

ATTO Utilities
Installation and Operation Manual
ATTO ConfigTool for Windows®, Linux® and macOS®
ATTO vConfigTool for VMware
ATTO RAID Management
ATTO BIOS/EFI Utilities
ATTO Utilities for Windows



The Power Behind the Storage

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1 ATTO Storage Adapter Management

The ATTO ConfigTool is a utility program that displays information about installed storage adapters, drivers and devices and provides a mechanism to configure installed storage adapters in local and remote hosts. The ATTO ConfigTool is used to manage all ATTO host based products including HBAs, RAID adapters and ThunderLink adapters.

The ATTO ConfigTool provides a central interface for managing local and remote hosts with ATTO storage adapters installed. Features include:

- The names of ATTO storage adapters installed in the host
- Information about the devices attached to ATTO storage adapters
- Information about the drivers and firmware controlling the storage adapters, including version information

You may also use the ATTO ConfigTool to:

- Update the flash image when a new version is released by ATTO
- Modify the NVRAM settings (refer to the product-specific NVRAM information sections in this manual)
- Manage RAID groups
- Configure RAID notifications
- Revert to default factory settings

The factory settings should provide excellent performance for a wide range of applications. However, some applications may benefit from modification of the storage adapters NVRAM settings which tune the storage adapters for a specific performance range.

Pre-Installation

The ATTO ConfigTool is a free utility available via the ATTO website at www.atto.com. This application supports a variety of operating systems. Please visit the ATTO website for specific operating system support information and downloads.

Oracle® Java version 1.5, or later, is required to use the ATTO ConfigTool. Visit <http://java.com> for the latest Java updates for Linux and Windows. The latest Java runtime for macOS can be obtained through Software Update.



Note

The GNU version of the JVM does not work with the ATTO installer. You must use Oracle Java.

To install the ATTO ConfigTool:

- Windows - run the .exe file
- macOS - mount the .dmg file
- Linux - expand the .tgz file

Installation

The ATTO ConfigTool includes two components: a GUI Application and a system service. Either, or both, of these components can be installed on a host, depending on the functionality desired. This creates several different use cases, described below:

- A host with both the GUI Application and the system service installed will be able to discover and manage local and remote hosts. This is the most comprehensive management capability. During installation of the ATTO ConfigTool select **FULL** installation for this coverage level.

- A host with only the GUI Application installed will be able to discover and manage remote hosts. This host will not be able to discover and manage any ATTO storage adapters installed on the same host. During installation of the ATTO ConfigTool select **APPLICATION ONLY** for this coverage level.
- A host with only the system service installed can be discovered and managed remotely, but it cannot be managed locally (the GUI Application is required for local management). It is common to have multiple hosts with only the system service installed being managed by a single host remotely. To set up a host without any local management capabilities, refer to the OS specific instructions below.

Installing the ATTO ConfigTool

Logging features are only available if the ATTO ConfigTool service is installed. We recommend installing the service as a minimum configuration.

Obtain the Installer Package

Download the ConfigTool package from the ATTO website. Package name is one of the following:

- win_app_configtool_xxx.exe (Windows)
- osx_app_configtool_xxx.dmg (macOS)
- lnx_app_configtool_xxx.tgz (Linux)

Windows Instructions:

1. Double-click the win_app_configtool_xxx.exe package file
2. Click "Unzip" to extract the installer files
3. The files are put in "C:\ATTO\ConfigTool\4.xx" directory

To install the Full Application or Application Only:

4. Navigate to the "C:\ATTO\ConfigTool\4.xx" directory
5. Double-click on the ConfigTool_xxx.exe installer executable
6. Select Full Installation or Application Only as desired
7. Follow the on-screen instructions

To install the System Service only:

1. Navigate to the "C:\ATTO\ConfigTool\4.xx\Service" directory
2. Double-click on the "attocfgd.msi" installer executable
3. Follow the on-screen instructions

macOS Instructions:

1. Double-click on the osx_app_configtool_xxx.dmg package file

Uninstalling the ATTO ConfigTool

Windows Instructions:

1. Navigate to Start -> Control Panel
2. Select "Programs and Features"
3. Select the "ATTO ConfigTool xxx" entry
4. Click the "Uninstall/Change" button
5. Follow the instructions on the launched uninstaller

2. A Finder window appears

To install the Full Application or Application Only:

1. In the Finder window that appears, double-click on the ConfigTool_xxx.app installer executable
2. Select Full Installation or Application Only as desired
3. Follow the on-screen instructions

To install the System Service only:

1. Navigate to the "Service" folder in the Finder window that appears
2. Double-click on the "attocfgd.mpkg" installer executable
3. Follow the on-screen instructions

Linux Instructions:

1. Extract the package file by running the following command in a terminal:
`tar -xvzf lnx_app_configtool_xxx.tgz`
2. Navigate to the extracted folder
"lnx_app_configtool_xxx"

To install the Full Application or Application Only:

1. Run the ConfigTool_xxx.bin installer executable as root or superuser.
2. Select Full Installation or Application Only as desired
3. Follow the on-screen instructions

To install the System Service only:

1. Navigate to the "Service" directory located inside the lnx_app_configtool_xxx directory
2. Run the "attocfgd.sei" installer executable as root or superuser using the following command line:
`./attocfgd.sei -i`

macOS Instructions:

1. Navigate to "/Applications/ATTO\ConfigTool/uninstall"
2. Run "uninstall.app" and follow the instructions on the launched uninstaller

Linux Instructions:

1. Open a terminal window and navigate to
"/usr/bin/attoconfig/uninstall"
2. Run the "uninstall" script and follow the instructions on the launched uninstaller.

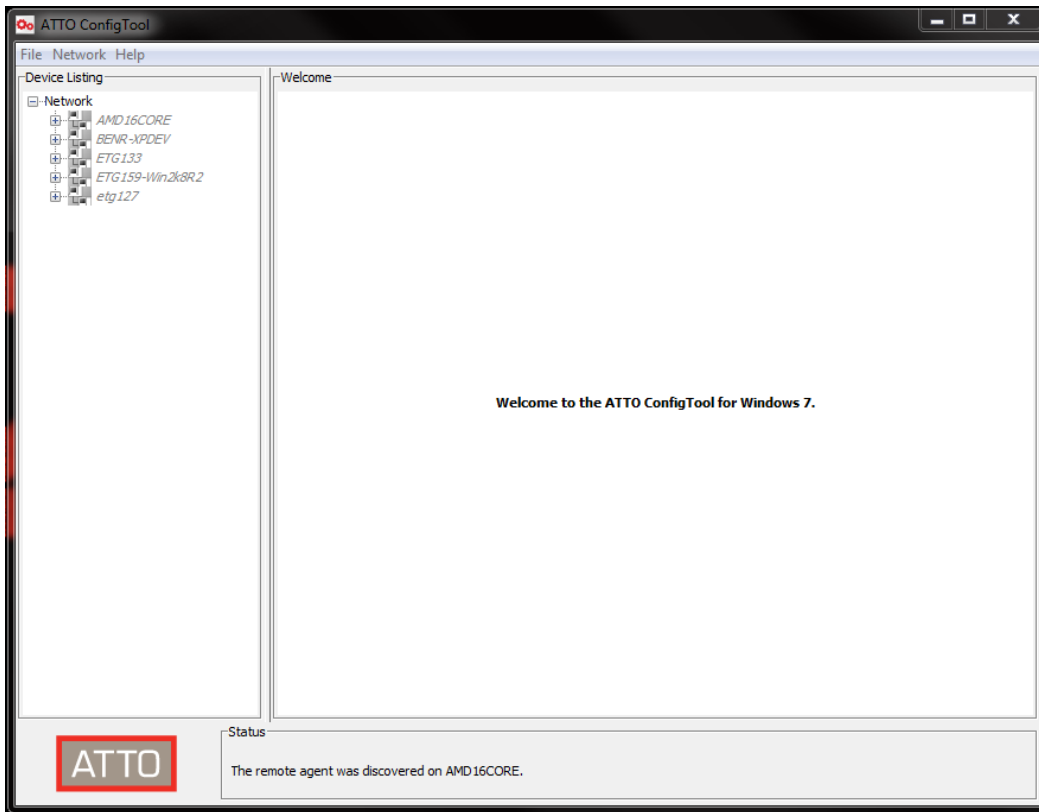
Using the ATTO ConfigTool

To use the ATTO ConfigTool, locate and double-click the application icon. The main page has three windows: **Device Listing**, **Configuration Options** and **Status**. The **Device Listing** window at the left of the display page lists local and remote hosts found on the network, as well as currently connected devices. You are required to login to manage any host. Once you login, the **device tree** will expand to reveal additional details on connected storage adapters.

The **Configuration Options** window in the right window provides information and options for a device highlighted in the device listing. If you highlight a device in the **Device Listing**, tabs and panels display for that device. The following chart lists the tabs displayed for each device type in the device listing tree.

The **Status** window provides general information about host and storage adapter settings.

Tree node	Tabs displayed
Network	Host Tab
Host	Basic Info, Notifications, SNMP
Storage Adapter	Basic Info, Flash, RAID, RAID CLI, Tasks
Channel	Basic Info, NVRAM
Devices	Basic Info, Flash, SES



Navigating the ConfigTool

CAUTION Save system data prior to installing or changing hardware configurations.

Host Discovery

The ATTO ConfigTool is able to discover hosts automatically, as well as manually. A host will be discovered and displayed in the **Device Listing** only if the system service is installed and running on the host. A host that only has the GUI Application installed will not be displayed in the **Device Listing**.

Automatic Discovery

Hosts on the local subnet are automatically discovered and placed into the **Device Listing**. Additionally, if you have previously discovered hosts via the **Manual Discovery** mechanism and opted to save the host, these saved hosts will also be automatically discovered as well.

Manual Discovery

A host can be found manually by using the Network menu and selecting "Find Host". The IP address or hostname of the remote host is required. If the host is already in the **Device Listing**, it is not added again. Previously entered hosts are available by beginning to type the IP address or hostname, or opening the drop down list. Additionally, you may opt to save the host in order for it to be automatically discovered in subsequent launches of the ConfigTool by selecting the "Remember Host" checkbox.

Managing Saved Hosts

If you no longer wish for a manually entered and saved host to be automatically discovered, you may remove it using the Network menu and selecting "Delete Host". Select the host(s) from the list provided in the displayed dialog, and click the "Delete" button to remove the host(s).

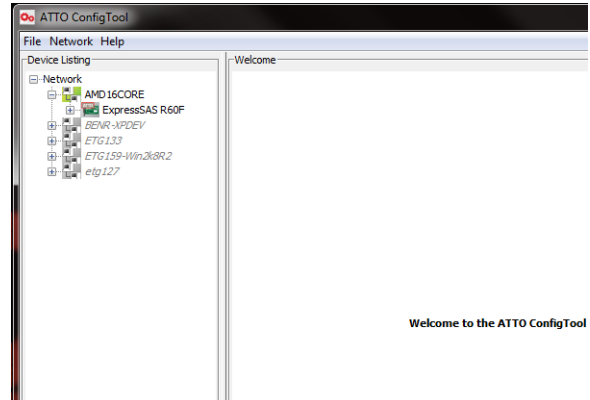
Host Login Status

The GUI Application must login into each host before that host can be managed or configured.

The GUI Application indicates the login status for a host as follows:

- A host that is not logged in will display the host icon and the text as gray and italicized.
- A host that is logged in will display the host icon with a green background and black non-italicized text.
- A host that was logged in but the host is rebooting will display the host icon and text as gray and italicized with a strike through.

Login to a Host



A login is started when the host's Device Listing tree is expanded. A login dialog box displays and you must enter a username and password. The username and password of an administrator for the host is required to proceed, and is checked against the user credentials stored on the host.


- In Windows and macOS, the login information is checked against any user in the Administrators group.
- In Linux, the login information used must specify a user that belongs to the "root" or "wheel" group, depending on the Linux platform."

Optionally, the password may be saved by selecting the "Remember Password" checkbox so the credentials do not have to be retyped for a subsequent login. If this option is selected, successfully authenticated credentials are saved and the last credentials used to successfully login to the host will populate the login dialog for a subsequent login attempt.

Between two Windows systems with ConfigTool 4.14 or later installed, the ConfigTool will attempt to authenticate using the credentials provided when the client logged into the operating system, without any user interaction. The user account can be either a domain account or a local account, but the account names and passwords must match on both systems, and the account where the service is installed must have the group membership described above. Having UAC enabled on the machine with the service will generally prevent a local account user from being authorized. If the client cannot be authenticated or authorized for any reason, the login prompt described above is shown

If three successive login attempts fail, the GUI Application will be locked out from the host for three minutes. All login attempts that occur during the lockout period will receive an error status. GUI Applications in other hosts will not be affected by the lockout period.

Once a login is established, the icon of the host is highlighted green and the text becomes black with normal font.

 Note *There is no logout facility.*

Select a Host

Select any host by clicking on it in the **Device Listing** window. The following tabs display in the **Configuration Options** window:

- The **Basic Info** tab displays information about the booted operating system on that host. It also shows scheduled reboot information and provides the ability to install a driver on that host.
- The **Notification** tab allows you to set up notification of certain events in the ExpressSAS RAID or ThunderStream Storage Adapters. Refer to [Setup RAID Notification](#)
- The **SNMP** tab allows for SNMP configuration. Refer to [SNMP Configuration](#)

Select a Storage Adapter

The following tabs display in the **Configuration Options** window when you select a specific storage adapter in the **Device Listing** window.

- The **Basic Info** tab provides basic information about the device currently highlighted in the device listing.
- The **Flash** tab provides information about the current revision of flash loaded on the highlighted storage adapter. Click on the **Browse** button at the bottom of the tab to search for new flash files on your host. Click on the **Update** button to initiate the firmware flashing process using the previously selected firmware.
- The **RAID** tab displays information about the drive inventory, existing RAID groups and Hot Spare devices. From the RAID tab you can create, modify and delete RAID groups.
- The **RAID CLI** tab allows experienced users to enter RAID Command Line Interface commands to the SAS RAID storage adapter.
- The **Tasks** tab displays information about tasks that are scheduled to run. In this tab, users can reschedule a task or remove the scheduled task.


Driver update

A Storage Adapter's driver can be installed or upgraded on a host by going to the **Basic Info** tab for that host, choosing a driver package in the driver update section and clicking update. The driver package is the .exe (Windows), .tgz (Linux) or .dmg (macOS) file which can be downloaded from the ATTO website. If a reboot is required, the GUI will prompt once the install completes. If a driver was installed that has

Select a Channel

The following tabs display in the **Configuration Options** window when you select a specific channel in the **Device Listing** window:

- The **Basic Info** tab displays PCI information for the selected channel.
- The **NVRAM** tab displays the NVRAM parameters of the selected channel. For:
- Celerity and ThunderLink FC – see [Celerity and ThunderLink NVRAM](#)
- FastFrame – see [FastFrame NVRAM](#)
- ExpressSAS, ThunderLink SH and ThunderStream SC – see [ExpressSAS NVRAM](#)

 Note *ATTO storage adapters are designed to operate properly using factory settings. Entering invalid or incorrect settings when using an NVRAM configuration utility such as the ATTO ConfigTool may cause your Storage Adapters to function incorrectly.*

Select a Device


The following tabs display in the **Configuration Options** window when you select a specific device in the **Device Listing** window:

- The **Basic Info** tab displays information about the selected device.
- The **Flash** tab provides a tool to update the firmware of the selected device. The flash tool is only available for devices that support flash update.
- The **SES** tab displays SES (SCSI Enclosure Services) status information, such as power supplies and fans, for SES devices.

About panel

The **About** panel, selected from the **About** menu item in the **Help** menu, is an informational page which displays a list of components installed for the ATTO ConfigTool, the tool's version number and ATTO Technology contact information.

no matching Storage Adapters, the GUI will prompt to shutdown and install the Storage Adapters.

 Note *It is important to keep firmware and drivers up-to-date for optimal performance. Refer to the product release notes (PRNs) on the ATTO website download page for additional information.*

System Reboot

A host can be rebooted using its **Basic info** tab. Select “Restart” and optionally provide a message. The host will reboot in 30 seconds for Windows or in one minute for Linux and macOS. The **Message** area will be updated to reflect the fact that the host has a scheduled reboot and display the time the reboot will occur.

Once a reboot is scheduled, another reboot cannot be scheduled. On Linux and macOS, pressing the **Refresh** button detects any scheduled reboot and displays the reboot information on the **Basic Info** tab. On Windows systems there is no way to detect a scheduled reboot. If the GUI Application

attempts to schedule a reboot and there is already one scheduled, the GUI Application will display an error status and the GUI Application is now aware that a scheduled reboot is active. A scheduled reboot can be cancelled using the **Cancel** button.

The host that is scheduled to reboot displays on its console a pop-up message that indicates the system will be rebooting. The format of the pop-up message is dependent upon the operating system.

Exhibit 1 The Basic Info tab when you choose a Host from the Device Listing.

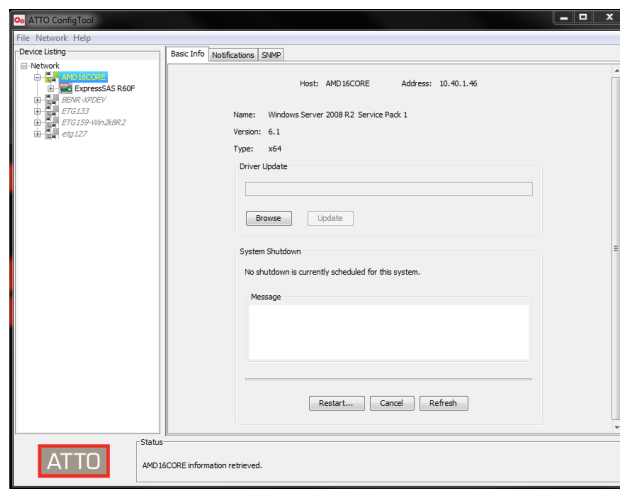


Exhibit 2 The Basic Info tab when a Storage Adapters is chosen from the Device Listing.

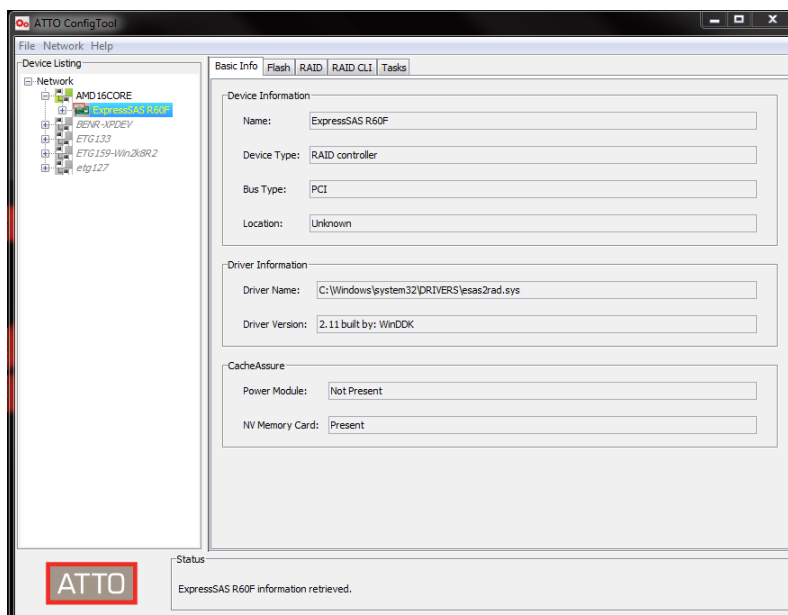


Exhibit 3 The Flash tab.

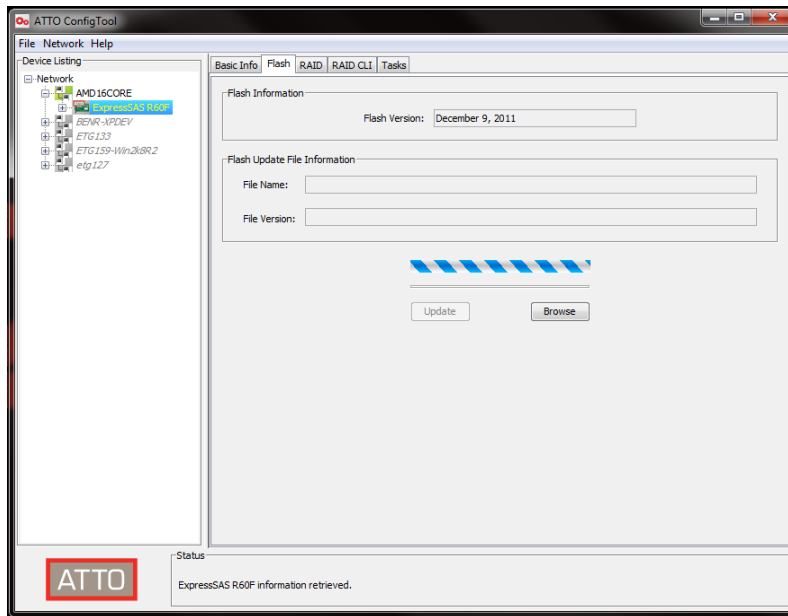
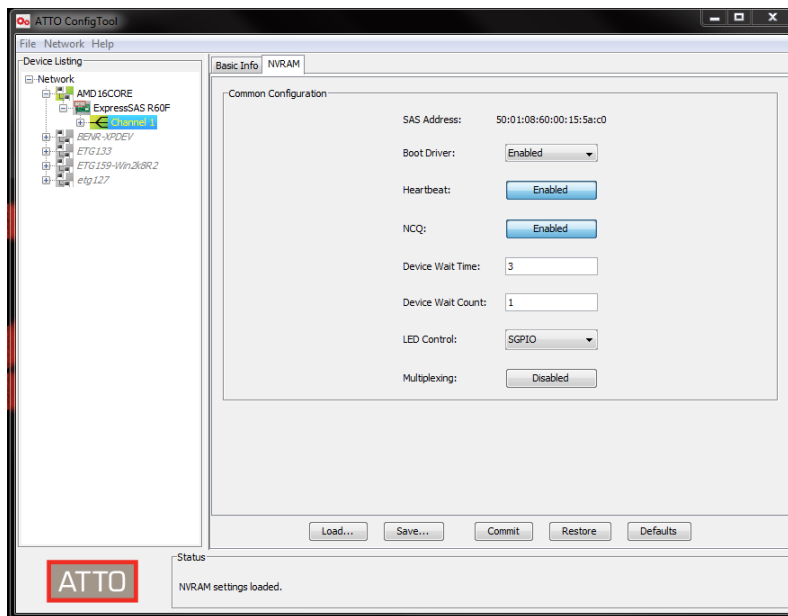



Exhibit 4 The NVRAM information page.



2 FastFrame NVRAM Settings

The settings in the NVRAM tab vary depending upon the selected adapter and the operating system. Settings unsupported by that OS are not displayed.

ATTO Storage are designed to operate properly using factory settings. Entering invalid or incorrect settings when using an NVRAM configuration utility such as the ATTO ConfigTool may cause your Storage Adapters to function incorrectly.

 **CAUTION** *Back up system data when installing or changing hardware configurations.*

Use caution when making changes to NVRAM settings and only make changes to those with which you are familiar. Once you have made the desired changes, click **Commit** to save the changes. Changes do not take effect until you reboot the system.

If you do not want to make any changes, you may choose one of the following:

- Defaults: restores the Storage Adapters to factory default settings. The Commit button must be clicked to save any changes.
- Restore: reverts to the NVRAM settings saved the last time the Commit button was used. Clicking Commit is not necessary.

Boot Driver (currently not available, future support)

Choices: enabled, scan only, disabled

Default: disabled

If enabled and disk drives or a bootable CD are detected during the bus scan, the BIOS driver remains resident. If disabled, the BIOS starts, resets the Storage Adapters chip and unloads the driver.

If Scan Only is selected, the BIOS driver scans the bus and displays the devices attached, then unloads itself after a brief delay.

FIP VLAN Discovery

Choices: enabled, disabled

Default: enabled

Specifies whether the Storage Adapters should attempt to use the FCoE Initialization Protocol (FIP) to discover configured VLANs.

Frame Size

Choices: 512, 1024, 2048

Default: 2048

Changes the size of the FC packet of information being sent. Typically, the initiator and target negotiates the desired frame size, starting with the largest value. The frame size should be set to the largest value for normal operation.

Device Discovery

Choices: Node WWN, Port WWN

Default: Port WWN

Specifies the type of device discovery the Storage Adapters performs. Use the Port WWN when the Storage Adapters requires separate paths to a device and the device is dual ported. A dual ported device has one path when the Node WWN is specified and two paths when the Port WWN is specified.

Interrupt Coalesce

Choices: None, Low, Medium, High

Default: Low

Specifies the time period a Storage Adapters chip delays an interrupt. This allows the Storage Adapters chip to queue up more than one interrupt before interrupting the CPU. When this methodology is chosen there is less overhead to service the interrupts. However, the coalescing time may delay the delivery of the completion for a single interrupt.

LLI Moderation

Choices: Disabled, Low, Medium, High

Default: Low

Specifies the time period an Storage Adapters chip delays a Low Latency Interrupt (LLI) for FCoE traffic. This is the equivalent of the Interrupt Moderation setting for low-latency FCoE frames.

3 Celerity and ThunderLink FC NVRAM Settings

The settings in the NVRAM tab vary depending upon the selected Celerity or ThunderLink Fibre Channel Storage Adapters and the operating system. Settings unsupported by that OS are not displayed.

Node Name

The Port WWN (World Wide Name) assigned to this adapter.

Port Name

The Port WWN (World Wide Name) assigned to this channel (port) of the adapter.

Boot Driver

Choices: enabled, scan only, disabled

Default: disabled

If enabled you will be able to boot off the Celerity Fibre Channel adapter.

 Note **Scan Only has no effect in macOS.**

Hard Address Enable

Choices: enabled, disabled

Default: disabled

When a Fibre Channel loop is initialized, each device selects and configures itself to an available ID. Hard Address Enable permits the host to select a value entered in the Hard Address field.

 Note **It is recommended to leave this disabled.**

Hard Address (Does not apply to Gen 6 16Gb/32Gb)

Choices: None, 0-125

Default: 0

The value used as the FC-AL hard address.

 Note **It is recommended not to change this setting.**

Execution Throttle

Choices: 1- 255

Default: 255 (Disabled)

Specifies the maximum number of concurrent commands which can be achieved per port or per SCSI Target. Higher numbers or disabling the feature may increase performance, but some Storage devices react poorly when flooded with too many commands at a time, ultimately decreasing performance. Note that the setting applies to the aggregate of all LUNs controlled by the SCSI Target.

Frame Size

Choices: 512, 1024, 2048

Default: 2048

Changes the size of the FC packet of information being sent.


 Note **It is not recommended to change this setting.**

Device Discovery (8Gb)

Choices: Node WWN, Port WWN

Default: Port WWN

Specifies the type of device discovery the adapter performs.

 Note **This should not be changed in a multipathing environment.**

Connection Mode Options (Only applies to 8Gb and Gen 5 16Gb)

Choices: AL, PTP, AL Preferred, PTP Preferred


Default: PTP Preferred

Arbitrated Loop (AL): Connects to either an Arbitrated Loop or a Fabric Loop Port (FL Port) on a switch. (8Gb and Gen 5 16Gb only)

Point-to-Point (PTP): Connects to a direct Fabric connection, such as an F port on a switch or directly to another device that is capable of running in PTP mode.

AL Preferred: Allows the card to determine what kind of connection to use, but tries to connect in Loop mode first, then Point-to-Point mode.

PTP Preferred: Allows the card to determine what kind of connection is to use, but tries to connect in Point-to-Point mode first, then Loop mode.

 Note **Sometimes it is necessary to force a given connect mode because there is no industry standard for the topology detection protocol and some devices may not connect when set to one of the automatic modes.**

When using the ATTO Celerity FC8X HBA for LTFs workflows in macOS, you must manually set the Max I/O Transfer Size to 1MB. To do so, proceed as follows.

1. Install the ATTO Configuration Tool.
2. Click to expand localhost in the left-hand Hosts pane.
3. You will be prompted for your administrative username and password.

4. Once logged in, your ATTO adapters will expand beneath the selected host entry. Click on your Celerity adapter to select it.
5. Click on the Advanced tab.
6. Select 1MB from the Max I/O Transfer Size drop-down. Then click the Commit button below.
7. Reboot your Mac for the setting to take effect.

Data Rate

Choices for 32 Gig: 8Gb/sec., 16Gb/sec., 32Gb/sec., AUTO

Choices for 16 Gig: 4Gb/sec., 8Gb/sec., 16Gb/sec., Auto

Choices for 8 Gig: 2Gb/sec., 4Gb/sec., 8Gb/sec., Auto

Default: Auto

Selects the Fibre Channel transmission rate. Auto indicates that the Storage Adapters determines the rate based upon the devices connected.



Note

16 Gig and Loop Only are incompatible choices and will not be allowed.

Interrupt Coalesce

Choices: None, Low, Medium, High

Default: (4Gb pre 3.20) Low; otherwise None

Specifies the time period a Storage Adapters chip delays an interrupt. This allows the Storage Adapters chip to queue up more than one interrupt before interrupting the CPU. When this methodology is chosen there is less overhead to service the interrupts. However, the coalescing time may delay the delivery of the completion for a single interrupt.



Note

Setting this value to low may be helpful when doing small IOs.

Port Down Retry Count (8Gb)

Choices: 0-255

Default: 8

The number of times the driver retries a command to a port which is currently logged out.

Example 1: Port Down Retry Count = 3

A command is sent out on the physical link.

The target port logs out for 500msec.

The target port logs back in. The command is retried (count is now 2).

The target port logs out for 500msec.

The target port logs back in. The command is retried (count is now 1)

The target port logs out for 500msec.

The target port logs back in. The command is retried (count is now 0)

The target port logs out for 500msec.

The error is now passed to the OS layer

Example 2: Port Down Retry Count = 3; Link Down Timeout = 10

Same scenario as above. The Link Down Timeout does not matter since all retries will be exhausted before the 10 second Link Down Timeout expires.

Link Down Timeout

Choices: 0-255

Default: 0

The number of seconds the driver waits for a link that is down to come up before reporting it to the operating system.

This only comes into effect when there is one path left to a Target/LUN. The following conditions:

- The link from the HBA to the target or switch could go down.
- The target could also explicitly logout.
- The controller can fail or be taken offline for maintenance.

Example: Link Down Timeout = 0 (special case = 1 second)

If the adapter port senses that the link has gone down to the device, the driver will wait 1 second and then report an error to the OS.

Spinup Delay

Choices: 0-255

Default: 0

Specifies number of seconds the driver waits for the first device to be logged in and become ready.



Note

This is only honored by the Celerity BIOS driver in 3.20 and later and all Gen 5 16Gb and Gen 6 16Gb and 32Gb BIOS drivers.

T10-PI

Valid settings = (Enabled, Disabled) Default = Enabled

This option enables or disables support for drives formatted with T10 protection information.

4 ExpressSAS NVRAM Settings

The settings in the NVRAM tab vary depending upon the selected Storage Adapters and the operating system

SAS Address

Read only

Displays the SAS address assigned to the Storage Adapters. The value cannot be modified.

Boot Driver

Choices: enabled, scan only, disabled

Default: enabled

If enabled and disk drives are detected during the bus scan, the BIOS driver remains resident. If disabled, the BIOS starts, resets the Storage Adapters chip and unloads the driver.

*If **Scan Only** is selected, the BIOS driver scans the bus and displays the devices attached, then unloads itself after a brief delay.*

Heartbeat

Choices: enabled, disabled

Default: enabled

When enabled, requires the firmware to respond to periodic activity. If the firmware does not respond, the system driver resets the firmware on the Storage Adapters.

NCQ

Choices: enabled, disabled

Default: enabled

When enabled, the Storage Adapters driver sends multiple simultaneous commands to NCQ capable SATA disk drives.

Phy Speed (ExpressSAS only)

Choices: Auto, 12Gb/s, 6Gb/s, 3Gb/s, 1.5 Gb/s

Default: Auto

Allows the user to manually adjust the speed of the PHY.

Drive Wait Time

Choices: 1-255 seconds

Default: 3

Specifies the number of seconds which the driver waits for devices to appear.

Device Wait Count

Choices: 1-255 devices

Default: 1

*Specifies the number of devices which must appear in order to cancel the **Error! Reference source not found.** period.*

LED Control (R608, R60F, H608, H60F, H1208 H1244, H1248, H1288 and H120F only)

Choices: SGPIO, I2C (R6xx, H6xx), Disabled

Default: SGPIO (H12xx, R6xx), Disabled (H6xx)

Specifies the method used to perform LED control. The Storage Adapters exposes a virtual SES device that provides standard SCSI SES commands for LED control. The standard SCSI commands can control the locate and failure LED. The virtual SES driver will use the specified method to send the commands to the drive backplane. See the ExpressSAS installation manual for instructions to connect cables for SGPIO or I2C LED control.

Spinup Delay

Choices: 0-20 seconds

Default: 0

Specifies the number of seconds each SAS PHY waits for disk drives to spin up.

Multiplexing (6Gb RAID Storage only)

Choices: enabled, disabled

Default: disabled

When enabled, it allows multiple 3Gb devices to aggregate 6Gb SAS bandwidth. In order to utilize this feature, devices must support Multiplexing and conform to SAS 2.0 compliancy.

5 Troubleshooting

You may see an error message informing you about an unexpected event or incorrect information discovered by the application. Using the help text presented with the error message, correct the issue before proceeding.

Warnings and error messages are posted in the **Status** area of the configuration utility. The exact message varies based on the first field with an out-of-range value.

Messages from NVRAM tab actions

An error occurred loading NVRAM data.

- The first time a channel is highlighted, the application tries to read NVRAM from the card. This message usually indicates the application could not communicate with the driver, probably because the application does not support the driver version in use.

Warning: NVRAM could not be read, defaults returned.

- NVRAM is corrupt and the driver returns to the default configuration. The defaults are presented via the graphical user interface. These defaults may be modified but the defaults or modifications must be committed in order to correct NVRAM.

An error occurred updating the NVRAM.

- The driver cannot put the new settings on the card; no changes are made to the card.

Feature bounds checking

When the Commit button is clicked, each NVRAM feature is validated before being sent to the card. If any one of these features is deemed inappropriate based on the implemented checks, further NVRAM feature validation checks are stopped and the message is displayed.

Execution Throttle is greater than the maximum allowable value of 255. No NVRAM configuration changes have been made to your card.

Messages from Flash tab actions

This is not a flash file, or it is corrupt.

- The ATTO-created flash file is corrupt or the ConfigTool does not recognize the file as a flash file. Only ATTO-created flash files may be selected using the flash file dialog box.
- This HBA is not compatible with the selected flash file. ATTO flash files are created based on the type of card flashed. ATTO flash files are only compatible with certain ATTO cards. When a flash file is selected, the flash file is inspected to determine if it is compatible.

A valid file was not selected.

- You clicked the Cancel button on the flash file selection dialog.
- An error occurred reading from the flash file, the file may be corrupt.
- You selected a compatible flash file but the contents are corrupt.

An error occurred updating the flash.

- You tried to flash a card when the firmware was not able to accept a flash.
- The card has been prepared for firmware updating, but the machine must be rebooted for the changes to take effect. You need to repeat this process after rebooting to actually update the firmware. Some firmware upgrades need to prepare the existing firmware in order to successfully update the adapter. Rebooting allows the changes made during the preparation process to take effect, and the same file should be flashed again.

6 RAID Group Management

ExpressSAS RAID Storage provides the capability to configure disk storage into RAID groups or hot spare drives.

Use the ATTO ConfigTool to set up RAID groups on your ExpressSAS RAID or ThunderStream SC Storage Adapters in one of the following RAID levels:

- JBOD
- RAID Level 0
- RAID Level 1
- RAID Level 4
- RAID Level 5
- RAID Level 6
- RAID Level 10
- RAID Level 50
- RAID Level 60
- ATTO DVRAID™

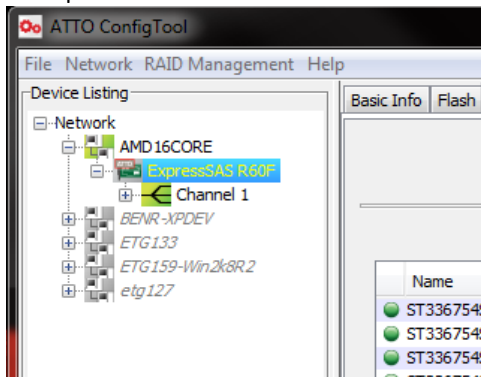
RAID Groups


RAID groups are created using the “Create RAID group” wizard and maintained using the “RAID Management” menu items. The status of existing RAID groups and Attached Drives is shown in the panels displayed when the “RAID” tab is clicked. RAID group creation and management can also be accomplished using the RAID Command Line Interface available in the “RAID CLI” tab (Refer to [Appendix B](#)). However, the ATTO ConfigTool procedures listed in this chapter are the preferred procedures for setting up RAID configurations for ExpressSAS RAID.

 **Note** *The ConfigTool screens are similar for all operating systems.*

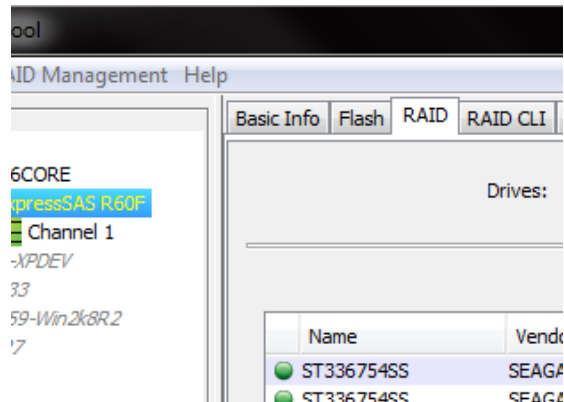
Preliminary Steps

1. Locate the ConfigTool icon in the folder you created during installation. Refer to [ATTO Storage Adapter Management](#)
2. Double-click on the icon to start the application.
3. The Welcome screen appears.
4. From the left-hand panel Device Listing, expand all the elements of the selected hosts in the Network tree. **Click on ExpressSAS R6XX.**



 **Note** *Refer to the [Appendix C](#) for more information on designing RAID groups.*


5. A new set of tabs appears in the right panel. Click on the **RAID** tab.



6. The application scans for drives.

A list of drives appears. Devices are displayed in the top panel and RAID groups and hot spares are displayed in the bottom panel.

RAID GROUP Creation Wizard

 **Note** *The instructions below refer only to creating RAID groups using the RAID group creation wizard for ExpressSAS RAID adapters. For instructions on creating RAID groups using Power Center Pro onboard RAID for ExpressSAS HBA's please see section 2.1 of the [Utilities Manual](#).*

The RAID GROUP Creation Wizard automates the RAID group creation process based upon the Attached Drives inventory displayed in the top panel. The RAID GROUP Creation Wizard runs in the bottom panel and it modifies which drives are displayed in the ATTACHED Drives inventory based upon the RAID group being created. The wizard is started using one of the following methods:

1. The RAID Management menu has “New Group” item in the RAID Management menu. The RAID Group Creation wizard is started by clicking on this menu choice.

2. Select the “Groups” tab in the bottom panel and right click within the panel. A menu box with one of the choices “New Group” is displayed. The RAID Group Creation wizard is started by clicking on the “New Group” item.
3. The RAID Group Creation wizard starts automatically when the “RAID” tab is selected and there are no RAID groups present.

The wizard presents the following choices for RAID groups:

- **HDD Group** - Creates a RAID group from Hard Disk Drives. This choice only appears when there are available Hard Disk Drives in the Attached Drives inventory.
- **SSD Group** - Creates a RAID group from Solid State Drives. This choice only appears when there are available Solid State Drives in the Attached Drives inventory.
- **DVRAID™** - Creates a RAID group of type DVRAID from all drives. This choice only appears when there are

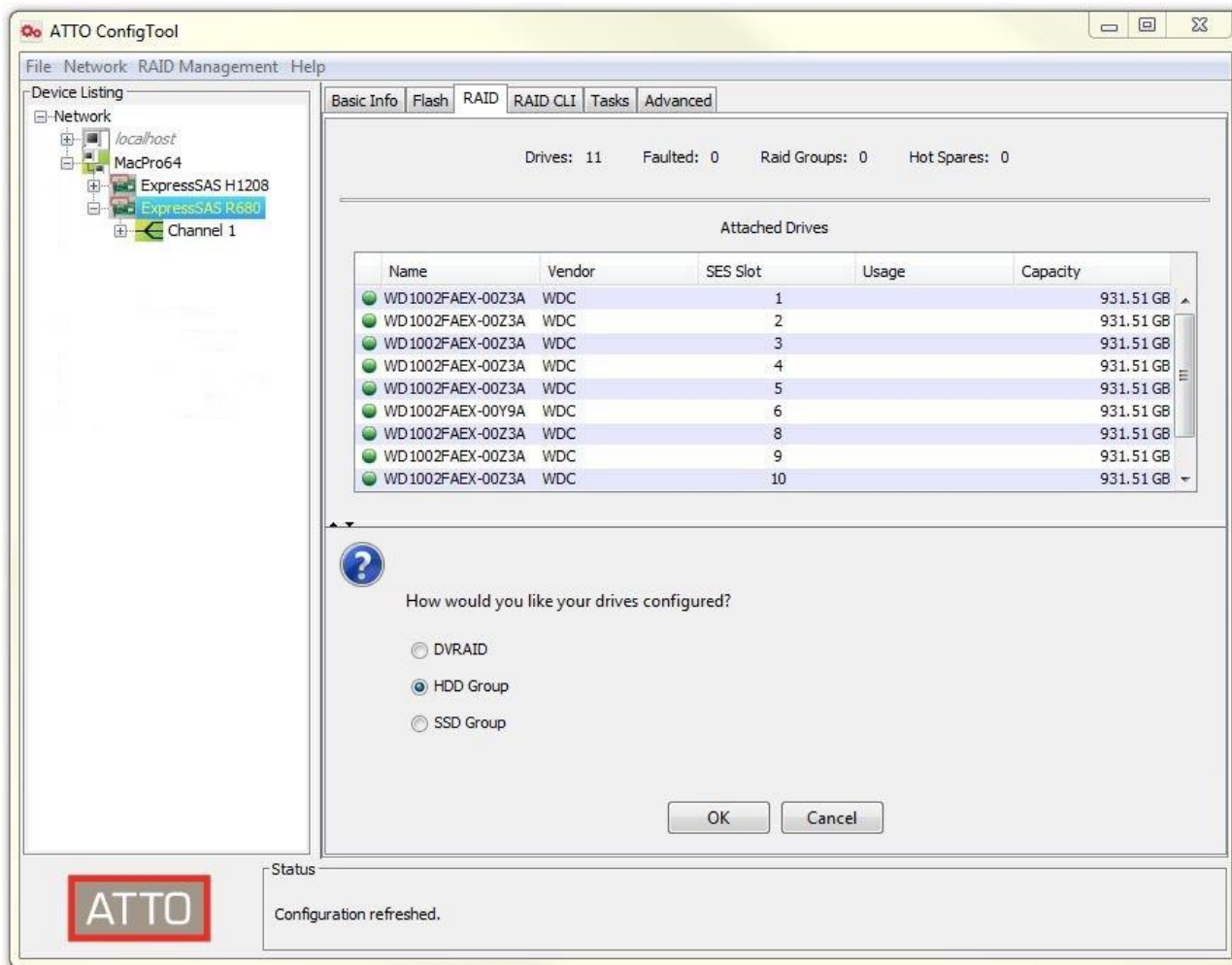
available Hard Disk Drives in the Attached Drives inventory and none of the drives in the Attached Drive inventory are part of a RAID group. This choice is not available if the Attached Drive inventory lists a Solid State Drive.

The user should select the RAID Group choice and click the “OK” button to continue or click the “Cancel” button to terminate the RAID Group Creation Wizard.

The wizard skips the step that presents the above choices if there is only one possible choice. The rules that govern if the RAID group choice should be skipped are the following:

- If all of the available drives are Solid State Disks then the SSD Group choice is selected.
- If all of the available drives are Hard Disk Drives and a RAID group already exists or hot spares exist then the HDD Group choice is selected

Exhibit 5 ConfigTool RAID page.



Create HDD RAID Group

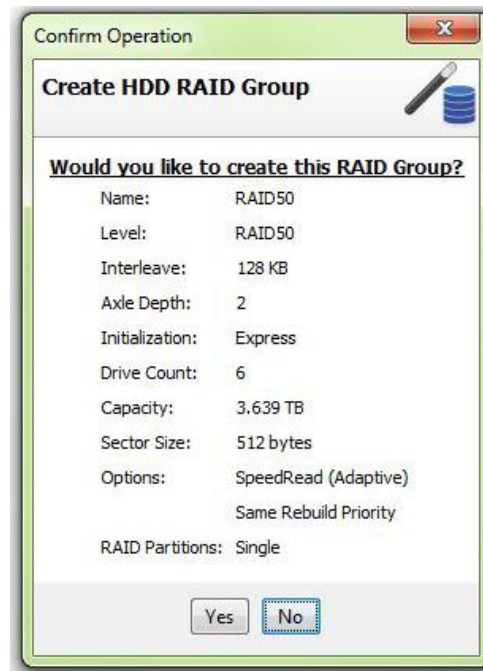
The Create HDD RAID Group wizard appears in the bottom panel when the HDD Group is selected. In addition, the Attached Drives inventory is modified to only display the drives that are available for the HDD RAID Group. The Attached Drives inventory does not display any HDD drives that are in a RAID group or are hot spares and it does not show any SSD drives.

1. Select the options to configure the new RAID group:
 - **RAID Group Name:** Assign a name to the RAID group. The name must be unique and no more than 14 characters.
 - **RAID Group Level:** Select a RAID group level from the drop-down box.
 - **RAID Group Interleave:** Select an interleave value. The default value is 128KB.
 - **RAID Group Mirror Count:** Select a mirror count for RAID groups that have mirrors. The mirror count specifies the number of drives used as mirror drives. Each mirror drive is a duplicate of the main drive.
 - **Axle Depth:** Axles are a collection of disk drives that are parity protected and then striped with other axles to form RAID 50 and 60 groups. Axle depth refers to the number of axles within the RAID group.
 - **Initialize:** Select the initialization method for the RAID group. The default is **Advanced**.
 - **Advanced initialization** is recommended for new drives because the procedure erases and verifies the drive media. The RAID group is unavailable until initialization is complete. A Media Scan is automatically scheduled to run one week after the RAID group initialization (parity RAID groups only) is completed. Refer to [RAID Media Scan](#) for more information about Media Scan.
 - **Express initialization** performs RAID group setup in the background and the RAID group is immediately available for use. A Media Scan is automatically scheduled to run one week after the RAID group initialization (parity RAID groups only) is completed. Refer to [RAID Media Scan](#) for more information about Media Scan.
2. Click **Next**.
3. Select the disk devices in the top panel and drag them into the device area in the bottom panel.
4. If you want the RAID group to be presented as one virtual disk (partition) with the default RAID group properties, click **Finish**.
5. If you want to change other parameters from default values, click Next and select the desired property.

- **SpeedRead, Auto-Rebuild and RAID Rebuild Priority:** Refer to [Change RAID Group Properties](#) for specific information on these parameters.
- **Sector Size:** specifies the sector size that each partition (virtual disk) within the RAID group presents to the host system. The sector size can be set to 512 bytes (default) or 4096 bytes. This parameter can only be set during RAID group creation. The available size is determined by the sector sizes of the physical disks selected for the RAID group. If the sector size for the physical disks is 512 bytes, then either 512 or 4096 is valid. If the sector size of the physical disks is 4096 bytes, then 4096 is the only valid value for this property.

The selection of a sector size of 4096 bytes provides the capability to create a 16TB virtual disk that is supported on Windows XP 32-bit version.

6. If you want more than one virtual disk (partition) click Next and select one of the following:
 - leave as one partition
 - partition by count
 - partition by size
7. When you have made all your selections, click Finish.
8. A confirmation dialog box asks you to confirm the configuration you have chosen. Click Yes.



9. The RAID group configuration you have chosen is initialized and completed. The time it takes to initialize the RAID configuration you have chosen depends on the RAID level selected, the capacity of the drives and the initialization method selected.

Exhibit 6 Selecting the options to configure the new RAID group.

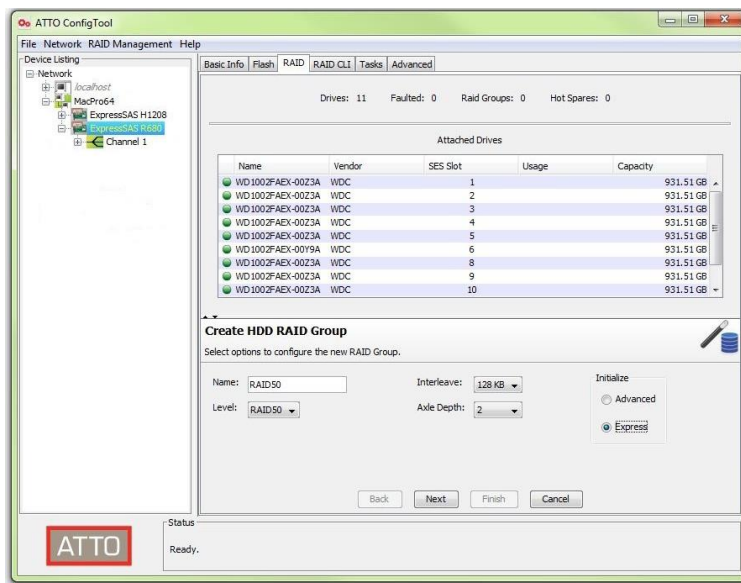
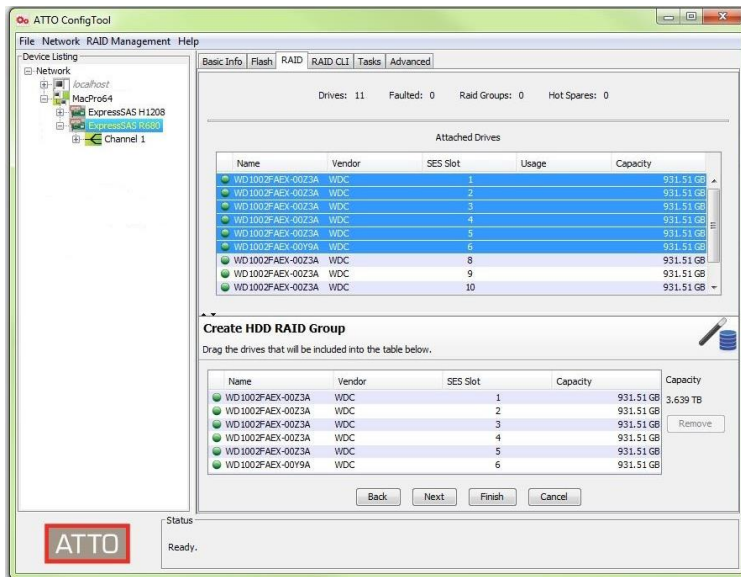


Exhibit 7 Selecting drives for a new RAID group.



Create SSD RAID Group

The Create SSD RAID Group wizard appears in the bottom panel when the SSD Group is selected. In addition, the Attached Drives inventory is modified to only display the drives that are available for the SSD RAID Group. The Attached Drives inventory does not display any SSD drives that are in a RAID group or are hot spares and it does not show any HDD drives.

Select the options to configure the new RAID group:

- **RAID Group Name:** Assign a name to the RAID group. The name must be unique and no more than 14 characters.

- **RAID Group Level:** Select a RAID group level from the drop-down box. RAID 4 and DVRAID cannot be selected for an SSD RAID Group.
- **RAID Group Interleave:** Select an interleave value. The default value is 128KB.
- **RAID Group Mirror Count:** Select a mirror count. The mirror count specifies the number of drives used as mirror drives. Each mirror drive is a duplicate of the main drive, for RAID groups that have mirrors.
- **Axle Depth:** Axles are a collection of disk drives that are parity protected and then striped with other axles to form RAID 50 and 60 groups. Axle depth refers to the number of axles within the RAID group.
- **Tune For:** Select one of the following:

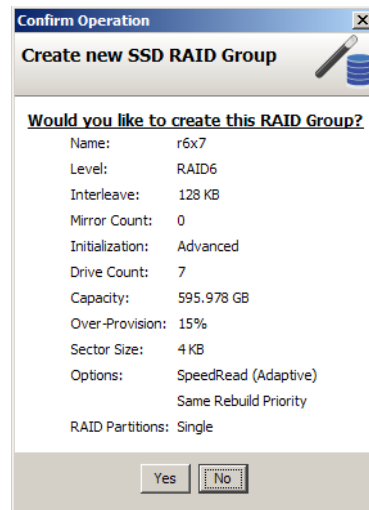
- **Capacity** - The full capacity of the drives will be used. The over-provisioning property for the RAID Group is set to 0%.
- **Performance** - A percentage of the drives capacity is reserved for over-provisioning. The over-provisioning property for the RAID Group is set to the ESAS RAID default value.

 **Note** *A description of over-provisioning is found in [SSD Over-provisioning Feature](#).*

10. Click Next.
11. Select the disk devices in the top panel and drag them into the device area in the bottom panel.
12. If you want the RAID group to be presented as one virtual disk (partition) with the default RAID group properties, click Finish.
13. If you want to change other parameters from default values, click Next and select the desired property:
 - **SpeedRead, Auto-Rebuild and RAID Rebuild Priority:** Refer to [Change RAID Group Properties](#) for specific information on these parameters.
 - **Sector Size:** specifies the sector size that each partition (virtual disk) within the RAID group presents to the host system. The default sector size for SSD RAID group is 4096 bytes. The default sector size provides optimal performance with SSD drives. The sector size can be set to 512 bytes if needed. This parameter can only be set during SSD RAID group creation.
 - **Over-provision:** specifies the percent of SSD drive capacity that is available for use by the SSD drive to perform its drive management functions. This parameter has a range from 0% - 30%.

 **Note** *A description of over-provisioning is found in [SSD Over-provisioning Feature](#)*

14. If you want more than one virtual disk (partition) click Next and select one of the following:
 - leave as one partition
 - partition by count
 - partition by size
15. When you have made all your selections, click Finish.
16. A confirmation dialog box asks you to confirm the configuration you have chosen. Click Yes.



17. The RAID group configuration you have chosen is initialized and completed. The time it takes to initialize the RAID configuration you have chosen depends on the RAID level selected, the capacity of the drives and the initialization method selected.

SSD Over-provisioning Feature

The design of SSD drives requires that data be written only to initialized storage locations. Using a reserved percentage of SSD drive space, SSD drive firmware performs background operations to initialize storage locations. This technique of reserving storage capacity for background operations is called 'over-provisioning'.

To improve performance and minimize latency, SSD enterprise drives reserve a large percentage (up to 30%) of the total storage locations whereas SSD desktop, or value drives, reserve a small percent (near 5%) of the total storage capacity. ExpressSAS RAID Adapters provide additional control of the over-provision property, reserving capacity beyond the SSD drive default settings. This feature provides added performance and endurance above the SSD built-in over-provisioning.


 **Note** *Optimal performance and endurance is attained when the total amount of over-provisioning is between 25% and 30%. This can be accomplished when a RAID Group composed of enterprise drives has a low value in the 'over-provision' property and a RAID Group composed of desktop or value drives has a high value in the 'over-provision' property.*

Exhibit 8 Selecting the options to configure the new RAID group

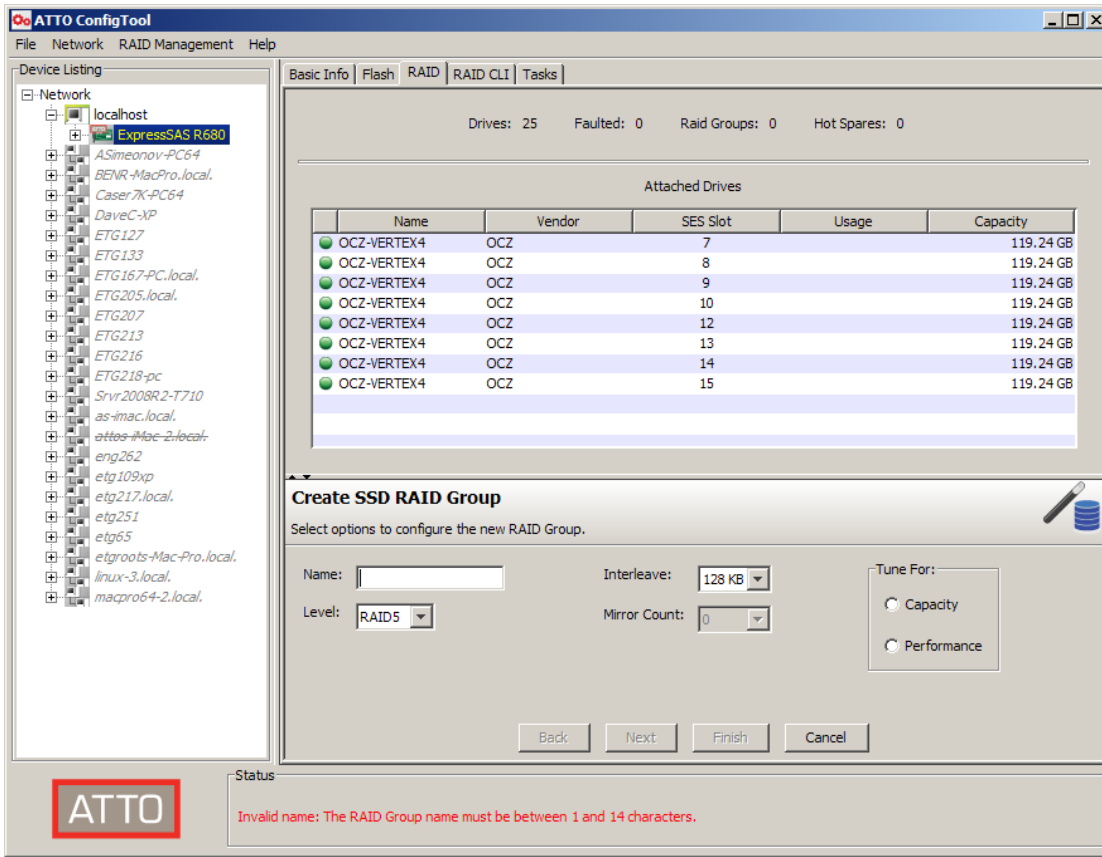


Exhibit 9 Selecting drives for a new RAID group.

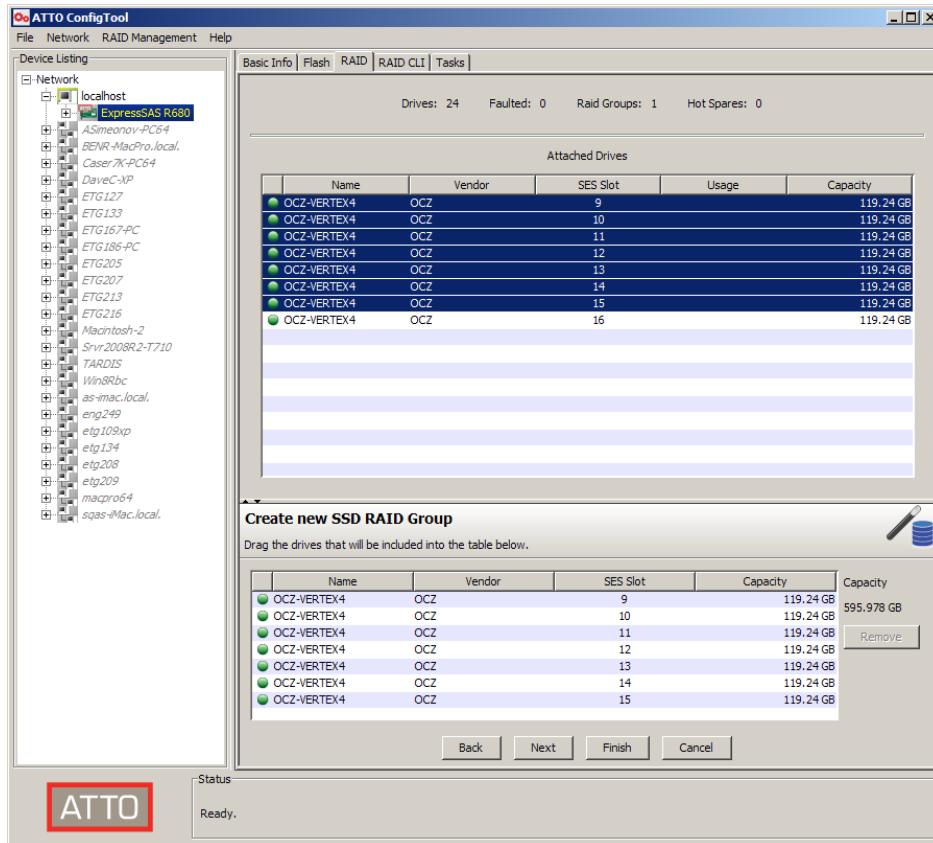
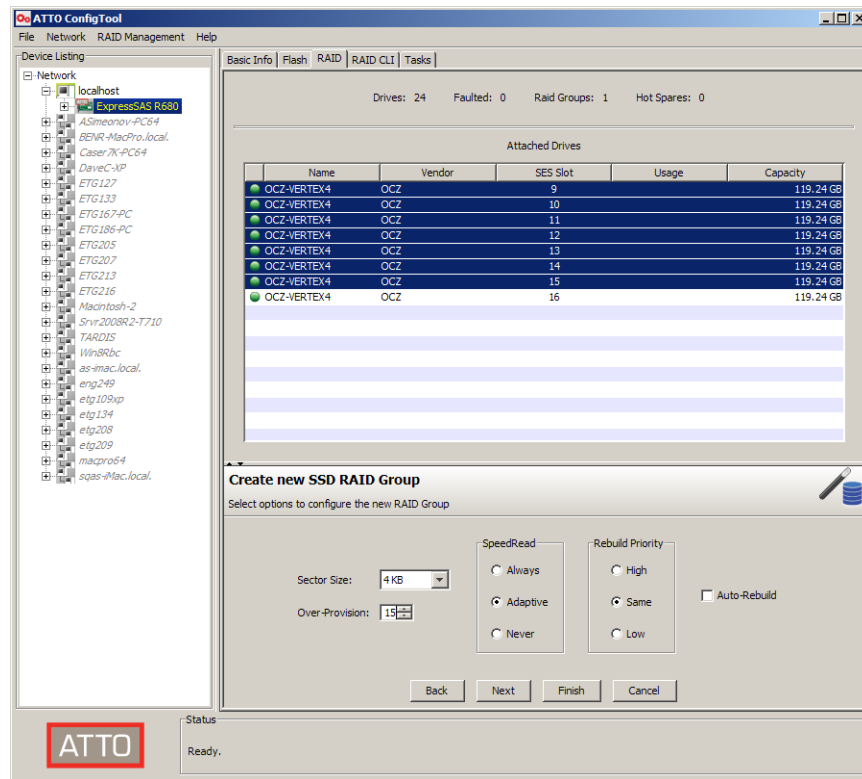


Exhibit 10 Change default properties for a new RAID group.



Create DVRAID Group

DVRAID (Digital Video RAID) provides parity redundancy for your data. Optimized for performance for the high data transfer rates required in digital video environments, DVRAID is ATTO Technology proprietary technology which supports the editing of uncompressed 10-bit High Definition (HD) video and multiple streams of real-time, uncompressed Standard Definition (SD) video. The DVRAID wizard automatically sets up DVRAID RAID group using all storage attached to the ExpressSAS RAID storage adapter.

If you do not want all storage set up in DVRAID, select HDD Group.

1. After following [Preliminary Steps](#), select the DVRAID radio button in the ConfigTool RAID wizard.
2. Click on OK.
3. The ExpressSAS RAID storage adapter firmware automatically uses all unassigned disks to create a DVRAID configuration.
4. A confirmation dialog box asks you to confirm the configuration you have chosen. Click Yes.
5. A message box displays while the RAID group is being created. When the RAID group is complete, the lower panel displays the RAID group(s). The DVRAID group begins to rebuild.
6. Double click on your RAID group in the lower panel to see more detail such as the status of the rebuild. Wait until

the rebuild is complete before sending data to the storage.



Note ***A RAID rebuild may take several hours to complete.***

Hot Spare Drives

A hot spare drive is a drive that has been designated to be used as a replacement drive for a “faulted” member of a RAID group. A drive can be designated as a global hot spare or a local hot spare.

- Global hot spare drive can be used as a replacement in any RAID group that has a “faulted” member.
- Local hot spare drive can only be used as a replacement drive in the RAID group to which it is assigned.

The following rules govern the selection or a replacement drive for a “faulted” drive:

1. The replacement drive must be the same type as the “faulted” drive. A HDD cannot be used to replace a “faulted” SSD and an SSD drive cannot replace a “faulted” HDD.
2. The replacement drive must have a storage capacity greater than or equal to the “faulted” drive.
3. A local hot spare must meet the above criteria when it is designated as a local hot spare.

Hot Spare Creation Wizard

The Hot Spare Creation Wizard is used to create either a global hot spare or a local hot spare. The wizard is started using one of the following methods:

1. The RAID Management menu has “Create Hot Spare” item that displays a sub-menu with the choices of “Global” and “Local”. The wizard is started by clicking on either of these sub-menu choices. The “Local” selection is enabled if a RAID group is selected in the “Groups” tab in the bottom panel.
2. Select the “Hot Spares” tab in the bottom panel and right click within the panel. A menu box with the choices “New Hot Spare” and “Delete Hot Spare” is displayed. The wizard is started by clicking on the “Create Hot Spare” menu item. The “Delete Hot Spare” selection is enabled if an existing hot spare is selected.
3. Select the “Groups” tab in the bottom panel and click on the RAID group that should get a local hot spare assigned. Right click on the selected RAID group and a

menu box is displayed. The wizard is started by clicking on the “New Local Hot Spare” menu item.

The Create Hot Spare wizard actions are the following:

4. Filter the “Attached Drives” inventory panel to only display the drives that meet the requirements for the hot spare being created.
5. Display the “Create Hot Spare” action box in the bottom panel. The heading for the action box will indicate that a global hot spare or a local hot spare is being created.
6. Select a drive from the “Attached Drives” panel and drag it into the “Create Hot Spare” action box.
7. Select “Finish” in the action box and the wizard will display a Confirmation dialog box. Click the “Yes” button to complete the hot spare wizard.
8. The wizard exits and the bottom panel now displays the “Groups” tab and the “Hot Spares” tab. The “Hot Spares” tab displays information for all of the hot spares existing for the RAID adapter.

Exhibit 11 Create Hot Spare Menu.

The screenshot shows the ATTO ConfigTool RAID Management interface. The 'RAID Management' menu is open, and the 'Create Hot Spare...' option is selected, displaying a sub-menu with 'Global' and 'Local' options. The 'Local' option is highlighted. The main interface displays the 'Attached Drives' table and the 'Spares' table.

Vendor	SES Slot	Usage	Capacity
TOSHIBA	1		3.64 TB
TOSHIBA	2		3.64 TB
TOSHIBA	3		3.64 TB
TOSHIBA	4		3.64 TB
TOSHIBA	5		3.64 TB
TOSHIBA	6		3.64 TB
TOSHIBA	7		3.64 TB
TOSHIBA	8		3.64 TB
TOSHIBA	9		3.64 TB
TOSHIBA	10	RAID60 (1)	3.64 TB
TOSHIBA	11	RAID60 (2)	3.64 TB

Level	Capacity	Members	Status	Rebuild
RAID60	101.88 TB	32	Online	None
RAID5	29.11 TB	9	Online	None

Exhibit 12 Local Hot Spares.

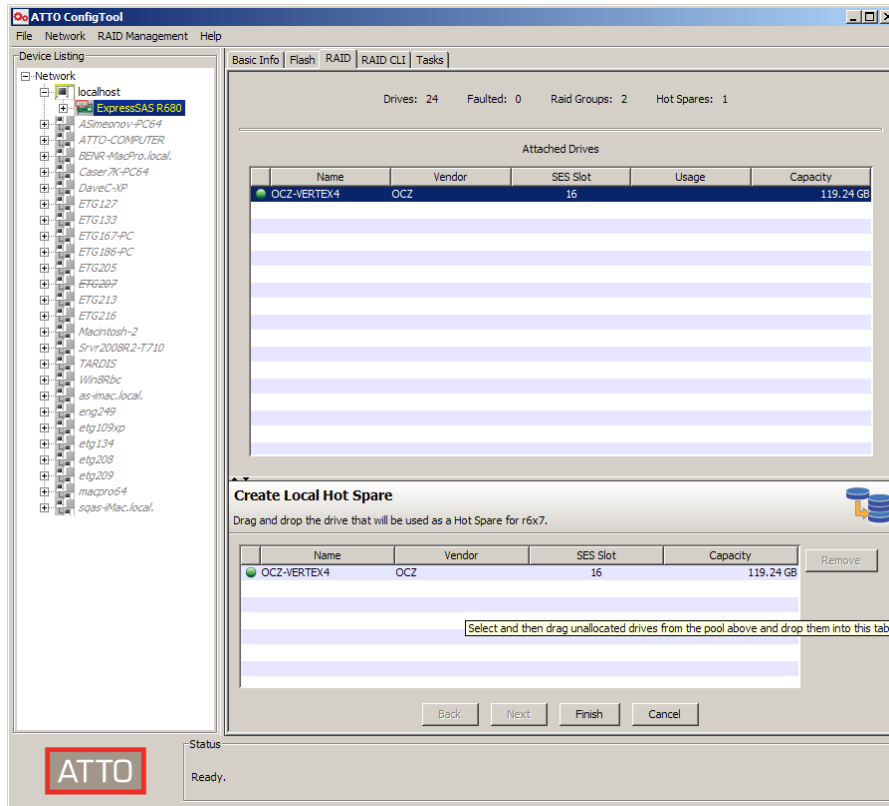
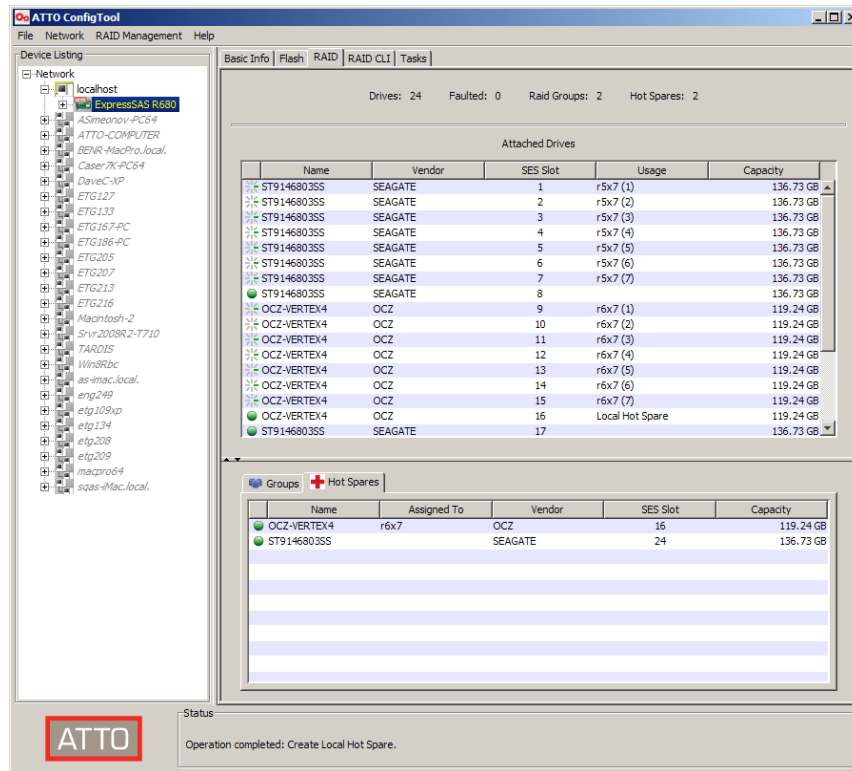



Exhibit 13 Complete the Hot Spare wizard.




Modifying RAID Groups

The ATTO ConfigTool interface may be used to replace a failed drive, add capacity to a RAID group, or change a RAID configuration from the current configuration to a new configuration.

 **CAUTION** *Data will be compromised or lost when deleting storage configurations.*

The ATTO ConfigTool interface takes you step by step through many procedures which allow you to modify your storage and RAID configurations. Read all notes and cautions carefully as you go to ensure the best performance and use of your storage. Many of these procedures are only available using unallocated storage.

Begin each process by following the [Preliminary Steps](#) and clicking on the desired process in the **RAID Management** menu.

 **Note** *An unallocated drive is storage which is not part of a RAID group or not designated as a hot spare.*

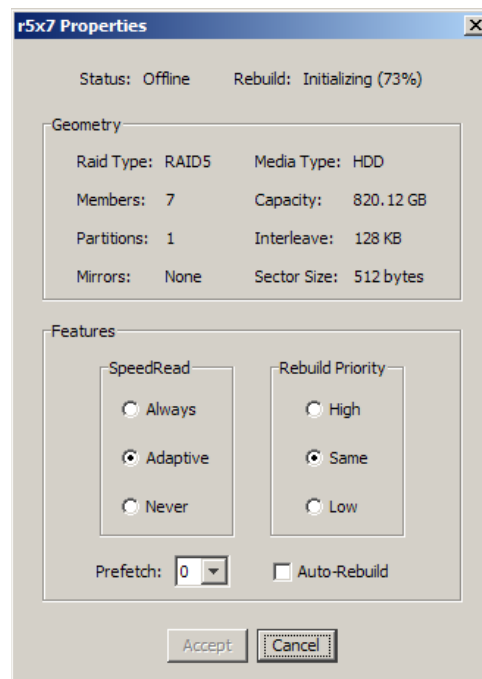
Delete a RAID group

To delete a RAID group using the ATTO ConfigTool, click on **Delete Group** in the **RAID Management** menu and follow the on-screen instructions.

Change RAID group properties

A RAID group has properties that are specific to the RAID group. The value of each property remains with the RAID group when it is moved from one computer to another. Some of the properties can only be specified during RAID group creation whereas others may be changed at any time during the life of the RAID group.

1. Select a RAID group in the Groups panel.
2. Click on Properties in the RAID Management menu.
3. View or change the current properties.




- **SpeedRead** specifies the cache policy to be used during read operations. Once a read command is given, the SAS/SATA RAID Adapters adapter retrieves the next set of sequential data from the RAID group and caches it in internal memory. If you select:
 - **Never**: read caching is never performed.
 - **Always**: read caching is always performed.
 - **Adaptive**: the default, SpeedRead is enabled or disabled depending on the sequential patterns detected in I/O requests.
- **Rebuild Priority** specifies the ratio of rebuild I/O activity to host I/O activity. A rebuild priority of either:
 - **Same** (default value) indicates that rebuild I/O and host I/O are treated equally.
 - **Low** indicates that host I/O is given a higher priority than rebuild I/O.
 - **High** indicates that rebuild I/O is given a higher priority than host I/O.
- **Prefetch** specifies the number of stripes that are read when SpeedRead is enabled or adaptive. The valid values for Prefetch are 0, 1, 2, 3, 4, 5 and 6, and the default value is 3. This property can only be changed after the RAID group is created.

4. Click Accept.

Replacing a faulted drive

If a drive in a RAID group fails, the RAID group's status becomes degraded. To return to optimal functionality, replace the faulted drive using one of the following mechanisms.

 **Note** *All of these mechanisms start a RAID group rebuild after the drive is replaced. A RAID group rebuild may take several*

hours to complete. The RAID group is accessible during rebuild; however, performance may be impacted, depending on the Rebuild Priority assigned.

Create a Hot Spare Pool

A faulted drive is automatically replaced if a suitable disk is available in the hot spare pool. You set up a hot spare pool with drives reserved until a RAID group member fails; they are not available when creating a RAID group. Refer to [Hot Spare Drives](#)

Manually replace a drive

You may replace a drive and rebuild a RAID group manually.

1. Select the “Groups” tab in the bottom panel and double click on the degraded RAID group.
2. A new tab will open and display all of the members of the RAID group.
3. Select an available drive from the “Attached Drives” panel.
4. Drag the selected drive over the faulted drive in the bottom panel.

The faulted drive is replaced with the selected drive if the selected drive is an appropriate replacement.

Setup RAID Notification

The ATTO ConfigTool provides a mechanism to issue a notification when a RAID event occurs in ExpressSAS RAID adapters.

RAID events are divided into three categories:

- Critical events indicate a serious problem has occurred and the administrator of the RAID group should perform corrective action.
- Warning events are less serious but still warrant notification.
- Information alerts provide additional useful information about warnings or critical events.

The **Notifications** tab provides numerous drop-down boxes that allow for the selection of the types of RAID events to receive for a notification. There are four options available in these drop-down boxes:

- **Critical:** Only RAID events of a Critical level are reported for the notification.
- **Warning:** Only RAID events of Warning and Critical level are reported for the notification.
- **All:** All RAID events (Information, Warning, Critical) are reported for the notification.
- **None:** No RAID events are reported for the notification. This level is particularly useful if a notification feature is not desired.

The notifications are specified at the host system level and apply to all ATTO SAS/SATA RAID adapter installed in the host system.

Basic alerts

The **Basic Alerts** section of the **Notifications** tab provides the controls to select the levels of RAID events for Audible and Visual notifications, as well as the level of RAID events to output to the system event log.

Audible Alerts utilize the system speaker and/or the hardware buzzer on a R6xx adapter to produce the notification. When triggered, the alarm continuously sounds until it is stopped by the user. There is an icon in the system tray (or system status area) that is used to turn off the alarm. The user must right-click on the icon and then select **Mute Audible Alert** from the menu. This will stop the alarm. The system tray icon also provides a control that will allow the user to enable/disable the hardware buzzer, so that only the alert via the system speaker is used. This allows the hardware buzzer to be turned off independently of the system speaker. It can also serve a remote purpose - if the daemon is on a server in a server room, the sysadmin can control the buzzer to disable it. The hardware buzzer is enabled by default.

Visual Alert utilize pop-up message boxes to display the contents of a RAID event. The pop-up may be closed using the pop-ups button.



Note

Audible alerts may not be available on your operating system.

Exhibit 14 Mute Audible Alert (Windows)

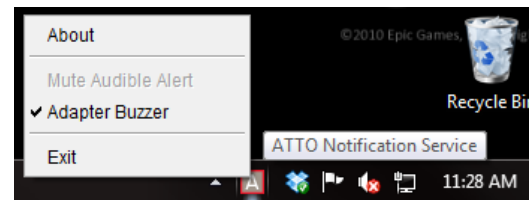
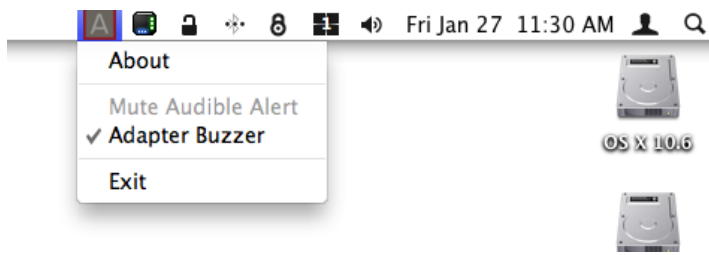


Exhibit 15 Mute Audible Alert (macOS)



Logging

The ATTO ConfigTool Service outputs RAID events and other useful informational messages to the system event log. The level of RAID events inserted into the system event log may be controlled by the System Log drop-down box in the Basic Alerts section of the Notifications tab.

The ConfigTool also generates a log on a per-adapter basis, as well as one for the SNMP functionality and the daemon itself. These are collected with the one-button diagnostics menu item. This can be useful when contacting ATTO Technical Support. Choose **Help, Run Diagnostics**, then choose a place to save the file output. It may take several minutes to gather the log.

Exhibit 16 The Basic Alerts controls of the Notifications tab in the ATTO ConfigTool.

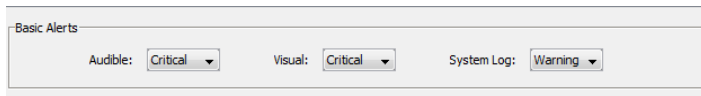


Exhibit 17 Run Diagnostics generates an extensive log to aide in troubleshooting



Email

The ATTO ConfigTool Service periodically sends email notifications to the designated email address(es) that have been input under the Notification Addresses: field(s). There

are three text fields under which email addresses can be specified, and more than one email address may be specified in each text field, as long as they are separated by a comma. Each email address text field can be configured to receive a specific level of RAID event via the drop-down box displayed next to each email address text field.

The ATTO ConfigTool Service can be configured to use a TLS/SSL email server (eg. Gmail™, Yahoo®, etc.) as well as the port to use when connecting to the email server. The ATTO ConfigTool Service's connection to the email server may be configured using the following controls:

- **Server Address:** specifies the address of the SMTP email server to use when sending an email (eg. smtp.example.com)
- **Sender Address:** specifies the text that will show in the "From" field in the sent email. This may contain an actual email address, or any other text that may be useful in identifying the sent email (eg. example@example.domainexample, server123, etc.)
- **Username:** specifies the username or login ID that is required when logging into the email server to send an email
 - Password: specifies the password for the account identified by the Username.
 - Enable SSL: when checked, the ATTO ConfigTool Service will attempt to connect to the email server using the SSL protocol. When unchecked, the ATTO ConfigTool Service will attempt to connect to the email server using an unsecured channel.
 - Port: specifies the port number to which the ATTO ConfigTool Service attempts to connect to the email server. Valid values are 1-65535.

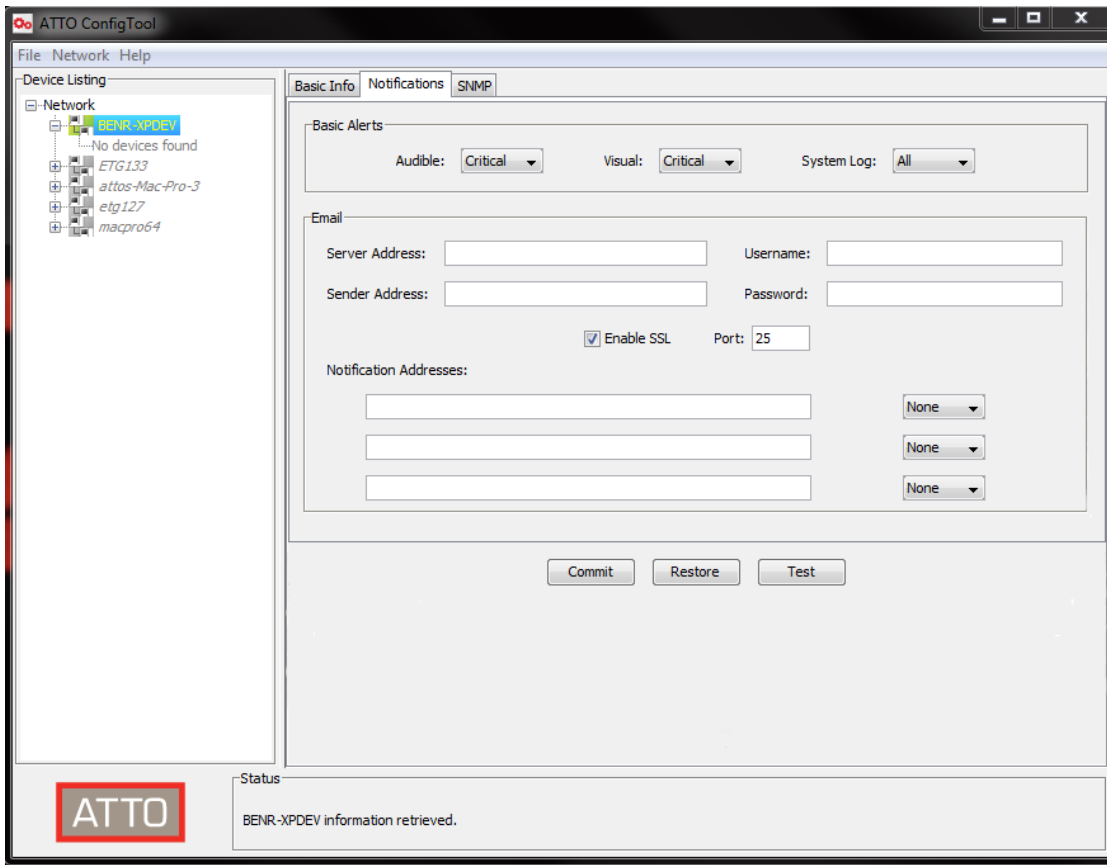


Note

Contact your email provider for the appropriate Port number. Using any other number will result in an email notification failure.

Email notifications are sent at 15-minute intervals. If a Critical RAID event is detected, an email notification will be sent after a 10-second delay. This delay allows the ATTO ConfigTool Service to gather supporting RAID events that may be useful in identifying why the Critical RAID event occurred.

Exhibit 18 The Notifications tab in the ATTO ConfigTool.



7 RAID Group Monitoring Tools

Using SCSI Enclosure Services (SES)

SAS/SATA drive enclosures may provide a SCSI Enclosure Processor which indicates enclosure health status, drive identification and drive fault identification.

The ATTO ConfigTool recognizes drive enclosures that provide SCSI Enclosure Services (SES). You may use SES to identify individual drives, all the drives in the same enclosure, all the drives in a single RAID group, or faulted drives. You may also select drives and monitor the status of the enclosure. To use SES, open the ATTO ConfigTool and follow one of the procedures below.

Identifying Drives

Drive Identification lights LEDs showing the drives you have selected using the ATTO ConfigTool. Most drive enclosures blink an LED next to the drive in the enclosure.

The ConfigTool provides a way to identify individually selected drives, all of the drives in the same enclosure, all drives in a RAID group, a selected mirror group in RAID 1 or RAID 10, and faulted drives.



Note

Drive Identification works for drives that are not controlled by a SCSI Enclosure Service. The ATTO ConfigTool provides functionality to locate all or specifically selected drives in a RAID group, when a SES processor is not present.

1. Select one or more drives individually or in enclosures or drives in RAID groups:
 - Select individual drives in the Attached Drives panel.
 - Select one or more RAID groups in the groups panel.
 - Select one or more drives in the Attached Drives panel, right click on one of the selected drives and select Enclosure.
2. Right-click on one of the selected drives or RAID groups.
3. Select Locate.



Note

If a RAID 1 or RAID 10 group was selected, the locate operation provides the capability to select a specific mirror of the group.

The status icon next to the selected drives blinks and the enclosure performs its specific identification method until you stop it.

4. To stop the drive identification, right-click on one of the selected drives or RAID groups and de-select Locate.

Identify Faulted Drives

Drive Fault Identification is performed automatically by the ExpressSAS RAID or ThunderStream SC Storage Adapters when a member of a RAID group becomes degraded by exhibiting unrecoverable errors during I/O.

The ExpressSAS RAID Adapters reports the status of the drive and asks the SES device to perform fault identification. The SES device usually illuminates a blinking red LED as a fault identification.

The fault identification continues until the drive is replaced or the RAID group is deleted.

Selecting All Drives in the Same Enclosure

Drive Selection selects all drives in the same enclosure using the ConfigTool. You may use drive selection if you need to select all the drives in one enclosure which are attached to a RAID storage adapter without selecting other enclosures, or if you are selecting members for a RAID group during RAID group creation.

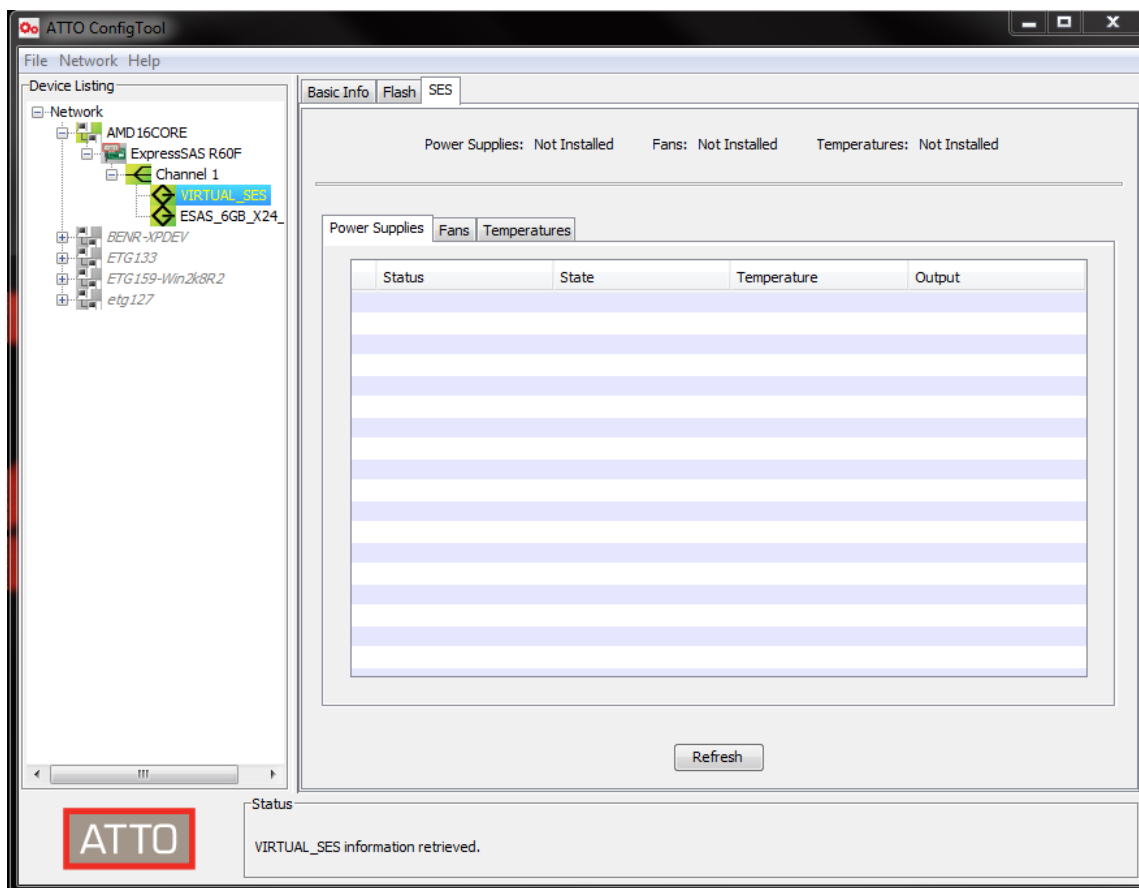
1. Right click on one drive in the Attached Drives panel.
2. Select Enclosure.
3. Select Drives. All drives in the same enclosure as the selected drive are selected.

Monitoring Health

The ATTO SAS/SATA RAID Adapters adapter performs **Enclosure Health Monitoring** automatically when an SES device is present. The RAID storage adapter monitors the status of the enclosure's power supplies, fans and temperatures. If the status of any of these sub-systems indicates a failure, the Storage Adapters reports the problem. The ConfigTool shows the status of selected SES devices and reports the specific health of each sub-system.

1. Select the SES device from the Device Listing tree in the ConfigTool.
2. Select the SES tab at the top of the right panel.
3. View the overall status of each component across the top of the right panel.
4. Select a specific sub-system (power supply, fans and temperatures) and view the status of the reporting sub-system.

Exhibit 19 The SES tab.



Monitoring S.M.A.R.T. Data

Self-Monitoring, Analysis and Reporting Technology, or S.M.A.R.T., is a system built into SATA drives to detect and report on various indicators of drive health.

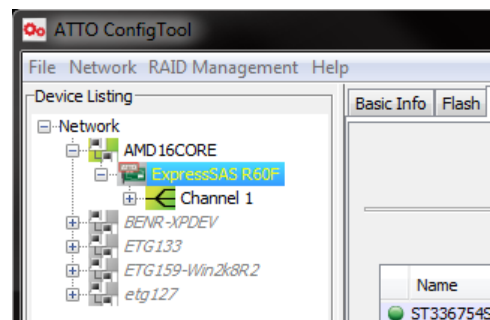
The S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) monitoring feature monitors and reports the status of SATA drives using certain parameters recorded by the drives. Notifications are sent when the values exceed certain pre-determined values.

Use the ATTO ConfigTool to view the files that record changes to S.M.A.R.T. parameters. The files are permanent and can be viewed independently whether you have enabled monitoring or not.

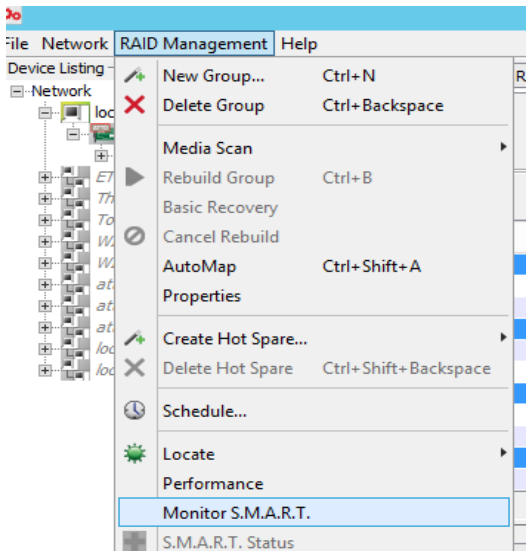
Enabling or Disabling S.M.A.R.T. Monitoring

You may enable or disable the monitoring feature at any time. Monitoring is disabled by default: if you want to use the feature, you must enable it.

1. Select the ExpressSAS RAID Storage Adapter from the Device Listing panel.



2. Select the **RAID** tab in the right panel.
3. Select the **RAID Management** menu item at the top of the screen.
4. Select the **Monitor S.M.A.R.T.** menu item to change the monitoring status. The Monitor S.M.A.R.T menu item under the RAID Management menu has a check mark when monitoring is enabled and no mark when it is disabled.



Checking S.M.A.R.T. Status

The ATTO ConfigTool interface displays the latest S.M.A.R.T. status record for a selected drive. All attributes reported by the drive are listed with each attribute's **Threshold**, **Worst**, **Current** and **Raw** value.

The threshold value is the value at which notification of a problem is generated by the software.

If there has been a change from a previous record of S.M.A.R.T. status, an arrow notes which way the change


Exhibit 20 S.M.A.R.T. status for a selected drive.

went, either higher or lower. For example, in [Exhibit 20](#) the temperature listed in this record is lower than the temperature listed in a previous record and the arrow next to that attribute points downward.

The S.M.A.R.T. status display also contains information such as the date and time the S.M.A.R.T. status was recorded, the total number of records for this drive, and the current monitoring status (enabled or disabled).

You may move to previous or subsequent records, query the drive or refresh the view using controls on the interface.

1. Select a single drive in the Attached Drives panel.
2. Right-click on the selected drive.
3. Select S.M.A.R.T. Status in the sub-menu.
4. The S.M.A.R.T. Status box displays.
 - Use the left arrow or right arrow control to move between S.M.A.R.T. status records
 - Use the Refresh button to query the drive for the latest values. If any values are different from the most recent record, a new record is created and displays.

 **Note** *If you click on the Refresh button when monitoring is disabled, a pop-up box displays. You can enable monitoring from the pop-up box to complete the refresh request.*

ID	Attribute	Threshold	Worst	Current	Raw
01	Raw Read Error Rate	51	200	200	000000000000
03	Spin Up Time	21	133	135	000000002801
04	Start/Stop Count	0	100	100	0000000000E9
05	Reallocated Sector Count	140	200	200	000000000000
07	Seek Error Rate	0	200	200	000000000000
09	Power on Hours Count	0	97	97	000000000AFD
0A	Spin Retry Count	0	100	100	000000000000
0B	Recalibration Retries	0	100	100	000000000000
0C	Power Cycle Count	0	100	100	0000000000E5
00	Power-off Retract Count	0	200	200	0000000000E1
C1	Load/Unload Cycle	0	200	200	000000000007
C2	Temperature	0	105	112	000000000028
C4	Reallocation Event Count	0	200	200	000000000000
C5	Current Pending Sector Count	0	200	200	000000000001
C6	Uncorrectable Sector Count	0	200	200	000000000001

Monitoring: Enabled

Aug 15, 2011 9:15:36 AM

1 of 1

Refresh

Filtering S.M.A.R.T. Attributes

Each of the S.M.A.R.T. status attributes is assigned one or more classification types:

- Performance
- Error Rate
- Event Count
- Critical

The **S.M.A.R.T. Status** dialog box can be filtered to display any combination of these types.

The default view is to display all types.

1. Open the S.M.A.R.T. Status box as described above.
2. Right click in the table area where the attribute values are displayed.
3. Each classification type that is visible has a check mark. Select any classification type to change the check mark

Exhibit 21 S.M.A.R.T. Status box with classification types.

The screenshot shows the 'S.M.A.R.T. Status' dialog box for device 'WD2002FYPS-02W38'. The status is 'OK'. A table lists various attributes with their IDs, thresholds, worst, current, and raw values. A context menu is open over the table, showing four checked classification types: Performance, Error Rate, Event Count, and Critical. There is also a 'Show All' option. The dialog includes a 'Refresh' button and a timestamp of 'Aug 15, 2011 9:15:36 AM'.

ID	Attribute	Threshold	Worst	Current	Raw
01	Raw Read Error Rate	51	200	200	000000000000
03	Spin Up Time	21	133	135	00000002801
04	Start/Stop Count	0	100	100	0000000000E9
05	Reallocated Sector Count	140	200	200	000000000000
07	Seek Error Rate	0	200	200	000000000000
09	Power on Hours Count	0	97	97	000000000AFD
0A	Spin Retry Count	0	100	100	000000000000
0B	Recalibration Retries	0	100	100	000000000000
0C	Power Cycle Count	0	100	100	0000000000E5
C0	Power-off Retract Count	0	200	200	0000000000E1
C1	Load/Unload Cycle	0	200	200	000000000007
C2	Temperature	0	105	112	000000000028
C4	Reallocation	0	200	200	000000000000
C5	Current Pe	0	200	200	000000000001
C6	Uncorrecta	0	200	200	000000000001

S.M.A.R.T. Notifications

S.M.A.R.T. status is collected from each SATA drive at 60 minute intervals and, if the data is different than the previous status, a S.M.A.R.T. status record is added to the S.M.A.R.T. status file for that drive.

A notification of the S.M.A.R.T. status difference is generated based upon the current settings in the **Notifications** tab.

The notification level of S.M.A.R.T. status is determined as follows:


- **Critical:** One or more of the status values was below a threshold value and one was classified as a critical attribute.
- **Warning:** One or more of the status values was below a threshold value but none were classified as a critical attribute.
- **Information:** None of the status values were below the threshold value

Test Drive Performance

The performance testing feature in the ATTO ConfigTool records the performance level of a drive in a RAID group under an I/O (input/output) load generated by a host application. The information can be used to compare the performance of each drive relative to others.

The performance feature of the ATTO ConfigTool counts the Megabytes per second (MB/sec.) which elapses from the time a start button is clicked until a stop button is clicked.

Drive performance can be measured for any combination of single drives within a RAID group or across multiple RAID groups, or for all the drives in a selected RAID group.

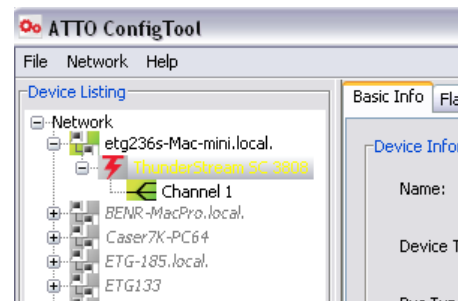
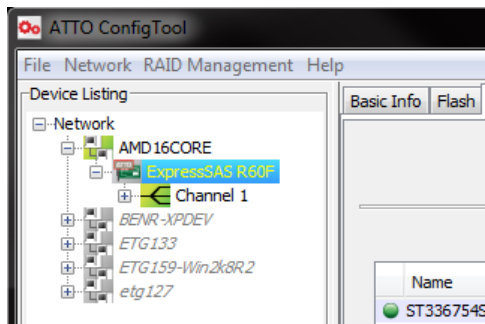
 **Note** *The performance test can only be performed on drives which belong to a RAID group.*

The **Performance** dialog box contains individual statistics for each drive selected. You should start I/O to the drives to be tested before beginning the test.

The collection of these statistics begins when the **Start** button is pressed and continues until the **Stop** button is pressed. You may press the **Reset** button and restart a test at any time.

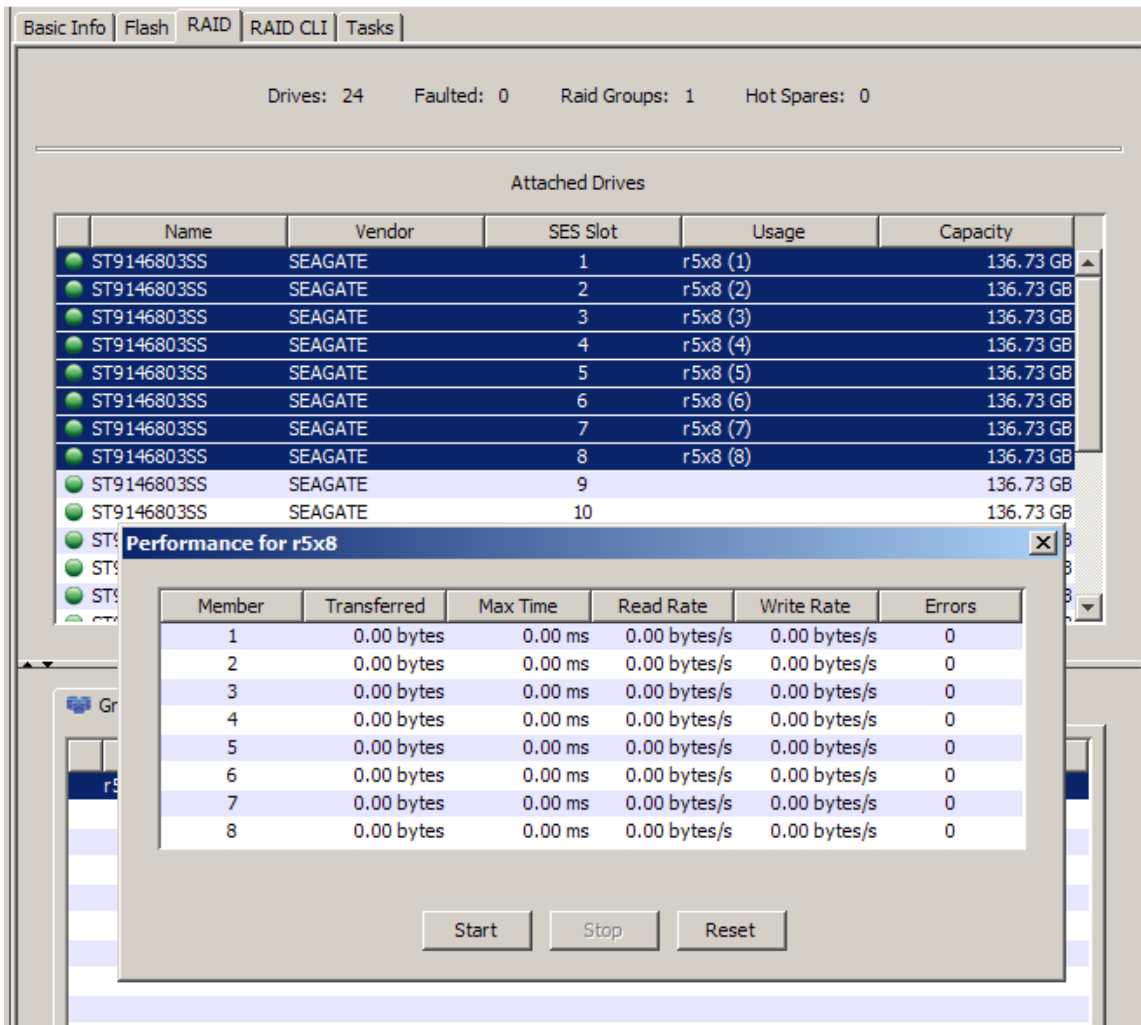
The ATTO ConfigTool can be closed after starting the performance test and re-opened to show the statistics from the most recent test.

1. Start I/O from the host system.
2. Select the ExpressSAS RAID Adapters from the Device Listing panel.



3. Select the RAID tab in the right panel.
4. Select the drives to be tested:
 - Select individual drives from the Attached Drives panel.
 - Select a single RAID group in the RAID Group panel.
5. Right-click on the selected drive(s) or RAID group.
6. Select the Performance menu item.
7. The Performance dialog box displays.
8. Click the Start button.
9. Click the Stop button to halt monitoring.
10. Click the Reset button to reset the performance values to zero at any time.
11. You can close the Performance dialog box while monitoring is in progress, and then open it later to see the performance results.
12. Stop I/O any time after you have stopped the performance test.

Exhibit 22 Detail of the Attached Drives window and the Performance dialog box with performance results for the selected drives before a test has been run.



RAID Media Scan Feature

The Media Scan feature scans disk drives for media errors and parity errors. All media errors are counted and fixed. All parity errors are reported in the event log. The two options are described below:

- **Media Scan** - Media Scan works with parity RAID group members, hot spare drives and unallocated drives. Media Scan evaluates selected drives. If a media error is found, it rewrites the data, relocating the bad sector to another part of the drive. Media Scan re-writes the correct data for a disk that is a member of an on-line parity RAID group. Media Scan writes random data to hot spare drives and unallocated drives. The Media Scan feature records the number of media errors detected and corrected for each drive. These counts are stored persistently if the drive is a RAID group member or a hot spare drive. The counts are not persistently stored for any other drives.

- **Media Scan with Parity Verify** - is a variation of Media Scan that is available for on-line parity RAID groups only. Parity verification is performed on each RAID group stripe that has no detected media errors. The parity of the stripe is recalculated and compared to the original parity for the stripe. If there is a mismatch, an error is generated and recorded in the event log and system log files.



Note

Media Scan is available on parity RAID groups. You cannot run a Media Scan on a RAID 0 or 10 RAID group. Additionally, a Media Scan cannot be run on a Degraded or Offline RAID group, with the exception of a RAID 6 or 60 group with a single degraded member.

Modes of operation for:

- **On-line RAID Group** – A Media Scan evaluates each stripe group. Parity verification is performed on a

stripe that has no media errors. Media Scan activity is prioritized using the *RAIDMediaScanPriority* CLI command. Media Scan is restarted after reboot if the Media Scan did not complete.

- **Degraded or Offline RAID Group** (RAID 6 or 60 with a single degraded number) – Media Scan performs SCSI Read commands for each stripe group of the on-line drives for a RAID 6 or 60 group with a single degraded member. No parity verification occurs. The Media Scan is restarted after a re-boot if the Media Scan did not complete.
- **Hot Spares & Unallocated Drives** –Media Scan evaluates each stripe group for each selected drive. Media Scan is not restarted after a re-boot if the Media Scan did not complete.

Starting a Media Scan



Note

A Media Scan is automatically scheduled to start one week after RAID group initialization is completed. Additional Media Scans are automatically scheduled to begin one week following the completion of previous Media Scan. Media Scan scheduling can be modified using the ConfigTool scheduling features. See [Media Scan](#) for additional information.

1. Select the ExpressSAS RAID or ThunderStream SC Storage Adapters from the Device Listing panel.
2. Select the RAID tab in the right panel.
3. Select the RAID group, hot spare drive(s) or unallocated drive(s) which will have a Media Scan. One RAID group can be selected or multiple hot spare and unallocated drives can be selected.
4. Select the RAID Management menu item at the top of the screen.
5. Select the Scanning menu item.
6. Select the Media Scan or Parity Verify from the sub-menu.
7. The Media Scan starts as soon as the sub-menu item is selected.

The screenshot shows the ATTO ConfigTool RAID Management window. The 'RAID Management' menu is open, and the 'Media Scan' option is selected. A sub-menu is visible with 'Scan Only' and 'Parity Verify' options. The main window displays RAID statistics and a table of attached drives.

Vendor	SES Slot	Usage	Capacity
TOSHIBA	25	newr5x9 (1)	3.64 TB
TOSHIBA	26	RAID60 (16)	3.64 TB
TOSHIBA	27	RAID60 (17)	3.64 TB
TOSHIBA	28	newr5x9 (4)	3.64 TB
TOSHIBA	29	RAID60 (18)	3.64 TB
TOSHIBA	30	RAID60 (19)	3.64 TB
TOSHIBA	31	newr5x9 (7)	3.64 TB
TOSHIBA	32	RAID60 (20)	3.64 TB
TOSHIBA	33	RAID60 (21)	3.64 TB
TOSHIBA	34	newr5x9 (9)	3.64 TB
TOSHIBA	35	RAID60 (22)	3.64 TB

Level	Capacity	Members	Status	Rebuild
RAID60	101.88 TB	32	Online	None
RAID5	29.11 TB	9	Online	None

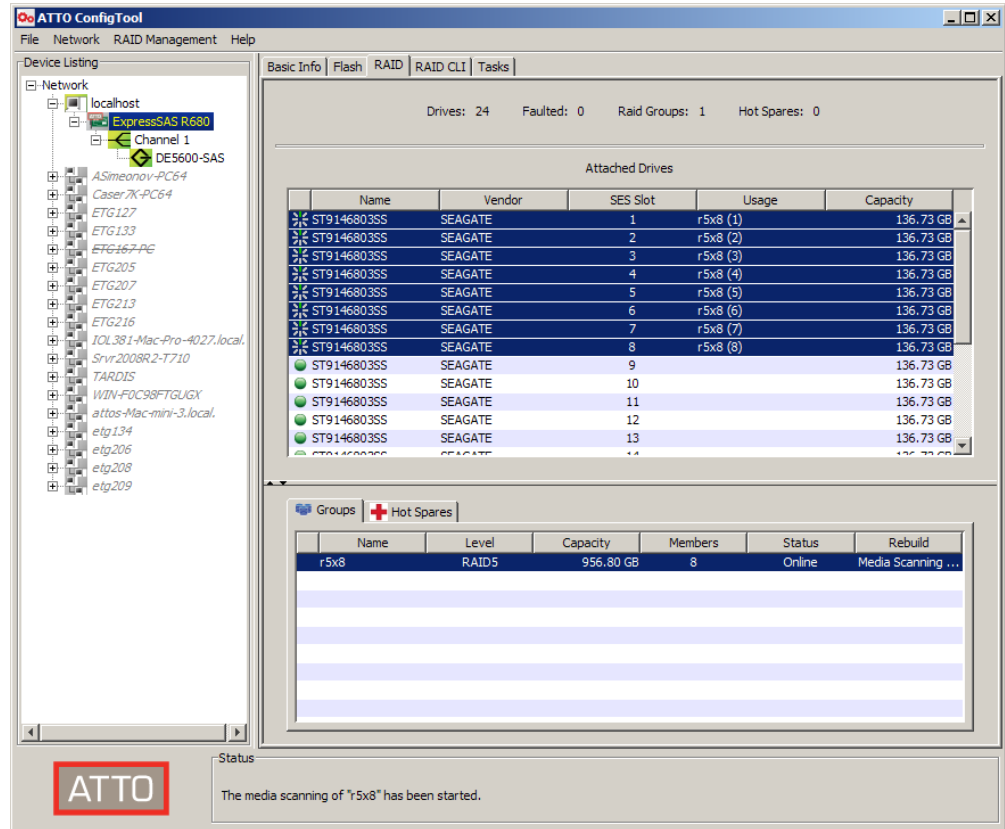
Status: Configuration refreshed.

Media Scan Status

The Media Scan starts as soon as the menu item is selected. The **Attached Drives** panel displays a rotating icon next to each drive being scanned. The **RAID Group** panel displays the type of scan being performed and a status for percent complete.


Viewing the Scan Report

1. Select the ExpressSAS RAID Storage Adapter from the Device Listing panel.
2. Select the RAID tab in the right panel.
3. Select the RAID group, hot spare drive(s) or unallocated drive(s) whose scan report should be displayed. One RAID group can be selected or multiple hot spare and unallocated drives can be selected.
4. Select the RAID Management menu item at the top of the screen.
5. Select the Scan Report from the menu.
6. A Media Scan Error Report message box appears with the scan results. If a scan is currently in process the Scanned column indicates the percent complete for the operation. The Scan Report includes the counts for the most recent scan and the total results for all Media Scan operations. This information is persistent for RAID group drives and hot spare drives since it is stored in meta-data of the drive. The results may be erased from the drive when the meta-data is re-written. e.g. The information is lost from a hot spare when the hot spare is added to a RAID group. The results of a Media Scan for an un allocated drive are only available until a reboot



- Media errors corrected on most recent scan.
- Total stripe groups scanned on most recent scan. This data is not displayed in ConfigTool.
- Media errors detected on all scans in the Total Errors column.
- Media errors corrected on all scans
- Total number of all scans in the Scans column.

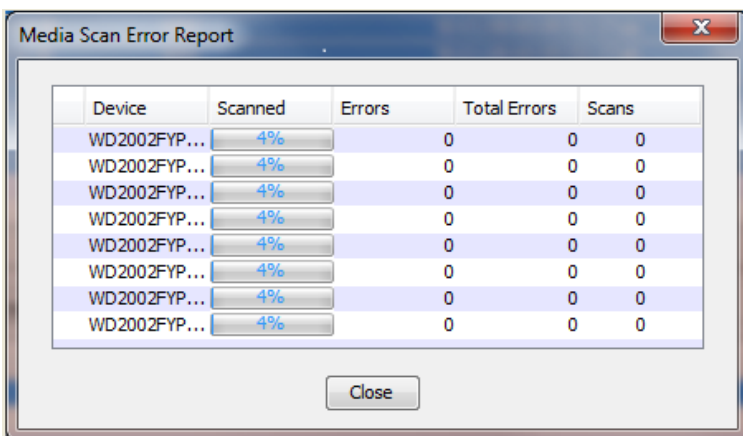
The **Media Scan Error Report** does not display the count of corrected errors. The corrected error count is displayed while the mouse pointer hovers over the **Errors** or **Total Errors** value for a specific drive. If the detected errors do not equal the corrected errors the warning icon appears to the left of device name column.

 **Note** *The Scan Report is updated by the ConfigTool every 10 seconds. The metrics are not updated when the Media Scan is paused.*

Pausing or Resuming Media Scan

Media Scan for a parity RAID group can be paused, resumed and cancelled. The ConfigTool provides menu items to pause and resume and CLI provides a command to cancel the Media Scan. The results of the Media Scan up to the time of the pause or cancel are saved persistently.

Media Scan for hot spare and unallocated drives can be cancelled and cannot be paused. Media Scan of Hot Plug and unallocated drives are run immediately and they are not

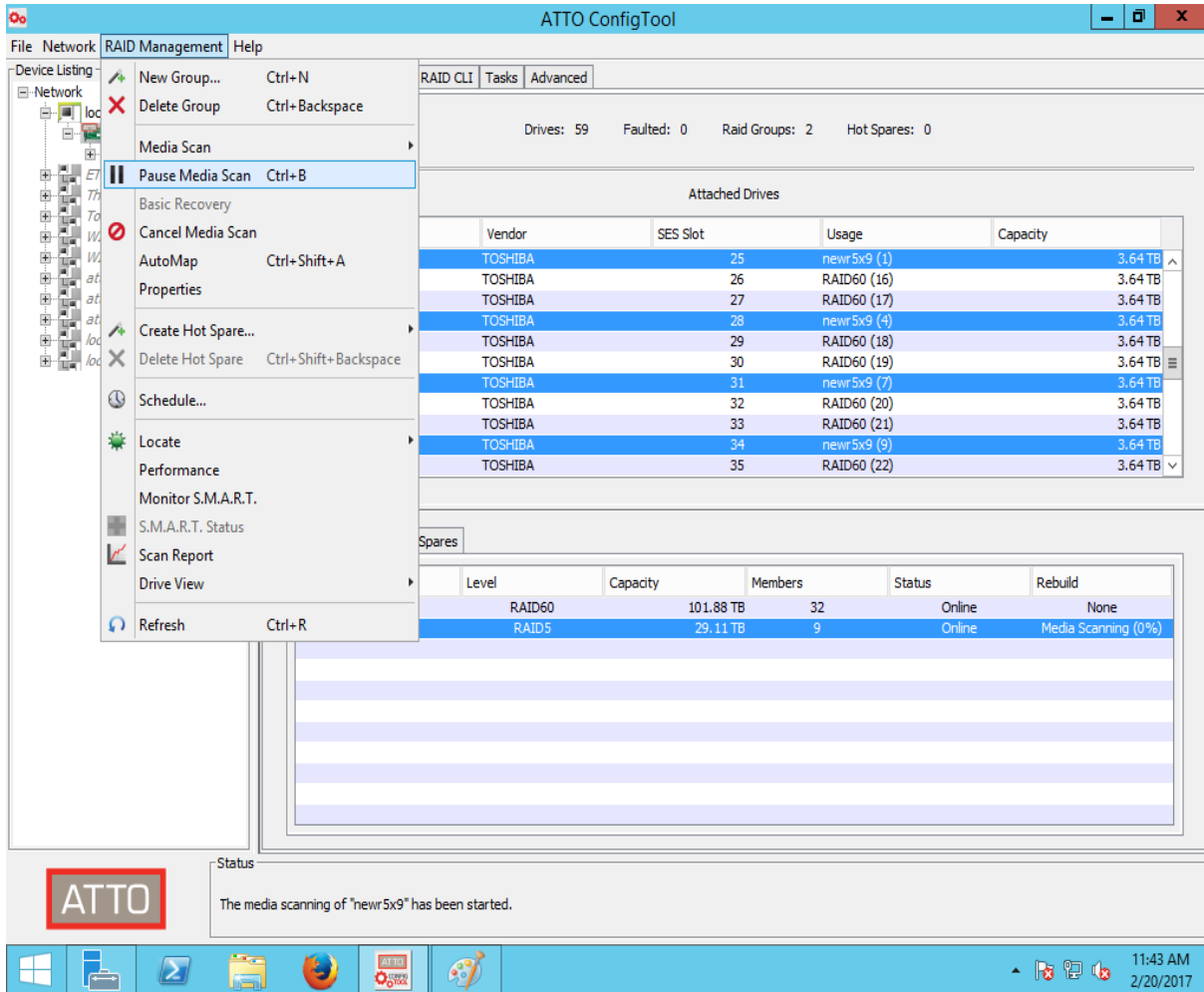


occurs.

Media Scan provides the following metrics:

- Media errors detected on most recent scan in the Errors column.

scheduled. The ConfigTool provides menu items to start and cancel Media Scan on these drives.



Scheduling Media Scan

The screenshot shows a dialog box titled "Schedule A Task" with a subtitle "Select a Type of Media Scan". It contains two radio button options: "Scan Only" and "Parity Verify". At the bottom, there are four buttons: "Back", "Next", "Finish", and "Cancel".

Media Scan for a parity RAID group can be scheduled to occur at a specified time for a specified frequency. The scheduling mechanism provides the means to specify the following:

- Day of the week and the time of day to run a Media Scan once a week
- Day of the week and the time of day to run a Media Scan once
- Time of day to run a Media Scan every day of week

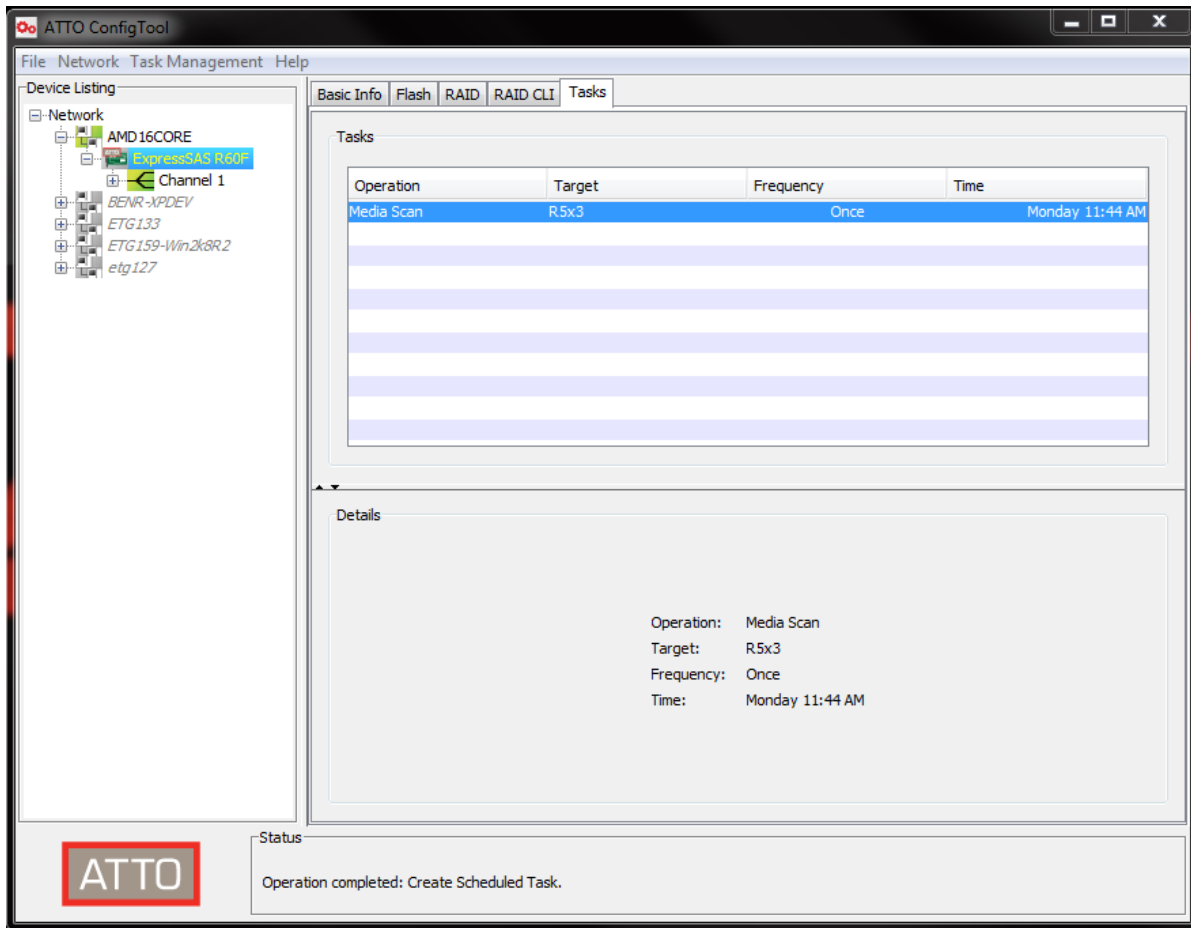
The screenshot shows a dialog box titled "Schedule A Task" with a subtitle "Select a Frequency to Perform the Task". It features a "Time:" field with spinners for hours (11), minutes (15), and AM/PM. Below it is a "Day:" dropdown menu set to "Thursday". To the right are three radio button options: "Once" (selected), "Daily", and "Weekly". At the bottom, there are four buttons: "Back", "Next", "Finish", and "Cancel".

A Media Scan is scheduled using the following procedure:

1. Select the ExpressSAS RAID Storage Adapter from the Device Listing panel.
2. Select the RAID tab in the right panel.
3. Select the parity RAID group that should have a scheduled Media Scan.
4. Select the RAID Management menu item at the top of the screen.
5. Select the Schedule... from the menu.
6. Select Scan Only or Parity Verify and press the Next button.
7. Select Once, Daily or Weekly as the frequency of the task.
8. Select the time of day to run the task.
9. Select the day of week to run the task. The day of week field is disabled when the frequency is daily.
10. Press the Finish button and a confirmation dialog box is displayed.
11. Press Yes to schedule the task. Media Scan for hot spare and unallocated drives cannot be scheduled.

Viewing Scheduled Tasks

The ConfigTool contains a Task tab for each RAID storage adapter present in the system. The tab contains a table that displays information for all of the currently scheduled tasks for the associated Storage Adapters. The table only contains an entry for items that have not occurred to date. It does not show any information for completed tasks. The table provides the capability to cancel a task or to change the schedule for the task. You cannot schedule a new task from this view.



Automatic Cancellation of Media Scan

A Media Scan can be automatically cancelled by the FW for the following reasons.

- A parity RAID group is being scanned and it requires a rebuild operation
- A parity RAID group is being scanned and the last drive is marked 'Faulted'
- A hot spare is being scanned and it is needed for a RAID group rebuild

8 RAID Group Diagnosis and Recovery

Data Recovery for OFFLINE RAID Groups

ATTO SAS/SATA RAID Adapters use DriveAssure™ to maintain error-free operation of RAID Group member drives. This includes features like Drive Initialization, Media Scan, Parity Verify, Performance Monitoring, and algorithms for latency and response management. Occasionally, a drive will suffer a mechanical or fatal media error that makes it unusable. A connection error may cause multiple drives to be inaccessible, resulting in an array that cannot be accessed normally. This document describes procedures to follow that may allow data to be partially recovered when drives fail or become inaccessible and cause the ATTO RAID Group to go OFFLINE.

Definitions

Exhibit 23 RAID Group Status Definitions

RAID Group Status	Definition
ONLINE	The RAID Group state is ONLINE for RAID Groups with all members available and fully operational.
DEGRADED	RAID Group does not have full data protection. This is the case when a non critical number of RAID Group Members are UNAVAILABLE, DEGRADED or FAULTED (i.e., 1 member in a RAID5 Group, 2 in a RAID6 Group, and so forth). On a READ command to inaccessible drive(s), the data is derived using redundancy or parity. A DEGRADED RAID Group may be initializing or rebuilding.
OFFLINE	RAID Group data cannot be accessed because a critical number of drives have FAULTED or been removed. For RAID 5, for example, two or more drives have failed.
RECOVERY BASIC	RAID Group is in BASIC data recovery mode. I/O may be limited to reads.
RECOVERY EXTREME	RAID Group is in EXTREME data recovery mode, which returns data at all costs. I/O may be limited to reads.
WAITING	The transient state of a group while it is being discovered.
DELETED	The transient state of a group while it is being deleted.
NEW	The state of a group that has been created but not yet committed.

Exhibit 24 RAID Member Status Values

Rebuild Status Values	
Ok	Data is up to date
Faulted	The operation was stopped due to an error
Halted	The operation was stopped by the user
Interrupted	The operation was stopped due to a disk removal or firmware restart
Rebuild Types	
Unknown	A pseudo value used if the type of operation is not recognized
Rebuilding	Represents the operation where a degraded group is repaired
Erasing	Represents the operation where the data contained in a group is purged by writing to every sector of the RAID group
Writing	Represents the operation where a specific data pattern is written to every sector of the RAID group
Initializing or Advanced Initializing	Represents the operation where new disks added to the group are undergoing full initialization. This can happen either when the group is created
Initializing or Express Initializing	Represents the operation where the group undergoes a parity rebuild (if applicable) for the new members added. This can happen either when the group is created
Media Scanning	Represents the operation where I/O is performed to each block on a device to force the reallocation of bad sectors. All error correcting is handled automatically by the device, and any errors detected will increment the appropriate counters
Parity Verifying	Represents the sector scan operation that also verifies the parity blocks on a RAID group are correct. If errors are found, they are left uncorrected, and the appropriate error counters are incremented
Parity Repairing	Represents the parity scan operation that also attempts to fix any parity errors that are encountered. Any errors detected will increment the appropriate error counters
Recovery Rebuilding	Represents the operation where an offline group is forced online prior to rebuilding it

Failure Scenario Table


RAID Groups cannot be accessed normally when their member disks fail, and the RAID Group is marked OFFLINE. RAID Groups of different RAID levels are marked OFFLINE for different reasons, as follows:

Exhibit 25 Failure Scenarios and Recovery Methods

RAID Level	Reason(s) for being marked OFFLINE	Recovery Method
JBOD and RAID 1	Any drive failure.	See Faults on Critical Number of Drives
RAID 1 and RAID 10	Error during rebuild	See Recovery from Failed Build
	Mistaken replacement of a good drive when its mirror has failed	See Recovery from Replacement of Wrong Drive
RAID 4, RAID 5 and RAID 50	Errors on two or more drives	See Faults on Critical Number of Drives
	Error during rebuild	See Recovery from Failed Build
	Mistaken replacement of a good drive when another member of the RAID Group has failed	See Recovery from Replacement of Wrong Drive
RAID 6 and RAID 60	Errors on three or more drives	See Faults on Critical Number of Drives
	Error during rebuild	See Recovery from Failed Build
	Mistaken replacement of good drive(s) when other members of the RAID Group have failed	See Recovery from Replacement of Wrong Drive

Replacing RAID Group Member Drives as Soon as They Fail

With parity and redundancy RAID levels, the RAID Group can withstand the loss of one member, and the data is still valid and accessible. In this case, the RAID Group goes into DEGRADED mode and uses parity or redundancy to generate the data. Although the RAID Group is fully operational, the RAID Group is at risk because if any other drive fails, data integrity is called into question.

 **CAUTION** *(Not valid for RAID 6/60) A very common reason that an array goes from DEGRADED mode to OFFLINE mode is when the wrong drives are replaced. For example, in a RAID 5, by pulling out a perfectly good drive, a double-drive fault occurs and there are insufficient drives to generate data. The following*

procedure is very important when you are considering removing a failed drive, to ensure the correct drive is pulled

Identifying Failed Drives

If a failed drive is in an enclosure that supports SES (SCSI Enclosure Services), the drive's Fault LED should be blinking. In that case, it is clear which drive should be replaced. If multiple drives are blinking, power cycling the array and/or the drives, and reseating the drives can sometimes correct intermittent conditions.

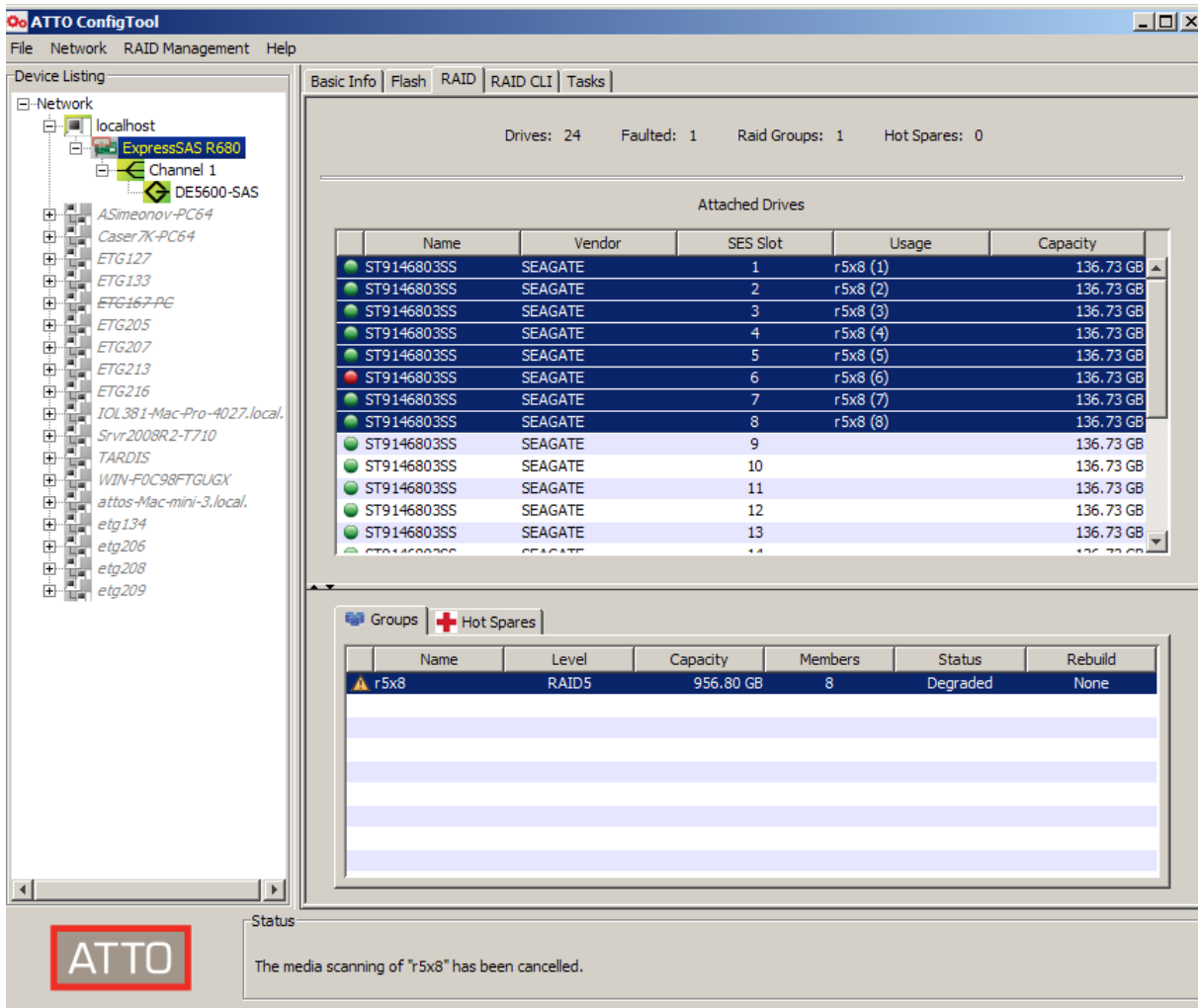
ATTO supplies other facilities to aid in failed drive identification. When there is some question about which drive has failed, use either the CLI command-line interface or

the ATTO ConfigTool procedures described below to be very sure as to which drive failed, prior to replacing the drive.

Using ATTO ConfigTool to Identify a Failed Drive

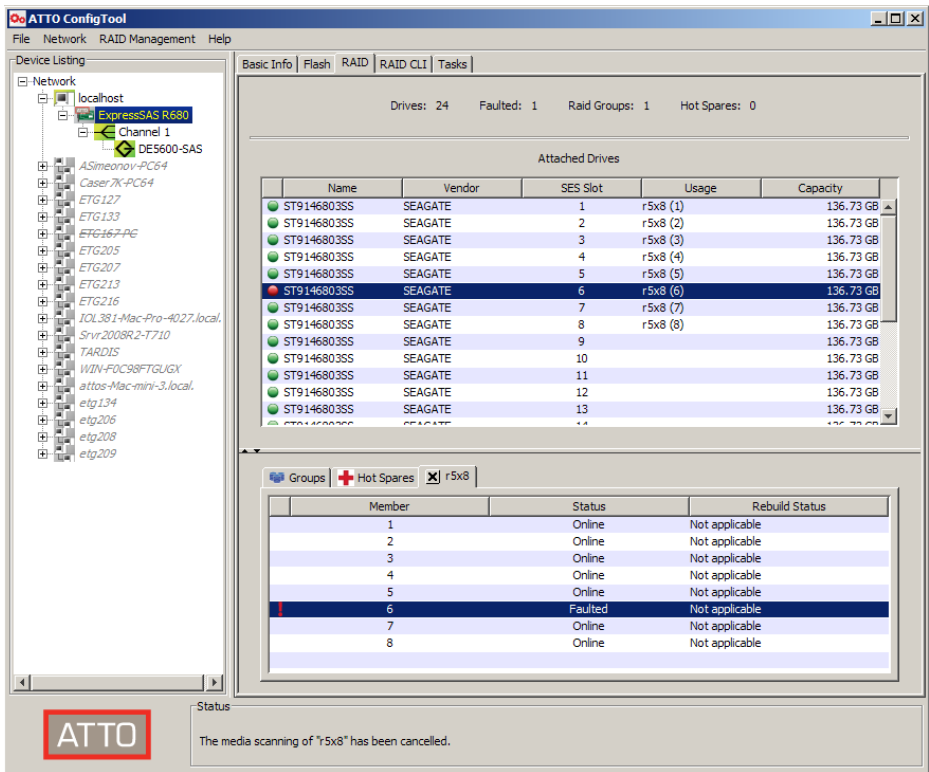
The ATTO ConfigTool provides a graphical display of RAID Groups and attached drives. The image below shows a RAID Group with a status of DEGRADED. The upper window shows attached disks and their association with RAID Groups.

Exhibit 26 RAID Display of Degraded Group



By double-clicking the RAID Group line, each RAID Member and its status is displayed.

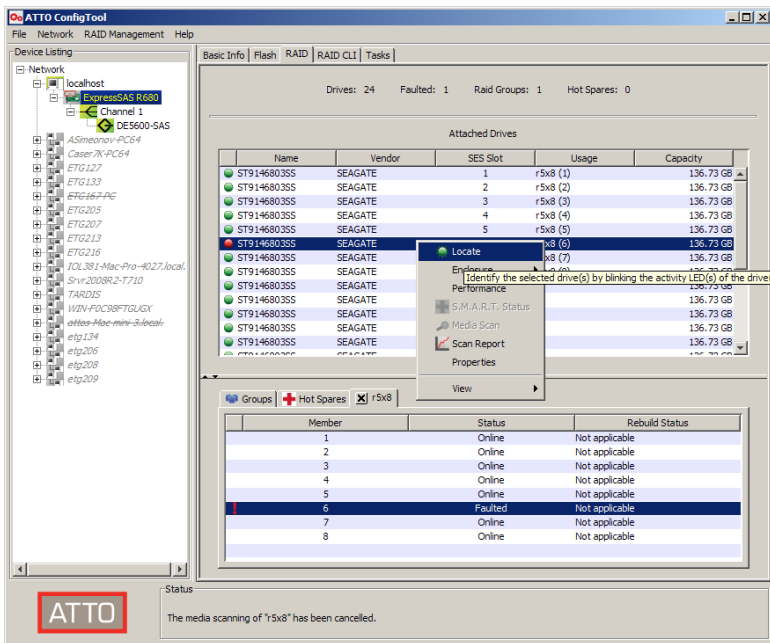
Exhibit 27 Member List for Degraded RAID Group



The member drive can be physically identified, in its enclosure, by right-clicking in the Attached Drives list and selecting Locate. The drive's Identify LED (or activity LED, in a non-SES enclosure) should blink.

Sometimes the activity LED won't blink because of a failure in the drive or enclosure electronics. One possible action is to blink all the other LEDs, and find the failed drive by process of elimination.

Exhibit 28 Identify a Drive Using Locate



Recovering from Failed Drives

Recovery from Replacement of Wrong Drive

Exhibit 29 RAID 5 Group with 4 Operational Drives

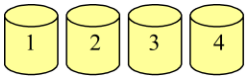


Exhibit 30 A Drive Fails; RAID Group goes DEGRADED

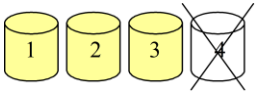


Exhibit 31 Drive 3 is replaced instead of drive 4! RAID Group goes OFFLINE



When a drive fails, but the wrong drive is replaced, a rebuild will not initiate and the RAID Group will be taken off line. The user should follow the procedure described earlier in this section to identify the failed drive, and ensure the correct drive is replaced.

The situation described above can be corrected. Replace the erroneously replaced drive (3A) with the original drive 3 in the above example; then identify and replace the failed drive (4); and then start a rebuild.

Recovery Mode

Sometimes, despite careful operation and maintenance, drives will coincidentally fail in such a way that the RAID Group integrity is compromised. After a RAID Group has been marked OFFLINE because of problems with member drives, there is a way to possibly recover some of the data. The following guidelines and commands can help recover data

from an OFFLINE RAID Group. The following descriptions refer to RAID 5 specifically, but the principles extend to other RAID types.

Recovery from Failed Rebuild

Fault During Rebuild - Recover by Forcing Rebuild to Continue



Note

The diagrams which follow illustrate a scenario where a failed drive is removed and replaced. The error recovery procedure is also valid if there is a hot spare.

Exhibit 32 RAID 5 Group with 4 Operational Drives



Exhibit 33 A Drive Fails; RAID Group goes DEGRADED

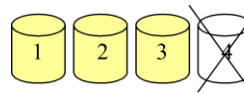


Exhibit 34 Drive is Removed and Replaced

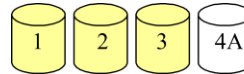
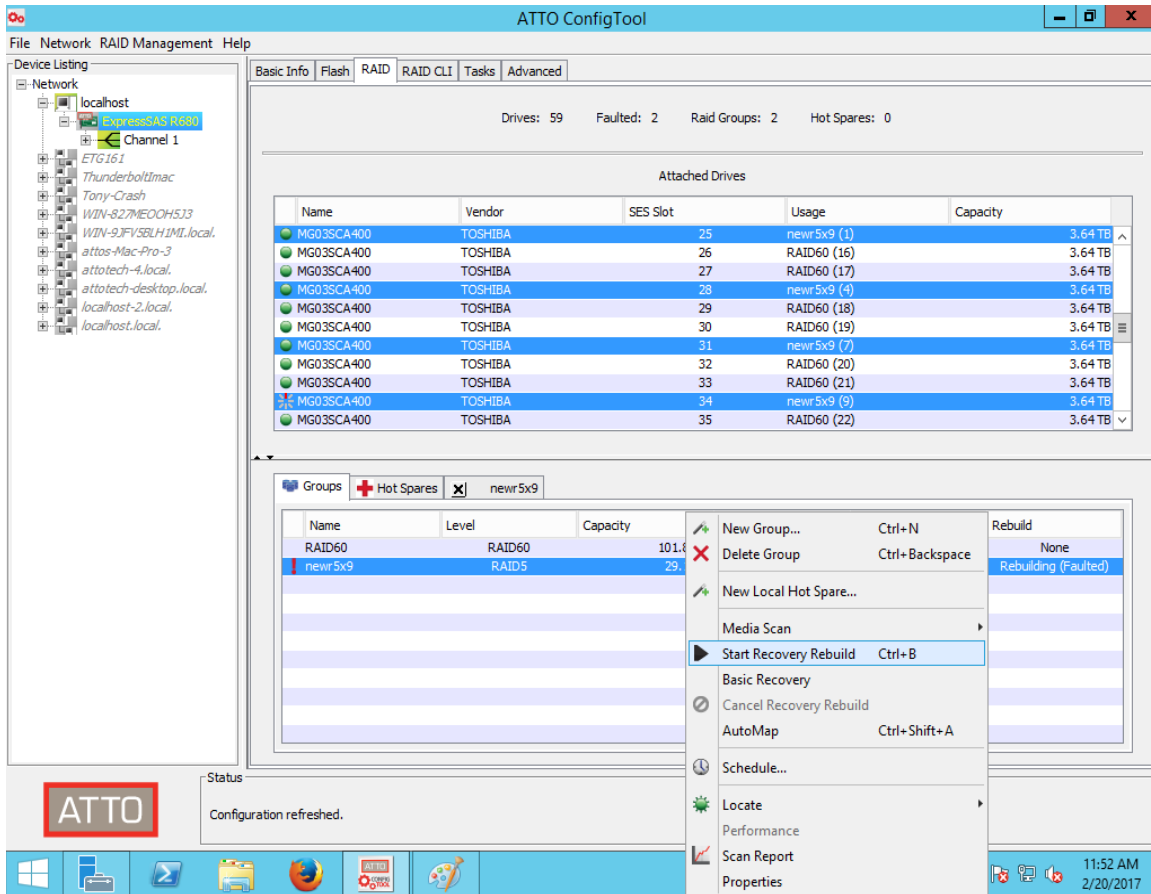


Exhibit 35 Media Error During Rebuild; Rebuild Halts, RAID Group goes OFFLINE



Use the ATTO ConfigTool to force the RAID Group to continue the rebuild. First, display the RAID Group information. Then right-click on the Offline RAID Group that has the Rebuild status **Rebuilding (Faulted)**. Select the option Start Recovery Rebuild.



The RAID Group status will change from **Offline** to **Degraded**. The Rebuild status will change from **Rebuilding (Faulted)** to **Recovery Rebuilding (n%)**, where n% is the completion percentage of the rebuild process.

At the end of the Rebuild Recovery, barring major problems, the RAID Group will be put back online. However, at the location corresponding to the Media Error, the data may be invalid. Anytime a RAID Group goes OFFLINE, data integrity **has been compromised**. It is imperative that data consistency checks and file system repair tools are used to validate the data before trying to use it.

Exhibit 36 Recover Rebuild; Rebuild Completes; RAID Group goes ONLINE



Note *If the rebuild cannot continue to the end because of unrecoverable errors on multiple drives, use the Extreme recovery mode, described below, to try to recover data.*

Serious Disk Failure During Rebuild - Using "Extreme" Mode
Exhibit 37 RAID 5 Group with 4 Operational Drives



Exhibit 38 A drive Fails; RAID Group goes DEGRADED

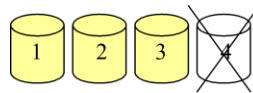


Exhibit 39 Drive is Removed and Replaced, and Rebuild Starts



Exhibit 40 Second Unrecoverable Failure; Rebuild Halts, RAID Group goes OFFLINE



Exhibit 41 Recover Extreme: All Drives Are Used to Try to Recover Data



When a serious disk failure occurs during a rebuild, the rebuild cannot be forced to continue, but the Extreme recovery mode may be viable. If there is an available slot, reinstall the original failed drive (the drive provides another possible source of data even if the data is stale). This original failed drive will only be accessed if there is an error on one of the other RAID Group members. Note that in this failure scenario, data may be extensively compromised.

Extreme Recovery Mode is only accessible from the Command Line Interface. Use the CLI command RGRRecover Extreme to enter the “extreme, read-at-all-costs” recovery mode. Use a host application to read the data (whatever you can) off of the drives and back it up to another location. The RAID Group will stay in recovery mode. If you use the CLI command RGRRecover Disable to disable this mode, the RAID Group will return to the OFFLINE state. There is no mechanism to put this RAID Group back online.

Once you have the data backed up, use only good drives to create a new RAID Group, and then restore the data to the new RAID Group.

Faults on Critical Number of Drives

Exhibit 42 RAID 5 Group with 4 Operational Drives

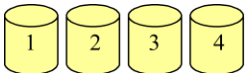


Exhibit 43 A drive Fails; RAID Group goes DEGRADED

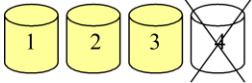
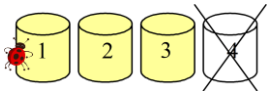


Exhibit 44 A Media Error occurs; RAID Group goes OFFLINE



In this scenario, the array will continue to operate in DEGRADED mode and return data when requested. However, once another error occurs, the array is OFFLINE and data has been compromised. Basic recovery mode should be used.

Basic Recovery Mode

CLI commands or the GUI can be used to put the drives into basic recovery mode. This allows you to read data to a backup location, replace all failed or marginal drives, and then restore the data to the new drives. However, at the location corresponding to the Media Error, the data may be invalid. Anytime a RAID Group goes OFFLINE, data integrity **has been**

compromised. It is imperative that data consistency checks and file system repair tools are used to validate the data.

To enter recovery mode from the ATTO ConfigTool, select the Offline RAID Group and right-click to get the menu options. Select the option Basic Rebuild as shown below.

Exhibit 45 Enable Basic Recovery Mode

The screenshot shows the ATTO ConfigTool interface with the RAID tab selected. The main window displays a table of attached drives and a RAID group configuration table. A context menu is open over the 'newr5x9' RAID group, with 'Basic Recovery' highlighted.

Name	Vendor	SES Slot	Usage	Capacity
MG03SCA400	TOSHIBA	25	newr5x9 (1)	3.64 TB
MG03SCA400	TOSHIBA	26	RAID60 (16)	3.64 TB
MG03SCA400	TOSHIBA	27	RAID60 (17)	3.64 TB
MG03SCA400	TOSHIBA	28	newr5x9 (4)	3.64 TB
MG03SCA400	TOSHIBA	29	RAID60 (18)	3.64 TB
MG03SCA400	TOSHIBA	30	RAID60 (19)	3.64 TB
MG03SCA400	TOSHIBA	31	newr5x9 (7)	3.64 TB
MG03SCA400	TOSHIBA	32	RAID60 (20)	3.64 TB
MG03SCA400	TOSHIBA	33	RAID60 (21)	3.64 TB
MG03SCA400	TOSHIBA	34	newr5x9 (9)	3.64 TB
MG03SCA400	TOSHIBA	35	RAID60 (22)	3.64 TB

Name	Level	Capacity	Mem
RAID60	RAID60	101.88 TB	
newr5x9	RAID5	29.11 TB	

The context menu for the 'newr5x9' RAID group includes the following options:

- New Group... (Ctrl+N)
- Delete Group (Ctrl+Backspace)
- New Local Hot Spare...
- Media Scan
- Start Recovery Rebuild (Ctrl+B)
- Basic Recovery**
- Cancel Recovery Rebuild
- AutoMap (Ctrl+Shift+A)
- Schedule...
- Locate
- Performance
- Scan Report
- Properties

The RAID Group status will change from **Offline** to **Recovery (Basic)**. Once you enter Recovery Mode, use a host application to read the data (whatever you can) off of the drives and back it up to another location. The RAID Group will stay in recovery mode. If you use the CLI command `RGRecover Disable` to disable this mode, the RAID Group will return to the OFFLINE state. There is no mechanism to put this RAID Group back online.

Once you have the data backed up, use only good drives to create a new RAID Group, and then restore the data to the new RAID Group.

Extreme Recovery Mode

When a critical number of drives fail, or if a Rebuild Recovery operation fails, the Extreme Recovery Mode may be an option. This will only work if one or both of the failed drives are still operational at some level, there are spare slots, and the data is not too far out of date. When this is the case, re-insert one or both drives into the array and enter Extreme Recovery mode. The original failed drives will only be accessed if there is an error on the other (non-failed) RAID Group drives. Follow the procedure outlined in section [Serious Disk Failure](#)

File System Repair Tools

When a RAID array has been made accessible by setting the drive states appropriately, the host's file system may still have integrity problems. Most operating systems have utilities that try to detect and repair file access issues.

Windows: CHKDSK


Chkdsk (Chkdsk.exe) is a Windows command-line tool that checks formatted disks for problems. Chkdsk then tries to repair any problems that it finds. For example, Chkdsk can repair problems related to bad sectors, lost clusters, cross-linked files, and directory errors. To use Chkdsk, you must log on as an administrator.

Click **Repair Disk** to verify and repair any problems on the selected volume(s). The results of the repair will be posted in the window. When no problems are found, it reports: "The volume "diskname" appears to be OK."

Occasionally, at the end of a scan, a message similar to the following will appear: "Scan complete. Problems were found, but Disk First Aid cannot repair them."

Linux: FSCK

The system utility fsck ("file system check") performs a file system consistency check and interactive repair. It has options to do a quick check, preen files, preen and clean files, and others.

 **Note** *If there are problems found, you should click **Repair Disk** to scan again. If the same problem(s) are found during the second scan, it means First Aid cannot repair the disk. This indicates that some of your files may be more severely damaged. To repair this damage, you can either back up your disk and reformat, or obtain a more comprehensive disk repair program.*

macOS: First Aid (part of Disk Utilities)

Launch Disk Utility from macOS or the macOS Installer. In the column on the left, select the volume you want to repair, and then on the right, click the **First Aid** tab.

Command Line Interface

Using CLI to Identify a Failed Drive

Blockdevscan

```
blockdevscan
```

```
6
;ID Vendor      Product                SerialNumber Capacity InUse      Port
;-----
0          ST3250310NS          9SF0800F 232.88GB r5
1          ST3250310NS          9SF076NJ 232.88GB r5
2          ST3160812AS-1       5LS25P51 149.10GB r5
3          ST3250620AS          6QF0LJ17 232.88GB r5
```

Ready.

The blockdevscan CLI command shows a list of all attached drives and their usage. Use this command to update the list of drive IDs, which are needed by other CLI commands

For members of a RAID Group, the InUse column shows the RAID Group name.

RGdisplay

This is the RAID Group display command. Use this command to display all RAID Groups and their statuses.

```
rgdisplay
```

```
3
;GroupName      Type      Interleave Capacity Partitions Members Status
-----
r5              RAID5    64        KB   447.0GB           1         4 DEGRADED
```

Ready.



Note

If rgdisplay shows a RAID Group is OFFLINE, then data recovery methods should be initiated; skip this section and go directly to the Section, [Recovering from Failed Drives](#)

If rgdisplay shows a RAID Group is DEGRADED, then it is important to replace the failed drive as soon as possible. Rmstatus shows the status of each of the member drives. If a member is FAULTED or UNAVAILABLE, it should be replaced. To match the displayed member to the physical drive, you can use sesidentify, which is the preferred method, or blockdevidentify, if there is no SES capability.

Rmstatus

Next, use rmstatus, the RAID Member status CLI command, to show information for each member of the RAID Group in question.

```
rmstatus r5
```

```
6
;ID Status      RebuildStatus      Vendor      Product      Rev SN
-----
0 ONLINE      OK
1 ONLINE      OK
2 FAULTED     OK
3 ONLINE      OK
          ST3250310NS      SDN1 9SF0800F
          ST3160812AS-1    H    5LS25P51
          ST3250310NS      SDN1 9SF076NJ
          ST3250620AS      K    6QF0LJ17
```

Ready.

SEsIdentify DRIVE (only valid if enclosure supports SES)

The drive FAULT LED should already be blinking. Use this CLI command to also blink the Identify LED for the drive. The ID from the blockdevscan command must be used, and not the member ID shown in the rmstatus command. Match the S/N of the FAULTED drive (9SF076NJ) from rmstatus to the blockdevscan drive IDs, and use that number to select the correct drive to blink.

```
SesIdentify DRIVE 1
```

Ready.

```
SesIdentifyStop All
```

Ready.

BlockDevidentify

Use this command to blink the activity LED for the drive (if the drive is working enough so the activity LED can operate). The ID from the blockdevscan command must be used, and not the member ID shown in the rmstatus command. Match the S/N of the FAULTED drive (9SF076NJ) from rmstatus to the blockdevscan drive IDs, and use that number to select the correct drive to blink.

Sometimes, when blockdeidentify must be used, the activity LED won't blink because the drive has failed so badly. One possible action is to blink all the other LEDs, and find the failed drive by process of elimination.

```
BlockDevIdentify 1
```

Ready.

```
BlockDevIdStop
```

Ready.



Note

If sesidentify is used, follow it up with the CLI command sesidentifystop All to turn the drive LEDs off. When blockdeidentify is used, follow it up with the CLI command blockdevidstop (no parameters) to turn the drive LEDs off.

Using CLI to Enable / Disable Recovery Mode

Display the RAID Group and RAID Group member drives:

```
rgdisplay
```

```
3
;GroupName      Type   Interleave Capacity Partitions Members Status
;-----
r5              RAID5  64      KB   447.0GB           1      4 OFFLINE
```

Ready.

```
rmstatus r5
```

```
6
;ID Status      RebuildStatus   Vendor      Product                Rev  SN
;-----
0 ONLINE      OK
1 FAULTED     OK              ST3160812AS-1  H      5LS25P51
2 FAULTED     OK              ST3250310NS    SDN1   9SF076NJ
3 ONLINE      OK              ST3250620AS    K      6QF0LJ17
```

Ready.

Put the RAID Group into Basic or Extreme recovery mode with read and write access:

```
Set RGRrecover r5 Basic (or Extreme or Rebuild)
```

Ready.

Display the RAID Group to see the results:

```
rgdisplay
```

```
3
;GroupName      Type   Interleave Capacity Partitions Members Status
;-----
r5              RAID5  64      KB   447.0GB           1      4 RECOVER
```

Ready.

Display the RAID Group members to see the results:

```
rmstatus r5
```

```
6
;ID Status   RebuildStatus   Vendor   Product           Rev   SN
-----
0 ONLINE    OK              ST3250310NS  ST3250310NS     SDN1  9SF0800F
1 ONLINE    OK              ST3160812AS-1  ST3160812AS-1  H     5LS25P51
2 ONLINE    OK              ST3250310NS  ST3250310NS     SDN1  9SF076NJ
3 ONLINE    OK              ST3250620AS   ST3250620AS     K     6QF0LJ17
```

Ready.

Once as much data as possible is retrieved from the drives, the Recovery Mode should be disabled and the FAULTED drives removed from the system.

Turn off Recovery Mode:

```
Set RGRRecover r5 Disable
```

Ready.

Using CLI to Enable Recovery with Writes

On occasion, the data that has been disrupted is part of the File System on the disk drives. When this is the case, it is useful to run the File System Repair Tools for your operating system. This requires write access to the drives.

 **CAUTION** *Use the `rgrecoverwithwrites` command only when necessary and use with caution!*

Put the RAID Group into Basic or Extreme recovery mode with read and write access:


```
Set RGRRecoverWithWrites r5 Basic (or Extreme)
```

Ready.

Run the appropriate file system repair utility prior to recovering data from the drives.

CacheAssure™

CacheAssure is available on ATTO's ExpressSAS 6Gb/s RAID storage adapters. CacheAssure is an innovative, data protection module that provides the security and confidence that your cached data will remain intact in the event of an unexpected power loss or system failure, within an environmentally friendly solution.

 **Note** *The CacheAssure feature will prevent data loss in the ATTO RAID storage adapter in case of a power outage but there still remains a risk of losing data in the cache of the disk drives. ATTO automatically disables the drive cache to ensure maximum protection.*

The ATTO ConfigTool will allow you to view the status of the Power Module and Non-Volatile (NV) Memory Card in the

Basic Info tab of the RAID storage adapter with the driver information.

Power Module Status

The status and availability of the CacheAssure Power Module can be verified by viewing the "Power Module" field within the Basic Info tab of the ConfigTool. The status will be reported as either:

- Not Present
- Not Charged
- Fully Charged

It takes approximately two minutes for the Power Module to become fully charged. The ConfigTool will refresh the status of the Power Module within 3 minutes of being launched

NV Memory Card Status

The availability of the CacheAssure NV Memory Card can be verified by viewing the "NV Memory Card Status" field within the Basic Info tab of the ConfigTool. The status will be reported as either:

- Not Present
- Present

Within the NV Memory card, there is flash based storage. In the event of system power failure, CacheAssure instantly detects the failure and transfers the data from DRAM to the flash memory, where it will safely remain for the life of your system, or until you regain power. Once power is restored, the data will proceed to then transfer to your ultimate

storage destination. The alternative solution, using Battery Back-Up (BBU's), will typically secure data for only a maximum of 72 hours and then it is lost forever.

CacheAssure powers up in less than 2 minutes and lasts for up to 10 years. With a BBU, every time you start your system you are degrading your battery lifespan. BBUs can require up to several hours to charge and needs replacing every 1-2 years. CacheAssure is the preferred solution due to the fact that it is a maintenance-free, flash-based system which eliminates monitoring, maintenance, disposal, and replacements costs, typically associated with the less desirable (BBU) alternative. CacheAssure increases system uptime and significantly reduces the overall total cost of ownership.

9 Power Center Pro

Power Center Pro is an integrated software RAID solution that brings the performance and protection of RAID to storage devices attached to your ATTO ExpressSAS host adapters and ThunderLink3128 adapters. ATTO's Power Center Pro is included for use with ExpressSAS 12Gb SAS HBAs and ThunderLink 3128 adapters with internal connections.



Note **Power Center Pro is supported on Mac, Windows, and Linux**

Power Center Pro provides RAID 0, 1, 1e and 10 capabilities for internally-mounted disk drives. A typical user might use this capability to add a level of performance or protection to a boot drive group. You can protect this boot group against drive failure, or if you'd like to achieve faster boot times, you can bundle several drives together to improve overall performance. Additionally, Power Center Pro may be used to set up a storage server with boot drives and additional storage for general use. These are just a few examples of the many ways to use Power Center Pro to provide a cost-effective option that adds performance and protection to your storage architecture.

Since users want an easy-to-use 'set it and forget it' interface, Power Center Pro is managed using a simple CLI-based or EFI interface. With a few, easy commands, your RAID group can be set up and ready to use. If you ever need to manage or monitor performance of your RAID group, you use the same interface. Everything is self-contained within the device driver. It all happens right on the ExpressSAS HBA and ThunderLink.



Note **During normal operation, no additional software is necessary. However, degraded and offline RAID groups require the ATTO ConfigTool service to complete the rebuild operation. ATTO's ConfigTool is a free application available for download at www.atto.com. ATTO ConfigTool installation and operation instructions are available in [Installation of this manual](#).**

With Power Center Pro, you have the option to create RAID 0, 1, 1e and 10 groups. Power Center Pro provides the protection and performance of RAID - all available at the cost of a host adapter and without any additional software or complicated set-up.

Features & benefits

- Self-contained application delivered as part of the 12Gb device driver.

- Easy-to-use CLI-based interface to create and manage RAID 0, 1, 1e and 10 groups to add performance and protection to direct attached storage.



Note **RAID 1 groups can be created by setting up a 2-member RAID 1e group. RAID 10 groups can be created by setting up a 4-member RAID 1e group.**

- Create up to 2 RAID groups per adapter; support for up to 8 internal drive members per RAID group; support for up to 2 hot spare disks per RAID group (maximum 2 hot spare disks per adapter).
- EFI support; full support for boot devices.
- Full support for solid state and hard disk drives.
- Persistent RAID group information - RAID groups are portable to other ATTO H12XX HBAs.

Hardware and software requirements

- Power Center Pro is available on the following ExpressSAS 12Gb/s SAS/SATA host adapters:
 - H1208 8-port internal 12Gb/s SAS/SATA host adapter
 - H120F 16-port internal 12Gb/s SAS/SATA host adapter
 - H1244 4-port internal 4-port external 12Gb/s SAS/SATA host adapter
 - H1288 8-port internal 8-port external 12Gb/s SAS/SATA host adapter
- Operates independently of the server or workstation hardware and operating system. Power Center Pro will work in all systems with which the ExpressSAS 12Gb/s HBA and ThunderLink 3128 is compatible. Check the ATTO website for details (<http://www.atto.com/support/interoperability/>), or contact technical support at techsupp@atto.com for information on HBA compatibility.
- No additional software or drivers are required to use Power Center Pro. It is a self-contained application that is easily configurable using any CLI shell or via EFI.

Power Center Pro Command Line Interface (CLI) Program

General information

- Power Center Pro can be accessed via your preferred CLI shell.
- RAID groups created using Power Center Pro will also be visible in the ATTO ConfigTool™ interface; however, they cannot be managed there. All set-up, configuration and maintenance of Power Center Pro RAID groups must be done via the 'atpcpro' CLI program.
- Power Center Pro RAID groups must be attached to a compatible ExpressSAS 12Gb SAS HBA to be usable. RAID groups set up using Power Center Pro and then moved to an ExpressSAS RAID adapter will not be usable. The opposite is also true - RAID groups set up using an ExpressSAS RAID adapter will not be usable if moved to a 12Gb SAS/SATA adapter.

- The majority of Power Center Pro capabilities are accessed using the -f command.



Note

During normal operation, no additional software is necessary. However, degraded and offline RAID groups require the ATTO ConfigTool service to complete the rebuild operation. ATTO's ConfigTool is a free application available for download at www.atto.com. ATTO ConfigTool installation and operation instructions are available in [Installation](#) of this manual.

- The CLI program uses a simple command structure to create, delete and manage RAID groups. The following command format is generally used:

```
atpcpro [command] [function]
        [required_modifiers] [optional_modifiers]
```

DevClean	Removes meta-data from blocked devices
DevDisplay	Displays information about devices*
DevLocate	Turns on or off the locate LED for device in chassis or enclosure
HsCreate	Create Hot Spares
HsDelete	Delete Hot Spares
RgCreate	Creates RAID groups
RgDelete	Deletes RAID groups
RgDisplay	Displays information about RAID groups*
RgLocate	Turns on or off the locate LED for RAID groups in chassis or enclosure
RgModify	Modifies degraded RAID group
RgRebuild	Rebuilds degraded RAID group
RgRename	Renames a RAID group
RgVerify	Verifies RAID group structure
RmDisplay	Displays information about RAID group members*

*Channel information will always be printed prior to any device or group information; enclosure information is printed prior to any device information; any display command can filter the output display by specifying the '-c', '-n' or '-u' parameters where applicable;

any command that has its output filtered must still show the channel and enclosure information related to the selected device; The value reported in the "Device ID" field is the ID that should always be used when selecting a device via the '-u' parameter.

- Some functions require additional information to properly process the command. These are designated as 'required' and 'optional' modifiers. The following modifiers are available when constructing commands
Creating, Managing and Monitoring Power Center Pro RAID Groups

-c	Selects a specific controller channel for the operation (Starts at 1, all channels are selected by default)
-d	Disable a feature. Values: boot Mark a group as a boot device. primary Set primary mirror members. wrcache Control write caching on group members
-e	Enable a feature. (same values as -d modifier)
-g	Specifies the group type. Group types are: raid0 RAID 0 group raid1e RAID 1E group
-h	Displays extended help text.
-k	Specifies the block size for new groups, defaults to the member block size or 4KB for SSDs. Values: 512 512 bytes per block 4096 4KB bytes per block
-l	Lists information on the ExpressSAS controllers in the system
-m	Specifies the member number for functions that operate on RAID group members
-n	Specifies the group name. The Maximum of 14 characters for new groups. Group names are case insensitive. Group names must be unique for each channel. Only one group name can be entered per command. If more than one channel exists and the same name exists on each channel, then the command must contain the '-c' parameter. If more than one channel exists and a group is being created then the command must contain the '-c' parameter.
-o	Specifies the new group name when renaming a group.
-u	Specifies one or more devices in a comma separated list of Device IDs. Device IDs are number that uniquely specify a device in the system. The Device ID is shown on all output from a display command. This ID is displayed in extended displays as Device ID and is displayed in summery displays as ID. A Device ID can be specified according to the following rules using the '-u' parameter:

	<p>A single Device ID can be entered using a decimal number. Multiple Device IDs can be entered by typing a comma separated list (E.g. '-u 1,3,5,7'). A hyphen may be used in lists to specify a range of Device IDs (E.g. '-u 1-3,5')</p> <p>If more than one channel is present, then the '-c' parameter is always required when specifying Device ID(s).</p>
-v	Displays non-error messages.
-x	Display extended information

1. Display summary device information

atpcpro -f devdisplay

Required modifiers: None

Optional modifiers:

-c {channel}	Filter the list to show devices on the specified channel.
-u {devIdList}	Filter the list to show only the specified devices.
-x	Displays extended information.

Output:

```
#####
Channel 1: ATTO ExpressSAS H120F
#####

Enclosure 0: AIC 5/10D Expander
Enclosure Status:      Ok
Slot Count:           10

  ID  Slot Vendor  Product / Serial Number  Rev  Group Name  Capacity
-----
  4   0  HITACHI  HUS723030ALS640  A220 *Available  2.73 TB
        SN:YHHD4GNA
  5   1  HITACHI  HUS723030ALS640  A220 *Available  2.73 TB
        SN:YHHD4ULA
  6   2  HITACHI  HUS723030ALS640  A220 *Available  2.73 TB
        SN:YHHD5D2A
 11   3  WDC      WD1000DHTZ-04N21  6A00 *Available  931.51 GB
        SN:WD-WX11EC188626
 12   4  ATA      ST3250310NS      SDN1 *Available  232.89 GB
        SN:9SF076NJ

Enclosure 1: ATTO Virtual SES
Enclosure Status:      Ok
Slot Count:           16

  ID  Slot Vendor  Product / Serial Number  Rev  Group Name  Capacity
-----
  0   0  HITACHI  HUC101473CSS300  A410 raid1e  68.37 GB
        SN:P2V0E6NA
  1   1  HITACHI  HUC101473CSS300  A410 raid1e  68.37 GB
        SN:P2V0EBWA
  2   2  HITACHI  HUC101473CSS300  A410 *Hot spare  68.37 GB
        SN:P2V0EN1A
  3   3  HITACHI  HUC101473CSS300  A410 *Hot spare  68.37 GB
        SN:P2V0HZAA
  7   8  ATA      D2CSTK251M14-024  2.22 raid0  223.57 GB
        SN:OCZ-2K89091HR22FMF07
```

2. Display detailed device information

atpcpro -f devdisplay -x

Required modifiers: None

Optional modifiers:

-c {channel}	Filter the list to show devices on the specified channel.
-u {devIdList}	Filter the list to show only the specified devices.
-x	Used to specify extended device information.

Output:

```
#####
:channel 1: ATTO ExpressSAS H120F
#####

:inclosure 0: AIC 5/10D Expander
  Enclosure Status:      Ok
  Slot Count:           10

  Device ID:             4
  Device State:          Available
  Device Status:         Online
  Bus:Target:LUN:        0:4:0
  Vendor:                HITACHI
  Product:               HUS723030ALS640
  Firmware Revision:     A220
  Serial Number:         YHHD4GNA
  Capacity:              2.73 TB
  Sector Size:           512 B
  SSD:                   No
  Port Address:          50:00:CC:A0:1A:4E:72:FD
  Group Name:            N/A
  Member Number:         N/A
  Operation:             N/A
  Slot Number:           0
  Locate:                off

  Device ID:             5
  Device State:          Available
  Device Status:         Online
  Bus:Target:LUN:        0:5:0
  Vendor:                HITACHI
  Product:               HUS723030ALS640
  Firmware Revision:     A220
  Serial Number:         YHHD4ULA
  Capacity:              2.73 TB
  Sector Size:           512 B
  SSD:                   No
  Port Address:          50:00:CC:A0:1A:4E:78:49
  Group Name:            N/A
  Member Number:         N/A
  Operation:             N/A
  Slot Number:           1
  Locate:                off
```


4. Create a group

```
atpcpro -f rgcreate -n {name} -g {groupType} -u {devIdList}
```

Required modifiers:

-g {type}	raid0 and raid1e are valid
-n {name}	Filter the list to show only the specified group.
-u {devIdList}	Filter the list to show only the specified devices.

Optional modifiers:

-c {channel}	Filter the list to show devices on the specified channel.
-d {feature}	'boot', 'wrcache' and 'primary' are valid.
-e {feature}	
-k {blockSize}	Only 512 and 4096 are valid.
-m {member}	For enabling the primary feature only on a RAID 1E group with an even number of members.

Comments:

- This creates a RAID group with the specified name and group type from the devices specified by the device list.
- These devices must be available and should be unmounted from the operating system before creating the RAID group.
- The device list must specify devices that have the same drive type. They must also have the same physical sector size.



Note

The "boot" feature cannot be selected for drives that are formatted for T10-DIF protection information.

Error Codes:

rgcreate	
"Group creation failed"	
Failed (RAID error 0x01).	An I/O error occurred while attempting to write metadata to a device.
Exceeded system limits (RAID error 0x03).	The maximum allowed group are already present or the RAID group specified has more members than the driver allows.
Invalid group type (RAID error 0x08).	The group type is not supported by the driver.
Invalid group name (RAID error 0x09).	The group name already being used by another group.
Invalid device ID (RAID error 0x0A).	One or more of the device IDs specified does not exist.
Invalid member count (RAID error 0x0C).	The member count is invalid for the group type. Currently only displayed when a 1 member RAID group is created.
Invalid block size (RAID error 0x0F).	The specified block size is not supported or is not a multiple of the member sector size.
Invalid feature (RAID error 0x10).	A group feature is unsupported. This could be caused by one of the following: the application is setting a feature that is unsupported by the driver; trying to set the boot feature on a group with a T10-DIF enabled drive; trying to set the primary feature on a group that is not a RAID1E even group.
Incompatible members (RAID error 0x11).	The members cannot form a RAID group due to conflicting parameters such as sector size, mixing SAS/SATA drives or mixing HDD/SDD drives.
Disk capacity too small (RAID error 0x12).	A member is not large enough (must be >48MB) for the metadata and user data.
Invalid device state (RAID error 0x17).	One or more of the devices specified is not available for RAID group creation.

5. Display summary group information

atpcpro -f rgdisplay

Required modifiers: None

Optional modifiers:

-c {channel}	Filter the list to show devices on the specified channel.
-n {name}	Filter the list to show only the specified group.
-x	Used to specify extended group information.

Output:

```
#####
Channel 1: ATTO ExpressSAS H120F
#####
```

Group Name	Type	Status	Capacity	Blk Sz	Boot	Wr Cache
raid0	RAID 0	Online	894.10 GB	4.00 KB	No	Enabled
raid1e	RAID 1E	Degraded	68.32 GB	512 B	Yes	Enabled

6. Display detailed group information

atpcpro -f rgdisplay -x

Required modifiers: None

Optional modifiers:

-c {channel}	Filter the list to show devices on the specified channel.
-n {name}	Filter the list to show only the specified group.
-x	Used to specify extended group information.

Output:

```
#####
Channel 1: ATTO ExpressSAS H120F
#####
```

```
Group Name: raid0
Bus:Target:LUN:      0:16:0
Group Type:          RAID 0
Capacity:            894.10 GB
Block Size:          4.00 KB
Interleave:          64.00 KB
Group Status:        Online
Boot Device:         No
Write Caching:       Enabled
```

8. Display member information for groups

atpcpro -f rmdisplay

Required modifiers: None

Optional modifiers:

-c {channel}	Filter the list to show devices on the specified channel.
-n {name}	Filter the list to show only the specified group.
-x	Used to specify extended group information.

Output:

```
#####  
Channel 1: ATTO ExpressSAS H120F  
#####
```

Group Name: raid0 (RAID 0, online)

Member	ID	Status	Locate	Operation
0	7	online	on	None
1	8	online	on	None
2	9	online	on	None
3	10	online	on	None

Group Name: raid1e (RAID 1E, Degraded)

Member	ID	Status	Locate	Operation
0	0	online	off	None
1	1	Degraded	off	Rebuilding (10%)

10. Display detailed member information for groups

atpcpro -f rmdisplay -x

Required modifiers: None

Optional modifiers:

-c {channel}	Filter the list to show devices on the specified channel.
-n {name}	Filter the list to show only the specified group.
-x	Used to specify extended group information.

```
#####  
Channel 1: ATTO ExpressSAS H120F  
#####
```

Group Name: raid0 (RAID 0, Online)

```
Member: 0  
Device ID: 7  
Device Status: Online  
Serial Number: OCZ-2K89091HR22FMF07  
Operation: None  
Bus:Target:LUN: 0:7:0  
Vendor: ATA  
Product: D2CSTK251M14-024  
FW Version: 2.22  
Capacity: 223.57 GB  
Sector Size: 512 B  
SSD: Yes  
Port Address: 50:01:08:60:00:17:F6:98  
Enclosure: ATTO Virtual SES  
Slot: 8  
Locate: on
```

Output:

12. Modify a group



Note

The "boot" feature cannot be selected for drives that are formatted for T10-DIF protection information

```
atpcpro -f rgmodify -n [name] -e {feature}
```

```
atpcpro -f rgmodify -n [name] -d {feature}
```

Required modifiers:

-n {name}	Specifies the group to modify.
-----------	--------------------------------

Optional modifiers:

-c {channel}	If there are 2 groups with same name on different channels then '-c' is required.
-d {feature}	Disable the specified feature. This can be specified multiple times.
-e {feature}	Enable the specified feature. This can be specified multiple times.
-m {member}	For enabling the primary feature only on a RAID 1E group with an even number of members.

Error Codes:

rgmodify	
"Group modify failed"	
Failed (RAID error 0x01).	An I/O error occurred while attempting to write metadata to a device.
Invalid feature (RAID error 0x10).	A group feature is unsupported. This could be caused by one of the following: the application is setting a feature that is unsupported by the driver; trying to set the boot feature on a group with a T10-DIF enabled drive; trying to set the primary feature on a group that is not a RAID1E even group.
Invalid device status (RAID error 0x16).	A group member is dual-ported. Disconnect the second port of the dual-ported member(s) to allow the group to be modified.

14. Create a hot spare

This creates one or more hot spares from the devices specified by the device list. These devices must be Available and should be unmounted from the operating system before creating the hot spares.

```
atpcpro -f hscreate -u {devList}
```

Required modifiers:

-u {devList}	Specifies a list of Device IDs to use to make hot spares.
--------------	---

Optional modifiers:

-c {channel}	If there is more than 1 channel then '-c' is required.
--------------	--

Error Codes:

hscreate	
"Hot spare creation failed on device ID D"	
Failed (RAID error 0x01).	An I/O error occurred while attempting to write metadata to the device.
Exceeded system limits (RAID error 0x03).	The maximum allowed spares are already present.
Invalid device ID (RAID error 0x0A).	The specified device ID does not exist.
Disk capacity too small (RAID error 0x12).	A member is not large enough (must be >48MB) for the metadata and user data.
Invalid device state (RAID error 0x17).	The specified device is not available for hot spare creation.

15. Delete a hot spare

This deletes the hot spares specified by the device list and presents them back to the operating system.

```
atpcpro -f hsdelete -u {devList}
```

Required modifiers:

-u {devList}	Specifies a list of hot spares that should be made into Available devices.
--------------	--

Optional modifiers:

-c {channel}	If there is more than 1 channel then '-c' is required.
--------------	--

Error Codes:

hsdelete	
"Hot spare deletion failed on device ID D"	
Failed (RAID error 0x01).	An I/O error occurred while attempting to clean metadata from the device.
Invalid device ID (RAID error 0x0A).	The specified device ID does not exist.
Invalid device status (RAID error 0x16).	The spare is dual-ported. Disconnect the second port of the dual-ported spare to allow the spare to be deleted.
Invalid device state (RAID error 0x17).	The specified device is not a hot spare.

17. Locate a device

Locate only works with devices that have supporting SES enclosures or SGPIO.

The command is a toggle such that the same command issued twice will result in the state before the 1st command was issued.

atpcpro -f devlocate -u {devList}

Required modifiers:

-u {devList}	Specifies a list of Device IDs that should toggle their locate status.
--------------	--

Optional modifiers:

-c {channel}	If there is more than 1 channel then '-c' is required.
--------------	--

18. Locate a group

Locate only works with devices that have supporting SES enclosures or SGPIO.

The command is a toggle such that the same command issued twice will result in the state before the 1st command was issued.

atpcpro -f rglocate -n {groupName}

Required modifiers:

-n {name}	Specifies a group that should toggle its locate status.
-----------	---

Optional modifiers:

-c {channel}	If have 2 groups with same name on different channels then '-c' is required.
--------------	--


19. Turn off locate in progress

A single command can be used to turn off any locate operations.

atpcpro -f devlocate

atpcpro -f rglocate

21. Rebuild a group using degraded member

 **Note** *During normal operation, no additional software is necessary. However, degraded and offline RAID groups require the ATTO ConfigTool service to complete the rebuild operation. ATTO's ConfigTool is a free application available for download at www.atto.com. ATTO ConfigTool installation and operation instructions are available in [Installation](#) on page 7 of this manual.*

This form of the command will use a currently degraded drive for the rebuild.

If the member drive selected is not degraded then an error is returned.

```
atpcpro -f rgrebuild -n {name} -m {member}
```

Required modifiers:

-m {member}	Member of the group to rebuild.
-n {name}	Name of the group to rebuild.

Optional modifiers:

-c {channel}	If have 2 groups with same name on different channels then '-c' is required.
-u {DevId}	Single Available device that will replace the current member specified by member number.

23. Rebuild a group using an available drive

This form of the command will use an available drive for the rebuild. The drive should be unmounted from the operating system before running the rebuild command. The device selected must have the same operational parameters as the members of the RAID group and physical sector size.

If the member drive selected is not degraded then an error is returned

```
atpcpro -f rgrebuild -n {name} -m {member} -u {DevId}
```

Required modifiers:

-m {member}	Member of the group to rebuild.
-n {name}	Name of the group to rebuild.

Optional modifiers:

-c {channel}	If there is more than 1 channel then '-c' is required.
-u {DevId}	Single Available device that will replace the current member specified by member number.

Error Codes:

rgrebuild	
"Group rebuild failed"	
Failed (RAID error 0x01).	An I/O error occurred while attempting to write metadata to a device.
Invalid group type (RAID error 0x08).	The group type does not allow rebuilds.
Invalid device ID (RAID error 0x0A).	The replacement drive device ID does not exist.
Invalid member number (RAID error 0x0D).	The specified member number is invalid.
Incompatible members (RAID error 0x11).	The new member cannot be added to the RAID group due to conflicting parameters such as sector size, mixing SAS/SATA drives or mixing SSD/HDD drives.
Disk capacity too small (RAID error 0x12).	The new device is not large enough to be a member of the group.
Operation already in progress (RAID error 0x15)	A rebuild is already in progress for this member.
Invalid device status (RAID error 0x16).	One of several: a group member is dual-ported - disconnect the second port of the dual-ported member(s) to allow the group to be rebuilt; the member being rebuilt/replaced is not degraded or faulted; the group is not degraded; the new member not an available drive or an online hot spare.
Invalid device state (RAID error 0x17).	The specified device is not an available drive and cannot replace the specified RAID member.

25. Rename a group


`atpcpro -f rgrename -n {name} -o {name}`

Required modifiers:

-n {name}	Specifies the name of the group to rename.
-o {name}	Specifies the new name of the group.

Optional modifiers:

-c {channel}	If have 2 groups with same name on different channels then '-c' is required.
-u {DevId}	Single Available device that will replace the current member specified by member number.

 Note *All members of a group must be present to rename a group.*

Error Codes:

rgrename	
"Group rename failed"	
Failed (RAID error 0x01).	An I/O error occurred while attempting to write metadata to a device.
Invalid group name (RAID error 0x09).	The group name already being used by another group.
Invalid member count (RAID error 0x0C).	A group member is missing so a rename cannot be done without orphaning the missing member.
Invalid device status (RAID error 0x16).	A group member is dual-ported. Disconnect the second port of the dual-ported member(s) to allow the group to be renamed.

26. Verify a group

`atpcpro -f rgverify -n {name}`

Required modifiers:

-n {name}	Name of the group to verify.
-----------	------------------------------

Optional modifiers:

-c {channel}	If have 2 groups with same name on different channels then '-c' is required.
--------------	--

 Note *This operation will fail if the group is not complete, the group is not online, or if a duplicate group is found.*

28. Clean a device

Devices that are marked as 'blocked' may need to be cleaned. A blocked device is cleaned to avoid accidental data loss. The clean operation will remove all metadata from the device and it will also write zeroes to the first 4KB of the device. The following command is used to clean a 'blocked' device.

```
atpcpro -f devclean -u [Device List]
```

Required modifiers:

-u {DevList}	List of Device IDs to clean.
--------------	------------------------------

Optional modifiers:

-c {channel}	If there is more than 1 channel then '-c' is required.
--------------	--

Error Codes:

devclean	
"Device clean failed on device ID D"	
Failed (RAID error 0x01).	An I/O error occurred while attempting to clean metadata from the device.
Invalid device ID (RAID error 0x0A).	The specified device ID does not exist.
Invalid device status (RAID error 0x16).	The device is not available for cleaning (i.e. not blocked).

29. Delete a group

This deletes the RAID group with the specified name and presents the member drives back to the operating system

```
atpcpro -f rgdelete -n [name]
```

Required modifiers:

-n {name}	Name of the group to delete.
-----------	------------------------------

Optional modifiers:

-c {channel}	If there are 2 groups with same name on different channels then '-c' is required.
--------------	---

Error Codes:

devclean	
"Device clean failed on device ID D"	
Failed (RAID error 0x01).	An I/O error occurred while attempting to clean metadata from the device.
Invalid device ID (RAID error 0x0A).	The specified device ID does not exist.
Invalid device status (RAID error 0x16).	The device is not available for cleaning (i.e. not blocked).

Troubleshooting

Device State and Status Messages

The Power Center Pro output often provides information on the device and RAID group state and status. Device states messages can be interpreted using the following table:

Device State	Device Status	Device Reason	Comments
Available	Online	None	The device is available for use as a RAID member or hot spare.
Unavailable	Online	Unsupported geometry	The device is not available for use as a RAID member or hot spare since it has either an unsupported sector size or is a SATA device that does not support NCQ.
		No serial number	The device is not available for use as a RAID member or hot spare since the serial number could not be read from the device or is invalid.
		Dual ported device	The device is a dual ported SAS device that cannot be used as a RAID member or hot spare.
		Externally connected	The device is connected to an external host connector and cannot be used as a RAID member or hot spare.
	Blocked	Metadata invalid	The device metadata is complete but some value in it is either invalid or unsupported.
		Metadata corrupt	The device metadata is incomplete or corrupt.
		Metadata unavailable	The location where RAID metadata is stored could not be read.
		Metadata unsupported	The device metadata is complete but the version of the metadata is unsupported by the host driver.
	Exceeded limits	The number of RAID group members supported by the host has been exceeded.	
	I/O error	An I/O error has occurred while attempting to discover RAID information from the device.	
Member	Online	None	The device is a valid RAID member.
		I/O error	An I/O error has occurred while accessing the RAID member.
	Offline	Conflict	The RAID member has metadata information that conflicts with another member of the RAID group.
		Replaced	The RAID member has been replaced by another device.
		Duplicate member	Two devices with the same member number and RAID group name have been discovered.
		Missing	The member is not physically present. This is only reportable if at least one other member of the group is present.
	Blocked	Unsupported geometry	The device metadata is valid but the device has either an unsupported sector size or is a SATA device that does not support NCQ.
		Exceeded limits	The number of RAID group members supported by the host has been exceeded.
		Dual ported device	The device is a dual ported SAS device that has valid RAID member metadata on it. The device will not be used to prevent damage to the user data.
		Incompatible	The device metadata is valid but was created by a host that is not compatible with this one.
		Externally connected	The device is connected to an external host connector but has valid RAID member metadata on it.
	Degraded	None	The device data is out of synch with another redundant member; generally caused by new data being written while the device was missing, an error while writing new data or the member is a new member of the group and needs to be rebuilt.
	Faulted	None	The device is physically present but enough errors have occurred to render the device inaccessible. This could also be caused by a write error during a rebuild.
Hot Spare	Online	None	The device is a valid RAID hot spare.
		Exceeded limits	The number of hot spares supported by the host has been exceeded.
	Blocked	Dual ported device	The device is a dual ported SAS device that has valid RAID hot spare metadata on it. The device will not be used to prevent damage to the user data.
		Incompatible	The device metadata is valid but was created by a host that is not compatible with this one.
		Externally connected	The device is connected to an external host connector but has valid RAID hot spare metadata on it.

RAID Group state and status messages can be interpreted using the following table:

RAID Group State	RAID Group Status	RAID Group Reason	Comments
(Group)	Online	None	All of the RAID members are Online.
		I/O error	At least one of the RAID members has a Device Reason of "I/O Error".
	Offline	None	Enough members of the group cannot be used that the group cannot be presented to the system.
		Waiting	The RAID group is still waiting for missing members before being presented to the system.
		Conflict	Members of the RAID group have conflicting metadata.
		Missing	Enough members of the group are not present that the group cannot be presented to the system.
	Blocked	Exceeded limits	The number of RAID groups supported by the host has been exceeded.
		Dual ported device	At least one of the RAID members has a Device Reason of "Dual ported device".
		Externally connected	At least one of the RAID members has a Device Reason of "Externally connected".
	Degraded	None	Enough members of the group are online to make the all device data accessible but some data redundancy does not exist.

Error Codes

Error messages may be returned if a command is not properly constructed, or if an operation is unable to be completed. The table below describes the meaning of these general errors:

Message	Meaning
Please select a function (-f).	AtPcPro requires an -f options with a valid function when the -l, -h or -v switch are not supplied.
An invalid option was specified for the selected function.	One or more options (of the set -d, -e, -g, -k, m, -n, -o, -u, -x) is incompatible with the function specified by -f. See the section on "Option Compatibility" for more information.
A required option was not specified for the selected function.	One or more necessary options (of the set -d, -e, -g, -k, m, -n, -o, -u, -x) for the function specified by -f was not supplied. See the section on "Option Compatibility" for more information.
Group names must contain only alphanumeric characters.	Group names must contain only characters from A-Z or 0-9, upper-case or lower-case.
Group names are limited to 14 characters.	Supplied group names have a maximum width of 14 characters.
Only one device may be selected for this operation.	When performing a rebuild (-f rgrebuild) only one replacement device may be specified with -u.
Please select a channel (-c).	When not displaying device information (devdisplay, rgdisplay, rmdisplay) and multiple adapters are installed and at least one device has been specified (-u) it is necessary to specify on which adapter the function will be performed. Otherwise it is ambiguous which adapter to use.
Please select a channel for the group (-c)	Multiple groups with the same name have been found on multiple adapters. Use the -c option to select a specific adapter so that only one group is used for the operation.
Group GROUP has missing members.	Determined during verification (rgverify) that group GROUP has 1 or more missing members.
Group GROUP is not online.	Determined during verification (rgverify) that group GROUP is not online.
Multiple groups named GROUP.	Determined during verification (rgverify) that multiple groups with the name GROUP exist.
Channel C: Could not discover RAID info.	Unable to query groups, members or drives on adapter C.
Channel C: Group NAME was not found.	A group with the name NAME was not found on adapter C.
Channel C: Group NAME already exists.	A group with the name NAME already exists on adapter C.
Channel C: The specified group features are not supported.	The group featured specified by either -e or -d is not supported by adapter C.
Channel C: The specified group type is not supported.	The group type specified by -g is not supported by adapter C.
Channel C: The specified device ID (D) does not exist.	The device ID D (specified by -u) does not exist on adapter C.
Channel C: Group NAME does not contain member number M.	The member number specified by -m does not exist for group NAME on adapter C.
OPERATION failed. Version is not supported (Error 0x02).	The CLI tool and driver are not compatible.
OPERATION failed. Invalid function (Error 0x04).	The CLI tool and driver are not compatible.
OPERATION failed. Controller is degraded (Error 0x0B).	The driver has been shut down due to too many errors.

Conflicting Groups

It is possible that different groups with the same name will be present. This can occur for the following scenarios:

- The members of a single group have conflicting information such that they have been split into two groups. Some examples of this are the following:
 - a. If one mirror is moved to a second system and then brought back to the original system. The two mirrors will have conflicting information and the user must decide which mirror is the correct mirror.
 - b. A two member RAID 1e group first comes up with one member and then on reboot the other member comes up. This is effectively the same as the previous scenario.

The CLI presents the above scenarios with the following display information.

1. One group will have the original name and the second group will have the original name with a '_n' appended to the name where 'n' is a digit between 1 and 9.
2. The user should determine the correct group to keep. They can use locate to determine the drives in each group or they may be able to review the data if the group is online.
3. The user should delete the group that is no longer needed via CLI commands.
4. The user would then add drives to the remaining group and start a rebuild.

The primary mirror property is a mechanism that can help in scenario 2.a. The user can designate a mirror to be specified to be the primary mirror and when scenario 2.a occurs the driver will automatically keep the primary mirror and mark the other mirror as degraded. The primary mirror only works when the raid group has an even number of drives. This mechanism is most useful in the situation where a user moves a mirror to another system, backs it up and then returns it to the original system.

10 SNMP Configuration

SNMP is a standard network protocol that provides the ability to monitor SNMP enabled systems from anywhere on the network. Once configured, 3rd party MIB browsers on a Management Station can be used to retrieve the current configuration and receive TRAP messages when significant events occur.

The ATTO SNMP agent has two modes, depending on your configuration. If the only SNMP agent on your server is the ATTO agent, the mode should be Enabled. If you have other SNMP agents running and you want them to integrate their data into a single tree of information or if you want to use advanced SNMP features, choose SubAgent mode (See Error! Reference source not found.).

Definitions

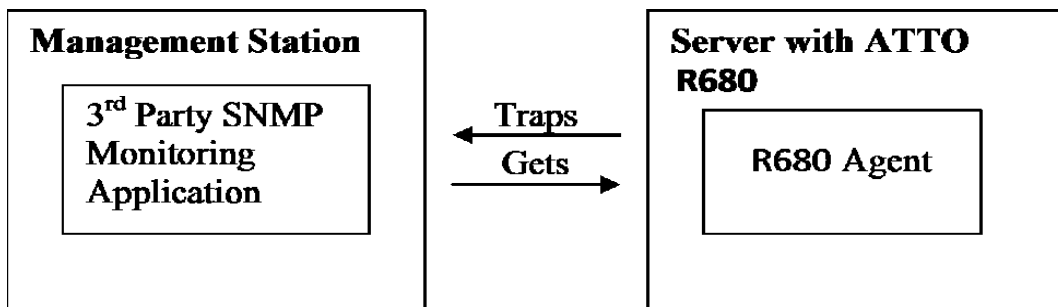
- SNMP - Simple Network Management Protocol
- Network Node - An addressable device attached to a computer network.
- Management Station - The host system that monitors network nodes.
- Trap - An alert that is sent to a management station by agents.
- Agent - A software process on the system being monitored that responds to queries using SNMP to provide status and statistics about a network node.
- SubAgent - A software process on the system being monitored that responds to SNMP queries from another agent, instead of a MIB browser. The request from the other agent is generated when it is contacted by a MIB browser.

Details

The ATTO SNMP agent supports protocol versions 1 and 2c. Communication with the agent requires UDP over IPv4. The ATTO specific information can be found under "attotech" in the "enterprises" node (1.3.6.1.4.1.4547). Read-only support is provided.

Enabled Mode

This mode of operation provides Management Stations with basic information for the standard OID tree, as well as the ATTO specific information. While this mode will also work if a system service is installed and running, the ATTO agent must be configured to listen on a different port than the system service to ensure both function properly. This mode is required to support SNMP if the system SNMP service (such as, Windows SNMP service or snmpd for macOS and Linux) is not already running.



SubAgent Mode


This mode of operation relies on the operating system's SNMP service being installed as a Master Agent and running. All Management Station requests must be directed to this Master Agent, **not** the ATTO agent. It is expected that only experienced SNMP administrators will use this mode, as installing and configuring the operating system services are beyond the scope of this document. Examples are Windows SNMP services, or the open-source Net-SNMP package.


In this mode, the system service is automatically reconfigured so that when the service receives requests for the ATTO

branch of the OID tree, the request is delegated to the ATTO agent through the loopback interface on a different port. While the primary benefit of subagent mode is to allow the Master Agent to handle most requests directly (the operating system services implement many more MIBs than the ATTO agent), and to allow multiple subagents to be merged into a single OID tree, this mode can be used to enable features that are not supported by the ATTO agent.


For example, if the system service supports version 3 of the protocol, all communication over the network between the Management Station and the service can be encrypted using the desired privacy options of version 3. The system service

will then communicate to the ATTO agent using one of the supported protocols.

 **Note** For security purposes, the ATTO agent will only respond to requests through the loopback interface when in subagent mode. If the system service is stopped, the ATTO agent will be inaccessible from any other host on the network.

 **Note** Other features that are not directly supported by the ATTO agent, but can be enabled with this configuration include source address filtering and stronger authentication than simple community strings provide. All of these features depend on

properly configuring the system service, and are beyond the control of the ATTO agent. Refer to the documentation for the system service to determine how to enable these features.

 **Note** On Windows Vista Service Pack 1 and Windows 2008, a bug in the Microsoft SNMP service prevents subagent mode from working correctly. This is a known issue that requires a hotfix: <http://support.microsoft.com/kb/950923>. The bug has been fixed in service pack 2. Enabled mode is not affected, nor is the Net-SNMP service if that is being used as a replacement for the Microsoft service.

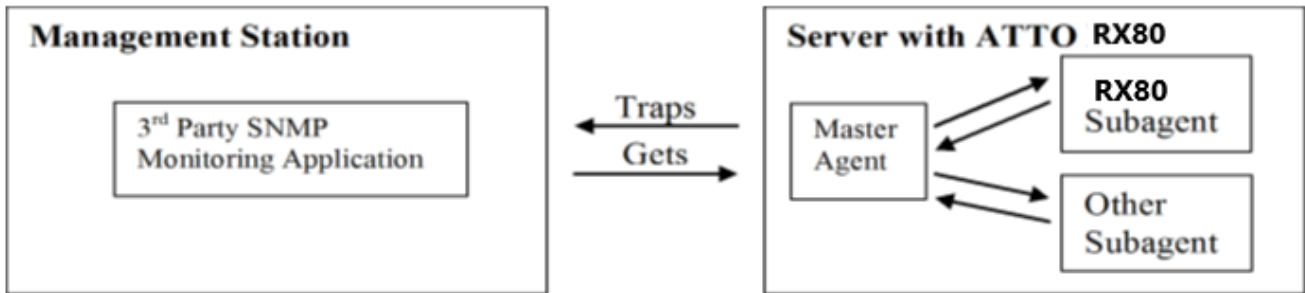


Figure 2: Subagent Mode

Disabled Mode

This mode disables the operation of the ATTO SNMP agent. Any network ports it has open to support SNMP are closed, making it inaccessible to any Management Station. The system service will not forward requests to it, and no TRAPs are sent out when events occur.

Basic Setup


The ATTO SNMP agent can be configured through the SNMP tab on the localhost node. When you first enter the SNMP tab, and until you commit a new mode, the SNMP mode will be **Disabled**. The various settings can be manually edited, but the simplest way to enable SNMP support in this case is to click the **Default** button and then click **Commit**. This will load the proper settings based on your current system configuration, and then reconfigure the agent to use them.


Configuration Options

Agent Port

This value specifies the UDP port that the ATTO SNMP agent listens on for incoming Management Station requests. The port cannot be used by any other process on the system, or the behavior of both the agent and the other process is undefined. The standard port value for SNMP is 161, but that


The operational mode (enabled or subagent) and port will be selected based upon whether or not an operating system SNMP service is running.

 **Note** The System Service and TRAP Service states are not updated dynamically as they change in the system. They can be manually updated at any time by clicking Refresh.

 **Note** In order to properly secure access to the agent from the local machine, it is suggested to change the default string in the Communities list before committing the default settings.

This basic setup will allow you to browse the information that is made available by the agent with a 3rd party application, but will not send out TRAPs. TRAP destinations are network specific, and cannot be determined programmatically.

is not the default value in subagent mode, because it is assumed that the system service is using that port.

 **Note** A binding error may not occur if the port is already in use. If you are not sure if a port is in use, use the netstat command.

In enabled mode, this is the port the Management Station uses to communicate with the agent. In subagent mode however, the agent will **not** respond on this port to Management Station requests from a different machine. The port the Management Station needs to use is the system service's port.

Communities

This is a list of community strings accepted by the agent when it receives an incoming request. If a Management Station makes a request and provides a community string that is not in this list, the request is dropped by the agent. If authentication traps are enabled, one will be sent to each configured destination. The list can be manipulated through the **Add**, **Edit** and **Remove** buttons below it. An existing community must be selected to edit or remove it. A valid community string has a length between 1 and 128 (inclusive) and can include any keyboard character.



Note

In subagent mode, only a single community can be specified since that is the community used by the Master Agent when talking to the ATTO SNMP subagent. The communities that Management Stations must use are configured through the system service.



Note

For added security in subagent mode, you should change the default community string. The agent cannot tell the difference between a local Management Station request and a request from the system service, which means a local user can bypass the authentication checks done by the system service if they know this community string and the agent's port. Send Authentication TRAP

When checked, the agent will send a TRAP to the configured TRAP destinations indicating that a Management Station attempted to contact the agent and used a community string that is not in the community list.



Note

In subagent mode, this may only be useful for debugging. The system service will perform Management Station authentication based on its configuration, and only forward the request to the ATTO agent once the Management Station is authenticated. Since the system service is reconfigured as needed

to use the community string on this panel when forwarding requests, there should not be authentication errors when the agent processes requests from the system service. The system service usually has the same option that can be enabled to see these authentication failures.

Enable TRAPs

When checked, the agent will send traps to the configured destinations, if any, if the agent itself is not disabled.

Trap Destination Table

This table lists the host address and community string used for each destination when a trap is triggered. The host column consists of the hostname or IP address of the Management Station to which the traps are sent, and the UDP port on which the trap receiver is listening. The community column displays the community string sent with the trap to that host. If the community string is not in the list of communities accepted by the receiver, the receiver will ignore the trap message.

The table can be manipulated through the Add, Edit and Remove buttons below it. An existing destination must be selected to edit or remove it. A valid community string has a length between 1 and 128.



Note

The trap configuration is completely independent of the enabled or subagent modes, but no traps are sent if the agent is disabled.

Many operating systems have a trap receiver service as part of their SNMP package, which can be configured to do various things when it receives a trap, such as writing to a log file or forwarding to another destination. In a similar manner to the way the system service and subagent mode can enable SNMPv3 support, the operating system trap service can be configured to translate traps it receives into SNMPv3 traps, with optional privacy, authentication and INFORM support. The ATTO agent then only needs to specify a single trap destination to this service in order to enable SNMPv3 support over the network. The manner in which the system service is configured is system specific, and beyond the scope of this document.

Control Buttons

Commit

This button will reconfigure the ATTO agent to use the settings as they are currently displayed on the screen, after validating them to the extent possible. The settings are persistently stored, so that they are available after a reboot.

If necessary, the system service will be reconfigured to support the agent's current operational mode.


Restore

This button will update the display to reflect the settings the agent is currently using, rolling back any changes made in the

panel that have not been committed. Since these are the current settings, they do not need to be committed.

Default

This button will update the display with the simplest configuration, based on the current system configuration. For example, if the operating system service is detected as running, the default mode is subagent. Otherwise, the mode is enabled and the registered SNMP port is displayed.

 **CAUTION** *Since it isn't possible to determine trap destinations and community strings programmatically, all trap destinations will be cleared.*

Test

This button will validate the settings displayed on screen, and then send a warm Start trap to each of the displayed trap

Troubleshooting


Requests from a MIB browser time out.

- Ensure the agent is not disabled
- Ensure the Management Station is using the port for the system service if the agent is in subagent mode or the port displayed on the SNMP panel if the agent is enabled.
- Ensure the community string used by the Management Station is accepted by the system service when in subagent mode or is displayed in the communities list on the SNMP panel if the agent is enabled. Be sure the Send Authentication TRAP option is selected, committed, and then try again. If the community is a problem, each of the configured trap destinations will be notified.
- Ensure the Management Station is using SNMPv1 or SNMPv2c, unless the system service is being used.
- If in subagent mode, the system service may be misconfigured. Try enabling the agent and using the Management Station to talk directly to it. You will have to change the port value and likely the community string.

Traps are not received when testing

- Ensure the agent is not disabled

destinations as if the displayed settings had been committed. Selecting disabled mode, unchecking the enable traps option or removing all trap destinations will prevent the test trap from being sent. Once an acceptable configuration is entered, a commit is needed for it to take effect.

 **Note** *The test is not performed by changing the settings used by the agent at the time of the test, so testing will have no effect on any concurrent Management Station requests.*


Save MIBs

This button will save the nonstandard MIBs implemented by the agent to the user specified directory as individual text files so they can be loaded into a MIB configuration. If one of the files already exists in that directory, the user is prompted to overwrite or skip the file, or cancel the operation.

- Ensure the Enable TRAPs option is checked.
- Ensure a trap recipient is properly configured and running on each machine in the destination table, at the specified port.
- Ensure the community associated with the destination is in the trap recipient's community list.

The RAID OIDs are skipped when walking or the tables are empty

- Ensure the driver for the RAID adapter is installed. This can be seen on the Basic Info panel for the adapter.

 **Note** *To properly work with Net-SNMP when configured as a subagent, the Net-SNMP package has to be installed "With Windows Extension DLL Support". This is an option during the installation of Net-SNMP.*


 **Note** *The architecture of Net-SNMP installed has to match the O/S; i.e. if you are using a 64bit O/S the 64bit version of Net-SNMP must be installed.*

Exhibit 46 Panel Image

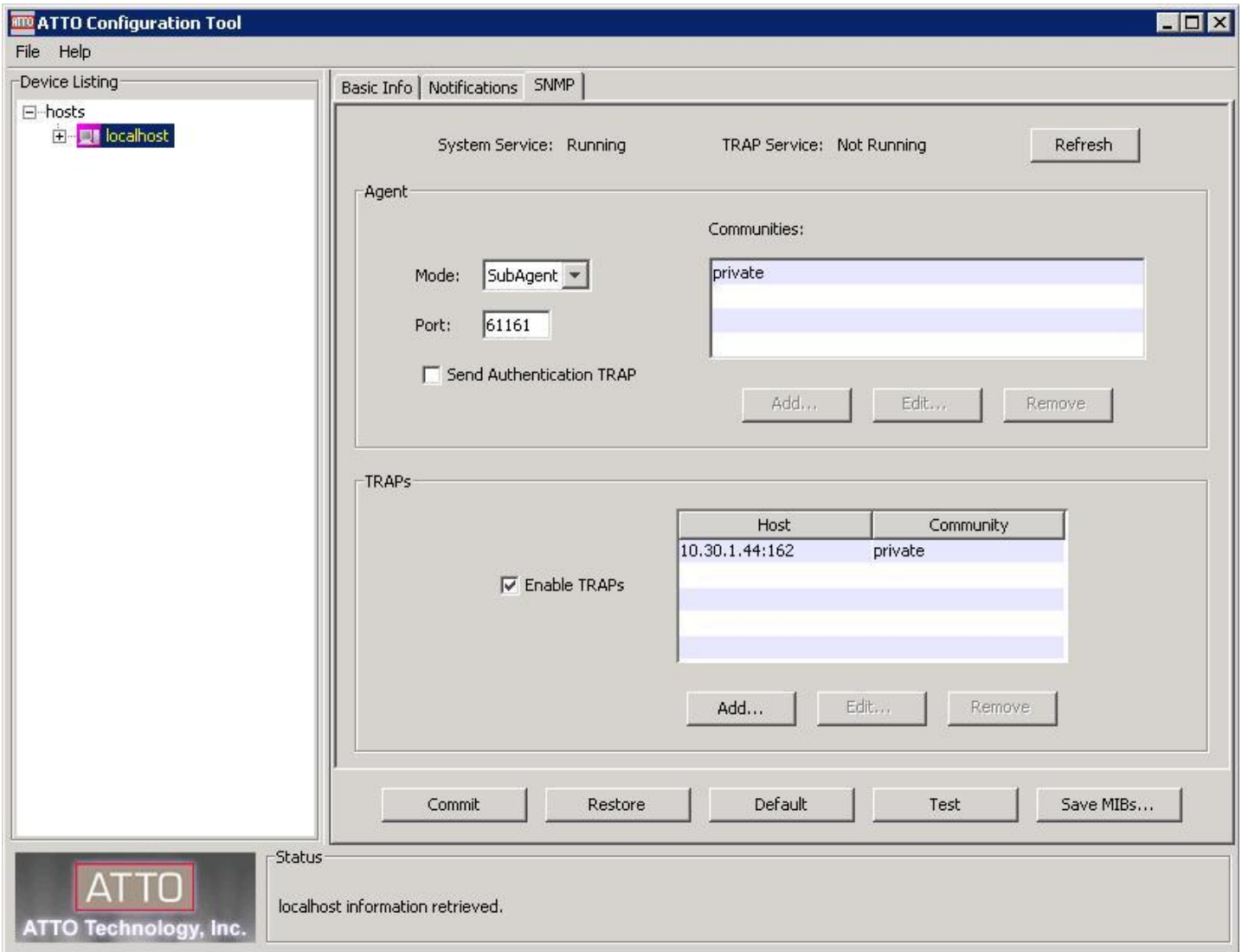


Exhibit 47 Community Image

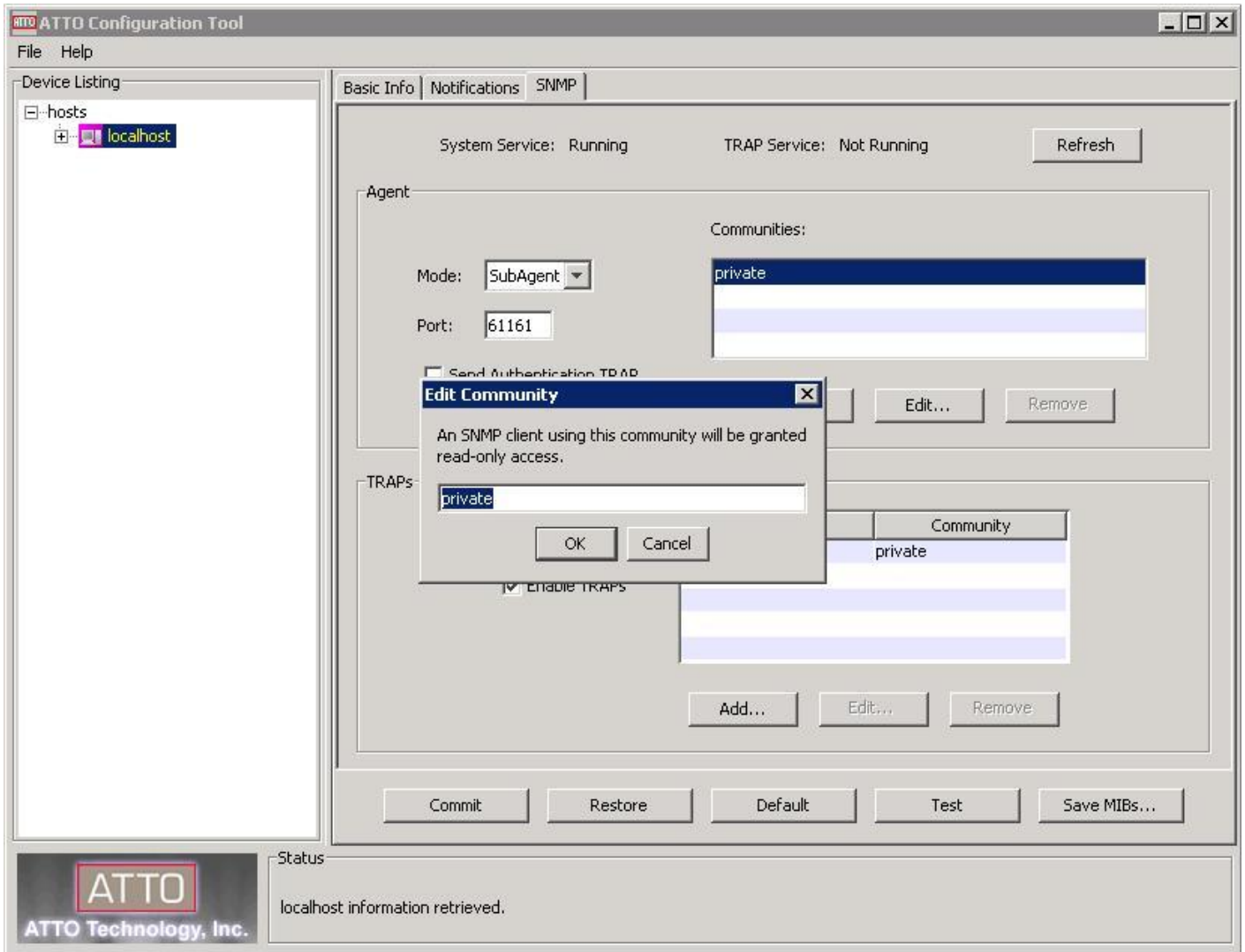


Exhibit 48 Edit Trap Image

The screenshot displays the ATTO Configuration Tool interface. On the left, a 'Device Listing' pane shows a tree view with 'hosts' expanded to reveal 'localhost'. The main window has tabs for 'Basic Info', 'Notifications', and 'SNMP'. The 'Basic Info' tab is active, showing 'System Service: Running' and 'TRAP Service: Not Running' with a 'Refresh' button. Below this, the 'Agent' section includes a 'Mode' dropdown set to 'SubAgent' and a 'Port' text box containing '61161'. A 'Communities' list contains 'private'. An 'Edit TRAP Destination' dialog box is open, displaying the text: 'TRAPs generated by the ATTO agent will be sent to this address, using the given community.' The dialog has input fields for 'Address' (10.30.1.44), 'Port' (162), and 'Community' (private), along with 'OK' and 'Cancel' buttons. In the background, a table lists TRAP destinations with columns for 'Address', 'Port', and 'Community'. At the bottom of the main window, there are buttons for 'Commit', 'Restore', 'Default', 'Test', and 'Save MIBs...'. A 'Status' bar at the very bottom shows the message 'localhost information retrieved.' and the ATTO Technology, Inc. logo.

11 Celerity Virtual Port Management

The ConfigTool provides the ability to manage virtual ports on Celerity HBAs installed on Windows platforms. Virtual port functionality is implemented by the Celerity driver according to the N_Port ID Virtualization (NPIV) extension to the Fibre Channel standard. N_Port ID Virtualization (NPIV) is an extension to the Fibre Channel industry standard. NPIV allows a single, physical adapter port to function as multiple virtual ports (VPorts), each having a unique Fibre Channel World-Wide-Name in the SAN. This allows a Storage Administrator to follow SAN best practices, such as zoning and masking, to control LUN access on a per-VPort basis. The ConfigTool NPIV interface can be used to create, delete and monitor virtual ports on either a local or remote Windows host.


Registry Settings for NPIV

Windows

 **Note** *NPIV support for Windows is currently limited to Windows Server 2008 R2 and later.*

The 8Gb, 16Gb and 32Gb Celerity drivers for Windows provide NPIV support compatible with Microsoft's Hyper-V virtualization platform. Each physical port on the adapter is capable of supporting up to eight virtual ports. NPIV functionality is disabled by default and must be enabled via

the Windows registry (refer to the “Registry Settings” section of the readme.html file in the ATTO install directory for details on modifying HBA registry parameters).

 **Note** *Modifying your registry incorrectly may result in making your machine unbootable. Please use care in editing the registry.*

All registry settings are DWORD values. The following registry values are applicable to NPIV:

Name	Default Value ^a	Range	Usage
NpivEnable	0	0, non-0	A non-zero value enables the NPIV functionality in the driver. A zero value disables NPIV.
MaxNpivVPorts	8	1-8	Sets the maximum number of virtual ports that can be created on each physical port in the adapter. Setting this parameter to a value outside the stated range will cause the driver to revert to the default value (note that zero is not a valid value).
TargetMode	0	0, non-0	A non-zero value enables the Target Mode functionality in the driver. This parameter must be either undefined or set to zero for the NPIV functionality to be enabled.

- a. The Default Value is the value assigned to the parameter when it is not explicitly defined in the registry.

NPIV functionality is not compatible with the existing Target Mode capabilities of the Windows driver. As such, Target Mode must be disabled in order for NPIV to be successfully enabled. Attempting to enable both Target Mode and NPIV will enable Target Mode, but disable NPIV, causing a Warning message (Event ID 32818) to be posted to the Windows Event Log.

For Hyper-V, virtual ports need to be explicitly created before they can be used by a virtual machine. The creation and management of virtual ports is a function of the ATTO ConfigTool.

For additional information about utilizing NPIV in a Hyper-V environment refer to TechNet topic “Configuring a SAN Environment for VMM” (<http://technet.microsoft.com/en-us/library/cc764269.aspx>).

VMware ESX/EXi

The Celerity drivers for VMware ESX/ESXi 6.0 and VMware ESXi 5.x provide NPIV support by default (the functionality does not have to be explicitly enabled). However, there are four driver parameters that affect the performance and behavior of the NPIV feature, they are as follows:

max_npiv_logins	The maximum number of target ports that can be logged into a virtual port. Default is 32; maximum is 256.
-----------------	---

max_npiv_vports	The maximum number of virtual ports for an adapter channel. The default is 16; maximum is 64
npiv_disc_wait_time	The time period (in ms) that the driver waits for discovery to complete after creating a virtual port. Default is 10000.
npiv_init_retries	The number of times to attempt to initialize a virtual port before giving up. Default is 10.

Information about the VPorts is shown in the Driver info file on the Service Console. Refer to the Supplemental Guide for VMware ESX/ESXi in this chapter for details on viewing or modifying the above values.

Virtual ports are created by the kernel when an associated VM is started, and deleted when the VM is stopped. Active

virtual ports will appear as additional Virtual Adapters in the vSphere client.

For additional NPIV configuration details, please consult the VMware Fibre Channel SAN Configuration Guide (http://www.vmware.com/pdf/vsphere4/r41/vsp_41_san_cfg.pdf).

The NPIV Panel

When the channel highlighted in the Device Listing belongs to a Celerity adapter residing on a Windows host, the NPIV tab is added to the Configuration Options window. Clicking on the NPIV tab will display the NPIV panel, which provides controls for creating and deleting virtual ports on the selected channel and also displays the attributes and status of each active port. The contents of the NPIV panel are illustrated below and summarized in the sections that follow.

 **Note** *If the remote host is running an older version of the Celerity driver that does not support NPIV, the NPIV panel will display the message: "This version of the driver does not support NPIV." Visit the ATTO website (www.atto.com) to download the latest Celerity driver*

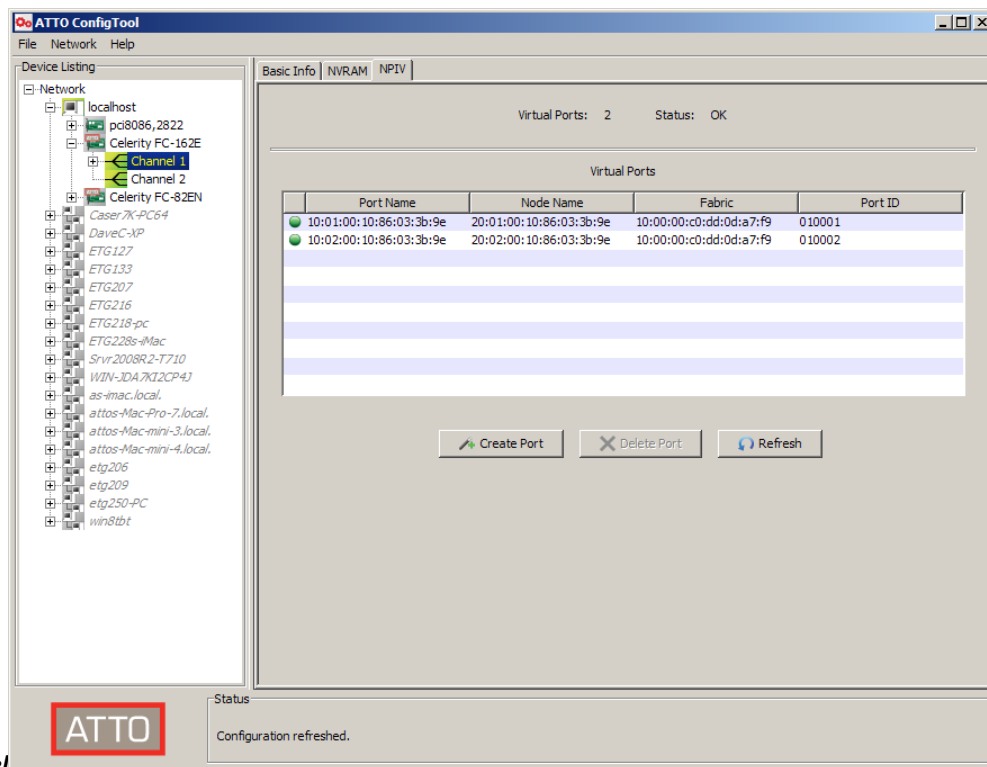


Exhibit 49 The NPIV Panel

Status

The NPIV status of the selected channel. This will be one of:

- **OK:** Virtual ports can be created on this channel.
- **Disabled:** NPIV is currently disabled on this channel. Refer to the Celerity Installation and Operation Manual for details on enabling NPIV.
- **Link Down:** The physical link is down.
- **Unsupported Topology:** The FC topology of the physical link does not support the creation of virtual ports.
- **Unsupported Switch:** The switch port connected to this channel does not support NPIV.
- **Unknown:** An unknown NPIV status (error code provided).

Virtual Port Count

The current number of active virtual ports on the selected channel.

Virtual Ports

A list of the active virtual ports on the selected channel. The following attributes are displayed for each virtual port:

- **Status LED:** Green indicates the port is up; red indicates the port is down.
- **Port Name:** The World-Wide-Port-Name assigned to the virtual port (supplied when the port is created).
- **Node Name:** The World-Wide-Node-Name assigned to the virtual port (supplied when the port is created).
- **Fabric:** The World-Wide-Name of the fabric that the virtual port is logged in to.
- **Port ID:** The N_Port ID assigned to the virtual port by the switch.

Create Port

Allows the user to create a new virtual port on the selected channel.

Delete Port

Allows the user to delete an existing virtual port from the selected channel.

Refresh

Forces a refresh of the information displayed on the NPIV panel.

Creating a Virtual Port

To create a new virtual port, perform the following steps:

- In the Device Listing window, select the Celerity adapter channel on which to create a new virtual port.
- Click on the NPIV tab in the Configuration Window to display the NPIV panel.



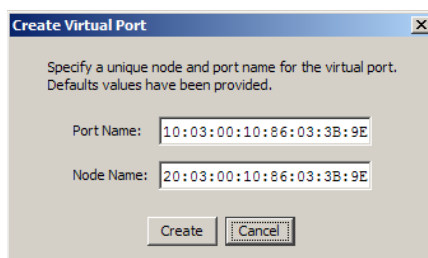
Note Refer to the *NPIV Troubleshooting* section if the *NPIV tab is not available or the panel does not contain any controls*.

- In the NPIV panel, verify that the reported Status is OK, which indicates that virtual ports can be created on the selected channel. If the status is not OK a virtual port cannot be created.



Note Refer to the *NPIV Troubleshooting* section for *suggestions on correcting a non-OK status*.

- Click Create Port, this will display the Create Virtual Port window, illustrated in Create Virtual Ports window

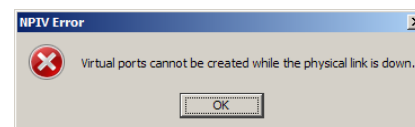


The ConfigTool will attempt to auto-fill the **Port Name** and **Node Name** fields with fabric-unique values derived from the port and node names of the physical port. Up to 255 unique name combinations are available. If all 255 names are in use, the ConfigTool will fill the Port and Node Names with zeroes and valid values will need to be entered manually. Note that the auto-generated names can be manually overwritten at the user's discretion.

- When the port and node names have been specified, click Create to create the port. If the virtual port is created successfully, it will appear in the Virtual Ports list and the Status window will read: "Created virtual port <Port-Name>", where <Port-Name> is the same as that specified in the Create Virtual Port window.

If the create operation fails, the ConfigTool will display the NPIV Error window. Refer to the NPIV Troubleshooting section for a complete list of the errors that can occur during port creation and recommendations for correcting common problems.

The "NPIV Error Message" window. The displayed message varies depending on the error.



Once a virtual port has been created on an adapter it will exist until it is either explicitly deleted or the adapter is moved to another physical host (virtual port data is not persistently stored on the card). Active virtual ports will be automatically re-created by the Celerity driver following a


system restart or power-cycle. Disabling NPIV on the adapter (see the Celerity Operators Manual for details) will prevent virtual ports from being re-activated on system startup; however, if NPIV is later re-enabled, any previously-existing virtual ports will return.

Deleting a Virtual Port

WARNING: Before attempting to delete a virtual port ensure that all I/O to devices exposed to the system through the targeted port has been stopped. Failing to stop all I/O prior to deleting a port may result in data corruption, system instability or crashes.

To delete an existing virtual port, perform the following steps:

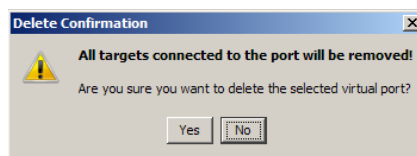
- In the Device Listing window, select the Celerity adapter channel from which to delete a virtual port.
- Click on the NPIV tab in the Configuration Window to display the NPIV panel.

 **Note** Refer to the NPIV Troubleshooting section if the NPIV tab is not available or the panel does not contain any controls.

- Select the virtual port to delete from the Virtual Ports list and click Delete Port; this will bring up the Delete Confirmation window illustrated in **Error! Reference source not found.**



Note The reported NPIV status for the selected channel does not have to be OK to delete a port; however, if the status is Disabled no virtual ports will be shown in the Virtual Ports list. Refer to the NPIV Troubleshooting section for how to correct a Disabled status. The “Delete Confirmation” window



- Click Yes in the Delete Confirmation window to delete the port. If the virtual port is deleted successfully, it will be removed from the Virtual Ports list and the Status window will read: “Deleted virtual port <Port Name>”, where <Port Name> is the World-Wide-Port-Name of the deleted port.
- If the delete operation fails, the ConfigTool will display the NPIV Error window. Refer to the NPIV Troubleshooting section for a complete list of the errors that can occur during port deletion and recommendations for correcting common problems.

NPIV Troubleshooting

The NPIV Tab is not visible in the Configuration Options window for the selected channel.

The NPIV tab will not appear in the Configuration Options window for any of the following reasons:

- The selected channel is not an 8Gb, 16Gb or 32Gb Celerity adapter channel.
- The remote host associated with the selected channel is not running Windows.
- The remote host associated with the selected channel is running an older version of the ConfigTool. NPIV support is available only in versions 4.09 and later.

The NPIV Tab is available, but only contains the message: “This version of the driver does not support NPIV”.

The version of the Celerity driver installed on the remote host associated with the selected channel does not support NPIV. Updated drivers are available on the ATTO web page (www.atto.com).

The NPIV Tab is available, but the reported NPIV Status is not OK.

If the NPIV status of the selected channel is not OK, look up the reported status in the following table and perform the steps called out in the Corrective Action column. Note that some actions may require a system restart to take effect.

NPIV Status	Explanation	Corrective Action
-------------	-------------	-------------------

Disabled	The NPIV feature is disabled on the adapter.	Refer to the Celerity Installation and Operation Manual for details on enabling NPIV on the adapter.
Link Down	The physical link is down.	<p>Verify that a working SFP is installed in the selected channel and the Fibre Channel cables are properly connected.</p> <p>Verify that the Data Rate NVRAM setting for the selected channel is either Auto or set to a speed that the switch supports.^a</p> <p>Verify that the Connection Mode NVRAM setting for the selected channel is either PTP or PTP Preferred.^a</p> <p>Verify that the speed and topology settings for the switch port match those of the selected channel.^b</p>
Unsupported Topology	The Fibre Channel topology of the physical link does not support the creation of virtual ports.	<p>Verify that the selected channel is connected point-to-point to a switch port (no hubs or loops allowed).</p> <p>Verify that the Connection Mode NVRAM setting for the selected channel is either PTP or PTP Preferred.^a</p> <p>Verify that the speed and topology settings for the switch port match those of the selected channel.^b</p>
Unsupported Switch	The switch port connected to this channel does not support NPIV.	Verify that the switch supports NPIV and that NPIV has been enabled on the connected port. ^b
Unknown	The NPIV status of the selected channel is unknown	Record the reported error code and contact ATTO customer support for assistance.

a. Changes to NVRAM settings require a system restart to take effect.

b. Refer to the switch documentation for details

Virtual port operation (create/delete) failed.

When virtual port operation fails, the ConfigTool will display the NPIV Error window, which will contain a message explaining the failure. The following table contains a list of

the error messages that may be observed when an operation fails and provides some recommended actions to take should the failure occur. Note that some actions may require a system restart to take effect.

Error Message	Occurs On...	Explanation	Recommended Action
"The operation failed"	Create/Delete	Typically a driver request timeout.	Retry the operation.
"The driver does not support this application"	Create/Delete	The version of the NPIV interface supported by the driver is not the same as that supported by the ConfigTool.	Verify that most recent versions of both the Celerity driver and ConfigTool are being used.
Error Message	Occurs On...	Explanation	Recommended Action
"Unsupported function"	Create/Delete	The driver received a NPIV request that it does not support.	Verify that most recent versions of both the Celerity driver and ConfigTool are being used.
"The host does not support NPIV"	Create/Delete	NPIV has been disabled on the adapter.	Refer to the Celerity Installation and Operation Manual for details on enabling NPIV on the adapter.
"An unknown error occurred (code: 0x??)"	Create/Delete	A catch-all error for unexpected failures.	Record the reported error code and contact ATTO customer support for assistance.
"Out of resources"	Create	The driver has run out of the resources required to create a new virtual port.	Delete any unused virtual ports and retry the create operation
"The fabric does not support NPIV"	Create	The FC topology is not P2P or NPIV is not enabled on the switch.	<p>Verify that the selected channel is connected point-to-point to a switch port (no hubs or loops allowed).</p> <p>Verify that the Connection Mode NVRAM setting for the selected channel is either PTP or PTP Preferred.^a</p> <p>Verify that the speed and topology settings for the switch port match those of the selected channel.^b</p> <p>Verify that the switch supports NPIV and that NPIV has been enabled on the connected port.^b</p>
"The maximum number of virtual ports have already been created"	Create	The maximum number of virtual port has already been created on the selected channel.	Refer to the Celerity Installation and Operation Manual for details about the maximum number of ports that can be created on a physical channel.

"The WWPN is already in use"	Create	The virtual port name specified already exists on the selected channel.	Specify a new port name and retry the operation.
"The WWPN is invalid"	Create	The virtual port name specified is not formatted properly.	Specify a new port name and retry the operation.
Error Message	Occurs On...	Explanation	Recommended Action
"The FC link is down"	Create	The physical link is down on the selected channel.	<p>Verify that a working SFP is installed in the selected channel and the Fibre Channel cables are properly connected.</p> <p>Verify that the Data Rate NVRAM setting for the selected channel is either Auto or set to a speed that the switch supports.^a</p> <p>Verify that the Connection Mode NVRAM setting for the selected channel is either PTP or PTP Preferred.^a</p> <p>Verify that the speed and topology settings for the switch port match those of the selected channel.^b</p>
"The WWPN does not exist"	Delete	The specified virtual port does not exist on the selected channel.	Wait 10 seconds and retry the delete operation.

- a. Changes to NVRAM settings require a system restart to take effect.
- b. Refer to the switch documentation for details.

12 ATTO vConfigTool Storage Adapter Management

ATTO's vConfigTool™ for VMware vCenter® Server™ is a software plug-in that integrates simplified, centralized management and monitoring of ATTO Celerity Fibre Channel and ExpressSAS SAS/SATA host bus adapters into VMware virtual environments.

The vConfigTool includes ATTO's exclusive storage I/O latency diagnostic tool – Latency Scout™, which helps IT administrators to quickly isolate data center bottlenecks with real-time latency histogram ensuring maximum infrastructure uptime and optimal performance.

The vConfigTool helps accelerate adapter deployments, optimize configurations, improve system availability and reduce the cost of VMware host infrastructures.

The ATTO vConfigTool comprises two software components: the ATTO vConfigTool CIM provider and the ATTO vConfigTool plugin for VMware's vSphere Web Client. The CIM provider is installed on an ESXi host and serves as the gateway to all ATTO adapters that are connected to the ESXi host. The ATTO vConfigTool plugin is installed on VMware vCenter Server and is required in order to view ATTO adapters and devices connected to ATTO adapters.

Support Requirements

- VMware vCenter Server 6.5, or later
- VMware vSphere
- Microsoft Edge Browser, Mozilla Firefox (v39 or later), or Google Chrome (v24 or later)

Installation

The ATTO vConfigTool consists of two components:

- The vConfigTool VMware vCenter Server Plugin component.
- The vConfigTool CIM provider for installation on ESXi Hosts.

The vCenter Server Plugin is available as a self-extracting installation script for two platforms, HTML and Flex. A user can install either HTML or Flex component in any configuration in accordance with expected use. The CIM provider is available as a VIB for direct deployment onto ESX/ESXi Hosts, or as an offline bundle.

Installing the ATTO vConfigTool

1. Install the ATTO vConfigTool CIM Provider
2. Transfer the ATTO vConfigTool CIM provider to each individual ESX/ESXi host that is to be serviced by the vConfigTool. ATTO recommends that you place the CIM provider VIB in a location that is conveniently referenced from the command line.
3. Stop the 'sfcdb' process before installing the ATTO vConfigTool CIM provider by executing the following command: `/etc/init.d/sfcdb-watchdog stop`.




Note *Stopping the 'sfcdb' process is required to ensure successful installation of the vConfigTool CIM provider.*

4. Remove any previous versions of the ATTO vConfigTool CIM provider by executing the following command: `esxcli software vib remove -n atto_cim`

5. Examine the output of the `esxcli` command to determine if the operation was successful. If `esxcli` states that the operation was not successful, please contact ATTO Technical Support.
6. Install the ATTO vConfigTool CIM provider by executing the following command: `esxcli software vib install -v file:///<path_to_ATTO_CIM_Provider_VIB>`
7. If you elect to use the offline bundle to install the CIM provider, execute the following command to install the ATTO vConfigTool CIM provider: `esxcli software vib install -d file:///<path_to_ATTO_CIM_Provider_VIB_Offline_Bundle>`
8. Examine the output of the `esxcli` command to determine if the operation was successful. If `esxcli` states that the operation was not successful, please contact ATTO Technical Support.
9. Configure the host to recognize the ATTO vConfigTool CIM provider by executing the following commands:

```
esxcfg-advcfg -A
CIMvmw_atto_cimProviderEnabled -T int -E "Enable or Disable the CIMvmw_atto_cimProviderEnabled" -
F 1 -N 0 -M 1esxcfg-advcfg --set 1
/UserVars/CIMvmw_atto_cimProviderEnabled
```
10. Examine the output of the `esxcli` commands to determine if the operation was successful. If `esxcli` states that the operation was not successful, please contact ATTO Technical Support.

11. Restart the 'sfcdb' process with the following command:
/etc/init.d/sfcdb-watchdog restart
12. Confirm that the 'sfcdb' process has been successfully restarted by issuing the following command: ps | grep atto

 **Note** *If the 'sfcdb' process has been successfully restarted, you will see multiple instances of the 'sfcdb-atto' process running. You may have to issue the command multiple times because the 'sfcdb' process may not start all of the processes instantaneously.*

 **Note** *The VMware vCenter Web Client may take a few minutes to load after restarting.*

13. Install the ATTO vConfigTool UI (vCenter Server Appliance only)

- a. Determine what vCenter playform is intended for us. Users planning on using the vCenter Flex client should use the Flex installer, while users planning on the HTML client should use the HTML installer. These can be installed individually or together on a vCenter system.
- b. Place the chosen ATTO vConfigTool installers in a location that is conveniently referenced from the command line.
- c. Execute the ATTO vConfigTool installer and follow the on-screen prompts. The installer will prompt for a reboot at the end of the installation process. Please be aware that the ATTO vConfigTool will not function with VMware vCenter Server until the appliance has been rebooted. A single reboot is sufficient after using both installers.

Using the ATTO vConfigTool

To use the ATTO vConfigTool, open a web browser and navigate to the vSphere Web Client site hosted by the vCenter server the ATTO vConfigTool is installed on. In the HTML version, the vConfigTool is accessed by navigating to the **Shortcuts** tab. Upon logging in, you will be able to view the vCenter home page which lists the available management tools provided by VMware vCenter.

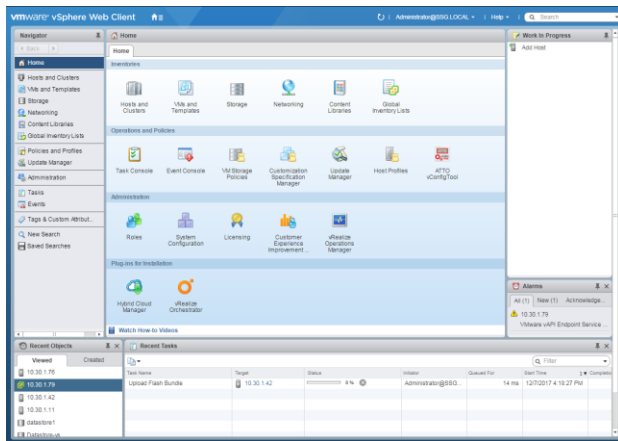
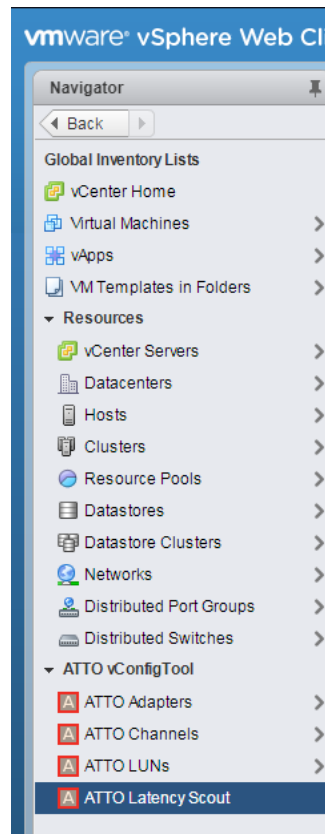


Exhibit 50 vCenter Home Page

To navigate to the ATTO vConfigTool on the Flex version, click on the Home item that appears in the top of the screen. The vCenter view will be displayed and the ATTO vConfigTool will be available from this view.

Exhibit 51 vCenter View with ATTO vConfigTool



The ATTO vConfigTool groups objects into three different categories: **Adapters, Channels, LUNs, and Latency Scout.**

- **Adapter** objects represent a physical Storage Adapter installed into an ESX host registered with the vCenter server
- **Channel** objects represent a configurable entity that is part of the related adapter object
- **LUN** objects represent a target storage device that is connected to the ESX host via the installed Storage Adapter
- **Latency Scout** displays information about the average I/O request latency for LUNs selected from ESX hosts registered with the vCenter server.

The vCenter view displays the total number of objects for each category. Clicking on a category will display the collection of objects and their related views.

Navigating the vConfigTool

ATTO objects (Adapters, Channels, and LUNs) will be discovered if and only if the ATTO vConfigTool CIM provider is

installed and running on a registered ESX host system, an ATTO product is installed, and an ATTO driver is loaded. An ESX host system that does not have the ATTO vConfigTool CIM provider, an ATTO product, or an ATTO driver installed will not present any ATTO objects.

When any one of the objects stated above are selected (adapter, channel, or LUN object), a variety of tabs will be presented in order to display information or allow for the management of the object. The tabs that are described below may or may not be presented for all objects, depending on (a) the type of information presented by the object and (b) what operations may be performed on the object:

Summary Tab

The **Summary Tab** presents basic information about a selected object. It normally provides high-level information such as the connection details, status, and relevant version information.

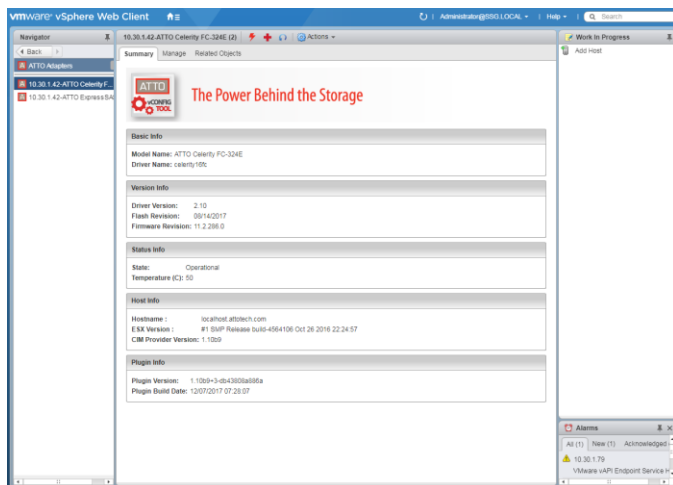


Exhibit 52 Summary Tab for an ATTO Adapter Object

Monitor Tab

The **Monitor Tab** provides more in-depth information about a selected object, such as statistical information for a selected ATTO channel object or related NPIV ports that are mapped to the ATTO channel object.



Exhibit 53 Monitor Tab for a Celerity FC Channel Object

Manage Tab

The **Manage Tab** presents the interface for changing settings for a selected object, such as driver parameters for a selected ATTO adapter object or parameters for a selected ATTO channel object.

Related Objects Tab

The **Related Objects** tab provides access to other objects that are associated with the currently selected object. For example, if an ATTO adapter object is currently selected, the **Related Objects** tab will show sub-tabs that provide access to the related **ATTO Channel** and **ATTO LUNs** objects. From this tab, it is easy to find and navigate to the appropriate related object depending on the operation you wish to perform and/or the information you wish to view.

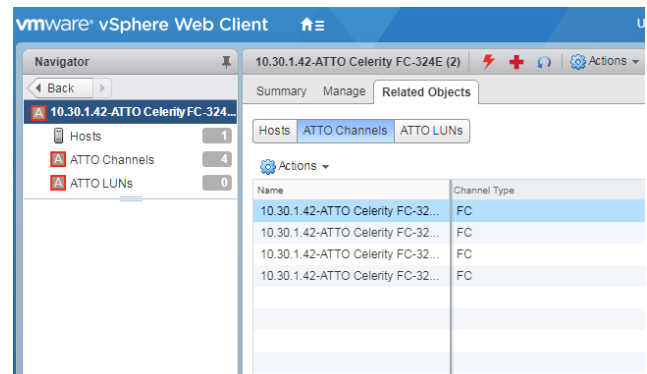


Exhibit 54 Related Objects Tab for an ATTO Adapter Object

Viewing an Adapter

To monitor the status of an installed ATTO adapter, you must first select an adapter object via one of the following methods:

1. Clicking on an adapter object via the **Adapter Listing** view. The **Adapter Listing** view is displayed by clicking on

the **ATTO Adapters** collection available via the **vCenter View**:

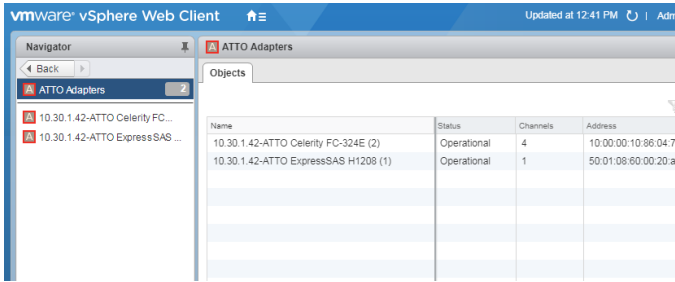


Exhibit 55 vConfigTool Adapter Listing View

To select an adapter, you may either double-click on one of the adapter objects presented in the table or single-click on one of the adapter objects presented in the navigation pane displayed on the left side of the **Adapter Listing** view.

- Clicking on an adapter object in the **Adapter Listing** view that is available via the **ATTO Adapters** sub-tab available from the **Related Objects** tab for an ATTO Channel, ATTO LUN, or VMware Host object.

Once you have selected an adapter object, the following tabs will be presented to manage the selected adapter:

Summary Tab

The **Summary Tab** provides basic information about the currently selected adapter and the ESX host it is installed in. Additionally, the **Summary Tab** also displays basic information about the ATTO vConfigTool plugin for easy access.

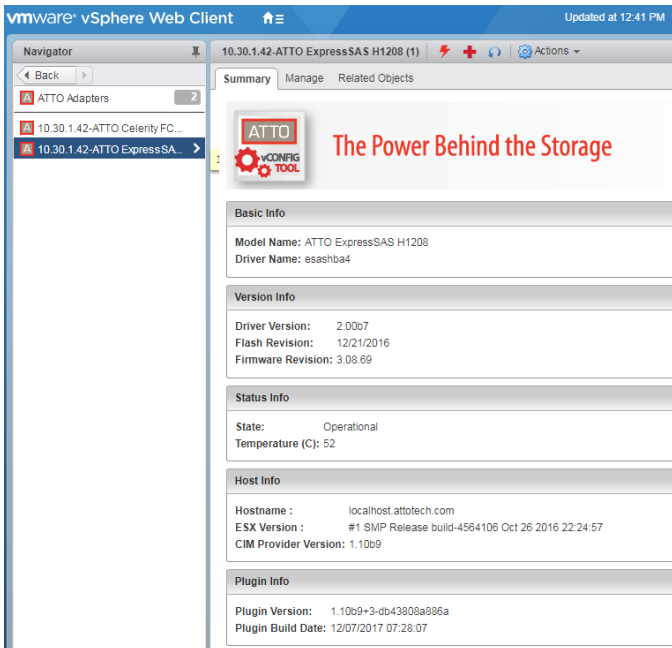



Exhibit 56 Summary Tab for an ATTO Adapter Object

Manage Tab

The **Manage Tab** provides information about the current driver parameters for the selected ATTO adapter family on the ESX host the adapter is installed in. It also provides for specific actions such as updating the flash bundle and retrieving diagnostic information.

Managing Driver Parameters

ATTO adapter driver parameters are configured via the **Manage Driver Parameters** section of the **Manage Tab** for a selected ATTO adapter. The driver parameters configured in this section affect **all** ATTO adapters in the same family on the associated ESX host.

 **Note** *Driver parameters should not be configured unless directed to do so by ATTO Technical Support.*

 **Note** *Altering driver parameters from their default value may have an adverse effect on ATTO adapter performance.*

To modify a driver parameter, enter a hexadecimal value into the available text fields. Press the **Commit** button to commit the changes to the associated ESX host. The changes will not take effect until the ESX host has been rebooted.

If you do not wish to modify the driver parameters, you may press the **Refresh** button to refresh the text fields with the current driver parameter settings. You may also press the **Defaults** button to reset the text fields to the driver parameter default values.

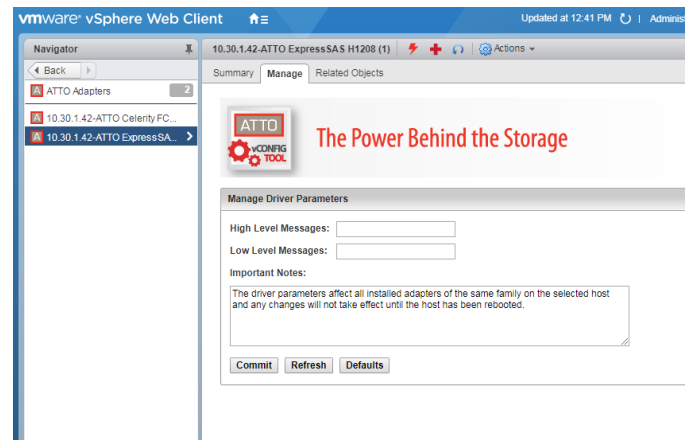


Exhibit 57 Manage Tab for an ATTO Adapter Object

Updating Flash Bundle

The ATTO vConfigTool may be used to update the flash image on supported ATTO devices. This process is typically

performed when a new firmware bundle has been released that addresses a relevant issue. To update the firmware:

1. Visit the ATTO website, www.atto.com, to download the flash bundle for your device.
2. Select the ATTO adapter whose flash image should be updated via the Adapter Listing view or a Related Object view.
3. From the 'Actions' menu, select the 'Update Flash Bundle' action.
4. Select the flash bundle file you wish to upload and click on the Update button inside of the Update Flash Bundle dialog.
5. Click the 'Global Refresh' button that appears next to the username credential in vSphere.
6. The progress will be displayed on the vSphere Tasks panel. It generally takes a couple of minutes for the flashing process to complete.

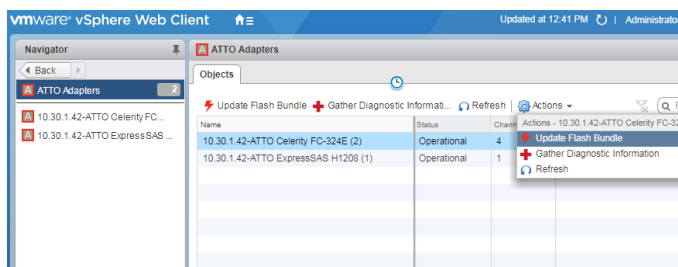


Exhibit 58 Menu Item to Update the Flash Bundle

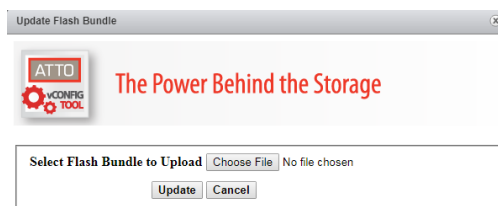


Exhibit 59 Update Flash Bundle Dialog

Retrieving Diagnostic Information

The vConfigTool is able to generate a bundle containing diagnostic information for a selected adapter. It may be useful to include this bundle when contacting ATTO Technical Support. To generate the diagnostics:

1. Select the ATTO adapter whose diagnostic info you wish to obtain via the Adapter Listing view or a Related Object view.
2. From the 'Actions' menu, select the 'Gather Diagnostic Information' action.
3. Click the Yes button inside the Run Diagnostics dialog to indicate that you wish to proceed.
4. Click the 'Global Refresh' button that appears next to the username credential in vSphere.

5. The progress will be displayed on the vSphere tasks panel. It typically takes several minutes for the diagnostics bundle to be generated.
6. The generated diagnostics file is saved to the `/home/vsphere-client` directory on the vSphere server.

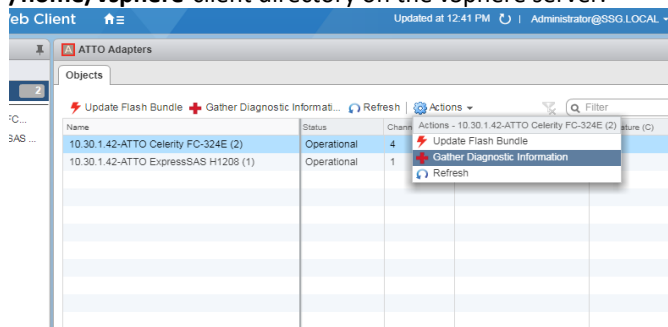


Exhibit 60 Menu Item to Generate a Diagnostics Bundle

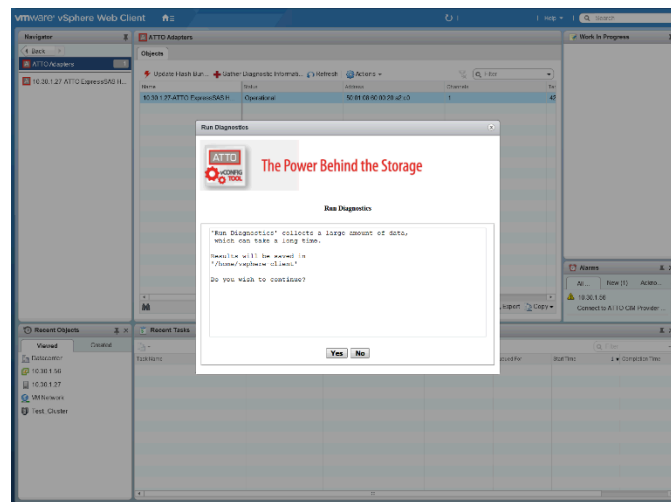


Exhibit 61 Run Diagnostics Dialog

Viewing a Channel

To monitor the status of an ATTO channel, you must first select a channel object via one of the following methods:

1. Clicking on a channel object via the Channel Listing view. The Channel Listing view is displayed by clicking on the ATTO Channels collection available via the vCenter View:

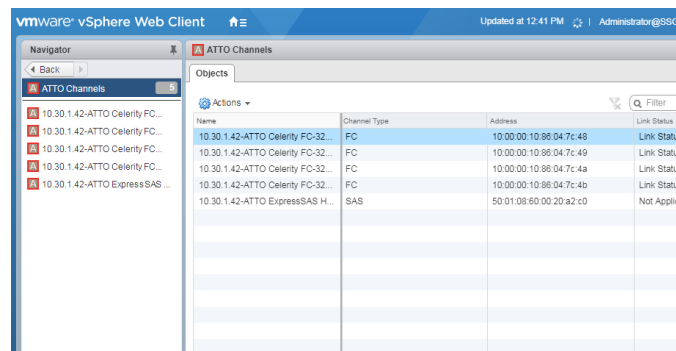


Exhibit 62 vConfigTool Channel Listing View

- To select a channel, you may either double-click on one of the channel objects presented in the table or single-click on one of the channel objects presented in the navigation pane displayed on the left side of the Channel Listing view.
- Clicking on a channel object in the Channel Listing view that is available via the ATTO Channels sub-tab available from the Related Objects tab for an ATTO Adapter, ATTO LUN, or VMware Host object.

Summary Tab

The **Summary Tab** provides basic information about the currently selected channel.

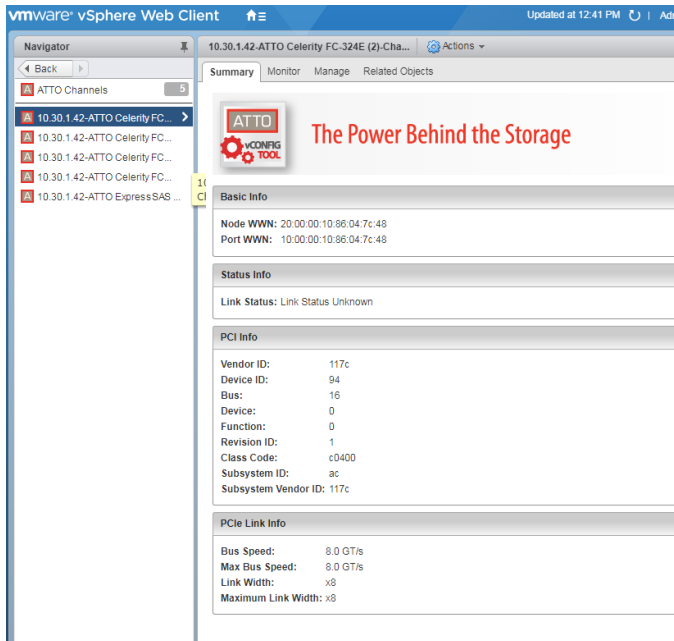


Exhibit 63 Summary Tab for an ATTO Channel

Monitor Tab

The **Monitor Tab** provides statistical information for the selected ATTO channel as well as additional useful information, such as associated NPIV ports for NPIV-enabled Celereity FC adapters.

Port Statistics (FC Only)

The **Monitor Tab** provides the ability to retrieve and display the port statistics for the selected ATTO channel. To view the port statistics, from the **Monitor Tab** select the **Port Statistics** sub-tab. Click the **Refresh** button to view the latest statistics. The statistics values may also be reset via clicking the **Reset** button.



Exhibit 64 Monitor Tab for a Celereity FC Channel Object

NPIV Ports (FC Only)

The **Monitor Tab** provides the ability to view the associated NPIV ports for the selected ATTO channel. To view the associated NPIV ports, from the **Monitor Tab** select the **NPIV Ports** sub-tab.



Exhibit 65 Associated NPIV Ports for a Celereity FC Channel

Latency Scout™

The ATTO Latency Scout is a tool that provides real time I/O latency as a roundtrip time for a command between a host adapter and the storage.

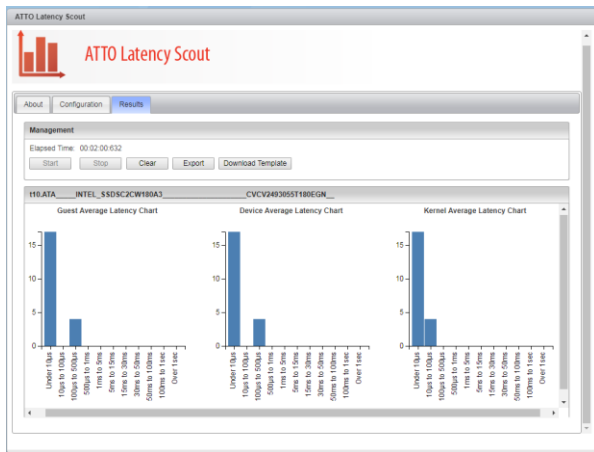


Exhibit 66 Latency Scout for an ATTO Channel

The ATTO Latency Scout™ allows you to view real-time performance readings on a LUN that is associated with the channel. To start the ATTO Latency Scout™, the following procedure is recommended:

1. Select the **Configuration** tab, and select an ESX host
2. Enter the username and password credentials of an Administrator for the associated ESX host.
3. Select the appropriate LUN object that you wish to collect performance readings upon.
4. Enter a refresh interval. The default is 5 seconds, however you may enter any value in-between 1 and 60 seconds. A longer refresh interval is recommended if the vCenter server has few available resources. A shorter refresh interval is recommended if you are attempting to diagnose an intermittent problem.
5. Select the graphs to display. The graphs are the **Device Average Latency Chart**, the **Kernel Average Latency Chart**, and the **Guest Average Latency Chart**. All are selected by default.
6. Set Threshold Alarms if desired.
7. Click the **Result** tab, then click start to begin collecting data.

The ATTO Latency Scout™ will periodically collect the latency information for the selected LUN and update the displayed graphs. The 'Elapsed Time' field will display the amount of time the collection has been running. The ATTO Latency Scout™ may be stopped at any time by clicking the 'Stop' button. The ATTO Latency Scout™ will automatically stop if you navigate away from the ATTO Latency Scout™ tab.

The ATTO Latency Scout™ displays the average I/O request latency in the following three graphs:

1. **Device Average Latency Chart:** This chart displays the average I/O request latency on the device driver level. It includes the roundtrip time for a command between a host adapter and the storage. This is a good indicator of the performance of the backend storage. If I/O latencies are suspected to be causing performance problems, this chart should be examined more closely.
2. **Kernel Average Latency Chart:** This chart displays the average I/O request latency while it is inside the ESX kernel. The values displayed by this graph should be very small in comparison to the Device Average Latency Chart and should be close to zero. However, if there is a lot of queuing in ESX, this graph may display averages that are as high as or even higher than those displayed in the Device Average Latency Chart. If this happens, you should examine the queue statistics via VMware's 'esxstop' utility available on the ESX host. You may also want to examine other ATTO statistics including those reported on the [Port Statistics \(FC Only\)](#) page.
3. **Guest Average Latency Chart:** This chart displays the average I/O request latency that is apparent to a guest OS for all I/O requests sent to a virtual storage device. If this chart reports high latency values, you may want to examine other ATTO statistics including those reported on the [Port Statistics \(FC Only\)](#) page. Other items that you may want to examine are SFP, Port, Link speed, and Max speed settings as well as troubleshooting guides for the fiber channel switch and connected storage.

The graphs displayed by the ATTO Latency Scout™ display the collected latency values in terms of frequency. The latency charts produced by the ATTO Latency Scout™ will vary depending on the storage topology and the type of I/O request load. Typically, SSD storage devices will produce graphs with lower reported latency values than HDD storage devices. However, this may not hold true depending on the variables mentioned above. The following graphs show the observed latency values for both 6Gb SSD and HDD storage devices attached to an ATTO ExpressSAS 12Gb adapter undergoing 16Kb randomized I/O with a queue depth of 32:

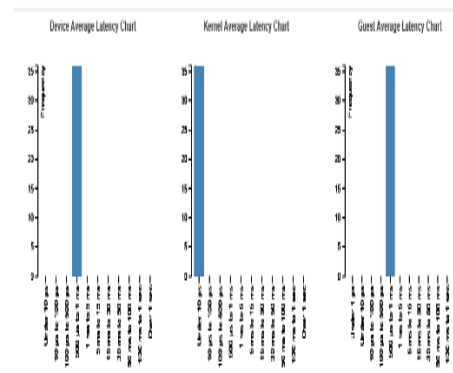


Exhibit 67 Observed Latency Patterns for SSD Storage Devices

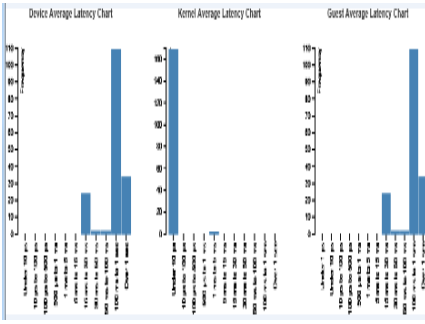


Exhibit 68 Observed Latency Patterns for HDD Storage Devices

Latency Scout Analysis

The ATTO Latency Scout comes with an **Excel analysis tool**. After exporting Latency Scout results, you can view and graph them in the Excel Analysis tool. To view results:

1. Open the template that you downloaded through the ATTO Latency Scout Plugin on the results tab.
2. Once open, on the overview tab of the excel file, click on the import button.
3. You will be prompted to select a .csv file that you wish to open into Excel. Pick the desired file with data downloaded from the ATTO Latency Scout. A new sheet will be created within and all of the data will be displayed on that new sheet. More than one file may be selected at once, and a new sheet will be created for each file selected.
4. To view a graph of your data go to the overview tab, and click 'Create Graph'. A dialog box will pop up with a dropdown box to select the sheet of data that you would like to select to create the graph from, and there will be options for what categories of the data that you would like to populate on the graph. Once selected, a new sheet with the graph of the data will be created and made the primary screen to view.
5. This process can be done as many times as you would like.
6. A button to clear out all of the data and graphs is included to easily get rid of unwanted or no longer needed data.

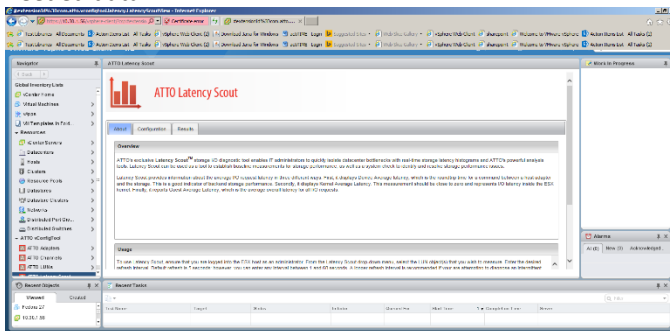


Exhibit 69 ATTO Latency Scout Excel Analysis Tool


Since latency patterns are dependent on the storage type and topology, ATTO recommends using the ATTO Latency Scout™ before attempting to reproduce a condition that may be causing excessive latency. The graphs displayed by the ATTO Latency Scout™ during this collection period should be used as a baseline for comparison. Should you experience problems regarding excessive device I/O latency, contact ATTO Technical Support at +1.716.691.1999 x242 or visit the ATTO Technical Support website at <http://www.atto.com/support/>.

Manage Tab

The **Manage Tab** provides information about the current NVRAM parameters for the selected ATTO channel.

Managing NVRAM

ATTO NVRAM parameters are configured via the **Manage NVRAM Settings** section of the **Manage Tab** for a selected ATTO channel. The NVRAM parameters configured in this section affect only the selected ATTO channel.

 **Note** *NVRAM settings should not be configured unless directed to do so by ATTO Technical Support.*

Note: ATTO adapters are designed to operate properly using factory settings. Entering invalid or incorrect settings when using an NVRAM configuration utility such as the ATTO vConfigTool may cause your adapter to function incorrectly and performance may be affected adversely.

To modify a NVRAM setting, you may select an appropriate value from the drop-down list item or enter the value in the associated text field. Press the **Commit** button to commit the changes to the associated ESX host. The changes will not take effect until the ESX host has been rebooted.

If you do not wish to modify the driver parameters, you may press the **Refresh** button to refresh the NVRAM settings with the currently applied settings. You may also press the **Defaults** button to reset the NVRAM settings to the default values.

See [Celery FC NVRAM Settings](#) for the list of appropriate NVRAM settings applicable to Celery FC adapters. See [ExpressSAS NVRAM Settings](#) for the list of appropriate NVRAM settings applicable to ExpressSAS adapters.

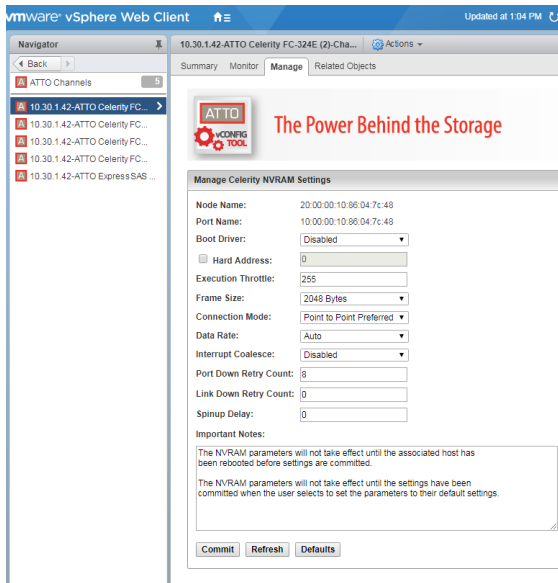


Exhibit 70 Celerity FC NVRAM Parameters

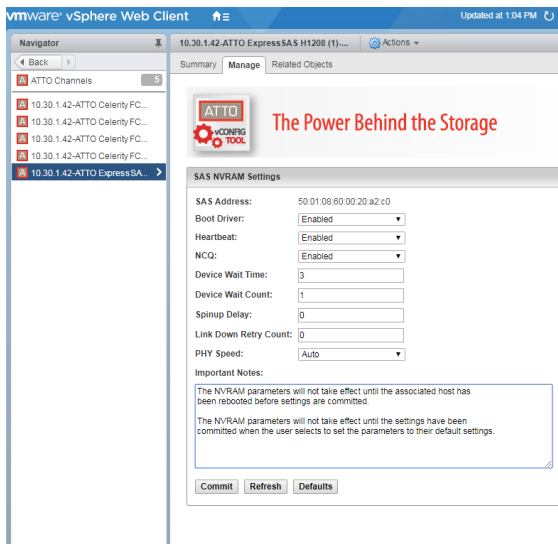


Exhibit 71 ExpressSAS NVRAM Parameters

Viewing a LUN

To monitor the status of an ATTO LUN, you must first select a LUN object via one of the following methods:

1. Clicking on a channel object via the LUN Listing view. The LUN Listing view is displayed by clicking on the ATTO LUNs collection available via the vCenter View:

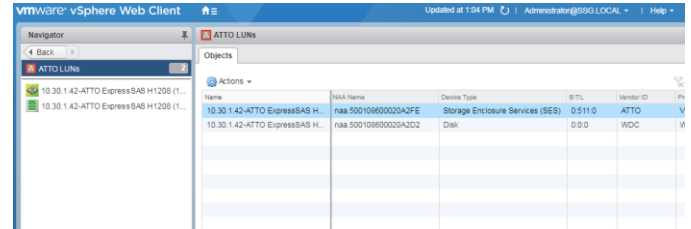


Exhibit 1.0-23 – vConfigTool LUN Listing View

2. To select a LUN, you may either double-click on one of the LUN objects presented in the table or single-click on one of the LUN objects presented in the navigation pane displayed on the left side of the LUN Listing view.
3. Clicking on a LUN object in the LUN Listing view that is available via the ATTO LUNs sub-tab available from the Related Objects tab for an ATTO Adapter, ATTO Channel, or VMware Host object.

Summary Tab

The **Summary Tab** provides basic information about the currently selected LUN.

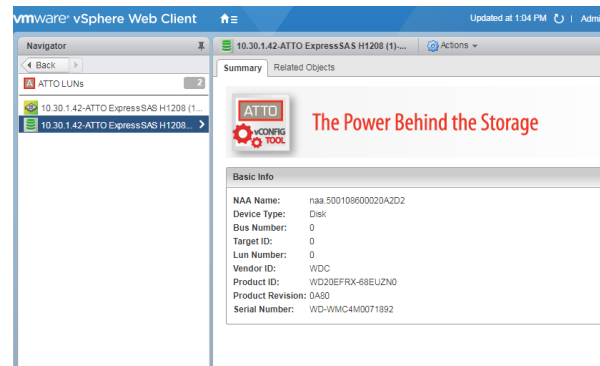



Exhibit 72 Summary Tab for an ATTO LUN

Celerity FC NVRAM Settings

ATTO adapters are designed to operate properly using factory settings. Entering invalid or incorrect settings when using an NVRAM configuration utility such as the ATTO vConfigTool may cause your adapter to function incorrectly.

 **CAUTION** *Back up system data when installing or changing hardware configurations.*

Use caution when making changes to NVRAM settings and only make changes to those with which you are familiar. Once you have made the desired changes, click **Commit** to save the changes. Changes do not take effect until you reboot the host.

If you do not want to make any changes, you may choose one of the following:

1. Defaults: restores the adapter to factory default settings. The Commit button must be clicked to save any changes
2. Refresh: reverts to the NVRAM settings saved the last time the Commit button was used. Clicking Commit is not necessary.

Node Name

The Node WWN assigned to this channel of the adapter.

Port Name

The Port WWN assigned to this channel of the adapter.

Boot Driver

Choices: enabled, disabled, scan only

Default: disabled

If enabled and disk drives or a bootable CD are detected during the bus scan, the BIOS driver remains resident. If disabled, the BIOS starts, resets the adapter chip and unloads the driver.

*If **Scan Only** is selected, the BIOS driver scans the bus and displays the devices attached, then unloads itself after a brief delay.*

Hard Address Enable Checkbox

Choices: enabled, disabled

Default: disabled

*When a Fiber Channel loop is initialized, each device selects and configures itself to an available ID. **Hard Address Enable** permits the host to select the value entered in the **Hard Address** field.*

Hard Address

Choices: None, 0-125

Default: 0

The value used as the FC-AL hard address. A value to represent the address if hard addressing is enabled.

Execution Throttle

Choices: 1-255

Default: 255 (Disabled)

Specifies the maximum number of concurrent commands which can be achieved per port or per SCSI Target. Higher numbers or disabling the feature may increase performance, but some Storage Adapters react poorly when flooded with too many commands at a time, ultimately decreasing performance. Note that the setting applies to the aggregate of all LUNs control by the SCSI Target.

Frame Size

Choices: 512, 1024n 2048

Default: 2048

Changes the size of the FC packet of information being sent. Typically, the initiator and target negotiates the desired frame size, starting with the largest value. The frame size should be set to the largest value for normal operation.

Connection Mode (Only applies to 8Gb and Gen 5 16Gb)

Choices: Arbitrated Loop, Point to Point, Arbitrated Loop Preferred, Point to Point Preferred

Default: Arbitrated Loop

Arbitrated Loop (AL): Connects to either an Arbitrated Loop or a Fabric Loop Port (FL Port) on a switch.

Point to Point (PTP): Connects to a direct Fabric connection, such as an F port on a switch or directly to another device that is capable of running in PTP mode.

Arbitrated Loop Preferred: Allows the adapter to determine what kind of connection to use, but tries to connect in Loop mode first, then Point to Point mode.

Point to Point Preferred: Allows the adapter to determine what kind of connection to use, but tries to connect in Point to Point mode first, then Loop mode.



Note

Sometimes it is necessary to force a given connect mode because there is no industry standard for the topology detection protocol and some devices may not connect when set to one of the automatic modes.

Data Rate

Choices: 4Gb/s, 8Gb/s, 16Gb/s, 32Gb/s, Auto

Default: Auto

*Selects the Fiber Channel transmission rate. **Auto** indicates that the adapter determines the rate based upon the devices connected.*

Interrupt Coalesce

Choices: Disabled, Low, Medium, High

Default: Disabled

Specifies the time period an adapter chip delays an interrupt. This allows the adapter chip to queue up more than one interrupt before interrupting the CPI. When this methodology is chosen, there is less overhead to service the interrupts. However, the coalescing time may delay the delivery of the completion for a single interrupt.

Port Down Retry Count

Choices: 0-255

Default: 8

The number of times the driver retries a command to a port which is currently logged out.

Link Down Timeout

Choices: 0-255

Default: 0

The number of seconds the driver waits for a link that is down to come up before reporting it to the operating system.

Spinup Delay

Choices: 0-255

Default: 0

Specifies the number of seconds the driver waits for the first device to be logged in and become ready.

ExpressSAS NVRAM Settings

ATTO adapter are designed to operate properly using factory settings. Entering invalid or incorrect settings when using an NVRAM configuration utility such as the ATTO vConfigTool may cause your adapter to function incorrectly.

 **CAUTION** *Back up system data when installing or changing hardware configurations.*

Use caution when making changes to NVRAM settings and only make changes to those with which you are familiar. Once you have made the desired changes, click **Commit** to save the changes. Changes do not take effect until you reboot the system.

If you do not want to make any changes, you may choose one of the following:

Defaults: restores the adapter to factory default settings.

The **Commit** button must be clicked to save any changes.

Refresh: reverts to the NVRAM settings saved the last time the **Commit** button was used. Clicking **Commit** is not necessary.

SAS Address

Displays the SAS address assigned to the adapter. The value cannot be modified.

Boot Driver

Choices: enabled, disabled, scan only

Default: enabled

*If enabled and disk drives are detected during the bus scan, the BIOS driver remains resident. If disabled, the BIOS starts, resets the adapter chip and unloads the driver. If **Scan Only** is selected, the BIOS driver scans the bus and displays the devices attached, then unloads itself after a brief delay.*

Heartbeat

Choices: enabled, disabled

Default: enabled

When enabled, requires the firmware to respond to periodic activity. If the firmware does not respond, the system driver resets the firmware on the adapter.

NCQ

Choices: enabled, disabled

Default: enabled

When enabled, the adapter driver sends multiple simultaneous commands to NCQ capable SATA disk drives.

PHY Speed

Choices: Auto, 12Gb/s, 6Gb/s, 3Gb/s, 1.5Gb/s

Default: Auto

Allows the user to manually adjust the speed of the PHY.

Device Wait Time

Choices: 1-255 seconds

Default: 3 seconds

Specifies the number of seconds which the driver waits for devices to appear.

Device Wait Count

Choices: 1-255 devices

Default: 1 device

Specifies the number of devices which must appear in order to cancel the Device Wait Time period.

Spinup Delay

Choices: 0-20 seconds

Default: 0 seconds

Specifies the number of seconds each SAS PHY waits for disk drives to spin up.

Link Down Timeout

Choices: 0-255 seconds

Default: 0 seconds

The number of seconds the drives waits for a link that is down to come up before reporting it to the operating system.

Troubleshooting

The following suggestions may help if you are having problems:

- If devices are not visible, check all cable connections and terminations on each device.
- Make sure each device is powered up and has completed its self-check before booting the ESX host.
- If an ATTO adapter or devices connected to an ATTO adapter are not visible in the ATTO vConfigTool, ensure the proper driver is loaded on the ESX host and that the ATTO CIM Provider is installed and running. See [Installing the ATTO vConfigTool](#) for the installation procedure for the ATTO CIM Provider.
- If the procedure to update a flash bundle fails, verify that you have selected the correct flash bundle for the adapter you are attempting to apply it to. If the procedure continues to fail, you may want to use the
- [Retrieving Diagnostics Information](#) procedure to gather additional diagnostic information.

13 BIOS/EFI Configuration Utility

The BIOS driver for all ATTO storage adapters has a built-in BIOS Configuration Utility which manages the Storage Adapters and the devices connected to the Storage Adapters.

The **BIOS Configuration Utility** for ATTO storage adapters uses a standard menu/choice model. The **Main Menu** presents the functions available from the utility. Selecting an item on the menu may bring up a secondary menu or a dialog box. The dialog box displays the items managed by that dialog box.

Accessing the Fibre Channel BIOS Utility

 **Note** *Celerity 8Gb, 16Gb and 32Gb adapters support both BIOS and EFI*

Options for Fibre Channel Storage Adapters configuration are described in [FC BIOS Configuration Utility](#)


1. During the Fibre Channel BIOS driver startup, press Ctrl-F at the prompt after the Storage Adapters boot string displays. If you do not press Ctrl-F within 3 seconds, you must reboot and start again.

2. The Fibre Channel BIOS Configuration Utility starts and displays the following menu:

- Configure Adapter Channels
- Reset All Parameters
- Display Device List
- Format Disk Drives
- Update Flash ROM
- Save Parameters and Exit
- Discard Changes and Exit

 **Note** *The Update Flash ROM selection is not available for 16*

Accessing the ExpressSAS BIOS Utility


 **Note** *ExpressSAS 6Gb HBAs and RAID adapters support both BIOS and EFI. ExpressSAS 12Gb HBAs only support EFI.*

Options for ExpressSAS adapter BIOS configuration are described in the [ExpressSAS BIOS Utility](#)

1. During the SAS BIOS driver startup, press Ctrl-Z at the prompt after the adapter boot string displays. If you do not press Ctrl-Z within 3 seconds, you must reboot and try again.

2. The SAS BIOS Configuration Utility starts and displays the following menu
3. Configure Adapter Settings
4. Display Drive List
5. Configure RAID Groups (ExpressSAS RAID only)
6. Exit

Accessing the ExpressSAS EFI Utility

 **Note** *ExpressSAS 6Gb HBAs and RAID adapters support both BIOS and EFI. ExpressSAS 12Gb HBAs only support EFI.*

Options for ExpressSAS adapter EFI configuration are described in [ExpressSAS EFI Utility](#)

The EFI Configuration Utility is accessed through a platform specific EFI shell. Different platforms have different means to enter an EFI shell, though it is generally done through a function key displayed during initialization. If the system does not have an EFI shell a 3rd party tool must be used.

Common BIOS Configuration Utility functions

Not all common configuration utility functions are available for all adapter families.

Selectable Boot Device

Allows you to select a disk drive or stripe group from which the system BIOS loads the operating system. Select the primary drive from any stripe set or any non-striped drive. Changing from No to Yes displays candidate disk drives.

If the selectable boot option is enabled, the BIOS driver routes any drive 80h I/O requests to the designated selectable boot drive. The operating system is loaded from this drive.

Display device list

Displays all devices detected in the bus scan. Scroll the list to see all devices.

Reset defaults

Resets all Storage Adapters settings to the manufacturer's defaults.

The Fibre Channel Configuration Utility presents this function on the main screen. All channels of all adapters are affected.

The Configuration Utility presents this function on the Configure Adapter Channels dialog box and applies to currently selected channel.

Save parameters and exit

Saves all changes you have made and exits the utility. The host reboots.

Discard parameters and exit

Discards all changes you have made, defaulting back to previous settings, and exits the utility. The host reboots.

14 FC BIOS Configuration Utility

Default NVRAM settings work for most applications, but your particular hardware configuration may require some changes. Fibre Channel Storage Adapters NVRAM settings may be changed from the **BIOS Configuration Utility**.

 **Note** *Celerity 8Gb, 16Gb and 32Gb adapters support both BIOS and EFI.*

The **Configure Adapter Channels** menu selection displays a dialog which contains the parameters for a specific adapter.

Adapter Node Name

The Node WWN assigned to this channel of the adapter.

Adapter Number

Choices: Variable

Default: 1

Choices depend upon the number of Fibre Channel adapters installed in your computer and the number of channels per adapter. If one single channel adapter is installed, 1 is the only choice. If two dual channel adapters are installed, choices are 1, 2, 3 and 4.

Adapter Port Name

The Port WWN assigned to this channel of the adapter.

Boot Driver

Choices: enabled, scan only, disabled

Default: disabled

If enabled and disk drives or a bootable CD are detected during the bus scan, the BIOS driver remains resident. If disabled, the BIOS starts, resets the adapter chip and unloads the driver.

*If **Scan Only** selected, the BIOS driver scans the bus and displays the devices attached, then unloads itself after a brief delay.*

Boot Node Name

Display Only

See Enable Selectable Boot

Displays the IEEE worldwide address assigned to the current boot device.

Boot LUN

Display Only

See Enable Selectable Boot

Displays the LUN address assigned to the current boot device.

Connect Mode (Only applies to 8Gb and Gen 5 16Gb)

Choices: AL, PTP, AL Preferred, PTP Preferred

Default: PTP Preferred

Arbitrated Loop (AL): Connects to either an FCAL Arbitrated Loop or a Fabric Loop Port (FL Port) on a switch.

Point-to-Point (PTP): Connects to a direct Fabric connection, such as an F port on a switch or directly to another device that is capable of running in PTP mode.

AL Preferred: Allows the card to determine what kind of connection to use, but tries to connect in Loop mode first, then Point-to-Point mode.

PTP Preferred: Allows the card to determine what kind of connection is to use, but tries to connect in Point-to-Point mode first, then Loop mode.

 **Note** *Sometimes it is necessary to force a given connect mode because there is no industry standard for the topology detection protocol and some devices may not connect when set to one of the automatic modes.*

Connect Speed

Choices for 32Gb: 8Gb/sec., 16Gb/sec., 32Gb/sec., Auto


Choices for 16Gb: 4Gb/sec., 8Gb/sec., 16Gb/sec, Auto

Choices for 8 Gb: 2Gb/sec., 4Gb/sec., 8Gb/sec, Auto

Choices for 4 b: 1Gb/sec., 2Gb/sec., 4Gb/sec, Auto

Default: Auto

Selects the Fibre Channel transmission rate. If Auto chosen, the adapter determines the rate based upon the devices connected.

 **Note** *16Gb and Loop Only are incompatible choices and will not be allowed on Gen 5 16Gb Celerity HBAs.*

Device Discovery By

Choices: Node WWN, Port WWN

Default: Port WWN

Specifies the type of device discovery the adapter driver performs. If you are using multipathing software you must select Port WWN. If you are not using multipathing software and your target devices have multiple ports and they present the same LUNs on both ports, changing this setting to Node WWN causes the driver to present the target device to the operating system as a single device but it will continue to allow access to the device's LUNs should one of the ports become inoperative. Target devices that have single ports are unaffected by this setting.

Enable Selectable Boot

Choices: Yes, No

Default: No

Specifies a boot device to use other than BIOS device 80. Selecting "Yes" will bring up a dialog box displaying all available disk drives. Select a drive from this list and press Enter. The Device WWN and LUN will be copied to the Boot Port Name and LUN at the bottom of the Host Adapter Settings screen.

Execution Throttle (8Gb, 16Gb or 32Gb)

Choices: 1-255

Default: 255 (Disabled)

Specifies the maximum number of concurrent commands which can be achieved per port or per SCSI Target. Higher numbers or disabling the feature may increase performance, but some storage targets react poorly when flooded with too many commands at a time, ultimately decreasing performance. Note that the setting applies to the aggregate of all LUNs controlled by the SCSI Target.

Frame Size

Choices: 512, 1024, 2048

Default: 2048

*Changes the size of the FC packet of information being sent. Typically, the initiator and target negotiates the desired frame size, starting with the largest value. The frame size should be set to the largest value for normal operation. However, some older devices may not properly negotiate frame size: use **Frame Size** to specify the size rather than permitting negotiation.*

Hard Address

Choices: None, 0-125

Default: None

When a Fibre Channel loop is initialized, each device selects and configures itself to an available ID. Hard Address Enable permits the host to select the value entered in the Hard Address field.

I/O Address

Display Only

Displays the legacy IRQ line assigned by the System BIOS for use by the adapter channel. Modern systems do not use Legacy IRQ lines.

IRQ:

Display Only

Displays the legacy IRQ line assigned by the System BIOS for use by the adapter channel. Modern systems do not use Legacy IRQ lines.

Interrupt Coalescing

Choices: None, Low, Medium, High

Default: None

Specifies the time period an adapter chip delays an interrupt. This allows the adapter chip to queue up more than one interrupt before interrupting the CPU. When this methodology is chosen there is less overhead to service the interrupts. However, the coalescing time may delay the delivery of the completion for a single interrupt.

Type

Display Only

Specifies the model number of the adapter associated with the selected Adapter Number.


15 ExpressSAS BIOS Utility

The BIOS driver for the ATTO ExpressSAS storage adapters has a built-in BIOS Utility which manages the adapter and the devices connected to the adapter.

The ExpressSAS BIOS Utility uses a standard menu/choice model. The Main Menu presents the functions available from the utility. Selecting an item on the menu may bring up a

secondary menu or a dialog box. The dialog box displays the items managed by that dialog box.

Configuring adapter settings

 **Note** *ExpressSAS 6Gb HBAs and RAID adapters support both BIOS and EFI. ExpressSAS 12Gb HBAs only support EFI.*

The Configure Adapter Settings menu displays:

1. **Edit Adapter Settings:** customizes the ExpressSAS adapter settings.
2. **Reset All Parameters to Defaults:** resets the ExpressSAS adapter settings to the factory default.
3. **Save Settings and Return to Main:** permanently saves the adapter settings and returns to the Main Menu.
4. **Discard Settings and Return to Main:** discards any changes to the adapter settings and retains the original settings.

Selecting the **Configure Adapter Settings** page displays information about the ExpressSAS adapter, including:

- **Adapter #:** allows you to select a specific ExpressSAS adapter from a list of installed ExpressSAS adapters.
- **Model:** displays the model number of the selected ExpressSAS adapter.
- **FW Version:** displays the firmware version of the selected ExpressSAS adapter.
- **SAS Addr:** displays the SAS Address assigned to the selected ExpressSAS adapter.

Select the following functions from this menu:

Boot Driver

Choices: enabled, scan only, disabled

Default: disabled

If enabled and disk drives are detected during the bus scan, the BIOS driver remains resident. If disabled, the BIOS starts, resets the adapter chip and unloads the driver. If Scan Only is selected, the BIOS driver scans the bus and displays the devices attached, then unloads itself after a brief delay.

Device Wait Time

Choices: 1-255 seconds

Default: 3

This field specifies the number of seconds which the driver waits for devices to appear.

Device Wait Count

Choices: 1-255 devices

Default: 1

This field specifies the number of devices which must appear in order to cancel the Device Wait period.

Spinup Delay

Choices: 0-20 seconds

Default: 0

Specifies the number of seconds each SAS port waits for disk drives to spin up.

Heartbeat

Choices: enabled, disabled

Default: enabled

When enabled, requires the firmware to respond to periodic activity. If the firmware does not respond, the system driver resets the firmware on the adapter.

Reset to Defaults

Returns all settings to the factory defaults.

Displaying the drive list (ExpressSAS RAID adapter only)

Selecting the **Display Drive List** menu displays a list of all disks which are connected to the adapter with the following information for each:

- **Adp#** indicates the adapter number for the ExpressSAS RAID adapter to which the drive is connected.
- **ID** displays the drive ID number within the adapter.
- **Vendor ID** displays the drive manufacturer's vendor name.
- **Product ID** displays the drive's product name.
- **Capacity** displays the drive's byte capacity.
- **RAID Group** contains the name of the RAID group to which the drive is assigned. The field may be blank or can indicate a RAID group name or Hot Spare status.
- **Member State** displays the drive's current state.

The **Display Drive List** menu highlights the first drive in the list. Use the up and down arrows to highlight other disks. The highlighted drive is accessed and its activity light blinks. Select the following functions from this menu:

Show Drive Detail

Type Enter or D to display more information about the highlighted drive.

Select Drive

Type Space Bar to allow multiple drives to be selected. The selection is removed by typing Space Bar a second time.

Scan

Type S to clear and refresh the drive list.

Clean

Type C to clean all metadata from the selected drives. Drives must be selected by typing Space Bar.

Hot Spare

Type H to assign the selected drives to the Hot Spare pool. Drives must be selected by typing Space Bar.

Remove Spare

Type R to remove the selected drives from the Hot Spare pool. Drives must be selected by typing Space Bar

Configuring RAID groups (ExpressSAS RAID adapter only)

Selecting the **Configure RAID Groups** menu displays a list of all detected RAID groups with the following information for each:

- **Group Name:** RAID group name
- **Drives:** number of drives in the RAID group
- **Capacity:** the RAID group's total capacity
- **Status:** the RAID group's current status
- **RAID Level:** the RAID group's RAID level

The **Configure RAID Groups** menu highlights the first RAID group in the list. Use the up and down arrows to highlight other RAID groups. Select the following functions:

View Selected RAID Group

Type Enter to display more information about the highlighted RAID group. If a RAID group is rebuilding, the command displays the completion percentage of the rebuild.

Create

Type Insert to build a new RAID group.

Delete

Type Delete to delete the highlighted RAID group. A confirmation prompt must be answered.


Rebuild

Type R to rebuild the highlighted RAID group. A confirmation prompt must be answered to start the rebuild.


Create a RAID group

Selecting **Create RAID Group** starts a wizard.

1. Type a RAID group name.
2. Select a RAID level: 0, 1, 4, 5, 6, 10 or JBOD.
3. Select an Interleave: 64KB, 128KB, 256KB, 512KB or 1MB.
4. Type Insert to add drives into the RAID group.
5. A drive list box of available drives is displayed. Press the Space Bar to select the drives to include in the new RAID group. The selected drives are highlighted.
6. Type Enter to create the RAID group.

 **CAUTION** *A rebuild occurs after creating a RAID Level 4, RAID Level 5 or RAID Level 6 group. The length of time required for the rebuild depends upon the size of the RAID group. Do not reboot the adapter until the rebuild process is complete.*

7. Type Enter to map the partitions of the new RAID group.

 **Note** *A RAID group is created with default properties which may be changed using the ConfigTool. Refer to [ATTO Storage Adapter Management](#)*

16 ATTO ConfigTool LiveISO

The ATTO ConfigTool LiveISO (previously ConfigUtility) is a bootable system image that can be used to update firmware on ExpressSAS and Celerity adapters, as well as to provide access to diagnostic utilities that may not be otherwise available on certain platforms. This image can be particularly useful when using open source Linux drivers or in VMware environments, since ATTO does not offer full support for the ConfigTool management application in these ecosystems. The application, flash bundles and tools are all contained in a disk image that can be copied to a USB drive.

The ATTO ConfigTool LiveISO uses a standard menu/choice model. The **Main Menu** presents the functions available from the utility. Selecting an item on the menu may bring up a secondary menu or a dialog box. The dialog box displays the items managed by that dialog box.

Installation



Note

These instructions presume a familiarity with Linux commands and command structure.

1. Validate the integrity of the image using the 'md5sum' utility:

```
md5sum lnx_app_configtoollive_<version>.iso | cut -  
d ' ' -f 1 | diff  
lnx_app_configtoollive_<version>.iso.md5 -
```

If no output is generated from the above command, then the image is valid. If the above command does produce output, then the image is likely corrupt. ATTO recommends re-downloading the image and re-validating before proceeding to install the image on the USB disk device.

2. Copy image to the USB drive using the 'dd' tool. For example:

```
dd if= md5sum lnx_app_configtoollive_<version>.iso  
of=/dev/sdb bs=4M
```



Note

The above command line assumes that the USB drive is the 'sdb' device listed under '/dev'. Depending on the configuration and how many disks may be present in the system, this name may vary. If you are not certain which device under '/dev' relates to the desired USB disk device, please examine the output from 'dmesg' in order to determine if the USB disk device was detected and successfully loaded.

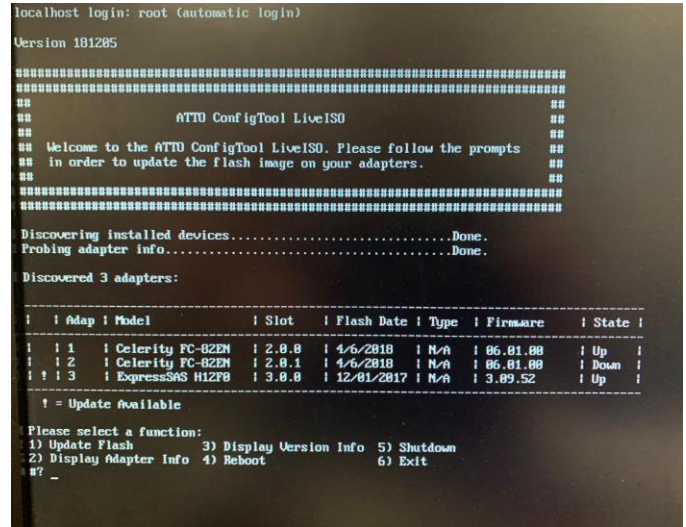
3. Use the 'sync' command in order to ensure that all data has been written to the USB disk device.
4. Insert the USB drive in the system containing the ExpressSAS and/or Celerity adapters that need to be updated.
5. During boot, enter to the BIOS configuration screen.
6. In the BIOS configuration, ensure that the USB drive is set as the primary boot device.
7. Exit the BIOS configuration to resume the boot process.

The ConfigTool LiveISO will automatically launch upon completion of the boot process.

Using the ATTO ConfigTool LiveISO

The ATTO ConfigTool LiveISO has a simple interface that allows users to easily update ExpressSAS and/or Celerity firmware, as well as access ATTO's CLI-based management and monitoring tools.

Upon boot, users are presented with the main interface screen displaying the ExpressSAS and/or Celerity adapters installed in the system as well as basic information about the adapter (i.e. current firmware flash date, physical slot number, etc.).



Several options are available:

Function	Description
Update Flash	Updates adapter flash to the version bundled with the ConfigTool LiveISO
Display Adapter Info	Displays the adapter information table
Display Version Info	Outputs the version information for the ConfigTool LiveISO application
Reboot	Initiates a system reboot
Shutdown	Shuts down system
Exit	Exits the ConfigTool LiveISO application into the command line shell

Updating Flash

- At the prompt on the main screen, enter "1"
- A list of adapters available for update is presented. Enter the adapter number you wish to update. To update multiple adapters simultaneously, enter each adapter number separated by a space, or enter "All" to update all available adapters.

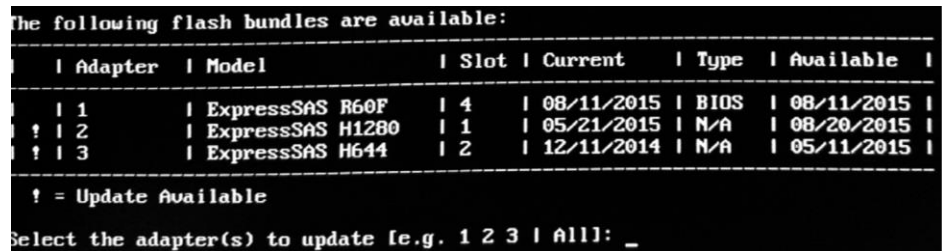
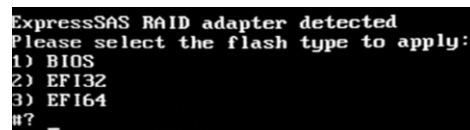


Exhibit 73 ATTO ConfigTool LiveISO Adapter Selection

- For RAID adapters, the user will be prompted to choose "BIOS", "EFI32" or "EFI64". Enter the appropriate flash type.



- Follow the prompt to continue and apply updates.

5. You will be returned to the ConfigTool LiveISO main screen once updates are completed.



Note

You must reboot for flash updates to take effect.

Using ATTO CLI Tool

1. On the main ConfigTool LiveISO screen, enter “6” to exit to the command line prompt.
2. Execute the desired CLI tool. Available tools are:
 - **atflash** - View and update the flash version of ATTO adapters.
 - **atinfo** - View basic information about ATTO adapters and their attached devices.
 - **atlocate** - Manage and locate LEDs present on ATTO adapters to physically differentiate multiple adapters in the same system. (12Gb HBAs only)

- **atpcpro** - View and manage Power Center Pro RAID groups on ExpressSAS 12Gb HBAs. (12Gb HBAs only)
- **atsasnvr** - View and modify the NVRAM parameters of ATTO ExpressSAS adapters to fine-tune adapter performance and behavior. Can save and restore NVRAM settings from a file.



Note

To obtain help and the supported operands for each command, run Linux command. /atinfo -h



Note

For more information on ATTO's CLI Tools, refer to [Appendix A](#).

17 EFI Configuration Utility

The EFI drivers for ATTO Celerity and ExpressSAS host adapters have a built-in EFI Configuration Utility which manages the adapter and the devices connected to the adapter

The EFI Configuration Utility for ATTO host adapters uses a standard menu/choice model. The Main Menu presents the functions available from the utility. Selecting an item on the menu may bring up a secondary menu or a dialog box. The dialog box displays the items managed by the dialog box.

Accessing the EFI Configuration Utility

The EFI Configuration Utility is accessed through a platform specific EFI shell. Different platforms have different means to enter an EFI shell, though it is generally done through a function key displayed during initialization. If the system does not have an EFI shell a 3rd party tool must be used.

1. Once at an EFI shell prompt, enter the 'drivers -b' command. Scroll through the list of installed EFI drivers

and find the ATTO driver. There may be more than one entry based on the number and type of adapter(s). Note the two or three digit hexadecimal driver handle on the far left of the screen.

2. At the prompt, enter 'drvcfg -s {handle}', where {handle} is the hexadecimal number from the previous step. This will launch the EFI Configuration Utility for the associated adapter.

```
CCAF0000,0xCD2EFFFF)/FvFile(5BEDB5CC-D830-4EB2-8742-2D4CC9B54F2C)
 99 0000000A D N N 2 0          MTFTP6 Network Service Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(99F03B99-98D8-49DD-A8D3-3219D0FFE41E)
 9A 0000000A D N N 2 0          TCP Network Service Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(1A7E4468-2F55-4A56-903C-01265EB7622B)
 9B 0000000A D N N 2 0          TCP Network Service Driver
 9C 0000000A B N N 6 8          UDP6 Network Service Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(D912C7BC-F098-4367-92BA-E911083C7B0E)
 9D 0000000A B N N 16 1         UEFI PXE Base Code Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(B95E9FDA-26DE-48D2-8807-1F9107AC5E3A)
 9E 0000000A ? N N 0 0          UEFI PXE Base Code Driver
 9F 00000016 B N N 1 1         G200eR Matrox Graphics UEFI Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(B4B90EA2-C206-4D57-BA63-9EB3D0B139AD)
 A0 0000000A ? N N 0 0          PERC S110 Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(8F8153E7-127C-4B7D-9035-DFA6490EC4A8)
 A5 01010022 ? N N 0 0          AMI Setup Browser Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(50D221E5-CE11-473D-9135-9908B4C6DE71)
 A6 01000019 ? N N 0 0          AMI Graphic Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(8DC7E653-45A8-41DA-9E58-038158FEB3F4)
 A7 01000014 ? N N 0 0          AMI MRE Driver MemoryMapped(0xB,0x
CCAF0000,0xCD2EFFFF)/FvFile(736197E2-5504-48E9-AEAD-2B9E63617C61)
 BF 00100204 B Y Y 1 1         Broadcom Gigabit Ethernet Driver
 C0 00100204 B Y Y 1 1         Broadcom Gigabit Ethernet Driver
158 03320200 B Y Y 1 2         ATTO ExpressSAS RAID Driver 3.50
Shell> drvcfg -s 158
```

ExpressSAS EFI Utility

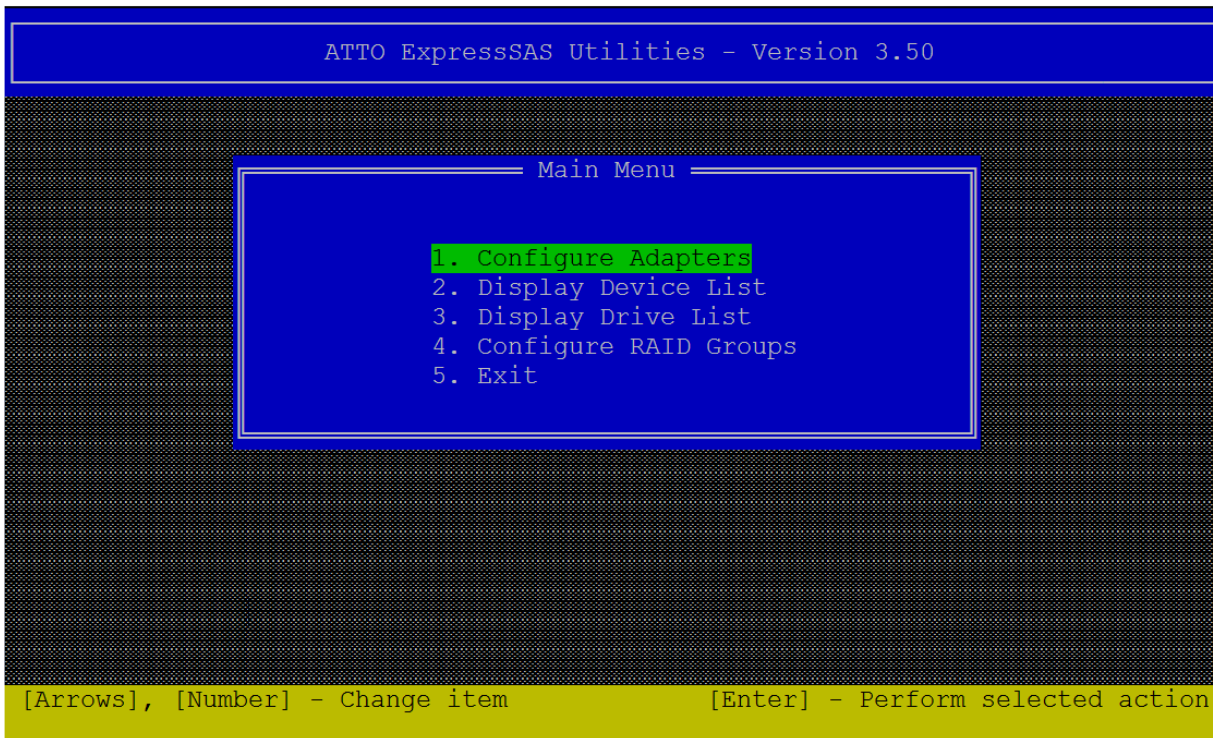
The EFI driver for ATTO ExpressSAS storage adapters have a built-in EFI Utility which manages the adapter and the devices connected to the adapter.

The ExpressSAS EFI Utility uses a standard menu/choice model. The Main Menu presents functions available from the utility. Selecting an item on the menu may bring up a secondary menu or a dialog box. The dialog box displays the

Exhibit 74 The ExpressSAS RAID Main Menu

items managed by that dialog box. See the [ExpressSAS RAID Main Menu](#). The SAS EFI Configuration Utility Main Menu displays the following items:

1. [Configure Adapter Settings](#)
2. [Display Device List](#)
3. [Display Drive List](#)
4. [Configure RAID Groups](#)



Configuring Adapter Settings

The Configure Adapter Settings menu displays information about the ExpressSAS adapter.

Channel Number

Allows you to select a specific ExpressSAS adapter from a list of installed ExpressSAS adapters.

SAS Address

Displays the SAS Address assigned to the selected ExpressSAS adapter.

Firmware Version

Displays the firmware version of the selected ExpressSAS adapter.

CacheAssure (ExpressSAS RAID adapters only)

Displays the current CacheAssure status of the selected ExpressSAS adapter. To refresh this display, exit and re-enter this screen.

Boot Driver

Choices: Enabled, Scan Only, Disabled

Default: Enabled

If enabled and disk drivers are detected during the bus scan, the boot driver (BIOS or EFI) remains resident and presents possible targets for booting. If disabled, the boot driver starts, resets the adapter chip and unloads the driver. If Scan Only is selected, the boot driver scans the bus and displays the devices attached, then unloads itself after a brief delay. For EFI, since there is no banner screen displayed during boot, Scan Only is used to discover devices in the Configuration Utility but these devices are not presented to the EFI system.

Heartbeat

Choices: Enabled, Disabled

Default: Enabled

When enabled, requires the firmware to respond to periodic activity. If the firmware does not respond, the system driver resets the firmware on the adapter.

NCQ

Choices: Enabled, Disabled

Default: Enabled

Disabled (H6xx)

When enabled, the adapter will use Native Command Queuing on any SATA drives that support this feature.

Phy Speed

Choices: Auto, 12Gb/s, 6Gb/s, 3Gb/s, 1.5 Gb/s

Default: Auto

Allows the user to manually adjust the speed of the PHYs on the adapter.

Device Wait Time

Choices: 1-255 seconds

Default: 3 seconds

This field specifies the number of seconds which the driver waits for devices to appear.

Device Wait Count

Choices: 1-255 devices

Default: 1 device

This field specifies the number of devices which must appear in order to cancel the Device Wait period.

Spinup Delay (except R60F)

Choices: 0-20 seconds

Default: 0 seconds

Specifies the number of seconds each SAS port waits to spin up the attached devices.

Link Down Timeout (H6xx and H12xx adapters only)

Choices: 0-255 seconds

Default: 0

Specifies the number of seconds each SAS port waits to for disconnected devices before informing the Operating System. A value of 0 specifies the driver chooses the default value.

LED Control (R608, R60F, H608, H60F, H1208 and H120F only)

Choices: SGPIO, I2C (R6xx, H6xx), Disabled

Default: SGPIO (H12xx, R6xx)

Disabled (H6xx)

Specifies the method used to perform LED control. The Storage Adapters exposes a virtual SES device that provides standard SCSI SES commands for LED control. The standard SCSI commands can control the locate and failure LED. The virtual SES driver will use the specified method to send the commands to the drive backplane. See the ExpressSAS installation manual for instructions to connect cables for SGPIO or I2C LED control.

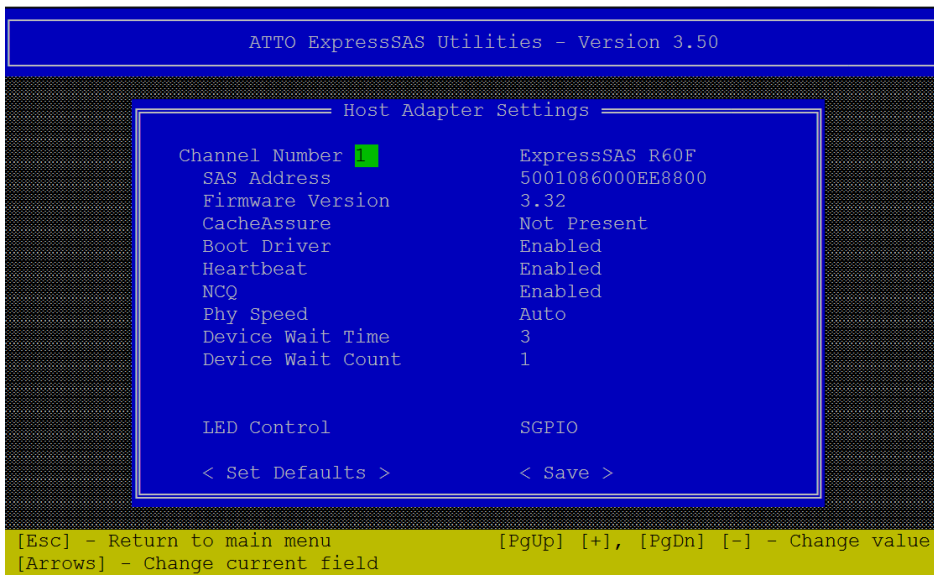
Set Defaults

Returns all settings to the factory defaults. This must be followed by a Save.

Save

Permanently saves the adapter settings to the current adapter.

Exhibit 75 The Configure Adapter Settings Menu



Displaying the Device List (ExpressSAS RAID adapter only)

Selecting the [Display Device List Menu](#) item displays a list of all devices which are displayed to the operating system. This list also displays virtual devices such as the ATTO Virtual SES device and any ATTO RAID groups that are currently mapped. The following information is displayed for each device:

Chan

Indicated the adapter number for the ATTO adapter to which the device is connected.

ID

Displays the device target ID number within the adapter.

LUN

Displays the device LUN.

Vendor

Displays the device manufacturer's vendor name.

Product

Displays the device's product name.

Type

Displays the SCSI device type of the device.

Capacity

Displays the device's capacity if it is a block device.

Status

Displays the current status of the device.

Exhibit 76 The Display Device List Menu

```
ATTO ExpressSAS Utilities - Version 3.50

Device List
-----
Chan ID LUN Vendor Product Type Capacity Status
-----
1 0 0 ATTO Virtual SES SES 0 B OK
1 2 0 ATTO r500 Disk 3.64TB OK

[Enter], [Esc] - Return to main menu
[Arrows] - Scroll through drive list
```


Displaying the Drive List (ExpressSAS RAID adapter only)

Selecting the [Display Drive List Menu](#) item displays a list of all disks which are connected to the adapter with the following information for each:

Chan	Indicates the adapter number for the ExpressSAS RAID adapter to which the drive is connected.	Capacity	Displays the drive's byte capacity.
Slot	Displays the drive's SES slot number if it is in an enclosure that supports SES, or N/A.	RAID Group	Contains the name of the RAID group to which the drive is assigned. The field may also contain other drive group status, such as that it is currently a Hot Spare or Available for inclusion in a new RAID group
Vendor	Displays the drive manufacturer's vendor name.	Member State	Displays the drive's current state.
Product	Displays the drive's product name.		

Exhibit 77 The Display Drive List Menu

Chan	Slot	Vendor	Product	Capacity	RAID Group	Member State
1	10	ATA	D2CSTK251M14-024	223.57GB	Available	Online
1	11	ATA	D2CSTK251M14-024	223.57GB	Available	Online
1	12	ATA	D2CSTK251M14-024	223.57GB	Available	Online
1	14	Hitachi	HDS723020BLA642	1.82TB	r5	Online
1	15	Hitachi	HDS723020BLA642	1.82TB	r5	Online
1	16	Hitachi	HDS723020BLA642	1.82TB	r5	Online

[Enter] Drive Details [Esc] Cancel [S] Scan [H] Hot Spare [E] Enclosure
[Space] Select Drives [C] Clean [R] Remove Spare [L] Locate

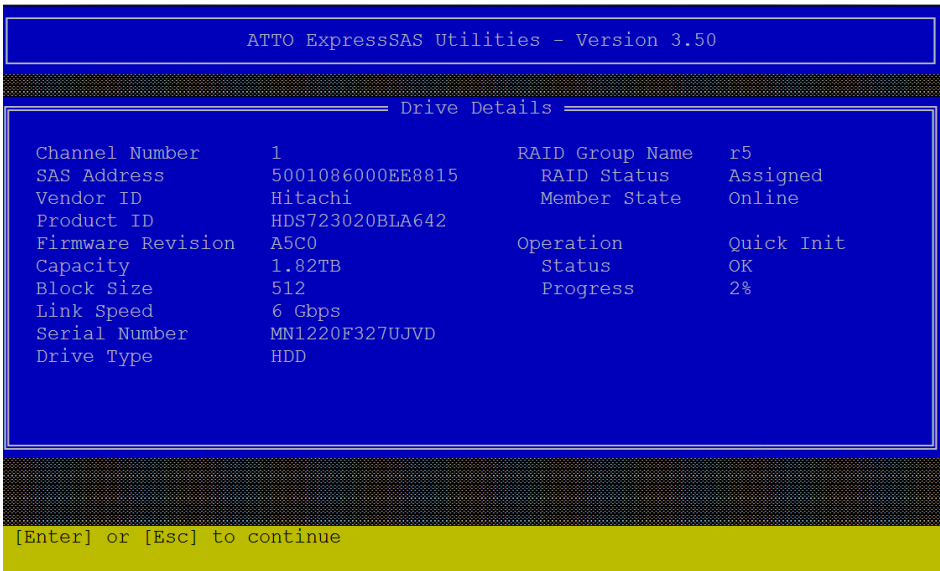
The Display Drive List menu highlights the first drive in the list. Use the up and down arrows to highlight other disks. Select the following functions from this menu:

Select Drive	Type Space Bar to allow multiple drives to be selected. The selected drive is removed by typing Space Bar a second time.	Hot Spare	Type H to assign the selected drives to the Hot Spare pool. Drives must be selected by typing Space Bar or E.
Enclosure	Type E to select all disks that are in the same enclosure.	Remove Spare	Type R to remove the selected drives from the Hot Spare pool. Drives must be selected by typing Space Bar or E.
Scan	Type S to clear and refresh the drive list.	Locate	Type L to make the selected drives blink their activity or location lights. Drives must be selected by typing Space Bar or E. Type L again to turn the lights off.
Clean	Type C to clean all metadata from the selected drives. Drives must be selected by typing Space Bar or E.		

Show Drive Detail

Type Enter to display more information about the highlighted drive. See the [Drive Details Window](#)

Exhibit 78 The Drive Details Window



Configuring RAID groups (ExpressSAS RAID adapter only)

Selecting the [Configure RAID Groups Menu](#) displays a list of all detected RAID groups with the following information for each:

Chan

Indicates the adapter number for the ExpressSAS RAID adapter to which the group belongs.

ID

Displays the group ID number within the adapter.

Group Name

RAID group name.

Drives

Number of drives in the RAID group.

Capacity

The RAID group's total capacity.

Status

The RAID group's current status.

RAID Level

The RAID group's RAID level.

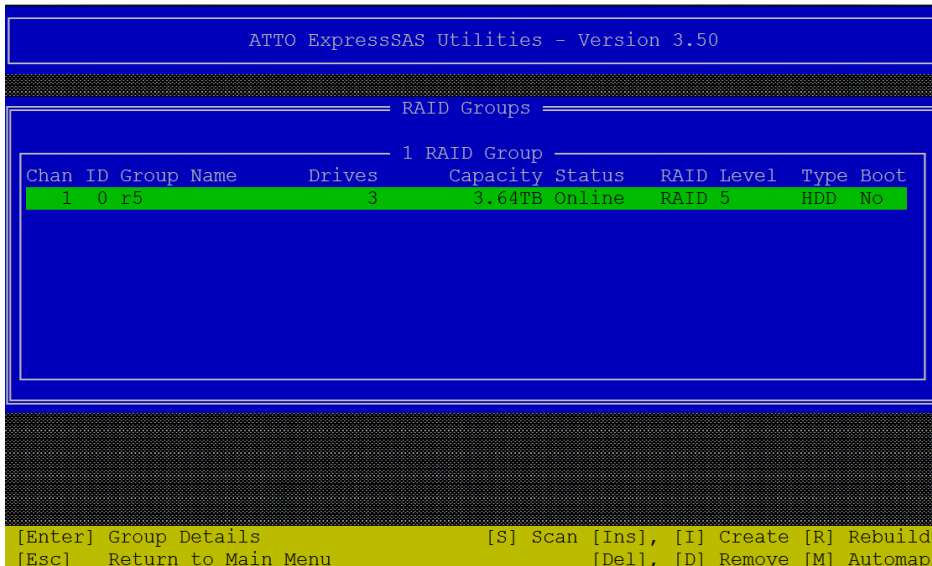
Type

The type of RAID group, either HDD or SDD.

Boot

Whether the RAID group is a Boot Group or not.

Exhibit 79 The Configure RAID Groups Menu



The **Configure RAID Groups** menu highlights the first RAID group in the list. Use the up and down arrows to highlight other RAID groups. Select the following functions:

Scan

Type **S** to clear and refresh the group list.

Create

Type **Insert** to build a new RAID group.

Delete

Type **Delete** to delete the highlighted RAID group. A confirmation prompt must be answered.

Rebuild

Type **R** to rebuild the highlighted RAID group. A confirmation prompt must be answered to start the rebuild.

Automap

Type **M** to automatically map all unmapped partitions on each adapter in the system.

View Selected RAID Group

Type **Enter** to display more information about the highlighted RAID group. If a RAID group is initializing or rebuilding, the [Group Details Window](#) displays the completion percentage of the operation.

Exhibit 80 The Group Details Window

```
ATTO ExpressSAS Utilities - Version 3.50

----- Group Details -----

Group Name           r5           Number of Drives    3
RAID Level           RAID 5       Number of Partitions 1
Interleave           128 KB      Group Status        Online
Sector Size          512         Rebuild State       Quick Init
Mirror Width         0           Rebuild Status      OK
Type                 HDD         Progress            2%
Boot RAID Group      No

[Enter] or [Esc] to continue
```

Create a RAID Group

Selecting Create RAID Group starts a wizard. The first screen of the wizard selects whether an SSD or HDD RAID group is going to be created. See the [Create RAID Group Menu](#).

Exhibit 81 The Select Group Type Menu

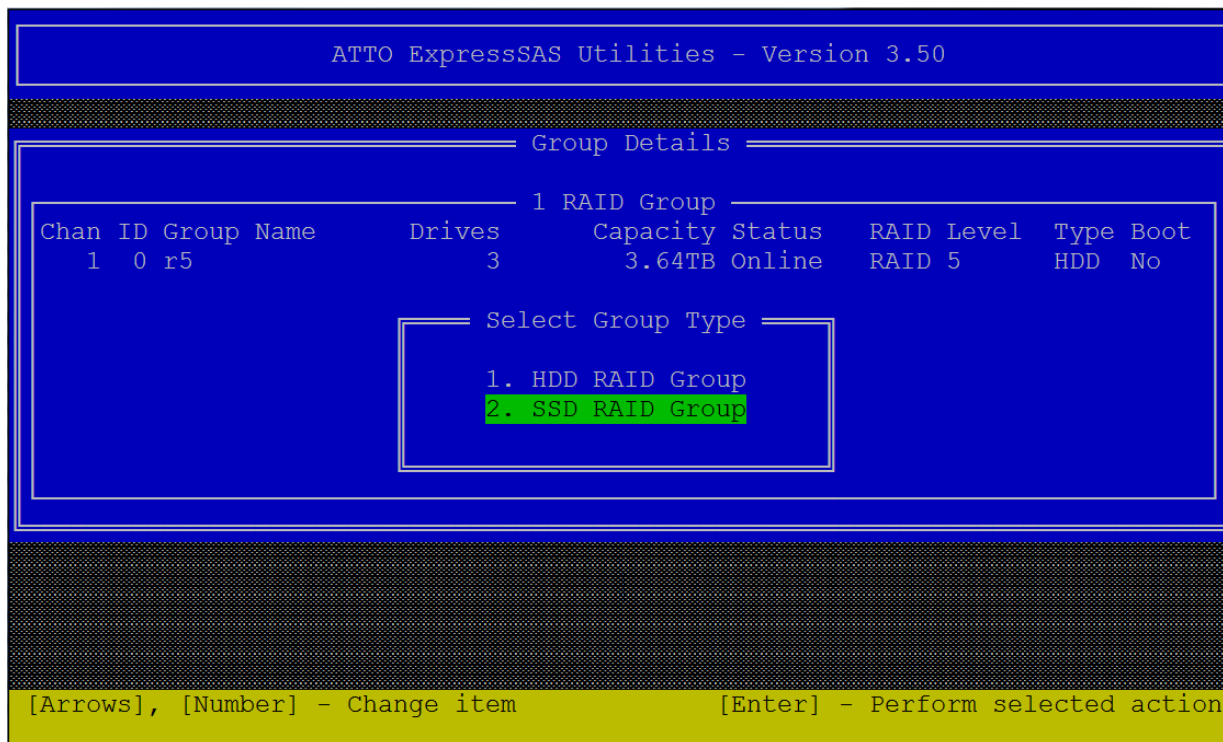
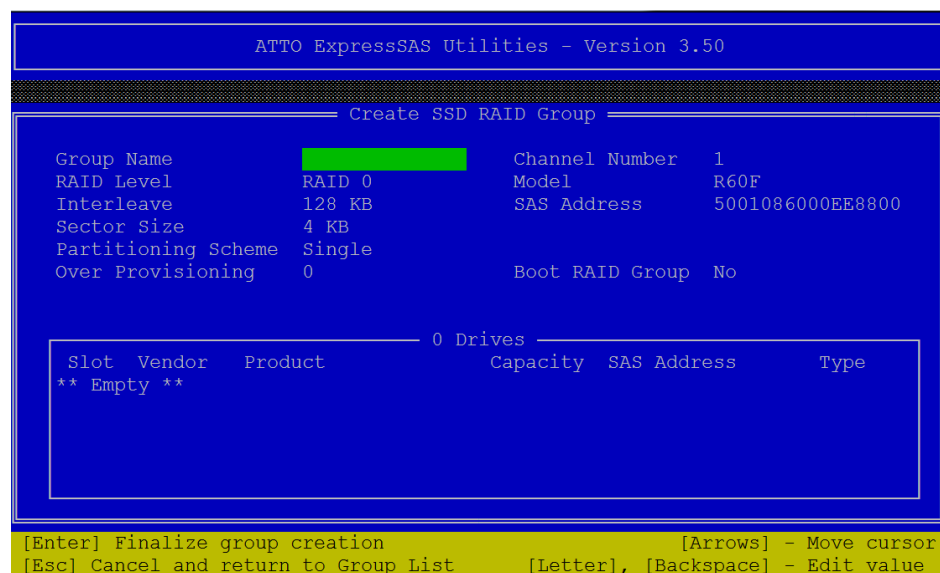



Exhibit 82 The Create RAID Group Menu



Once the type of RAID group is selected the Create RAID Group screen is displayed – see the [Create RAID Group Menu](#).

1. Type a RAID group name. The name must be unique and no more than 14 characters.
2. Select a RAID Level: 0,1,4,5,6,10 or JBOD.

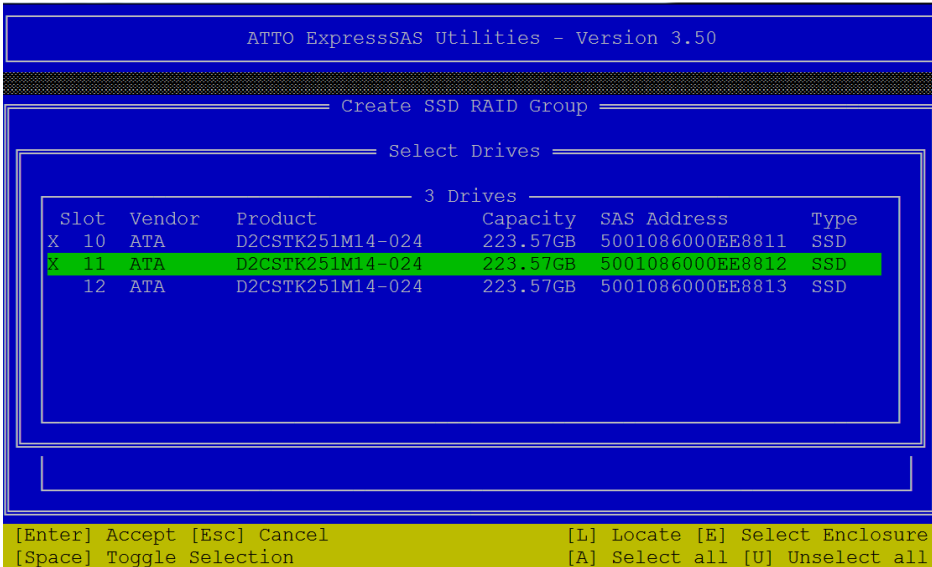
3. Select an Interleave: 64KB, 128KB, 256KB, 512KB, or 1MB
4. Select a Sector Size: 512 B or 4KB.
5. Select an Initialize type: Express or Advanced

 **Note** *that initialization type cannot be selected for SSD groups since an SSD Advanced Initialization is always done.*

6. Select a Partitioning Scheme: Single, By Count or By Size.
7. For SSD groups, the amount of over provisioning for the members can be selected: 0% - 30%.
8. Select a Mirror Count, a copy of the original data stored on a separate disk, for RAID groups that have mirrors.

9. Select whether this RAID group will be used as a Boot RAID group.
10. Type Insert on the Drive list box to add drives to the RAID group. See [Select Drives for RAID Group Menu](#)

Exhibit 83 Select Drives for RAID Group Menu



11. A list box of available drives is displayed. Press the Space Bar to select the drives to include in the new RAID group.

- Press E to select drives that are in the same enclosure.
- Type Enter to finalize drive selection.
12. Type Enter to create the RAID group.

CAUTION *A rebuild occurs after creating a RAID Level 4, RAID Level 5, or RAID Level 6 group. The length of time required for the rebuild depends upon the size of the RAID group. Do not reboot the adapter until the rebuild process is complete.*

Note *A RAID group is created with default properties which may be changed using the ConfigTool. Refer to [ATTO Storage Adapter Management](#)*

18 ATTO Utilities for Windows

The ATTO Utilities for Windows is a collection of programs which provide adapter management, device management and SAN management. These utilities execute on the Windows Server operating systems for x86 and x64 platforms.

The ATTO Utilities for Windows is available on the ATTO website for download.

ConfigTools

ATTO provides a full suite of ConfigTools and supplemental utilities to enhance the performance of ATTO Storage. The suite is comprised of the following utilities:

- **Bench32**, a disk benchmark program, measures disk performance.
- **FC LUN Masking** selects devices on a SAN visible to the system.

ATTO Disk Benchmark

The ATTO Utilities for Windows suite includes a utility to measure peak and sustained throughput for disk reads and disk writes.

The ATTO Disk Benchmark measures peak and sustained throughput for disk reads and writes.

1. Launch the application.
2. Select the drive letter for the disk to benchmark.
3. Select the transfer sizes to test.
4. Select the I/O option.
5. Click the Start button.
6. Wait for benchmark to run through the desired transfer sizes.
7. The Test Results Display at the bottom of the window is updated as the test progresses. The y-axis of the graph represents the transfer sizes in the selected range. The x-axis represents the transfer speeds in MB/sec. I/O speeds in KB/sec. for each transfer size are displayed textually to the right of the graph.
8. Click the Stop button to stop the test.

When the test completes, the results can be saved or printed.

If errors were detected, a dialog box displays the errors in a table with the following four columns and a button:

- **Benchmark Transfer Size:** transfer size at which the error occurred.
- **Buffer Index:** index into the data block at which the error occurred.
- **Actual Value:** the value read from the file.
- **Expected Value:** the value written to the file.
- **Log to File:** Logs the error table to a *.log file and closes the dialog. The file is given the same name as the test file and saved in the same directory. If the test was not previously saved, errors are logged to the generic file Bench32Error.log in the root of the test drive. If the log file already exists, the new errors are appended to the previously recorded errors. This is the only way to save detected errors. They are not saved in the test document file.

If the I/O comparison option was selected and errors were not detected, the message No errors detected is displayed.



Note *Additional information on using Bench32 is available by accessing the Help menu in the application.*

Benchmark fields

The benchmark fields include.

- **Drive:** Select the logical drive to benchmark. A test can be performed on any system drive.
- **Transfer Size:** Select the range of transfer sizes used for reading and writing data to the test drive. Transfer speeds are displayed for each size in the range. If the first size is greater than the second size, the test is not performed for any transfer size.
- **Total Length:** Select the total size of the data file to be created on the test drive. This file is deleted when testing completes.
- **Direct I/O:** If this option is checked, file I/O on the test drive is performed with no system buffering or caching. Combine this option with Overlapped I/O for maximum asynchronous performance.
- **Radio Button Group**
- **Overlapped I/O** performs queued I/O. Upon selection, the Queue Depth option displays to select the maximum number of read or write commands which may be executed simultaneously.
- **I/O Comparison** compares the data read from the test file to the data written on a per block basis. You can select the data pattern for comparison from the Test Pattern dropdown box.
- **Run continuously** runs the test continuously for a specified number of minutes. The test stops before the specified time if any errors are detected.

- Neither: Select if you do not want to perform overlapped I/O or I/O comparisons.

The following fields do not affect the benchmark but are informational, providing documentation of the test environment.

- Stripe Group: If the test drive is a stripe group, select its name from the list box. The names and quantities of drives in the stripe group are printed to the Description box. Select Clear to clear the contents of the Description box.
- Controlled by displays all ATTO Storage on the system.
- Description: Enter additional information about the test which can be saved or printed. Be sure to enter additional information after making a selection from the Stripe Group dropdown box, as this erases the current description.

Performing multiple benchmark tests

The ATTO Disk Bench supports four command line parameters for uninterrupted testing:

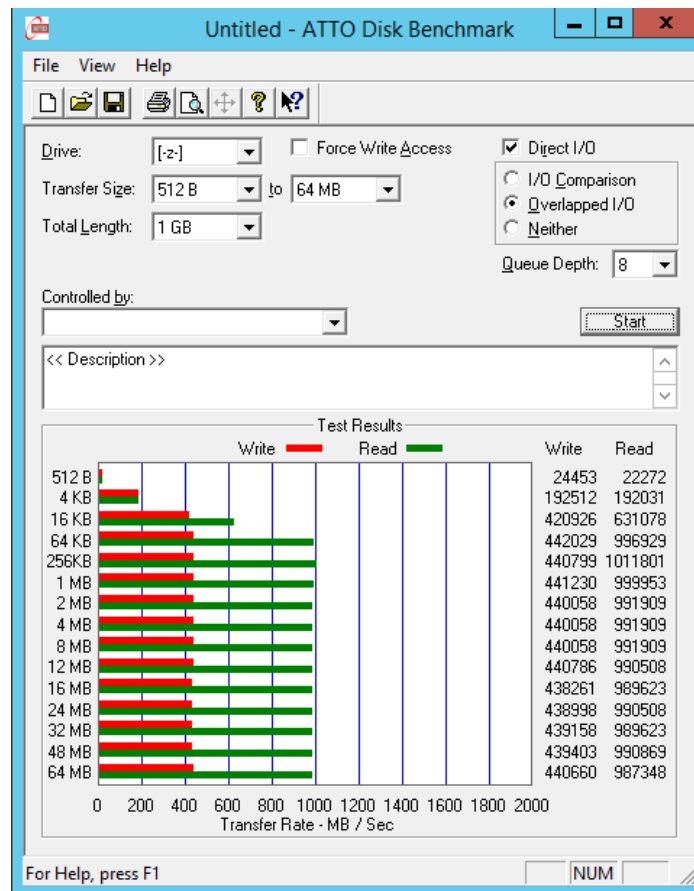
Testfile opens and executes the test named testfile with the extension .bmk or .tst (older versions of Disk Bench).

Textfile opens the text file named textfile. This file contains a list of test file names which have an extension of .bmk or .tst. Each test in this list is opened and executed in order. Stopping one test in the list prevents further tests from being executed. Error logging is the same as the command line parameter testfile, but all errors generated from all tests in the list are logged to one file: textfile.log.

/p testfile: Same as testfile, only the test is printed to the default system printer instead of being executed.

/p textfile: Same as textfile, only the tests in the list are printed to the default system printer instead of being executed.

Exhibit 84 The Bench 32 window after a test has been run.



19 FC LUN Masking Utility

ATTO Storage Adapters drivers allow you to select which devices and Logical Unit Numbers (LUNs) on a SAN are visible to Windows operating systems

Many devices, including RAID controllers and SCSI-to-Fibre Channel bridges, use LUNs to allow access to multiple drive units through a single World Wide Name (WWN). However, you may not want to allow all users connected to one device to have access to all devices. The ATTO LUN masking utility allows you, as the administrator, to select which LUNs each user may access, allowing greater flexibility in configuring a Fibre Channel SAN.

The utility gives information, allows you to add a new device to an adapter or allows LUN masking using three windows:

Main Window

Monitors and manages all LUN masking functions. The page is divided into two sub-sections: **Adapters** and **Devices**.

- Adapter List displays information about all the adapters detected or configured on this system.
- The first column displays the WWN of the adapter. If the adapter is installed, the second column displays the model of the adapter. Clicking on an adapter in the adapter list updates the device list.
- Device List displays information about all devices detected or configured for the adapter selected in the adapter list.
- The first column displays the device's WWN. The second column displays whether the first column refers to a Node WWN, Port WWN, Any WWN or is Disabled. The third column displays the current LUN mask configuration.

Adding a new device to an adapter

1. Select the adapter in the Main Window adapter list.

2. Click on the Add Device button at the bottom of the page.
3. Enter the WWN of the device or select a WWN from the drop down box.
4. Select the type of WWN to use:
 - Disabled
 - Node
 - Port
 - Any
 - Click OK.
5. The device name displays in that adapter's Device List on the bottom half of the main window. Click the Save Changes button on the bottom of the windows.

Using the Edit LUN Mask Dialog box

1. Double click the WWN of the device you wish to edit in the Devices List or select it and click the Edit LUN Mask button. If you do not see the device listed, you may need to add it.
2. Select Mask all LUNs or Mask LUN List to enter the specific LUNs you wish to mask.
3. When you have completed configuring the LUN mask for this device, click the OK button. Saving and applying your changes
4. Click the Save Changes button on the bottom of the windows.



Note *You must have Write Access to the registry key and all its sub-keys to save changes. Consult your system administrator if you cannot save changes.*

5. If you want the changes to take effect immediately, click the Apply Changes button before exiting but after saving. This causes the driver to reread the registry settings and alter its internal device database.

ATTO LUN Masking Utility page.

ATTO LUN Masking Utility

Config View Help

Adapters

WWN	Model
2000001086005555	Celerity FC-22XH Dual Channel with Hub (ClrtyFC)
2000001086005556	Celerity FC-22XH Dual Channel with Hub (ClrtyFC)

Devices

WWN	Type	LUNs Masked
5005076717002B46	Node WWN	none
500507671700425F	Node WWN	6-9

Add Device Revert to Saved Edit LUN Mask Apply Changes Save Changes Exit

For Help, press F1 NUM

20 Troubleshoot ATTO Utilities for Windows

The following suggestions may help if you are having problems.

- Using the Device Manager, ensure all drives are visible to the operating system.
- If drives are not visible, check all cable connections and terminations on each device.
- Make sure each device is powered up and has completed its self-check before booting your machine.
- Reboot your system any time you make changes to a stripe group.
- Have you partitioned your drive, and then activated that partition?
- Did you format the drive for your operating system?

If problems persist, contact your ATTO Technology technical support representative.

Appendix A CLI Tools for Configuration and Diagnostics

The command line interface (CLI) is a set of ASCII-based commands which perform configuration and diagnostic tasks.



CAUTION

Do not use the CLI unless you are directed to by an ATTO technician. Changing parameters may cause loss of data and/or disruption to performance and reliability of ATTO Storage Adapters. The ATTO ConfigTool interface is the preferred method to operate and manage ATTO products.

The following CLI Tools are available to help manage and monitor ATTO adapters.

- **atcnanvr** - View and modify NVRAM parameters of ATTO FastFrame Converged Network adapters and NICs to fine-tune adapter performance and behavior. Can save and restore NVRAM settings from a file.
- **atfcnicvr** - View and modify the NVRAM parameters of ATTO Celerity Fibre Channel adapters to fine-tune adapter performance and behavior. Can save and restore NVRAM settings from a file.
- **atdevinfo** – View detailed information about devices attached to ATTO adapters.
- **atfcinfo** – View topology and link information about ATTO Celerity Fibre Channel adapters
- **atflash** - View and update the flash version of ATTO adapters.
- **atinfo** - View basic information about ATTO adapters and their attached devices.
- **atlocate** - Manage and locate LEDs present on ATTO adapters to physically differentiate multiple adapters in the same system.
- **atmpinfo** -View basic information about ATTO MultiPath Director™ driver.
- **atmpcfg** - View and modify parameters for the ATTO Celerity adapters using the ATTO MP Director driver.
- **atpcpro** - View and manage Power Center Pro RAID groups on ExpressSAS 12Gb HBAs.
- **atsasinfo** – View topology and link information about ATTO ExpressSAS adapters.
- **atsasnvr** - View and modify the NVRAM parameters of ATTO ExpressSAS adapters to fine-tune adapter performance and behavior. Can save and restore NVRAM settings from a file
- **atraidcli** - Send RAID CLI commands to ATTO ExpressSAS RAID adapters (ex. create RAID groups, monitor RAID groups). Can send individual commands or a list of commands from a file.




Note

To obtain help and the supported operands for each command, run command -h. Examples include './atinfo -h' (Linux), or './atinfo -h' (macOS), or './atinfo -h' (VMware), or 'atinfo.exe -h' (Windows).

ATTO CLI Support Key


	ATTO CLI TOOL	atc na nvr	atde vinfo	atsa stop	atc nvr	atfc info	atfl ash	ati nfo	atloc ate	atm pcfg	atmp info	atni cnvr	atpc pro	atrai dcli	atsa snvr	atsas info
ATTO Product	Celerity 8Gb FC		✓				✓	✓		✓	✓					
	Celerity 16Gb FC		✓			✓	✓	✓		✓	✓					
	Celerity 32Gb FC		✓			✓	✓	✓								
	ExpressSAS 6Gb HBA		✓	✓			✓	✓							✓	✓
	ExpressSAS 12Gb HBA		✓	✓			✓	✓	✓	✓			✓		✓	✓
	ExpressSAS 6Gb RAID		✓				✓	✓						✓	✓	✓
	FastFrame 10Gb NIC	✓						✓				✓				
	ThunderLink FC		✓		✓	✓	✓	✓		✓	✓					
	ThunderLink SH		✓	✓			✓	✓						✓	✓	✓
	ThunderLink NT/NS	✓					✓	✓				✓				
ThunderStream SC		✓				✓	✓						✓	✓	✓	

 Note **The default location for the CLI Tools is: (Linux) %system root%/usr/local/sbin, (macOS) %system root%/Applications/ATTO. VMWare and Windows are user defined**

Appendix B ConfigTool RAID CLI Tab

The RAID CLI tab in the ATTO ConfigTool allows experienced users to enter RAID Command Line Interface (CLI) commands to the SAS RAID adapter. The CLI uses ASCII commands typed while in CLI mode.

- CLI commands are context sensitive and generally follow a standard format [Get|Set] Command [Parameter1|Parameter2] followed by the return or enter key.
- CLI commands are case insensitive (however the 'group name' is case sensitive): you may type all upper or all lower case or a mixture. Upper and lower case in this manual and the help page are for clarification only.
- Commands generally have three types of operation: get, set and immediate.
- The get form returns the value of a parameter or setting and is an informational command.
- Responses to get commands are followed by Ready.
- The set form is an action which changes the value of a parameter or configuration setting. It may require a SaveConfiguration command and a restart of the system before it is implemented. A number of set commands may be issued before the SaveConfiguration command.
- Responses to set commands are either an error message or Ready. *. The asterisk indicates you must use a SaveConfiguration command to finalize the set command.
- Set commands which do not require a SaveConfiguration command, defined as immediate commands, are immediately executed.

 **Note** *Using certain CLI commands during normal operation can impact system performance. Once command actions are complete, performance should return to normal levels.*

Symbols, typefaces and abbreviations used to indicate functions and elements of the command line interface used in this manual.

Symbol	Indicates
[]	Required entry
< >	Optional entry
	Pick one of
n-n	A range (6 – 9 = 6, 7, 8, 9)
BlockDevID	Index designation of a block device not assigned to any other RAID group; the index of a block device provided by the Error! Reference source not found. c ommand.
GroupName	The name of the RAID group to which the block device is assigned, or blank if the block device is available
MemberIndex	Index designation of a RAID group member as found in the Error! Reference source not found. command
PartIndex	Index designation of a partition as found in the Error! Reference source not found. command
SASIndex	Index designation of SAS drives as found in Error! Reference source not found.
TID	Target ID: 0<=n<=255

CLI error messages

The following error messages may be returned by the Command line Interface

- ERROR Invalid Command. Type 'Help' for command list.
- ERROR Command Not Processed
- ERROR Wrong/Missing Parameters
- ERROR Invalid Hot Spare Serial Number
- ERROR Invalid RAID GroupName
- ERROR Invalid RAID Group State
- ERROR Insufficient number of RAID Group members
- ERROR RAID Group does not exist
- ERROR No RAID Groups found
- ERROR Invalid RAID Type
- ERROR RAID Group is already unmapped
- ERROR Invalid Block Device Index
- ERROR Invalid RAID MemberIndex
- ERROR Invalid RAID Member State
- ERROR Missing RAID Member
- ERROR Invalid RAID Member Capacity
- ERROR Invalid Partition Index
- ERROR Maximum number of RAID Groups exceeded
- ERROR Maximum number of Partitions exceeded
- ERROR Invalid number of Partitions
- ERROR Maximum number of RAID Members exceeded
- ERROR Maximum stripe width
- ERROR Invalid number of Partitions specified
- ERROR Invalid Span Depth specified
- ERROR Cannot perform operation on mapped Partition
- ERROR Cannot perform operation. RAID Group has mapped Partitions
- ERROR Cannot perform operation. RAID Group has Outstanding Commands
- ERROR Block Device at specified index no longer available
- ERROR Insufficient RAID Group members for RAID type
- ERROR Incorrect number of RAID Group members for QuickVideo configuration
- ERROR Invalid Virtual Drive ID
- ERROR Specified capacity is invalid
- ERROR Too many Indices specified.
- ERROR Only one add storage operation is permitted at any given time.
- ERROR No free block devices
- ERROR Cannot benchmark a drive that is being initialized
- ERROR Specified drive is not being monitored

CLI summary

The following chart summarizes the Command Line Interface commands, their defaults, and an example of how to enter the commands. Commands which have no default values have a blank entry in that column of the table.

 **CAUTION** Do not use CLI unless you are directed to by an ATTO technician. Changing parameters may cause loss of data and/or disruption to performance and reliability of ATTO products.

Command	Default	Example
AutoMap		automap
AutoMapOnBoot	disabled	set automaponboot enabled
AutoResume	rebuild = enabled erase = disabled initialize = enabled	set autoresume erase enabled raidgroup1
BlockDevClean		blockdevclean 30
BlockDevIdentify		blockdevidentify 30
BlockDevIDStop		blockdevidstop
BlockDevInfo		blockdevinfo
BlockDevScan		blockdevscan
BuzzerOnError (6Gb RAID Adapter w/CacheAssure)		set buzzeronerror enabled
BuzzerTest (6Gb RAID Adapter w/CacheAssure)		buzzertest on 5
CACacheStatus (6Gb RAID Adapter w/CacheAssure)		get cacachestatus
CACleanCache (6Gb RAID Adapter w/CacheAssure)		cacleancache
CAPowerStatus (6Gb RAID Adapter w/CacheAssure)		get capowerstatus
CAProtectionMode (6Gb RAID Adapter w/CacheAssure)	Hi (High) Protection	set caprotectionmode hipformance
ClearEventLog		cleareventlog
Date		
DeleteScheduledTasks		

DisplayScheduledTasks		
DriveAssureReport		driveassurereport groupname1
DriveHealth	disabled	set drivehealth enabled
DriveHealthDisplay		drivehealthdisplay all
DriveHealthStatus		drivehealthstatus
DriveSpinDownAtIdle		DriveSpinDownAtIdle = disabled
DriveTest		drivetest begin
DriveTestClearList		drivetestclearlist all
DriveTestConfig	not initiated	set drivetestconfig read
DriveTestList		get drivetestlist all
DriveTestStatus		get driveteststatus
DumpConfiguration		dumpconfiguration
DumpEventLog		dumpeventlog
EventLog	enabled	set eventlog disabled
EventLogFilter	all all all	set eventlogfilter gen info all
FanSpeed	AUTO	set fanspeed high
FUAWrites	enabled	set fuawrites disabled
HBADrive		
HBAMode	manual	
Help		help eventlog
HSAdd		hsadd 3
HSDisplay		hsdisplay
HSRemove		hsremove 3
IdentifyBridge	Disabled	set IdentifyBridge enabled
Info		info
IsReserved		isreserved


MaxOpTemp	85 Celsius	set MaxOpTemp 60
MediaScanErrorReport		
Metrics		metrics display all
MinOpTemp	0 Celsius	set MinOpTemp 13
MirrorIdentify		set mirroridentify rg1
MirrorIdentifyStop		mirroridentifystop rg1
OEMConfigFile	ATTO	get oemconfigfile
OpTempWarn	15 Celsius	set OpTempWarn 13
Partition		partition alpha1 6 4 GB
PartitionDisplay		partitiondisplay alpha1
PartitionMerge		partitionmerge all
PartitionSplit		partitionsplit alpha1 22 2
PartitionWriteCache		set partitionwritecache enabled
PassThroughMode		set passthroughmode all
PassThroughPersistent		passthroughpersistent
PassThroughRediscover		passthroughrediscover
RAIDMediaScanPriority	low	set raidmediascanpriority low
RAIDRebuildPriority	same	set raidrebuildpriority low
RAIDSpeedWriteLimit	8	set raidspeedwritelimit 16
RebuildContinueOnError	Disabled	set rebuildcontinueonerror all enabled
Reserve		reserve
RestoreConfiguration		restoreconfiguration default
RGAutoRebuild	disabled	set rgautorebuild all enabled
RGAxleDepth	1	set rgaxledepth groupname1 8
RGCancelMediaScan		
RGCommit		rgcommit all

RGCreate		rgcreate groupname1 raid0
RGDiskWriteCache	enabled	set rgdiskwritecache all disabled
RGDisplay		rgdisplay all
RGErase		rgerase groupname1
RGHaltErase		rghalterase groupname1
RGHaltInitialization		rghaltinitialization groupname1
RGHaltMediaScan		
RGHaltRebuild		rghaltrebuild groupname1
RGMediaScan		
RGMediaScanErrorReport		set rghdparameter groupname1 30
RGMemberAdd		rgmemberadd groupname1 30
RGMemberRemove		rgmemberremove groupname1 30
RGOverprovision		set rgoverprovision
RGPrefetch		
RGReadDirect	enabled	set rgreaddirect groupname 1 disabled
RGRebuild		rgrebuild groupname1
RGRecover		rgrecover g1 rebuild
RGRecoverWithWrites		rgrecoverwithwrites g1 basic
RGResumeErase		rgresumeerase groupname1
RGResumeInitialization		rgresumeinitialization groupname1
RGResumeMediaScan		
RGResumeRebuild		rgresumerebuild groupname1
RGSectorSize	512	set rgsectorsize groupname1 4096
RGSpanDepth	1	set rgspandepth groupname1 8
RGSpeedRead	all disabled	set rgspeedread groupname1 enabled
RGUnmap		rgunmap groupname1

RGWaitTimeout	3	rgwaittimeout 30
RMStatus		rmstatus groupname1
Route		route host 1 raid groupname1 6
RouteDisplay		routedisplay host 0
SasPortList		
SASTargets		sastargets
SaveConfiguration		saveconfiguration
SerialNumber		get serialnumber
SES	enabled	
SESArmTest		
SESDiskFailureAlarm	disabled	
SESEnclosures		
SESIdentify	off	set sesidentify all
SESIdentifyStop		sesidentifystop all
SESMute		
SESPoll	30	set sespoll 0
SESStartingSlot	1	
SESStatus		
Temperature		get temperature
Time		set time 03:32:30
TimeZone	EST	set timezone pst
VerboseMode	enabled	set verbosemode disabled
VirtualDriveInfo		virtualdriveinfo

CLI command explanations

Command Line Interface commands are listed alphabetically with explanations of what they are used for, their defaults and syntax.

 **CAUTION** Using CLI without contacting an ATTO technician is not recommended because changing parameters may cause loss of data and/or disruption to performance and reliability of the ExpressSAS adapter.

AutoMap (Immediate, Disabled on Error)

Automap automatically maps each RAID Partition to a Target ID on the host system (maximum 256 maps allowed). If the optional 'passthrough' parameter is entered then AutoMap stores maps for currently connected SAS/SATA Pass Through Devices. Existing maps for available targets are preserved.

Usage: AutoMap <passthrough>

AutoMapOnBoot (OEM Configurable, Disabled on Error) (Not valid for 3808/4808)

Enables or disables automatic device detection and mapping at startup.

Usage: set AutoMapOnBoot [enabled | disabled]
get AutoMapOnBoot

BlockDevClean (Immediate, Disabled on Error)

BlockDevClean removes any RAID configuration data from the block device with the specified BlockDevID. BlockDevID is the index of a block device provided by the BlockDevScan CLI command. Caution: All RAID Group setup information is lost and you lose all RAID Group data.

Usage: BlockDevClean [BlockDevID]

BlockDevIdentify (Immediate, Disabled on Error)

Lights the LED of a disk drive. Use either RAID Group name and member index, or BlockDevID. BlockDevID is the index of a block device provided by the BlockDevScan CLI command.

Usage: BlockDevIdentify [[Groupname MemberIndex] | BlockDevID]

BlockDevIdStop (Immediate, Disabled on Error)

Turns off the IO LED of a previously identified disk drive. Specify RAID group name and member index, BlockDevID, or no parameters (which will turn off all previously identified drives). BlockDevID is the index of the block device provided by the BlockDevScan CLI command.

Usage: BlockDevIdStop <[GroupName MemberIndex] | BlockDevID>

BlockDevInfo (Immediate, Disabled on Error)

BlockDevInfo gives detailed information about connected physical block devices along with any potential RAID Group association.

Usage: BlockDevInfo [BlockDevID | all]

BlockDevScan (Immediate, Disabled on Error)

BlockDevScan lists all currently connected physical block devices along with any potential RAID Group association. Each block device listed is assigned a unique index at the time of the scan. This index is used to identify block devices for other CLI operations.

Usage: BlockDevScan

BuzzerOnError (OEM Configurable) (6Gb RAID Adapter w/CacheAssure)

When enabled, the audible alarm will sound under error conditions. When disabled, the audible alarm is muted.

Usage: set BuzzerOnError [enabled | disabled]
get BuzzerOnError

BuzzerTest (Immediate) (6Gb RAID Adapter w/CacheAssure)

Turns the audible alarm on or off regardless of the BuzzerOnError state. The optional seconds parameter specifies the length of time that the alarm is on. If the seconds parameter is omitted, the audible alarm will not turn off until the BuzzerTest Off command is issued.

Usage: BuzzerTest [on <seconds> | off]

CACacheStatus (6Gb RAID Adapter w/CacheAssure)

Returns the current status of the CacheAssure NV Memory Card. This includes whether or not it is installed.

Usage: get CACacheStatus

CACleanCache (Immediate) (6Gb RAID Adapter w/CacheAssure)

Deletes the contents of CacheAssure flash memory. Warning: CacheAssure may contain data for drives that are not connected, and issuing this command will cause that data to be lost!

Usage: CACleanCache

CAPowerStatus (6Gb RAID Adapter w/CacheAssure)

Returns the current status of the CacheAssure Power Module. This includes whether or not it is installed and whether or not it is fully charged.

Usage: get CAPowerStatus

CAProtectionMode (OEM Configurable, Disabled on Error) (6Gb RAID Adapter w/CacheAssure)

Use this command to determine behavior when CacheAssure is installed. HiProtection mode causes Disk Write Caching to be immediately Disabled for new and existing RAID Groups. HiPerformance mode enables Disk Write Caching for new and existing RAID Groups with a small risk of data loss on power failure.

Usage: set CAProtectionMode [HiProtection |
HiPerformance]
get CAProtectionMode

ClearEventLog (Immediate)

ClearEventLog clears the contents of the event log.

Usage: ClearEventLog

Date

Sets/displays the current date. The date range is 01/01/2000 to 12/31/2099.

Usage: set Date [MM/DD/YYYY]
get Date

DeleteScheduledTasks (Immediate, Disabled on Error)

Deletes a scheduled task with the Id returned by DisplayScheduledTasks.

Usage: DeleteScheduledTasks [Id]

DisplayScheduledTasks (Immediate, Disabled on Error)

Immediate command that displays all outstanding scheduled tasks.

Usage: DisplayScheduledTasks

DriveAssureReport (Immediate, Disabled on Error)

Displays drive timeout error statistics for all member drives in the specified RAID group.

Usage: DriveAssureReport [GroupName | all]

DriveHealth (OEM Configurable, Disabled on Error)

Changes the system's ability to acquire drive health data from connected drives. Issuing this command during I/O operations may adversely affect performance.

Usage: set DriveHealth [enabled | disabled]
get DriveHealth

DriveHealthDisplay (Immediate, Disabled on Error)

Retrieves and displays S.M.A.R.T. data from SATA disk drives, and MEDIUM DEFECT and INFORMATION EXCEPTIONS counts from other drives. Issuing this command during I/O operations may adversely affect performance. S.M.A.R.T data may be optionally filtered by attribute type: Performance, Error Rate, Event Count, Critical, or All. If filtering is used, only data for SATA drives is shown.

Usage: DriveHealthDisplay [BlockDevID | all] <perf | error |
evtcnt | crit | all>

DriveHealthStatus (Immediate, Disabled on Error)

Displays the current S.M.A.R.T. support of specified SATA disk drives and MEDIUM DEFECT and INFORMATION EXCEPTION support in other disk drives.

Usage: DriveHealthStatus [BlockDevID | all]

DriveSpinDownAtIdle (OEM Configurable, Disabled on Error)

Change the behavior toward attached drives during periods of inactivity. When enabled, a START STOP UNIT command is issued to spin down each drive for power conservation.

Usage: set DriveSpinDownAtIdle [enabled | disabled]
get DriveSpinDownAtIdle

DriveTest (Immediate, Disabled on Error)

Immediate command which starts or stops a drive test with the previously specified configuration and drive list. Drives which are in-use by the test are not available for RAID configuration or RAID operations. Only one test can be run at a time.

Usage: DriveTest [Begin | Cancel]

DriveTestClearList (Immediate, Disabled on Error)

Specifies drives to be removed from the drive test list. The 'drive BlockDevID' parameter will remove the specified drive from the list. The 'all' parameter automatically removes all drives from the list.

Usage: DriveTestClearList [drive [BlockDevID] | all]

DriveTestConfig (Disabled on Error)

Configures the drive test to perform one of the following operations: initialize (destructive write-only), mediascan (destructive for sectors with medium errors), read (non-destructive read-only), verify (destructive verify), or init-verify (destructive write-read-verify). The test is not started until the DriveTest Begin command is given. A new configuration may not be set while a drive test is being performed.

Usage: set DriveTestConfig [init | read | verify | mediascan | init-verify]

get DriveTestConfig

DriveTestList (Disabled on Error)

Specifies drives to be run in the next drive test. DriveTestConfig should be setup prior to adding any drives into the test list. This command can be called with different eligible BlockDev IDs and each one will be added to the list. Drives which are part of a RAID Group are only eligible for read drive tests. Additionally, Hot Spare drives are only eligible for mediascan and read drive tests. The 'all' parameter automatically chooses eligible drives. The test is not started until the DriveTest Begin command is given.

Usage: set DriveTestList [drive [BlockDevID] | all]

get DriveTestList

DriveTestStatus

Displays the status of the currently running drive test. This command does not display performance metrics. If a block device ID is not running or cannot be found, its state will be 'idle' and percent complete will be 0.

Usage: get DriveTestStatus <drive [BlockDevID]>

DumpConfiguration (Immediate)

Dumps system's configuration

Usage: DumpConfiguration

DumpEventLog (Immediate)

DumpEventLog can be used to dump the entire contents of the event log.

Usage: DumpEventLog

EventLog (OEM Configurable, Disabled on Error) (Not valid for 3808/4808)

EventLog can be used to enable/disable the event logging feature. When enabled, various system events are recorded to the event log.

Usage: set EventLog [enabled | disabled]

get EventLog

EventLogFilter (OEM Configurable, Disabled on Error) (Not valid for 3808/4808)

Specifies what events to include in the event log display. Type "get EventLogFilter" for a list of valid subsystems. Specify a subsystem with "none" to disable event display for that subsystem. Levels are "info", "warn" and "crit". Specify "info" to display all levels, "warn" to display warnings and critical events, "crit" to display only critical events. Events are classified "factory" or "user" (factory events provide detailed information for factory debug, and they are marked with a dash.) Specify "factory" to display all events, or specify "user" to display only user events.

Usage: set EventLogFilter [subsys | all] [[info | warn | crit]

[factory | user]] | none]

get EventLogFilter

FanSpeed

Sets the fan speed. Use "HIGH" to force speed to 100%. Use "AUTO" to have the speed adjust based on the temperature.

Usage: set FanSpeed [High | Auto]

get FanSpeed

FUAWrites

FUAWrites command is used to enable or disable applications to send FUAWrites to the disk drive.

Usage: set FUAWrites [enabled | disabled]

get FUAWrites

HBADrive (Disabled on Error)

Use this command to enable or disable drives for HBAMode. (Also see HBAMode command.) Only disks not in use by RAID may be selected. Select drives by their BlockDevID, the index of the block device provided by the BlockDevScan CLI command. A maximum of 5 drives can be enabled for HBAMode.

Usage: set HBADrive [BlockDevID] [enabled | disabled]

get HBADrive

HBAMode (OEM Configurable, Disabled on Error)

Configures HBA Mode, where non-RAID drives may be exposed directly to the host. Manual mode allows maps of user-Specified drives to be persistently saved. Automatic mode dynamically maps eligible drives upon discovery. Each HBAMode-enabled drive must be disabled before changing modes (see HBADrive command).

Usage: setHBAMode [manual | automatic]

get HBAMode

Help (Immediate)

The *Help* command issued with no parameters displays a list of available CLI commands. When a CLI Command name is specified, a command usage string and command description is presented on the CLI.

Usage: Help <command>

HSAdd (Immediate)

Assigns a Block Device to the Hot Spare pool.

Usage: HSAdd [BlockDevID]

HSDisplay (Immediate)

HSDisplay outputs a list of all of the devices in the Hot Spare pool.

Usage: HSDisplay

HSRemove (Immediate)

Removes a Block Device from the Hot Spare pool.

Usage: HSRemove [BlockDevID | all]

IdentifyBridge

IdentifyBridge causes the 'Alert' LED to blink to enable identification of this system. Disable this option to cancel the blinking.

Usage: set IdentifyBridge [enabled | disabled]

Info (Immediate)

Info displays version numbers and other product information for key components. Use the optional 'brief' parameter to show a more concise subset of system information.

Usage: Info <brief>

IsReserved (Immediate)

IsReserved displays the reservation status of the current services session/interface.

Usage: IsReserved

MaxOpTemp (OEM Configurable, Disabled on Error)

MaxOpTemp sets/displays the maximum operating temperature in degrees Celsius. Valid entries are between 55 and 85 degrees.

Usage: set MaxOpTemp [55 - 85]

get MaxOpTemp

MediaScanErrorReport (Immediate, Disabled on Error)

MediaScanErrorReport displays Media Scan error statistics for either a single block device or all block devices in the system.

Usage: MediaScanErrorReport [BlockDevID | all]

Metrics (Immediate)

The *Metrics* CLI command offers control over the collection of standard data metrics within a product via the command's 'Start', 'Stop', and 'Display' parameters.

Usage: Metrics [Start|Stop|Display|Clear] [[drive [BlockDevID]]|all|running]

MinOpTemp (OEM Configurable, Disabled on Error)

MinOpTemp sets/displays the minimum operating temperature in degrees Celsius. Valid entries are between 0 and 15degrees.

Usage: set MinOpTemp [0 -15]

get MinOpTemp

MirrorIdentify(Immediate)

For RAID 1 and RAID 10, *MirrorIdentify* blinks the Identify LEDs for a set of RAID Group Drives that contain a complete copy of the data. Use *MirrorNumber* 0 to identify the original set.

Usage: set MirrorIdentify [GroupName <MirrorNumber>]

get MirrorIdentify [GroupName <MirrorNumber>]

MirrorIdentifyStop(Immediate)

MirrorIdentifyStop stops identifying the specified set of RAID Group drives. *GroupName* with no mirror number stops identifying all drives in the RAID Group.

Usage: MirrorIdentifyStop [GroupName <MirrorNumber>]

OEMConfigFile (Disabled on Error)

This command returns the "name" (i.e., the contents of the first record) of the OEM configuration file stored in persistent memory.

Usage: get OEMConfigFile

OpTempWarn (OEM Configurable, Disabled on Error)

OpTempWarn sets/displays the offset in degrees Celsius when a warning will be issued prior to a thermal control event. Valid entries are between 0 and 15 degrees.

Usage: set OpTempWarn [0 - 15]

get OpTempWarn

Partition (Immediate)

Partition sets the specified partition to the specified capacity in gigabytes (GB), megabytes (MB), or blocks. The specified capacity must be smaller than the specified partition's current capacity. A new partition is created to acquire the remainder of the original partition's space.

Usage: Partition [GroupName] [PartIdx] [capacity] [GB | MB | blocks]

PartitionDisplay (Immediate)

PartitionDisplay outputs a list of all of the partitions available in the specified RAID Group. The partitions are listed in order of contiguousness (as opposed to index order). GroupName is the ASCII name of the RAID Group for which partitions will be displayed.

Usage: PartitionDisplay <GroupName>

PartitionMerge (Immediate)

PartitionMerge merges the specified contiguous partitions into one partition. GroupName is the ASCII name of the RAID Group containing the partitions to merge. PartIdx is the index of a partition to merge, along with a number of contiguous partitions to merge to that index. 'All' indicates that all partitions in the RAID Group will be merged into a single Virtual Disk. The RAID Group must not be in a NEW state. None of the partitions to merge may be mapped.

Usage: PartitionMerge [GroupName] [[PartIdx] [2-128]] | all]

PartitionSplit (Immediate)

PartitionSplit splits the specified partition into one or more partitions whose capacities are evenly distributed among the capacity of the original partition. GroupName is the ASCII name of the RAID Group containing the partition to split. PartIdx is the index of the partition to split. The partition to split cannot be mapped. The RAID Group must not be in a NEW state.

Usage: PartitionSplit [GroupName] [PartIdx] [2-128]

PartitionWriteCache

Enable RAID internal Write Cache for higher write performance with a small risk of data loss after a system failure. Disable RAID internal Write Cache for a higher level of data integrity with lower write performance.

Usage: set PartitionWriteCache [GroupName] [PartIdx] [enabled | disabled]

get PartitionWriteCache [GroupName] [PartIdx] | all]

PassThroughMode (OEM Configurable, Disabled on Error)

PassThroughMode specifies the non-disk device types which will be automatically mapped at boot time. The "all" option allows all non-disk devices to be mapped. The "SES" option allows dedicated SES processor LUNs to be mapped. The "non-SES" option allows all non-SES devices to be mapped. The "disabled" option disables the pass-through mode.

Usage: set PassThroughMode [all | SES | non-SES | disabled]

get PassThroughMode

PassThroughPersistent (Immediate, Disabled on Error)

PassThroughPersistent stores maps for currently-attached passthrough devices to persistent memory.

Usage: PassThroughPersistent

PassThroughRediscover (Immediate, Disabled on Error)

PassThroughRediscover will make any previously deleted pass through target devices visible to the host.

Usage: PassThroughRediscover

RAIDMediaScanPriority

Set the RAID Media Scan priority. A Media Scan priority that is set to high will give a higher priority to the Media Scan and a lower priority to the processing of simultaneous I/O transactions. A Media Scan priority that is set to same will give equal priority to the Media Scan and the processing of simultaneous I/O transactions. If all, or no, RAID groups are specified, the system default and all of the individual RAID groups are set. If a RAID group name is specified, only that group is set.

Usage: set RAIDMediaScanPriority <GroupName|all> [high | low | same]

get RAIDMediaScanPriority <GroupName | all>

RAIDRebuildPriority

Set the RAID rebuild priority. A RAID rebuild priority that is set to high, will give higher priority to RAID rebuilds and lower priority to the processing of simultaneous I/O transactions. A RAID rebuild priority that is set to low, will give lower priority to RAID rebuilds and higher priority to the processing of simultaneous I/O transactions. A RAID rebuild priority that is set to same, will give equal priority to RAID rebuilds and the processing of simultaneous I/O transactions. If all or no groups are specified, the system default and all of the individual RAID Groups are set. If a group name is specified, only the group specified is set.

Usage: set RAIDRebuildPriority <GroupName | all> [high | low | same]

get RAIDRebuildPriority <GroupName | all>

RAIDSpeedWriteLimit (OEM Configurable, Disabled on Error)

Set or get the limit on the coalescing factor. Warning: changing the default setting (8) may result in poor performance or timeouts. A lower setting is recommended when using multiple initiators. A higher setting may improve performance with multiple streams of sequential write I/O, but too high a setting will cause timeouts.

Usage: set RAIDSpeedWriteLimit [0 - 32]

get RAIDSpeedWriteLimit

RebuildContinueOnError (Disabled on Error)

Allows a rebuild to continue to completion even if media read errors are encountered during the rebuild operation.

Usage: set RebuildContinueOnError [GroupName | all]
[enabled | disabled]

get RebuildContinueOnError [GroupName | all]

Reserve (Immediate)

Reserve prevents other CLI sessions from modifying the system. When the management interface is reserved, set commands are unavailable to other sessions, but get commands are available.

Usage: Reserve

RestoreConfiguration (Immediate, Disabled on Error)

RestoreConfiguration issued with the 'default' option will force the NVRAM settings to their original defaults. The 'saved' option will undo any changes made to this session since the last save.

Usage: RestoreConfiguration [default | saved]

RGAutoRebuild

RGAutoRebuild enables and disables Auto-Rebuild functionality for one or more RAID Groups. Auto-Rebuild uses drives assigned as Hot Spares, followed by available drives, as automatic replacements for any member that fails. Auto-Rebuild is disabled by default.

Usage: set RGAutoRebuild [GroupName | all] [enabled | disabled]

get RGAutoRebuild [GroupName | all]

RGAxleDepth

Set or get the axle depth on the specified existing NEW RAID Group. Only supported on RAID level 50 and 60 Groups.

Usage: set RGAxleDepth [GroupName] [2-8]

get RGAxleDepth [GroupName | all]

RGCommit (Immediate, Disabled on Error)

RGCommit stamps a NEW RAID Group's configuration to its member drives. Advanced Initialization is highly recommended for new drives; this erases and verifies the drive media. The RAID Group is unavailable until the operation completes. SSD RAID Groups can take up to 20 minutes to commit, depending on the make and model of the drive. Express Initialization performs a background initialization and the RAID Group is immediately available for use. GroupName is the ASCII name of the NEW RAID Group to commit.

Usage: RGCommit < GroupName <Advanced | Express> | all
<Advanced | Express> >

RGCreate (Immediate)

RGCreate creates a NEW empty RAID Group. GroupName is an ASCII name for the RAID Group (14 chars max, no spaces). The optional value after the RAID Group type parameter represents the desired interleave for the RAID Group. KB denotes interleave in kilobytes; without the KB suffix, interleave is set in 512 byte blocks. If interleave is not provided, the system-default interleave is used.

Usage: RGCreate [GroupName]
[RAID[0|1|10|4|5|6|50|60]|JBOD]
<64KB|128KB|256KB|512KB|1024KB
|128|256|512|1024|2048>

RGDiskWriteCache

Enable RAID member disk Write Cache for higher write performance with a small risk of data loss after a system failure. Disable RAID member disk Write Cache to force the drives to update the storage media at the expense of some write performance.

Usage: set RGDiskWriteCache [GroupName | all] [enabled | disabled]

get RGDiskWriteCache [GroupName | all]

RGDisplay (Immediate)

RGDisplay displays RAID Group status information. GroupName is an ASCII name for an existing RAID Group.

Usage: RGDisplay <GroupName | all>

RGErase (Immediate)

RGErase erases the data from the specified existing RAID Group. WARNING: All data will be lost!

Usage: RGErase [GroupName]

RGHaltErase (Immediate)

RGHaltErase halts the erase on the specified existing RAID Group.

Usage: RGHaltErase [GroupName]

RGHaltInitialization (Immediate)

RGHaltInitialization halts the initialization of the specified RAID Group.

Usage: RGHaltInitialization [GroupName]

RGHaltMediaScan (Immediate, Disabled on Error)

RGHaltMediaScan halts a Media Scan on the specified existing RAID Group.

Usage: RGHaltMediaScan [GroupName]

RGHaltRebuild (Immediate)

RGHaltRebuild halts the rebuild(s) on the specified existing RAID Group. Optional parameter MemberIndex specifies the RAID Member whose rebuild will be halted. For RAID6 Groups, if a MemberIndex is specified, all rebuilding RAID Members on the span with that MemberIndex will halt as well. If no MemberIndex is specified, all rebuilds on that RAID Group will be halted.

Usage: RGHaltRebuild [GroupName] <MemberIndex>

RGMediaScan (Immediate, Disabled on Error)

RGMediaScan initiates a Media Scan. A Media Scan reads all member drives and corrects Media Errors by calculating the expected data and rewriting it, so the drive can relocate it to a good sector. The 'verify' option adds a data integrity check by verifying that the data and parity match. 'Verify' plus 'fix' causes the parity to be re-written when a verify mismatch occurs. Enter time (must be HH:MM in 24-hour time format) and day of week without the 'daily/weekly' option to schedule a one-time scan for a later date. Enter time, day of week and 'daily' or 'weekly' to schedule a scan on a recurring basis.

Usage: RGMediaScan [GroupName] <verify | verify fix>
<[HH:MM] <day of week> <daily | weekly>>

RGMediaScanErrorReport (Immediate, Disabled on Error)

Displays error statistics for either a single RAID Group or all RAID Groups in the system.

Usage: RGMediaScanErrorReport [GroupName | all]

RGMemberAdd (Immediate)

RGMemberAdd adds disk members specific to a RAID group. HDDs and SSDs cannot be mixed in a RAID Group. GroupName is the ASCII name of the RAID Group to receive the RAID Member. BlockDevID is the index of an available block device provided by the BlockDevScan CLI command. Up to 10 BlockDevIDs may be specified. If all is specified, then all available unused BlockDevIDs will be added to the RAID Group until the maximum number of RAID Group members has been met. This command also resets the number of RAID Group partitions to 1.

Usage: RGMemberAdd [GroupName] [BlockDevID | all].

RGMemberRemove (Immediate)

RGMemberRemove removes a RAID Member from a NEW RAID Group. GroupName is the ASCII name of the NEW RAID Group from which to remove the RAID Member. MemberIndex is the index of the RAID Member to remove. This also resets the number of partitions to 1.

Usage: RGMemberRemove [GroupName] [MemberIndex]

RGOverprovision

Adjust the overprovisioning level of an SSD RAID Group, which is the percentage of a RAID Group's capacity that will not be

exposed to the user, but will be used by the RAID Group to help lower write amplification. This can only be applied to uncommitted SSD RAID Groups.

Usage: set RGOverprovision [GroupName] [0 to 6]
get RGOverprovision [GroupName | all]

RGPrefetch

Set or Get the prefetch for all or for the specified RAID Group. This command will fail if the RAID Group does not exist. GroupName is the ASCII name of the RAID Group for which the parameter will apply.

Usage: set RGPrefetch [GroupName | all] [Value 0 to 6]
get RGPrefetch [GroupName | all]

RGReadDirect

Directly read data from SAS hardware into host memory. This feature eliminates store-and-forward delays that are inherent with reading data into RAID internal cache first and then transferring it to host memory.

Usage: set RGReadDirect [GroupName | all] [enabled | disabled]
get RGReadDirect [GroupName | all]

RGRebuild (Immediate)

RGRebuild starts rebuilding the specified RAID Group. If no parameters are specified, all degraded members are rebuilt. Optional parameters MemberN specify the members to rebuild. Optional parameter BlockDevIDN specifies the block device to be rebuilt in place of MemberN. RAID 6 or RAID 60 groups can rebuild two members using the optional 'and'.

Usage: RGRebuild [GroupName] <Member1> | <Member1 BlockDevID1> <<and Member2> | <and Member2 BlockDevID2>>

RGRRecover (Immediate)

RGRRecover provides mechanisms for assisting in the read-only access of data in OFFLINE RAID Groups. Specify "Rebuild" if the RAID Group was rebuilding and the rebuild faulted. "Basic" forces a RAID Group ONLINE with only up-to-date members and returns CHECK CONDITION on READ errors. "Extreme" forces a RAID Group ONLINE with older members and replaces READ error data with zeros. "Disabled" turns off RGRRecover for "Basic" and "Extreme". NOTE: Before running RGRRecover, power off and power back on all drives in the affected RAID Group drives to ensure the drives are at a known state and ready for data recovery.

Usage: RGRRecover [GroupName] [Rebuild | Basic | Extreme | Disabled]

RGRecoverWithWrites (Immediate)

RGRecoverWithWrites performs the same functions as RGRecover except the affected RAID Group allows WRITES to the RAID Group to occur normally. NOTE: Care must be exercised to minimize WRITE activity. Proceed with WRITES at your own risk.

Usage: RGRecoverWithWrites [GroupName] [Basic | Extreme]

RGResumeErase (Immediate)

RGResumeErase resumes the erase on the specified existing RAID Group.

Usage: RGResumeErase [GroupName]

RGResumeInitialization (Immediate)

RGResumeInitialization resumes the initialization of the specified RAID Group.

Usage: RGResumeInitialization [GroupName]

RGResumeMediaScan (Immediate, Disabled on Error)

RGResumeMediaScan resumes a Media Scan on the specified existing RAID Group.

Usage: RGResumeMediaScan [GroupName]

RGResumeRebuild (Immediate)

RGResumeRebuild resumes the rebuild(s) on the specified existing RAID Group. Optional parameter MemberIndex specifies the RAID Member whose halted rebuild will be resumed. For RAID6 Groups, if a MemberIndex is specified, all halted RAID Members on the span with that MemberIndex will resume as well. If no MemberIndex is specified, all halted rebuilds on that RAID Group will be resumed.

Usage: RGResumeRebuild [GroupName] <MemberIndex>

RGSectorSize

Set or get the sector size of the specified RAID Group. The desired RAID Group sector size must be evenly divisible by the sector size of any member disk. 512 bytes is the default size for most operating systems. Use 4 KB sectors to enable large volume support (greater than 2 TB) in Windows XP (32-bit).

Usage: set RGSectorSize [GroupName] [512-8192]
get RGSectorSize [GroupName | all]

RGSpanDepth

Set or get the span depth on the specified existing NEW RAID Group. All RAID Group types are supported except JBOD, which implicitly supports spanning as members are added.

Usage: set RGSpanDepth [GroupName] [1-16]
get RGSpanDepth [GroupName | all]

RGSpeedRead

Perform look-ahead during reads from RAID Group member disks for all or the specified RAID Group. GroupName is the ASCII name of the RAID Group for which look-ahead reads will be performed. Auto will choose the algorithm based on each I/O command.

Usage: set RGSpeedRead [GroupName | all] [enabled | disabled | auto]

get RGSpeedRead [GroupName | all]

RGUnmap (Immediate)

RGUnmap removes all of the mapped partitions of the specified RAID Group or the specified RAID Group's partition or contiguous partitions from the routing table. The partitions themselves will be unaffected, though they will now be inaccessible by any initiators.

Usage: RGUnmap [[[GroupName] <PartIdx] <2-128>] | all]

RGWaitTimeout (OEM Configurable, Disabled on Error)

The RGWaitTimeout field specifies the number of seconds which the driver waits for devices to appear. The time out is used during system boot and when the BlockDevScan command is issued. You should adjust the time out setting when you have more than one RAID group in a chassis so that the chassis has enough time to bring all the drives involved in RAID groups online. If not, there is a chance that the RAID adapter may not discover all the drives for a RAID group and will either fault or degrade the RAID group.

Usage: set RGWaitTimeout [1-300]
get RGWaitTimeout

RMStatus (Immediate)

RMStatus displays the status of all RAID Members within the specified RAID Group or a specific RAID member (if specified) within the specified RAID Group. This command will fail if the specified RAID Group does not exist or a specified member index within the RAID Group does not exist.

GroupName is the ASCII name of the RAID Group for which status will be displayed.

Usage: RMStatus <[GroupName] <MemberIndex>>

Route (Immediate, OEM Configurable, Disabled on Error)

Route is used to map a RAID Partition or SAS/SATA Pass Through device to a Target ID on the host system. If a map with the specified Target Id already exists, then it will be overwritten. Use 'Delete' for a Target ID to remove the map.

Usage: Route host [tid] [[RAID [GroupName] [PartIdx]] | [SAS [SasIdx]] | Delete]

RouteDisplay (Immediate)

RouteDisplay will display a list of host protocol address to target destination device mappings. The optional 'tid' parameter will limit the list to the maps which satisfy a search for the given Target ID. If the "Passthrough" parameter is entered then all SATA/SATA Pass Through devices are displayed. Otherwise all mapped RAID Partitions are displayed. If the "Persistent" parameter is entered then only persistent maps will be displayed. Otherwise both persistent and non-persistent maps will be displayed.

Usage: RouteDisplay host < <tid> | <<passthrough>> <<persistent>> >

SasPortList (Immediate)

SasPortList lists the status of all available SAS ports.

Usage: SasPortList

SASTargets (Immediate, Disabled on Error)

This command lists the physical devices that are connected to all SAS ports.

Usage: SASTargets

SaveConfiguration (Immediate, Disabled on Error)

SaveConfiguration will save configuration changes. Please note that certain modifications require a system restart.

Usage: SaveConfiguration

SerialNumber

SerialNumber displays the serial number. The serial number is a 13 character field. The first seven alphanumeric characters are an abbreviation representing the product name. The remaining six digits are the individual system's number.

Usage: get SerialNumber

SES (OEM Configurable, Disabled on Error)

SES enables support for SES enclosures that have been discovered by the system.

Usage: set SES [enabled | disabled]
get SES

SESAAlarmTest (Immediate, Disabled on Error)

SESAAlarmTest commands the specified enclosure's audible alarm to be turned on at the specified warning level. "Reset" turns off the alarm that has been set at any warning level. Note that SESEnclosures must be executed prior to executing SESAlarmTest.

Usage: SESAlarmTest [EnclIdx] [SET | RESET] [INFO | NON-CRIT | CRIT | UNRECOV]

SESDiskFailureAlarm (OEM Configurable, Disabled on Error)

SESDiskFailureAlarm when enabled, activates an audible alarm when the system determines that a RAID member disk drive has failed. The enclosure which contains the failed disk drive will be sounded, other enclosures will be unaffected.

Usage: set SESDiskFailureAlarm [enabled | disabled]
get SESDiskFailureAlarm

SESEnclosures (Immediate, Disabled on Error)

SESEnclosures displays a list of SES-enabled enclosures which have been discovered by the system.

Usage: SESEnclosures

SESIIdentify (Disabled on Error)

SESIIdentify commands the appropriate SES enclosure to identify the specified element(s). "ALL" identifies all disks. "RAID" and RAID Group name identifies all disks in a RAID Group. If the MemberIndex is also specified, only that disk is identified. "ENC" and enclosure index identifies all slots in the specified enclosure. "DRIVE" and BlockDevID identifies the specified disk. Note that SESEnclosures must be executed prior to executing SESIdentify with the qualifier ENC and BlockDevScan must be executed prior to executing SESIdentify with the qualifier ALL.

Usage: set SESIdentify [ALL | RAID GrpName <MemberIndex> | ENC EnclIdx | DRIVE BlockDevID]
get SESIdentify [ALL | RAID GrpName <MemberIndex> | ENC EnclIdx | DRIVE BlockDevID]

SESIIdentifyStop (Immediate, Disabled on Error)

SESIIdentifyStop commands the appropriate SES enclosure to stop identifying the specified element(s). "ALL" stops identifying all enclosures' drive slots. "RAID" and RAID Group name stops identifying disks in a RAID Group. "ENC" and enclosure index stops identifying all slots in the specified enclosure. "DRIVE" and BlockDevID stops identifying the specified drive. Note that SESEnclosures must be executed prior to executing SESIdentify with the parameters ALL or ENC.

Usage: SESIdentifyStop [ALL | RAID GrpName <MemberIndex> | ENC EnclIdx | DRIVE BlockDevID]

SESMute (Immediate, Disabled on Error)

SESMute causes all known enclosures' audible alarms to be set to either the "mute" or "remind" state. The default action is "mute". The enclosure index qualifier is optional. The optional parameter "REMIND" may be specified to set the "remind" state, which causes an occasional audible reminder of the alarm condition (if supported). Note that SESEnclosures must be executed prior to executing SESMute.

Usage: SESMute <EnclIdx> <REMIND>

SESPoll (OEM Configurable, Disabled on Error)

SESPoll specifies the SES enclosure polling interval, in seconds. At the specified interval, all known SES enclosures are polled for their current status. A setting of 0 disables SES enclosure polling.

Usage: set SESPoll [0 | 30 - 3600]
get SESPoll

SESStartingSlot (OEM Configurable, Disabled on Error)

SESStartingSlot establishes the starting slot/ID number for all attached SES enclosures.

Usage: set SESStartingSlot [0 | 1]
get SESStartingSlot

SESStatus (Immediate, Disabled on Error)

SESStatus displays the last polled status of the specified element type in the specified enclosure. SupportLevel indicates the SES features supported by the specified enclosure: Fan,Power,Temp,Alarm, DriveLEDs. If no element type is specified, all status is displayed for the specified enclosure. Note that SESEnclosures must be executed prior to executing SESStatus.

Usage: SESStatus [all | [EnclIdx <ENC | DRIVE | FAN | POWER | TEMP | ALARM | SUPPORTLEVEL>]]

Temperature

Temperature returns the current internal operating temperature in degrees Celsius. The value is read-only.

Usage: get Temperature

Time (Disabled on Error)

Time sets/displays the current time in 24 hour format.

Usage: set Time [HH:MM:SS]
get Time

TimeZone (OEM Configurable, Disabled on Error)

Timezone sets/displays the time zone or an offset from GMT. GMT offset must be in the format +/-HH:MM

Usage: set TimeZone [[EST | CST | MST | PST] | [[+|-]
[HH]:[MM]]]
get TimeZone

VerboseMode (OEM Configurable)

VerboseMode controls the level of detail in CLI 'Help' output and command response output for the current CLI session.


Usage: set VerboseMode [enabled | disabled]
get VerboseMode

VirtualDriveInfo (Immediate)

VirtualDriveInfo displays characteristics and statistics for all the available virtual drives or any available virtual drive identified by its virtual drive ID.

Usage: VirtualDriveInfo <VirtualDrive ID>

ATTO provides instant hardware data protection and intelligence to existing storage, independent of the storage type.

 **CAUTION** *RAID improves data accessibility and reliability during normal operations, however, you still need a good backup strategy for long-term protection of your data.*

To set up RAID Groups refer to [RAID Group Management](#) on page 21.

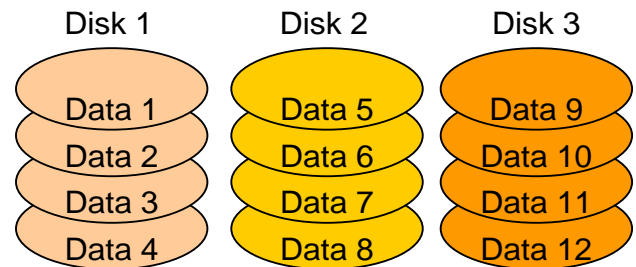
ATTO ExpressSAS RAID allows RAID functionality. In general, the process begins with individual drives called block devices.

A RAID Group is a virtual, independent single drive whose data is written to physical drives according to a RAID algorithm. ATTO supports JBOD, DVRAID, RAID Level 0, 1, 10, 4, 5, 6, 50 and 60.

RAID improves data accessibility and reliability during normal operations, however, you still need a good backup strategy for long-term protection of your data.

JBOD: Just a Bunch of Disks

JBOD configuration allows many individual drives to be available for normal storage operations with no special data protection by combining several drives into one large drive. A special case of a RAID Group, multiple physical drives are assigned to a JBOD RAID Group and their storage areas appear as a single spanned area of storage.



DVRAID: Digital Video RAID

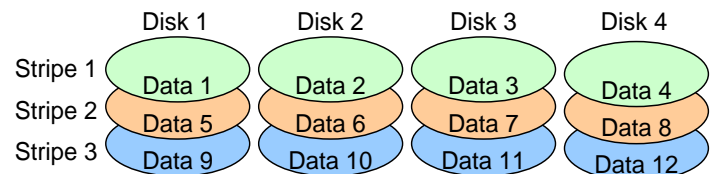
Digital Video RAID provides parity redundancy for your data. Optimized for performance for the high data transfer rates required in digital video environments, DVRAID is ATTO Technology proprietary technology which supports the

editing of uncompressed 10-bit High Definition (HD) video and multiple streams of real-time, uncompressed Standard Definition (SD) video.

RAID Level 0: striping, no redundancy

RAID Level 0 (striping) is based on the fact that increased performance can be achieved by simultaneously accessing data across multiple drives, increasing data transfer rates while reducing average access time by overlapping drive seeks. Drives are accessed alternately, as if stacked one on top of the other. RAID Level 0 provides no data protection. If

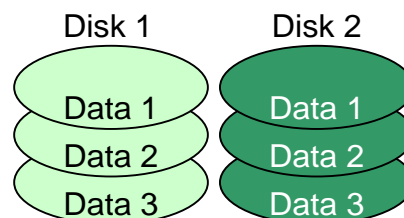
one drive fails, all data within that stripe set is lost.



RAID Level 1: mirroring (duplicate drives)

RAID Level 1 ensures the security of data by writing the exact same data simultaneously to two different drives. With RAID Level 1, the host sees what it believes to be a single physical drive of a specific size: it does not know about the mirrored pair.

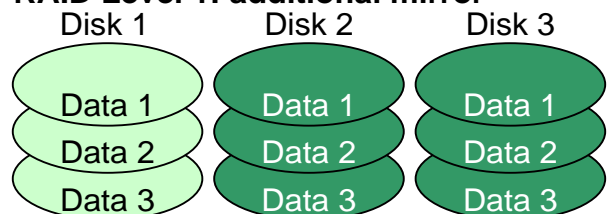
This application is used for critical data which cannot be at risk to be lost or corrupted due to the failure of a single drive.



RAID Level 1 plus additional mirroring

RAID Level 1 with multiple mirrors uses at least 3 drives with the same data on each drive. This application offers the highest fault-tolerance with good performance, especially for small database applications.

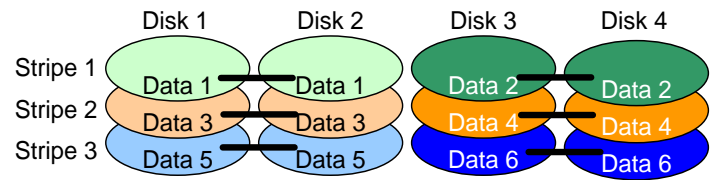
RAID Level 1: additional mirror



RAID Level 1+0: striping, mirror spans two drives

RAID Level 1+0 increases data transfer rates while ensuring security by writing the exact same data simultaneously to two or more different drives.

RAID Level 1+0 is used in applications requiring high performance and redundancy, combining the attributes of RAID Levels 1 and 0.

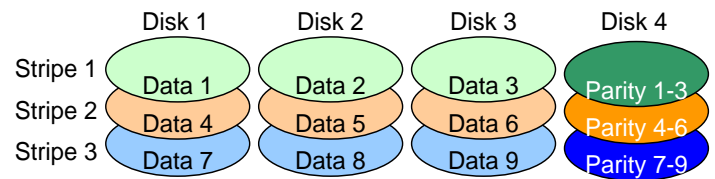


RAID Level 4: striping, one parity drive

RAID 4 writes data across multiple drives or devices (striping) with parity blocks written to a single drive in the RAID Group. This increases reliability while using fewer drives than mirroring.

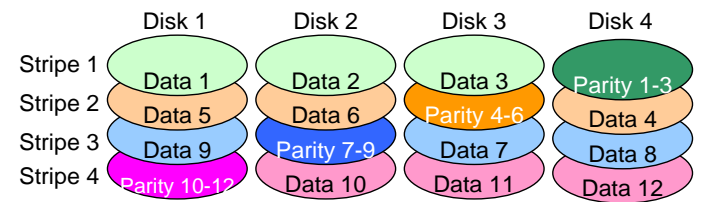
RAID Level 4 is best suited for applications that perform mostly sequential access such as video applications.

You must have at least three drives to set up RAID Level 4.



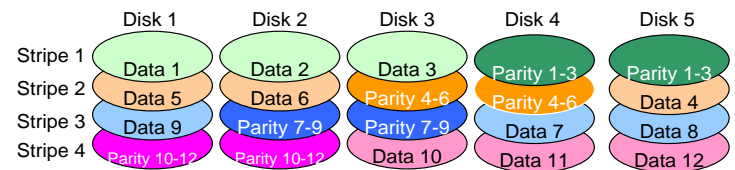
RAID Level 5: striping, parity distributed among drives

RAID Level 5 increases reliability while using fewer drives than mirroring by using parity redundancy: parity is distributed across multiple drives.



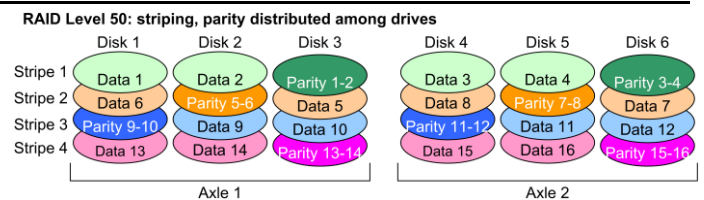
RAID Level 6: striping, two parity blocks distributed among drives

RAID Level 6 increases reliability for mission critical applications by striping both data and dual parity across multiple drives, writing data and parity blocks across all the drives in a RAID Group. RAID 6 can tolerate failure of two drives and provides redundancy during rebuilds.



RAID Level 50: striping, multiple parity RAID 5 axes

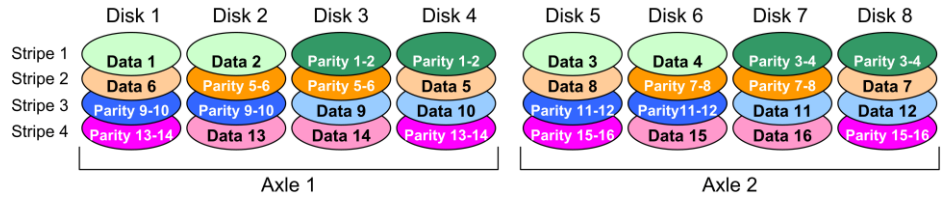
RAID Level 50 increases reliability and allows larger size RAID groups. Each RAID 5 AXLE can sustain 1 drive failure without losing data.



RAID Level 60: striping, multiple parity RAID 6 axes

RAID Level 60 is one of the most reliable data protection schemes available. Each RAID 6 axle can sustain 2 drive failures without losing data.

RAID Level 60: striping, two parity blocks distributed among drives



Glossary

Some terms used in the Fibre Channel industry are defined below. More information is available through the ATTO Technology website (www.atto.com), the Fibre Channel Industry Association, Cern, the Storage Area Networking Industry Association (www.snia.org), and the Fibre Channel Consortium.

Term	Definition
ANSI	American National Standards Institute.
arbitrate	The process of selecting one L_Port from a collection of ports which ask for use of the arbitrated loop at the same time.
arbitrated loop	A loop topology (FC-AL) in which two or more ports are interconnected, but only two ports can communicate at one time. Low-cost solution which may or may not use hubs and switches.
autonegotiation	A process when hardware senses and automatically responds depending on configuration.
BER	Bit Error Rate: a measure of transmission accuracy; the ratio of bits received in error to bits sent.
bit	The smallest unit of data a computer can process: a single binary digit, either 0 or 1.
bus	A collection of unbroken signal lines used to transmit information from one part of a computer system to another. Taps on the lines connect devices to the bus.
Byte	An ordered set of 8 bits.
channel	A Point-to-Point link which transports data from one point to another.
CPU	Central Processing Unit: the portion of the computer which performs computations.
CRC	Cyclic Redundancy Check: an error-correcting code which calculates a numeric value for received and transmitted data. If no error has occurred during transmission, the CRC for both received and transmitted data should be the same.
destination address	A value in the frame header of each frame which identifies the port in the node where the frame is being sent.
device driver	A program which allows a microprocessor to direct the operation of a peripheral device.
DMA	Direct Memory Access: a way to move data from a storage device directly to RAM without using the CPU's resources.
DMA bus master	Allows a peripheral to control the flow of data to and from system memory by block as opposed to allowing the processor to control the data by bytes (PIO or programmed I/O).
fabric	A Fibre Channel switch or two or more Fibre Channel switches interconnected to physically transmit data between any two N_Ports on the switch or switches.
FC	Fibre Channel.

F_port	A port in the Fibre Channel fabric where a N_port may attach.
FL_port	A port in the Fibre Channel fabric where a NL_port may attach in an arbitrated loop.
frame	An indivisible unit for transfer of information in Fibre Channel.
frame header	The first field in the frame containing the address and other control information about the frame.
full duplex	A communication protocol which allows transmission in both directions at the same time.
half duplex	A communication protocol which allows transmission in both directions, but only one direction at a time.
host	A processor, usually a CPU and memory, which communicates with devices over an interface.
initiator device	A component which originates a command.
L_port	A port in an arbitrated loop, either a NL_port or a FL_port.
LED	Light-Emitting Diode: a type of diode which emits light when current passes through it. Visible LEDs are used as indicator lights on all sorts of electronic devices.
LUN	Logical Unit Number: an identifier for a logical unit (0-7).
multi-mode fiber	An optical fiber which can carry several beams of light at once.
N_port	A port attached to a node used with Point-to-Point or fabric configurations.
NL_port	A port attached to a node in Fibre Channel arbitrated loop or fabric loop configuration.
originator	An initiating device; a component which originates a command.
parity checking	A method which verifies the accuracy of data transmitted over the SCSI bus by adding one bit in the transfer to make the sum of all the bits either odd or even (for odd or even parity). An error message occurs if the sum is not correct.
PCI	Peripheral Component Interconnect. allows peripherals to be connected directly to computer memory, bypassing the slower ISA and EISA busses.
Point-to-Point	A topology where two ports communicate.
port	An access point in a device: see N_port, NL_port, etc.
port address	The address, assigned by the PCI bus, through which commands are sent to the Storage Adapters. Also known as "port number".
read direct	A RAID Group feature in which data is passed directly to the OS without first being read into the Storage Adapters cache. This can result in read performance improvements, especially for large, sequential transfers. This feature is only available for RAID 5.
receiver	The ultimate destination of data transmission; a terminal device.

SCSI	Small Computer Systems Interface: a processor-independent standard for system-level interface between a computer and intelligent devices including hard disks, floppy disks, CD-ROM, printers, scanners, etc.
SES	SCSI Enclosure Services: a processor which identifies individual drives, all the drives in the same enclosure, all the drives in a single RAID group and faulted drives; selects drives, and monitors the status of the enclosure.
single-mode fiber	An optical fiber with a small core which supports one wavelength (ray of light). The core radius is nearly equal to the wavelength of the source.
topology	The logical layout of the parts of a computer system or network and their interconnections.
transceiver	A transmitter/receiver module.

transfer rate	The rate at which bytes or bits are transferred, as in megabytes or gigabits per second.
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Appendix C Retrieving vCenter Server SSL Thumbprint

The procedure to view this information is as follows:

Mozilla Firefox

Click on the 'lock' icon that appears next to the web address.

Click on 'More Information' to display the website security information dialog.

Click on 'View Certificate' to view the server's SSL certificate information. The thumbprint value will be available under the 'SHA1 Fingerprint' field.

Google Chrome

Click on the 'lock' icon that appears next to the web address.

Click on the 'Certificate Information' link to display the website SSL certificate information dialog.

Click on the 'Details' tab to view the server's SSL certificate information. The thumbprint value will be available via the 'Thumbprint' field.

Internet Explorer

Click the 'lock' icon that appears next to the web address.

Click 'View certificates' to display the website SSL certificate information dialog

Click on the 'Details' tab to view the server's SSL certificate information. The thumbprint value will be available via the 'Thumbprint' field.

Appendix D vCenter Glossary

The procedure to view this information is as follows:

Some terms used in the Fibre Channel and SAS industry are defined below. More information is available through the ATTO Technology website (www.atto.com), the Fibre Channel Industry Association, Cem, the Storage Area Network Industry Association (www.snia.org), and the Fibre Channel Consortium.

Term	Definition
ANSI	American National Standards Institute
Arbitrate	The process of selecting one L_Port from a collection of ports which ask for use of the arbitrated loop at the same time.
Arbitrated loop	A loop topology (FC-AL) in which two or more ports are interconnected, but only two ports can communicate at one time. Low-cost solution which may or may not use hubs and switches.
Autonegotiation	A process when hardware senses and automatically responds depending on configuration.
BER	Bit Error Rate: a measure of transmission accuracy; the ratio of bits received in error to bits sent.
Bit	The smallest unit of data a computer can process: a single binary digit, either 0 or 1.
Bus	A collection of unbroken signal lines used to transmit information from one part of a computer system to another. Taps on the lines connect devices to the bus.
Byte	A ordered set of 8 bits.
Channel	A Point-to-Point link which transports data from one point to another.
CPU	Central Processing Unit: the portion of the computer which performs computations.
CRC	Cyclic Redundancy Check: an error-correcting code which calculates a numeric value for received and transmitted data. If no error has occurred during transmission, the CRC for both received and transmitted data should be the same.
Destination address	A value in the frame header of each frame which identifies the port in the node where the frame is being sent.
Device driver	A program which allows a microprocessor to direct the operation of a peripheral device.
DMA	Direct Memory Access: a way to move data from a storage device directly to RAM without using the CPU's resources.
DMA bus master	Allows a peripheral to control the flow of data to and from system memory by block as opposed to allowing the processor to control the data by bytes (PIO or programmed I/O).
Fabric	A Fibre Channel switch or two or more Fiber Channel switches interconnected to physically transmit data between any two N_Ports on the switch or switches.
FC	Fibre Channel

F_Port	A port in the Fibre Channel fabric where a N_Port may attach
FL_Port	A port in the Fibre Channel fabric where a NL_Port may attach in an arbitrated loop.
Frame	An indivisible unit for transfer of information in Fibre Channel.
Frame header	The first field in the frame containing the address and other control information about the frame.
Full duplex	A communication protocol which allows transmission in both directions at the same time.
Half duplex	A communication protocol which allows transmission in both directions, but only one direction at a time.
Host	A processor, usually a CPU and memory, which communicates with devices over an interface.
Initiator device	A component which originates a command.
L_Port	A port in an arbitrated loop, either an NL_Port or a FL_Port.
LED	Light-Emitting Diode: a type of diode which emits light when current passes through it. Visible LEDs are used as indicator lights on all sorts of electronic devices.
LUN	Logical Unit Number: an identifier for a logical unit (0-7).
Multi-mode fiber	An optical fiber which can carry several beams of light at once.
N_Port	A port attached to a node used with Point-to-Point or fabric configurations.
NL_Port	A port attached to a node in Fibre Channel arbitrated loop or fabric loop configuration.
Originator	An initiating device; a component which originates a command.
Parity checking	A method which verifies the accuracy of data transmitted over the SCSI bus by adding one bit in the transfer to make the sum of all the bits either odd or even (for odd or even parity). An error message occurs if the sum is not correct.
PCI	Peripheral Component Interconnect. Allows peripherals to be connected directly to computer memory, bypassing the slower ISA and EISA busses.
Point-to-Point	A topology where two ports communicate.
Port	An access point in a device: see N_Port, NL_Port, etc...
Port Address	The address, assigned by the PCI bus, through which commands are sent to the storage controller. Also known as the "port number".
Receiver	The ultimate destination of data transmission; a terminal device.
SCSI	Small Computer Systems Interface: a processor-independent standard for system-level interface between a computer and intelligent devices including hard disks, floppy disks, CD-ROM, printers, scanners, etc...
SES	SCSI Enclosure Services: a processor which identifies individual drives, all the drives in the same enclosure, all the drives in a single RAID group and faulted drives; selects drives, and monitors the status of the enclosure.

Single-mode fiber	An optical fiber with a small core which supports on wavelength (ray of light). The core radius is nearly equal to the wavelength of the source.
Topology	The logical layout of the parts of a computer system or network and their interconnections.
Transceiver	A transmitter/receiver module.
Transfer rate	The rate at which bytes or bits are transferred, as in megabytes or gigabits per second.