion operation.
- You cannot add grid nodes to an existing site as part of the same expansion.
- All sites must include at least three Storage Nodes.
- Adding a new site does not automatically increase the number of objects you can store. The total object capacity of a grid depends on the amount of available storage, the ILM policy, and the metadata capacity at each site.
- When sizing a new site, you must ensure that it includes enough metadata capacity.

  StorageGRID keeps a copy of all object metadata at every site. When you add a new site, you must ensure that it includes enough metadata capacity for the existing object metadata and enough metadata capacity for growth.

  For more information, see the following:

  - Manage object metadata storage
  - Monitor object metadata capacity for each Storage Node
- You must consider the available network bandwidth between sites, and the level of network latency. Metadata updates are continually replicated between sites even if all objects are stored only at the site where they are ingested.
- Because your StorageGRID system remains operational during the expansion, you must review ILM rules before starting the expansion procedure. You must ensure that object copies are not stored to the new site until the expansion procedure is complete.

  For example, before you begin the expansion, determine if any rules use the default storage pool (All Storage Nodes). If they do, you must create a new storage pool that contains the existing Storage Nodes and update your ILM rules to use the new storage pool. Otherwise, objects will be copied to the new site as soon as the first node at that site becomes active.

  For more information about changing ILM when adding a new site, see the example for changing an ILM policy in the instructions for managing objects with ILM.

Gather required materials

Before performing an expansion operation, gather the materials and install and configure any new hardware and networks.

Item	Notes
StorageGRID installation archive	If you are adding new grid nodes or a new site, you must download and extract the StorageGRID installation archive. You must use the same version that is currently running on the grid. For details, see the instructions for downloading and extracting the StorageGRID installation files. **Note:** You do not need to download files if you are adding new storage volumes to existing Storage Nodes or installing a new StorageGRID appliance.
Service laptop	The service laptop has the following: • Network port • SSH client (for example, PuTTY) • Supported web browser
`Passwords.txt` file	Contains the passwords required to access grid nodes on the command line. Included in the Recovery Package.
Provisioning passphrase	The passphrase is created and documented when the StorageGRID system is first installed. The provisioning passphrase is not in the `Passwords.txt` file.

StorageGRID documentation	• Administer StorageGRID
	• Release notes
	• Installation instructions for your platform
	  ◦ Install Red Hat Enterprise Linux or CentOS
	  ◦ Install Ubuntu or Debian
	  ◦ Install VMware

Current documentation for your platform	For supported versions, see the Interoperability Matrix.

Download and extract the StorageGRID installation files

Before you can add new grid nodes or a new site, you must download the appropriate StorageGRID installation archive and extract the files.

About this task

You must perform expansion operations using the version of StorageGRID that is currently running on the grid.

Steps

1. Go to the NetApp Downloads page for StorageGRID.

NetApp Downloads: StorageGRID

2. Select the version of StorageGRID that is currently running on the grid.
3. Sign in with the username and password for your NetApp account.
4. Read the End User License Agreement, select the check box, and then select **Accept & Continue**.
5. In the **Install StorageGRID** column of the download page, select the `.tgz` or `.zip` file for your platform.

   The version shown in the installation archive file must match the version of the software that is currently installed.

   Use the `.zip` file if you are running Windows on the service laptop.

Platform	Installation archive

Red Hat Enterprise Linux or CentOS	`StorageGRID-Webscale-`*`version`*`-RPM-`*`uniqueID`*`.zip`
	
	`StorageGRID-Webscale-`*`version`*`-RPM-`*`uniqueID`*`.tgz`

Ubuntu or Debian or Appliances	`StorageGRID-Webscale-`*`version`*`-DEB-`*`uniqueID`*`.zip`
	
	`StorageGRID-Webscale-`*`version`*`-DEB-`*`uniqueID`*`.tgz`

VMware	`StorageGRID-Webscale-`*`version`*`-VMware-`*`uniqueID`*`.zip`
	
	`StorageGRID-Webscale-`*`version`*`-VMware-`*`uniqueID`*`.tgz`

OpenStack/other Hypervisor	To expand an existing deployment on OpenStack, you must deploy a virtual machine running one of the supported Linux distributions listed above and follow the appropriate instructions for Linux.

6. Download and extract the archive file.
7. Follow the appropriate step for your platform to choose the files you need, based on your platform, planned grid topology, and how you will expand your StorageGRID system.

   The paths listed in the step for each platform are relative to the top-level directory installed by the archive file.

8. If you are expanding a Red Hat Enterprise Linux or CentOS system, select the appropriate files.

Path and file name	Description
`./rpms/README`	A text file that describes all of the files contained in the StorageGRID download file.
`./rpms/NLF000000.txt`	A free license that does not provide any support entitlement for the product.
`./rpms/StorageGRID-Webscale-Images-`*`version`*`-SHA.rpm`	RPM package for installing the StorageGRID node images on your RHEL or CentOS hosts.

Path and file name	Description
`./rpms/StorageGRID-Webscale-Service-`*`version`*`-SHA.rpm`	RPM package for installing the StorageGRID host service on your RHEL or CentOS hosts.
Deployment scripting tool	**Description**
`./rpms/configure-storagegrid.py`	A Python script used to automate the configuration of a StorageGRID system.
`./rpms/configure-sga.py`	A Python script used to automate the configuration of StorageGRID appliances.
`./rpms/configure-storagegrid.sample.json`	An example configuration file for use with the `configure-storagegrid.py` script.
`./rpms/storagegrid-ssoauth.py`	An example Python script that you can use to sign in to the Grid Management API when single sign-on is enabled.
`./rpms/configure-storagegrid.blank.json`	A blank configuration file for use with the `configure-storagegrid.py` script.
`./rpms/extras/ansible`	Example Ansible role and playbook for configuring RHEL or CentOS hosts for StorageGRID container deployment. You can customize the role or playbook as necessary.
`./rpms/extras/api-schemas`	API schemas for StorageGRID. **Note**: Before you perform an upgrade, you can use these schemas to confirm that any code you have written to use StorageGRID management APIs will be compatible with the new StorageGRID release if you do not have a non-production StorageGRID environment for upgrade compatibility testing.

9. If you are expanding an Ubuntu or Debian system, select the appropriate files.

Path and file name	Description
`./debs/README`	A text file that describes all of the files contained in the StorageGRID download file.
`./debs/NLF000000.txt`	A non-production NetApp License File that you can use for testing and proof of concept deployments.
`./debs/storagegrid-webscale-images-version-SHA.deb`	DEB package for installing the StorageGRID node images on Ubuntu or Debian hosts.

Path and file name	Description
`./debs/storagegrid-webscale-images-version-SHA.deb.md5`	MD5 checksum for the file `/debs/storagegrid-webscale-images-version-SHA.deb`.
`./debs/storagegrid-webscale-service-version-SHA.deb`	DEB package for installing the StorageGRID host service on Ubuntu or Debian hosts.
Deployment scripting tool	**Description**
`./debs/configure-storagegrid.py`	A Python script used to automate the configuration of a StorageGRID system.
`./debs/configure-sga.py`	A Python script used to automate the configuration of StorageGRID appliances.
`./debs/storagegrid-ssoauth.py`	An example Python script that you can use to sign in to the Grid Management API when single sign-on is enabled.
`./debs/configure-storagegrid.sample.json`	An example configuration file for use with the `configure-storagegrid.py` script.
`./debs/configure-storagegrid.blank.json`	A blank configuration file for use with the `configure-storagegrid.py` script.
`./debs/extras/ansible`	Example Ansible role and playbook for configuring Ubuntu or Debian hosts for StorageGRID container deployment. You can customize the role or playbook as necessary.
`./debs/extras/api-schemas`	API schemas for StorageGRID. **Note**: Before you perform an upgrade, you can use these schemas to confirm that any code you have written to use StorageGRID management APIs will be compatible with the new StorageGRID release if you do not have a non-production StorageGRID environment for upgrade compatibility testing.

10. If you are expanding a VMware system, select the appropriate files.

Path and file name	Description
`./vsphere/README`	A text file that describes all of the files contained in the StorageGRID download file.
`./vsphere/NLF000000.txt`	A free license that does not provide any support entitlement for the product.

Path and file name	Description
`./vsphere/NetApp-SG-version-SHA.vmdk`	The virtual machine disk file that is used as a template for creating grid node virtual machines.

`./vsphere/vsphere-primary-admin.ovf`
 	
`./vsphere/vsphere-primary-admin.mf`
	The Open Virtualization Format template file (`.ovf`) and manifest file (`.mf`) for deploying the primary Admin Node.

`./vsphere/vsphere-non-primary-admin.ovf`
 	
`./vsphere/vsphere-non-primary-admin.mf`
	The template file (`.ovf`) and manifest file (`.mf`) for deploying non-primary Admin Nodes.

`./vsphere/vsphere-archive.ovf`
 	
`./vsphere/vsphere-archive.mf`
	The template file (`.ovf`) and manifest file (`.mf`) for deploying Archive Nodes.

`./vsphere/vsphere-gateway.ovf`
 	
`./vsphere/vsphere-gateway.mf`
	The template file (`.ovf`) and manifest file (`.mf`) for deploying Gateway Nodes.

`./vsphere/vsphere-storage.ovf`
 	
`./vsphere/vsphere-storage.mf`
	The template file (`.ovf`) and manifest file (`.mf`) for deploying virtual machine-based Storage Nodes.

Deployment scripting tool	**Description**
`./vsphere/deploy-vsphere-ovftool.sh`	A Bash shell script used to automate the deployment of virtual grid nodes.
`./vsphere/deploy-vsphere-ovftool-sample.ini`	An example configuration file for use with the `deploy-vsphere-ovftool.sh` script.
`./vsphere/configure-storagegrid.py`	A Python script used to automate the configuration of a StorageGRID system.
`./vsphere/configure-sga.py`	A Python script used to automate the configuration of StorageGRID appliances.
`./vsphere/storagegrid-ssoauth.py`	An example Python script that you can use to sign in to the Grid Management API when single sign-on is enabled.
`./vsphere/configure-storagegrid.sample.json`	An example configuration file for use with the `configure-storagegrid.py` script.
`./vsphere/configure-storagegrid.blank.json`	A blank configuration file for use with the `configure-storagegrid.py` script.

Path and file name	Description
`./vsphere/extras/api-schemas`	API schemas for StorageGRID. **Note**: Before you perform an upgrade, you can use these schemas to confirm that any code you have written to use StorageGRID management APIs will be compatible with the new StorageGRID release if you do not have a non-production StorageGRID environment for upgrade compatibility testing.

11. If you are expanding a StorageGRID appliance-based system, select the appropriate files.

Path and file name	Description
`./debs/storagegrid-webscale-images-version-SHA.deb`	DEB package for installing the StorageGRID node images on your appliances.
`./debs/storagegrid-webscale-images-version-SHA.deb.md5`	Checksum of the DEB installation package used by the StorageGRID Appliance Installer to validate that the package is intact after upload.

> For appliance installation, these files are only required if you need to avoid network traffic. The appliance can download the required files from the primary Admin Node.

Verify hardware and networking

Before beginning the expansion of your StorageGRID system, ensure the following:

- The hardware needed to support the new grid nodes or new site has been installed and configured.
- All new nodes have bidirectional communication paths to all existing and new nodes (a requirement for the Grid Network).
- The primary Admin Node can communicate with all expansion servers that are intended to host the StorageGRID system.
- If any of the new nodes has a Grid Network IP address on a subnet not previously used, you have already added the new subnet to the Grid Network subnet list. Otherwise, you will have to cancel the expansion, add the new subnet, and start the procedure again.
- You are not using network address translation (NAT) on the Grid Network between grid nodes or between StorageGRID sites. When you use private IPv4 addresses for the Grid Network, those addresses must be directly routable from every grid node at every site. Using NAT to bridge the Grid Network across a public network segment is supported only if you use a tunneling application that is transparent to all nodes in the grid, meaning the grid nodes require no knowledge of public IP addresses.

  This NAT restriction is specific to grid nodes and the Grid Network. As required, you can use NAT between external clients and grid nodes, such as to provide a public IP address for a Gateway Node.

Add storage volumes

Add storage volumes to Storage Nodes

You can expand the storage capacity of Storage Nodes that have 16 or fewer storage volumes by adding additional storage volumes. You might need to add storage volumes to more than one Storage Node to satisfy ILM requirements for replicated or erasure-coded copies.

What you'll need

Before adding storage volumes, review the guidelines for adding object capacity to ensure that you know where to add volumes to meet the requirements of your ILM policy.

> These instructions apply to software-based Storage Nodes only. See Add expansion shelf to deployed SG6060 to learn how to add storage volumes to SG6060 by installing expansion shelves. Other appliance Storage Nodes cannot be expanded.

About this task

The underlying storage of a Storage Node is divided into a number of storage volumes. Storage volumes are block-based storage devices that are formatted by the StorageGRID system and mounted to store objects. Each Storage Node can support up to 16 storage volumes, which are called *object stores* in the Grid Manager.

> Object metadata is always stored in object store 0.

Each object store is mounted on a volume that corresponds to its ID. For example, the object store with an ID of 0000 corresponds to the `/var/local/rangedb/0` mount point.

Before adding new storage volumes, use the Grid Manager to view the current object stores for each Storage Node as well as the corresponding mount points. You can use this information when adding storage volumes.

Steps

1. Select **NODES** > ***site*** > ***Storage Node*** > **Storage**.
2. Scroll down to view the amounts of available storage for each volume and object store.

   For appliance Storage Nodes, the Worldwide Name for each disk matches the volume world-wide identifier (WWID) that appears when you view standard volume properties in SANtricity software (the management software connected to the appliance's storage controller).

   To help you interpret disk read and write statistics related to volume mount points, the first portion of the name shown in the **Name** column of the Disk Devices table (that is, *sdc*, *sdd*, *sde*, and so on) matches the value shown in the **Device** column of the Volumes table.

Disk devices

Name	World Wide Name	I/O load	Read rate	Write rate
sdc(8:16,sdb)	N/A	0.05%	0 bytes/s	4 KB/s
sde(8:48,sdd)	N/A	0.00%	0 bytes/s	82 bytes/s
sdf(8:64,sde)	N/A	0.00%	0 bytes/s	82 bytes/s
sdg(8:80,sdf)	N/A	0.00%	0 bytes/s	82 bytes/s
sdd(8:32,sdc)	N/A	0.00%	0 bytes/s	82 bytes/s
croot(8:1,sda1)	N/A	0.04%	0 bytes/s	4 KB/s
cvloc(8:2,sda2)	N/A	0.95%	0 bytes/s	52 KB/s

Volumes

Mount point	Device	Status	Size	Available	Write cache status
/	croot	Online	21.00 GB	14.73 GB	Unknown
/var/local	cvloc	Online	85.86 GB	80.94 GB	Unknown
/var/local/rangedb/0	sdc	Online	107.32 GB	107.17 GB	Enabled
/var/local/rangedb/1	sdd	Online	107.32 GB	107.18 GB	Enabled
/var/local/rangedb/2	sde	Online	107.32 GB	107.18 GB	Enabled
/var/local/rangedb/3	sdf	Online	107.32 GB	107.18 GB	Enabled
/var/local/rangedb/4	sdg	Online	107.32 GB	107.18 GB	Enabled

Object stores

ID	Size	Available	Replicated data	EC data	Object data (%)	Health
0000	107.32 GB	96.44 GB	1.55 MB	0 bytes	0.00%	No Errors
0001	107.32 GB	107.18 GB	0 bytes	0 bytes	0.00%	No Errors
0002	107.32 GB	107.18 GB	0 bytes	0 bytes	0.00%	No Errors
0003	107.32 GB	107.18 GB	0 bytes	0 bytes	0.00%	No Errors
0004	107.32 GB	107.18 GB	0 bytes	0 bytes	0.00%	No Errors

3. Follow the instructions for your platform to add new storage volumes to the Storage Node.
    - VMware: Add storage volumes to Storage Node
    - Linux: Add direct-attached or SAN volumes to Storage Node

VMware: Add storage volumes to Storage Node

If a Storage Node includes fewer than 16 storage volumes, you can increase its capacity by using VMware vSphere to add volumes.

What you'll need

- You have access to the instructions for installing StorageGRID for VMware deployments.
    - Install VMware
- You have the `Passwords.txt` file.
- You have specific access permissions.

> Do not attempt to add storage volumes to a Storage Node while a software upgrade, recovery procedure, or another expansion procedure is active.

About this task

The Storage Node is unavailable for a brief time when you add storage volumes. You should perform this procedure on one Storage Node at a time to avoid impacting client-facing grid services.

Steps

1. If necessary, install new storage hardware and create new VMware datastores.
2. Add one or more hard disks to the virtual machine for use as storage (object stores).

    a. Open VMware vSphere Client.

    b. Edit the virtual machine settings to add one or more additional hard disks.

    The hard disks are typically configured as Virtual Machine Disks (VMDKs). VMDKs are more commonly used and are easier to manage, while RDMs may provide better performance for workloads that use larger object sizes (for example, greater than 100 MB). For more information about adding hard disks to virtual machines, see the VMware vSphere documentation.

3. Restart the virtual machine by using the **Restart Guest OS** option in the VMware vSphere Client, or by entering the following command in an ssh session to the virtual machine:`sudo reboot`

    > Do not use **Power Off** or **Reset** to restart the virtual machine.

4. Configure the new storage for use by the Storage Node:

    a. Log in to the grid node:

    i. Enter the following command: `ssh admin@grid_node_IP`

    ii. Enter the password listed in the `Passwords.txt` file.

    iii. Enter the following command to switch to root: `su -`

    iv. Enter the password listed in the `Passwords.txt` file. When you are logged in as root, the prompt changes from `$` to `#`.

b. Configure the new storage volumes:

```
sudo add_rangedbs.rb
```

This script finds any new storage volumes and prompts you to format them.

c. Enter **y** to accept the formatting.

d. If any of the volumes have previously been formatted, decide if you want to reformat them.

- Enter **y** to reformat.
- Enter **n** to skip reformatting.

e. When asked, enter **y** to stop storage services.

The storage services are stopped, and the `setup_rangedbs.sh` script runs automatically. After the volumes are ready for use as rangedbs, the services start again.

5. Check that the services start correctly:

a. View a listing of the status of all services on the server:

```
sudo storagegrid-status
```

The status is updated automatically.

b. Wait until all services are Running or Verified.

c. Exit the status screen:

```
Ctrl+C
```

6. Verify that the Storage Node is online:

a. Sign in to the Grid Manager using a supported web browser.

b. Select **SUPPORT** > **Tools** > **Grid topology**.

c. Select ***site*** > ***Storage Node*** > **LDR** > **Storage**.

d. Select the **Configuration** tab and then the **Main** tab.

e. If the **Storage State - Desired** drop-down list is set to Read-only or Offline, select **Online**.

f. Select **Apply Changes**.

7. To see the new object stores:

a. Select **NODES** > ***site*** > ***Storage Node*** > **Storage**.

b. View the details in the **Object Stores** table.

Result

You can use the expanded capacity of the Storage Nodes to save object data.

Linux: Add direct-attached or SAN volumes to Storage Node

If a Storage Node includes fewer than 16 storage volumes, you can increase its capacity by adding new block storage devices, making them visible to the Linux hosts, and adding the new block device mappings to the StorageGRID configuration file used for the

Storage Node.

What you'll need

- You have access to the instructions for installing StorageGRID for your Linux platform.
  - Install Red Hat Enterprise Linux or CentOS
  - Install Ubuntu or Debian
- You have the `Passwords.txt` file.
- You have specific access permissions.

> Do not attempt to add storage volumes to a Storage Node while a software upgrade, recovery procedure, or another expansion procedure is active.

About this task

The Storage Node is unavailable for a brief time when you add storage volumes. You should perform this procedure on one Storage Node at a time to avoid impacting client-facing grid services.

Steps

1. Install the new storage hardware.

   For more information, see the documentation provided by your hardware vendor.

2. Create new block storage volumes of the desired sizes.
   - Attach the new disk drives and update the RAID controller configuration as needed, or allocate the new SAN LUNs on the shared storage arrays and allow the Linux host to access them.
   - Use the same persistent naming scheme you used for the storage volumes on the existing Storage Node.
   - If you use the StorageGRID node migration feature, make the new volumes visible to other Linux hosts that are migration targets for this Storage Node. For more information, see the instructions for installing StorageGRID for your Linux platform.
3. Log into the Linux host supporting the Storage Node as root or with an account that has sudo permission.
4. Confirm that the new storage volumes are visible on the Linux host.

   You might have to rescan for devices.

5. Run the following command to temporarily disable the Storage Node:

   ```
   sudo storagegrid node stop <node-name>
   ```

6. Using a text editor such as vim or pico, edit the node configuration file for the Storage Node, which can be found at `/etc/storagegrid/nodes/<node-name>.conf`.
7. Locate the section of the node configuration file that contains the existing object storage block device mappings.

   In the example, `BLOCK_DEVICE_RANGEDB_00` to `BLOCK_DEVICE_RANGEDB_03` are the existing object storage block device mappings.

```
NODE_TYPE = VM_Storage_Node
ADMIN_IP = 10.1.0.2
BLOCK_DEVICE_VAR_LOCAL = /dev/mapper/sgws-sn1-var-local
BLOCK_DEVICE_RANGEDB_00 = /dev/mapper/sgws-sn1-rangedb-0
BLOCK_DEVICE_RANGEDB_01 = /dev/mapper/sgws-sn1-rangedb-1
BLOCK_DEVICE_RANGEDB_02 = /dev/mapper/sgws-sn1-rangedb-2
BLOCK_DEVICE_RANGEDB_03 = /dev/mapper/sgws-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
```

8. Add new object storage block device mappings corresponding to the block storage volumes you added for this Storage Node.

   Make sure to start at the next `BLOCK_DEVICE_RANGEDB_nn`. Do not leave a gap.

   - Based on the example above, start at `BLOCK_DEVICE_RANGEDB_04`.
   - In the example below, four new block storage volumes have been added to the node: `BLOCK_DEVICE_RANGEDB_04` to `BLOCK_DEVICE_RANGEDB_07`.

```
NODE_TYPE = VM_Storage_Node
ADMIN_IP = 10.1.0.2
BLOCK_DEVICE_VAR_LOCAL = /dev/mapper/sgws-sn1-var-local
BLOCK_DEVICE_RANGEDB_00 = /dev/mapper/sgws-sn1-rangedb-0
BLOCK_DEVICE_RANGEDB_01 = /dev/mapper/sgws-sn1-rangedb-1
BLOCK_DEVICE_RANGEDB_02 = /dev/mapper/sgws-sn1-rangedb-2
BLOCK_DEVICE_RANGEDB_03 = /dev/mapper/sgws-sn1-rangedb-3
BLOCK_DEVICE_RANGEDB_04 = /dev/mapper/sgws-sn1-rangedb-4
BLOCK_DEVICE_RANGEDB_05 = /dev/mapper/sgws-sn1-rangedb-5
BLOCK_DEVICE_RANGEDB_06 = /dev/mapper/sgws-sn1-rangedb-6
BLOCK_DEVICE_RANGEDB_07 = /dev/mapper/sgws-sn1-rangedb-7
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
```

9. Run the following command to validate your changes to the node configuration file for the Storage Node:

   ```
   sudo storagegrid node validate <node-name>
   ```

   Address any errors or warnings before proceeding to the next step.

If you observe an error similar to the following, it means that the node configuration file is attempting to map the block device used by `<node-name>` for `<PURPOSE>` to the given `<path-name>` in the Linux file system, but there is not a valid block device special file (or softlink to a block device special file) at that location.

```
Checking configuration file for node <node-name>…
ERROR: BLOCK_DEVICE_<PURPOSE> = <path-name>
<path-name> is not a valid block device
```

Verify that you entered the correct `<path-name>`.

10. Run the following command to restart the node with the new block device mappings in place:

    ```
    sudo storagegrid node start <node-name>
    ```

11. Log in to the Storage Node as admin using the password listed in the `Passwords.txt` file.
12. Check that the services start correctly:
    a. View a listing of the status of all services on the server:
       `sudo storagegrid-status`

       The status is updated automatically.

    b. Wait until all services are Running or Verified.
    c. Exit the status screen:

       `Ctrl+C`

13. Configure the new storage for use by the Storage Node:
    a. Configure the new storage volumes:

       `sudo add_rangedbs.rb`

       This script finds any new storage volumes and prompts you to format them.

    b. Enter **y** to format the storage volumes.
    c. If any of the volumes have previously been formatted, decide if you want to reformat them.
       - Enter **y** to reformat.
       - Enter **n** to skip reformatting.
    d. When asked, enter **y** to stop storage services.

       The storage services are stopped, and the `setup_rangedbs.sh` script runs automatically. After the volumes are ready for use as rangedbs, the services start again.

14. Check that the services start correctly:
    a. View a listing of the status of all services on the server:

       `sudo storagegrid-status`

The status is updated automatically.

b. Wait until all services are Running or Verified.

c. Exit the status screen:

```
Ctrl+C
```

15. Verify that the Storage Node is online:
    a. Sign in to the Grid Manager using a supported web browser.
    b. Select **SUPPORT** > **Tools** > **Grid topology**.
    c. Select ***site*** > ***Storage Node*** > **LDR** > **Storage**.
    d. Select the **Configuration** tab and then the **Main** tab.
    e. If the **Storage State - Desired** drop-down list is set to Read-only or Offline, select **Online**.
    f. Click **Apply Changes**.
16. To see the new object stores:
    a. Select **NODES** > ***site*** > ***Storage Node*** > **Storage**.
    b. View the details in the **Object Stores** table.

Result

You can now use the expanded capacity of the Storage Nodes to save object data.

Add grid nodes or site

Add grid nodes to existing site or add new site

You can follow this procedure to add grid nodes to existing sites or to add a new site, but you cannot perform both types of expansion at the same time.

What you'll need

- You have the Root access or Maintenance permission.
- All existing nodes in the grid are up and running across all sites.
- Any previous expansion, upgrade, decommissioning, or recovery procedures are complete.

> You are prevented from starting an expansion while another expansion, upgrade, recovery, or active decommission procedure is in progress. However, if necessary, you can pause a decommission procedure to start an expansion.

Steps

1. Update subnets for Grid Network.
2. Deploy new grid nodes.
3. Perform expansion.

Update subnets for Grid Network

When you add grid nodes or a new site in an expansion, you might need to update or add subnets to the Grid Network.

StorageGRID maintains a list of the network subnets used to communicate between grid nodes on the Grid Network (eth0). These entries include the subnets used for the Grid Network by each site in your StorageGRID system as well as any subnets used for NTP, DNS, LDAP, or other external servers accessed through the Grid Network gateway.

What you'll need

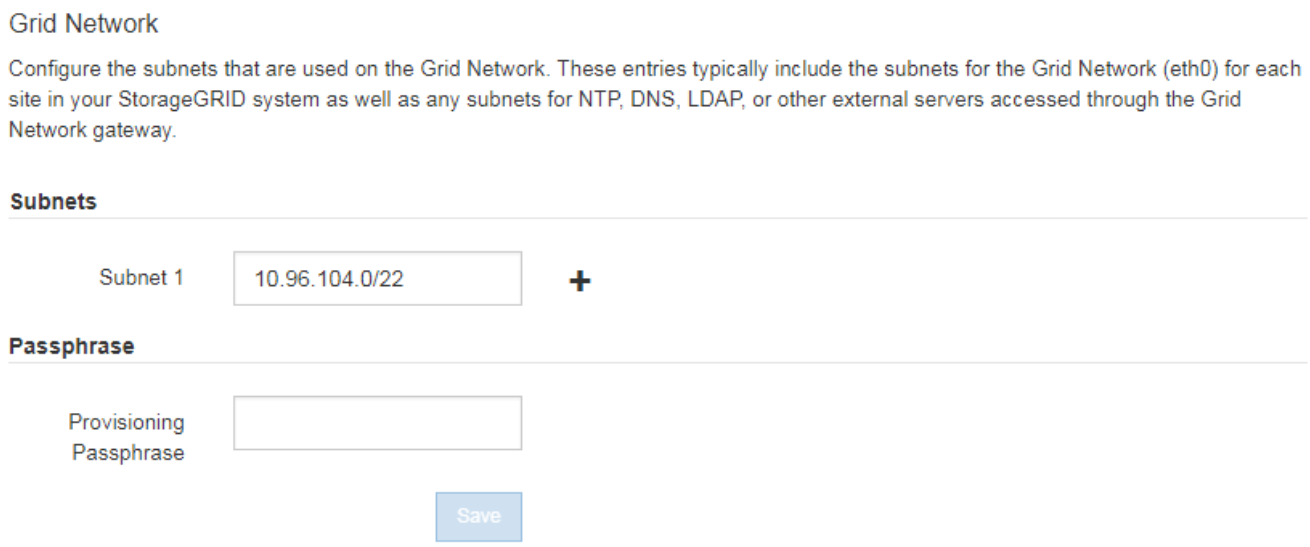
- You are signed in to the Grid Manager using a supported web browser.
- You have the Maintenance or Root access permission.
- You have the provisioning passphrase.
- You have the network addresses, in CIDR notation, of the subnets you want to configure.

About this task

If any of the new nodes has a Grid Network IP address on a subnet not previously used, you must add the new subnet to the Grid Network subnet list before starting the expansion. Otherwise, you will have to cancel the expansion, add the new subnet, and start the procedure again.

Steps

1. Select **MAINTENANCE** > **Network** > **Grid Network**.



2. In the Subnets list, select the plus sign to add a new subnet in CIDR notation.

   For example, enter 10.96.104.0/22.

3. Enter the provisioning passphrase, and select **Save**.

   The subnets you have specified are configured automatically for your StorageGRID system.

Deploy new grid nodes

The steps for deploying new grid nodes in an expansion are the same as the steps used when the grid was first installed. You must deploy all new grid nodes before you can perform the expansion.

When you expand the grid, the nodes you add do not have to match the existing node types. You can add VMware nodes, Linux container-based nodes, or appliance nodes.

VMware: Deploy grid nodes

You must deploy a virtual machine in VMware vSphere for each VMware node you want to add in the expansion.

Steps

1. Deploy the new node as virtual machine and connect it to one or more StorageGRID networks.

   When you deploy the node, you can optionally remap node ports or increase CPU or memory settings.

2. After you have deployed all new VMware nodes, perform the expansion procedure.

Linux: Deploy grid nodes

You can deploy grid nodes on new Linux hosts or on existing Linux hosts. If you need additional Linux hosts to support the CPU, RAM, and storage requirements of the StorageGRID nodes you want to add to your grid, you prepare them in the same way you prepared the hosts when you first installed them. Then, you deploy the expansion nodes in the same way you deployed grid nodes during installation.

What you'll need

- You have the instructions for installing StorageGRID for your version of Linux, and you have reviewed the hardware and storage requirements.
  - Install Red Hat Enterprise Linux or CentOS
  - Install Ubuntu or Debian
- If you plan to deploy new grid nodes on existing hosts, you have confirmed the existing hosts have enough CPU, RAM, and storage capacity for the additional nodes.
- You have a plan to minimize failure domains. For example, you should not deploy all Gateway Nodes on a single physical host.

  > In a production deployment, do not run more than one Storage Node on a single physical or virtual host. Using a dedicated host for each Storage Node provides an isolated failure domain.

- If the StorageGRID node uses storage assigned from a NetApp AFF system, confirm that the volume does not have a FabricPool tiering policy enabled. Disabling FabricPool tiering for volumes used with StorageGRID nodes simplifies troubleshooting and storage operations.

Steps

1. If you are adding new hosts, access the installation instructions for deploying StorageGRID nodes.
2. To deploy the new hosts, follow the instructions for preparing the hosts.
3. To create node configuration files and to validate the StorageGRID configuration, follow the instructions for

deploying grid nodes.

4. If you are adding nodes to a new Linux host, start the StorageGRID host service.
5. If you are adding nodes to an existing Linux host, start the new nodes using the storagegrid host service CLI:`sudo storagegrid node start [<node name\>]`

After you finish

After deploying all new grid nodes, you can perform the expansion.

Appliances: Deploying Storage, Gateway, or non-primary Admin Nodes

To install the StorageGRID software on an appliance node, you use the StorageGRID Appliance Installer, which is included on the appliance. In an expansion, each storage appliance functions as a single Storage Node, and each services appliance functions as a single Gateway Node or non-primary Admin Node. Any appliance can connect to the Grid Network, the Admin Network, and the Client Network.

What you'll need

- The appliance has been installed in a rack or cabinet, connected to your networks, and powered on.
- You have used the StorageGRID Appliance Installer to complete all of the "configure hardware" steps in the appliance installation and maintenance instructions.
    - SG100 and SG1000 services appliances
    - Configure hardware (SG5600)
    - Configure hardware (SG5700)
    - Configure hardware (SG6000)

  Configuring appliance hardware includes the required steps for configuring StorageGRID connections (network links and IP addresses) as well the optional steps for enabling node encryption, changing the RAID mode, and remapping network ports.

- All Grid Network subnets listed on the IP Configuration page of the StorageGRID Appliance Installer have been defined in the Grid Network Subnet List on the primary Admin Node.
- The StorageGRID Appliance Installer firmware on the replacement appliance is compatible with the StorageGRID software version currently running on your grid. For example, version 3.6 of the StorageGRID Appliance Installer is compatible with version 11.6 of StorageGRID. (If the versions are not compatible, you must upgrade the StorageGRID Appliance Installer firmware.)
- You have a service laptop with a supported web browser.
- You know one of the IP addresses assigned to the appliance's compute controller. You can use the IP address for any attached StorageGRID network.

About this task

The process of installing StorageGRID on an appliance node has the following phases:

- You specify or confirm the IP address of the primary Admin Node and the name of the appliance node.
- You start the installation and wait as volumes are configured and the software is installed.

  Partway through appliance installation tasks, the installation pauses. To resume the installation, you sign into the Grid Manager, approve all grid nodes, and complete the StorageGRID installation process.

If you need to deploy multiple appliance nodes at one time, you can automate the installation process by using the `configure-sga.py` Appliance Installation Script.

Steps

1. Open a browser, and enter one of the IP addresses for the appliance's compute controller.

   `https://Controller_IP:8443`

   The StorageGRID Appliance Installer Home page appears.

2. In the **Primary Admin Node** connection section, determine whether you need to specify the IP address for the primary Admin Node.

   If you have previously installed other nodes in this data center, the StorageGRID Appliance Installer can discover this IP address automatically, assuming the primary Admin Node, or at least one other grid node with ADMIN_IP configured, is present on the same subnet.

3. If this IP address is not shown or you need to change it, specify the address:

Option	Description
Manual IP entry	a. Unselect the **Enable Admin Node discovery** check box. b. Enter the IP address manually. c. Click **Save**. d. Wait for the connection state for the new IP address to become ready.
Automatic discovery of all connected primary Admin Nodes	a. Select the **Enable Admin Node discovery** check box. b. Wait for the list of discovered IP addresses to be displayed. c. Select the primary Admin Node for the grid where this appliance Storage Node will be deployed. d. Click **Save**. e. Wait for the connection state for the new IP address to become ready.

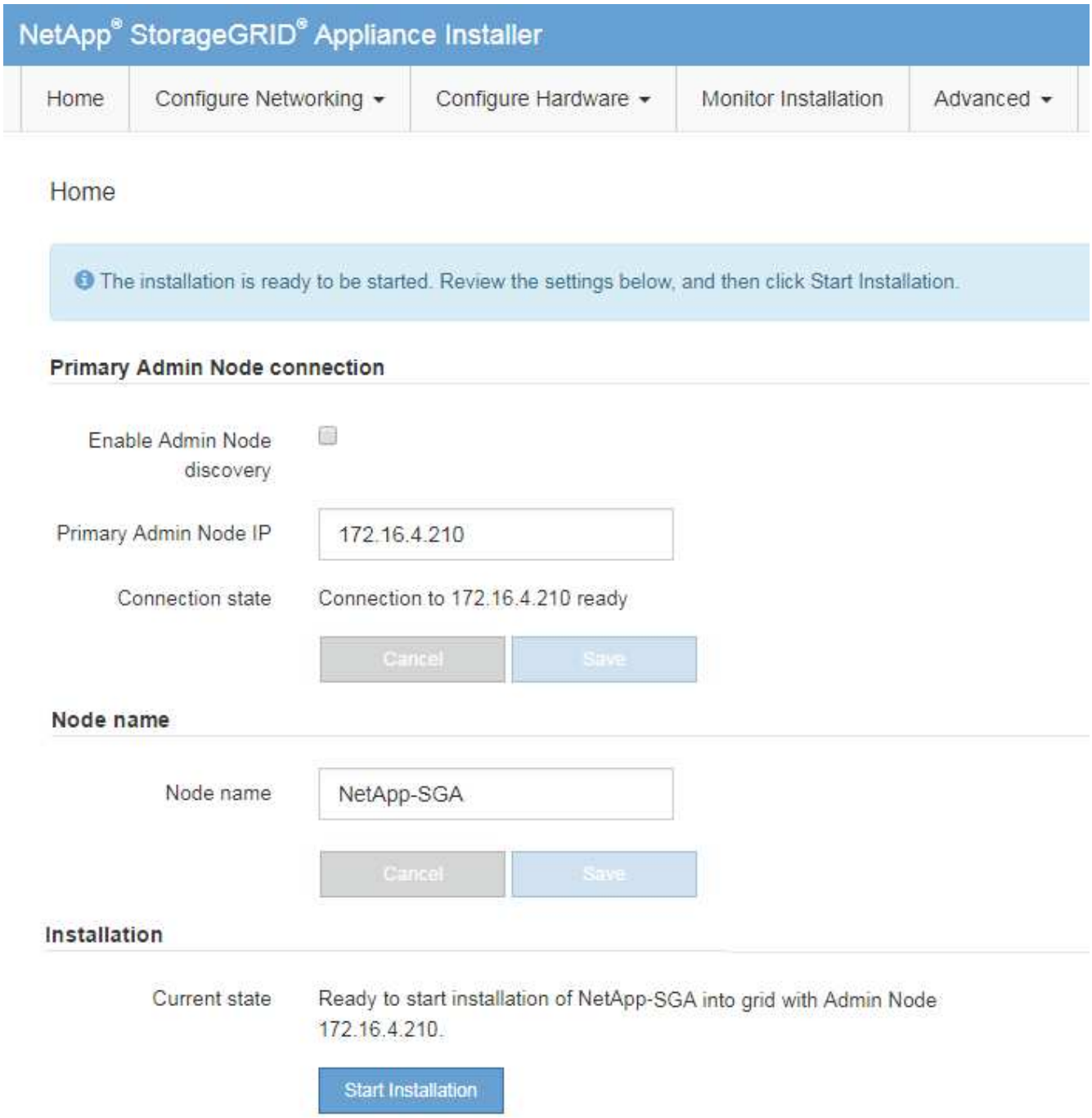
4. In the **Node name** field, enter the name you want to use for this appliance node, and select **Save**.

   The node name is assigned to this appliance node in the StorageGRID system. It is shown on the Nodes page (Overview tab) in the Grid Manager. If required, you can change the name when you approve the node.

5. In the **Installation** section, confirm that the current state is "Ready to start installation of *node name* into grid with primary Admin Node *admin_ip*" and that the **Start Installation** button is enabled.

   If the **Start Installation** button is not enabled, you might need to change the network configuration or port settings. For instructions, see the installation and maintenance instructions for your appliance.

6. From the StorageGRID Appliance Installer home page, select **Start Installation**.



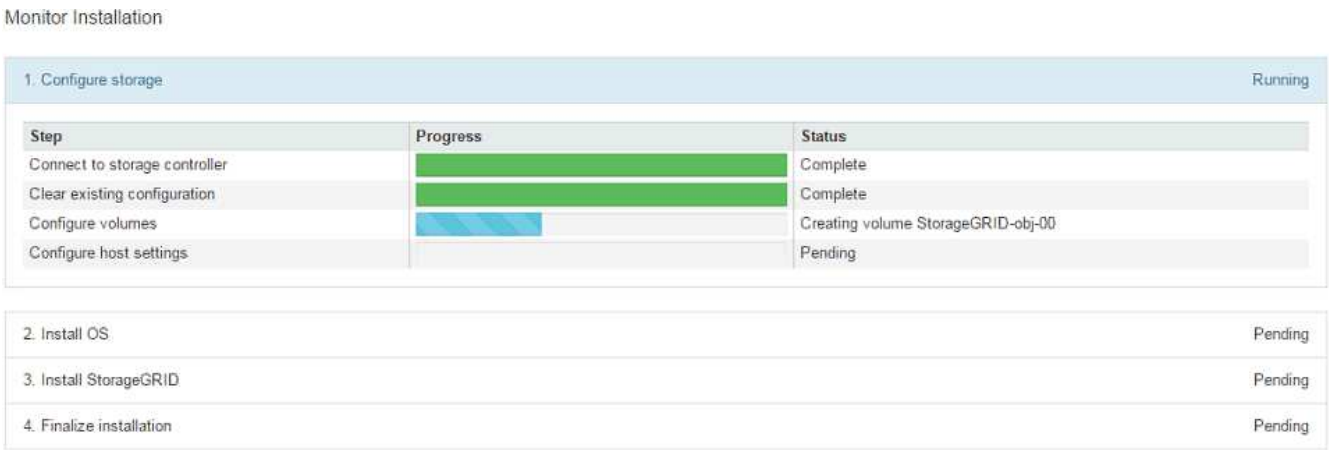
The Current state changes to “Installation is in progress,” and the Monitor Installation page is displayed.

7. If your expansion includes multiple appliance nodes, repeat the previous steps for each appliance.

> If you need to deploy multiple appliance Storage Nodes at one time, you can automate the installation process by using the configure-sga.py appliance installation script.

8. If you need to manually access the Monitor Installation page, select **Monitor Installation** from the menu bar.

   The Monitor Installation page shows the installation progress.



The blue status bar indicates which task is currently in progress. Green status bars indicate tasks that have completed successfully.

> The installer ensures that tasks completed in a previous install are not re-run. If you are re-running an installation, any tasks that do not need to be re-run are shown with a green status bar and a status of “Skipped.”

9. Review the progress of first two installation stages.

   1. Configure appliance

   During this stage, one of the following processes occurs:

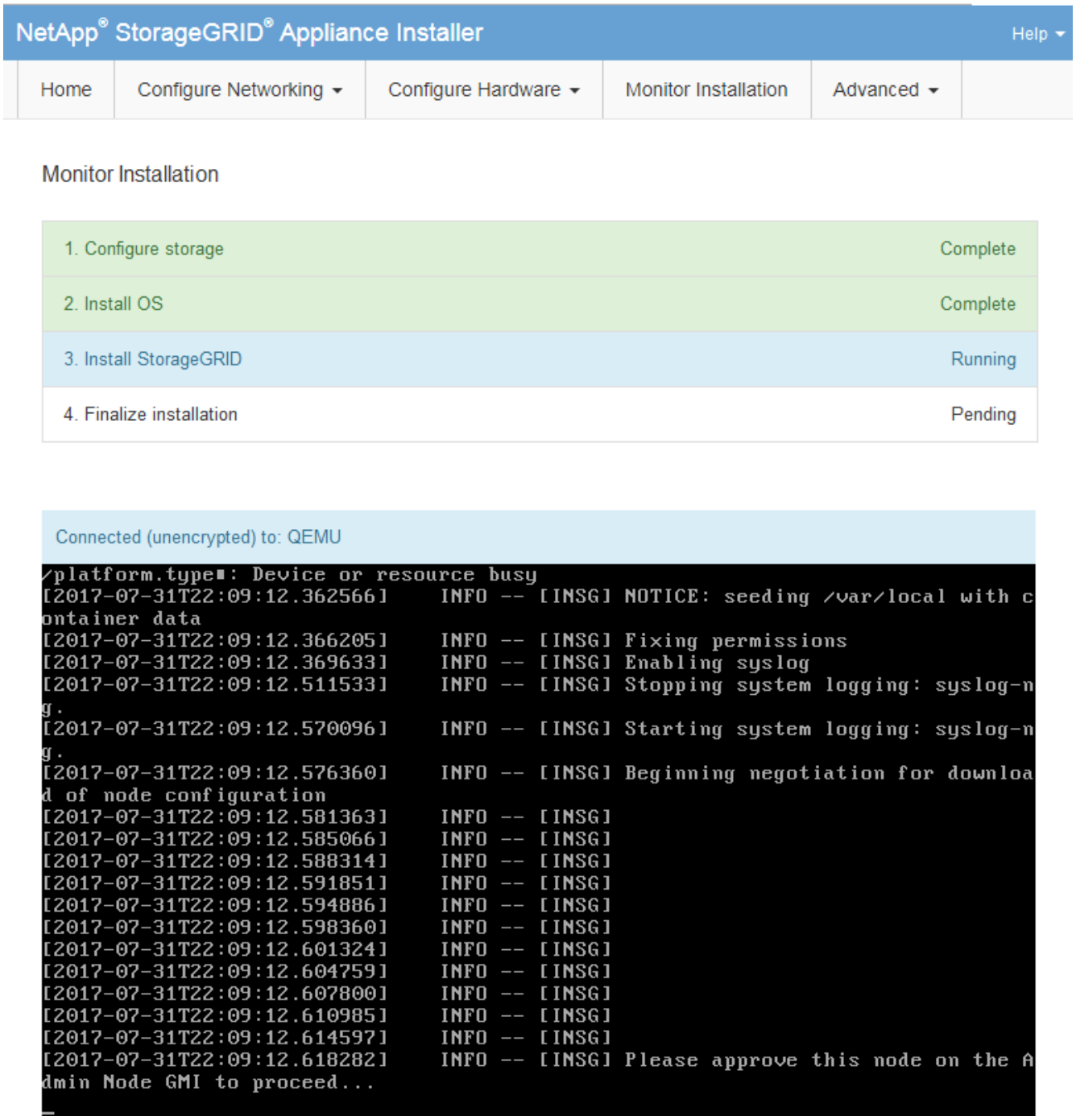
   - For a storage appliance, the installer connects to the storage controller, clears any existing configuration, communicates with SANtricity software to configure volumes, and configures host settings.
   - For a services appliance, the installer clears any existing configuration from the drives in the compute controller, and configures host settings.

   2. Install OS

   During this stage, the installer copies the base operating system image for StorageGRID to the appliance.

10. Continue monitoring the installation progress until a message appears in the console window, prompting you to use the Grid Manager to approve the node.

> Wait until all nodes you added in this expansion are ready for approval before going to the Grid Manager to approve the nodes.



Perform expansion

When you perform the expansion, the new grid nodes are added to your existing StorageGRID deployment.

What you'll need

- You are signed in to the Grid Manager using a supported web browser.
- You have the Maintenance or Root access permission.
- You have the provisioning passphrase.
- You have deployed all of the grid nodes that are being added in this expansion.

- If you are adding Storage Nodes, you have confirmed that all data-repair operations performed as part of a recovery are complete. See Check data repair jobs.
- If you are adding a new site, you must review and update ILM rules before starting the expansion procedure to ensure that object copies are not stored to the new site until after the expansion is complete. For example, if a rule uses the default storage pool (All Storage Nodes), you must create a new storage pool that contains only the existing Storage Nodes and update the ILM rule to use the new storage pool. Otherwise, objects will be copied to the new site as soon as the first node at that site becomes active. See the instructions for managing objects with ILM.

About this task

Performing the expansion includes these phases:

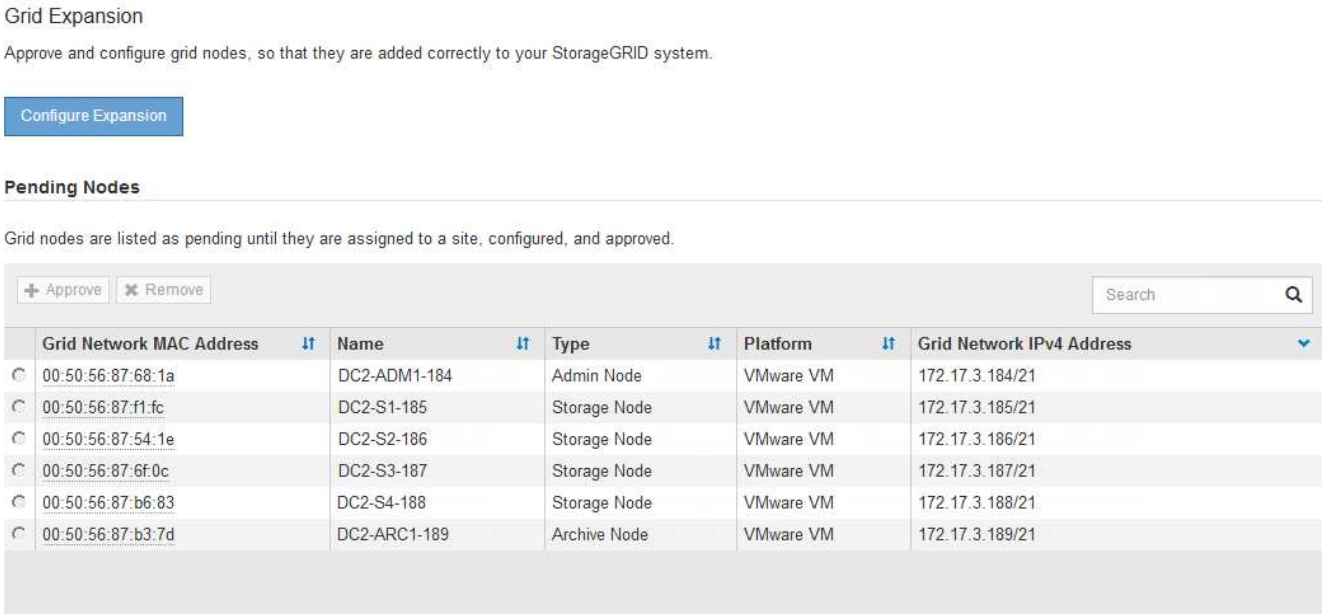
1. You configure the expansion by specifying whether you are adding new grid nodes or a new site and approving the grid nodes you want to add.
2. You start the expansion.
3. While the expansion process is running, you download a new Recovery Package file.
4. You monitor the status of the grid configuration stages, which run automatically. The set of stages depends on what types of grid nodes are being added and on whether a new site is being added.

> Some stages might take a significant amount of time to run on a large grid. For example, streaming Cassandra to a new Storage Node might take only a few minutes if the Cassandra database is empty. However, if the Cassandra database includes a large amount of object metadata, this stage might take several hours or longer. Do not reboot any Storage Nodes during the either the "Expanding the Cassandra cluster" or "Starting Cassandra and streaming data" stages.

Steps

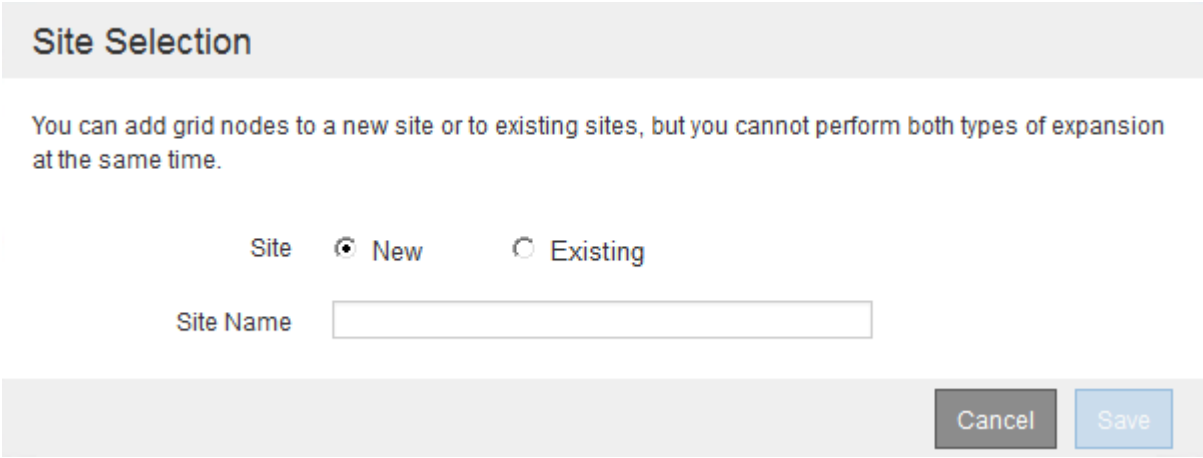
1. Select **MAINTENANCE** > **Tasks** > **Expansion**.

   The Grid Expansion page appears. The Pending Nodes section lists all nodes that are ready to be added.



2. Select **Configure Expansion**.

The Site Selection dialog box appears.



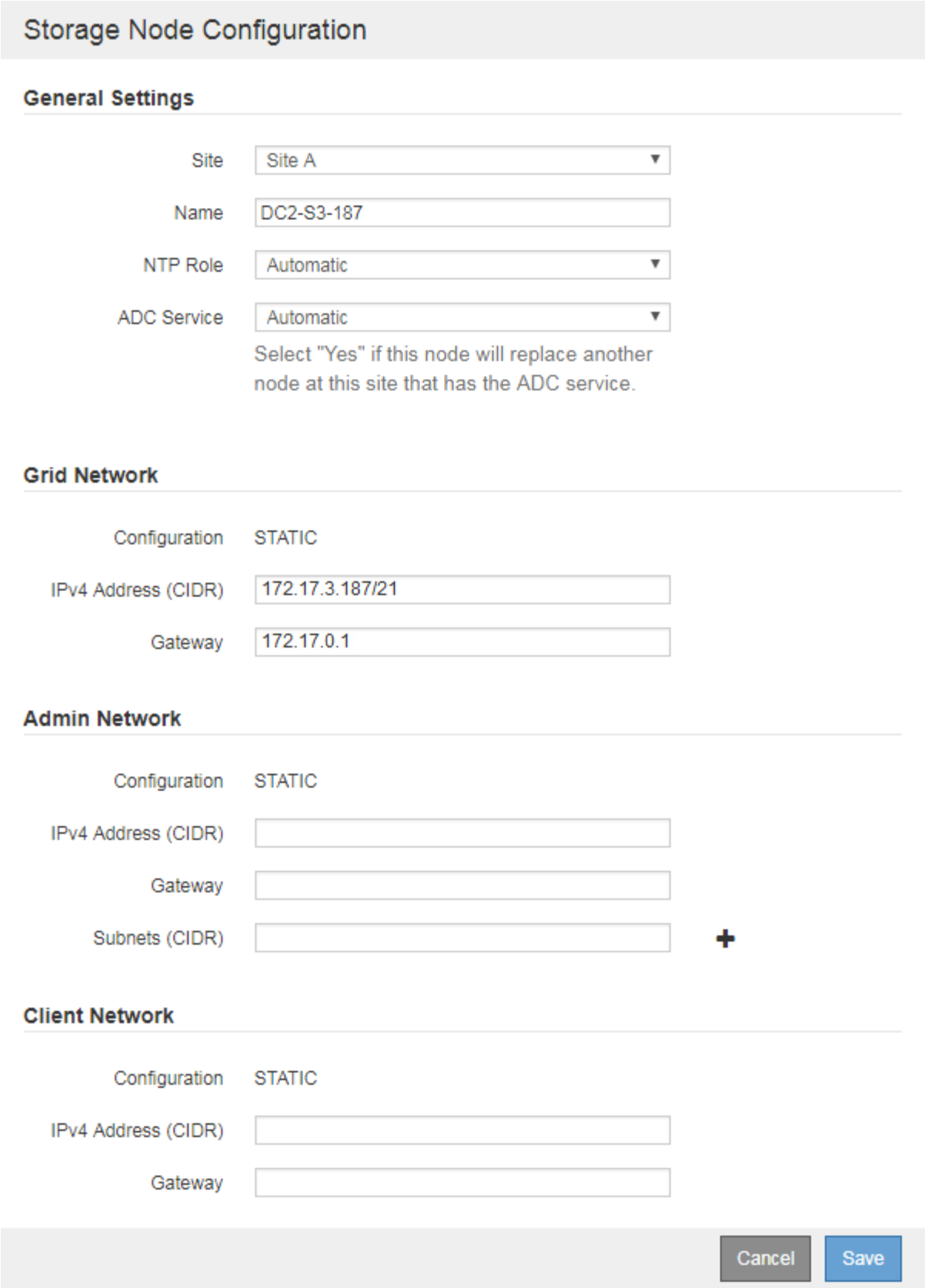
3. Select the type of expansion you are starting:
   - If you are adding a new site, select **New**, and enter the name of the new site.
   - If you are adding grid nodes to an existing site, select **Existing**.
4. Select **Save**.
5. Review the **Pending Nodes** list, and confirm that it shows all of the grid nodes you deployed.

   As required, you can hover your cursor over a node's **Grid Network MAC Address** to see details about that node.

> If a grid node is missing, confirm that it was deployed successfully.

6. From the list of pending nodes, approve the grid nodes for this expansion.
   a. Select the radio button next to the first pending grid node you want to approve.
   b. Select **Approve**.

      The grid node configuration form appears.



c. As required, modify the general settings:

- **Site**: The name of the site the grid node will be associated with. If you are adding multiple nodes, be sure to select the correct site for each node. If you are adding a new site, all nodes are added to the new site.

- **Name**: The hostname that will be assigned to the node, and the name that will be displayed in the Grid Manager.
- **NTP Role**: The Network Time Protocol (NTP) role of the grid node. The options are **Automatic**, **Primary**, and **Client**. Selecting **Automatic** assigns the Primary role to Admin Nodes, Storage Nodes with ADC services, Gateway Nodes, and any grid nodes that have non-static IP addresses. All other grid nodes are assigned the Client role.

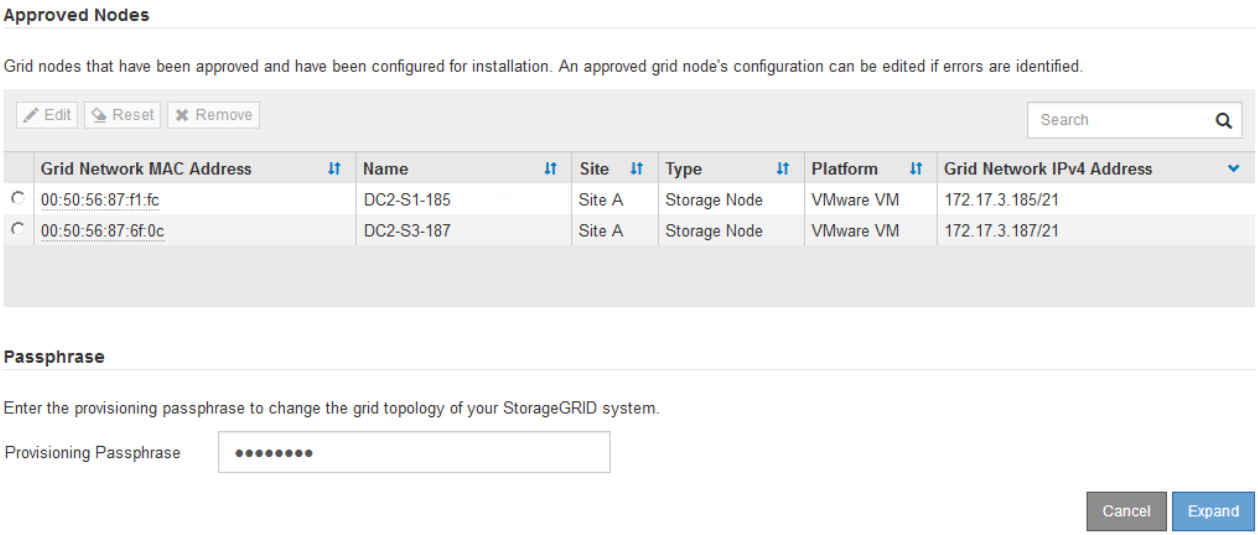
  > Assign the Primary NTP role to at least two nodes at each site. This provides redundant system access to external timing sources.

- **ADC Service** (Storage Nodes only): Whether this Storage Node will run the Administrative Domain Controller (ADC) service. The ADC service keeps track of the location and availability of grid services. At least three Storage Nodes at each site must include the ADC service. You cannot add the ADC service to a node after it is deployed.
  - If you are adding this node to replace a Storage Node, select **Yes** if the node you are replacing includes the ADC service. Because you cannot decommission a Storage Node if too few ADC services would remain, this ensures that a new ADC service is available before the old service is removed.
  - Otherwise, select **Automatic** to let the system determine whether this node requires the ADC service. Learn about the ADC quorum here.

d. As required, modify the settings for the Grid Network, Admin Network, and Client Network.
   - **IPv4 Address (CIDR)**: The CIDR network address for the network interface. For example: 172.16.10.100/24
   - **Gateway**: The default gateway of the grid node. For example: 172.16.10.1
   - **Subnets (CIDR)**: One or more subnetworks for the Admin Network.

e. Select **Save**.

   The approved grid node moves to the Approved Nodes list.



   - To modify the properties of an approved grid node, select its radio button, and select **Edit**.
   - To move an approved grid node back to the Pending Nodes list, select its radio button, and select **Reset**.

- To permanently remove an approved grid node, power the node off. Then, select its radio button, and select **Remove**.

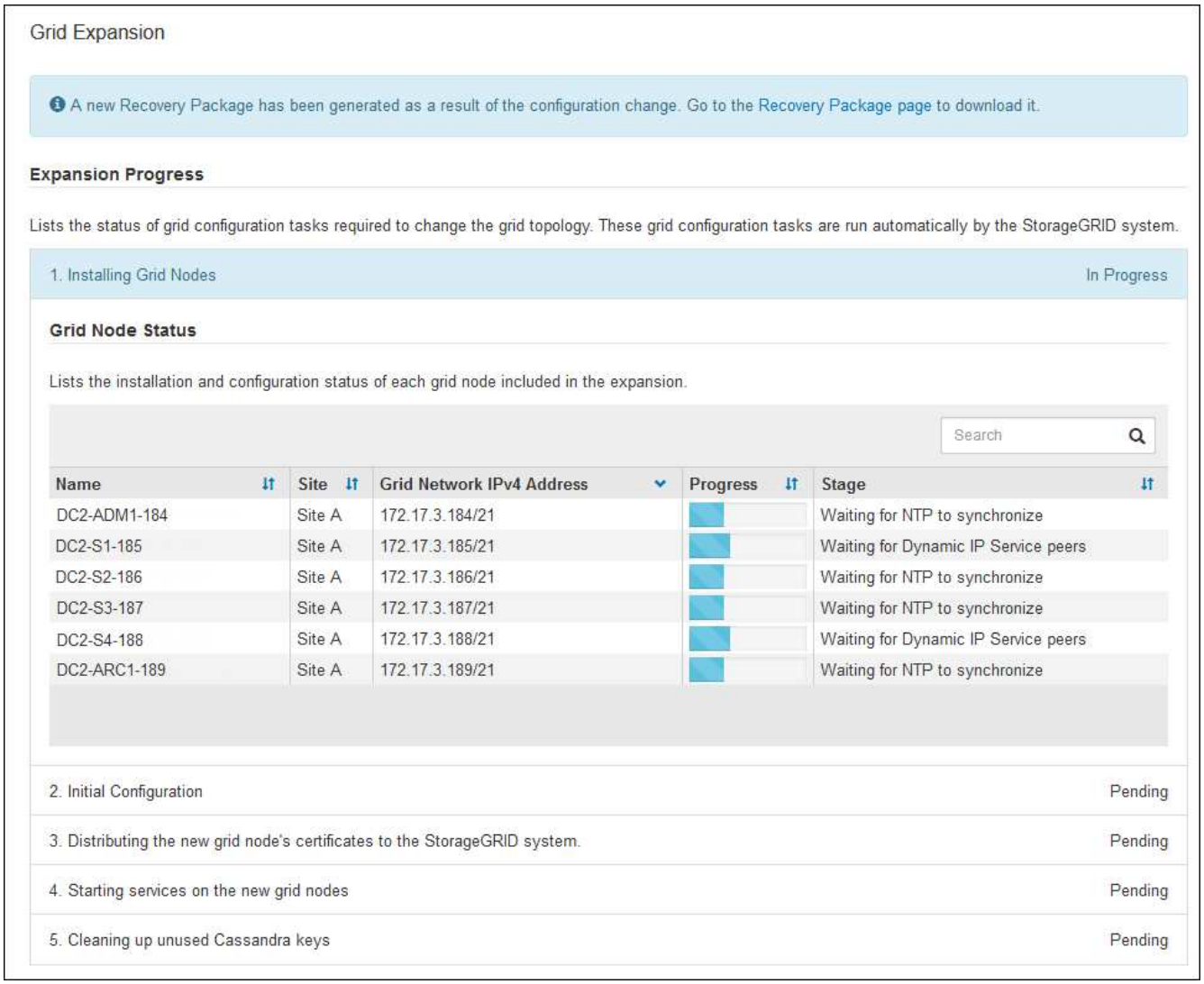
f. Repeat these steps for each pending grid node you want to approve.

> If possible, you should approve all pending grid notes and perform a single expansion. More time will be required if you perform multiple small expansions.

7. When you have approved all grid nodes, enter the **Provisioning Passphrase**, and select **Expand**.

   After a few minutes, this page updates to display the status of the expansion procedure. When tasks that affect individual grid node are in progress, the Grid Node Status section lists the current status for each grid node.

> During this process, for appliances the StorageGRID Appliance Installer shows installation moving from Stage 3 to Stage 4, Finalize Installation. When Stage 4 completes, the controller is rebooted.



> A site expansion includes an additional task to configure Cassandra for the new site.

8. As soon as the **Download Recovery Package** link appears, download the Recovery Package file.

You must download an updated copy of the Recovery Package file as soon as possible after making grid topology changes to the StorageGRID system. The Recovery Package file allows you to restore the system if a failure occurs.

a. Select the download link.

b. Enter the provisioning passphrase, and select **Start Download**.

c. When the download completes, open the `.zip` file and confirm it includes a `gpt-backup` directory and a `_SAID.zip` file. Then, extract the `_SAID.zip` file, go to the `/GID*_REV*` directory, and confirm you can open the `passwords.txt` file.

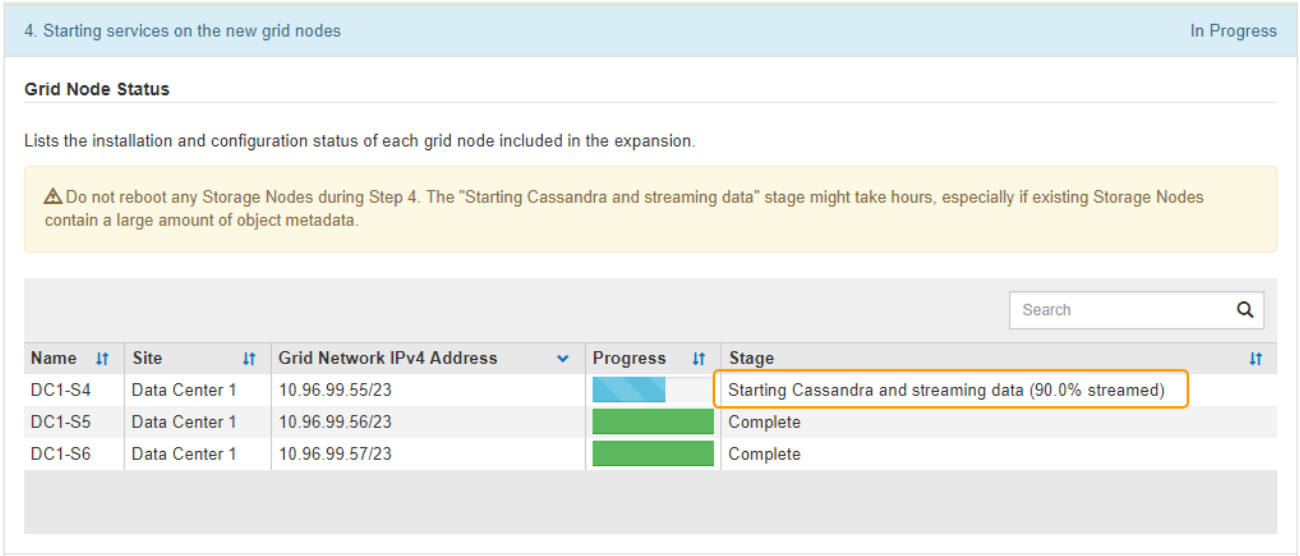
d. Copy the downloaded Recovery Package file (.zip) to two safe, secure, and separate locations.

> The Recovery Package file must be secured because it contains encryption keys and passwords that can be used to obtain data from the StorageGRID system.

9. Follow the instructions for adding a Storage Node to an existing site or adding a new site.

Add Storage Node to existing site

If you are adding one or more Storage Nodes to an existing site, monitor the progress of the "Starting Cassandra and streaming data" stage by reviewing the percentage shown in the status message.



This percentage estimates how complete the Cassandra streaming operation is, based on the total amount of Cassandra data available and the amount that has already been written to the new node.

> Do not reboot any Storage Nodes during either the "Expanding the Cassandra cluster" or "Starting Cassandra and streaming data" stages. These stages might take many hours to complete for each new Storage Node, especially if existing Storage Nodes contain a large amount of object metadata.

Add new site

If you are adding a new site, use `nodetool status` to monitor the progress of Cassandra streaming and to see how much metadata has been copied to the new site during the "Expanding the Cassandra cluster" stage. The total Data Load on the new site should be within about 20% of the total of a current site.

> Do not reboot any Storage Nodes during either the "Expanding the Cassandra cluster" or "Starting Cassandra and streaming data" stages. These stages might take many hours to complete for each new Storage Node, especially if existing Storage Nodes contain a large amount of object metadata.

10. Continue monitoring the expansion until all tasks are complete and the **Configure Expansion** button reappears.

After you finish

Depending on which types of grid nodes you added, you must perform additional integration and configuration steps. See Configuration steps after expansion.

Configure expanded system

Configuration steps after expansion

After completing an expansion, you must perform additional integration and configuration steps.

About this task

You must complete the configuration tasks listed below for the grid nodes you are adding in your expansion. Some tasks might be optional, depending on the options selected when installing and administering your system, and how you want to configure the grid nodes added during the expansion.

Steps

1. If you added a Storage Node, complete the following configuration tasks:
   a. Review the storage pools used in your ILM rules to ensure the new storage will be used. See Manage objects with ILM.
      - If you added a site, create a storage pool for the site and update ILM rules to use the new storage pool.
      - If you added a Storage Node to an existing site, confirm that the new node uses the correct storage grade.

      > By default, a new Storage Node is assigned to the All Storage Nodes storage grade and added to storage pools that use that grade for the site. If you want a new node to use a custom storage grade, you must assign it to the custom grade manually (**ILM** > **Storage grades**).

   b. Verify that the Storage Node is ingesting objects. See Verify that the Storage Node is active.
   c. Rebalance erasure-coded data (only if you were unable to add the recommended number of Storage Nodes). See Rebalance erasure-coded data after adding Storage Nodes.
2. If you added a Gateway Node, complete the following configuration task:
   - If high availability (HA) groups are used for client connections, optionally add the Gateway Node to an HA group. Select **CONFIGURATION** > **Network** > **High availability groups** to review the list of existing HA groups and to add the new node. See Administer StorageGRID.
3. If you added an Admin Node, complete the following configuration tasks:
   a. If single sign-on (SSO) is enabled for your StorageGRID system, create a relying party trust for the new Admin Node. You cannot sign in to the node until you create this relying party trust. See Configure single sign-on.
   b. If you plan to use the Load Balancer service on Admin Nodes, optionally add the new Admin Node to a HA group. Select **CONFIGURATION** > **Network** > **High availability groups** to review the list of existing HA groups and to add the new node. See Administer StorageGRID.
   c. Optionally, copy the Admin Node database from the primary Admin Node to the expansion Admin Node if you want to keep the attribute and audit information consistent on each Admin Node. See Copy the Admin Node database.
   d. Optionally, copy the Prometheus database from the primary Admin Node to the expansion Admin Node if you want to keep the historical metrics consistent on each Admin Node. See Copy Prometheus metrics.
   e. Optionally, copy the existing audit logs from the primary Admin Node to the expansion Admin Node if you want to keep the historical log information consistent on each Admin Node. See Copy audit logs.
   f. Optionally, configure access to the system for auditing purposes through an NFS or a CIFS file share.

See Administer StorageGRID.

> Audit export through CIFS/Samba has been deprecated and will be removed in a future StorageGRID release.

g. Optionally, change the preferred sender for notifications. You can make the expansion Admin Node the preferred sender. Otherwise, an existing Admin Node configured as the preferred sender continues to send notifications, including AutoSupport messages, SNMP notifications, alert emails, and alarm emails (legacy system). See Administer StorageGRID.

4. If you added an Archive Node, complete the following configuration tasks.
   a. Configure the Archive Node's connection to the targeted external archival storage system. When you complete the expansion, Archive Nodes are in an alarm state until you configure connection information through the **ARC** > **Target** component. See Administer StorageGRID.
   b. Update the ILM policy to archive object data through the new Archive Node. See Manage objects with ILM.
   c. Configure custom alarms for the attributes that are used to monitor the speed and efficiency of object data retrieval from Archive Nodes. See Administer StorageGRID.
5. To check if expansion nodes were added with an untrusted Client Network or to change whether a node's Client Network is untrusted or trusted, go to **CONFIGURATION** > **Network** > **Untrusted Client Network**.

   If the Client Network on the expansion node is untrusted, then connections to the node on the Client Network must be made using a load balancer endpoint. See Administer StorageGRID.

6. Configure the Domain Name System (DNS).

   If you have been specifying DNS settings separately for each grid node, you must add custom per-node DNS settings for the new nodes. See Modify DNS configuration for single grid node.

   The best practice is for the grid-wide DNS server list to contain some DNS servers that are accessible locally from each site. If you just added a new site, add new DNS servers for the site to the grid-wide DNS configuration.

   > Provide two to six IPv4 addresses for DNS servers. You should select DNS servers that each site can access locally in the event of network islanding. This is to ensure an islanded site continues to have access to the DNS service. After configuring the grid-wide DNS server list, you can further customize the DNS server list for each node. For details, see Modify DNS configuration for single grid node..

7. If you added a new site, confirm that Network Time Protocol (NTP) servers are accessible from that site. See Configure NTP servers.

   > Make sure that at least two nodes at each site can access at least four external NTP sources. If only one node at a site can reach the NTP sources, timing issues will occur if that node goes down. In addition, designating two nodes per site as primary NTP sources ensures accurate timing if a site is isolated from the rest of the grid.

Verify that Storage Node is active

After an expansion operation that adds new Storage Nodes completes, the StorageGRID system should automatically start using the new Storage Nodes. You must use the

StorageGRID system to verify that the new Storage Node is active.

Steps

1. Sign in to the Grid Manager using a supported web browser.
2. Select **NODES** > ***Expansion Storage Node*** > **Storage**.
3. Hover your cursor over the **Storage Used - Object Data** graph to view the value for **Used**, which is the amount of the Total usable space that has been used for object data.
4. Verify that the value of **Used** is increasing as you move your cursor to the right on the graph.

Copy Admin Node database

When adding Admin Nodes through an expansion procedure, you can optionally copy the database from the primary Admin Node to the new Admin Node. Copying the database allows you to retain historical information about attributes, alerts, and alerts.

What you'll need

- You have completed the required expansion steps to add an Admin Node.
- You have the `Passwords.txt` file.
- You have the provisioning passphrase.

About this task

The StorageGRID software activation process creates an empty database for the NMS service on the expansion Admin Node. When the NMS service starts on the expansion Admin Node, it records information for servers and services that are currently part of the system or added later. This Admin Node database includes the following information:

- Alert history
- Alarm history
- Historical attribute data, which is used in the charts and text reports available from the **SUPPORT** > **Tools** > **Grid topology** page

To ensure that the Admin Node database is consistent between nodes, you can copy the database from the primary Admin Node to the expansion Admin Node.

> Copying the database from the primary Admin Node (the*source Admin Node*) to an expansion Admin Node can take up to several hours to complete. During this period, the Grid Manager is inaccessible.

Use these steps to stop the MI service and the Management API service on both the primary Admin Node and the expansion Admin Node before copying the database.

Steps

1. Complete the following steps on the primary Admin Node:
   a. Log in to the Admin Node:
      i. Enter the following command: `ssh admin@grid_node_IP`
      ii. Enter the password listed in the `Passwords.txt` file.

iii. Enter the following command to switch to root: `su -`

iv. Enter the password listed in the `Passwords.txt` file.

b. Run the following command: `recover-access-points`

c. Enter the provisioning passphrase.

d. Stop the MI service: `service mi stop`

e. Stop the Management Application Program Interface (mgmt-api) service: `service mgmt-api stop`

2. Complete the following steps on the expansion Admin Node:

a. Log in to the expansion Admin Node:

i. Enter the following command: `ssh admin@`*`grid_node_IP`*

ii. Enter the password listed in the `Passwords.txt` file.

iii. Enter the following command to switch to root: `su -`

iv. Enter the password listed in the `Passwords.txt` file.

b. Stop the MI service: `service mi stop`

c. Stop the mgmt-api service: `service mgmt-api stop`

d. Add the SSH private key to the SSH agent. Enter:`ssh-add`

e. Enter the SSH Access Password listed in the `Passwords.txt` file.

f. Copy the database from the source Admin Node to the expansion Admin Node: `/usr/local/mi/bin/mi-clone-db.sh` *`Source_Admin_Node_IP`*

g. When prompted, confirm that you want to overwrite the MI database on the expansion Admin Node.

The database and its historical data are copied to the expansion Admin Node. When the copy operation is done, the script starts the expansion Admin Node.

h. When you no longer require passwordless access to other servers, remove the private key from the SSH agent. Enter:`ssh-add -D`

3. Restart the services on the primary Admin Node: `service servermanager start`

Copy Prometheus metrics

After adding a new Admin Node, you can optionally copy the historical metrics maintained by Prometheus from the primary Admin Node to the new Admin Node. Copying the metrics ensures that historical metrics are consistent between Admin Nodes.

What you'll need

- The new Admin Node is installed and running.
- You have the `Passwords.txt` file.
- You have the provisioning passphrase.

About this task

When you add an Admin Node, the software installation process creates a new Prometheus database. You can keep the historical metrics consistent between nodes by copying the Prometheus database from the primary

Admin Node (the *source Admin Node*) to the new Admin Node.

> Copying the Prometheus database might take an hour or more. Some Grid Manager features will be unavailable while services are stopped on the source Admin Node.

Steps

1. Log in to the source Admin Node:
   a. Enter the following command: `ssh admin@grid_node_IP`
   b. Enter the password listed in the `Passwords.txt` file.
   c. Enter the following command to switch to root: `su -`
   d. Enter the password listed in the `Passwords.txt` file.
2. From the source Admin Node, stop the Prometheus service: `service prometheus stop`
3. Complete the following steps on the new Admin Node:
   a. Log in to the new Admin Node:
      i. Enter the following command: `ssh admin@grid_node_IP`
      ii. Enter the password listed in the `Passwords.txt` file.
      iii. Enter the following command to switch to root: `su -`
      iv. Enter the password listed in the `Passwords.txt` file.
   b. Stop the Prometheus service: `service prometheus stop`
   c. Add the SSH private key to the SSH agent. Enter:`ssh-add`
   d. Enter the SSH Access Password listed in the `Passwords.txt` file.
   e. Copy the Prometheus database from the source Admin Node to the new Admin Node: `/usr/local/prometheus/bin/prometheus-clone-db.sh Source_Admin_Node_IP`
   f. When prompted, press **Enter** to confirm that you want to destroy the new Prometheus database on the new Admin Node.

      The original Prometheus database and its historical data are copied to the new Admin Node. When the copy operation is done, the script starts the new Admin Node. The following status appears:

      ```
      Database cloned, starting services
      ```

   g. When you no longer require passwordless access to other servers, remove the private key from the SSH agent. Enter:

      ```
      ssh-add -D
      ```

4. Restart the Prometheus service on the source Admin Node.

   ```
   service prometheus start
   ```

Copy audit logs

When you add a new Admin Node through an expansion procedure, its AMS service only

logs events and actions that occur after it joins the system. As required, you can copy audit logs from a previously installed Admin Node to the new expansion Admin Node so that it is in sync with the rest of the StorageGRID system.

What you'll need

- You have completed the required expansion steps to add an Admin Node.
- You have the `Passwords.txt` file.

About this task

To make historical audit messages available on a new Admin Node, you must copy the audit log files manually from an existing Admin Node to the expansion Admin Node.

> By default, audit information is sent to the audit log on Admin Nodes. You can skip these steps if either of the following applies:
>
> - You configured an external syslog server and audit logs are now being sent to the syslog server instead of to Admin Nodes.
> - You explicitly specified that audit messages should be saved only on the local nodes that generated them.
>
> See Configure audit messages and log destinations for details.

Steps

1. Log in to the primary Admin Node:
   a. Enter the following command: `ssh admin@_primary_Admin_Node_IP`
   b. Enter the password listed in the `Passwords.txt` file.
   c. Enter the following command to switch to root: `su -`
   d. Enter the password listed in the `Passwords.txt` file.

      When you are logged in as root, the prompt changes from `$` to `#`.
2. Stop the AMS service to prevent it from creating a new file: `service ams stop`
3. Rename the `audit.log` file to ensure that it does not overwrite the file on the expansion Admin Node you are copying it to:

   ```
   cd /var/local/audit/export
   ls -l
   mv audit.log new_name.txt
   ```
4. Copy all audit log files to the expansion Admin Node:

   ```
   scp -p * IP_address:/var/local/audit/export
   ```
5. If prompted for the passphrase for `/root/.ssh/id_rsa`, enter the SSH Access Password for the Primary Admin Node listed in the `Passwords.txt` file.
6. Restore the original `audit.log` file:

   ```
   mv new_name.txt audit.log
   ```

7. Start the AMS service:

```
service ams start
```

8. Log out from the server:

```
exit
```

9. Log in to the expansion Admin Node:
   a. Enter the following command: `ssh admin@expansion_Admin_Node_IP`
   b. Enter the password listed in the `Passwords.txt` file.
   c. Enter the following command to switch to root: `su -`
   d. Enter the password listed in the `Passwords.txt` file.

      When you are logged in as root, the prompt changes from `$` to `#`.

10. Update the user and group settings for the audit log files:

```
cd /var/local/audit/export
chown ams-user:bycast *
```

11. Log out from the server:

```
exit
```

Rebalance erasure-coded data after adding Storage Nodes

In some cases, you might need to rebalance erasure-coded data after you add new Storage Nodes.

What you'll need

- You have completed the expansion steps to add the new Storage Nodes.
- You have reviewed the considerations for rebalancing erasure-coded data.

> Only perform this procedure if the **Low Object Storage** alert has been triggered for one or more Storage Nodes at a site and you were unable to add the recommended number of new Storage Nodes.

- You understand that replicated object data will not be moved by this procedure and that the EC rebalance procedure does not consider the replicated data usage on each Storage Node when determining where to move erasure-coded data.
- You have the `Passwords.txt` file.

About this task

When the EC rebalance procedure is running, the performance of ILM operations and S3 and Swift client operations are likely to be impacted. For this reason, you should only perform this procedure in limited cases.

> The EC rebalance procedure temporarily reserves a large amount of storage. Storage alerts might be triggered, but will resolve when the rebalance is complete. If there is not enough storage for the reservation, the EC rebalance procedure will fail. Storage reservations are released when the EC rebalance procedure completes, whether the procedure failed or succeeded.

> S3 and Swift API operations to upload objects (or object parts) might fail during the EC rebalancing procedure if they require more than 24 hours to complete. Long-duration PUT operations will fail if the applicable ILM rule uses Strict or Balanced placement on ingest. The following error will be reported:
>
> `500 Internal Server Error`

Steps

1. Review the current object storage details for the site you plan to rebalance.
   a. Select **NODES**.
   b. Select the first Storage Node at the site.
   c. Select the **Storage** tab.
   d. Hover your cursor over the Storage Used - Object Data chart to see the current amount of replicated data and erasure-coded data on the Storage Node.
   e. Repeat these steps to view the other Storage Nodes at the site.
2. Log in to the primary Admin Node:
   a. Enter the following command: `ssh admin@`*`primary_Admin_Node_IP`*
   b. Enter the password listed in the `Passwords.txt` file.
   c. Enter the following command to switch to root: `su -`
   d. Enter the password listed in the `Passwords.txt` file.

      When you are logged in as root, the prompt changes from `$` to `#`.
3. Enter the following command:

   ```
   rebalance-data start --site "site-name"
   ```

   For `"`*`site-name`*`"`, specify the first site where you added new Storage Node or nodes. Enclose `site-name` in quotes.

   The EC rebalance procedure starts, and a job ID is returned.
4. Copy the job ID.
5. Monitor the status of the EC rebalance procedure.
   - To view the status of a single EC rebalance procedure:

     ```
     rebalance-data status --job-id job-id
     ```

     For *`job-id`*, specify the ID that was returned when you started the procedure.

- To view the status of the current EC rebalance procedure and any previously completed procedures:

  ```
  rebalance-data status
  ```

  > To get help on the rebalance-data command:
  >
  > ```
  > rebalance-data --help
  > ```

- To view the estimated time to completion and the completion percentage for the current job, select **SUPPORT** > **Tools** > **Metrics**. Then, select **EC Overview** in the Grafana section. Look at the **Grid EC Job Estimated Time to Completion** and **Grid EC Job Percentage Completed** dashboards.

6. Perform additional steps, based on the status returned:
   - If the status is `In progress`, the EC rebalance operation is still running. You should periodically monitor the procedure until it completes.
   - If the status is `Failure`, perform the failure steps.
   - If the status is `Success`, perform the success step.
7. If the EC rebalance procedure is generating too much load (for example, ingest operations are affected), pause the procedure.

   ```
   rebalance-data pause --job-id job-id
   ```

8. If you need to terminate the EC rebalance procedure (for example, so you can perform a StorageGRID software upgrade), enter the following:

   ```
   rebalance-data terminate --job-id job-id
   ```

   > When you terminate an EC rebalance procedure, any data fragments that have already been moved remain in the new location. Data is not moved back to the original location.

9. If the status of the EC rebalance procedure is `Failure`, follow these steps:
   a. Confirm that all Storage Nodes at the site are connected to the grid.
   b. Check for and resolve any alerts that might be affecting these Storage Nodes.

      For information about specific alerts, see the monitoring and troubleshooting instructions.

   c. Restart the EC rebalance procedure:
      `rebalance-data start --job-id job-id`
   d. If the status of the EC rebalance procedure is still `Failure`, contact technical support.
10. If the status of the EC rebalance procedure is `Success`, optionally review object storage to see the updated details for the site.

    Erasure-coded data should now be more balanced among the Storage Nodes at the site.

11. If you are using erasure coding at more than one site, run this procedure for all other affected sites.

Contact technical support

If you encounter errors during the grid expansion process that you are unable to resolve, or if a grid task fails, contact technical support.

About this task

When you contact technical support, you must provide the required log files to assist in troubleshooting the errors you are encountering.

Steps

1. Connect to the expansion node that has experienced failures:

   a. Enter the following command:`ssh -p 8022 admin@grid_node_IP`

   > Port 8022 is the SSH port of the base OS, while port 22 is the SSH port of the container engine running StorageGRID.

   b. Enter the password listed in the `Passwords.txt` file.

   c. Enter the following command to switch to root: `su -`

   d. Enter the password listed in the `Passwords.txt` file.

   Once you are logged in as root, the prompt changes from `$` to `#`.

2. Depending on the stage the installation reached, retrieve any of the following logs that are available on the grid node:

Platform	Logs
VMware	• `/var/log/daemon.log` • `/var/log/storagegrid/daemon.log` • `/var/log/storagegrid/nodes/<node-name>.log`
Linux	• `/var/log/storagegrid/daemon.log` • `/etc/storagegrid/nodes/<node-name>.conf` (for each failed node) • `/var/log/storagegrid/nodes/<node-name>.log` (for each failed node; might not exist)

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