

NEXSAN

A StorCentric Company

V-SERIES All Flash Array User Guide



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Preface

This user guide is intended to be a comprehensive summary of user-level operations on the V-SERIES V1000 SE and V1000 XE All Flash Array. The guide is designed for use by administrators and storage managers who are responsible for configuring, monitoring, and maintaining the V-SERIES Array in a production environment.

Conventions

The following conventions are used in this document:

Element	Convention
Button	Arial, 10 pt, Bold
Command Line Interface input/output	Courier New, 10 pt, Bold
Emphasize a word or phrase	Underline
Event notifications or other message	Times New Roman, 10 pt, Bold
Key	COURIER NEW, 11 PT, CAPS
Literals	Times New Roman, 10 pt, Bold
Titles	Italic
Window option	Arial, 10 pt, Bold
Variable, represents text that must be entered	< <i>Courier New, 10 pt, Bold, Italic</i> >

Document Conventions

Related Documents

The following documents provide additional information about the V1000 SE and V1000 XE All Flash Array:

- *V-SERIES Array Release Notes*: Provides most recent release updates
- *V-SERIES Array Best Practices Guide*: Provides details on optimal configurations

Contacting NEXSAN

To obtain additional information or technical support for NEXSAN products, or to obtain an RMA number and replacement product, contact us at:

- Phone US Toll Free: +1 800 734 4716
- Global Support Numbers available at: <https://www.NEXSANsystems.com/support-services/>
- E-mail: support@x-io.com and support@NEXSANsystems.com

Introduction

The V-SERIES V1000 SE and V1000 XE are high-density, fully redundant, rack-mountable storage device that integrates NVMe drives with advanced Array controllers and environmental support components to provide an extremely reliable self-contained storage unit that outperforms more traditional storage sub-systems.

As a fully redundant unit, the V-SERIES Array consists of pairs of redundant, active components; each member of the pair can function in the absence of the other member, maintaining operation in the event of failure of an active component. If a component fails, the system supplies information designed to assist in completing corrective actions. The V-SERIES Array can continue to operate with multiple component failures while making intelligent decisions to provide the highest level of data protection and integrity.

V1000 SE and V1000 XE Advanced Features

The V-SERIES Array provides the following advanced features:

- a. **Web-based User Interface** for Storage Management and Provisioning: **MAESTRO** is the Web-based User Interface that provides storage management and provisioning services for all networked V-SERIES and XIO G4 Arrays.
- b. **Managed Reliability**: The Array contains processes that improve system reliability through intelligent error management. These processes include:
 - A hierarchy of table-driven recovery actions that repair drive errors ranging from simple errors to those requiring more advanced error handling.
 - In-place drive remanufacture that predicts, diagnoses, and repairs drive degeneration and failures.
 - A closed-loop feedback system between the installation and the manufacturer that collects and analyzes a variety of system operating metrics. This feature greatly reduces failures by remotely predicting and diagnosing potential problems and providing proactive system servicing.
- c. **High-performance data I/O**: The system architecture leverages the power of a single processor with multiple cores, Fibre Channel or iSCSI data paths, and SSDs to deliver outstanding data I/O performance.
- d. **Quality of Service (QoS)**: Control of performance expectations, useful when running different applications on the same Array. By default, this is actively self-managed by the Array software.
- e. **Thin Provisioning**: Allows the user to optimize how the available space is utilized on the Array by allowing the user to over provision the storage. Thinly Provisioned Volumes allocate storage space based on the actual data written.
- f. **Deduplication**: A data compression technique that eliminates duplicate copies of data allowing the user to optimize their storage usage. The Array enables in-line deduplication on a per volume basis.
- g. **Snapshot**: Space efficient snapshots are supported on dedupe volumes.
- h. **Snapshot schedules** can be created per volume, with a total of 2 unique schedules per volumes. Thinning will automatically occur on snapshots created from schedules, with the oldest removed first. The number of snapshots retained is 24, by default, but can be adjusted through the “keep” option on schedules. A user can also mark a snapshot to be “excluded” from the thinning. Manually created

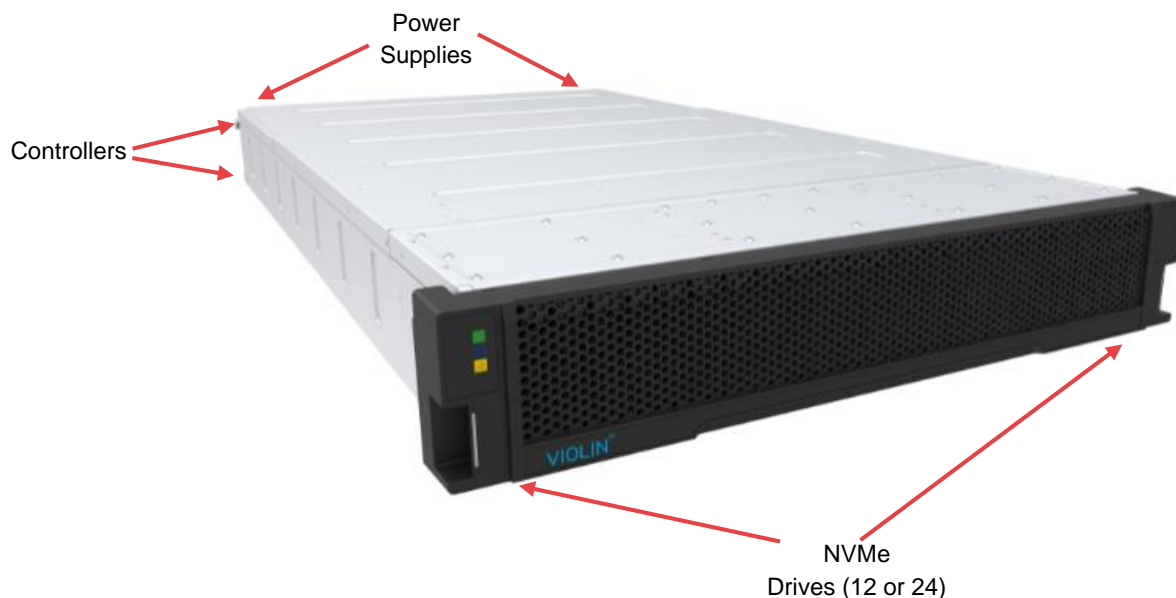
snapshots are always marked as “excluded” from thinning. Refer to the V-SERIES Array Best Practices for more details.

- i. **Dual controllers:** Both controllers actively participate in data I/O, simultaneously accessing all drives in the system. This configuration provides maximum performance as well as reliability.
- j. **Automatic failover/failback:** The system performs automatic transfer of volume access from an out of service controller to the partner in conjunction with appropriate multi-path drivers at the host level.
- k. **Run-time controller software and drive firmware upgrades:** The system provides the ability to upgrade the internal controller software and drive firmware with new versions without service interruption. Should a controller experience an unrecoverable error during the software upgrade process, the controller software is returned to the previously installed version.
- l. **Background parity scan:** Provides enhanced data integrity by employing an embedded function to automatically check all data for RAID parity consistency and flag inconsistent data with a media error.
- m. **LUN Expansion:** As volume space needs increase, individual LUNs can be expanded.
- n. **Activewatch:** Provides full telemetry.

V-SERIES Array Components

Refer to the *V-SERIES Array Hardware Guide* for a complete description of each component.

The V1000 SE and V1000 XE All Flash Array have the basic external view:



Rear view of V1000 XE or 4 port V1000 SE. V1000 SE has option of 2 ports

The V-SERIES Array components are (external and internal):

1. Two Power Supply Units (PSUs), providing a redundant power source
2. Dual Redundant PSUs N+1 (~2000w), Support AC 220V(180Vrms~264Vrms) input
3. Two Managed Reliability Controllers (Fibre Channel or iSCSI), providing control and value-added features
4. Five Fans
5. Supports up to 22 Dual-Port NVMe SSDs
 - a. 11 or 22 drives, with slots 12 and 24 empty
 - b. V1000 XE software version 5.0 configurations support 12 and 24 drives
6. Cable management system
7. One chassis, custom-designed to house the active components of the Array
8. Bezel
9. Serial Console port (see below)

A serial cable can be connected into each controller. The open port is located under the MRC ports.



Serial Port (9 pin)

The serial port cable is a 9 pin on the user end:



Controller

The V-SERIES Array Controller (two per Array) uses built-in diagnostics and recovery tools to analyze, identify, and recover from a variety of common drive problems. Each Controller has the ability to send telemetry information back to the NEXSAN headquarters and notify the Services organization that something has gone wrong. This is enabled by default and should remain enabled upon installation unless the customer's business does not allow it.

Drives, Open DataPacs, and Pools

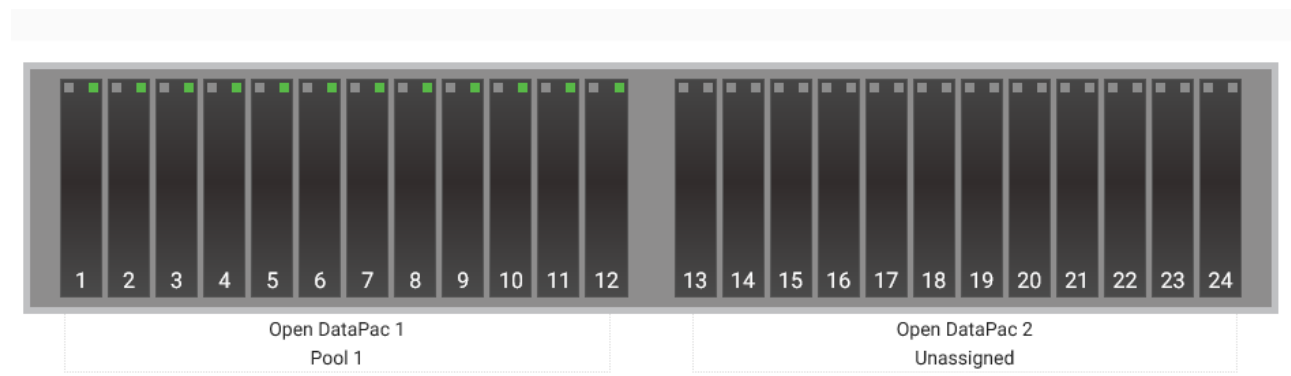
The V-SERIES Array supports several different capacities of NVMe SSDs (drives). There is support for 11 or 22 drives, with drive slots 12 and 24 empty. The V1000 XE with 5.0 configurations supports 12 or 24 drives.

A collection of 11 same-capacity NVMe drives (installed consecutively) is called an Open DataPac. Open DataPac 1 contains drives 1-11 and Open DataPac 2 contains drives 13-23.

A pool is a collection of one or more Open DataPacs. Future expansion of the Pool is supported by inserting 11 drives into Open DataPac2.

At initialization of the Pool, 10% of each Open DataPac capacity is reserved as a spare. The spare capacity is used in the event of a drive failure. Spare capacity is equivalent to "hot-spare" drives in a more traditional storage solution. Note: V1000 XE Arrays configured at 5.0 contain 12 drive Open DataPacs and reserve 20% spare capacity.

The below diagram, from the MAESTRO User Interface, shows 12 installed NVMe SSDs (green LED), from V-SERIES Array installed at software release 5.1. These drives are assigned to Pool 1:



A drive Green LED indicates it is installed and ready for use or in use.

Host Data Traffic

The V-SERIES Array provides high-speed data traffic through eight Fibre Channel or iSCSI ports for the V1000 XE and four or eight Fibre Channel ports for the V1000 SE.

iSCSI Arrays have four 25/10G ports on each Controller and uniquely identified as Data Networks A, B, C, D.

Fibre Channel

The Fibre Channel ports are 16Gb and can connect to a host directly (Direct-Attached) or through a Fibre Channel switch.

Controller 1 is the top controller. FC ports are numbered left to right, as shown below. This is the V1000 XE which has 4 FC ports per Controller. The V1000 SE has 2 or 4 FC ports per Controller.



Controller 2 is the bottom controller. FC ports are numbered right to left, as shown below..



iSCSI

The iSCSI ports are 25/10Gb and are supported through a switch. The iSCSI controller ports are shown below, labeled A, B, C, D (left to right) on Controller 1 (top). Controller 2 (bottom) ports are right to left.



The iSCSI Controllers each have Data Network A, B.

Reference the V-SERIES Array Best Practices document for configuration details for HBA, switch, and multipath settings.

Array Management

The V-SERIES Array management is provided through the 10/100/1Gb Ethernet ports, via the Array Command Line Interface (CLI) or a web-based User Interface, **MAESTRO**. The preferred method of management is through the web-based User Interface, **MAESTRO**.

Management Tools

Reserved Characters

MAESTRO accepts special characters in text-entry fields except for those characters listed in the table below.

Character	Name
&	ampersand
"	double quotes
/	forward slash
\	back slash
'	single quote

Table 1: Supported MAESTRO Characters

In addition to the above, the CLI accepts special characters in text-entry fields except for those characters listed in the table below.

Character	Name
%	percent
&	ampersand
<	less than
>	greater than
\	back slash
'	single quote

Table 2: Supported CLI Characters

Command Line Interface

The Array contains an embedded Command Line Interface (CLI) that responds to commands entered at the CLI prompt on a remote console or invoked through a script. Standard command line protocol (such as terminating a command by pressing `ENTER`) applies. Although, multiple users may be connected to the Array simultaneously, this is not recommended due to possible conflicts. This section describes the requirements and connection procedure of the CLI.

Remote Console Requirements

The remote console used to control the Array may be any terminal connection application that has Secure Shell connection capability (protocol version 2) through port 22. Secure Shell connection capability is a secure form of telnet. The Array will not respond to a regular telnet connection request.

Connecting

This section describes the steps to connect to the Array through the remote console.

1. To connect to the target Array use any terminal connection application on the remote console and configure it for SSH service on port 22.
2. Type the IP address or the host name of one of the controllers in the Array into the application's connection field and connect.
3. The application requests SSH access credentials.
4. Enter the access credentials as follows:

```
User name: administrator  
Password: <password>
```

The user password for the first-time login, built into the Array during its manufacture, is **administrator**. If the password **administrator** is rejected, check with the network administrator to obtain the current valid user password.

5. Connect to the Array by entering its network friendly name or IP address and the prompt appears.
6. CLI commands can now be entered to control the Array as described throughout this document.
7. Enter help at the prompt to display a list of available commands. Appendix B, also shows the list of available commands.
8. To exit from the CLI, type **exit** or **quit** at the prompt.

Reserved Characters

The CLI permits special characters in text-entry fields except for those characters listed in Tables 1 and 2. An argument in a CLI field may contain spaces if the entire argument entry is enclosed in quotation marks.

MAESTRO

The V-SERIES Array management tool of choice is the Web-based User Interface called MAESTRO. MAESTRO can manage a single Array or multiple. It also manages XIO G4 Arrays. MAESTRO includes a dashboard that provides a high level overview of the Array status, storage usage, performance monitoring, and component health.

MAESTRO runs within a VM on each of the controllers. One controller's VM is active and the other controller's VM is "stand-by", which will take over if the managing controller is physically removed. The use of a VM within the Array eliminates the need for installation of a separate application or dependencies on where the UI can be run.

MAESTRO supported browsers:

- **Google Chrome on Windows 7, Windows 8 and Windows 10**
- **Firefox**
- **IE 11**
- **Edge**

To launch MAESTRO:

1. Using a supported browser: Enter the name or IP address for a V-SERIES Array Controller
2. On the login screen the Username will auto-populate to Administrator
3. Enter the password (**made4you**)
4. Click **Login**



Configuring the Array

Configuring the Array can be accomplished by through the command line interface (CLI) or the Web-based User Interface, **MAESTRO**. The installation and initial configuration of the Array is typically provided by a certified NEXSAN partner. Additional user configuration management can be done through either interface, with the preferred method using MAESTRO. The following sections will provide guidance through MAESTRO. The CLI will be documented for areas that are not available through MAESTRO or are more convenient to use through that interface.

Initializing the Array

The Array will be installed by a certified NEXSAN partner, or remote Professional Services. Initial configurations such as network address assignments and Data Security (Data-At-Rest Protection) need to be planned prior to initialization. Once the Array is initialized, it is ready to configure and write data. Re-initializing the Array will delete all data. Contact VIOLIN prior to attempting to re-initialize the system.

Data Security

Must be enabled PRIOR to Array initialization

The V-SERIES Array supports two levels of data security: **Data-At-Rest Protection** and **Passkey Protection**. The Data-At-Rest Protection is a feature provided in software versions 5.1.2 and later. These

features **must be enabled prior to initialization** of the Array. Passkey Protection is an additional level of security that is enabled by default when Data-At-Rest Protection is enabled.

Data-At-Rest Protection

Data-At-Rest Protection provides a secured handshake on data transfers to the drives, using AES-256 encryption. Data-At-Rest Protection is supported in software 5.1.2 or later and only enabled **prior** to initialization of the Array. When enabling this feature, a user supplied passkey is required. This passkey is also used to enable **Passkey Protection** of the Array. Data-At-Rest Protection can only be disabled by reformatting the Array.

The passkey is not retrievable by Violin Systems. The user must take care to remember the passkey

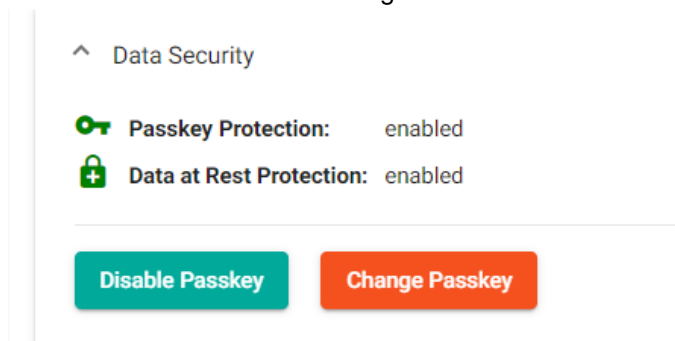
Passkey Protection

Passkey Protection is an additional level of security that is only available when Data-At-Rest Protection is enabled. This feature is optional but enabled by default when Data-At-Rest Protection is enabled. Passkey Protection can be disabled by the user at any time. This additional level of security prevents access to the data after a power loss, or shutdown of the Array, until the Array is unlocked with the passkey. The user will be prompted in MAESTRO or through the command line interface for the passkey. Once the passkey is provided, the Array will complete the power-up process and allow access to the luns.

Passkey Protection changes can be made only if Data-At-Risk Protection is enabled. Array Passkey Protection operations (MAESTRO or command line) are:

- Encryption enable [encryption –enable <passkey>]
- Encryption disable [encryption -disable <passkey>]
- Encryption change passkey [encryption –change <current passkey> <new passkey>

MAESTRO >> Advanced Settings



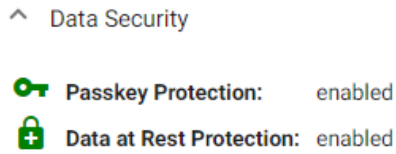
The passkey is not retrievable by Violin Systems. The user must take care to remember the passkey.

Data Security Status

The status of Data-At-Rest Protection and Passkey Protection are displayed in MAESTRO and the command line “show ise”.

The below display, from MAESTRO Advanced Settings, indicates the Array was enabled with Data-At-Risk Protection, which by default enabled Passkey Protection:

MAESTRO Advanced Settings >> Data Security



When Data-At-Rest Protection is not enabled, Passkey Protection is also not enabled:



Configuration Management

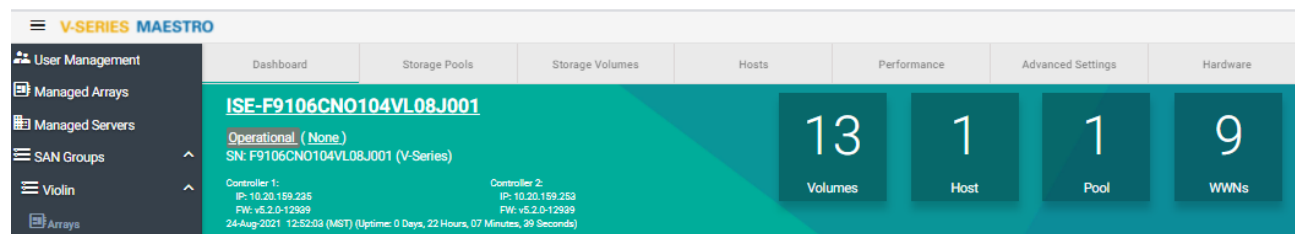
After initialization, MAESTRO can be used to manage additional configuration preferences.

Array system configuration options include:

Desired Action	MAESTRO Suite Action
Create Host	SAN Groups >> <i>san_group</i> >> Hosts >> Create Host Client
Server View	Managed Servers
Daylight Savings	SAN Groups >> <i>san_group</i> >> Advanced Settings tab
SNMP Configuration	SAN Groups >> <i>san_group</i> >> Advanced Settings tab
System Clock	SAN Groups >> <i>san_group</i> >> Advanced Settings tab
Telemetry (Subscriptions)	SAN Groups >> <i>san_group</i> >> Advanced Settings tab
Create Volume	SAN Groups >> <i>san_group</i> >> Storage Volumes tab
Email Notifications	SAN Groups >> <i>san_group</i> >> Advanced Settings tab
DHCP/Static	SAN Groups >> <i>san_group</i> >> Advanced Settings tab

System Parameters

Once navigated into an Array Dashboard, clicking on any of the component tabs (header) will display the details for that component and allow for various system parameters to be configured.



Network Settings

The Array network settings are typically configured during installation of the Array. They can be easily managed later through **MAESTRO**.

The network settings include two Ethernet ports (**1** and **2**), the Media Access Control (MAC) address, link status (connected or unknown), and Dynamic Host Configuration Protocol (DHCP) mode (enabled or disabled). Connections to the CLI are made through the Ethernet ports.

When DHCP mode is enabled, the network DHCP server assigns an IP address, mask, and gateway to each of the Ethernet ports. These addresses are displayed in MAESTRO under Advanced Settings. The Array enables DHCP Mode by default.

When DHCP mode is disabled, the IP address, mask, and gateway for **Port 1** and **Port 2** must be supplied at system setup time and manually changed to reflect any network changes that have an impact.

Once the IPs have been changed, MAESTRO will need the updated IPs entered for management. Click on Managed Arrays >> <Array name> >> Update New IP

Note: Toggling from Static to DHCP or changing static IPs requires at restart of the Array.

System Clock Settings

During Array manufacture, the system clock is set to Coordinated Universal Time (UTC). If desired, the system clock can be set as needed to meet site requirements. When the system clock is set on one controller, the system clock of the companion controller is automatically and immediately synchronized.

To approximately synchronize the Array to a local server manually, enter a synchronization time and wait for the server's clock to cycle to that synchronization time before pressing **ENTER** while in the CLI.

MAESTRO: To display or change the System Clock Settings, select **Array _Name >> Advanced Settings >> Time Settings**, then select Edit to update as desired.

The following formats apply to setting time :

- a. Date: *dd-mmm-yyyy*, where *mmm* is the 3-letter representation of a month (for example, Nov for November). Enter the month in uppercase or lowercase or a combination of both; it is displayed in lowercase with an initial capital.
- b. Time: *hh:mm:ss* using a 24-hour clock.

c. *Time Zone:*

In the CLI, type `help timezone` to see the time zone options.

d. *Daylight:* Enable this option to automatically adjust the time for the change to and from Daylight Savings Time. The Daylight option is enabled by default.

Maestro Time Settings EDIT

NTP Server

When using an NTP Server, "Automatic" will use DHCP to obtain the NTP server address, where as "Static" uses the specified NTP server IP address that is supplied.

System Clock Attribute	CLI Command
Date	<code>configure --date=<dd-mm-yyyy></code>
Time	<code>configure --time=<hh:mm:ss></code>
Timezone	<code>configure --timezone=<zoneoption></code> Use <code>help timezone</code> to view options
Automatic Daylight Time	<code>configure --timezone=<zoneoption></code> To disable <code>configure --timezone=<zoneoption> --dst</code> To enable

Setting System Clock Attributes—CLI Commands

Fibre Channel Port Speed

The Fibre Channel host port speed can be set to one of the following settings:

- Speeds of 4, 8,16Gb on the individual Controller ports

- **Auto (default):** Using the protocol defined in the T11 Auto-Negotiation standard, the Array will auto-negotiates with the Fibre Channel switch to determine and set the highest port speed that both devices support.

MAESTRO: *Array_Name* >> **Hardware** >> **Controller** >> **FC Port Information**

FC speed can be changed per Controller port by selecting the FC Port >> Speed Setting

FC speed can be changed on all Controller ports at one time using the **Set Global Port Speed**

Hardware

Controller | Open DataPac

Global Controller Speed Settings

Set Global Port Speed **- Select Speed -** Update

Controller 1 Identify

Properties | **FC Ports Information** | SFP Information

FC Port	Status	WWN	Speed	Speed Setting
FC Port 1	Operational	2000001F93400930	8 Gb/s	Auto
FC Port 2	Operational	2000001F93400931	8 Gb/s	Auto

iSCSI Interconnect Speed

The V-Series Array iSCSI ports that can operate at 25/10Gb. There are 4 ports per Controller. The negotiated speed is displayed in the iSCSI Hardware Tab. Each Data Network negotiated speed is display per Controller.

Below is an example of Network A for each Controller.

Network-A

DHCP: Disabled
IP Mask: 255.255.255.0
Protocol: ipv4
MTU: Jumbo (9000)

Ports

Port-1 (Controller 1)

IP Address: 192.168.10.3
Endpoint: iqn.2004-11.com.x-io:f9005cth103an9ck02g-t1
Speed: 10Gbps
Link Status: Connected

Port-1 (Controller 2)

IP Address: 192.168.10.4
Endpoint: iqn.2004-11.com.x-io:f9005cth103an9ck02g-t1
Speed: 10Gbps
Link Status: Connected

Edit

iSCSI Attributes

CHAP and Jumbo Frames iSCSI attributes can be managed through the Hardware iSCSI tab:

The screenshot shows the 'Hardware' section of the management interface. At the top, there is a horizontal navigation bar with tabs for 'Controller', 'Open DataPac', 'Power Supply', 'Network', and 'iSCSI'. The 'iSCSI' tab is highlighted in yellow. Below this bar, there are two main sections: 'Network-A' and 'Network-B'. Under 'Network-A', the 'DHCP' status is 'Disabled'. Under 'Network-B', the 'DHCP' status is also 'Disabled'.

Jumbo Frames

The iSCSI Arrays support “normal” Ethernet frames of 1500 bytes or “jumbo” frames of up to 9000 bytes. MTU can be adjusted in the iSCSI tab under the Array Hardware page. Reference the V-SERIES Array Best Practices for additional recommendations for setting Jumbo Frames.

Network-A	Network-B
DHCP: Enabled	DHCP: Enabled
IP Mask:	IP Mask:
Protocol: ipv4	Protocol: ipv4
MTU: Jumbo (9000)	MTU: Jumbo (9000)
Ports	Ports
Port-1 (Controller 1)	Port-2 (Controller 1)

CHAP

The iSCSI Array can be configured to enable CHAP security. The CHAP security model can either perform authentication of the initiator by the target (one-way) or it can authenticate the initiator by the target and then authenticate the target with the initiator (two-way or mutual authentication). The iSCSI Array can use either authentication model as long as the CHAP secret meets the criteria of being 12–16 characters long. If using mutual authentication, the CHAP secrets must be different.

Note: The Array uses a single username and password combination for all hosts. The use of separate username and password combinations for each host is not currently supported.

Chap enable/disable option is located in the iSCSI Configuration section of the page:

iSCSI Configuration

Nameserver: Disabled
Chap In: Disabled
Chap Out: Disabled

Edit

iSCSI Configuration

Nameserver:

Nameserver

0.0.0.0

Chap In:

Chap Out:

Username

Username

Password

Password

Cancel

Submit

Once enabled, the iSCSI configuration section will display a username and password. The below is what is displayed when Chap In is enabled but Chap Out is still disabled.

iSCSI Configuration

Nameserver: Disabled

Chap In:

Username:

Password:

Chap Out: Disabled

[Edit](#)

When Chap In and Chap Out are both enabled, the display will appear as following:

iSCSI Configuration

Nameserver: Disabled

Chap In:

Username:

Password:

Chap Out:

Username:

Password:

[Edit](#)

Managed Arrays

Once logged into MAESTRO, the Array(s) to be managed need to be added to the Managed Arrays list.

Launch MAESTRO, click on Manage Arrays > Add Array

The screenshot shows the MAESTRO web interface. On the left is a navigation sidebar with options: User Management, Managed Arrays (highlighted), Managed Servers, SAN Groups, and QV2020. The main content area is titled "Managed Arrays" and contains an "Array List" section. At the top right of this section is a yellow "Add Array" button. Below the title, there is a dropdown menu set to "10", a "Name" dropdown, and a "Search Value" input field. A table with the following headers is displayed: NAME, SERIAL NUMBER, MRC 1 IP, MRC 2 IP, and LOCATION. The table body is empty, with the text "No Arrays Defined" centered below it. At the bottom left, it says "Showing 0 - 0 of 0". At the bottom right, there are navigation buttons: "<< First" and "Last >>".

Add V1000 SE or V1000 XE

When adding the Array, some options are useful to configure:

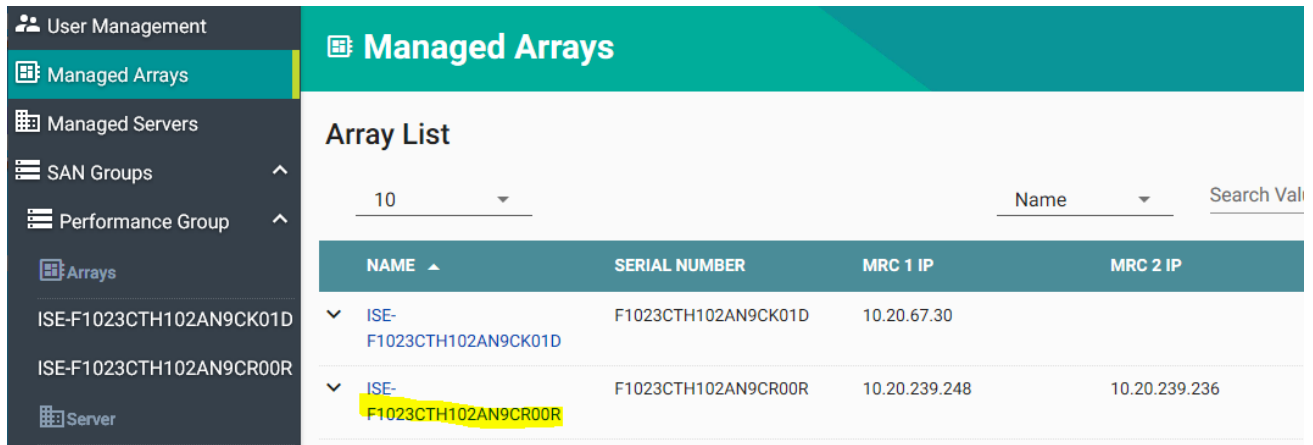
System Name
The system name is an optional user-defined name for the Array. A name is any alphanumeric string of up to thirty-two characters. Embedded blanks and special characters, except “Reserved Characters” shown in tables 1 and 2, are permitted.
Address
The Address is an optional user-defined address for the Array, such as a physical address, building, or any address string. The address is any alphanumeric string of up to sixty characters. Embedded blanks and special characters, except “Reserved Characters” shown in tables 1 and 2, are permitted.
Location
The Location is an optional user-defined location for the Array, such as a data center, room number, rack number, rack position, or any other type of locator. The location is any alphanumeric string of up to sixty characters. Embedded blanks and special characters, except Reserved Characters shown in tables 2 and 2, are permitted.
Contact Name
The Contact Name is an optional user-defined name for a person associated with this Array, such as a storage manager, network administrator, or other associated person. The contact name is any alphanumeric string of up to sixty alphanumeric characters. Embedded blanks and special characters, except Reserved Characters shown in tables 1 and 2, are permitted.
Contact Phone
The Contact Phone is an optional user-supplied phone number for the contact person See “Contact Name”. The contact phone is any alphanumeric string of up to sixteen characters. Embedded blanks and special characters, except Reserved Characters shown in tables 1 and 2, are permitted.
Contact Email
The Contact Email is an optional user-defined e-mail address for the contact person. See “Contact Name”. The Contact Email field accepts any valid e-mail address of up to sixty alphanumeric characters.

The above information is reported back to NEXSAN through the Activewatch services. It can provide useful information for shipment of parts and who to contact.

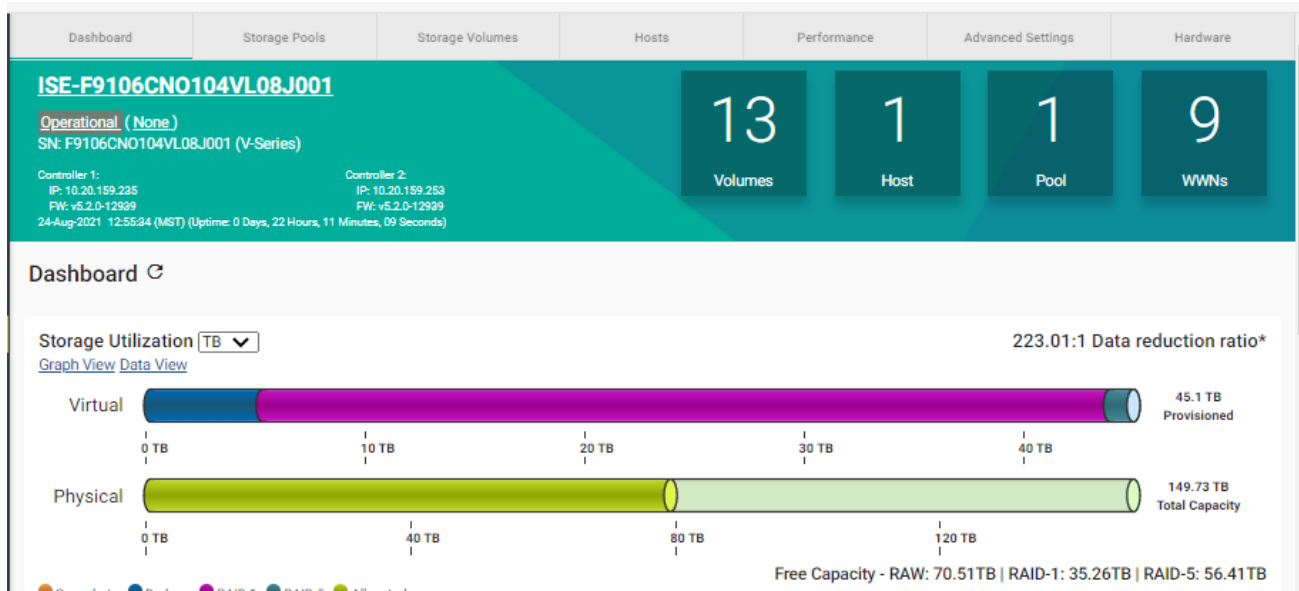
Once the Arrays are added to the Managed Arrays list, MAESTRO will maintain persistent information for all the Arrays regarding performance, San Group assignments, and Managed Servers. This data is stored on a mirrored VM on the “managing” Array. The managing Array is the IP used to launch MAESTRO.

Note: If MAESTRO is launched to a non-managing Array, the same data will not be available until it is also added to the Managed Arrays in that instance of MAESTRO.

Management and configuring of an Array is just one click-away. Click on the Array name in the Managed Arrays list:



This launches into the Dashboard for the Array:

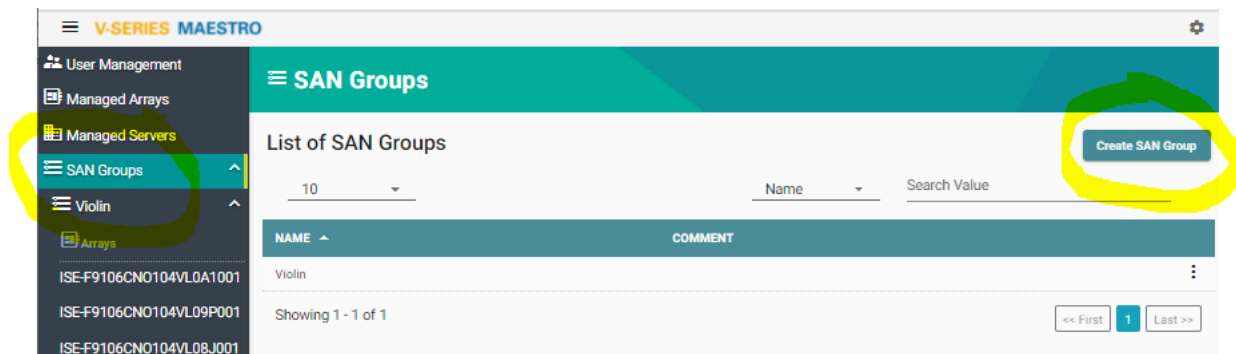


SAN Groups (optional)

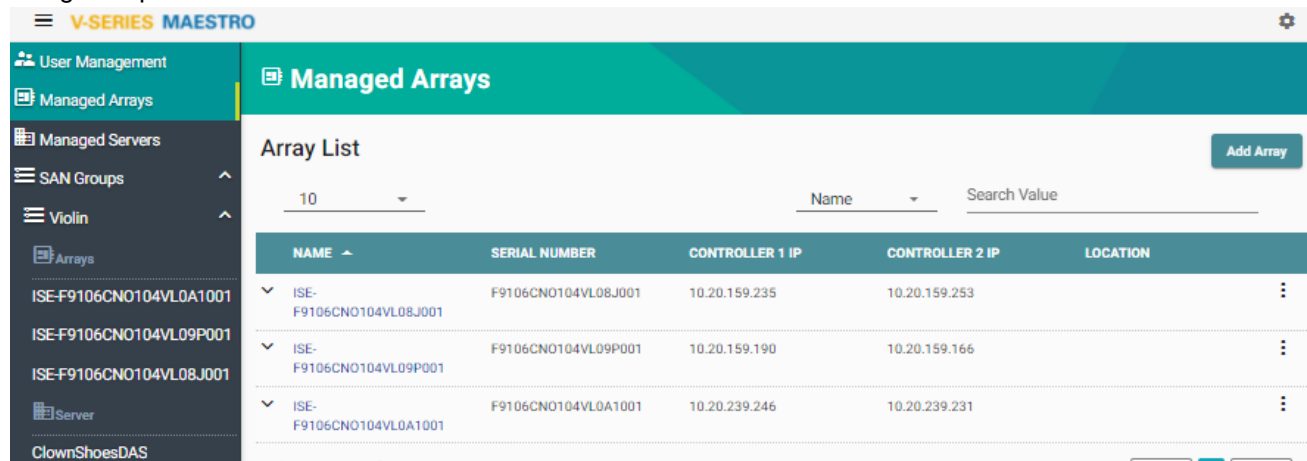
The V-SERIES Arrays and XIO G4 Array can be logically grouped into SAN Groups. A SAN Group is a collection of Arrays that that allows quick access to a group of Arrays. This is useful when there are large number Arrays in the Managed Arrays. A SAN Group can be created when an Array is added to Managed Arrays or independently by clicking in the left Navigation pane on SAN Groups. When fewer Arrays are in the Managed Arrays list, access to the Array can easily occur by clicking on the Array name in the Managed Arrays list, instead of adding to a SAN Group.

Arrays are added to a SAN Group either when they are added into Managed Arrays or after a SAN Group is created.

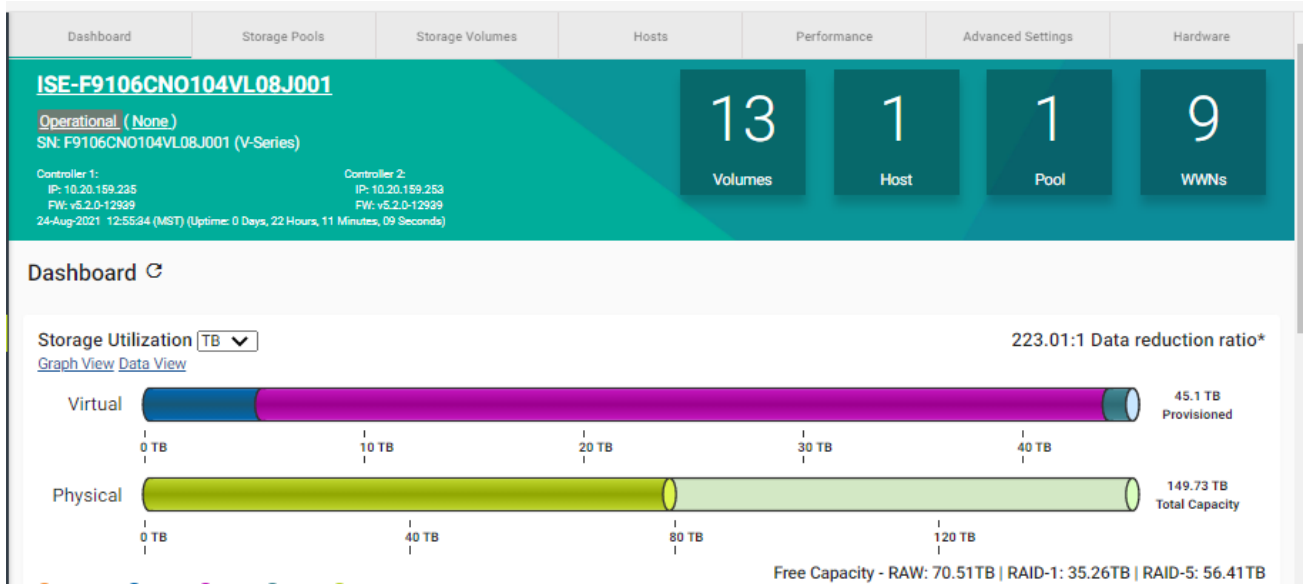
Click on SAN Group name in navigation pane and ADD the Array via a SAN Group:



The Arrays that are being monitored by MAESTRO are shown after clicking on Managed Arrays in the left navigation pane.



Click on an Array and the status summary is displayed in the Dashboard.



Dashboard —Status Summary

Storage Pools

The V-SERIES Array storage capacity is organized into entities called storage pools or pools.

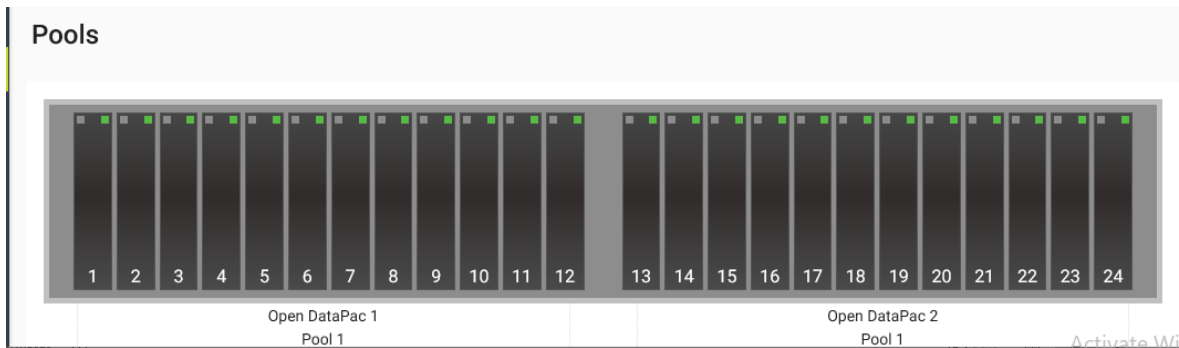
An Open DataPac is a collection of NVMe drives. 11 drives are in Open DataPac. One or two Open DataPacs are supported, for a total of 22 drives. The V1000 XE configured at software version 5.0 supports 12 drive Open Datapacs. for a total of two Open DataPacs and 24 drives.

Open DataPacs are allocated by default to Pool1. Pool expansion is supported by installing Open DataPac 2, after the Array is initialized.

A pool consists of all available capacity provided by one or two Open DataPacs. The overall capacity of each pool is determined by the number and size of the drives in the Open DataPac(s) allocated to the pool, minus the 10% that is reserved for spare capacity. V1000 XE configured at software version 5.0 are initialized by default to 20% spare capacity.

Volumes are created within a pool. Volumes can be RAID-1 or RAID-5, and thin or thick provisioned or type deduplication. Deduplication is enabled by default through MAESTRO. Dedupe volumes are restricted to Pool1. QoS can be enabled on thick and thin volumes. QoS is not supported on dedupe volumes.

Open DataPac and Storage Pools page:



V1000 XE configured at software version 5.0, with 24 drives

Pool Information

Pool capacity and usage details are displayed on the Storage Pools page.

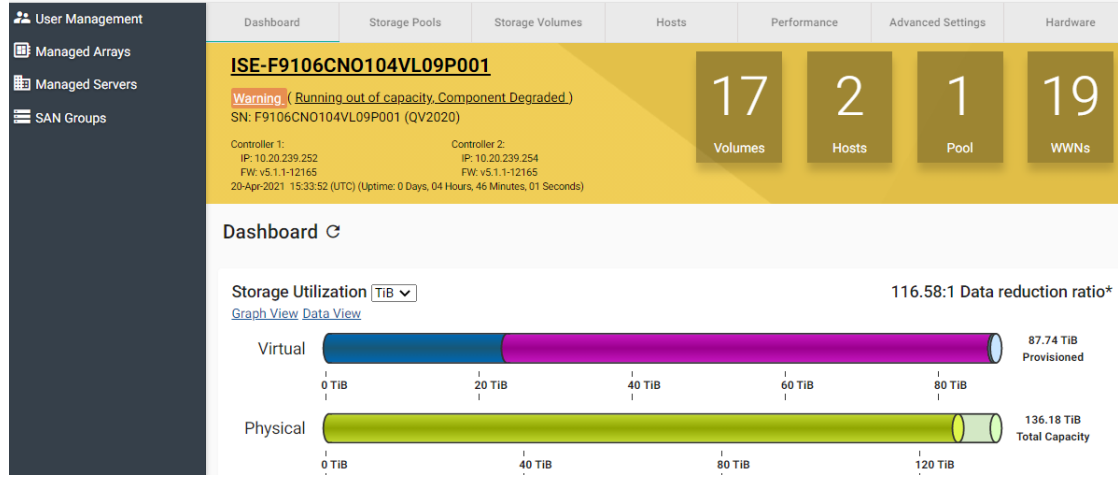
^ Pool 1 [Free: 170889 GiB | Used: 238 GiB | Status: Operational(Spare capacity could be improved)]

Deduplication Usage (used/provisioned) System Data: 120/120 GiB User Data: 48/48 GiB	Available Capacity: RAID-1 85444 GiB Available Capacity: RAID-5 136711 GiB ThinThreshold: 75 %	Open DataPac 1 Open DataPac 2
--	--	----------------------------------

Thin Threshold (Running Out of Capacity)

Thin Threshold provides an alert when the Array total used capacity has reached the threshold, or beyond. By default it is set to alert when 75% of the Array user capacity has been written/used. The Thin Threshold setting is displayed in Pool information. Thin Threshold can be adjusted, via command line, to alert at lower or higher thresholds.

Several alerts are generated when the threshold is reached: email alert (if enabled), Maestro will display a yellow banner (Running out of capacity), and command line “show ise” command will indicate warning status. Below are examples of these alerts.



```
oem:> show ise

System Information
-----
ISE-F9106CNO104VL09P001 (IP Address: 10.20.239.254)
-----
Status       : Warning (Running out of capacity, Component Degraded)
Details      : 0x00000002
Date/Time    : 20-Apr-2021 15:35:16
Time Zone    : UTC
Up Time      : 0 Days, 4 Hours, 54 Minutes, 39 Seconds
Identifier    : 2000001F93400930
Serial Number : F9106CNO104VL09P001
```

Although this feature is mainly intended to alert for configurations with thin volumes, it actually provides an alert for any configuration running out of capacity.

Pool Expansion

Additional capacity can be added to the Array if the drive slots are not fully populated. After inserting additional drives, Pool 1 can be expanded by clicking on the Expand Pool button, as shown below.

Pool 1 [Free: 290366 GiB | Used: 141116 GiB | Status: Operational(None)]

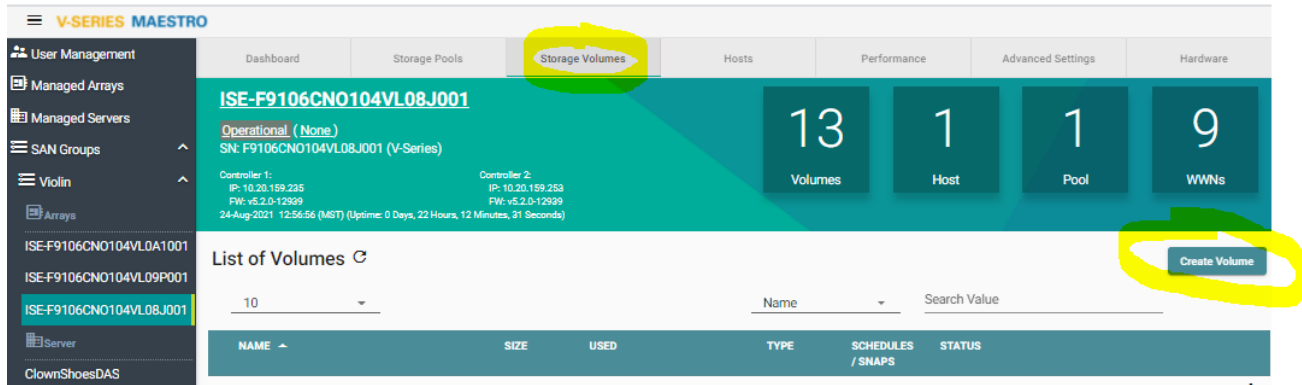
Deduplication Usage (used/provisioned) System Data: 36/36 GiB User Data: 20/20 GiB	Available Capacity: RAID-1 145183 GiB Available Capacity: RAID-5 232292 GiB ThinThreshold: 75 %	Open DataPac 1
--	---	----------------

Expand Pool
Delete Pool

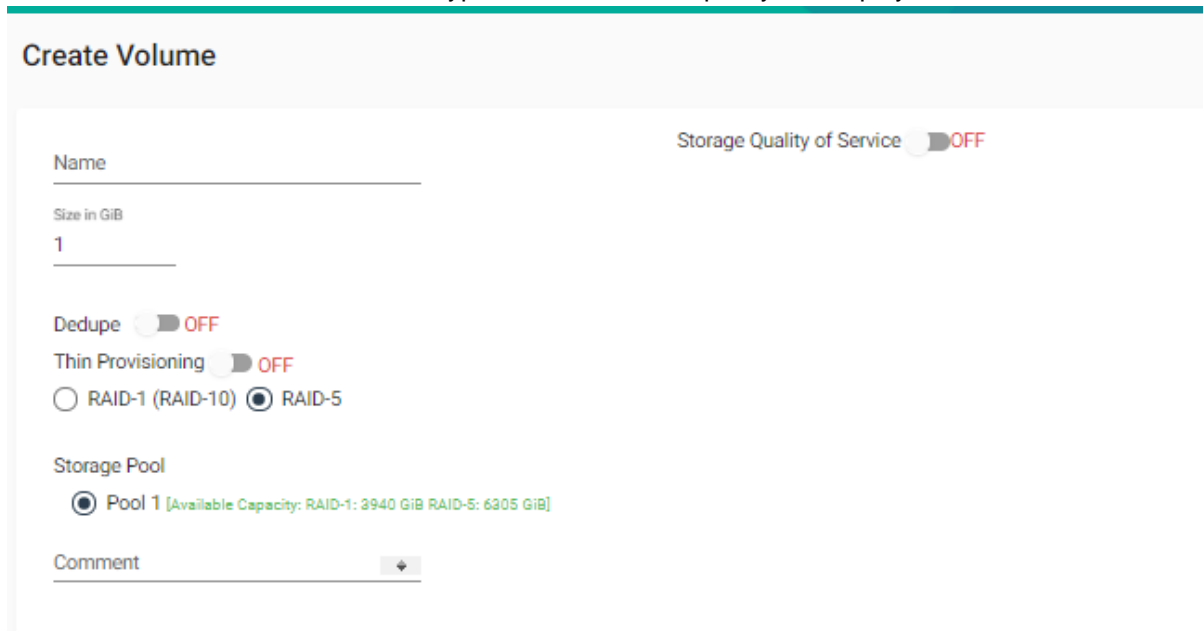
Expand Pool feature must be initiated by Service and is only supported in software version 5.2.0 and newer

Volumes

Volumes can be created through the Array Storage Volumes tab.




Click on Create Volume and volume types and available capacity will display:



Thin Provisioning

Thin Provisioning is a method of over-subscribing or over-provisioning the amount of space on a storage Array. One of the advantages of thin provisioning is on-demand allocation. This allows the storage administrator to present volume to an Operating System without having to fully allocate the space on the storage Array. By using Thin Provisioned volumes, the Array can be used in a more space efficient manner. Only when new writes are requested are the new blocks actually allocated to the Thin Provisioned volume. Blocks that are re-written do not require new blocks to be allocated. Thin Provisioning thresholds are implemented on a per pool basis.



NOTE: The default Thin threshold is 75% of the pool storage. Use the CLI `modify -pool=<pool_ID>` command to change the threshold value.

Deduplication

Dedupe is a volume type that is utilized when the user wants to optimize storage capacity by allowing the Array to detect duplicate data and store only one copy. The V-SERIES Array detects duplicates across all dedupe volumes and optimizes into one copy of the data.

The dedupe volume size is not reserved within the system and full capacity is not guaranteed like a thick volume. As unique writes come in for a volume, the requested capacity growth will be measured against the original volume size. As with thin volumes, dedupe volume data will not be allowed to be written if the required increased volume size has reached the Array available capacity.

Deduplication requires execution of complex algorithms within the Array. As such, dedupe volumes are traditionally not as high performing as non-dedupe volumes.

Quality of Service (QoS)

QoS settings are available per volume. This optional feature is available on thick and thin volumes. It is not supported on dedupe volumes. Setting the IOPS limits effectively sets a priority for volumes. If these goals or limits are not met, the Array automatically adjusts the service levels in order to make sure that necessary QoS levels for your highest priority applications are nearly always maintained.

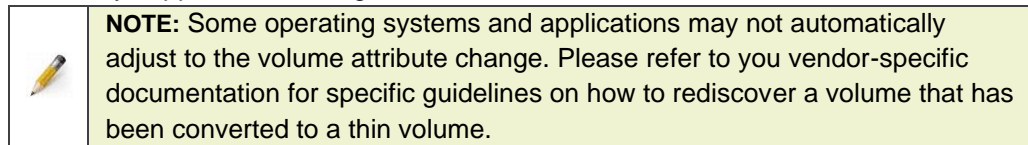
Min Goal IOPS can be considered a means of “reserving” performance for given LUNs and will throttle back other LUN performance to achieve this goal. Throttling delays the I/O request, which adds latency to the I/O to slow down the host. The Min can be guaranteed only if the host is generating the I/O to reach that minimum, so care should be taken to set a realistic Min value.

Max Limit IOPS is used in conjunction with Min Goal and is only applied when other volumes are unable to achieve their minimum goals and the system is under. Max Limit per volume can be considered a soft threshold for IOPS. As long as volumes are achieving their Min Goal, then IOPS can go higher and reach the Burst Limit (hard threshold) for an indefinite period of time.

Burst Limit IOPS “caps” the IOPS as a hard threshold or ceiling. IOPS can never exceed the Burst Limit. If a user is using QoS for the use case of provisioning IOPS, this generally will set Burst Limit the same as Max Limit.

Converting Volumes from Thick to Thin

The Array supports converting thick volumes to thin volumes.



MAESTRO: In *Edit Volume dialog*, select Thin Provisioning option.

Re-size LUNs

The Array supports LUN re-sizing, expansion, and shrink without first copying data to another volume. LUN re-sizing in the Array is done in multiples of 1GB by adding to or subtracting from the currently highest numbered logical block address. During LUN re-sizing, independent of the LUN re-size amount, host I/O to the volume is momentarily paused (no more than ten seconds).

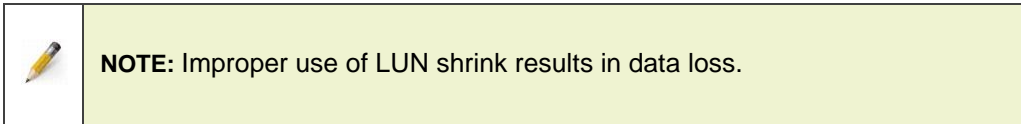
A re-sizing process cannot be aborted once initiated, cannot be undone, and the original presentation persists. Presentation changes must be done manually after the LUN is re-sized. The re-size process is unaffected by controller failovers and reboots.

LUN Expansion

When the expansion process begins, the Array reserves enough space to complete the expansion.

LUN Shrink

The operating system volume shrink must be completed before a LUN shrink is attempted. Not all operating systems, file systems, and databases support volume shrink. Refer to the operating system documentation for recommended procedures prior to volume shrink.

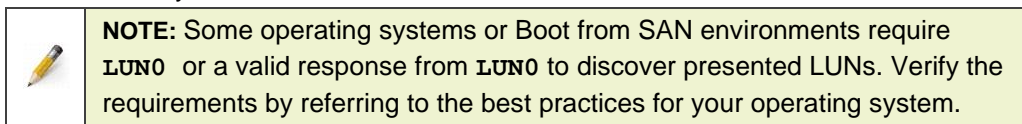


Configuring Hosts

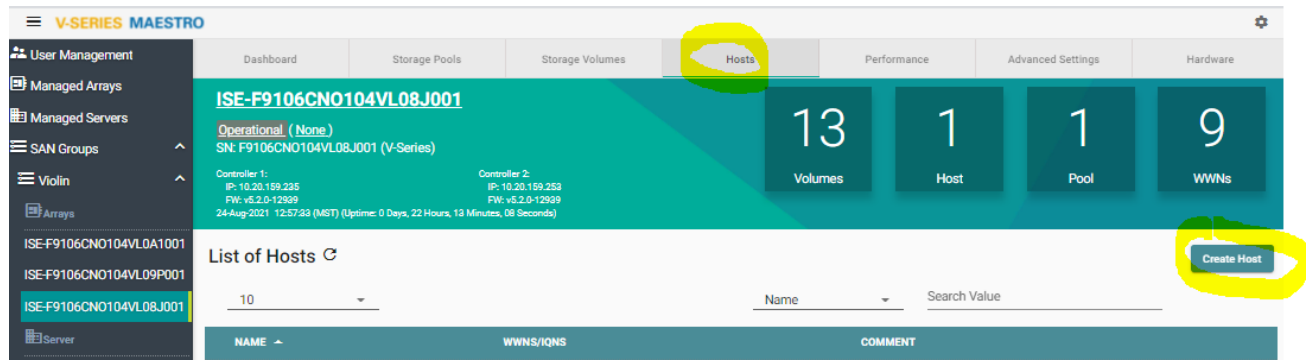
In the Array, the Host Bus Adapter (HBA) port World Wide IDs (WWIDs) are organized into entities called hosts. A host consists of one or more HBAs under a single name, by which all the HBAs in the host are referenced. Volumes must be presented to a Host for a server to have access to the LUN.

Mapping Volumes and Hosts

When presenting a volume to a host, a mapping between that host and that volume is created. Each time a mapping is made, the Array assigns an incrementing LUN number (starting with 1) to the volume so that it can be seen by that host.



. Hosts can be created and volumes assigned through the Array Hosts page;



Click on Create Host, select volumes (already created) by clicking the slider.

Creating a **Fibre Channel host** to present volumes will look like the below, with a list of available WWNs. If nothing is listed as available, then the host Fibre connections have not yet logged into the Array or all WWNs have already been assigned to an Array “host”.

Create Host

Name

comment

Available WWNs

2100000E1E28F390

2100000E1E28F391

21000024FF266A64

21000024FF266A65


21000024FF66BA79

Cancel
Next
Create Host

After assigning WWNs for a Fibre Channel Host, the display will appear as follows, where WWNs will be listed under the WWNS column:

List of Hosts

10 

NAME 	WWNS
▼ cos-qa-ucs01bld05	20000025B500002F, 20000025B500005F
▼ cos-qa-ucs01bld06	20000025B500002E, 20000025B500005E
▼ cos-qa-ucs01bld07	20000025B500000F, 20000025B500001F
▼ cos-qa-ucs01bld08	20000025B500000E, 20000025B500001E

Showing 1 - 4 of 4

Creating a **iSCSI host** to present volumes will look like the below, with a list of available IQNs. If nothing is listed as available, then the host iSCSI connections on the host have not yet been enabled. The list will only display IQNs that have logged into the Array and have not been assigned to an Array “host”.

Create Host

Name

comment

Available WWNs/IQNs

iqn.1994-05.com.redhat:83a81061c428

Cancel


Next

Create Host

After assigning IQNs for an iSCSI Host, the display will appear as follows, where IQNs will be listed under the WWNS column:

List of Hosts

10 

NAME 	WWNS
▼ cos-qa-tc03s08t	iqn.1994-05.com.redhat:83a81061c428
▼ cos-qa-tc03s09t	iqn.1994-05.com.redhat:c829fc7fdaf0
▼ cos-qa-tc03s10t	iqn.1994-05.com.redhat:95fffe3d706b
▼ cos-qa-tc03s14t	iqn.1994-05.com.redhat:984b7ce77047

Managed Servers (optional)

Once hosts are created and volumes are presented, MAESTRO provides an optional feature called **Managed Servers**. This feature generates a top-down logical view of servers, as defined by their HBAs, and associations to managed Arrays and volumes.

Click on Managed Servers and then Create Server to create a Server.

Once a server is created, MAESTRO will poll all the Managed Arrays and generate a collective list of all the volumes presented to that server, via Hosts:

^ Server148

Vol Name (GUID) ^	Capacity (%Alloc)	LUN	Array Name
dedup1 (6001F9340004000035DA000200000000)	1200GiB (5.39%)	1	ISE-F9005CTH103AN016008
dedup1-001 (6001F9340004000035DB000200000000)	1200GiB (4.51%)	2	ISE-F9005CTH103AN016008
dedup1-002 (6001F9340004000035DC000200000000)	1200GiB (99.95%)	3	ISE-F9005CTH103AN016008
dedup1-003 (6001F9340004000035DD000200000000)	1200GiB (99.95%)	4	ISE-F9005CTH103AN016008
dedup1-004 (6001F9340004000035DE000200000000)	1200GiB (99.95%)	5	ISE-F9005CTH103AN016008
dedup1-005 (6001F9340004000035DF000200000000)	1200GiB (99.91%)	6	ISE-F9005CTH103AN016008
dedup1-006 (6001F9340004000035E0000200000000)	1200GiB (99.91%)	7	ISE-F9005CTH103AN016008
dedup1-007 (6001F9340004000035E1000200000000)	1200GiB (99.91%)	8	ISE-F9005CTH103AN016008
dedup1-008 (6001F9340004000035E2000200000000)	1200GiB (99.91%)	9	ISE-F9005CTH103AN016008
thick1 (6001F9340004000035E3000200000000)	100GiB (100%)	10	ISE-F9005CTH103AN016008
thick1-001 (6001F9340004000035E4000200000000)	100GiB (100%)	11	ISE-F9005CTH103AN016008
thick1-002 (6001F9340004000035E5000200000000)	100GiB (100%)	12	ISE-F9005CTH103AN016008
thick1-003 (6001F9340004000035E6000200000000)	100GiB (100%)	13	ISE-F9005CTH103AN016008
Dedup1-v1 (6001F934000300002D02000200000000)	2000GiB (1.09%)	1	ISE-F9005CTH103AN9CK02J
Dedupe-v1-001 (6001F934000300002D03000200000000)	2000GiB (1.12%)	2	ISE-F9005CTH103AN9CK02J

This view is helpful when scheduling server maintenance to verify which Arrays/LUNs are associated. In the above display, two Arrays (highlighted) have volumes that are presented to Server148.

Edits and management to an Array or volume from the Server list is as simple as clicking on the Array or volume link:

Servers List Create Server

Filter By: value

Collapse All

^ **Server148** (Performance Group)

Vol Name (GUID) ^	Capacity (%Alloc)	LUN	Array Name
dedup1 (6001F934000400003A38000200000000)	3000GiB (27.36%)	1	ISE-F1023CTH102AN9CR00R
dedup1-001 (6001F934000400003A39000200000000)	3000GiB (25.70%)	2	ISE-F1023CTH102AN9CR00R
dedup1-002 (6001F934000400003A3A000200000000)	3000GiB (63.21%)	3	ISE-F1023CTH102AN9CR00R
dedup1-003 (6001F934000400003A3B000200000000)	3000GiB (63.73%)	4	ISE-F1023CTH102AN9CR00R
dedup1-004 (6001F934000400003A3C000200000000)	3000GiB (63.26%)	5	ISE-F1023CTH102AN9CR00R
dedup1-005 (6001F934000400003A3D000200000000)	3000GiB (62.40%)	6	ISE-F1023CTH102AN9CR00R
dedup1-006 (6001F934000400003A3E000200000000)	3000GiB (64.42%)	7	ISE-F1023CTH102AN9CR00R
dedup1-007 (6001F934000400003A3F000200000000)	3000GiB (61.71%)	8	ISE-F1023CTH102AN9CR00R
thick (6001F934000400003A40000200000000)	10GiB (100.00%)	9	ISE-F1023CTH102AN9CR00R
thick-001 (6001F934000400003A41000200000000)	10GiB (100.00%)	10	ISE-F1023CTH102AN9CR00R

Snapshots

Space efficient snapshots are supported on dedupe volumes. This feature can be managed in MAESTRO through the Volumes tab. Snapshots can be manually created or automatically generated based on schedules.

MRC1: IP: 10.20.144.40 FW: v5.0.0-10309
MRC2: IP: 10.20.144.42 FW: v5.0.0-10309
20-Mar-2020 04:26:41 (MST) (Uptime: 0 Days, 00 Hours, 32 Minutes, 29 Seconds)

Volumes
Hosts
Pods

List of Volumes Refresh

10 ▼ Name ▼ Search Value

NAME ^	SIZE	USED	TYPE	DEDUPE RATIO	SCHEDULES / SNAPS	STATUS
vol0000	89 GiB	89 GiB (100%)	Thick	N/A	0 / 0	Operational(None)
vol0001	156 GiB	156 GiB (100%)	Thick	N/A	0 / 0	Operational(None)

- ☰ Details
- ✎ Edit
- 🕒 Snapshots
- 📷 Take Snapshot
- 🔄 Calculate Ratio
- 🗑️ Delete

Snapshots

Snapshot Schedules

Schedules allow for snapshots to be automatically generated at a fixed interval with an initial start date/time.

Snapshot schedules “Next Run Date” is based on the **Array timezone**, noted in the Banner time.



When creating a schedule, the Array time zone and date/time are used. All future snapshots will be dated with the Array time.

Create Snapshot Schedule

Next Run Date

mm/dd/yyyy Time (hh:mm) (Current Array Time: 08-Apr-2020 13:31:33)

Interval

Take snapshot every 1 Hour(s)

Keep

24

of snapshots to keep - 0 = keep all until manually deleted

Cancel Create

A “**keep**” option on the schedule allows for a default of 24 snapshots to accumulate, per schedule, before thinning occurs. The keep value can be adjusted per schedule. Snapshots created by schedules can be changed to “exclude from thinning”.

Special Considerations:

- 1) A maximum of two non-identical schedules can be assigned per volume.
- 2) Schedules that coincide at the same time on multiple volumes will have slight overhead in performance due to background thinning. It is recommended to stagger these intervals to avoid concurrent operations.
- 3) Time changes on the Array will not update the original time for the snapshot schedules. Each schedule will need to be updated or recreated with the new timestamp baseline.

Promoted Snapshot

Snapshots are not accessible by the client/server to preserve the original data. If data needs to be read or written from a snapshot, the snapshot must be “promoted”. Promote will clone the data from the snapshot and create a new Array volume. The new volume is independent from the original parent volume of the snapshot. Data written on the promoted volume will not be written to the original snapshot nor the parent volume of the

snapshot. A snapshot can be promoted through the Volume Snapshot page, by selecting the details on the snapshot.

Snapshot Schedules Create New

SCHEDULE ID	INTERVAL	NEXT	# TO KEEP	⋮
0491BE187AEF459D89C8D35 E11A342C3	Every 5m	14-Nov-2019 17:24:00	24	⋮

Snapshots

10
Name
Search Value

NAME	CREATOR	TIMESTAMP	THINNING	STATUS	⋮
0491BE187AEF459D89C8D35E11A342C3_1 573777140-lab55-dedup1	Schedule	14-Nov-2019 17:19:00	Include	Operational(None)	⋮

✎ Edit

★ Promote

🗑 Delete

Refer to the V-Series Best Practices Guide for how to configure and manage snapshots and schedules through MAESTRO.

V-SERIES Array vCenter Plugin

A vCenter storage plug-in is available in the V-SERIES V1000 XE Array software release 5.0.11 and later, with V1000 SE included in 5.1 software version and later. The Array plugin allows the ability to create and manage datastores on the Array from within vCenter. The plugin includes Array volume create, delete, and modify, as well as presentation to an ESX host as a datastore. MAESTRO provides easy-of-use to install, uninstall, or verify install of the Array plug-in.

The plugin is supported on vCenter versions:

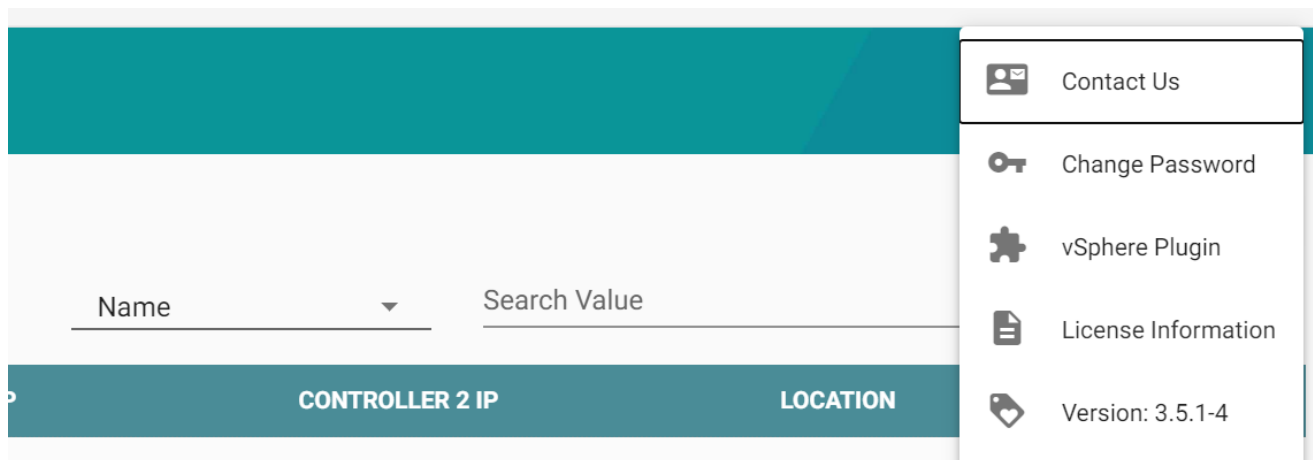
- 6.5 U3
- 6.7 U3
- 7.0

Note: vCenter versions prior to 7.0 may require a ESX server reboot to update the installation status of the plugin.

Registering V-SERIES Array vCenter Plugin

The Array plugin is registered (installed) within vCenter by using MAESTRO.

To register (install), unregister (uninstall) or check the status of the vCenter plugin, log into MAESTRO and select vSphere Plugin from the gear options.



The vCenter https address and credentials are required. Once these fields are populated, MAESTRO can verify the registration status of the plugin and register or unregister the VIOLIN plugin.

Select Register Plugin to install the V-SERIES Array plugin.

vSphere Plugin

vSphere URL
ex. https://client-hostname:port

vSphere Username

vSphere Password

Registration Status: Unknown

Using the V-SERIES Array Plugin

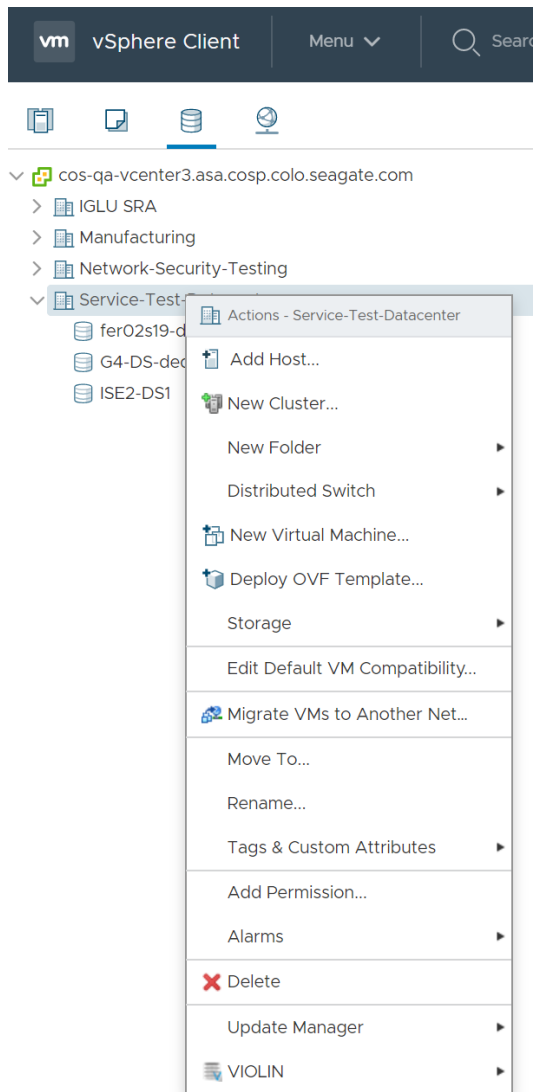
Once the Array plugin is registered in the vCenter, the plugin will display in the list of vCenter plug-ins in the Administration page:

Client Plug-Ins

ENABLE DISABLE

Name	Vendor	Version	Description
<input type="radio"/> Violin QV2020 Plugin	Violin Systems	5.0.9.10642	Manage Violin Storage QV2020 Arrays

The plugin will be called “VIOLIN QV2020 Plugin” and can be accessed like any other vCenter storage plug-in by right-clicking on Hosts and Clusters or Storage view:



Click on the VIOLIN pull-down for datastore management options.

When using the plugin, the address and login credentials for MAESTRO are required to access to the V-SERIES Managed Arrays.

Creating a Datastore

Through the VIOLIN QV2020 plugin, click on Create Datastore. The name supplied for the Datastore will be viewable in vCenter, as well as in the Array volumes list through MAESTRO.



Create Violin Datastore

Located on Array: 10.20.239.223

Datastore Name

(0 / 80) chars

ESX Host: 10.20.67.49

Allocation Type: Thin Deduplication Thick

Storage Pool: Pool 1

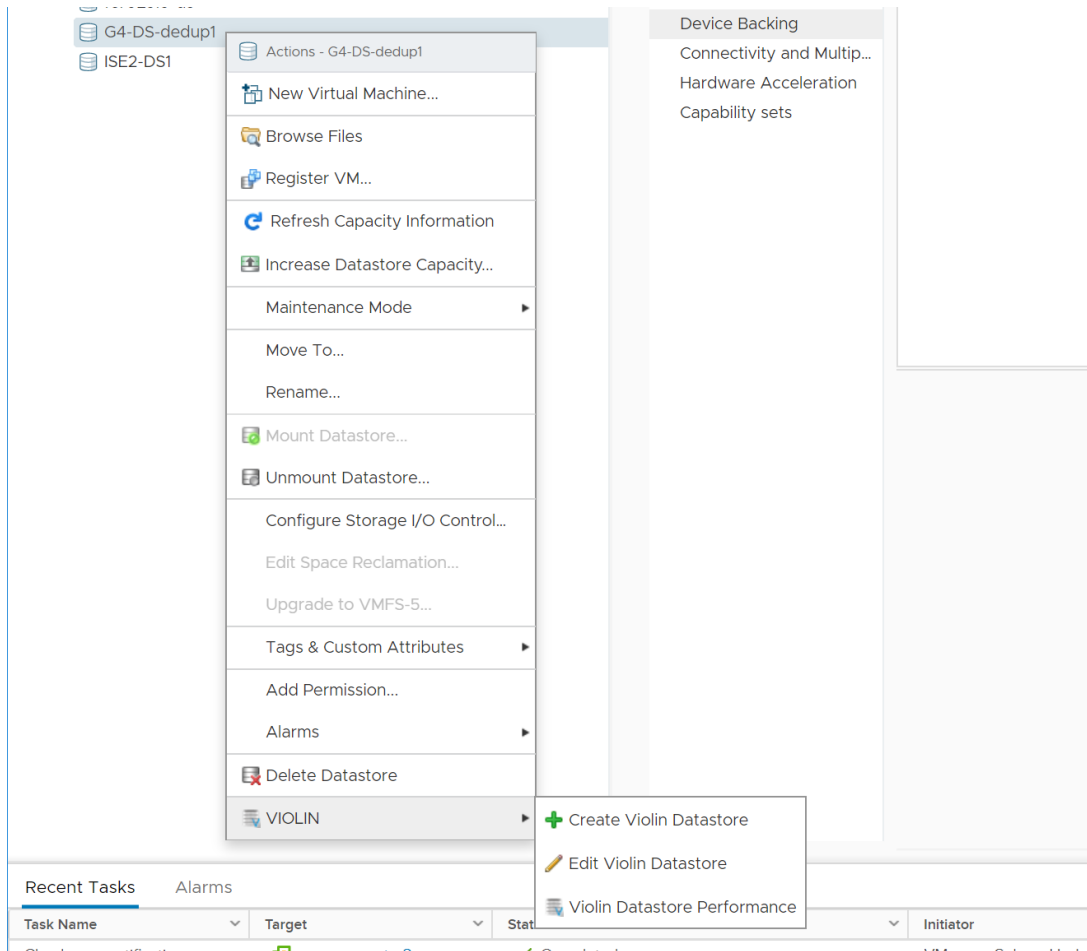
Size GiB

min:1 max:8192

CANCEL CREATE

Managing a Datastore

Once a datastore is created on the Array, it can be deleted or modified through the VIOLIN plugin.



Array Monitoring

The V-SERIES Array offers multiple methods to monitor the health and capacity usage of the Array. Automated health is sent to the VIOLIN Activewatch System (phone home). This automated service runs every 24 hours. It will alert the Violin Services team to events that may need attention.

Note, this service should never be the sole method of managing an Array. A customer should also monitor their systems. This will provide coverage when there may be outages in sending the information to NEXSAN (network outages, for example) or receipt of the information within NEXSAN.

In addition to automated Activewatch Service, MAESTRO provides status-at-a-glance of the Array health, through Array Dashboard and San Group overview pages.

San Group Status-at-a-Glance (optional)

If managed Arrays have been added into a SAN Group, click on the SAN Group name to display a high level health status of the Arrays in that group, as well as IPs, volume and host count.

SAN Groups

Performance Group
2 array(s) available under this SAN Group

ISE-F1023CTH102AN9CR00R			
MRC1 IP : 10.20.239.248			
MRC2 IP : 10.20.239.236			
1	14	1	
Pool	Volumes	Host	
Added on Mar 19, 2020 17:34:54			

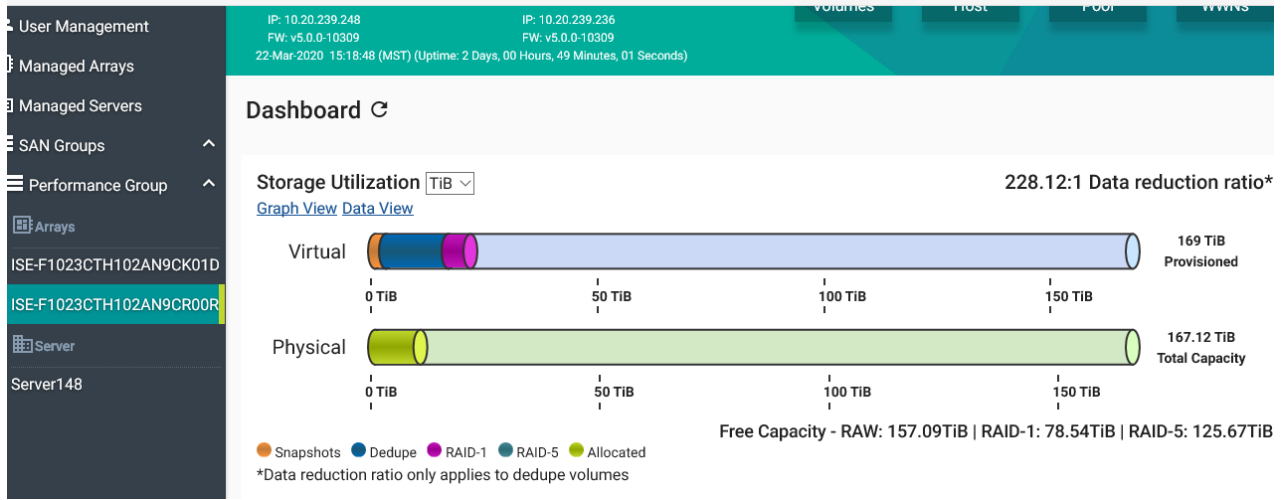
ISE-F1023CTH102AN9CK01D			
MRC1 IP : 10.20.67.30			
MRC2 IP :			
0	0	0	
Pools	Volumes	Hosts	
Added on Mar 19, 2020 19:57:31			

San Group “Performance Group” status-at-a-glance

Array Dashboard

The Dashboard provides a summary of an Array, including component health and storage capacity usage.

Click on an Array to display the Dashboard:



Storage Utilization

Overall capacity of the Array and usage are displayed in the Virtual and Physical bars in the dashboard.

Physical capacity is the total user capacity available, minus metadata and deduplication metadata, measured against actual written capacity.

Virtual capacity is the total requested volume capacity (create volume size) measured against actual allocated capacity.

The colored bars within Virtual and Physical indicate allocated capacity and the type: Thick Raid-1, Thick Raid-5, Dedupe, Thin, and snapshots.

To get a data view instead of graph view, click on Data View under Storage Utilization

Dashboard [↻](#)

Storage Utilization TiB ▾ 228.4:1 Data reduction ratio*

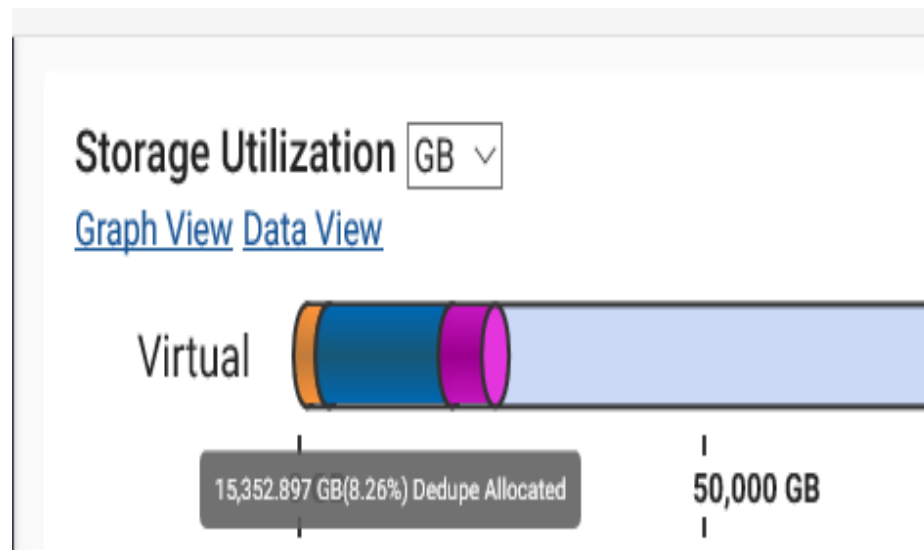
[Graph View](#) [Data View](#)

Virtual (169TiB Provisioned)		Physical (167.12TiB Total Capacity)		Free Capacity	
Snaps Allocated:	2.527TiB (1.5%)	Allocated:	10.027TiB (6%)	RAW:	157.089TiB
Dedupe Allocated:	14.023TiB (8.3%)			RAID-1:	78.544TiB
RAID-1 Allocated:	4.885TiB (2.89%)			RAID-5:	125.671TiB

*Data reduction ratio only applies to dedupe volumes

Storage utilization defaults to TiB. To change the unit of measurement, click on the Storage Utilization pulldown. Options are TB, TiB, GB and GiB.

Hover over the various colored bars to get detailed information on type of allocated storage and usage.



Volume Monitoring

Details on volumes are display in the Array Volumes page.

SIZE is the initial requested size of the volume during the create volume. This does not include the additional capacity that is allocated for the volume redundancy type, such as RAID-1 which allocates double the capacity to mirror the data. RAID-5, Dedupe or Thin provisioned volumes also have allocated overhead for redundancy.

USED is actual allocated capacity for the volume against the SIZE. It does not include redundancy allocated capacity.

For **Thick** volumes, this will always be the same as the size requested in the create volume, since data space is fully allocated at creation time.

For **Thin** and **Dedupe** volumes this is the allocated (written) capacity, which can grow as data is written or shrink as data is deleted and space is reclaimed. Note that that reclamation of capacity upon a delete is a background task and could take time to complete. Therefore, the USED value could decrease over time.

List of Volumes [↻](#)

10 ▼ Name ▼ Search Value

NAME	SIZE	USED	TYPE	SCHEDULES / SNAPS ▼
▼ vol0009	159 GiB	0 GiB (0%)	Dedupe	2 / 2
▼ vol0011	751 GiB	0.53 GiB (0.07%)	Dedupe	2 / 2
▼ vol0008	851 GiB	1.53 GiB (0.18%)	Dedupe	2 / 1
▼ vol0010	271 GiB	0.3 GiB (0.11%)	Dedupe	2 / 1
▼ vol0000	103 GiB	103 GiB (100%)	Thick	0 / 0
▼ vol0001	1027 GiB	1027 GiB (100%)	Thick	0 / 0
▼ vol0002	342 GiB	342 GiB (100%)	Thick	0 / 0
▼ vol0003	842 GiB	842 GiB (100%)	Thick	0 / 0
▼ vol0004	585 GiB	146.25 GiB (25%)	Thin	0 / 0
▼ vol0005	190 GiB	68.4 GiB (36%)	Thin	0 / 0

Snapshot Monitoring

Snapshots and snapshot schedules are supported on Dedupe type volumes. The number of snapshots and automated schedules is displayed on a volume under Schedules/Snaps.

List of Volumes [↻](#) Create Volume

10 ▼ Name ▼ Search Value

NAME ▲	SIZE	USED	TYPE	DEDUPE RATIO	SCHEDULES / SNAPS	STATUS	
▼ dedup1	3000 GiB	820.8 GiB (27.36%)	Dedupe	206.37 : 1	1 / 24	Operational(None)	⋮
▼ dedup1-001	3000 GiB	771 GiB (25.7%)	Dedupe	199.77 : 1	1 / 24	Operational(None)	⋮
▼ dedup1-002	3000 GiB	2128.5 GiB (70.95%)	Dedupe	201.47 : 1	0 / 0	Operational(None)	⋮
▼ dedup1-003	3000 GiB	2140.8 GiB (71.36%)	Dedupe	230.75 : 1	0 / 0	Operational(None)	⋮

To take a single snapshot, click on the “three dots” on the right side of a volume and click on **Take Snapshot**. To create a schedule, view details of a schedule or snapshot, click on **Snapshots**.

List of Volumes [C](#) Create Volume

10 Name Search Value

NAME	SIZE	USED	TYPE	SCHEDULES / SNAPS	STATUS	
vol0009	159 GiB	0 GiB (0%)	Dedupe	2 / 2	Operational(None)	⋮
vol0011	751 GiB	0.53 GiB (0.07%)	Dedupe	2 / 2	Operational(None)	⋮
vol0008	851 GiB	1.53 GiB (0.18%)	Dedupe	2 / 1	Operational(None)	⋮
vol0010	271 GiB	0.3 GiB (0.11%)	Dedupe	2 / 1	Operational(None)	⋮
vol0000	103 GiB	103 GiB (100%)	Thick	0 / 0	Operational(None)	⋮
vol0001	1027 GiB	1027 GiB (100%)	Thick	0 / 0	Operational(None)	⋮
vol0002	342 GiB	342 GiB (100%)	Thick	0 / 0	Operational(None)	⋮
vol0003	842 GiB	842 GiB (100%)	Thick	0 / 0	Operational(None)	⋮
vol0004	585 GiB	146.25 GiB (25%)	Thin	0 / 0	Operational(None)	⋮

- Details
- Edit
- Snapshots
- Take Snapshot
- Delete

The Snapshot Schedules section indicates when the next snapshot is scheduled to automatically occur, as well as how many copies to keep. This can be edited by clicking on the “three dots” on the far right of the schedule name. Name of the snapshot can also be changed from the default generated name.

Snapshot Schedules Create New

SCHEDULE ID	INTERVAL	NEXT	# TO KEEP	
F1A3AF479B324D2F8A367543FBB66755	Every 1h	22-Mar-2020 11:04:00	24	⋮

Snapshots Take Snapshot

10 Name Search Value

NAME	TIMESTAMP	CREATOR	USED	THINNING	STATUS	COMMENT	
F1A3AF479B324D2F8A367543FBB66755_1584871440-dedup1	22-Mar-2020 17:04:01	Schedule	11.4 GiB (0.38%)	Include	Operational (None)		⋮
F1A3AF479B324D2F8A367543FBB66755_1584867840-dedup1	22-Mar-2020	Schedule	46.2 GiB (1.54%)	Include	Operational (None)		⋮

Snapshots created from schedules or manually by clicking the Snapshot or Take Snapshot are listed in the Snapshots section. Default names are generated. These can be changed by clicking the “three dots”.

Thinning indicates if a snapshot will be kept until manually deleted by the user or automatically removed based on the **KEEP** value of a schedule. Manually created snapshots will only get deleted manually by the user. Scheduled snapshots get deleted one at a time as they “age out” according to the KEEP value. When the KEEP value is reached, the next snapshot (new) will cause the oldest snapshot for that schedule to get deleted. Each schedule maintains its own set of snapshots and the KEEP value is independent of other schedules.

Snapshots

[Take Snapshot](#)

10 Name Search Value

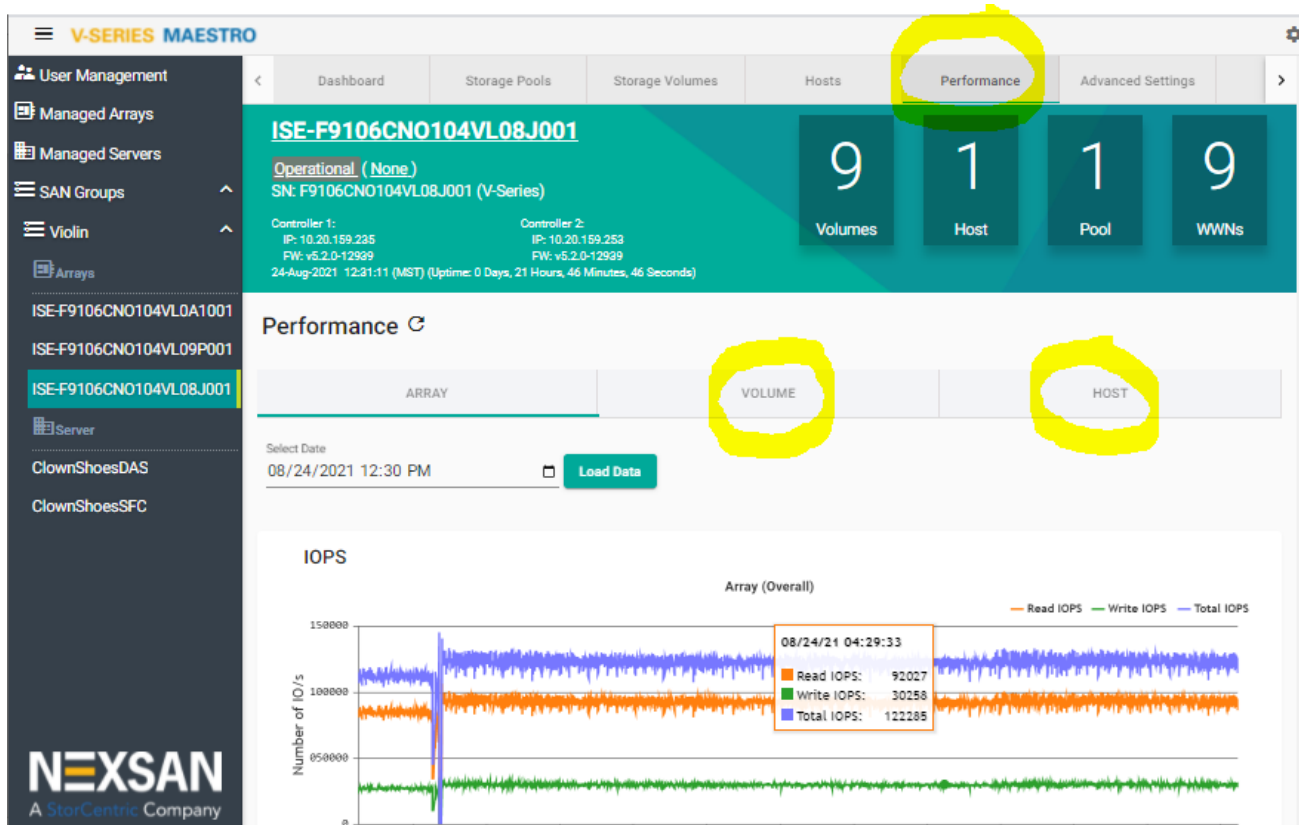
NAME	TIMESTAMP	CREATOR	USED	THINNING	STATUS	COMMENT
F1A3AF479B324D2F8A367543FBB66755_1584 878640-dedup1	22-Mar-2020 19:04:00	Schedule	7.2 GiB (0.24%)	Include	Operational (None)	⋮
F1A3AF479B324D2F8A367543FBB66755_1584 875040-dedup1	22-Mar-2020 18:04:00	Schedule	51 GiB (1.7%)	Include	Operational (None)	✎ Edit ★ Promote 🗑 Delete
F1A3AF479B324D2F8A367543FBB66755_1584 871440-dedup1	22-Mar-2020	Schedule	51.6 GiB (1.72%)	Include	Operational (None)	

Additional information on Snapshots and Schedules can be found in the *Snapshots* section of this document.

Performance

MAESTRO provides performance monitoring on an Array. The graphs are real-time, as well as the option to review historical data.

Overall Array performance summary is provided in the Array Dashboard. Additional details for volume and host performance are displayed in the Array Performance page:

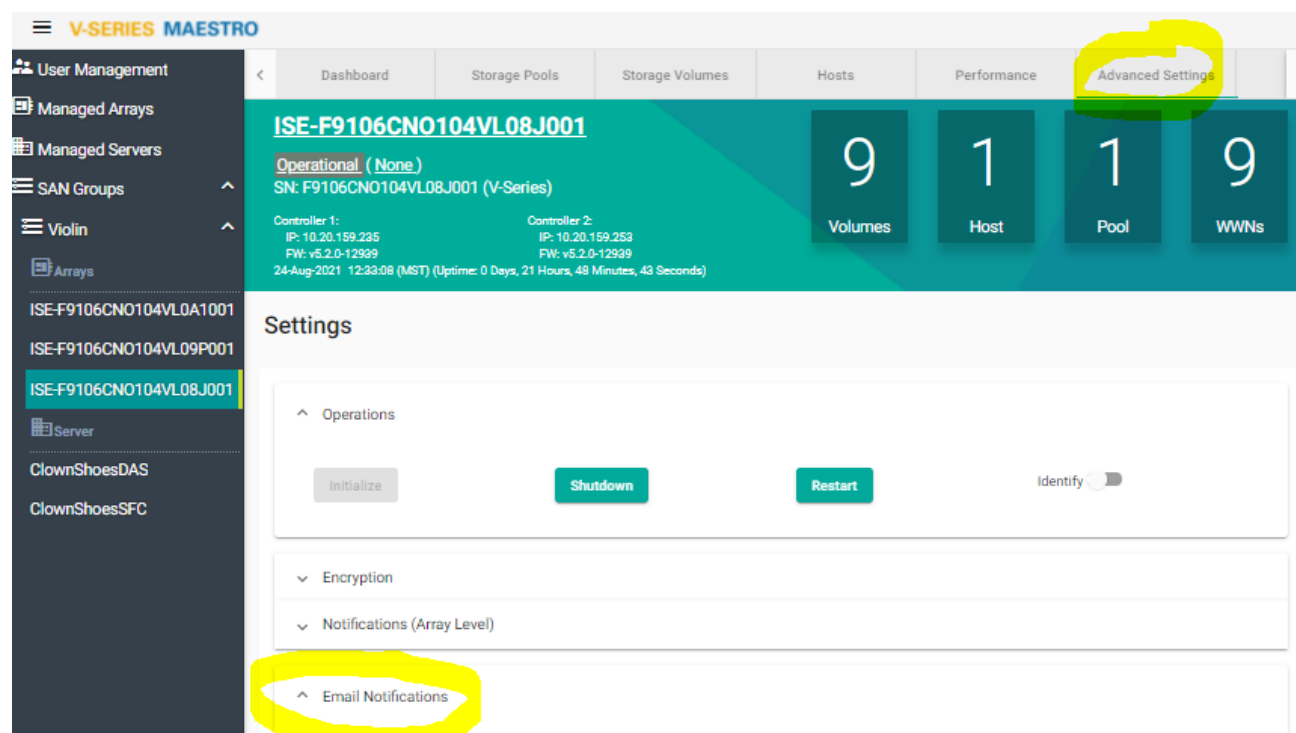


Array Performance

The **Performance Information** view shows a one-second snapshot of the performance statistics. This information will update automatically on the screen. The **Load Data** button will allow data to be displayed from a time period of interest.

Email Notification

Email notification can be enabled on the Array to send email to multiple users for various Array conditions. Each email user has the option to send email for various events: Critical, Severe, Error, Warning, Informational, Normal and all. Email notifications can be configured under the Array Advanced Settings:



SNMP

The Array has a number of configurable SNMP settings as well as fixed factory settings. SNMP V1 and V2 are supported, and the SNMP protocol data units (PDUs) are implemented. In addition, the Array includes an algorithm to prevent denial of service attacks.

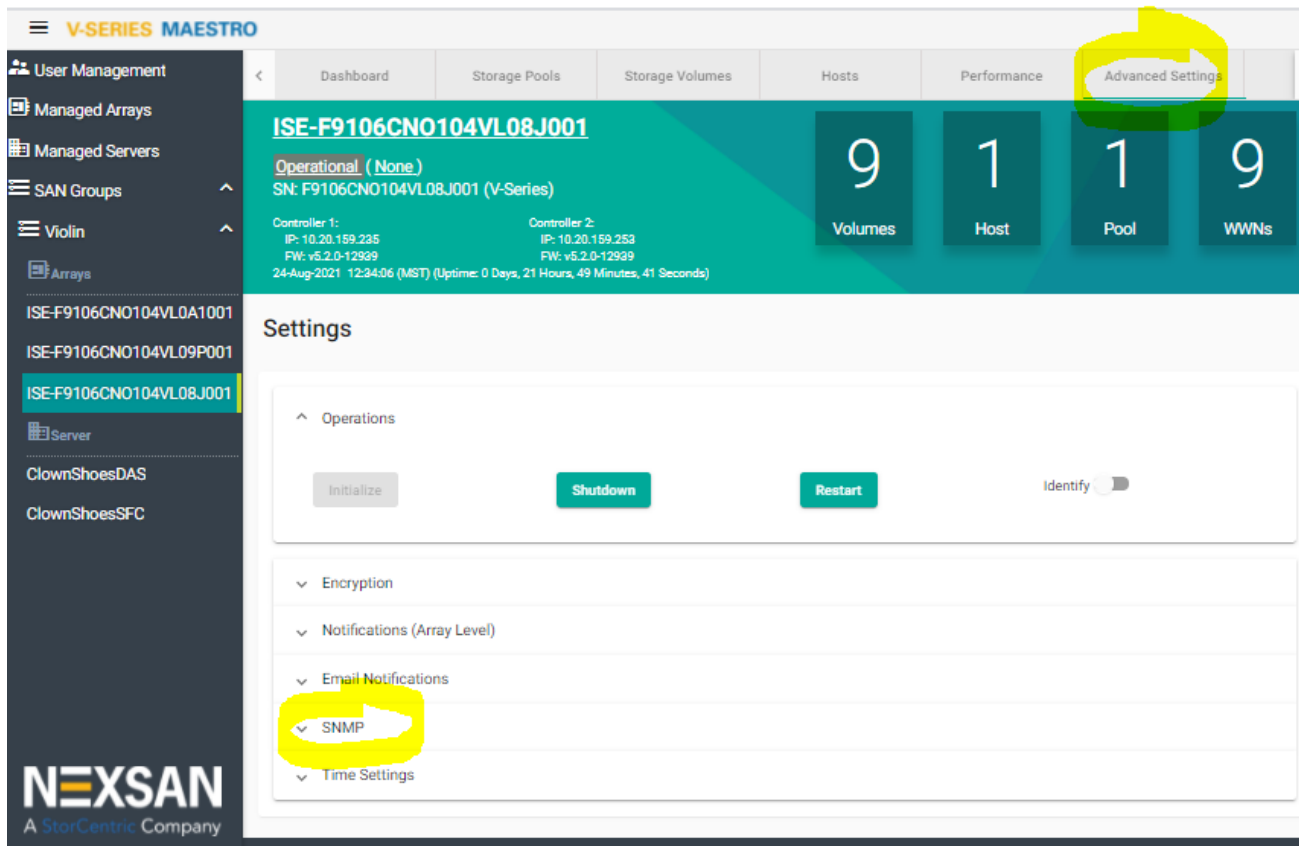
SNMP PDU	Support Status	Notes
GetRequest	Yes	Array monitors port 161
GetNextRequest	Yes	Array monitors port 161
Response	No	—
SetRequest	No	Array is set through the CLI
GetBulkRequest	Yes	Array monitors port 161
InformRequest	No	—

TrapV2	Yes	Array sends on port 162
Report	No	—

SNMP PDUs Implementation

Configuring SNMP

SNMP contact information, MIB root OID, Event subscriptions, and SNMP trap destination IP address are the configurable SNMP settings. This feature is in MAESTRO under the Array Advanced Settings:



Clicking on the SNMP header will open the menu for SNMP settings:

^ SNMP

SNMP Contact Information

Community
public

Contact
X-IO Colorado Springs, CO

Organization
X-IO Technologies

Description
X-IO Intelligent Storage Element

Old Name
1.3.6.1.4.1.xio.xio.iseProducts.iseStorage

Old Number
ise.org.dod.internet.private.enterprise.2366.6.1.3

Save Download MIB File

Event Subscriptions

Select events that you would like to forward to your SNMP client application

Available Subscriptions (you can select multiple subscriptions)

- ISE Initialization Complete
- Storage Pool Initialization Complete
- Volume Create Complete
- Volume Delete Complete
- Volume has gone non-operational
- A drive has failed
- System Is Shutting Down
- MRC Inserted

SNMP Trap Destination Setup

Enter new Address or edit/delete existing

Enter New Address Add

SNMP Contact Settings

The information entered in the four SNMP Contact settings is included in the Management Information Base (MIB) file for the Array and in SNMP GetRequest and Trap notification packets. The SNMP Contact information settings are:

- Community string
- Contact information
- Organization
- Description

MIB Root OID Setting

The Array Root OID Name and Number are also displayed.

When any change to the four Contact Information parameters is saved by clicking **SUBMIT** or **SAVE CHANGES**, the system automatically regenerates the MIB file to include the new information.

MIB File

The Management Information Base (MIB) file for the Array can be viewed or downloaded to be compiled into an SNMP device-monitoring tool using the on-screen instructions. The Array automatically regenerates the MIB file when changes to any logical object in the system are made, ensuring that the MIB file is always current.

Event Subscriptions

Event subscriptions provide the means to designate which events are to be forwarded to the SNMP Client Application. Upon an event, the system checks this list to determine whether to send the event as an SNMP trap to the SNMP Trap Destination list see the “SNMP Trap Destination Setup” section. SNMP traps are datagrams and do not have guaranteed delivery. Traps are sent only once and are not saved locally. Trap service is provided by one of the two Controllers; if the trap-serving Controller experiences an exception causing a reboot, the surviving Controller resumes trap service using only the traps and destinations defined for itself. Traps defined only for an out-of-service Controller are not sent by the surviving Controller. Should trap service need to be restarted on the surviving Controller, some traps may be lost during the transition.

SNMP Trap Destination Setup

The SNMP trap destination setup allows specification of site-specific IP addresses to which the selected SNMP events (see “Event Subscriptions”) are sent. Events can be sent to different IP addresses from each port if desired. Duplicate IP addresses are not permitted in the address lists and cannot be added.

System Monitoring with SNMP

The Array provides an SNMP MIB containing the Object Identifiers (OIDs) of Array variables. These variables can be monitored using SNMP Get Request PDUs see “SNMP Setup” . The following example shows the MIB entry for Array (ISE) temperature, where **n** is a company’s assigned private enterprise OID.

```

iseTemperature      OBJECT-TYPE
                    SYNTAX Integer32
                    MAX-ACCESS read-only
                    STATUS current
                    DESCRIPTION
                    "ISE Temperature"
                    ::= { ise 32 }      -- 1.3.6.1.4.1.N.6.1.1.1.2.32
    
```


Figure 1: Sample MIB Entry

An SNMP Get Request with the OID in this example returns an integer representing the current temperature of the Array.

Array Notifications/Subscriptions

The Array **Activewatch Service** (phone home) ships with a default destination address and the subscription function enabled. This destination uses a secure SSL connection.

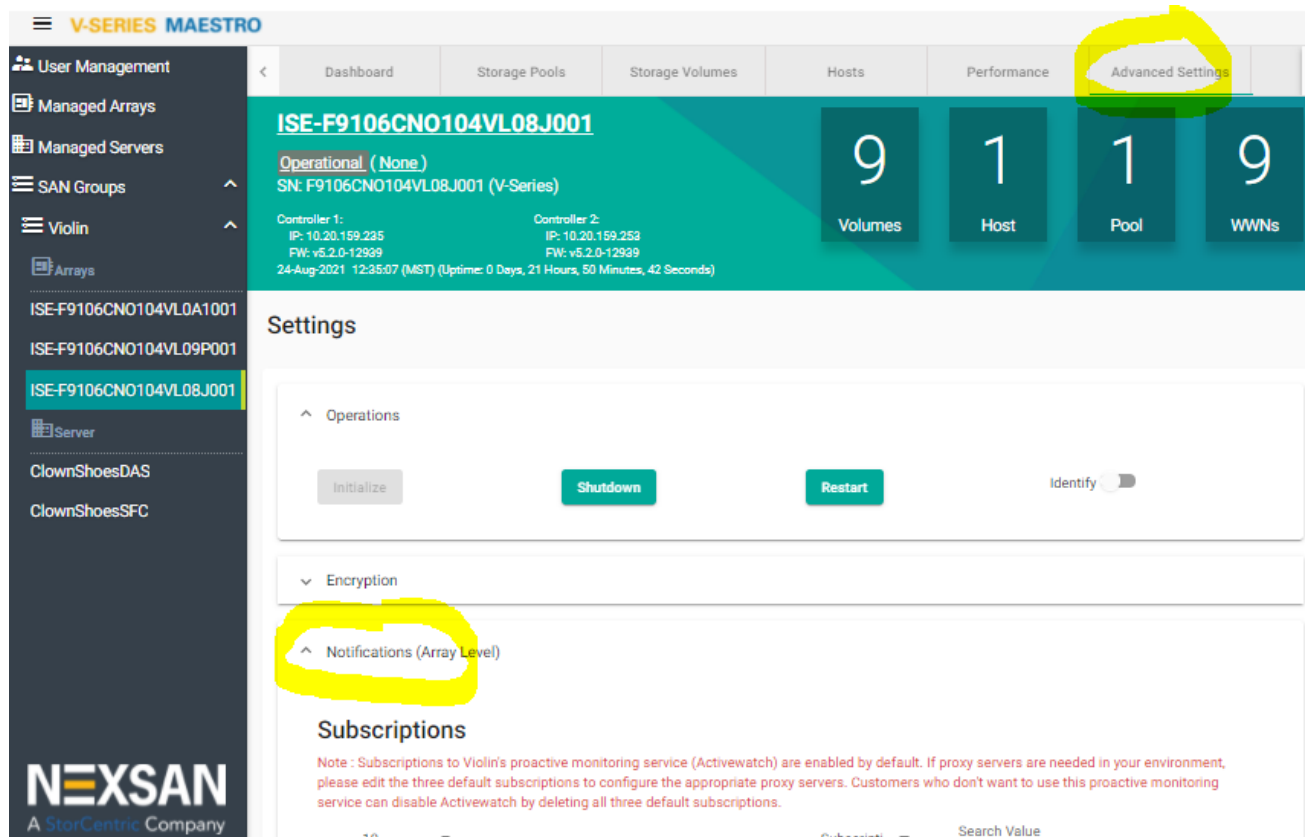
To use the **Activewatch Service**, it may be necessary to configure the site firewall to allow outbound HTTPS communication (port 443 using TCP). To specify the destination, define the target address as **207.250.72.215**—this restricts other HTTPS traffic.



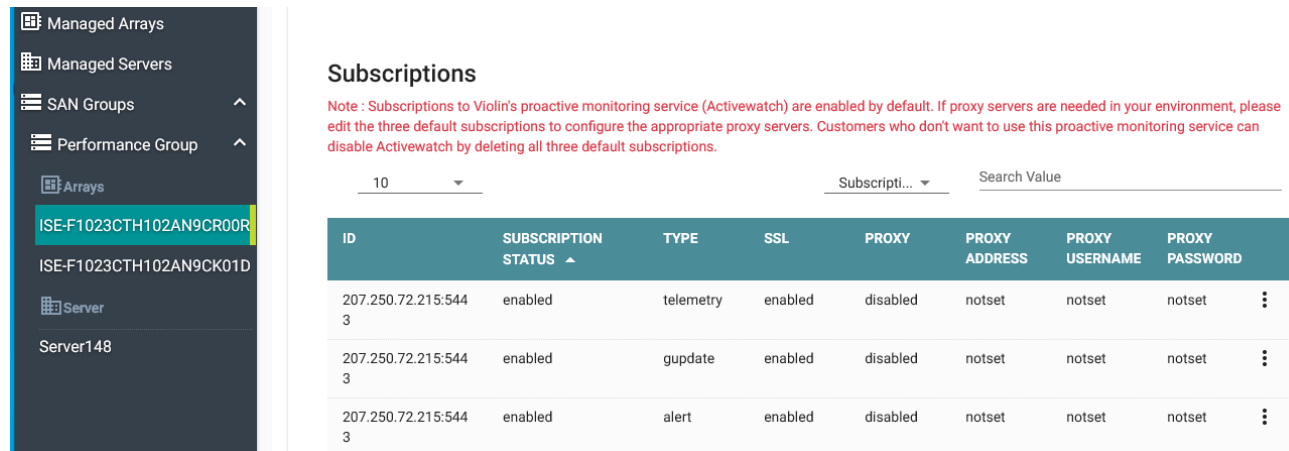
[1] **NOTE:** The interval for Telemetry and General Update subscriptions can be specified, but Alert subscriptions cannot be specified.

[2] When creating or changing Telemetry update subscriptions, it is recommended that the interval be left at **1440**. If a smaller interval is specified, the Array can run out of resources and log the following event in the SMGT event log:

Subscriptions are viewable in MAESTRO under Advanced Settings >> Notifications for an Array:



When subscriptions need to be modified or removed, this can be done by clicking on the far-right “3 dots” and EDIT.



Note that if one subscription type is disabled or enable, all subscription types to the same ID will be enabled or disabled. This maintains consistency on what data is proactively sent.

Send Telemetry Data File

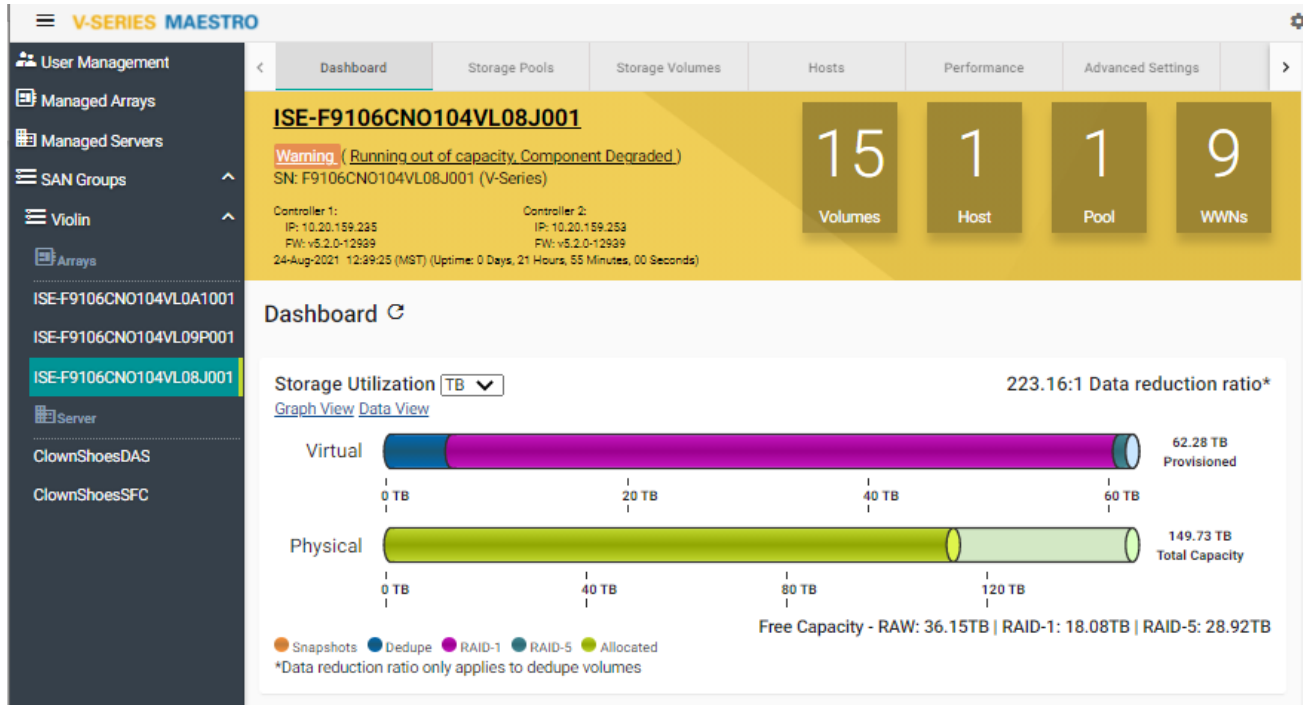
An immediate transmission of a Telemetry data, outside the normal schedule, can be sent using the Array command line. The transmission uses a secure SSL operation.

To initiate immediate transmission of the Telemetry data file, enter the following command at the CLI prompt.

```
telemetry send
```

Environment Status

The Array Dashboard banner provides an overall health status. If an error or informational event occurs, it will be display in the status section of the banner. Click on the link and it will launch to the appropriate area of concern. Below is an example where sparing capacity could be improved due to a failed drive. Clicking on the highlighted “Sparing capacity could be improved” will launch to the Storage Pools page where additional details can be reviewed.



Controller FC Ports Information

Controller FC or iSCSI information can be found under Array >>Hardware >>Controller, as in the below display.

V-SERIES MAESTRO

Dashboard | Storage Pools | Storage Volumes | Hosts | Performance | Advanced Settings | **Hardware**

ISE-F9106CNO104VL08J001

Warning (Running out of capacity, Component Degraded)
SN: F9106CNO104VL08J001 (V-Series)

Controller 1: IP: 10.20.159.235, FW: v5.2.0-12999, 24-Aug-2021 12:41:07 (MST) (Uptime: 0 Days, 21 Hours, 56 Minutes, 42 Seconds)
Controller 2: IP: 10.20.159.253, FW: v5.2.0-12999

Hardware

Controller | Open DataPac | Power Supply | Network | Fans

Global Controller Speed Settings
Set Global Port Speed -- Select Speed -- Update

Controller 1 Identify

Properties	FC Ports Information	SFP Information
Status	: Operational	
Detailed Status	: None	
Position	: 1	
Serial Number	: G1001CTH105AN05S05X	
Part Number	: R3040-G1001-01	
Hardware Version	:	

Controller 2 Identify

Properties	FC Ports Information	SFP Information
Status	: Operational	
Detailed Status	: None	
Position	: 2	
Serial Number	: G1001CTH105AN05S058	
Part Number	: R3040-G1001-01	
Hardware Version	:	

NEXSAN
A StorCentre Company

Click on FC Ports Information to display the status of each Controller FC port.

Properties	FC Ports Information	SFP Infor
FC Port 1		
Status	Operational	
WWN	2000001F93400040	
Speed	16 Gb/s	
Speed Setting	Auto	
FC Port 2		
Status	Operational	
WWN	2000001F93400041	
Speed	16 Gb/s	
Speed Setting	Auto	
FC Port 3		
Status	Operational	
WWN	2000001F93400042	
Speed	16 Gb/s	
Speed Setting	Auto	
FC Port 4		
Status	Link Down	
WWN	2000001F93400043	
Speed	Offline	
Speed Setting	Auto	
FC Port 5		
Status	Operational	
WWN	2000001F93400044	
Speed	16 Gb/s	
Speed Setting	Auto	
FC Port 6		
Status	Operational	
WWN	2000001F93400045	
Speed	16 Gb/s	
Speed Setting	Auto	
FC Port 7		
Status	Operational	
WWN	2000001F93400046	
Speed	16 Gb/s	
Speed Setting	Auto	
FC Port 8		
Status	Operational	
WWN	2000001F93400047	
Speed	16 Gb/s	
Speed Setting	Auto	

Speed indicates active FC port speed.

Speed Setting indicates if the Controller port is set to Auto negotiate or Fixed speed.

Each FC port functions independently of each other and can be set to differing supported speeds.

To globally set all FC ports to the same speed, select the “Set Global Port Speed” pulldown and select a setting.

The screenshot displays the 'Hardware' configuration interface. At the top, there are navigation tabs for 'MRC', 'Open DataPac', 'Power Supply', 'Network', and 'Fans'. The 'MRC' tab is active, showing 'Global MRC Speed Settings'. A 'Set Global Port Speed' dropdown menu is set to '- Select Speed -', with an 'Update' button next to it. Below this, there are two MRC sections: 'MRC 1' and 'MRC 2', each with an 'Identify' toggle switch.

Below the MRC sections, there are two detailed views of FC ports. The left view shows 'FC Port 1' through 'FC Port 4', and the right view shows 'FC Port 5' through 'FC Port 8'. Each port view includes a table of properties:

Port	Status	WWN	Speed	Speed Setting
FC Port 1	Operational	2000001F93400040	16 Gb/s	Auto ✓
FC Port 2	Operational	2000001F93400041	16 Gb/s	Auto ✓
FC Port 3	Operational	2000001F93400042	16 Gb/s	Auto ✓
FC Port 4	Link Down	2000001F93400043	Offline	Auto ✓
FC Port 5	Operational	2000001F93400044	16 Gb/s	Auto ✓
FC Port 6	Operational	2000001F93400045	16 Gb/s	Auto ✓
FC Port 7	Operational	2000001F93400046	16 Gb/s	Auto ✓
FC Port 8	Operational	2000001F93400047	16 Gb/s	Auto ✓

iSCSI Attributes

Information on the iSCSI configuration such as speed, jumbo frames and CHAP can be found in the iSCSI tab under the Array Hardware page.

Hardware

Controller	Open DataPac	Power Supply	Network	iSCSI
------------	--------------	--------------	---------	-------

Network-A

DHCP: Disabled
 IP Mask: 255.255.255.0
 Protocol: ipv4
 MTU: Jumbo (9000)

Ports

Port-1 (Controller 1)

IP Address: 192.168.10.5
 Endpoint: iqn.2004-11.com.x-io:f9005cth103an9ck02e-t1
 Speed: 10Gbps
 Link Status: Connected

Port-1 (Controller 2)

IP Address: 192.168.10.6
 Endpoint: iqn.2004-11.com.x-io:f9005cth103an9ck02e-t3
 Speed: 10Gbps
 Link Status: Connected

[Edit](#)

Network-B

DHCP: Disabled
 IP Mask: 255.255.255.0
 Protocol: ipv4
 MTU: Jumbo (9000)

Ports

Port-2 (Controller 1)

IP Address: 192.168.20.5
 Endpoint: iqn.2004-11.com.x-io:f9005cth103an9ck02e-t2
 Speed: 10Gbps
 Link Status: Connected

Port-2 (Controller 2)

IP Address: 192.168.20.6
 Endpoint: iqn.2004-11.com.x-io:f9005cth103an9ck02e-t4
 Speed: 10Gbps
 Link Status: Connected

[Edit](#)

Power Supply

Power supply status is available under the Array Hardware >> Power Supply page.

Hardware

MRC	Open DataPac	Power Supply	Network	Fans
-----	--------------	--------------	---------	------

Power Supply 1 Identify

Status : Operational
 Position : 1
 Serial Number : 2021216J44B0116
 Model :
 Part Number : CPR-2021-2M16

Power Supply 2 Identify

Status : Operational
 Position : 2
 Serial Number : 2021216J44B0209
 Model :
 Part Number : CPR-2021-2M16

The following information is displayed for each Power Supply:

Field	Comment
-------	---------

Status	Overall power supply state, normally Operational , other possible states are: Warning , Critical , and Non-Operational
Detailed Status	Shown in parentheses after Status; normal is None , abnormal states are detailed here
Serial Number	Serial number of the power supply
Model	Model of the power supply
Part Number	Part number of the power supply
Position	Physical bay location in the chassis. 1=left, 2=right

Power Supply

Array Maintenance

The V-SERIES Array provides a number of maintenance features, including:

- Restart and Shutdown of the Array
- Changing password
- Identifying components
- Upgrading Array software and drive firmware
- Battery Calibration (software version 5.1.2 and newer)

Restart and Shutdown

Restarting the Array involves the following actions:

- Completion of all in-progress I/O commands from all hosts
- Flushing of all data from cache
- Preparation of internal processes for a graceful shutdown
- Shutting down the Array
- Restart the Array

During a restart or shutdown of the Array, all configuration settings are retained. A restart or shutdown will terminate any CLI sessions and make the Array inaccessible in MAESTRO.

When the restart completes, the Array again accepts a connection from a remote console or MAESTRO.

Shutdown will require the user to pull power to the Array and then restore power before it will restart.

The restart and shutdown operations are found in the Array Advanced Settings page:

The screenshot shows the MAESTRO interface for a V-Series array. The top navigation bar includes 'User Management', 'Managed Arrays', 'Managed Servers', 'SAN Groups', 'Violin', and 'Arrays'. The main content area displays the array name 'ISE-F9106CNO104VL08J001' and its status 'Operational (None)'. Key metrics are shown: 13 Volumes, 1 Host, and 1 Pool. The 'Settings' section is expanded to show 'Operations', which includes buttons for 'Initialize', 'Shutdown', 'Restart', and 'Identify'. The 'Restart' button is highlighted with a yellow circle.

Changing the Password

The **administrator** password can be changed through the Managed Arrays page

Click on the “three dots” on the right of the Array to get a pulldown list of options. Select Change Password

The screenshot shows the MAESTRO interface for Managed Arrays. On the left is a navigation sidebar with options like User Management, Managed Arrays, Managed Servers, SAN Groups, Performance Group, Arrays, and Server. The main area displays an 'Array List' table with columns for NAME, SERIAL NUMBER, MRC 1 IP, MRC 2 IP, and LOCATION. Three arrays are listed: 'ISE-F1023CTH102AN9CK01D', 'ISE-F1023CTH102AN9CR00R', and 'tuna'. A context menu is open for the 'tuna' array, showing options: Edit, Delete, Change Password (highlighted in yellow), Add/Remove SAN Group, and Update New IP.

After the password is changed, click again on the “three dots” and select Edit to store the new password in MAESTRO.

Identifying Components

To physically locate the Array or components, use the Identify slider available on each component page for the Array in MAESTRO.

For example, to identify a Controller, click in the Array Hardware >> Controller page

The screenshot shows the 'Hardware' page in MAESTRO. It features a navigation bar with tabs for MRC, Open DataPac, Power Supply, Network, and Fans. Below this is a 'Global MRC Speed Settings' section with a dropdown menu and an 'Update' button. The main content area displays two panels for 'MRC 1' and 'MRC 2'. Each panel has an 'Identify' slider that is currently turned on (indicated by a yellow dot). Below the sliders are tabs for 'Properties', 'FC Ports Information', and 'SFP Infor'. The 'Properties' tab is selected for both, showing details like Status (Operational), Detailed Status (None), and Position (1 for MRC 1, 2 for MRC 2).

Array Software Upgrades

Upgrading the Array software is an offline event. A maintenance window must be scheduled to upgrade the Array. **Contact NEXSAN Service to schedule an upgrade for the V1000 SE or V1000 XE.**

Battery Calibration

Battery Calibration will occur every 180 days (6 months), starting with software 5.1.2. When battery calibration starts, one controller at a time will be taken offline for approximately 12 hours. IO will continue to be serviced from the remaining online controller. During battery calibration, the controller status will report offline due to battery calibration. Email alerts are generated at the start and completion of battery calibration for each controller. Battery calibration requires both controllers to be online and operational to start. If a controller replacement occurs, or battery calibration has never been run on the Array, the process will start within 2 hours of being online.

Below shows Controller1 during battery calibration in Maestro:

The screenshot displays the Maestro web interface for a storage array. The left sidebar shows navigation options like 'User Management', 'Managed Arrays', and 'SAN Groups'. The main content area shows the array 'ISE-F9106CNO104VL08J001' with a warning: 'Warning: (One or more MRCs in degraded state)'. Below this, hardware details for two controllers are shown. Controller 1 is highlighted in red and its status is 'Non-Operational' (circled in yellow), with a sub-status of 'Battery Calibration in progress'. Controller 2 is highlighted in green and is 'Operational'. The interface also shows 'Global Controller Speed Settings' and tabs for 'Properties', 'FC Ports Information', and 'SFP Information' for each controller.

Command line show mrc output will indicate Battery Calibration and ports offline:

```
administrator:> show mrc
```

```
MRC Information =====
```

```
MRC-1 (NXO) -----  
Status      : Non-Operational (Battery Calibration in progress, Offline,
```

```
Unknown state, Fibre Channel Port Unavailable)
```

```
Part Number  : R3040-G1001-01      Serial Number  : G1001CTH105AN05S05X
```

```
Firmware Ver. : v5.1.2-12664      Hardware Ver.  :
```

```
Temperature  : 40 C (Warning: 100 C, Critical: 105 C)
```

FCPort	Type	WWN	Speed	Setting	Status
0	Unknown	2000001F93400890	Offline	Unknown	Link Down
0	Unknown	2000001F93400891	Offline	Unknown	Link Down
0	Unknown	2000001F93400892	Offline	Unknown	Link Down
0	Unknown	2000001F93400893	Offline	Unknown	Link Down

SFP ID	Present	Serial No.	Status
1	yes		Warning (No Access)
2	yes		Warning (No Access)
3	yes		Warning (No Access)
4	yes		Warning (No Access)

Feedback

NEXSAN welcomes feedback, positive and negative, and NEXSAN Global Services at 1.800.734.4716 stands ready to assist as needed.

Contacting NEXSAN

To obtain additional information or technical support for V-SERIES products, or to obtain an RMA number and replacement product, contact us at:

- Phone US Toll Free: +1 800 734 4716
- Global Support Numbers available at: <https://www.violinsystems.com/support-services/>
- E-mail: support@x-io.com and support@violinsystems.com



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