NETGEAR®

ReadyNAS® OS Flex–RAID Volume Optimization Guide

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INTRODUCTION

With any network storage device, selecting the right RAID level and the right amount of drives for your volumes is imperative to how well your storage applications perform. This becomes increasingly important as you deal with ReadyNAS storage servers that have large amounts of drive bays (12 bays and up).

> **Note:** This guide is applicable to ReadyNAS OS 6.7 and newer.

> **Note:** The 60-bay ReadyNAS 4360X(S) does not have X-RAID and only supports Flex-RAID.

RAID GROUPS AND RAID LEVELS EXPLAINED

RAID is short for Redundant Array of Inexpensive (Independent) Disks. A RAID group is a logical representation of one or more physical disks setup in a configuration that enhances data redundancy, performance, or both. While one or more physical disks can form a RAID group, one or more RAID groups can form a Volume.

Below is a table containing the various RAID levels supported by the ReadyNAS and recommended number of drives for each RAID level.

RAID	Min. # selected drives	Max. # of drives for single volume (RAID group)	Redundancy (# of drive failure tolerance)	Notes
JBOD	1	1	0	Selecting JBOD will remove all disk protection in the event a disk fails.
1	2	2	1	
5	3	6	1	Selecting more than 6 disks is not recommended for the performance and reliability of the ReadyNAS.
6	4	15	2	Selecting more than 15 disks is not recommended for the performance and reliability of the ReadyNAS.
10	4	4	1	
50	6	6 (In a single RAID group)	1 per RAID group	Selecting more than 10 RAID groups is not recommended for the performance of the ReadyNAS.
60	8	15 (In a single RAID group)	2 per RAID group	Selecting more than 4 RAID groups is not recommended for the performance of the ReadyNAS.
Remaining Disks	Global Spare	–	–	

DEFAULT VOLUMES

On initial setup, the ReadyNAS will automatically create volumes based on the number of drives installed in the unit.

The table below indicates the default number of volumes and RAID levels for different installed drive numbers. This is also the recommended RAID configuration should you choose to create the RAID groups yourself. The recommendations below will provide a good balance between performance, capacity and redundancy for most use cases such as backup, file sharing, surveillance, and virtualization.

Note: For virtualization applications with high random IOPS (such as multiple high traffic volume mail servers), we recommend RAID 10 for best performance.

# of disks	RAID	Comments
1	JBOD	The ReadyNAS will create a single non-redundant volume. You will need to add disks to provide redundancy.
2	1	Best read performance, minimum capacity, best redundancy.
< 6	5	Better performance, max capacity, moderate redundancy.
<=14	6	Good performance, medium capacity, max redundancy.
15-19	3x RAID group (of x drives) RAID 5+0 with Global Spares	Highest performance, medium capacity, moderate redundancy.
20-24	4x RAID group (of x drives) RAID 5+0 with Global Spares	Highest performance, medium capacity, moderate redundancy.
25-29	5x RAID group (of x drives) RAID 5+0 with Global Spares	Highest performance, medium capacity, moderate redundancy.
30-44	2x RAID group RAID 6+0 with Global Spares	Better performance, medium capacity, high redundancy.
45-59	3x RAID group RAID 6+0 with Global Spares	Better performance, medium capacity, high redundancy.
60	4x RAID group RAID 6+0	Better performance, medium capacity, high redundancy.
>60	We do not recommend expanding across multiple chassis.	**Note**: The ReadyNAS does not create volumes automatically on the expansion chassis, and you will need to go do the volume tab and create your desired volume on the expansion chassis.

THE VOLUME WIZARD

Due to the complexity of managing volumes for ReadyNAS devices with a high number of drive bays, we've added a Volume Wizard in ReadyNAS OS 6.7. The Volume Wizard provides users with a step-by-step guide to create/modify volumes to have performance characteristics that match their application.

CREATING A NEW VOLUME

Out of the box when you first setup the ReadyNAS, it automatically creates a volume that is optimized for the number of drives you currently have installed in the ReadyNAS. However, after initial setup is complete, you can elect to delete this current volume and create a new volume(s) based on your own settings. To create a new volume, go to **System -> Volumes** and select the drives you wish to create the volume with from the drive map in the middle. Once you have at least one drive selected, the three buttons on the right side will change from white to grey and become clickable. As you select more drives, the buttons will become clickable/non-clickable based on what are the appropriate actions for that number of drives. Click on the **New Volume** button to start the wizard.

When creating the volume, you will be presented the following options:

- Volume name
- RAID Level
- Number of RAID groups
- Number of disks per RAID group (*number of disks and RAID groups will reflect each other*)
- Display the remaining unused disks noting that they will be used for Global Spares

Each selection will display the performance, capacity, and reliability characteristics of the volume. Once all the fields are filled out, click **Next**.

New Volume

Name:	Production
Protection Level:	RAID 50
Number of RAID Groups:	2
Number of drives for RAID Group:	3
Remaining drives allocated to Global Spare:	0

Capacity

Performance   Reliability

Description: Best performance, high capacity, high redundancy.

Next   Cancel

In the next step, optionally select whether you want to set quotas and/or encrypt your volume. If there is no requirement to set quotas, leave it unchecked as enabling quotas may impact performance. Finally, click **Create**.

New Volume

Quota:

Encryption:

⚠ If you lose your key, the data on the volume cannot be recovered.

USB to store key:

Send key by Email:

Create   Cancel

VOLUME OPERATIONS

Starting in ReadyNAS OS 6.7.0, you can now perform various volume operations such as Add Parity, Expand, and Add Group on your existing Volumes.

ADDING PARITY

Adding Parity allows you to increase the redundancy of your volume. For example, adding parity to a RAID 5 volume with one-disk failure tolerance would convert it to a RAID 6 volume with two-disk failure tolerance.

EXPANDING AN EXISTING VOLUME

Expanding a volume means you add drives to the existing RAID or RAID groups. This adds to the capacity of your volume but will not change its RAID characteristics. If your volume has more than one RAID group, you'll need to add at least 1 drive per RAID group.

ADDING GROUPS

In addition to expanding your existing volumes, ReadyNAS allows you to add additional RAID groups to your volume. Depending on your current RAID level, either one or both of Striped or Concatenated options may be presented to you.

Striped: Adds an additional RAID group in a Striped configuration to your volume. This new RAID group will need to have the same number of drives as the other RAID groups currently in the volume. Because it is Striped, there will be additional drives reading/writing to the RAID for every file operation so the overall performance of the volume will increase.

Concatenated: Adds an additional RAID group in a Concatenated configuration. This new RAID group does not need to have the same number of drives as the other RAID groups in the volume which provides flexibility. However, because it is not Striped with the other RAID groups, read/writes do not go beyond individual RAID groups in the volume and as a result the overall performance of the volume will remain unchanged.

Both options:

Add Group

When adding RAID Group, your ReadyNAS system adds an extended RAID to the existing volume. This process is instant, and it consumes two more parity disk for your RAID configuration.

○ **RAID0/Stripe**
- Requires the same amount of drives.
- Improves performance.

  1 RAID6 Group with 4 disks

○ Concatenated
- Varied amount of drives allowed.
- Same performance.

  All selected disks will be used with current RAID configuration for this RAID Group
  1 RAID6 Group with 4 disks

Do you really want to expand this volume?

Apply Cancel

Striped only:

Add Group

When adding RAID Group, your ReadyNAS system adds an extended RAID to the existing volume. This process is instant, and it consumes two more parity disk for your RAID configuration.

Do you really want to expand this volume?

Apply   Cancel

Concatenated only:

Add Group

When adding RAID Group, your ReadyNAS system adds an extended RAID to the existing volume. This process is instant, and it consumes one more parity disk for your RAID configuration.

◉ Concatenated

- Varied amount of drives allowed.
- Same performance.

  1 RAID1 Group with 2 disks

Do you really want to expand this volume?

Apply   Cancel

ADDING TIER

ReadyTier or tiering is a performance increasing technology that stores different types of data in tiers based on the performance characteristics of available media on the system. It can be beneficial for a wide range of applications such as virtualization, database applications, and file servers. With ReadyNAS 6.9, users can now add an SSD tier to their Flex-RAID volume and leverage the low latency of SSDs to increase I/O performance. In 6.9.0, meta-data will be written to the higher tier while general data will be written to the mechanical hard drive tier. Based on the size/amount/type of data being written, tiering can potentially increase performance by up to 20X. (We observed a 20X increase in write performance in a lab environment with random synchronized writes)

Requirements for ReadyTier:

1. The ReadyNAS is running 6.9.0 and above.
2. The ReadyNAS must be in Flex-RAID mode and not X-RAID.
3. If there is more than one RAID group in the volume, then the volume must be a concatenated volume. (You cannot add a tier to a striped volume)
4. The number of SSDs for the SSD tier should be equal to the number of drives in the RAID group.

To add a tier, start by selecting unused SSDs in the device view.
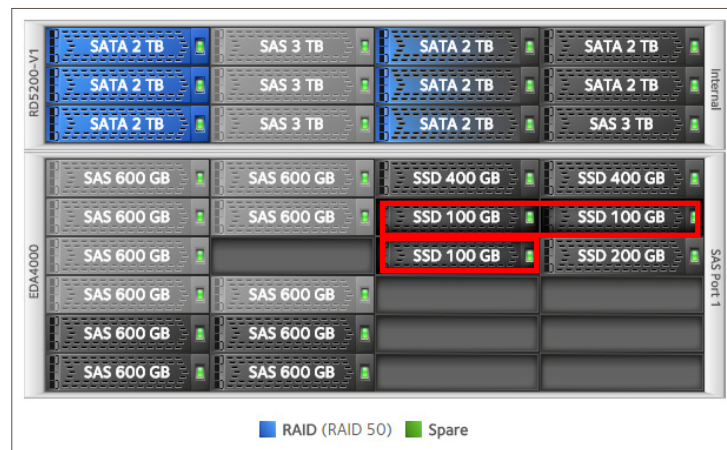
When the requirements for the number of selected SSDs are met, the button **Add Group** will change to **Add Tier**. Click on **Add Tier** and follow the on-screen instructions.
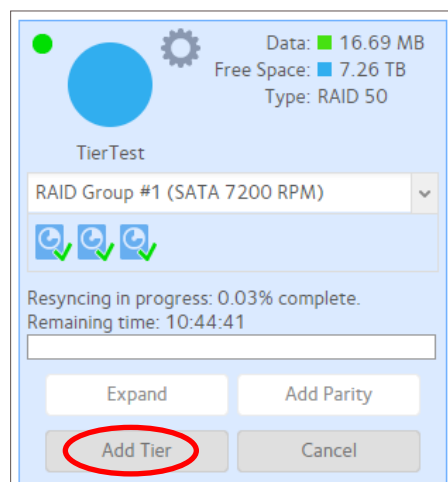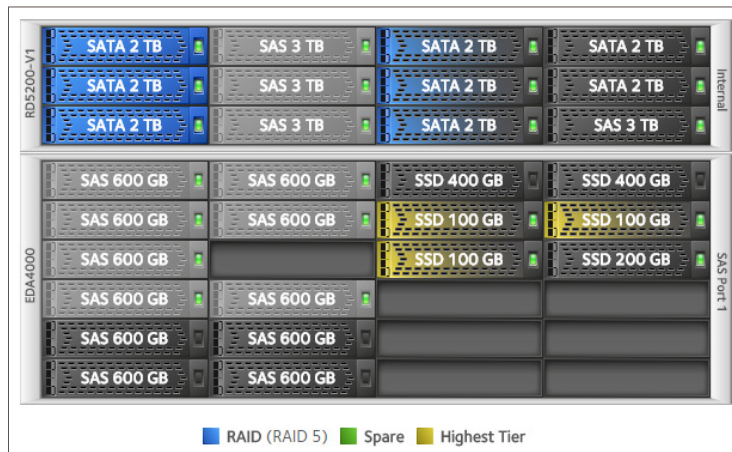
How much space would be needed for the highest tier (or how large the highest tier SSDs should be) depends on how much meta-data that volume currently has and how much you anticipate it growing. To see how much space is currently used for meta-data, simply hover over the data pie chart in your volume.

Global Spares

Prior to ReadyNAS OS 6.7, ReadyNAS used an implicit Global Spare rule, where the ReadyNAS would acknowledge that, while in Flex-RAID, a hot, unused disk could be used to rebuild the volume in the event one of the drives of a volume experienced failure. That drive would be pulled into the RAID and a resync would begin.

In OS 6.7, the ReadyNAS will first look for explicit Global Spares, drives that are designated for being Global Spares, before trying implicitly to pull non-marked drives. Global Spares will be visible as green-colored drives. To add a Global Spare to an existing volume, select the volume, select the drives you wish to allocate as explicit Global Spares and then click on the Global Spare button.

Volume Operations Table

The following table lists the volume operations available for each RAID level and what the resulting RAID level will be after an operation is performed. Please use this as a reference when performing volume operations such as Add Parity, Expand, and Add Group.

RAID	Volume Operation	Available?	Resulting RAID Level	Notes
JBOD	Add Parity	Yes	RAID 1	
	Expand	No	n/a	
	Add Group	Yes	JBOD	
0	Add Parity	Yes	RAID 5	
	Expand	No	n/a	
	Add Group	Concatenated	RAID 0 Concatenated	
1	Add Parity	No	n/a	
	Expand	Yes	RAID 5	
	Add Group	Concatenated	RAID1 Concatenated or RAID 5 Concatenated	
5	Add Parity	Yes	RAID 6	
	Expand	Yes	RAID 5	
	Add Group	Striped	RAID 50	
		Concatenated	RAID 5 Concatenated	RAID 1 and or RAID 5 depending on number of drives selected.
6	Add Parity	No	n/a	
	Expand	Yes	RAID 6	
	Add Group	Striped	RAID 60	
		Concatenated	RAID 6 Concatenated	
10	Add Parity	No	n/a	
	Expand	Yes, available in 6.8.0	RAID 10	
	Add Group	Yes	RAID 10	
50	Add Parity	Yes	RAID 60	
	Expand	Yes	RAID 50	Must have add least one drive per RAID group
	Add Group	Striped	RAID 50	
60	Add Parity	No	n/a	
	Expand	Yes	RAID 60	Must have add least one drive per RAID group
	Add Group	Striped	RAID 60	

APPENDIX

For more information:

ReadyNAS Volume Management with Flex-RAID Video

ReadyNAS OS 6 Software Manual