Expansion planning

StorageGRID software

NetApp
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Expansion planning

Expansion planning for replicated data in StorageGRID

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. For information about object replication, see What is replication.

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.

When planning the timing of an expansion, remember to consider how long it might take to procure and install additional storage. To simplify expansion planning, consider adding Storage Nodes when existing Storage Nodes reach 70% capacity.

Expansion planning for erasure-coded (EC) data in StorageGRID

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 What are erasure-coding schemes for information about erasure-coding profiles.

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 led to this recommendation or to develop a more precise plan for your site, see Considerations for rebalancing erasure-coded data. For a custom recommendation optimized for your situation, contact your NetApp Professional Services consultant.

Learn about EC rebalancing after expansion in StorageGRID

If you are performing an expansion to add Storage Nodes and you use ILM rules to erasure code data, you might need to perform the erasure coding (EC) rebalance procedure if you can't add enough Storage Nodes for the erasure-coding scheme you are using.

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 added Storage Nodes at a site.

The EC rebalance procedure:

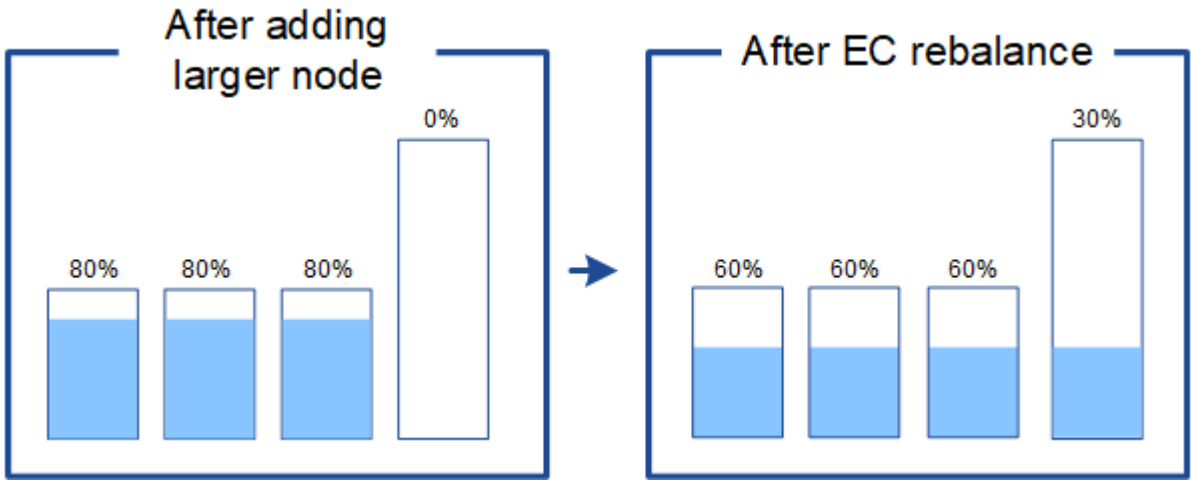
- Only moves erasure-coded object data. It does not move replicated object data.
- Redistributes the data within a site. It does not move data between sites.
- Redistributes data among all Storage Nodes at a site. It does not redistribute data within storage volumes.
- Attempts to distribute the same number of bytes to each node. Nodes that contain more replicated data will store less erasure-coded data after rebalance is complete.
- Redistributes erasure-coded data evenly between Storage Nodes without considering the relative capacities of each node. Replicated data is included in the calculation.
- Won't distribute erasure-coded data to Storage Nodes that are more than 80% full.
- Might decrease the performance of ILM operations and S3 client operations when it runs—additional resources are required to redistribute the erasure-coding fragments.

When the EC rebalance procedure is complete:

- Erasure-coded data will have moved from Storage Nodes with less available space to Storage Nodes with more available space.
- The data protection of erasure-coded objects will be unchanged.
- Used (%) values might be different between Storage Nodes for two reasons:
  - Replicated object copies will continue to consume space on the existing nodes—the EC rebalance procedure does not move replicated data.
  - Larger-capacity nodes will be relatively less full than smaller-capacity nodes, even though all nodes will end up with approximately the same amount of data.

    For example, suppose three 200-TB nodes are each filled to 80% (200 × 0.8 = 160 TB on each node,

or 480 TB for the site). If you add a 400-TB node and run the rebalance procedure, all nodes will now have approximately the same amount of erasure-code data (480/4 = 120 TB). However, the Used (%) for the larger node will be less than the Used (%) for the smaller nodes.



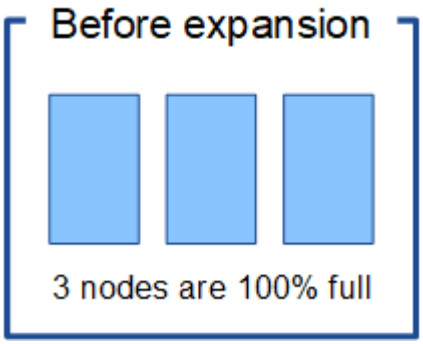
When to rebalance erasure-coded data

The EC rebalance procedure redistributes existing erasure-coded data to ensure nodes don't become or stay full. The procedure helps to ensure that EC encoding can continue on the site.

Run the rebalance procedure when there's a concerning bias in the data distribution on a site and the site stores mostly EC data (since replicated data cannot be moved by rebalance).

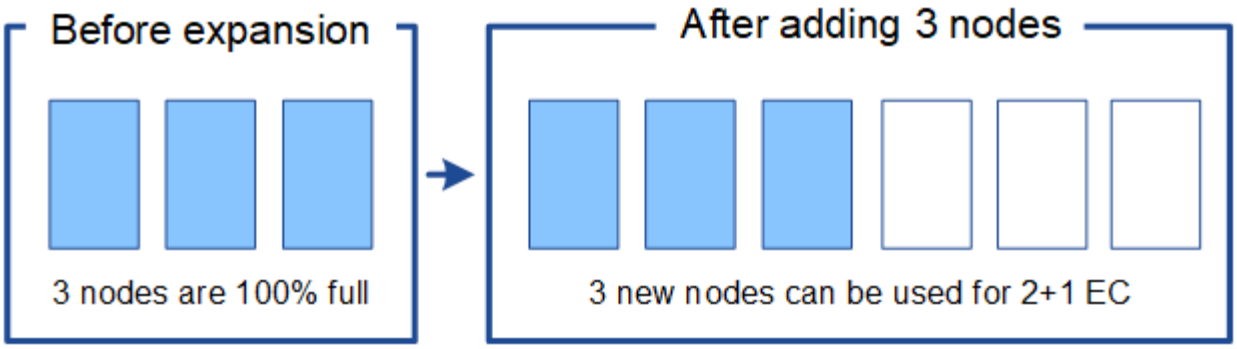
Consider the following scenario:

- 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. The **Low Object Storage** alert has been triggered at the major severity level.



Rebalance is not required if you add enough nodes

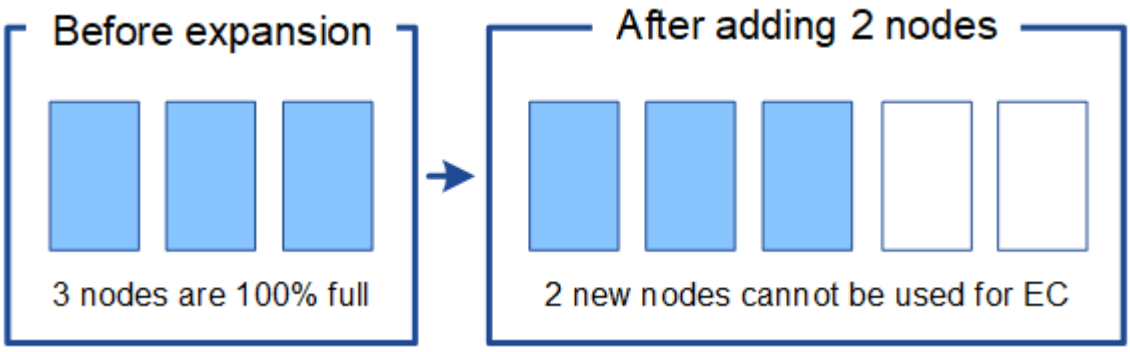
To understand when EC rebalance is not required, suppose you added three (or more) new Storage Nodes. In this case, you don't need to perform EC rebalance. The original Storage Nodes will remain full, but new objects will now use the three new nodes for 2+1 erasure coding—the two data fragments and the one parity fragment can each be stored on a different node.



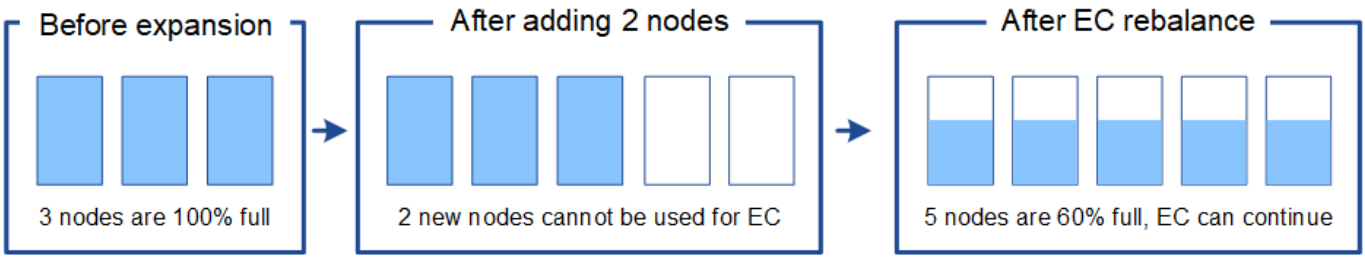
While you can run the EC rebalance procedure in this case, moving the existing erasure-coded data will temporarily decrease the grid's performance, which might impact client operations.

Rebalance is required if you can't add enough nodes

To understand when EC rebalance is required, suppose you can only add two Storage Nodes, instead of three. Because the 2+1 scheme requires at least three Storage Nodes to have space available, the empty nodes can't be used for new erasure-coded data.



To make use of the new Storage Nodes, you should run the EC rebalance procedure. When this procedure runs, StorageGRID redistributes existing 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.



Recommendations for EC rebalancing

NetApp requires EC rebalancing 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 enough new Storage Nodes for the erasure-coding scheme in use. See Add storage capacity for erasure-coded objects.
- Your S3 clients can tolerate lower performance for their write and read operations while the EC rebalance procedure is running.

You can optionally run the EC rebalance procedure if you prefer Storage Nodes to be filled to similar levels and your S3 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 can't 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.
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, run the EC rebalance procedure after adding all new nodes.
Upgrade procedure	No. If you need to upgrade StorageGRID software, 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, run the EC rebalance procedure after adding the new node.
Hotfix procedure	Yes. You can apply a StorageGRID hotfix while the EC rebalance procedure is running.

Procedure	Allowed during EC rebalance procedure?
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, don’t start using an ILM rule that has a different erasure-coding profile. If you need to make such ILM changes, you should terminate the EC rebalance procedure.

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