

NETGEAR®

Volume Performance and Configuration on ReadyDATA Platforms

Performance and Configuration Guide

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Optimize Performance on a ReadyDATA System

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This chapter covers the following topics:

- *Introduction*
- *Summary of Recommendations*
- *Hard Disk Drives*
- *RAID Types*
- *Boost Disks and Advanced Features*
- *Comparison of Disk Type and RAID Level Combinations*
- *RAID Performance on SAN Volumes*

Introduction

This guide was developed to help you decide which RAID type and hard disk drives (HDDs) to implement in a ReadyDATA system to achieve the best performance on a SAN or NAS volume *with* support for redundancy. In addition, this guide includes procedures that describe how to create a volume, a secure LUN, and a share on a ReadyDATA system.

The three characteristics of a storage configuration are capacity, performance, and redundancy. In any configuration, you can select only two of these three characteristics. NETGEAR recommends that you always select redundancy to protect your data. Therefore, the critical factor in a ReadyDATA configuration is to determine the correct balance between capacity and performance. The purpose of this guide is to help you quantify that decision and ensure that ReadyDATA users are able to align their configuration with the performance and capacity requirements of their environment.

In this guide, throughput performance is measured in MB/s for drag and drop (D&D) operations. Read and write performance is measured in input/output operations per second (IOPS) for random and sequential operations.

The recommendations that are summarized in the next section are explained and illustrated throughout this guide.

Summary of Recommendations

The HDDs that NETGEAR offers with ReadyDATA systems differ in capacity, performance, and price. To determine the type and number of HDDs for a ReadyDATA system, first consider the level of performance that is required, then determine the RAID configuration that you will use, and finally consider the usable capacity of the ReadyDATA system. Some network environments require high performance volumes, while for other environments, capacity is most important. The combination of the selected RAID type and HDDs determines the performance and capacity of a volume.

Recommendations for RAID types and HDDs

NETGEAR recommends the following combinations of RAID types and HDDs:

- **High performance.** RAID 10 volume that consists entirely of SSD or SAS drives.
- **Intermediate performance.** RAID 5+0 or RAID 6+0 volume that consists entirely of SATA drives or that consists of a hybrid configuration with SATA spindle drives and SATA SSD drives.
- **Moderate performance.** RAID 5 volume that consists entirely of SATA drives.
- **Low performance.** RAID 6 volume that consists entirely of SATA drives.

General Recommendations

NETGEAR makes the following general recommendations:

- For a volume that is used for random reads and writes, use SAS drives.
- If high I/O performance is required, do not use RAID 5 or RAID 6.
- For applications that require low latency and high performance, use SAS drives in a RAID 10 volume. Examples of such applications include virtual servers (VMware, Hyper-V, XenServer), databases, email, video, and processing.
- For general file serving, use large-capacity SATA or NL-SAS drives in a RAID 5+0 volume with SSD read and write caching boost disks.
- For disk-to-disk backup, use large-capacity SATA or NL-SAS drives in a RAID 5 or RAID 6 volume with a maximum of 12 drives per RAID group.

Hard Disk Drives

HDDs differ in capacity, performance, and price. The following table compares hard disk drives, storage capacity, and performance in a RAID 5 SAN volume.

Table 1. Hard disk drives and performance in a RAID 5 SAN volume

HDD	Description	Available Storage Capacity	Performance	Conclusion
SATA	Serial ATA drive 7,200 rpm	1 TB, 2 TB, 3 TB, and 4 TB	Low	SATA disks offer large storage capacity and are a good compromise between price and performance.
SAS	Serial attached SCSI drive 15,000 rpm	300 GB, 450 GB, and 600 GB	High	SAS disks show a stronger performance than SATA disks but offer more limited storage capacity.
SATA SSD	Serial ATA solid-state drive	50 GB, 100 GB, and 200 GB	Highest	SSD disks outperform SATA and SAS spindle disks but are more expensive and offer limited storage capacity. SSD disks can be used as boost disks in a hybrid volume.

Volume Performance and Configuration on ReadyDATA Platforms

The following figure shows the drag and drop performance for reads and writes in Mbps on different HDDs. All volumes are RAID 5 SAN volumes.

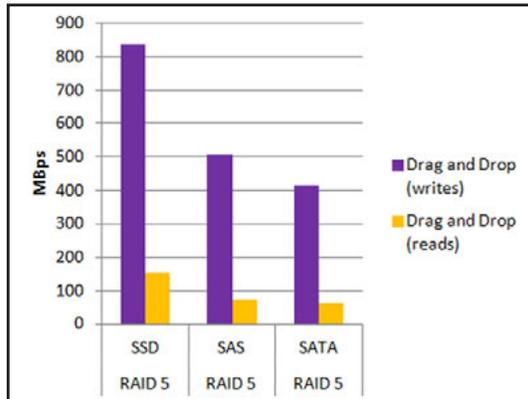


Figure 1. Performance of different HDDs

The following figure shows the IOPS for random reads and writes using a 4k block size on different HDDs. All volumes are RAID 5 SAN volumes. SSD disks completely outperform SAS and SATA disks.

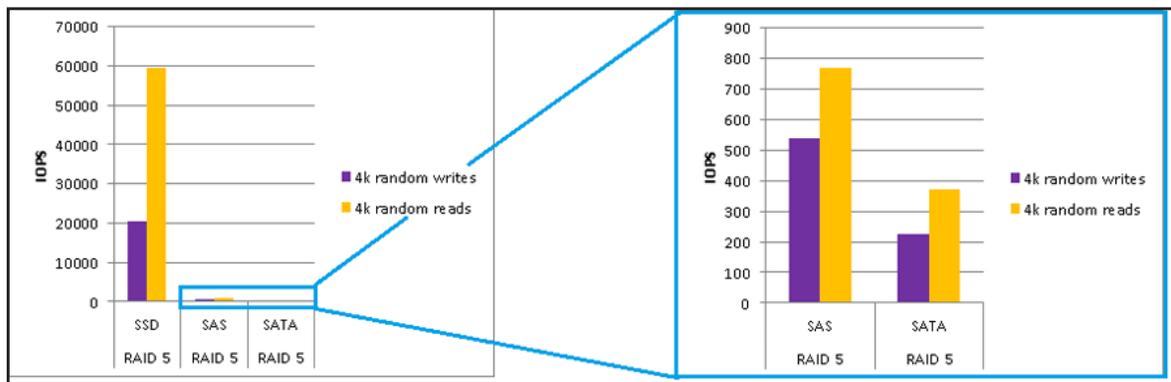


Figure 2. IOPS for random reads and writes using a 4k block size on different HDDs

The following figure shows the IOPS for sequential reads and writes using a 4k block size on different HDDs. All volumes are RAID 5 SAN volumes.

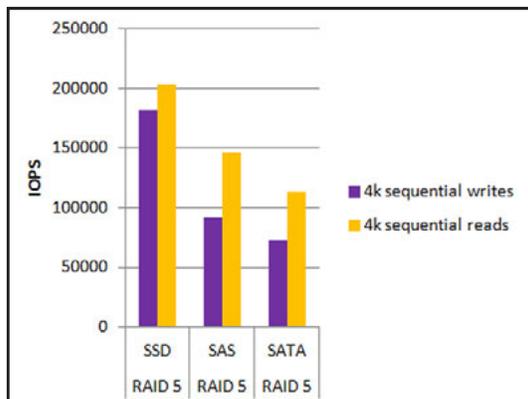


Figure 3. IOPS for sequential reads and writes using a 4k block size on different HDDs

RAID Types

The selection of the RAID type and the types of HDDs determine the performance of the volume.

The following table compares RAID types and performance when all volumes have the same types of HDDs (except for the hybrid volume, which also includes SSD boost disks).

Note: RAID 0 does not support redundancy and is therefore not considered in this guide.

The table is sorted by RAID type from highest to lowest performance.

Table 2. RAID types arranged from highest to lowest performance

RAID Type	Performance
RAID 10	<ul style="list-style-type: none"> Highest throughput performance and lowest number of IOPS compared to the other RAID types. Requires one mirror disk for each storage disk.
Hybrid RAID 5+0 with three SSD boost disks	<ul style="list-style-type: none"> The expansion allows for highly increased performance compared to RAID 5 without boost disks. Requires one parity disk for each expansion. Requires a minimum of two drive bays for boost disks.
RAID 5+0	<ul style="list-style-type: none"> The expansion allows for increased performance compared to RAID 5 without expansion. Requires one parity disk for each expansion.
RAID 6+0	<ul style="list-style-type: none"> The expansion allows for increased performance compared to RAID 6 without expansion. Requires two parity disks for each expansion.
RAID 5	<ul style="list-style-type: none"> Low performance compared to the other RAID types.
RAID 6	<ul style="list-style-type: none"> Lowest performance compared to the other RAID types.

The following three graphs are based on a volume with 12 SATA disks and a transfer of 200 GB data over iSCSI.

Volume Performance and Configuration on ReadyDATA Platforms

The following figure shows that a hybrid volume with SSD boost disks and a RAID 5+0 x4 volume provides the highest average drag and drop throughput. A RAID 10 volume provides the highest throughput for read operations. All volumes provide good throughput for write operations.

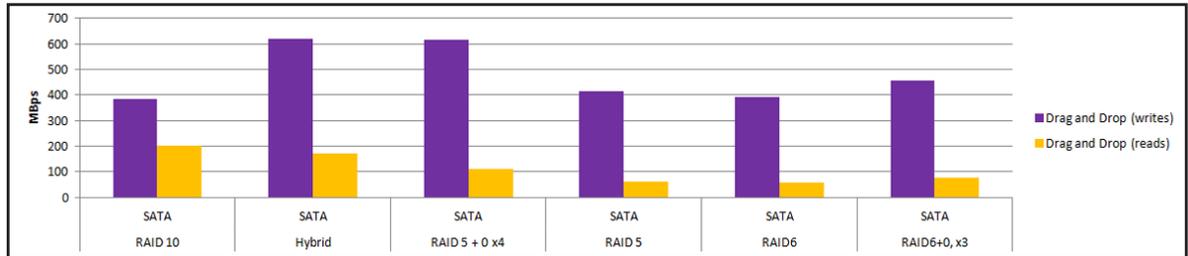


Figure 4. Drag and drop performance on SAN volumes with SATA disks

The following figure shows that a RAID 10 volume provides the highest performance for random read and write operations. A RAID 5 volume and a RAID 6 volume provide low performance.

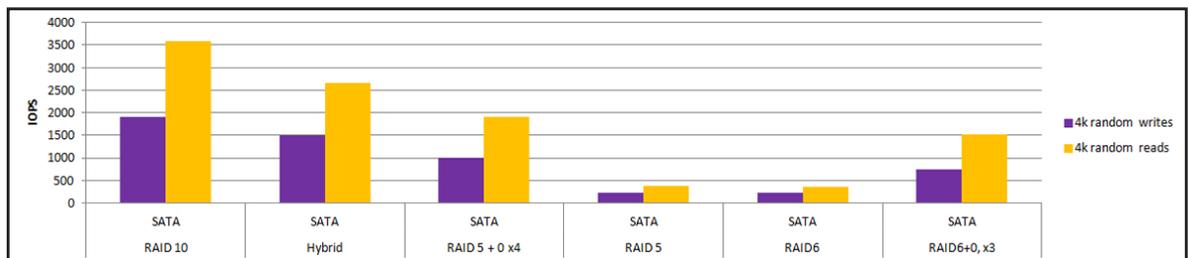


Figure 5. Random read and write performance on SAN volumes with SATA disks

The following figure shows that a RAID 10 volume and a hybrid volume with SSD boost disks provide the highest performance for sequential read and write operations. All volumes provide good performance for read operations.

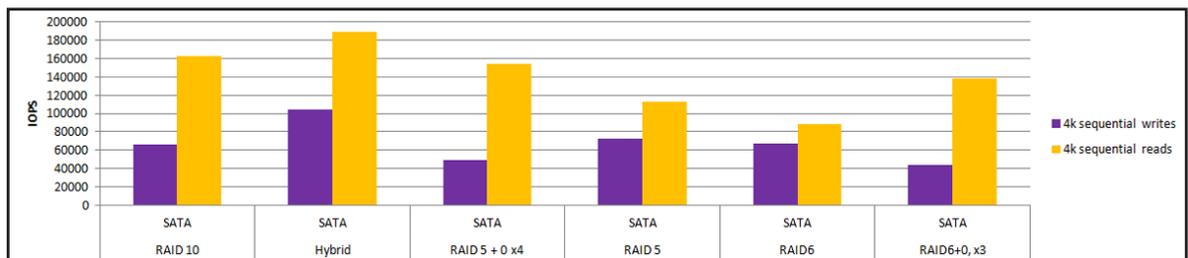


Figure 6. Sequential read and write performance on SAN volumes with SATA disks

In a virtualized server environment, the types of hard disk drives and RAID type that you select determine the performance of a volume.

The following table describes the RAID nomenclature and disk requirements; n indicates the sequential expansion number, and x indicates *times* (for example, 2x is two times).

Table 3. RAID nomenclature and requirements on a ReadyDATA platform

RAID Type	New RAID	Expanded RAID	Number of Required Disks	Number of Disks Dedicated to Redundancy
RAID 0	RAID 0+	RAID 0+	One or more	Redundancy is not supported
RAID 1	RAID 1+	RAID 1+0, nx	Two only (more disks are not supported in RAID 1)	Half (n/2) of the disks in a RAID group
RAID 5	RAID 5+	RAID 5+0, nx	Three or more	One disk in a RAID group
RAID 6	RAID 6+	RAID 6+0, nx	Four or more	Two disks in a RAID group
RAID 10	RAID 1+0	RAID 1+0	Four or more, but an even number	Half (n/2) of the disks in a RAID group

For more information about volumes, see [Overview of Volumes](#) on page 28.

Boost Disks and Advanced Features

This section describes the advantages of SSD boost disks in a hybrid volume configuration and the disadvantages of compression and deduplication on LUNs.

SSD Boost Disks

You can install SSD boost disks in a volume that consist of SATA or SAS storage disks. Such a volume is referred to as a hybrid volume. The SSD disks are not used for storage but exclusively to boost the performance of the volume.

SSD boost disks cache data based on two algorithms: most recently used (MRU) and most frequently used (MFU). SSD caching provides a performance improvement because, for most storage applications, some data are accessed more frequently than others, and caching ensures that frequently accessed data is served from the fastest disk (that is, from an SSD disk).

- **SSD read boost disk.** A read boost disk increases general read response time and performance. Generally, a single read boost disk is sufficient to increase the performance of a volume, but some data sets require additional read boost disks. A read boost disk is also referred to as a cache disk.
- **SSD write boost disk.** A write boost disk increases the performance of a volume for synchronous write operations to the volume. For most configurations, NETGEAR recommends one boost disk. A write boost disk is also referred to as a log disk.

The positive effect of SSD boost disks on performance in a SATA volume can be clearly seen in the following graphs.

Drag and Drop Performance on a Hybrid Volume

The following figure shows that a hybrid volume improves the drag and drop performance for read operations.

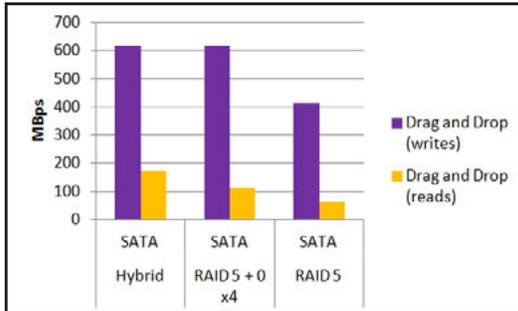


Figure 7. Drag and drop performance with SSD boost disk

Random Read and Write Performance on a Hybrid Volume

The following figure shows that a hybrid volume improves the random performance for both read and write operations.

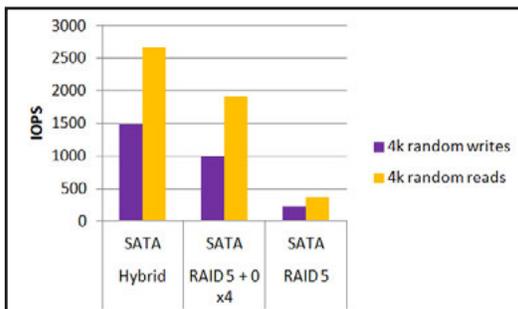


Figure 8. Random read and write performance with SSD boost disk

Sequential Read and Write Performance on a Hybrid Volume

The following figure shows that a hybrid volume improves the sequential performance for both read and write operations.

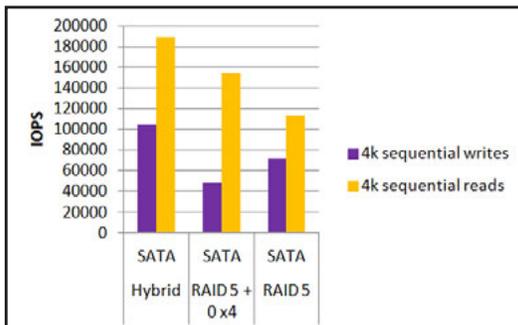


Figure 9. Sequential read and write performance with SSD boost disk

Compression and Deduplication on LUNs

NETGEAR recommends that you do *not* enable deduplication and compression on LUNs. This recommendation does not apply to shares.

Deduplication can come with a high performance overhead. NETGEAR recommends that you employ only one deduplication technology for a data set. For example, use the deduplication feature of your backup software application instead of the ReadyDATA's deduplication, or the other way around.

If the deduplication ratio is below 1.5, NETGEAR recommends that you disable deduplication to avoid performance overhead. In general, NETGEAR recommends that you start with compression, rather than deduplication. Compression has minimal performance overhead and often saves as much capacity as deduplication. If you intend to use deduplication on a large data set (for example, over 4 TB), NETGEAR recommends that you purchase a read cache SSD to avoid high performance overhead.

Deduplication

NETGEAR strongly advises against enabling deduplication on any LUN. Deduplication prevents storage of redundant data on a LUN. Unique data is stored only once on the LUN, and other instances of the identical data are removed and replaced by a pointer to the unique data. However, deduplication rarely increases the speed of data transfers, and it does not effectively save storage space for a LUN.

Whether you use a thin or a thick LUN, a LUN size is statically defined and therefore does not grow when the volume storage space increases: deduplication on a LUN might decrease the performance without delivering more storage capacity for the LUN.

For more information about deduplication on LUNs, visit http://kb.netgear.com/app/answers/detail/a_id/22685/related/1.

Compression

Compression uses the CPU and memory of the ReadyDATA platform to compress and decompress data. Although compression can increase the speed of data transfers, it does not effectively save storage space for a LUN.

Whether you use a thin or a thick LUN, a LUN size is statically defined and therefore does not grow when the volume storage space increases: compression on a LUN might decrease the performance without delivering more storage capacity for the LUN.

The following graphs show that enabling compression on a LUN does not provide any real benefits. Write operations are more affected than read operations.

Drag and Drop Performance Overhead with Compression

The following figure shows that enabling compression weakens the drag and drop performance for both read and write operations. The two bars on the left show write operations. The two bars on the right show read operations.

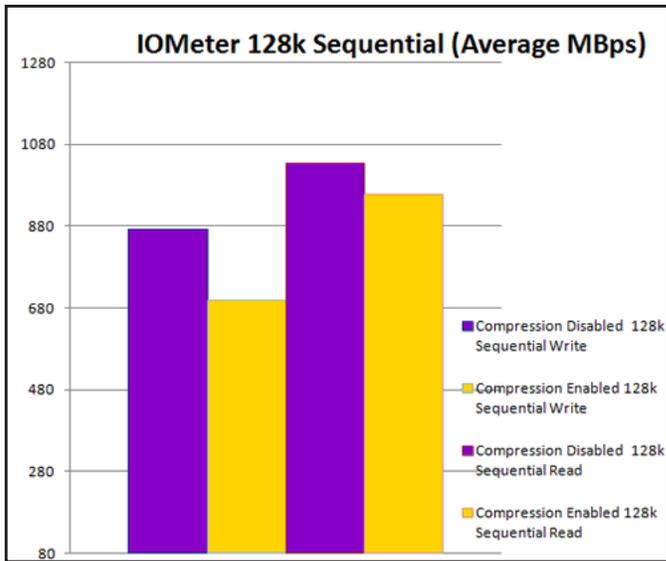


Figure 10. Drag and drop performance overhead with compression

Random Read and Write Performance Overhead with Compression

The following figure shows that enabling compression improves the random performance for write operations but weakens the random performance for read operations. The two bars on the left show write operations. The two bars on the right show read operations.

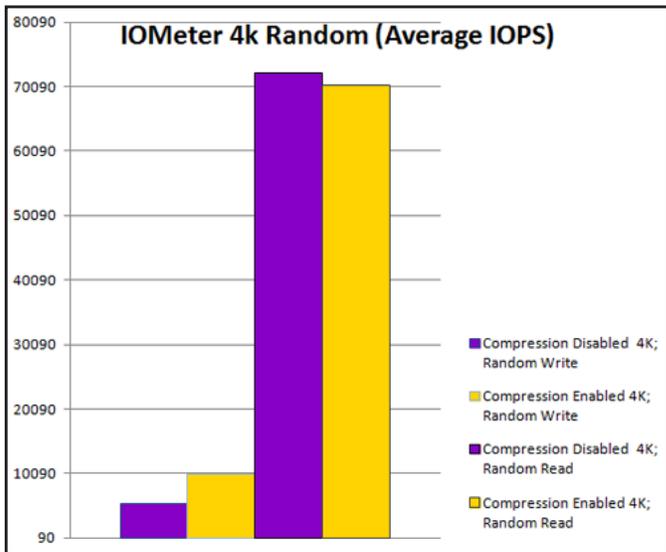


Figure 11. Random read and write performance overhead with compression

Sequential Read and Write Performance Overhead with Compression

The following figure shows that enabling compression weakens the sequential performance for read operations. Write operations are affected very minimally. The two bars on the left show write operations. The two bars on the right show read operations.

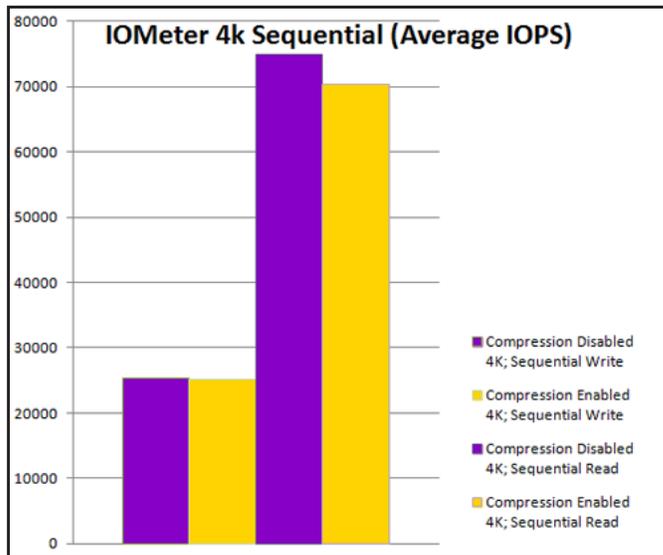


Figure 12. Sequential read and write performance overhead with compression

Comparison of Disk Type and RAID Level Combinations

The graphs in this section illustrate how the selection of HDDs affects the RAID performance on a SAN volume and a NAS volume.

Hard Disk Drives and RAID Performance on a SAN Volume

While pure SSD volumes always outperform volumes with spinning disks such as SAS or SATA disks, pure SSD volumes are usually not practical because of high cost and capacity limitations. Taking cost and capacity into consideration, SAS drives in a RAID 10 configuration provide the best all-around performance for SAN volumes. NETGEAR strongly recommends using SAS drives in a RAID 10 configuration for virtualization, iSCSI applications, and any other storage application that requires high IOPS, low latency, or both.

For more information about the RAID performance on a SAN volume with SATA disks and a SAN volume with SAS disks, see [RAID Performance on SAN Volumes](#) on page 18.

The graphs in the following sections are based on a volume with 12 disks and a transfer of 200 GB data over iSCSI.

Drag and Drop Performance on SAN Volumes

The following figure shows that a RAID 10 volume with SAS disks provides the best overall drag and drop (D&D) performance. Even though all volumes perform D&D write operations very well, a RAID 5 volume with SSD disks, a RAID 10 volume with SAS disks, and a RAID 5+0 x4 volume with SAS disks lead the performance for D&D write operations. The D&D read performances are in general not as strong, but a RAID 5+0 x4 volume with SSD disks and a RAID 10 volume with either SATA or SAS disks provide good performance.

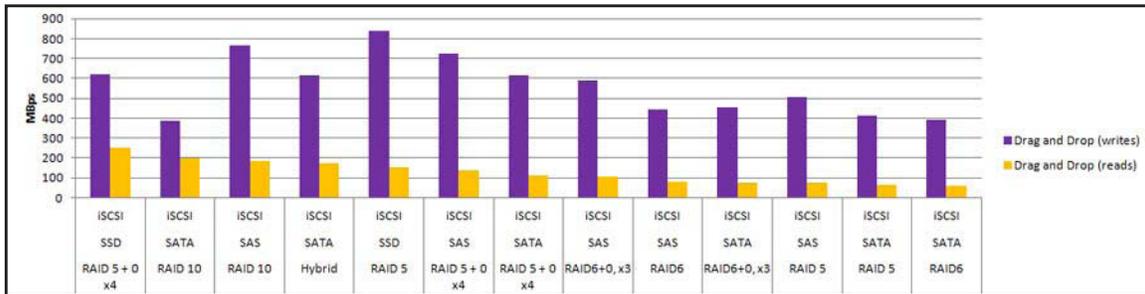


Figure 13. Drag and drop performance on SAN volumes

Random Read and Write Performance on SAN Volumes

The following figure shows that a RAID 5 volume that consists of SSD drives completely outperforms any other configuration for random reads and writes. The breakout graph shows only SATA and SAS drives. In this comparison, a RAID 10 volume that consists of SAS drives outperforms other SAS and SATA configurations for random reads and writes.



Figure 14. Random read and write performance on SAN volumes

Sequential Read and Write Performance on SAN Volumes

The following figure shows that a RAID 5 volume with SSD disks provides the best overall performance for sequential reads and writes. A RAID 5+0 x4 volume with SSD disks and a RAID 10 volume with SAS disks provide good alternatives.

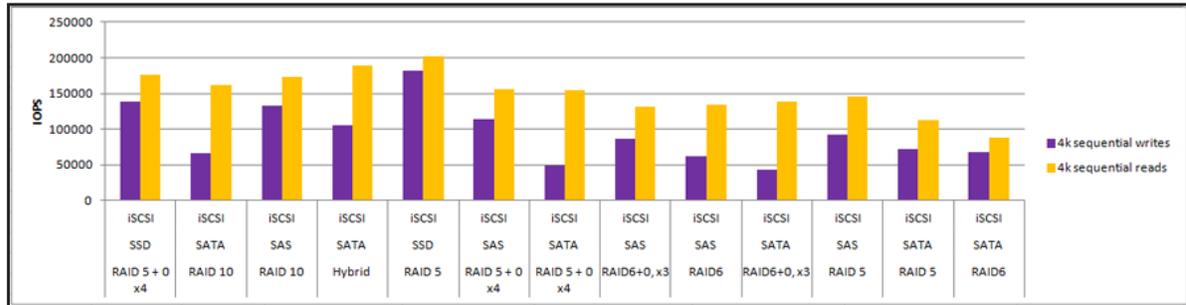


Figure 15. Sequential read and write performance on SAN volumes

Hard Disk Drives and RAID Performance on a NAS Volume

While pure SSD volumes always outperform volumes with spinning disks such as SAS or SATA disks, pure SSD volumes are usually not practical because of high cost and capacity limitations. Taking cost and capacity into consideration, SAS drives in a RAID 10 configuration provide the best all-around performance for NAS volumes. NETGEAR strongly recommends using SAS drives in a RAID 10 configuration for virtualization and storage application that requires high IOPS, low latency, or both. For applications that do require high IOPS such as general file serving and backup applications, SATA drives offer a high-capacity, low-performance alternative.

The graphs in the following sections are based on a volume with 12 disks and a transfer of 10 GB data over SMB.

Drag and Drop Performance on NAS Volumes

The following figure shows that a RAID 5 volume with SSD disks and a RAID 5+0 4x volume with SSD disks provide the best overall D&D performance. A RAID 5 volume with SAS disks, a RAID 5+0 4x volume with SAS disks, or a RAID 10 volume with SAS disks provides a good alternative.

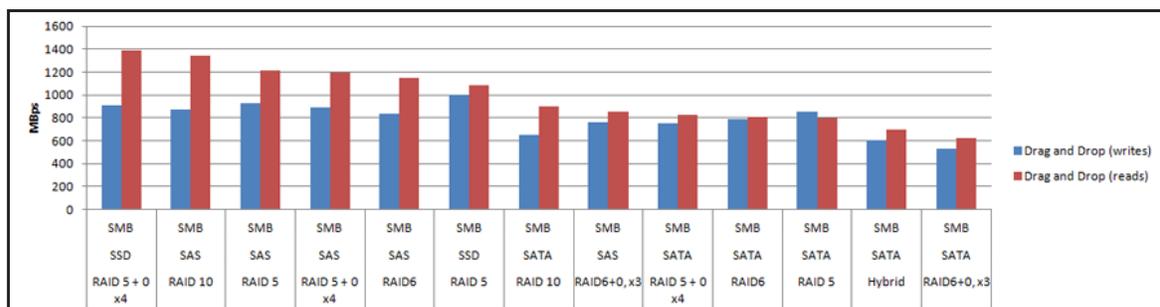


Figure 16. Drag and drop performance on NAS volumes

Random Read and Write Performance on NAS Volumes

The following figure shows that the performance of random read operations is strong on all volumes. Taking the much weaker performance of random write operations into consideration, a RAID 5 volume with SSD disks, a RAID 5+0 4x volume with SSD disks, and a RAID 10 volume with SAS disks provide a good overall performance.

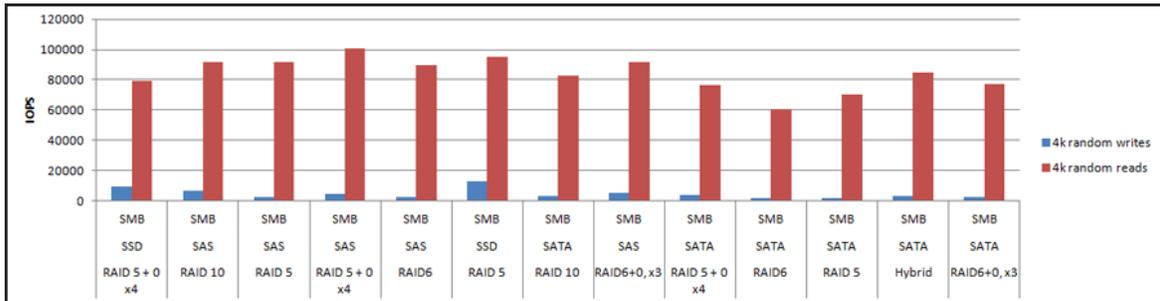


Figure 17. Random read and write performance on NAS volumes

Sequential Read and Write Performance on NAS Volumes

The following figure shows that the performance of sequential read operations is strong on all volumes. The sequential write performance of a RAID 10 volume with SAS disks is the strongest, making this configuration the best overall performer for sequential operations.

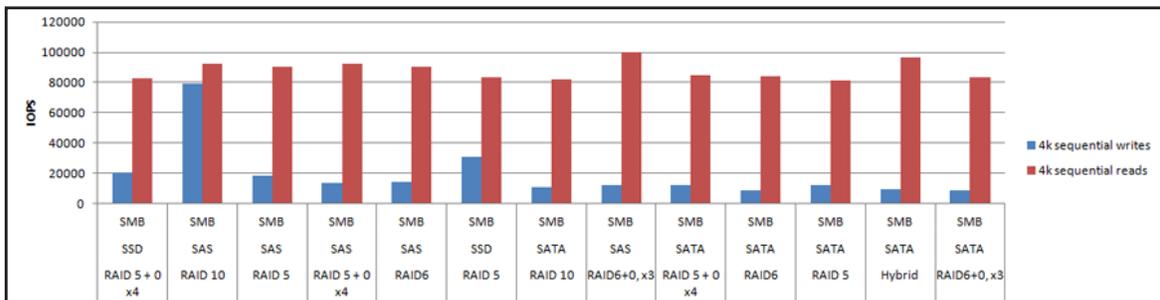


Figure 18. Sequential read and write performance on NAS volumes

RAID Performance on SAN Volumes

This section describes and illustrates in detail the RAID performance of a volume with SATA disks and the RAID performance of a volume with SAS disks.

The data and graphs in this section are based on two volumes, one with 12 SATA disks and one with 12 SAS disks, and a transfer of 200 GB data over iSCSI.

Table 4. RAID performance on SAN volumes

RAID Type	Operation	Performance		Conclusion
		SATA Disks	SAS Disks	
RAID 10	D&D writes	386 Mbps	764 Mbps	RAID 10 is the best choice for storage applications that require high IOPS and low latency.
	D&D reads	202 Mbps	184 Mbps	
	4k random writes	1,896 IOPS	3,030 IOPS	
	4k random reads	3,592 IOPS	6,214 IOPS	
	4k sequential writes	65,816 IOPS	132,297 IOPS	
	4k sequential reads	162,160 IOPS	173,561 IOPS	
Hybrid This volume is a RAID 5+0 x3 volume that consists of three disks that have been expanded two times for a total of three RAID groups. The volume also includes SSD boost disks.	D&D writes	618 Mbps	Not measured	A hybrid volume offers performance that approaches that of a RAID 10 SAS volume, but it should not be considered an equivalent. When the performance needs are moderate and large capacity is required, a hybrid volume is viable only when paired with SATA disks that are configured in a RAID 10 or RAID 5+0 volume.
	D&D reads	172 Mbps	Not measured	
	4k random writes	1,498 IOPS	Not measured	
	4k random reads	2,665 IOPS	Not measured	
	4k sequential writes	104,714 IOPS	Not measured	
	4k sequential reads	189,297 IOPS	Not measured	
RAID 5+0 x4 This volume consists of three disks that have been expanded three times for a total of four RAID groups.	D&D writes	617 Mbps	724 Mbps	RAID 5+0 provides higher performance than RAID 5, RAID 6, or RAID 6+0. You can use RAID 5+0 for file serving, backup, and archive applications, but RAID 5+0 is not recommended for storage applications that are sensitive to latency.
	D&D reads	111 Mbps	139 Mbps	
	4k random writes	995 IOPS	2,202 IOPS	
	4k random reads	1,910 IOPS	3,778 IOPS	
	4k sequential writes	48,581 IOPS	114,316 IOPS	
	4k sequential reads	154,625 IOPS	155,655 IOPS	

Table 4. RAID performance on SAN volumes (continued)

RAID Type	Operation	Performance		Conclusion
		SATA Disks	SAS Disks	
RAID 5	D&D writes	414 Mbps	507 Mbps	RAID 5 offers the highest usable capacity when performance is not important. Additionally, RAID 5 offers lower redundancy than other RAID types that are listed in this table. Accordingly, designation of a hot spare disk is highly recommended. Use RAID 5 only for data archiving and backup applications.
	D&D reads	63 Mbps	74 Mbps	
	4k random writes	226 IOPS	541 IOPS	
	4k random reads	373 IOPS	770 IOPS	
	4k sequential writes	72,028 IOPS	91,846 IOPS	
	4k sequential reads	113,091 IOPS	146,444 IOPS	
RAID 6+0 x3 This volume consists of four disks that have been expanded two times for a total of three RAID groups.	D&D writes	455 Mbps	591 Mbps	RAID 6+0 delivers higher performance than RAID 5 or RAID 6, but is recommended only for storage applications that are not sensitive to latency.
	D&D reads	76 Mbps	106 Mbps	
	4k random writes	737 IOPS	1,731 IOPS	
	4k random reads	1,523 IOPS	2,979 IOPS	
	4k sequential writes	43,611 IOPS	86,711 IOPS	
	4k sequential reads	138,751 IOPS	131,750 IOPS	
RAID 6	D&D writes	390 Mbps	442 Mbps	RAID 6 configurations provide the lowest throughput and available IOPS. Use RAID 6 only for data archiving and backup applications.
	D&D reads	59 Mbps	80 Mbps	
	4k random writes	215 IOPS	507 IOPS	
	4k random reads	353 IOPS	807 IOPS	
	4k sequential writes	67,609 IOPS	62,475 IOPS	
	4k sequential reads	87,894 IOPS	133,579 IOPS	

Drag and Drop Performance

The following figure shows that a hybrid volume with SSD boost disks and a RAID 5+0 x4 volume provide the highest average drag and drop throughput. A RAID 10 volume provides the highest throughput for read operations. All volumes provide good throughput for write operations.

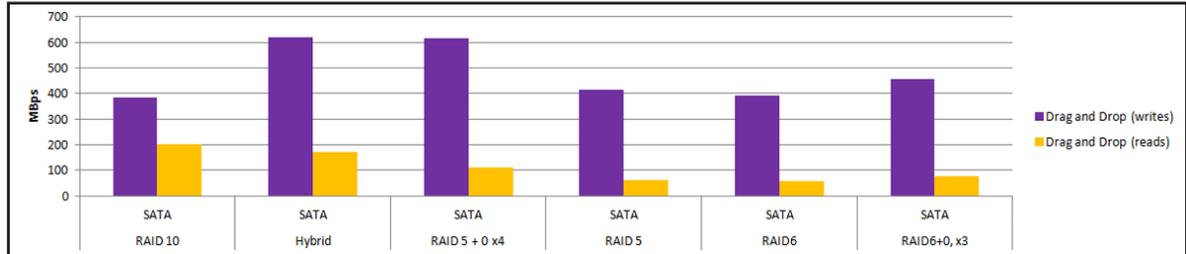


Figure 19. Drag and drop performance on SAN volumes with SATA disks

The following figure shows that a RAID 10 volume and a RAID 5+0 x4 volume provide the highest average drag and drop throughput. A RAID 10 volume provides the highest throughput for read operations. All volumes provide a rather limited throughput for read operations.

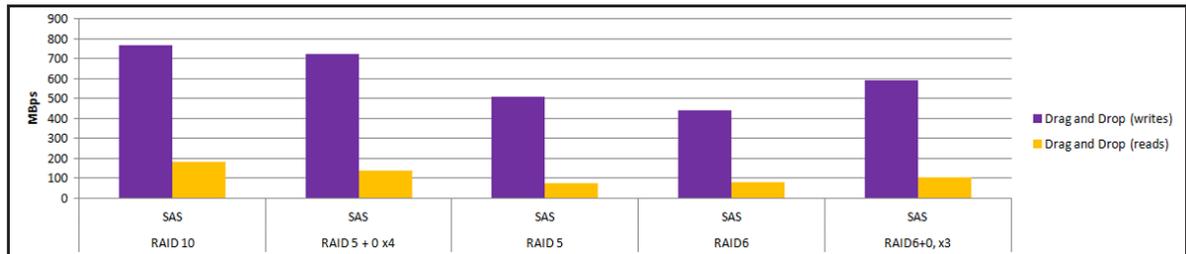


Figure 20. Drag and drop performance on SAN volumes with SAS disks

Random Read and Write Performance

The following figure shows that a RAID 10 volume provides the highest performance for random read and write operations. A RAID 5 volume and a RAID 6 volume provide low performance.

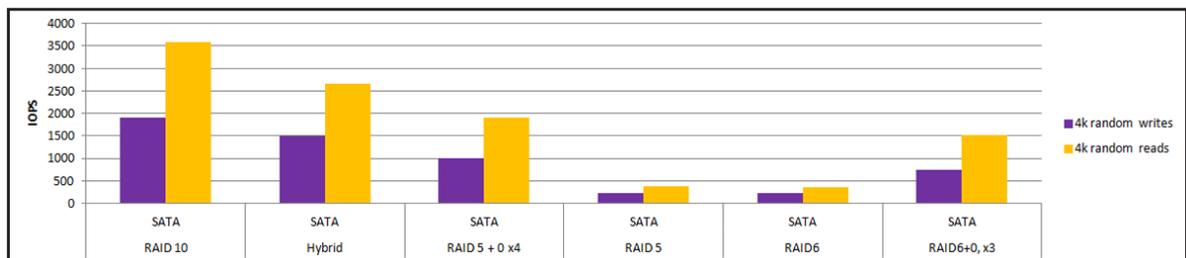


Figure 21. Random read and write performance on SAN volumes with SATA disks

The following figure shows that a RAID 10 volume provides the highest performance for random read and write operations. A RAID 5 volume and a RAID 6 volume provide low performance.

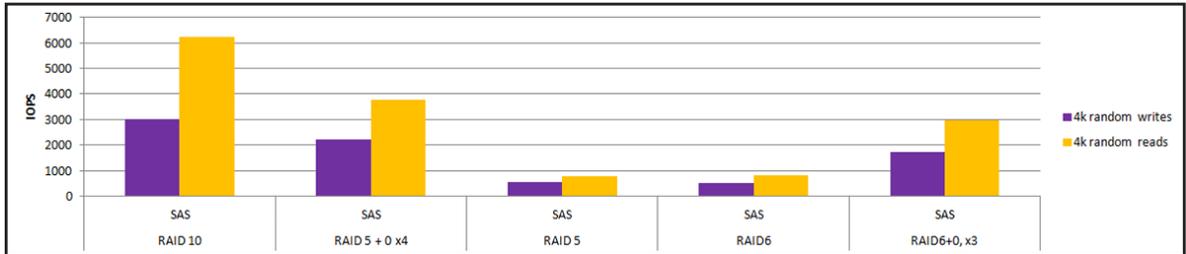


Figure 22. Random read and write performance on SAN volumes with SAS disks

Sequential Read and Write Performance

The following figure shows that a hybrid volume with SSD boost disks provides the highest performance for sequential read and write operations. All volumes provide good performance for read operations.

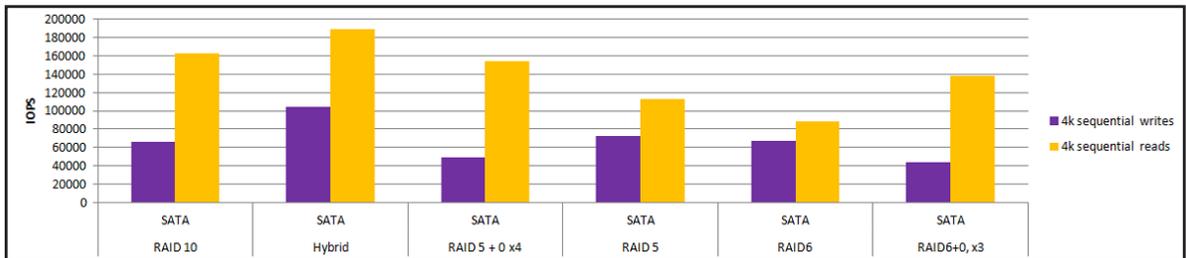


Figure 23. Sequential read and write performance on SAN volumes with SATA disks

The following figure shows that a RAID 10 volume provides the highest performance for sequential read and write operations. All volumes provide good performance for read operations.

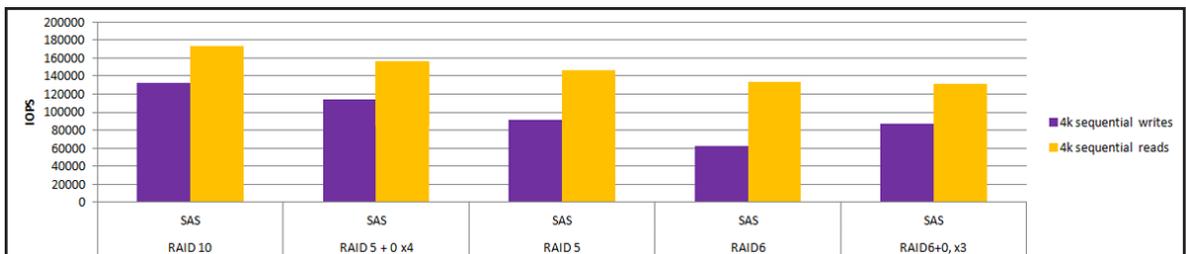


Figure 24. Sequential read and write performance on SAN volumes with SAS disks

2. Configure Volumes, LUNS, Shares, and Security

2

This chapter covers the following topics:

- *Recommendations for iSCSI Initiators in SAN Volumes*
- *Configure Channel Bonding for NAS Volumes*
- *Create a Volume*
- *Configure a LUN and LUN Security*
- *Configure a Share*
- *Configure Access Settings for an NFS Share*

Recommendations for iSCSI Initiators in SAN Volumes

An iSCSI initiator application lets you set up a connection from a server to a LUN group (and therefore to individual LUNs).

NETGEAR recommends the following settings for iSCSI initiators:

- Format the disk on the iSCSI initiator on the client side to an 8 k size.
Because iSCSI uses strictly 8 k block sizes instead of variable block sizes, formatting the disk on the iSCSI initiator on the client side to the same 8 k size provides the best performance.
- Disable the vStorage APIs for Array Integration (VAAI) feature on all VMWare hosts that connect to iSCSI LUNs on a ReadyDATA platform.

For more information about VAAI, visit

http://kb.netgear.com/app/answers/detail/a_id/22691/related/1.

Configure Channel Bonding for NAS Volumes

If you intend to use a NAS volume in an NFS configuration, NETGEAR recommends that you configure a bonded channel. A bonded channel uses Link Aggregation Control Protocol (LACP) to provide optimum performance and reliability in the network.

A bonded channel combines two Ethernet interfaces into a single logical link or link aggregation group (LAG). Network devices treat the aggregation as if it were a single link, which increases fault tolerance and provides load sharing.

The ReadyDATA system supports a static LAG and a dynamic LAG with active or passive LACP for automatic configuration of a channel link with another device. Both the ReadyDATA system and the device with which the channel link is established (usually a switch) need to support the same mode (static LAG or dynamic LAG).

Configure Channel Bonding on a ReadyDATA System

Configure the bonded channel first on the ReadyDATA system and then on the switch to which the ReadyDATA system is connected. If you do not follow this order, loss of communication might occur between the ReadyDATA system and the switch.

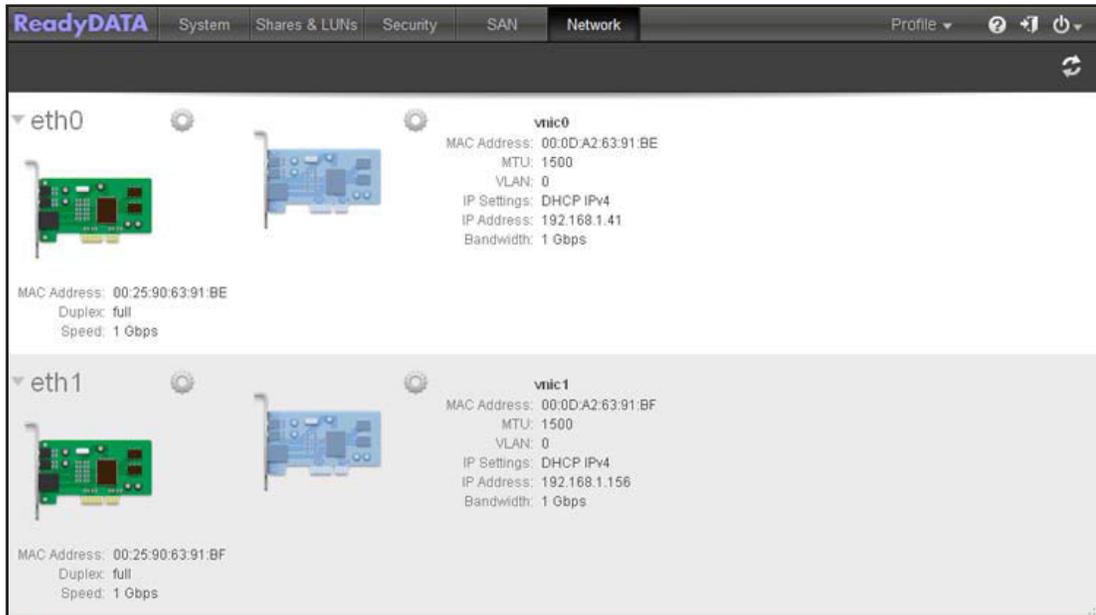
➤ **To configure a channel bonding on a ReadyDATA system:**

1. Log in to the ReadyDATA platform using the default or your personalized login credentials.

The Dashboard home screen displays.

2. Select **Network**.

The Network screen displays:

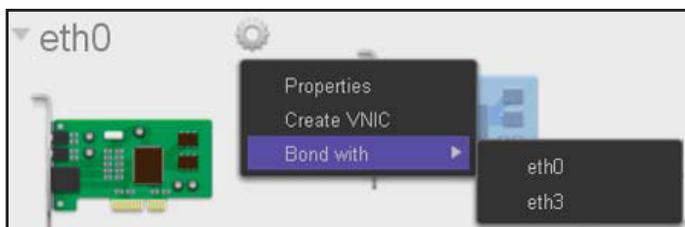


3. Click the gear icon to the right of an Ethernet interface.

A pop-up menu displays (see the figure in [Step 4](#)).

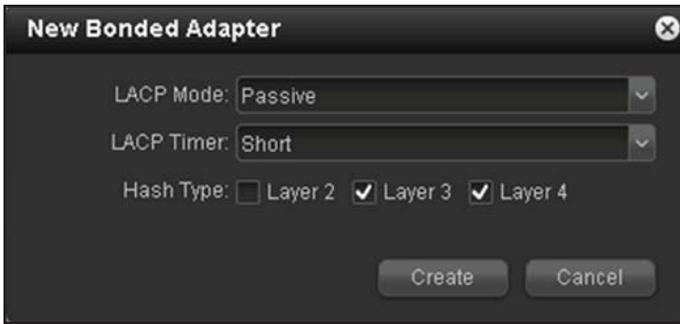
4. Select **Bond with**.

A second pop-up screen displays the Ethernet interfaces and, if already configured, the aggregated interfaces (bonded channels):



5. Select the name of the interface that you want to be member of the bonded channel.

The New Bonded Adaptor pop-up screen displays:



6. Configure the settings as explained in the following table:

Item	Description
LACP Mode	<p>Select the LACP mode from the drop-down list:</p> <ul style="list-style-type: none"> • Active. The aggregation interface actively transmits LACPDU s to other LACP devices to set up a link channel. Select this mode for a dynamic LAG with active LACP. • Passive. The aggregation interface responds only to LACPDUs from other LACP devices. Select this mode for a dynamic LAG with passive LACP. <p>Note: For connections to a NETGEAR switch, NETGEAR recommends passive mode.</p> <p>Note: If both the ReadyDATA platform and the device with which the channel link needs to be established function in passive mode, the channel link cannot be established. At least one side needs to function in active mode.</p>
LACP Timer	<p>If the LACP mode is set to Active, select a value for the LACP timer from the drop-down list:</p> <ul style="list-style-type: none"> • Short. LACPDUs are sent frequently, that is, a short interval occurs between LACPDU transmissions. This is the default setting. • Long. LACPDUs are sent infrequently, that is, a long interval occurs between LACPDU transmissions.
Hash Type	<p>Select one or more check boxes to specify the hash types to be used:</p> <ul style="list-style-type: none"> • Layer 2. The channel link that is established is based on the source and destination MAC addresses. • Layer 3. The channel link that is established is based on the source and destination IP addresses. • Layer 4. The channel link that is established is based on the source and destination port numbers. <p>Note: Because of how the hash algorithms calculate the channel load and the sequential way that the MAC addresses are arranged on the ReadyDATA system, NETGEAR recommends using Layer 3 and Layer 4 hash types. The Layer 2 hash type uses short separation values in the MAC addresses, which might not provide optimal load balancing.</p>

7. Select **Create**.

8. Configure channel bonding on the switch to which the ReadyDATA system is attached.

For more information, see [Recommendations for Channel Bonding on a NETGEAR Switch](#) on page 27.

Note: After you have configured channel bonding on both the ReadyDATA system and the switch, it might take a few moments for the ReadyDATA system to receive the IP addresses on all VNICs. During this time, access to the ReadyDATA system is interrupted.

The new bonded channel displays as an aggregation interface (aggrX, in which X is a number in sequential and ascending order) with its VNICs and associated IP addresses on the Network screen.



Note: In this sample procedure, the MAC addresses and IP addresses in the previous figure do not match up with those in the figure in [Step 2](#).

Note the following about channel bonding:

- Any additional VNICs that you create are children of the Ethernet interface (NIC) that you used to create the channel bond. A child VNIC receives a MAC address that is identical to the MAC address of the parent NIC except for the second transmission octet, which increments by 1. The following is an example:
 - MAC address of the parent NIC: 00:**0D**:A2:C7:91:AF
 - MAC address of a child VNIC: 00:**0E**:A2:C7:91:AF
- After configuring channel bonding, if you lose communication with the ReadyDATA system, connect to one of the available NICs on the ReadyDATA system to reestablish communication.
- While you configure channel bonding, if the ReadyDATA system cannot locate a DHCP server, or fails to release an IP address, it assigns an automatic private IP address (APIPA) to a VNIC. This IP address is in the 169.254.x.x/16 subnet. The last two octets of the address are derived from the MAC address of the VNIC.

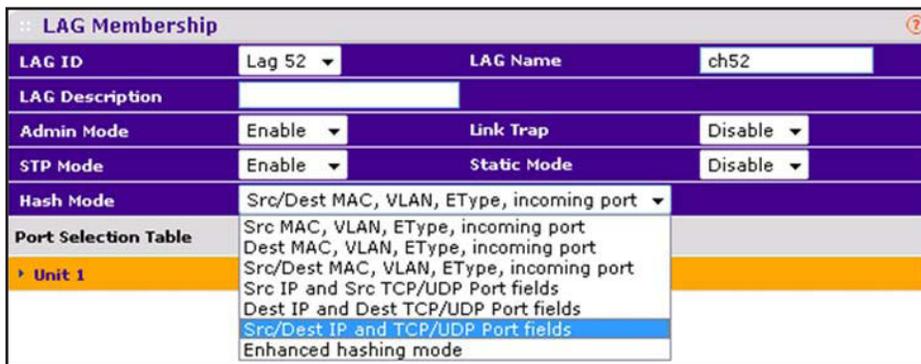
To connect to a VNIC that has an APIPA:

1. Convert the last two hexadecimal values of the MAC address in the IP address to decimal values.
2. Configure a computer to operate in the same subnet as the newly derived IP address (that is, the IP address with the converted decimal values).
3. Use a supported browser to connect to the VNIC.

Recommendations for Channel Bonding on a NETGEAR Switch

NETGEAR recommends the following settings for channel bonding on a NETGEAR switch:

- Navigate to a screen on which you can configure the LAG membership. The navigation path depends on the switch model. For the hash mode, select **Src/Dest IP and TCP/UDP Port fields**. The following figure shows an example.



Src/Dest IP corresponds to Layer 3 and TCP/UDP to Layer 4. This combination provides a good match for the settings on the ReadyDATA system.

For switches from other vendors, you need to find an equivalent setting.

- If you have VLANs in your network, make sure that the participations and VIDs are correctly configured on the LAG on your switch.

Create a Volume

This section provides an overview of the volumes and describes the basic steps to create a volume and select the RAID level.

For extensive information about managing volumes, see “Manage Volumes” in Chapter 2, “Manage Disks and Volumes,” of the *ReadyDATA OS Software Manual*, which you can download from <http://downloadcenter.netgear.com>.

Overview of Volumes

All following volume examples use 1 TB SATA disks and have deduplication disabled.

RAID 10

RAID 10 (also referred to as RAID 1+0) supports both striping and mirroring and provides the highest performance. The drawback is the number of disks that you need for this configuration: You require one dedicated parity disk for each storage disk.

The following figure shows a volume that is configured for RAID 10 with six storage disks and six parity disks:

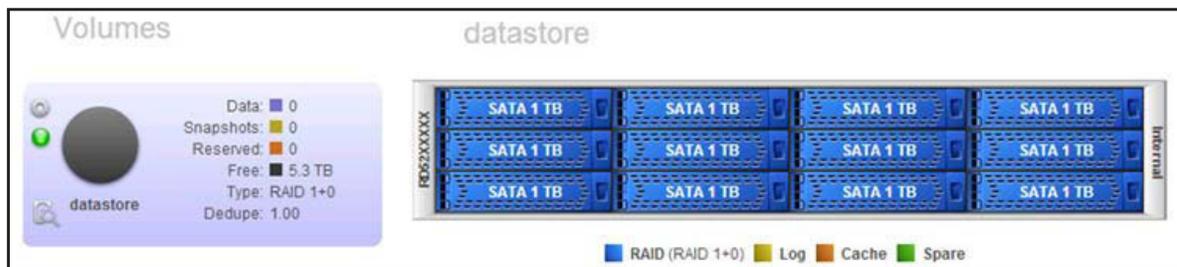


Figure 25. RAID 10

RAID 5+0

RAID 5+0 supports striping across multiple volumes during expansion. RAID 5+0 provides good performance but requires a smaller number of disks than RAID 10 because parity is distributed across the storage disks. Part of the storage space on each disk is sequestered and dedicated to parity.

The following figure shows a RAID 5+0 x4 volume with three disks that have been expanded three times for a total of four RAID groups:



Figure 26. RAID 5+0

RAID 5+0 with Write and Read Boost Disks

A RAID 5+0 volume with a single SSD write (log) boost disk and two SSD read (cache) boost disks increases the performance for the sequential IOPS. Compared with a RAID 10 volume, the writing performance is increased; compared with a regular RAID 5+0 volume, the reading performance is increased.

The following figure shows a RAID 5+0 x3 volume with three disks that have been expanded two times for a total of three RAID groups and that includes one SATA SSD write boost disk and two SATA SSD read boost disks.

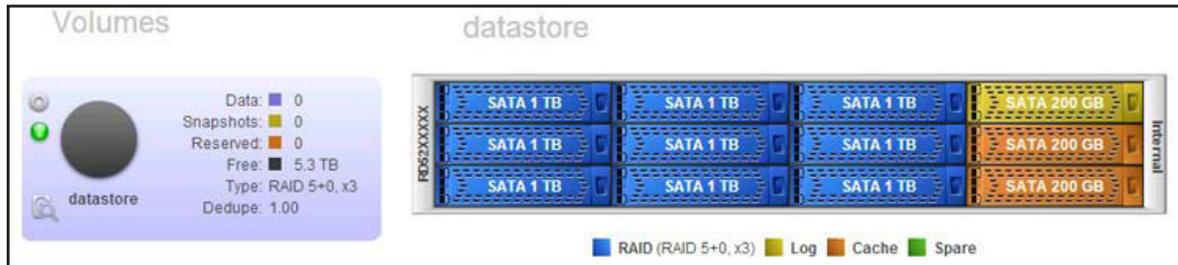


Figure 27. RAID 5+0 with boost disks

RAID 6+0

RAID 6+0 supports striping across multiple volumes during expansion. RAID 6+0 provides good performance but requires a smaller number of disks than RAID 10 because parity is distributed across the storage disks. A relatively large part of the storage space on each disk is sequestered and dedicated to parity.

The following figure shows a RAID 6+0 x3 volume with four disks that have been expanded two times for a total of three RAID groups:

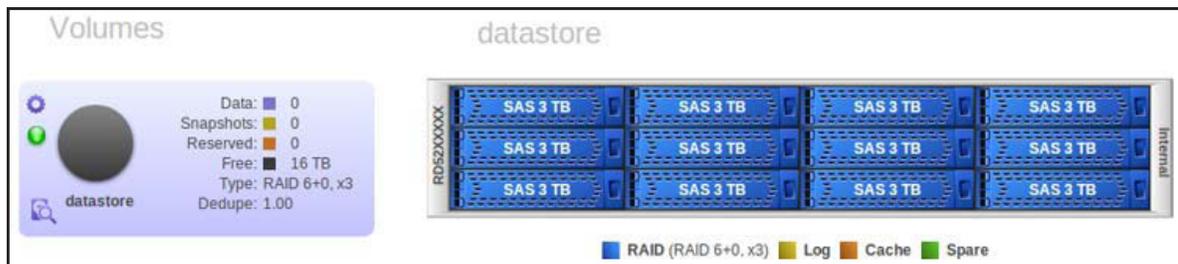


Figure 28. RAID 6+0

Create a Volume

When you create a volume, you need to select the disks and the RAID level.

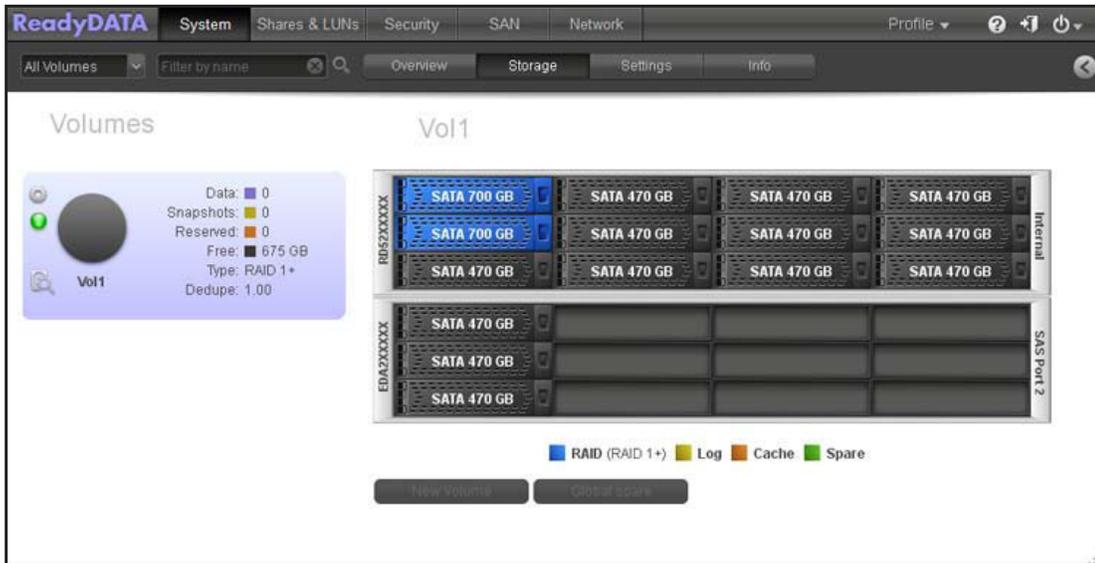
➤ **To create a volume and select the RAID level:**

9. Log in to the ReadyDATA platform using the default or your personalized login credentials. The Dashboard home screen displays.

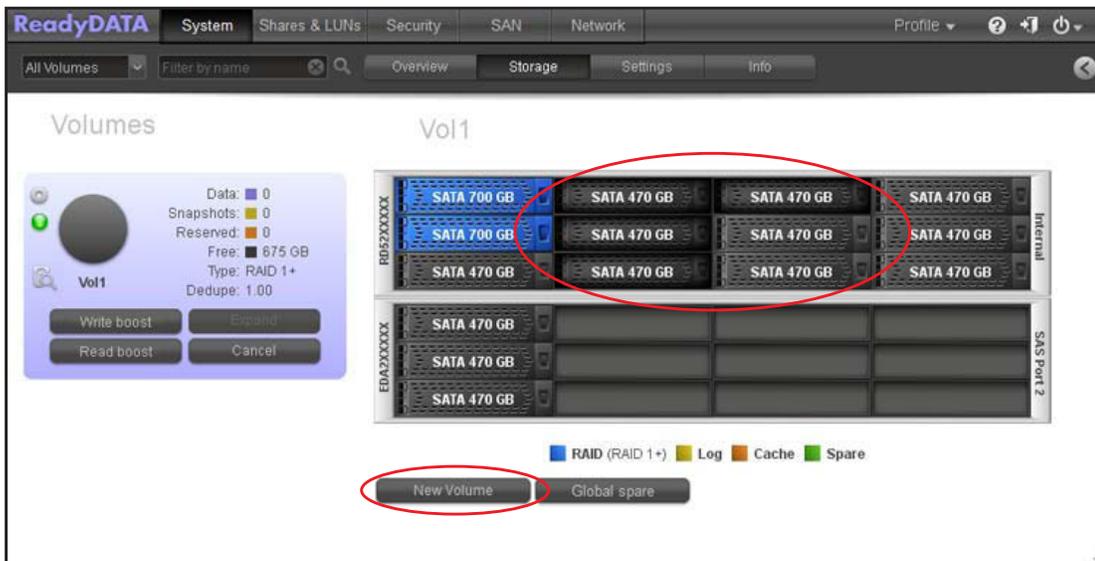
10. Select **System > Storage**.

The Storage screen displays.

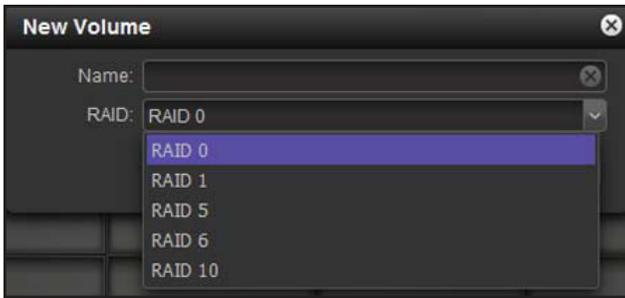
The following figure shows one existing volume and an optional expansion disk array.



11. In the enclosure, click the disks that you want to select as members of the volume.
You can select disks with a black color coding only. If you have an expansion disk array, you can select disks from both the ReadyDATA platform and the expansion disk array.
The selected disks are highlighted and all volume buttons become available, including the New Volume button under the enclosure:



12. Below the enclosure, click **New Volume**.
The New Volume pop-up screen displays:



The RAID levels that are displayed depend on the number of disks that you selected.

13. Configure the following settings:

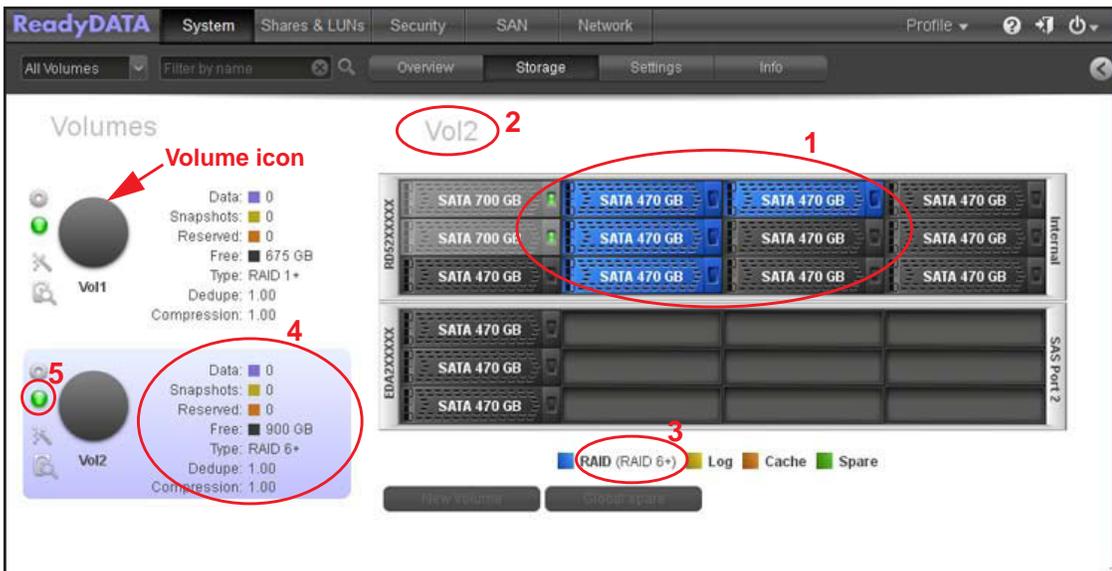
- **Name.** Enter a name for the volume. The volume name must begin with a letter, and can contain only alphanumeric characters, underscores (_), hyphens (-), periods (.), and colons (:). The volume names *mirror*, *logs*, and *spare* are reserved and cannot be used, as are all names that begin with the *c[0–9]* pattern. However, you can use names that begin with the *C[a–z0–9]* or *c[a–z]* pattern.
- **RAID.** From the menu, select the RAID level. The RAID level that you can select depends on the number of disks that you selected in *Step 11*.

14. Click **Create**.

The volume is created.

15. To the left of the enclosure, click the new volume, and note the following:

- The color of the selected disks in the enclosure turns blue (1).
- The name of the new volume displays above the enclosure (2).
- The selected RAID level for the new volume displays below the enclosure (3).
- Information about the new volume displays to the left of the enclosure (4).
- The virtual LED indicates the health status of the volume (5).



Configure a LUN and LUN Security

This section describes the basic steps to create a LUN on a SAN volume.

For extensive information about managing LUNs, see “Manage LUNs for Storage Area Networks” in Chapter 4, “Manage Shares and LUNs,” of the *ReadyDATA OS Software Manual*, which you can download from <http://downloadcenter.netgear.com>.

Configure a LUN

The configuration settings of a LUN are stored in the volume (that is, in the pool) in which the LUN resides. This design allows a LUN to be portable when a disk is moved from one array to another array. However, iSCSI settings are *not* moved when you migrate a LUN from one volume to another volume or when you move the disk or disks on which the volume with the LUN resides to another array.

➤ To create a LUN:

1. Log in to the ReadyDATA platform using the default or your personalized login credentials.

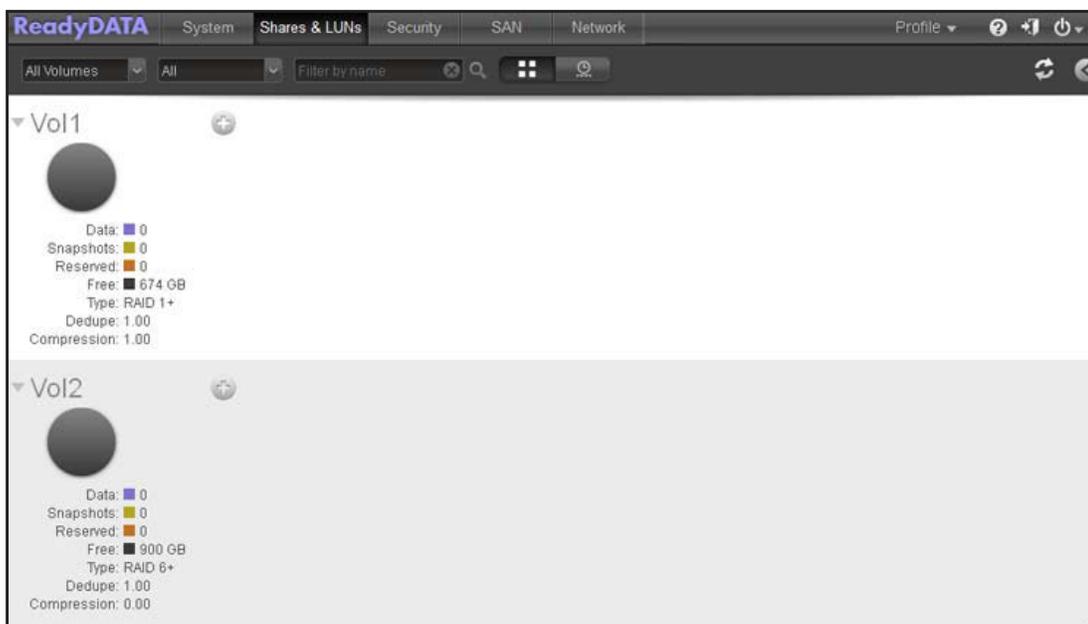
The Dashboard home screen displays.

2. Select **Shares & LUNs**.

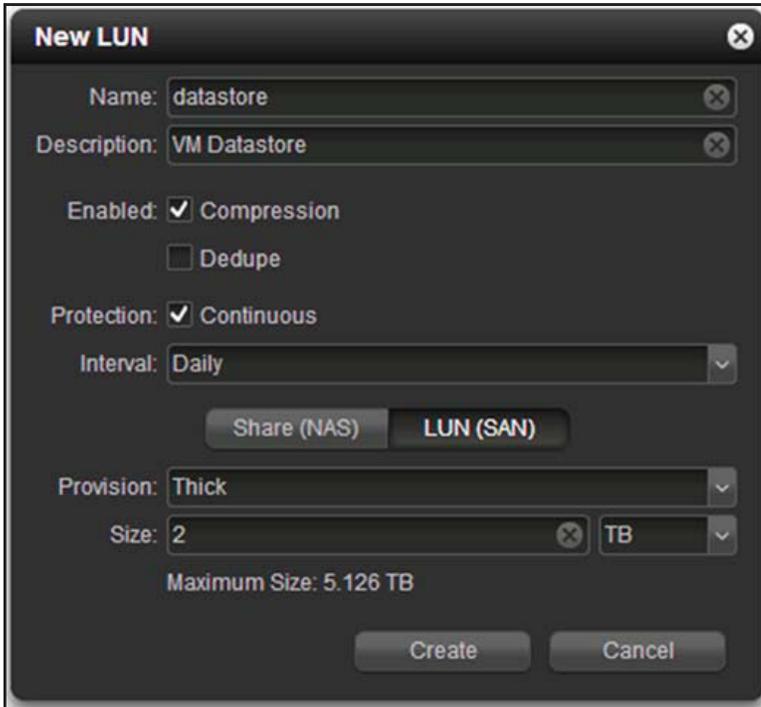
Note: In some versions, the tab is called *Shares* rather than *Shares & LUNs*.

3. Click the **Data Set** button (with four cubes, ).

The Shares & LUNs screen displays, showing the existing volumes on the left:



- Click the + button (⊕) to the right of the volume to which you want to add a LUN.
The New LUN pop-up screen displays:



- Configure the settings as explained in the following table:

Item	Description	
Name	A unique name to identify the LUN. Do not include spaces in the name.	
Description	An optional description to help identify the LUN.	
Compression	For optimum performance, NETGEAR recommends that you keep compression disabled (the default setting) when you create a LUN. For more information, see Compression and Deduplication on LUNs on page 12.	
Dedupe	For optimum performance, NETGEAR recommends that you keep deduplication disabled (the default setting) when you create a LUN. For more information, see Compression and Deduplication on LUNs on page 12.	
Protection	Keep the Continuous check box selected (the default setting) to enable data protection through snapshots (backups), and configure the frequency at which snapshots are made.	
	<table border="1"> <tr> <td>Interval</td> <td>The interval specifies how often a snapshot is made. Make a selection from the menu: <ul style="list-style-type: none"> Hourly. A snapshot is taken every hour on the hour. Daily. A snapshot is taken every day at midnight. This is the default setting. Weekly. A snapshot is taken every week on Friday at midnight. </td> </tr> </table>	Interval
Interval	The interval specifies how often a snapshot is made. Make a selection from the menu: <ul style="list-style-type: none"> Hourly. A snapshot is taken every hour on the hour. Daily. A snapshot is taken every day at midnight. This is the default setting. Weekly. A snapshot is taken every week on Friday at midnight. 	
LUN (SAN)	Click the LUN (SAN) button.	

Item	Description		
Provision	<p>Select how storage space is provisioned. Make a selection from the menu:</p> <ul style="list-style-type: none"> • Thin. Even though you specify the size of the LUN when you create it, storage space is assigned on demand instead of up front. The size of the LUN is reported as the total storage space that you specify when you create the LUN. • Thick. All storage space that you specify when you create the LUN is also allocated up front. The size of the LUN is reported as the total storage space that you specify when you create the LUN. This is the default method. <p>Note: Make sure that you watch the volume capacity of the volume on which the overallocated LUN resides so you do not run out of storage space unexpectedly.</p> <p>Note: NETGEAR recommends that you do not use an overallocated thin LUN for storage of critical data. Instead, use a thick LUN.</p>		
Size	<p>Specify the size of the LUN. The maximum size that you can allocate to the LUN is stated at the bottom of the screen.</p> <table border="1"> <tr> <td>Unit</td> <td> <p>Select the unit of measurement from the menu:</p> <ul style="list-style-type: none"> • MB. • GB. This is the default unit of measurement. • TB. </td> </tr> </table>	Unit	<p>Select the unit of measurement from the menu:</p> <ul style="list-style-type: none"> • MB. • GB. This is the default unit of measurement. • TB.
Unit	<p>Select the unit of measurement from the menu:</p> <ul style="list-style-type: none"> • MB. • GB. This is the default unit of measurement. • TB. 		

6. Click **Create**.

The ReadyDATA platform confirms the creation of a LUN with the message “Data Set successfully created.” The new LUN is added to the Shares & LUNs screen. Basic information is displayed to the right of the LUN.

Configure LUN Security

This section describes the basic steps to set up LUN security. The steps involve creating a LUN group, assigning a LUN to the LUN group, and configuring access rights to the LUN group.

For more information about LUN security, see “Assign LUNs to LUN Groups and Manage Access Rights” in Chapter 4, “Manage Shares and LUNs,” of the *ReadyDATA OS Software Manual*, which you can download from <http://downloadcenter.netgear.com>.

Create a LUN Group and Assign a LUN to the LUN Group

When you create a LUN, the LUN is unassigned. You need to create a LUN group and assign one or more LUNs to the LUN group.

➤ **To create a LUN group and assign a LUN to it:**

1. Log in to the ReadyDATA platform using the default or your personalized login credentials.

The Dashboard home screen displays.

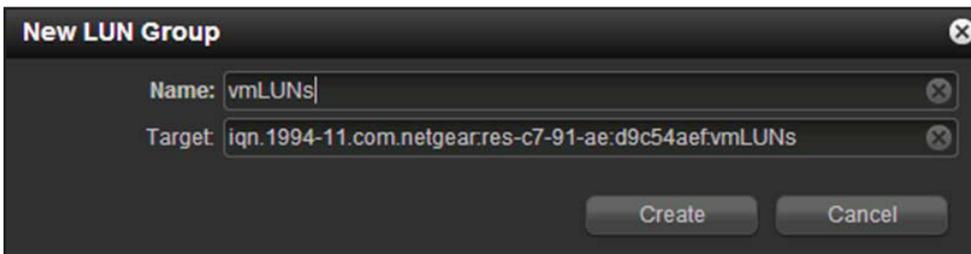
2. Select **SAN**.

The SAN screen displays the LUNs that you have created (see *Configure a LUN and LUN Security* on page 32):



3. To create a LUN group, click the + button (⊕) in the upper right of the screen.

The New LUN Group pop-up screen displays:



4. In the Name field, enter a name for the LUN group.

The default name is groupX, in which X is a number in sequential and ascending order.

The Target field is automatically populated. The target is the string that an iSCSI client needs to be able to connect to the LUN.

5. Click **Create**.

The New LUN group is added to the SAN screen (see the following figure). By default, CHAP is disabled and no client is allowed to access the LUN group.

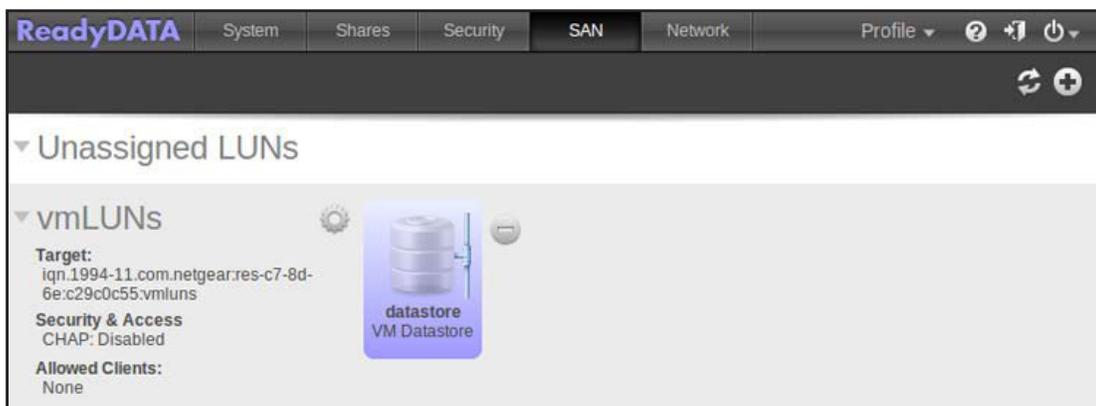
6. To assign the LUN that you have created to the newly created LUN group, click the + button (⊕) to the right of the unassigned LUN.

The Assign to pop-up menu displays.

7. Select **Assign to** (or hover your cursor over **Assign to**), and select a LUN group from the submenu:



The LUN is now assigned to the selected LUN group:



Manage Access Rights for LUN Groups

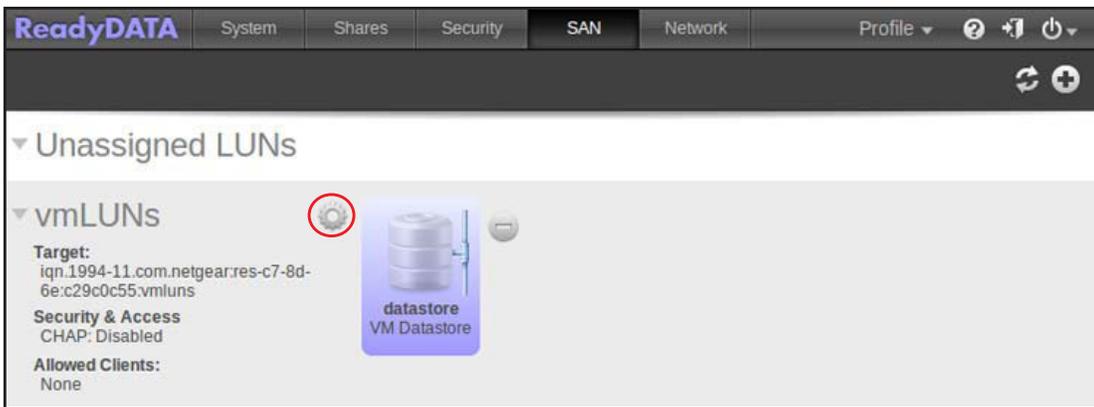
➤ **To configure client access to a LUN group:**

1. Log in to the ReadyDATA platform using the default or your personalized login credentials.

The Dashboard home screen displays.

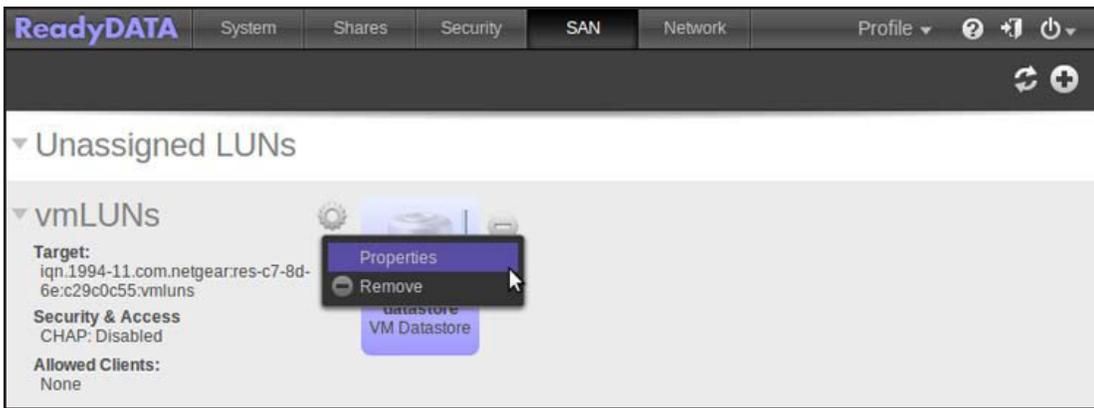
2. Select **SAN**.

The SAN screen displays:



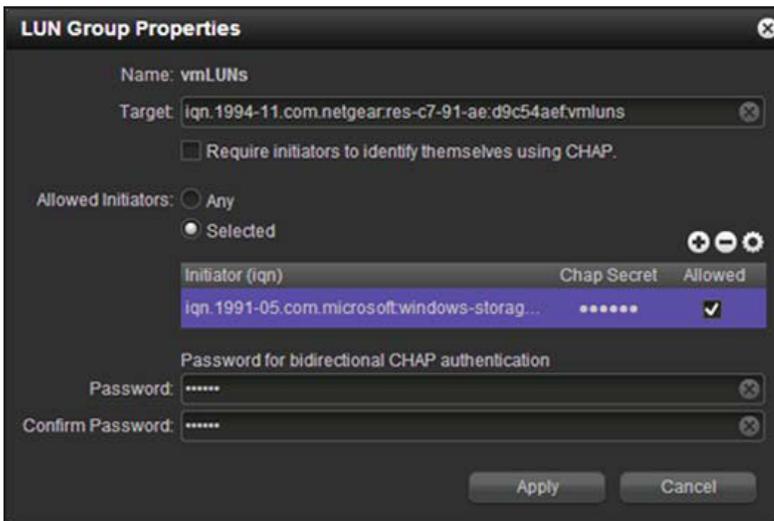
3. Click the gear icon to the right of the LUN group.

A pop-up menu displays:

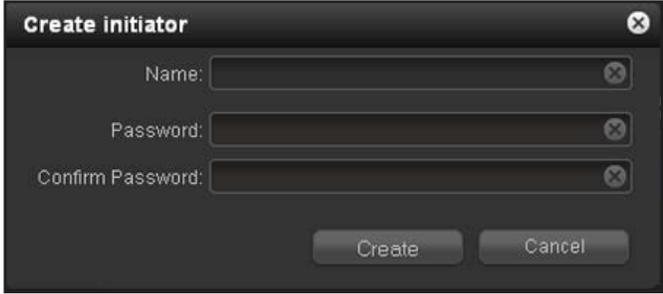


4. Select **Properties**.

The LUN Group Properties pop-up screen displays (the following figure shows examples):



5. Configure the properties as explained in the following table:

Item	Description	
Name	The name is provided for information only and cannot be changed.	
Target	The target is the address that an iSCSI client (that is, an initiator) needs to access the LUN group. The Target field is automatically populated, but you can delete the content by clicking the cross at the right of the field and then replace the content with a custom target address.	
	Require initiators to identify themselves using CHAP	By default, access to the LUN group is open to the initiators that you add to the table onscreen. Select this check box to enable CHAP authentication, and to allow only authenticated initiators access to the LUN group.
Allowed Initiators	<p>Select the Selected radio button.</p> <p>Access to the LUN group is granted to iSCSI qualified names (IQNs) only. (If CHAP authentication is enabled, access is dependent on CHAP authentication.)</p> <p>To add an IQN to the table and allow access to the LUN group:</p> <ol style="list-style-type: none"> Click the + button to the right of the empty table. The Create initiator pop-up screen displays: 	
	 <ol style="list-style-type: none"> In the Name field, enter an IQN in the format as defined by RFC3720, for example, iqn.2012-04.com.netgear:sj-tst-5200:a123b456. Enter a CHAP password with a length of at least 12 characters. Confirm the CHAP password. Click Create. The IQN is added to the table on the LUN Group Properties pop-up screen. In the Allowed column of the table, select (that is, flag) the check box to allow the initiator access to the LUN group. 	
Password for bidirectional CHAP authentication	By default, access to an initiator by a LUN in the LUN group is open. To require a LUN in the LUN group to be authenticated before accessing an initiator, set a password for bidirectional CHAP authentication.	
	Password	Enter a CHAP password with a length of at least 12 characters.
	Confirm Password	Confirm the CHAP password.

6. Click **Apply**.

The new LUN group properties take effect immediately.

Configure a Share

This section describes the basic steps to create a share on a NAS volume.

For extensive information about managing shares, see “Manage Shares for Network Attached Storage” in Chapter 4, “Manage Shares and LUNs,” of the *ReadyDATA OS Software Manual*, which you can download from <http://downloadcenter.netgear.com>.

The configuration settings of a share are stored in the volume (that is, in the pool) in which the share resides. This design allows a share to be portable when a disk is moved from one array to another array.

➤ To create a share:

1. Log in to the ReadyDATA platform using the default or your personalized login credentials.

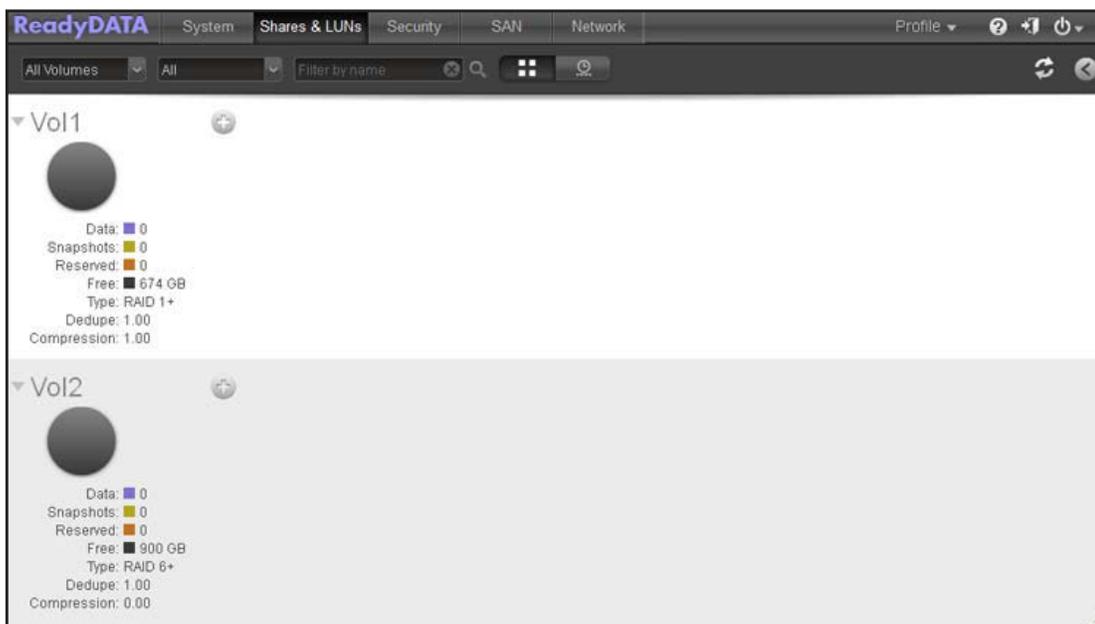
The Dashboard home screen displays.

2. Select **Shares & LUNs**.

Note: In some versions, the tab is called *Shares* rather than *Shares & LUNs*.

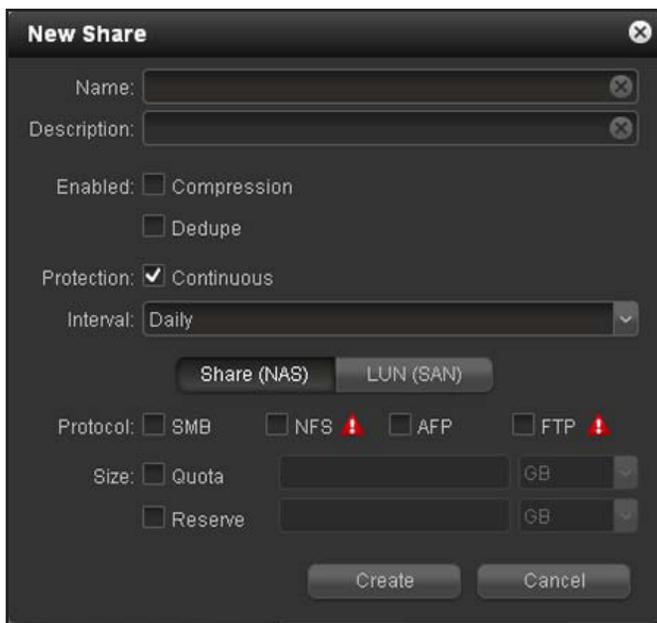
3. Click the **Data Set** button (with four cubes, ).

The Shares & LUNs screen displays, showing the configured volumes on the left:



4. Click the **+** button () to the right of the volume to which you want to add a share.

The New Share pop-up screen displays:



5. Configure the settings as explained in the following table:

Item	Description
Name	A unique name to identify the share. Do not include spaces in the name.
Description	An optional description to help identify the share.
Compression	Select the Compression check box to enable data compression. Compression saves storage space and increases the speed of data transfers, but the compression and decompression processes require additional resources. By default, the Compression check box is cleared.
Dedupe	Select the Dedupe check box to enable deduplication, which prevents storage of redundant data on the share. Unique data is stored only once on the share, and other instances of the identical data are removed and replaced by a pointer to the unique data. This storage method saves storage space and increases the speed of data transfers. By default, the Dedupe check box is cleared. Note: Deduplication degrades the performance while saving space. For a virtual machine environment, NETGEAR recommends that you disable deduplication.
Protection	Select the Continuous check box to enable data protection through snapshots and configure the frequency at which snapshots are made. By default, the Continuous check box is selected.
Interval	The interval specifies how often a snapshot is made. Make a selection from the drop-down list: <ul style="list-style-type: none"> • Hourly. A snapshot is taken every hour on the hour. • Daily. A snapshot is taken every day at midnight. This is the default setting. • Weekly. A snapshot is taken every week on Friday at midnight.

Item	Description	
Share (NAS)	Click the Share (NAS) button, which is the default setting.	
	Type	<p>Select the check boxes for the file-sharing protocols that you want to enable on the share:</p> <ul style="list-style-type: none"> • SMB. Used mainly by Microsoft Windows computers and sometimes by Mac OS X computers. SMB uses TCP/IP. • NFS. Used by Linux and Unix clients. Mac OS X users can access NFS shares through console shell access. The ReadyDATA platform supports NFS over UDP and TCP. • AFP. Used by Mac OS X computers. • FTP. The ReadyDATA platform supports anonymous or user access for FTP clients. You can elect to set up port forwarding to nonstandard ports for passive FTP, allowing clients to initiate a connection to the ReadyDATA platform. <p>Note: If the New Share pop-up screen displays a red triangle with an exclamation mark for a protocol (for example, ) , the protocol is globally disabled.</p>
Size	If you do not set a size, the share has unlimited access to the storage space on the volume, and the utilization rate of the share is greatly improved (over predefining the size) because storage space is assigned only as data is written to the share. By default, quota and reserve are not set when you create a share.	
	Quota	Select the Size check box and enter the size of the storage space that is available to the share.
	Reserve	Select the Reserve check box to reserve guaranteed storage space for the share on the volume.
		Select the unit of measurement from the drop-down list: <ul style="list-style-type: none"> • MB. • GB. This is the default unit of measurement. • TB.

6. Click **Create**.

The ReadyDATA platform confirms the creation of a share with the message “Data Set successfully created.” The new share is added to the Shares & LUNs screen. Basic information is displayed to the right of the share.

Configure Access Settings for an NFS Share

For more information about access settings for shares, see “Set Up Access Rights to Shares” in Chapter 4, “Manage Shares and LUNs,” of the *ReadyDATA OS Software Manual*, which you can download from <http://downloadcenter.netgear.com>.

In addition to NFS, you can configure access settings for SMB, AFP, or FTP, or a combination of the file-sharing protocols. The following procedure uses NFS as an example.

➤ **To configure access settings for an NFS share:**

1. Log in to the ReadyDATA platform using the default or your personalized login credentials.

The Dashboard home screen displays.

2. Select **Shares & LUNs**.

Note: In some versions, the tab is called *Shares* rather than *Shares & LUNs*.

The Shares & LUNs screen displays.

3. Select the share that you want to configure.

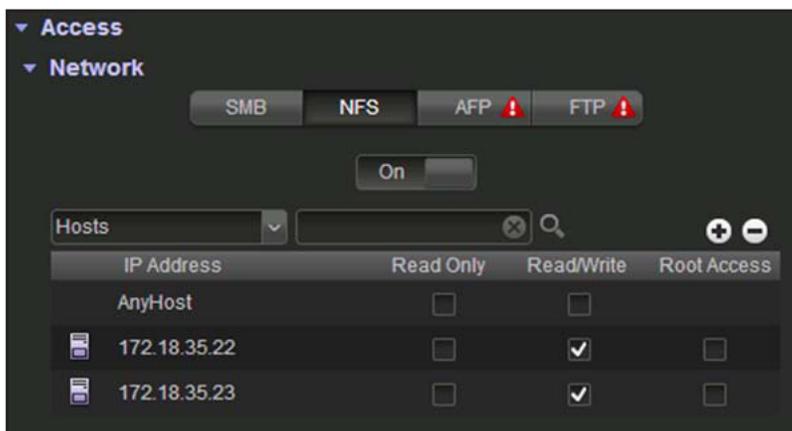
The color of the share turns purple.

4. Click the screen **Expand** button (⏏) on the top right of the screen.

The Properties pane displays for the selected share.

5. Scroll down to the Access section.

6. If it is not visible already, open the Network subsection.



7. Click the **NFS** button.

NFS is selected as the file-sharing protocol.

Note: To prevent file access conflicts, limit the file-sharing protocol to NFS.

8. Click the **+** button (+).

The Add Host pop-up screen displays.

9. Enter the host IP address in the IP address field.

10. Click **Add**.

The host is added to the table.

Note: You can set access rights for AnyHost, which is a default entry in the host table. You cannot grant root access to AnyHost.

11. Select one of the following check boxes:

- **Read Only.** The users on the selected host are permitted to only read files on the share.
- **Read/Write.** The users on the selected host are permitted to read, edit, create, and delete files on the share.

The access rights that you configure for the host apply to all users on the host.

12. (Optional) Select the **Root Access** check box.

Users are granted root access.