

Array Management Guide

Adaptec Array1000CA Family

Array Adapters



Adaptec Array1000CA Family Array Management Guide	
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Getting Started

This *Array Management Guide* explains how to create and manage arrays using the software included with your Adaptec®

Array1000™ CA Family adapter. It includes instructions on using all the software features and also information on how to replace drives, reconstruct arrays, etc. To learn how to *install* the software (including drivers) on your computer, see the *Installation and Hardware Guide*.

The Array1000CA Family includes two array solutions that have similar features but use different implementations:

The AAA™ -131CA **PCI-to-Wide UltraSCSI Array Adapter** is a single-channel, caching array adapter designed to provide the highest data throughput for demanding PC workstation applications. The AAA-131CA has both 50-pin and 68-pin internal connectors as well as a 68-pin external connector to support up to fifteen UltraSCSI and legacy SCSI devices.

The ARO™ -1130 **RAIDport™ II Card** is a RAID co-processor upgrade card for RAIDport II On-board systems and motherboards. RAIDport II On-board systems and motherboards include a RAIDport II connector and one or more Adaptec UltraSCSI ASICs on the motherboard. The ARO-1130CA upgrades UltraSCSI channels on the motherboard to Adaptec RAID. The ARO-1130CA card itself has no internal or external SCSI connectors.

Array Management Software Overview

Here is a brief description of the array management software included with your Array1000CA Family product.

- **ArrayConfigCA™** - After you install the Array1000CA Family product in your computer, you use the ArrayConfigCA program to create the first array with the convenient Express Setup wizard option. ArrayConfigCA asks you a few simple questions and then creates a 2-disk array that best fits your requirements. (There is also a Custom Setup option for advanced users.) ArrayConfigCA runs from a self-booting diskette and is documented in Part 1 (Chapter 2) of this manual.
- **Adaptec CI/O Workstation Array Management Software** - You use this full-featured program to create, monitor, and manage arrays and other devices on your Windows NT™ Workstation computer. Adaptec CI/O Workstation Array Management Software also enables you to tune and monitor the data input/output performance of arrays. This program is documented in Part 3 (Chapters 3 through 7) of this manual.

Using the Array Management Software

Here are some general comments on how to use the Adaptec array management software most effectively. (Use the Table of Contents and the Index to find instructions for specific software commands.)

- Use ArrayConfigCA to create the first array on your computer. We recommend that you use the Express Setup option to quickly and easily create the array.
- If you want the fastest possible data input and output from the array, select **Optimized for Performance** in Express Setup. If your main concern is protecting the data on the array from disk failure, select **Optimized for Data Protection**.
- Use Adaptec CI/O Workstation Array Management Software to create additional arrays and to monitor the performance and status of arrays and other devices in your computer.
- If your arrays are **Optimized for Data Protection**, you should add and configure spare disks for the arrays. You can add and delete spares with ArrayConfigCA and with Adaptec CI/O Workstation Array Management Software.

- Use Adaptec CI/O Workstation Array Management Software to test fault-tolerant arrays and spares. Respond immediately to arrays in *Critical* status. Replace failed spare disks promptly.
- Use the password feature of Adaptec CI/O Workstation Array Management Software to protect your system configuration.

Conventions and Advisories

This document uses the following typographic conventions:

bold

Used for key names (... press the **Enter** key ...) and for options you are told to select (... select **Configure SCSI Channels**...).

Helvetica

Used for screen messages (...Save changes?...) and for text that must be typed exactly as shown.

Helvetica Italics

Used for program and file names when referenced in the text (... these changes are made to the *config.sys* file...).

This document uses two kinds of advisories:



Note: This kind of advisory presents reminders, tips, or suggestions for using the array management software.



Caution: This kind of advisory cautions you about actions that could destroy data or damage the computer system.

Use caution when handling any electrical equipment. Advisories in this document can only cover the procedures contained here, and not all situations may have been addressed. Adaptec does not claim to have included every condition or situation that might require a Caution or Warning. You must refer to the documentation for your computer and peripheral devices when you are installing equipment or changing its configuration.



▼▼▼▼ Part 1

Using Array*Config*CA

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Using the ArrayConfigCA Program

This chapter explains how to use the ArrayConfigCA program to create arrays on your system. You can use ArrayConfigCA in two ways:

- Choose **Express Setup** if you want to create an array quickly and easily. ArrayConfigCA asks you a few simple questions and uses your answers to create the kind of array that best meets your needs.
- Choose **Custom Setup** if you want to have more control over the array configuration or if you want to add spare disks to the array.

ArrayConfigCA runs from a convenient, self-booting diskette. Nearly all ArrayConfigCA functions can also be performed with Adaptec CI/O Workstation Array Management Software, which runs under Windows NT.

See the *Installation and Hardware Guide* provided with your Adaptec array card for information on connecting SCSI devices, installing software, preparing to run ArrayConfigCA, and creating your first array with ArrayConfigCA.

Creating an Array with Express Setup

ArrayConfigCA's Express Setup option allows you to quickly create a two-disk array for your system by answering some basic questions about what kind of array you want. This process is similar to the "wizards" used in many Windows programs. When you use the Express Setup option you do not need to know the technical details of how arrays are configured.

Follow these steps to create an array with the Express Setup. (You can probably complete the Express Setup process by simply following the instructions that appear on the screen.)



Note: To select ArrayConfigCA menu options, type the *hot key*—the letter that appears in a different color. (The hot key letters are underlined in the following instructions). You can also press the ↑ and ↓ keys until the option is highlighted and then press **Enter**.

- 1 Insert the ArrayConfigCA diskette in drive A and reboot your computer. Wait until ArrayConfigCA starts automatically.
- 2 Read the text that appears on the initial ArrayConfigCA screens. Press any key to view the next screen, or press **Esc** to return to the previous screen.
- 3 When you see the Setup Type Selection Menu, select **Express Setup**.
- 4 When the next screen appears, select the type of array you want to create:
 - Select **Optimized for Performance** if you want the fastest possible data input and output from the new array. This type of array does not have special data protection features, however; if one disk fails, all data on the array is lost. When prompted, type the number of disks you want in this array.
 - Select **Optimized for Data Protection** if your main concern is to protect the files on the array from disk failure. This type of array safeguards files in the array even if one of the array disks fails. (This kind of array has two disks by definition, so you will *not* be prompted to enter the number of disks you want in the array.)

- 5 When the next menu appears, select the type of application that you will run on your computer. (Select **Others** if you are not sure what type of application you will use.)
ArrayConfigCA will use your answer to create the best array configuration for your applications.
- 6 When the next menu appears, select a boot order for the new array.
 - Select **Disk Array will be Boot Drive** (recommended) if you want your computer to boot from the new array. If you selected **Optimized for Data Protection** in Step 4, booting from an array safeguards the information on your boot drive. If you selected **Optimized for Performance**, booting from an array improves operating system performance. (To boot from an array, you must also install the operating system software on the array, as described in the *Installation and Hardware Guide* for your Adaptec Array1000CA family product.)
 - Select **Disk Array will not be a Boot Drive** if you do not want your computer to boot from the new array.
- 7 When you have finished all these menu selections, wait while ArrayConfigCA creates the array. This may take a long time, especially if the disk drives are large.

A message appears when the array has been created. An error message appears if fewer than two disks are available or if ArrayConfigCA encounters some other problem. If this happens, install more disk drives or run ArrayConfigCA again and use the **Custom Setup** option.

Creating an Array with Custom Setup

ArrayConfigCA's Custom Setup option allows advanced users to create arrays with customized configuration and to manage arrays that are already created. (You can also perform these advanced options with Adaptec CI/O Workstation Array Management Software, which is described in Part 2 of this document.) Use Custom Setup if you want to

- delete an array
- initialize an array
- add or delete spare disks
- make an existing array the boot array

Follow these instructions to create an array with Custom Setup.

- 1 Insert the ArrayConfigCA diskette in drive A and reboot your computer. Wait until ArrayConfigCA starts automatically.
- 2 Read the text that appears on the initial ArrayConfigCA screens. Press any key to view the next screen, or press **Esc** to return to the previous screen.
- 3 When you see the Setup Type Selection Menu, select **Custom Setup**. Then wait while ArrayConfigCA scans your system for information about your host adapter and SCSI devices.
- 4 When the Main Menu appears, select **Disk Array Operations**.
- 5 Select **Create New Array** from the Disk Array Operations menu.
- 6 Type a name for the array and press **Enter**. The name can be up to 15 characters long and can include spaces and any other printable characters.
- 7 Select an array type from the following options:
 - **RAID 0**: Data is striped across the disks in a RAID 0 array, allowing for faster data input and output than a single disk. RAID 0 arrays do not store redundant data; if any disk in the array fails, all data is lost. (This is the type of array that is created if you choose **Optimized for Performance** under Express Setup.)

- **RAID 1:** Data is mirrored on one pair of disks. If one disk fails, data is still safe. The actual usable data capacity of the array equals half the available disk space. (This is the type of array that is created if you choose **Optimized for Data Protection** under Express Setup.)

See *Selecting a RAID Level for an Array* on page 9-4 for more information on selecting a RAID level.

- 8 Type the number of drives you want in the array, not including spare drives, and press **Enter**. The number of drives available for assignment is listed on the screen.



Note: This step only applies if you are creating a RAID 0 array; RAID 1 arrays have two drives by definition.

- 9 When the next screen appears, press **Tab** to highlight a channel (if your Adaptec array card uses more than one SCSI channel). Select drives for the array by pressing the ↑ and ↓ keys until the drive name is highlighted, and then press **Ins** or **Enter**. The names of selected drives appear in the box on the right side of the screen.

To select drives on a different channel (if necessary) press **Tab** to select another channel and then select the drives from the SCSI IDs on Channel menu. To deselect the drive you most recently added, press **Del**.



Caution: A warning appears if you select a disk that has partitions. *Do not* select disks with partitions if they contain data you want to keep, because any existing data will be erased when the disk becomes part of the array.

When you have selected the number of drives you specified in step 8, the next screen appears automatically. If you are creating a RAID 1 array, and if there are any unassigned drives, the screen prompts you to define spare drives for the array.



Note: A spare must have at least the capacity of the smallest drive in the array.

- 10 If you do not want a spare, type n and continue with step 12. If you want to select dedicated spares, follow these steps:
 - a At the prompt, type y.
 - b At the next prompt, type 1 or 2.
 - c Select one or two spares, using the same method you used to select disks for the array.
- 11 When the Initialize Mode menu appears, select **Initialize Array to Zero**. This operation begins immediately. A graph on the screen shows the progress of this operation.



Caution: If the drives contain data, all the data is lost when you initialize the array.

Select **Low-Level Format** only if the drives were previously formatted on another system or if you think they may have surface defects. Low-level formatting takes a long time for large disk drives. (See *Initializing an Array* on page 2-9 for more information.)

- 12 When the menu of block sizes appears, select a block size. (This menu does not appear if the array is a mirrored array with only two drives.)

The default block size (64 KBytes) gives the best overall performance. The allowable block sizes are 8, 16, 32, 64, and 128 KBytes.



Note: If your disk drives initialize very slowly when you create arrays, you may be able to speed them up by changing a setting in the *arconfig.ini* file (located on the ArrayConfigCA diskette). To do this, open *arconfig.ini* in a text editor and find this line: `rem WriteSame=Yes`. Delete the letters `rem` and save the file in text-only format. The next time you run ArrayConfigCA the disks should initialize faster.

- 13 When you see the message Initialization of [array name] is complete, press any key to return to the Disk Array Operations menu.
- 14 To create additional arrays (if disks are available), return to Step 5. When all arrays are created, exit from ArrayConfigCA, remove the ArrayConfigCA diskette, and reboot the computer. After you reboot you can write data to the arrays.

Other Custom Setup Options

Making the Array Bootable

Follow these steps if you want your computer to boot from the newly created array or if you want to change the boot order of existing arrays:

- 1 Select **D**isplay **B**oot **O**rders from the Main Menu. The Boot Order for Singles and Arrays window appears.
- 2 If the newly created array is listed as Unit 0 at the top of the list, no changes are necessary; if it has some other unit number, highlight the array name and press **E**nter to select it.
- 3 Use the arrow keys to move the selected array to the top of the list. Then press **E**nter to deselect it.
- 4 When you are finished, press **E**sc to return to the Main Menu.



Note: You cannot use this procedure to change the boot order of a stand-alone SCSI disk drive. If you want to do this, create a one-disk RAID 0 array from the disk.

For more important information on creating a bootable array, see the *Installation and Hardware Guide* for your Adaptec array card.

Displaying Array Information

Follow these steps to display information about existing arrays defined in your computer:

- 1 Select **Disk Array Operations** from the Custom Setup Main Menu.
- 2 Select **Display Arrays** from the Disk Array Operations menu.
- 3 When the list of arrays appears, highlight the array for which you want information and press **Enter**.
- 4 View the information that appears on the screen. This includes array type and status, array size, and information about each disk in the array.
- 5 Press any key to return to the Disk Array Operations menu.

Deleting an Array



Caution: All data is lost when you delete an array! Before you delete an array, back up any data you want to keep.

Follow these steps to delete an array:

- 1 Select **Disk Array Operations** from the Main Menu.
- 2 Select **Delete Array** from the Disk Array Operations menu.
- 3 When the list of arrays appears, select the array you want to delete.



Caution: A warning appears if you select an array that has partitions. *Do not* delete an array with partitions if it contains data you want to keep, because any existing data will be erased. Be especially careful not to select your boot array!

- 4 View information about the array and make sure you really want to delete it. Press any key to continue.

- 5 Type y to delete the array (or n to cancel the operation).
- 6 When the message [Array name] deleted appears, press any key to continue.

The drives that were formerly part of the array can now be used as stand-alone drives or as members of another array. Deleting an array may change the boot order and the drive assignment of other arrays and disks.



Note: If the drive assignment changes, you can identify individual drives by blinking the drive lights while you are running Adaptec CI/O Workstation Array Management Software. For more information, see *Blinking the Drive Light* on page 5-16.

Initializing an Array

When you create a new array in Custom Setup, you are automatically prompted to initialize (format) it. You can also select the Format/Initialize Array option as a separate Custom Setup command. This could be necessary to reinitialize an array that has become corrupted.

Here is some additional information on the two initialization methods:

- **Initialize Array to Zero:** (Recommended method) Fills the array with zeroes. This option is faster than a low-level format, but it does not verify the integrity of the disks.
- **Low-level Format:** Performs a low-level SCSI format. This writes a consistent pattern to the disks, checks the disks for defects, and fills the array with zeroes. Low-level formatting can take a long time if the disks are large. You cannot abort a low-level format once it has started.



Caution: Formatting or initializing an array erases all data on the array and cannot be aborted once it has started. If the array contains data you want to keep, be sure to back it up first!

Follow these steps to initialize an array:

- 1 Select **Disk Array Operations** from the Main Menu.
- 2 Select **Format/Initialize Array** from the Disk Array Operations menu.
- 3 When the list of arrays appears, select the array you want to initialize.
- 4 Type y to confirm that you want to initialize the array.



Caution: A warning appears if you select an array that has partitions. *Do not* initialize an array with partitions if it contains data you want to keep, because any existing data will be erased. Be especially careful not to initialize your boot array!

- 5 When the Select Format Mode menu appears, select **Initialize Array to Zero** (recommended) or **Low-Level Format**.
- 6 When the list of block sizes appears, select a block size. The allowable block sizes are 8, 16, 32, 64 (the default), or 128 KBytes. (This menu does not appear if the array is a mirrored array with only two drives.) The default block size gives the best overall performance. Formatting begins immediately.
- 7 When you see the message Initialization of [array name] is complete, press any key to return to the Disk Array Operations menu.

Creating and Deleting Spares

Dedicated spare disks (*spares*) are an important data protection and real-time recovery feature of RAID 1 arrays. (RAID 0 arrays do not support spares.) Up to two dedicated spares can be defined for each RAID 1 array. If a disk in an array fails while the computer is running, a spare is activated immediately to take its place. The array software automatically reconstructs the necessary data on the new disk, and array operation continues uninterrupted.

Adding a Dedicated Spare

When you create an array you have the option of adding one or two dedicated spares to it. You can also add dedicated spares to an existing array at a later time.

You *cannot* add dedicated spares to an array if

- The array already has two dedicated spares
- The remaining single disks are not at least as large as the smallest disk in the selected array

Follow these steps to add one or two dedicated spares to an already-existing RAID 1 array:

- 1 Select **Disk Array Operations** from the Main Menu.
- 2 Select **Add/Delete Spare Drive** from the Disk Array Operations menu.
- 3 Select the array to which you want to add the dedicated spare.
- 4 Select **Add Spare Drive** from the Add/Delete Spare menu.
- 5 Select a SCSI channel on the left, if necessary, and then press → to move to the list of disks on the right. Disks are grayed out if they are already used in an array or if they are smaller than the members of the array. Highlight an available disk and press **Enter**. Then select another disk for the second spare, if necessary. The new dedicated spare is added immediately.



Caution: A warning appears if you select a disk that has partitions. *Do not* select disks with partitions if they contain data you want to keep, because any existing data will be erased. Be especially careful not to select your boot disk as a spare!

- 6 Press any key to continue.

Deleting a Dedicated Spare

Follow these steps to delete a dedicated spare:

- 1 Select **Disk Array Operations** from the Main Menu.
- 2 Select **Add/Delete Spare Drive** from the Disk Array Operations menu.
- 3 When the list of spare drives appears, select the one you want to delete and press **Enter**.
- 4 Select **Delete Spare Drive** from the Add/Delete Spare Drive menu. The dedicated spare is deleted immediately.
- 5 Press any key to continue. The disk that was formerly a dedicated spare can now be used as a spare for another array or as a member of a new array.



▼▼▼▼ Part 2

Using Adaptec CI/O Workstation Array Management Software for Windows NT Workstation

....3

Configuring Arrays and Spares

This chapter explains how to use Adaptec CI/O Workstation Array Management Software to add and delete arrays and spares on your Windows NT Workstation computer. The following topics are explained in this chapter:

- *Creating an Array* on page 3-2
- *Making an Array the Boot Device* on page 3-8
- *Deleting an Array* on page 3-9
- *Initializing an Array* on page 3-10
- *Creating Dedicated Spares or a Spare Pool* on page 3-12
- *Deleting a Spare* on page 3-15

Starting the Program

Follow these steps to start the Adaptec CI/O Workstation Array Management Software and prepare to configure arrays and spares.

- 1 Start Windows NT.
- 2 Double-click the  icon in the Adaptec CI/O Workstation Array Management Software group to start the program.

- 3 If the Storage Configuration window does not open automati-

cally, open it by clicking the  icon on the toolbar.

Creating an Array

Follow these steps to create arrays with Adaptec CI/O Workstation Array Management Software.

- 1 Start Adaptec CI/O Workstation Array Management Software and open the Storage Configuration window, as described in *Starting the Program* on page 3-1. This window looks similar to the one shown in Figure 3-1.

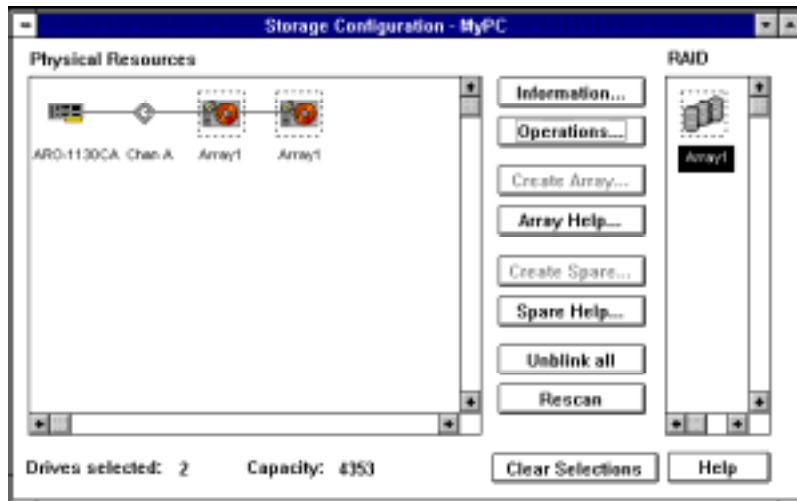


Figure 3-1. Storage Configuration Window

The icons on the left side of the Storage Configuration window represent the computer's *physical resources*—the Array1000CA Family device, channels, and SCSI devices installed in your computer. The icons on the right side represent the computer's *Array resources*—the arrays and spares you define. You click the buttons in the middle of the window to perform operations on selected device icons.

- 2 Before you start defining the new array, decide what RAID level you want to use, how many disks you want it to have,


and whether you want to define dedicated spares for the array). The following table lists your array options. See *Selecting a RAID Level for an Array* on page 9-4 for information on the advantages and disadvantages of each RAID level.

PERFORMANCE TIP:
If your main reason for creating an array is speeding up your computer's data I/O performance, you should create a RAID 0 array with at least two disks. RAID 0 arrays do not use *spare disks*, so you can ignore any instructions about *dedicated spares* or *spare pools*.

RAID Level	Minimum # of Disks Allowed	Maximum # of Disks Allowed ¹	Dedicated Spares Allowed
RAID 0 (Striped)	1 ²	16	None
RAID 1 (Mirrored)	2	2	1 or 2

¹ This is the maximum number of disks supported by the software driver. The maximum for your computer may be less, depending on how many SCSI channels and devices you have.

² The purpose of one-disk RAID 0 arrays is to give you more control over the virtual device order of disks connected to SCSI channels controlled by the Array1000CA Family device.

- 3
- Select disks for the new array by clicking disk icons  that have the word **Single** beneath them, as shown in Figure 3-2.

Do not include disks that you want to use as spares. Click a second time on an icon to deselect it, or click the **Clear Selection** button if you want to deselect all disk icons.

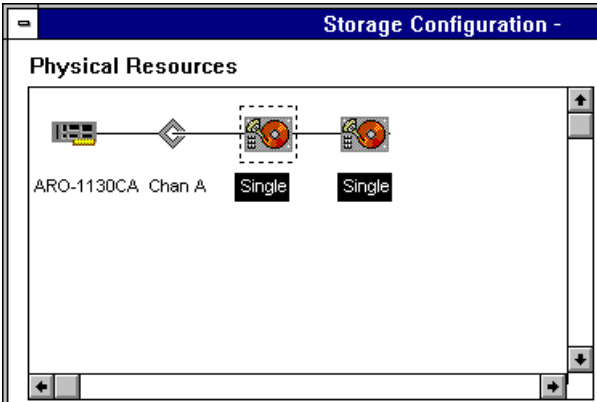


Figure 3-2. Selecting Array Members

Do not select a disk that has a partition. If the partition is recognized by the operating system, you *cannot* use the disk in the array.

You are prevented from using disks with recognized partitions for the array so you will not accidentally erase the computer's boot disk. To find out if a disk has a partition, double-click the



icon and click the **Check Partitions** button in the SCSI Information dialog box. A small popup box indicates whether the selected disk has a partition and whether the partition is visible to the operating system. If you really want to use a disk with a recognized partition in the array, exit from Adaptec CI/O Workstation Array Management Software, back up any data you want to keep, and delete the partition from the disk.



Caution: All data on a disk is deleted when it becomes an array member! Back up any data you want to keep before selecting a disk as an array member.

- 4 Click the **Create Array...** button. The Create Array dialog box appears, as shown in Figure 3-3.

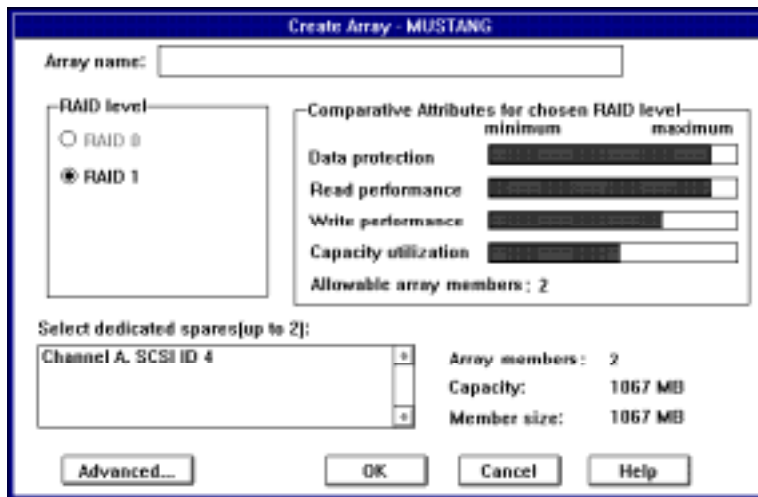


Figure 3-3. Create Array Dialog Box

The number of disks in the array and the array capacity are listed on the right of the dialog box.

- 5 Type a name for the new array. The name can be up to 15 characters, including spaces and any other printable characters. It is used to display the array and to identify the source of event notifications.
- 6 Select a RAID level for the array by clicking one of the buttons on the left. The bar graphs on the right show you the relative levels of data protection, read performance, write performance, and capacity utilization for each RAID level.

RAID levels are grayed out if they are not consistent with the number of disks you have selected. (See the table on page 3-3.)

- 7 (*Optional*) If you created a RAID 1 array, select one or two dedicated spares for it from disks on the scrollable list. (Use **Ctrl-Click** to select multiple disks.) The disks on the list are the single disks you did not select as array members. Select spares that are at least as large as the smallest array member. Otherwise the usable capacity of each array member will be reduced to the capacity of the spare. (See *Creating Dedicated Spares or a Spare Pool* on page 3-12 to learn how to create a *spare pool* that can be used by any array.)
- 8 (*Optional*) Click the **Advanced...** button to examine or change the Advanced Array options. The Advanced Array Options dialog box appears. See *Setting Advanced Array Options* on page 3-7 for more information.
- 9 Click **OK** and then click **Yes** to confirm that you want to create the array. You will see error messages if your array selections are inconsistent. If this happens, change your selections and click **OK** again. You will see a warning if you selected a dedicated spare that is smaller than the array members.

The array is initialized at this point, unless you deselected **auto-initialize** in Advanced Array Options. (If you deselected auto-initialize, skip to step 11.) If you want to abort the initialization process (not recommended), open the Array Activity



Monitor window, select the icon for that array, and click **Abort**.

- 10 Wait until the new array is initialized. A popup box will appear to inform you that event notifications are waiting and can be viewed in the Historic Event Log. Then an icon like this



for the new array appears in the right-hand section of the Storage Configuration window. Another event notification is generated when the initialization process finishes.



Note: Event notifications may appear as popups or just as entries in the Historic Event Log, depending on the Event Notification options you selected in the Client Settings dialog box.

- 11 Exit from Adaptec CI/O Workstation Array Management Software. Then reboot the computer. (You cannot use the new array until you reboot.) You must then partition the new array with the Windows NT Disk Administrator, just as you would partition a new stand-alone disk drive.

Setting Advanced Array Options

The Advanced Array Options dialog box is shown in Figure 3-4. *Do not* change these options from their default settings unless you fully understand what the options mean and you have a specific reason for changing them.

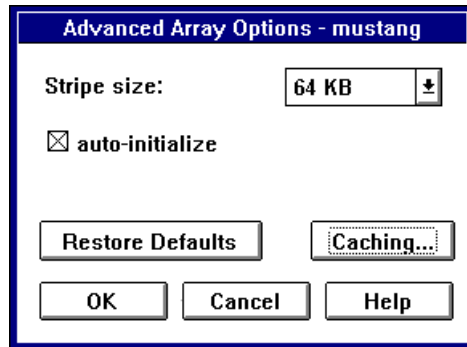


Figure 3-4. Advanced Array Options Dialog Box

Here is a brief description of the advanced options:

- **Stripe Size** is the size that will be used to stripe data across the disks in the array. The optimal stripe size depends on the type of data being stored on the array and the operating system. The default stripe size of 64 KBytes works best in most cases.
- Deselect **auto-initialize** if you want to create the array now but initialize it at a later time. You might want to do this if you plan to define several arrays and initialize them all at the same time.



Caution: RAID 1 arrays *must* be initialized before you can write data to them. We recommend that you zero-initialize RAID 0 arrays as well.

- Click the **Restore Defaults** button if you want to restore the Advanced Array Options settings to the way they were when you opened the dialog box.
- Click the **Caching** button if you want to set Read/Write caching options for the array. For more information on this option, see *Using Read and Write Caching* on page 7-1.

Making an Array the Boot Device

Use this command if you want the computer to boot from an array instead of from a stand-alone disk. (If you want to use a stand-alone SCSI disk as your boot device, we recommend that you assign SCSI ID 0 to this device. If your computer has multiple SCSI channels, connect this SCSI disk to SCSI Channel A.)

You make an array bootable by assigning it virtual device order #0. The *virtual device order* is the sequence in which the computer's operating system detects the arrays, single disks, and other installed devices when the computer boots.



Caution: When you make an array the boot device, the drive letters assigned to other drives and arrays on the computer may change, which can cause data access problems. If you create a bootable array with *ArrayConfigCA*, you will have more control of the virtual device order of all SCSI devices on the computer. See *Making the Array Bootable* on page 2-7 for more information.

Follow these steps to create a bootable array:

- 1 Start Adaptec CI/O Workstation Array Management Software and open the Storage Configuration window, as described in *Starting the Program* on page 3-1.



- 2 Click the icon in the right-hand part of the window for the array that you want to make bootable.
- 3 Click the **Operations** button.



- 4 Click the button.
- 5 When the message appears, click **OK** to confirm that you want to make this array the boot device.
- 6 Exit from Adaptec CI/O Workstation Array Management Software. If the selected array does not already have a bootable

partition on it, reboot the computer to a floppy disk or to a CD-ROM drive.

- 7 Install the operating system on the array. See the *Installation and Hardware Guide* for more information.

The next time you boot the computer, it will attempt to use this array as the boot device.

Deleting an Array



Caution: Back up the data on an array before you delete it. All data on the array disks is lost when you delete the array.

If you delete an array, all the disks that were part of the array become single, *stand-alone* disks. You can then use the disks as spares or as members of a new array.

Follow these steps to delete an array:

- 1 Start Adaptec CI/O Workstation Array Management Software and open the Storage Configuration window, as described in *Starting the Program* on page 3-1.



- 2 Click the icon in the right-hand area of the window for the array you want to delete.
- 3 Click the **Operations** button.
- 4 When the Array Operations dialog box appears, click the




button to delete the array.

A warning appears if the selected array has a partition. If the partition is recognized by the operating system, you *cannot* delete the array. If the partition is *not* recognized by the operating system, you *can* delete the array.

You are prevented from deleting an array with a recognized partition so you will not accidentally delete the computer's boot array. To find out if an array has a partition, double-click



the  icon and click the **Check Partitions** button in the Array Information dialog box. A small popup box indicates whether the selected array has a partition and whether the partition is visible to the operating system. If you really want to delete an array with a recognized partition, exit from Adaptec CI/O Workstation Array Management Software, back up any data you want to keep, and delete the partition from the disk. Then start Adaptec CI/O Workstation Array Management Software again and delete the array.

- 5 When the confirmation message appears, click **OK** to confirm that you want to delete the array.



Note: After you delete an array you can immediately use the disks that formerly belonged to the array to create spares or a new array without rebooting the computer. However, you must reboot the computer before you can use the disks as single disks that are *not* members of an array. Deleting an array may change the boot order and the drive assignment.

Initializing an Array

When you create a new array it is initialized immediately by default unless you deselect the **auto-initialize** option, as described on page 3-7. If you deselect **auto-initialize**, you can initialize the array later by following the instructions in this section. You can also reinitialize an existing array, if necessary.




Caution: All arrays except RAID 0 arrays *must* be initialized or formatted before you can write data to them. We recommend that you zero-initialize RAID 0 arrays as well. All pre-existing data on the disks is overwritten when you initialize an array.

If you want to low-level format the array instead of initializing it with zeros, use the Array*Config*CA program. Low-level formatting checks the surface of the disks for defects.

Follow these steps to initialize an array:

- 1 Start Adaptec CI/O Workstation Array Management Software and open the Storage Configuration window, as described in *Starting the Program* on page 3-1.

- 2 Click the icon  of the array you want to initialize. The Operations button becomes active.


- 3 Click the **Operations** button.

- 4 When the Array Operations window appears, click the



button.


A warning appears if the selected array has a partition. If the partition is recognized by the operating system, you *cannot* initialize the array. You are prevented from initializing an array with a partition so you will not accidentally erase the computer's boot array. To find out if an array has a partition, dou-

ble-click the  icon, and click the **Check Partitions** button in the Array Information dialog box. A small popup box indicates whether the selected array has a partition. If you really want to initialize an array with a partition, exit from Adaptec CI/O Workstation Array Management Software, back up any data you want to keep, and delete the partition from the disk. Then start Adaptec CI/O Workstation Array Management Software again and initialize the array.

- 5 When the confirmation message appears, click **Initialize** to confirm that you want to initialize the array.

To abort the initialization process (not recommended), open



the Array Activity Monitor window, select the  icon, and click **Abort**.

It may take a long time to initialize an array. If you wish, you can watch the progress of the initialization process in the Array Activity Monitor window.

Creating Dedicated Spares or a Spare Pool

Each RAID 1 array can have one or two *dedicated spares*, which automatically replace failed array members *only* for that array. You can create dedicated spares when you create the array, or you can add them to the array at a later time. Each Array1000CA Family device can have a *spare pool* of up to eight disks which automatically replace failed members of *any* RAID 1 array whose disks are controlled by the card.

If you have two or more RAID 1 arrays, a spare pool protects the arrays with fewer disks than what would be required for dedicated spares.



Note: When you install Adaptec CI/O Workstation Array Management Software it is automatically configured to test all spares on the computer once a day to assure they are always available, if needed, to replace failed disks in arrays. We recommend that you leave this default setting so that all spares are tested regularly.

Follow these steps to add a dedicated spare or a pool spare:

- 1 Start Adaptec CI/O Workstation Array Management Software and open the Storage Configuration window, as described in *Starting the Program* on page 3-1.
- 2 Select the disk you want to configure as a spare by clicking on its icon in the left-hand part of the window. (Choose a disk that has the word **Single** beneath it.)
- 3 Click **Create Spare...** The Create Spare dialog box appears, as shown in Figure 3-5. A list of already-defined spares appears on the right. Names of existing arrays appear on the left only if

the disk you selected is large enough to protect that array as a spare.

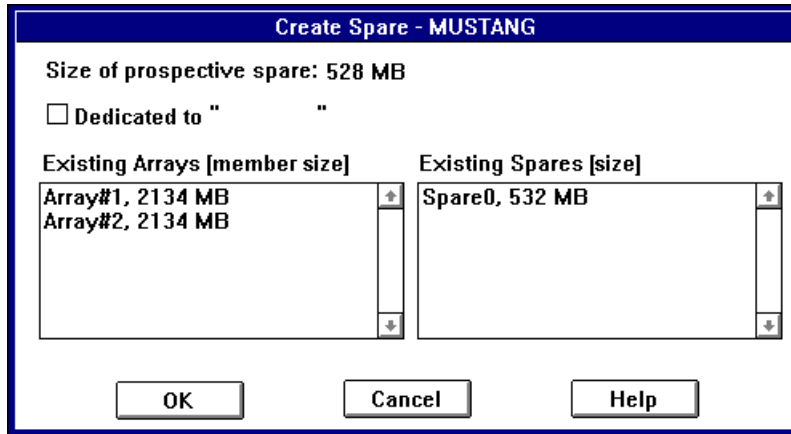



Figure 3-5. Create Spare Dialog Box



Note: In the Storage Configuration window, pool spares are labeled p-spare and dedicated spares are labeled d-spare in both the left and right parts of the window.

- 4 If you want to dedicate the spare to a specific array, select **Dedicated To** and click the array name in the scrollable list. If you want to add the spare to the pool of spares available to *all* arrays on the controller, do not select the Dedicated To box.
- 5 Click **OK** to create the spare. A warning message appears if you select a disk that has a partition. If the partition is recognized by the operating system, you *cannot* use the disk as a spare. If the partition is *not* recognized by the operating system (for example, if the disk was previously partitioned under another operating system), you *can* use the disk as a spare.

You are prevented from using disks with recognized partitions so you will not accidentally erase the computer's boot disk. To

find out if a disk has a partition, double-click the  icon and click the **Check Partitions** button in the SCSI Information

dialog box. A small popup box indicates whether the selected disk has a partition and whether the partition is visible to the operating system. If you really want to use a disk with a recognized partition as a spare, exit from Adaptec CI/O Workstation Array Management Software, back up any data you want to keep, and delete the partition from the disk.

Newly-created spares are immediately available for use, without rebooting the computer. If an array is in Critical status, it will be reconstructed as soon as you create the spare (unless the spare is dedicated to another array).



Note: You can add a disk of any size to the spare pool, even if the disk is too small to protect the existing arrays. For example, if you have created two arrays with 8-GByte disks, you can add a 4-GByte disk to the spare pool, even though this disk is too small to replace any failed array member. The spare pool feature is designed like this to give you additional flexibility. For example, you may be planning to create another array later with 4-GByte disks.

To see which arrays are protected by an existing spare, select the spare in the Existing Spares list; the arrays covered by this spare are highlighted in the Existing Arrays list. You can double-click an array or a spare to view detailed information about it.

To see which spares protect an existing array, select the array in the Existing Array list. The spares that protect the array are highlighted in the Existing Spares list.

Deleting a Spare

Follow these steps to delete a spare disk:


- 1 Start Adaptec CI/O Workstation Array Management Software and open the Storage Configuration window, as described in *Starting the Program* on page 3-1.
- 2 Click the icon in the Array part of the window for the spare you want to delete.
- 3 When the confirmation message appears, click **OK** to confirm that you want to delete the spare.





After you delete an existing spare, and before you reboot the computer, you can use a former spare to create a new array or spare. However, this disk does not become visible to the operating system as a single disk until after you reboot the computer.



Viewing Array, Device, and System Information

Adaptec CI/O Workstation Array Management Software allows you to view information about arrays, spares, SCSI channels, and SCSI devices installed in your computer. You view this information in the Storage Configuration window. Follow these steps to open the Storage Configuration window:

- 1 Select **Configuration** from the View menu, or click the  icon on the toolbar.
- 2 When the Storage Configuration window appears, double-click the icon that represents the device for which you want to view information. The icons for the more commonly used devices are as follows:

-  Array
-  Spare
-  ARO-1130CA card or AAA-131CA adapter
-  Channel




Note: There are also icons for SCSI tape drive, CD changer, SCSI printer, SCSI scanner, etc.

The array and spare icons appear on the right side of the Storage Configuration window. The icons representing the Array1000CA Family device, channels, and SCSI devices appear on the left side of the window.

The following sections explain the information that appears when you click an icon for a virtual or physical device.

Viewing Array Information

When you double-click an array icon  in the Storage Configuration window, the Array Information dialog box appears, as shown in Figure 4-1.

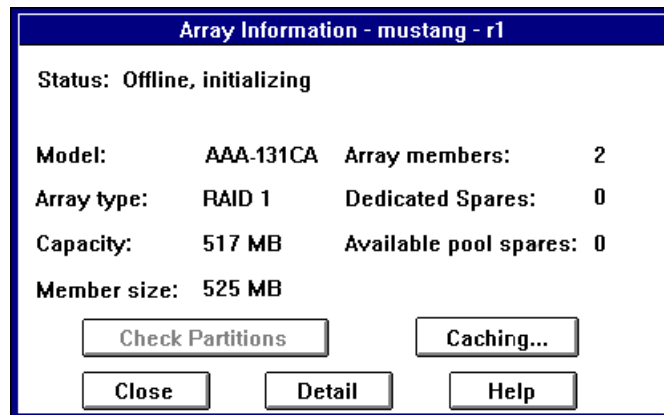


Figure 4-1. Array Information Dialog Box

Viewing Array, Device, and System Information

The following information appears in the Array Information dialog box:

- **Status:** current status of the array, such as On-line, Off-line, Fault-tolerant, Critical, etc.
- **Model:** model name of the Adaptec Array1000 product.
- **Array type:** RAID level of the array. The supported levels are RAID 0 and RAID 1.
- **Capacity:** total usable disk space available in the array, in MBytes.
- **Member size:** size of the array members.
- **Array members:** number of disks in the array.
- **Dedicated spares:** number of spare disks dedicated to this array, if any.
- **Available pool spares:** number of pool spares available to protect this array.

Click the **Check Partitions** button to determine if the array has a partition. A small dialog box indicates whether the selected array has a partition and whether the partition is visible to the operating system.

Click the **Caching** button to view information about the array's Read and Write caching options. (The caches exist in memory on the Array1000CA Family device.) For more information, see *Using Read and Write Caching* on page 7-1.


When you click the **Detail** button, you can view the following additional information about the array:

- **Stripe size:** data striping size used on this array.
- **Virtual device order:** the sequence in which the operating system detects this array when it boots. If the array's virtual device order is 0, then this array is the first device the operating system detects at boot time.
- **Creation date:** date on which the array was created.
- **Date of last verify:** date on which the array was last verified. See *Verifying Array Integrity* on page 5-6 for information on how to verify an array.

- **Date of last reconstruct:** date on which the array was last reconstructed. See *Reconstructing an Array* on page 5-2 for information on how to reconstruct an array.

Click **Close** to close the Array Detail and Array Information dialog boxes.

Viewing Spare Information

When you double-click a spare icon  in the *right* side of the Storage Configuration window the Spare Information dialog box appears, as shown in Figure 4-2.

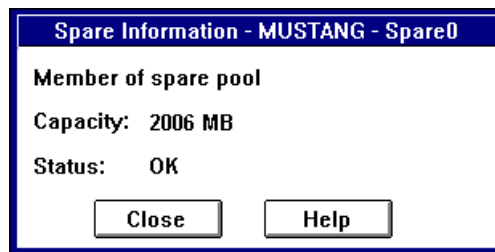


Figure 4-2. Spare Information Dialog Box

When you double-click a spare icon in the *left* side of the window you will see the SCSI Information dialog box, the same as for a single SCSI disk.


The Spare Information dialog box shows which array the spare is dedicated to, whether it is a member of a spare pool, its capacity, and its current status. An *Available* status means the spare is fully functional and is available to replace a failed array disk.



Note: The spare icons in the Storage Configuration window are labeled p-spare for pool spares and d-spare for dedicated spares.

Click **Close** to close the Spare Information dialog box or SCSI Information dialog box.

Viewing Array Card Information

When you double-click an array card icon , the Controller Information dialog box appears, as shown in Figure 4-3.

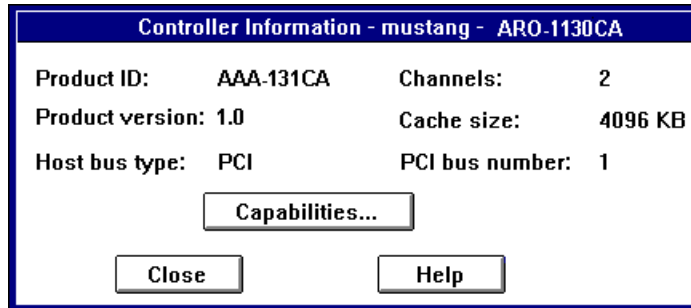


Figure 4-3. Controller Information Dialog Box

The information in the Controller Information dialog box is self-explanatory. The *PCI bus number* field indicates which PCI slot the Array1000CA Family device is installed in.


Click the **Capabilities** button to view a list of the features supported by this Array1000CA Family device. The list is informational only; you cannot enable or disable the capabilities on the list. Here are some controller capabilities that may appear on the list:

- **Automatic Verify:** indicates that the product automatically verifies SCSI parity.
- **Auto Fix:** indicates that the product automatically corrects data miscompares.
- **Supported RAID Levels:** lists the RAID levels the product supports.
- **Maximum Number of Spares:** lists the maximum number of pool spares that the product supports.
- **Maximum Number of Physical Arrays:** lists the maximum number of arrays the product supports.
- **Maximum Number of Drives for a Single Array:** lists the maximum number of disks the product supports for a single array.

- **Maximum/Minimum Stripe Size:** lists the range of data and parity stripe sizes that the product supports.
- **Spare Pool:** indicates that the product supports using spares from a spare pool.

Click **Close** to close the Capabilities dialog box and the Controller Information dialog box.

Viewing Channel Information

When you double-click a channel icon , the Channel Information dialog box appears, as shown in Figure 4-4.

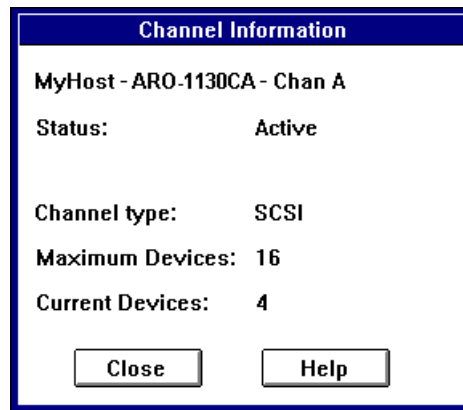




Figure 4-4. Channel Information Dialog Box

The following information appears in the Channel Information dialog box:

- **Status:** current operational status of the channel (for example, Active, Inactive).
- **Channel type:** type of this channel—for example, *SCSI*.
- **Maximum Devices:** maximum number of SCSI devices that the channel supports. If this number is 16 (for example) it means you can connect up to 15 devices, since the channel itself counts as one device.
- **Current Devices:** number of SCSI devices currently connected to the channel.

Click **Close** to close the Channel Information dialog box.

Viewing SCSI Device Information

When you double-click a SCSI device icon, such as a disk  or a CD-ROM drive , the SCSI Information dialog box appears, as shown in Figure 4-5.

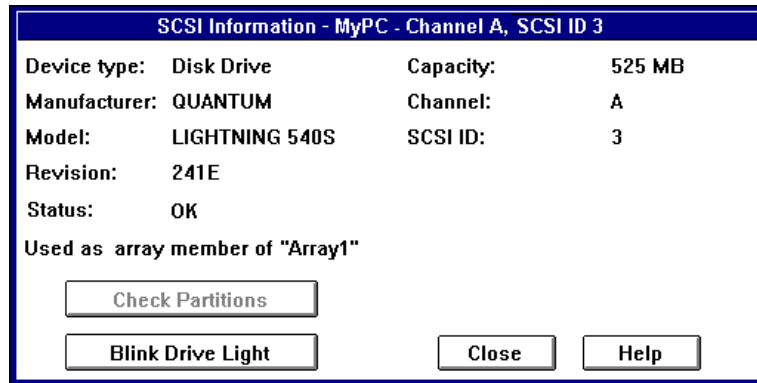


Figure 4-5. SCSI Information Dialog Box

The information in this dialog box is self-explanatory. When you are creating an array you can view this dialog box to determine if a disk you want to use for the array has partitions on it. Simply click the **Check Partitions** button. A small popup box indicates whether the selected disk has a partition and whether the partition is visible to the operating system.



Note: You cannot use a disk in an array if it has a partition that is visible to the operating system. (This is a safety feature that prevents you, for example, from accidentally erasing your boot disk.) If you really *do* want to use a disk with a recognized partition in the array, exit from Adaptec CI/O Workstation Array Management Software, back up any data you want to keep, delete the partition, and then run Adaptec CI/O Workstation Array Management Software again.

Click the **Blink Drive Light** button if you are not sure which physical device the icon represents. The light on the front of the drive will flash briefly. (This option is not available for other kinds of SCSI devices, such as CD-ROM drives.)

Click **Close** to close the SCSI Information dialog box.

Rescanning the Computer

Whenever you boot your computer the operating system software scans for installed devices such as arrays and SCSI devices. Adaptec CI/O Workstation Array Management Software displays icons for these devices in the Storage Configuration window.


Sometimes you need to issue a Rescan command while Adaptec CI/O Workstation Array Management Software is running so it can “see” a new hardware configuration. You need to do a Rescan if

- you connect a new SCSI device to a SCSI channel controlled by the Array1000CA Family device without using the Pause I/O command
- you remove a SCSI device from a SCSI channel controlled by the Array1000CA Family device without using the Pause I/O command

A Rescan is done automatically if you pause and resume I/O to an array or a device. You do not need to issue a Rescan command to detect a failed array member. Adaptec CI/O Workstation Array Management Software does this automatically.

Follow these steps to rescan the computer:




- 1 Click the  button on the toolbar. The Storage Configuration window appears.
- 2 Click the **Rescan** button, which appears in the area between the Physical Resources and Array areas of the window.
- 3 When the message appears, click **Yes** to rescan the computer. When the rescan is complete, any hardware changes are reflected in the icons in the Storage Configuration window.
- 4 Click **OK** when the message appears indicating that the rescan was completed successfully.

Viewing System Event Information

Adaptec CI/O Workstation Array Management Software maintains a log of information about array-related events that occur on your computer system. The information is saved in a log file and can be viewed on the screen. System events include creating or deleting an array, verifying the integrity of an array, failure of a disk in an array, etc.

Follow these steps to view the log of system events:



- 1 Click the  button on the toolbar. The Historic Event Log appears, as shown in Figure 4-6.

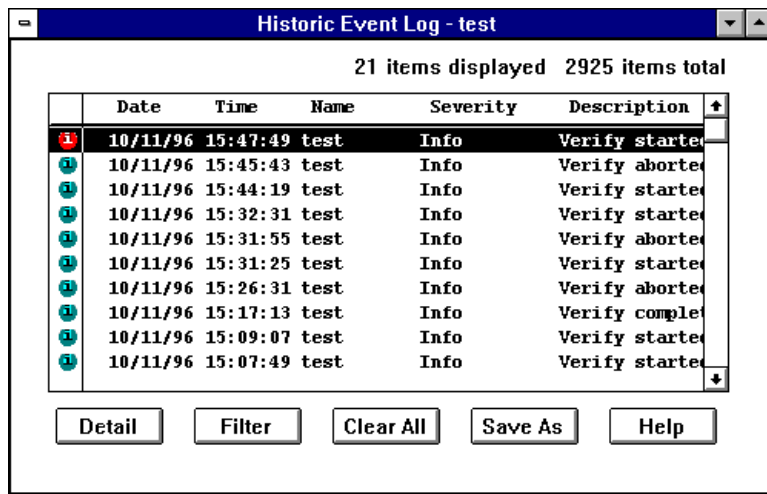


Figure 4-6. Historic Event Log Window

- 2 View the system event information. New entries are added to the top of the list as they occur. A color-coded circle at the beginning of each message indicates its severity. (See the next section, *Interpreting and Responding to System Event Messages*, for more information.)
- 3 To view detailed information about a log entry, double-click the entry, or highlight the entry and click the **Detail** button. The Log Detail dialog box appears. Click **OK** when you are finished viewing this dialog box.

- 4 Click **Filter** to change the message filter options. These changes apply only while the window is open and will revert to the defaults if you close the Historic Event Log and open it again. We recommend that you leave all boxes checked so all system messages will be displayed. Follow the instructions in *Setting Preferences* on page 4-11 if you want to permanently change the filter settings.

If you choose to filter out some kinds of messages, the *Items displayed* number above the log entries lists the number of messages that are actually displayed. The *Items total* field always indicates the total number of messages of all types.

- 5 Click **Clear All** to delete all existing log entries. Click **Save As** to save the log to a file.






Note: When you open the Historic Event Log, only the most recent log entries are initially retrieved from the log file. If you scroll down beyond these entries, another groups of entries is retrieved. This avoids the delay that might occur if an entire large log file were retrieved at one time. To keep the log file from getting too large, specify a maximum size for it in the initialization file. (See Appendix A, *Configuration Settings*.)

- 6 Close the window when you are finished viewing log entries, or minimize it as an icon on the screen.

Interpreting and Responding to System Event Messages

There are three severity levels for system events:


-  **Critical** event messages (red dot) indicate an array problem that requires immediate action. An example is an array going off-line because two array members have failed. See *Responding to an Off-line Array* on page 9-3 for more information.
-  **Warning** event messages (yellow dot) indicate an array or system problem that may require attention. An example is a channel on which data I/O is paused.

-  **Informational** event messages (green dot) inform you about some normal operation, such as creating a new array, adding a spare, or verifying an array.

Setting Preferences

You use the Preferences dialog box to specify how you want to be notified of system events and what kinds of events you want to view in the Historic Event Log. The preferences that you set here remain in effect until you change them again.

Follow these steps to change or view event preferences:

- 1 Click the  button. The Preferences dialog box appears, as shown in Figure 4-7.

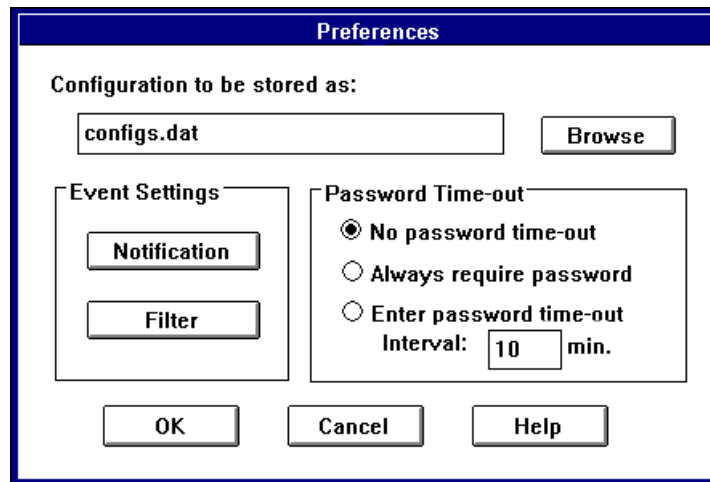


Figure 4-7. Preferences Dialog Box

- 2 Click the **Notification** button to change the way in which you are alerted of event notifications. The Event Notifications Options dialog box appears, as shown in Figure 4-8. Select one or more of the available options, then click **OK** to save these settings.

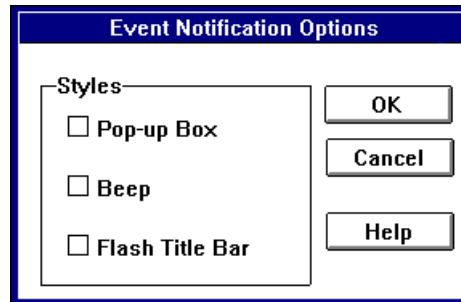


Figure 4-8. Event Notification Options Dialog Box



Note: Regardless of the options you choose, Adaptec CI/O Workstation Array Management Software will always notify you of Critical events with a pop-up message, a beep, and a flashing title bar.

- 3 Click the **Filter** button to view the Log Filter dialog box, as shown in Figure 4-9. Select or deselect the check boxes to change the filtering of messages in the Historic Event Log, then click **OK** to save these settings.

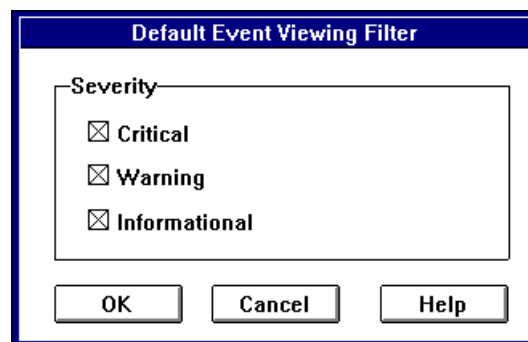


Figure 4-9. Log Filter Dialog Box

Viewing Array, Device, and System Information

We recommend that you select all the boxes so you are fully informed of all system events.

- 4 Click **OK** to change the option information or to close the Preferences dialog box. These settings are the new default settings for the Historic Event Log window.



...5

Performing Operations on Arrays and Other System Devices

You can use Adaptec CI/O Workstation Array Management Software to perform a number of *operations* on arrays, spares, array cards, channels, and stand-alone disk drives. These operations include reconstructing an array, testing spares, and blinking the lights on disks drives, changing Read/Write cache settings, and graphing system performance. Some of the operations are performed immediately; others can be scheduled for a later time, or can be scheduled to occur at stated intervals.






To perform operations on arrays and other system devices, you first open the Storage Configuration window. To do this:

- 1 Select **Configuration** from the View menu, or click the



icon on the toolbar.

- 2 When the Storage Configuration window appears, *single-click*

an icon that represents an array , spare , array card , SCSI channel , or SCSI disk .

When you do this, the Operations button becomes active.

- 3 Click the **Operations** button. A dialog box appears with icons for the operations that you can perform on the selected device.
- 4 Click the button for the operation you want to perform. See the appropriate section of this chapter for a description of these operations.

Performing Array Operations

Here is a list of the array operations. Note that some of these operations are described in other chapters.

- *Reconstructing an Array* on page 5-2
- *Pausing I/O on an Array* on page 5-5
- *Verifying Array Integrity* on page 5-6
- *Blinking Array Drive Lights* on page 5-8
- *Reactivating an Off-line Array* on page 5-9
- *Changing an Array Name* on page 5-9
- *Forcing a Spare* on page 5-10
- *Making an Array the Boot Device* on page 3-8
- *Deleting an Array* on page 3-9
- *Initializing an Array* on page 3-10
- *Optimizing Array Performance* (See *Using Read and Write Caching* on page 7-1)
- *Graphing Array Performance* (See *Graphing System Performance* on page 7-6)

Reconstructing an Array

If a spare disk is available when a disk in a RAID 1 array fails, the data on the disk is automatically reconstructed on the spare, and you do not need to use the Reconstruct operation. However, if a disk in an array fails and no spare is available to replace it, you receive an event notification that the array is Critical. You may need to reconstruct the array with this command after the drive is replaced. In either case, data on the array is not lost.


You can reconstruct an array immediately after you replace the failed disk (recommended), or you can schedule the reconstruct to occur at a later time.

Follow these steps to reconstruct a RAID 1 array when a disk fails:

- 1 Determine which array is in Critical status and which disk in the array has failed.
- 2 If the disks are in an array enclosure, pause I/O to the array. (See *Pausing I/O on an Array* on page 5-5.) If they are installed inside a regular computer case, turn OFF the computer, disconnect the power cord, and open the computer case.
- 3 Replace the failed disk with a good disk of at least the same storage capacity. Be sure that the SCSI ID of the new disk is different from the SCSI ID of other installed devices. Or, if an array disk was accidentally disconnected, reconnect it.
- 4 Wait until I/O automatically resumes after the pause period. Or close the computer case, reconnect the power cord, and turn ON the computer.
- 5 If you installed a new disk (or disks), make the disk into a spare by following the directions in *Creating Dedicated Spares or a Spare Pool* on page 3-12. Be sure the new spare disk is at least as large as the smallest array member.



Note: When the spare is created, Adaptec CI/O Workstation Array Management Software should automatically start a Reconstruct operation on the array. If for some reason the reconstruct does *not* begin automatically, follow the remaining steps to perform it manually.

- 6 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 7 Click on the array icon that looks like this . The Operations button becomes active.

- 8 Click the **Operations** button. The Array Operations dialog box appears, as shown in Figure 5-1.

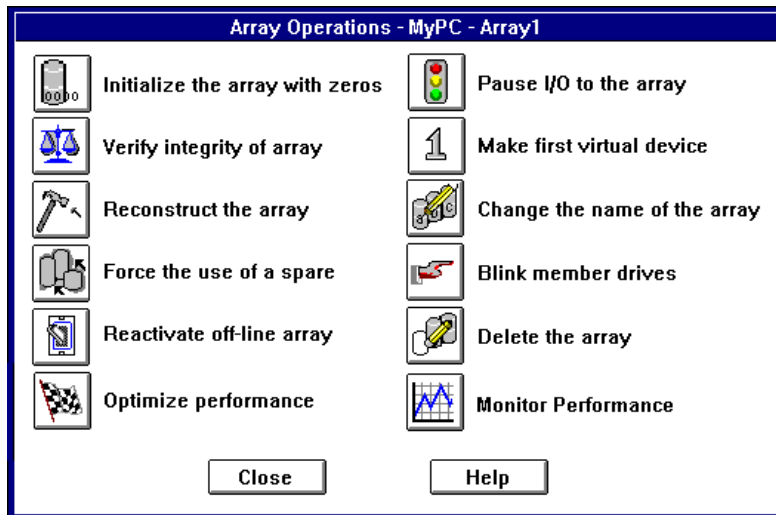



Figure 5-1. Array Operations Dialog Box

- 9 Click the  button. The Scheduler dialog box appears.
- 10 Enter the required information for the Reconstruct operation in the Scheduler dialog box. You can select **Immediate** to reconstruct the drive immediately or select **Once** to schedule the operation for a later time. (See *Setting Scheduling Options* on page 6-1 for more information.)
- 11 Select an Execution Priority - **high**, **medium**, or **low**.
- 12 Click **OK**.
- 13 When the message appears, confirm that you want to reconstruct the array member.
- 14 Read the event notifications that appear in the Historic Event Log (they may also appear as popups on the screen) to determine when the reconstruct is complete.

Open a Watch box if you want to monitor the progress of the array reconstruction. (See *Monitoring Activities that are Running* on page 6-5.)

Pausing I/O on an Array

Use this option to pause data I/O on an array so you can replace a disk on a RAID 1 array, reconnect a loose connection, etc. If your computer system includes a special array enclosure that supports *hot swapping*¹, you can replace an array disk without pausing I/O.



Note: You can pause data I/O for up to 120 seconds. This is enough time to replace a bad disk in an array enclosure, but not enough time to replace a bad disk inside a regular computer case. If the array disk you want to replace is not in an array enclosure, simply shut down the system, replace the bad disk, and restart the system.

When you pause an array, all other devices connected to the Adaptec card are also paused. I/O is automatically resumed after a specified pause interval. The Pause I/O command is disabled if a Verify, Reconstruct, or Initialize operation is running.

Follow these steps to pause and resume I/O on an array:

- 1 Open the Storage Configuration window and select the icon of

the array  you want to pause.

- 2 When the Array Operations dialog box appears, click the



button.

- 3 When the Pause I/O dialog box appears, enter a pause interval that does not exceed the maximum allowable pause period (120 seconds), and click **OK** to pause the array. Wait a few seconds until data I/O stops.

¹ *Hot swapping* support means that the array enclosure electrically isolates the bad disk's SCSI connector from the SCSI bus while the disk is being swapped to prevent data corruption. Data can still be transferred to and from the remaining good disks while the bad disk is replaced. Check with the manufacturer of the array enclosure if you are not sure whether it supports hot swapping


- 4 Do whatever you need to do with the array disks. Data I/O resumes automatically at the end of the pause period.

Verifying Array Integrity

Use this option to verify the integrity of redundant data stored on RAID 1 arrays. When you run this operation, Adaptec CI/O Workstation Array Management Software checks the array for mismatches and corrects them automatically. A *mismatch* occurs when some part of the data on a mirrored disk pair in a RAID 0/1 or RAID 1 array does not match.

In Adaptec CI/O Workstation Array Management Software you can schedule the Verify operation to run later or schedule it to run at a regularly occurring interval. We recommend that you schedule a verification of all arrays at least once a week. See *Setting Scheduling Options* on page 6-1 for more information.

Follow these steps to verify the integrity of redundant array data:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Click on the array icon . The Operations button becomes active.
- 3 Click the **Operations** button.

- 4 When the Array Operations dialog box appears, click the



button to verify the data on the array. The Scheduler dialog box appears, as shown in Figure 5-2.

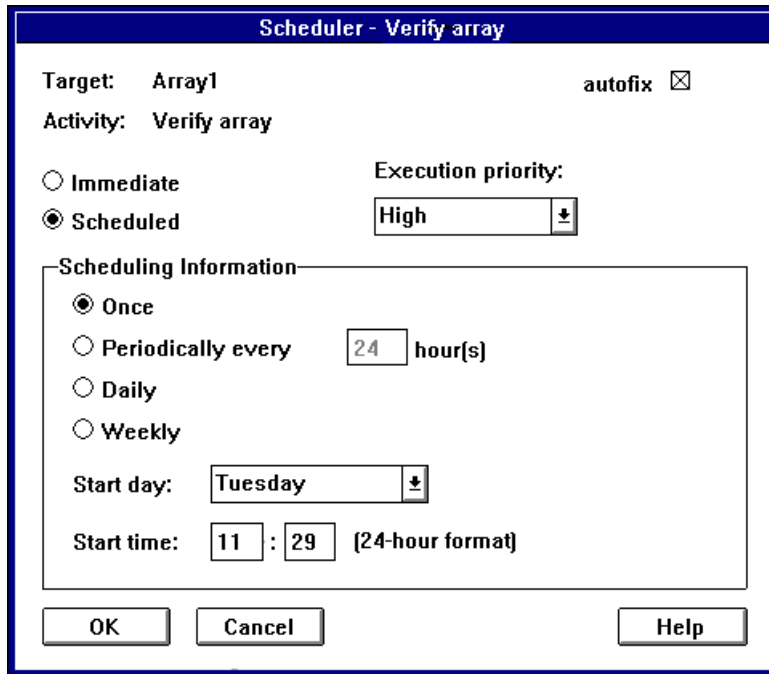


Figure 5-2. Scheduler Dialog Box

- 5 Leave the **autofix** box checked so that data mirroring mismatches will be corrected automatically.
- 6 Select **Immediate** if you want to verify parity immediately, or select **Scheduled** if you want to schedule the operation for a future time.
- 7 If you select **Scheduled**, enter a start time, start day of the week, and other information. (See *Setting Scheduling Options* on page 6-1 for more information.)
- 8 Select an Execution Priority - **high**, **medium**, or **low**. This determines how much system resources are devoted to the operation. A high priority means the Verify operation will use

a lot of system resources, which may slow down other system activity.


- 9 Click **OK** to start the operation (if you selected Immediate) or to enter it on the list of scheduled activities.

You can open a Watch window to monitor the progress of the operation as it is running. See *Monitoring Activities that are Running* on page 6-5 for more information.

Blinking Array Drive Lights

You can issue a command to blink the drive lights of all the disks in a selected array. This allows you to see which physical drives actually form the array.


Follow these steps to blink the drive lights of the disks in an array:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Click on an array icon in the right side of the dialog box. The Operations button becomes active.
- 3 Click the **Operations** button.
- 4 When the Array Operations dialog box appears, click the  button.
- 5 Observe the blinking drive lights to determine which disks are members of the array.
- 6 Click **OK** in the popup box to stop the drive lights from blinking.

Reactivating an Off-line Array

An array may go off-line because a cable is disconnected, because a disk failed, or because you mistakenly removed the wrong disk while trying to replace a failed disk. In these situations, the array shuts down temporarily. Depending on the reason why the array went off-line, it is possible that you can reactivate it and resume I/O without data loss. See *Responding to an Off-line Array* on page 9-3 for more information.

After you correct any hardware problems, follow these steps to reactivate an off-line array:



- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Click on the grayed-out icon of the off-line array. The Operations button becomes active.
- 3 Click the **Operations** button.
- 4 When the Array Operations dialog box appears, click the  button.
- 5 When the message appears, confirm that you want to reactivate the array. Be sure that any hardware problems are corrected before you do this.
- 6 If the array is fault-tolerant, run a Verify operation on it (see *Verifying Array Integrity* on page 5-6). If it is a RAID 0 array, run *chkdsk* to check the array integrity.

Changing an Array Name

When you create an array, you assign it a name of your choosing. This name appears beneath the array icon and in many of the windows and dialog boxes. It is also used to identify the source of event notifications. You can change this name at a later time, if necessary.

Follow these steps to change the name of an existing array:


- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.

- 2 Click the icon  of the array whose name you want to change. The Operations button becomes active.
- 3 Click the **Operations** button.
- 4 When the Array Operations dialog box appears, click the  button. The Change Name dialog box appears.
- 5 Type the new array name and click **OK**.
- 6 When the confirmation message appears, confirm that you want to change the array name. This change appears immediately in the Storage Configuration window.

Forcing a Spare

Forcing a spare means issuing a command for a spare disk to replace a specific disk in an array. You can do this if the array disk is not performing well and is giving some indication that an array member may fail soon. (If an array member actually does fail, a spare replaces it automatically without requiring you to force a spare.)

Follow these steps to force a spare:

- 1 Be sure that one or more spares are available for the array. These can either be dedicated spares for the array or spares from a spare pool. See *Creating Dedicated Spares or a Spare Pool* on page 3-12 for more information on configuring spares.
- 2 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 3 Click on the icon of the array with the suspect disk. The Operations button becomes active.
- 4 Click the **Operations** button.
- 5 When the Array Operations dialog box appears, click the  button. This button is grayed out if no spares are available.
- 6 Select the disk that you want to replace.

- 7 Click **OK** to replace this disk with a spare.
- 8 When the confirmation message appears, confirm that you want to replace the disk with the spare. At this point the spare is automatically activated to replace the disk.

If there is a pool of available spares, you cannot control which disk from the pool is activated when you force a spare. You can control this if there is only *one* dedicated spare or *one* pool spare. If both dedicated spares and pool spares are available, the dedicated spares are used first. An error message appears if the spare is not at least as large as the smallest disk in the array. If this happens, add a larger spare.

Performing Spare Operations

Here is a list of the spare operations available in Adaptec CI/O Workstation Array Management Software. (Note that Deleting a Spare is covered in an earlier chapter):

- *Testing All Spares* on page 5-11
- *Blinking the Spare Drive Light* on page 5-13
- *Deleting a Spare* on page 3-15

Testing All Spares

Reliable spares must be available to immediately (and automatically) replace any array disk that fails. Spares should be tested regularly to assure that they are working properly. We recommend that you test all spares daily. You can run this operation immediately by issuing a command, or you can use the Scheduler function to set up a recurring check of all the spares at a later time.



Note: When you install Adaptec CI/O Workstation Array Management Software it automatically sets up a daily Test All Spares operation. We recommend that you leave this default setting so that all spares are tested regularly.

Follow these steps to test all spares:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.

- 2 Click on the icon of any spare on the right side of the dialog box. The Operations button becomes active.
- 3 Click the **Operations** button.
- 4 When the Spare Operations dialog box appears, click the



button. The Scheduler dialog box appears, as shown in Figure 5-2 on page 5-7.

- 5 Select **Immediate** if you want to test all spares immediately, or select **Scheduled** if you want to schedule the operation for a later time.
- 6 If you select **Scheduled**, enter a starting time, starting day, and other information.
- 7 Click **OK** to start the operation (if you selected Immediate) or to enter it on the list of scheduled activities.
- 8 When the confirmation message appears, confirm that you want to test the spares.
- 9 Read the popup message that appears when the test is completed. (The message is also recorded in the Historic Event Log.) If any spares failed the test, look at the spare disk icons in the Storage Configuration window. The icons of the failed



disks will look like this .

- 10 Replace any failed disks immediately with good disks of at least the same capacity.

Blinking the Spare Drive Light

You can issue a command to blink the drive light of a spare whose icon you have selected. This allows you to see which physical drive is the actual spare.

Follow these steps to blink the drive light of a spare:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Click on a spare icon in the right side of the dialog box. The Operations button becomes active.
- 3 Click the **Operations** button.
- 4 When the Spare Operations dialog box appears, click the



button.

- 5 Determine which disk light is blinking.
- 6 Click **OK** in the popup box to stop the drive light from blinking.

Performing Array Card Operations

If you select an array card icon, you have two operation options: Optimizing Performance and Graphing.

Optimizing Array Card Performance

Follow these steps to optimize array card performance by adjusting the Read and Write caching options:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Click on an array card icon in the left side of the dialog box. The Operations button becomes active.
- 3 Click the **Operations** button.

- 4 When the Adapter Operations dialog box appears, click the



button. A list of arrays controlled by the array card appears.

- 5 Select the array whose caching options you want to change and click the **Caching** button. (Each array has its own Read and Write cache, so you must change the options separately for each device.) The Optimize Performance dialog box appears.



Note: Some RAID levels may not support the Read/Write caching feature. Unsupported functionality is grayed out.

- 6 Change cache settings as needed. Follow the instructions in *Using Read and Write Caching* on page 7-1.

Graphing Array Card Performance

Follow these steps to view a graph of the array card I/O performance:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Click on an array card icon in the left side of the dialog box. The Operations button becomes active.
- 3 Click the **Operations** button.
- 4 When the Adapter Operations dialog box appears, click the



button. The CI/O Profiler window appears.

- 5 Follow the instructions in *Graphing System Performance* on page 7-6. The information you will see on the graph is a total for all arrays and disks controlled by the array card.

Performing SCSI Channel Operations

If you select a SCSI channel icon, you can view a graph of I/O performance on the channel.

Graphing SCSI Channel Performance

Follow these steps to view a graph of the I/O performance on the SCSI channel:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Click on a SCSI channel icon in the left side of the dialog box. The Operations button becomes active.
- 3 Click the **Operations** button.
- 4 When the Channel Operations dialog box appears, click the



button. The CI/O Profiler window appears.

- 5 Follow the instructions in *Graphing System Performance* on page 7-6. The information you will see on the graph is a total for all arrays and disks connected to the selected channel.

Performing Disk Operations

You can perform the following disk operations with a single disk or with a disk that is an array member:


- *Blinking the Drive Light* on page 5-16
- *Downing a Drive* on page 5-17
- *Pausing I/O to a Disk Drive* on page 5-18

You can also graph the disk performance of a single disk that is *not* an array member. See *Graphing System Performance* on page 7-6.

Blinking the Drive Light

You can issue a command to blink the light of a disk whose icon you have selected. This allows you to see which physical disk corresponds to the disk icon.

Follow these steps to blink a drive light:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Click on a disk icon in the left side of the window. The Operations button becomes active.
- 3 Click the **Operations** button.
- 4 When the Drive Operations window appears, click the button. 
- 5 Observe which disk light is blinking.
- 6 Click **OK** in the popup box to stop the drive light from blinking.

Downing a Drive

Use this option to stop all data I/O to a member of an array. You might need to do this if the disk generates a S.M.A.R.T.¹ alert indicating that it is about to fail. When you down an array member, a spare is activated immediately (if available) to replace it, and a reconstruct is triggered for RAID levels that support it.



Note: The Down a Drive command can only be used for array members, not for spare disks or single disks.

Follow these steps to down a disk:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Select the icon of the disk you want to down.
- 3 Click the **Operations** button.
- 4 When the Drive Operations dialog box appears, click the



- button. If a spare is available, it replaces the downed disk immediately and a reconstruct of the array is triggered.
- 5 Wait until the Reconstruct operation is completed.

¹ S.M.A.R.T. stands for Self-Monitoring, Analysis and Reporting Technology. Hard disk drives that support this technology continually analyze their performance and generate an alert if they determine that the disk is likely to fail soon. Adaptec CI/O Workstation Array Management Software generates an event notification if it receives this alert, giving you an opportunity to replace the disk before it actually fails.

Pausing I/O to a Disk Drive

Use this option to pause data I/O on a disk drive. You might need to do this if you want to replace a disk in an array enclosure. If your computer system has a special array enclosure that supports *hot swapping*¹, you can replace a disk without pausing I/O.

When you pause I/O to a disk drive, *all* other devices on the SCSI channel(s) are paused as well. I/O resumes automatically at the end of the pause period. The Pause I/O command is disabled if a Verify, Reconstruct, or Initialize operation is running.



Note: You can pause data I/O for up to 120 seconds. This is enough time to replace a bad disk in an array enclosure, but not enough time to replace a bad disk inside a regular computer case. If the array disks are not in an array enclosure, simply shut down the system, replace the bad disk, and restart the system.

Follow these steps to pause data I/O to a disk:

- 1 Select **Configuration** from the View menu. The Storage Configuration window appears.
- 2 Select the icon of the disk you want to pause.
- 3 Click the **Operations** button. When the Array Operations dia-



log box appears, click the button.

- 4 When the Pause I/O dialog box appears, enter a pause interval that does not exceed the maximum allowable pause period (120 seconds), and click **OK** to pause the disk. Wait a few seconds until data I/O stops.

¹ *Hot swapping* support means that the array enclosure electrically isolates the bad disk's SCSI connector from the SCSI bus while the disk is being swapped to prevent data corruption. Data can still be transferred to and from the remaining good disks while the bad disk is replaced. Check with the manufacturer of the array enclosure if you are not sure whether it supports hot swapping

Performing Operations on Arrays and Other System Devices

- 5 Do whatever you need to do to the disk. Be sure to complete your work before the pause period expires. I/O resumes automatically at the end of this period.



...6

Scheduling and Monitoring Array Operations

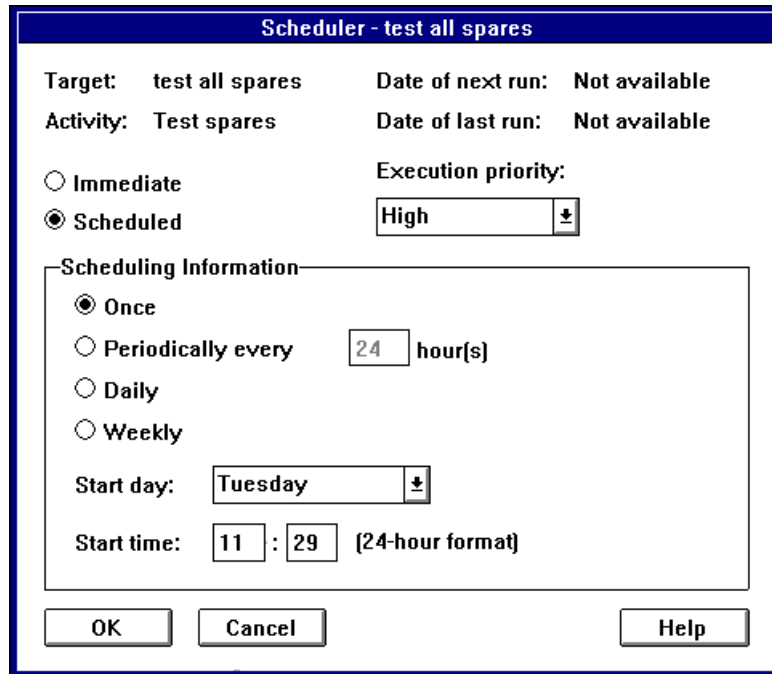
Adaptec CI/O Workstation Array Management Software enables you to schedule some kinds of operations to run at a later time, or to schedule them to run at regularly recurring intervals. You set up these scheduled jobs when you give the command to run the activity, as described in *Verifying Array Integrity* on page 5-6, *Reconstructing an Array* on page 5-2, and *Testing All Spares* on page 5-11.

Setting Scheduling Options

The Scheduler dialog box allows you to schedule the Reconstruct an Array, Verify Integrity of Array, and Test All Spares operations. Reconstruct an Array is a one-time event for which you can enter a date and time. Verify Integrity of Array and Test All Spares can be scheduled as hourly, daily, or monthly recurring events. The Scheduler appears automatically when you define a new scheduled operation.

Follow these steps to set scheduling options for a newly added operation:

- 1 Define a new scheduled operation: Reconstruct an Array, Verify Integrity of Array, or Test All Spares. The Scheduler dialog box appears, as shown in Figure 6-1.



The image shows a Windows-style dialog box titled "Scheduler - test all spares". It contains the following fields and controls:

- Target:** test all spares
- Activity:** Test spares
- Date of next run:** Not available
- Date of last run:** Not available
- Execution priority:** High (with a dropdown arrow)
- Scheduling Information:**
 - ☒ Once
 - ☐ Periodically every 24 hour(s)
 - ☐ Daily
 - ☐ Weekly
 - Start day:** Tuesday (with a dropdown arrow)
 - Start time:** 11 : 29 (24-hour format)
- Buttons:** OK, Cancel, Help

Figure 6-1. Scheduler Dialog Box

- 2 Select **Immediate** to perform the action immediately or **Scheduled** to schedule it for later.
- 3 If you select **Scheduled**, select **Once**, **Periodically**, **Daily**, or **Weekly**. Enter other information such as day of the week or start time/date, as required.



Note: If you are scheduling an array reconstruct, you can only select the Once option.

- 4 Click **OK** to record the scheduling options. You may be prompted to confirm the activity.

Viewing and Managing Scheduled Activities

You can view information about scheduled and currently running activities in the Array Activity Monitor window. You can abort activities that are running or delete scheduled activities.



Note: When you install Adaptec CI/O Workstation Array Management Software it automatically sets up a daily Test All Spares operation.

Follow these steps to view and manage scheduled activities:

- 1 Select **Activities** from the View menu. The Array Activity Monitor window appears, as shown in Figure 6-2.

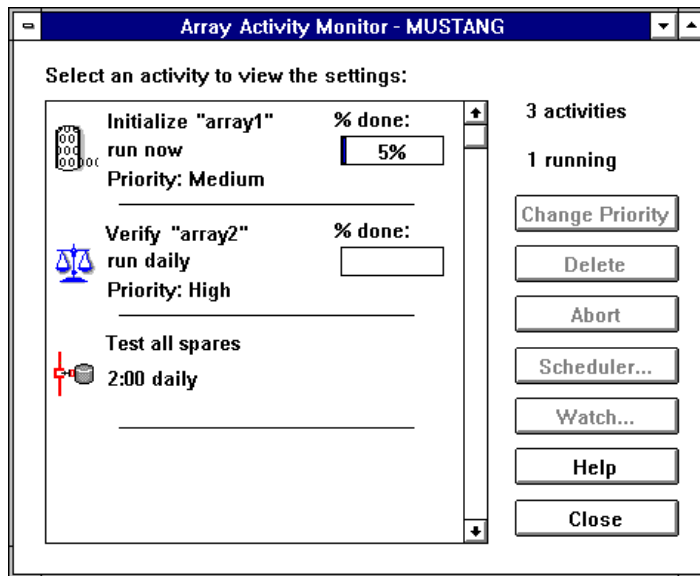


Figure 6-2. Array Activity Monitor Window

- 2 Select an activity icon from the left part of the window. Information about the activity is shown in the window. Each kind of activity has a distinctive icon. The icon labels indicate which array or spare the activity applies to.

To view more detailed information about the activity, double-click the activity icon. The Scheduler dialog box appears, as shown in Figure 6-1. Click **Cancel** to close the dialog box.

- 3 If you want to change the priority of a Verify or Reconstruct operation that is currently running (as indicated by a moving icon), select the activity icon on the left of the window and then click **Change Priority**. When the Change Priority dialog box appears, select an option and click **OK**.



Note: The priority change applies only while the activity is running this time. If it is a regularly scheduled activity, the next time it runs it will have the priority originally assigned to it. You cannot change the priority of an Initialize or Test all Spares operation that is currently running.

- 4 If you want to delete an activity that is *not* currently running, select its icon and click the **Delete** button. After you confirm the command, the activity is deleted from the list.
- 5 If you want to abort a currently-running activity, select its icon and click the **Abort** button. After you confirm the command, the activity stops running immediately. If this is a regularly recurring activity, such as a nightly test of all spares, it will run again in the future at the next scheduled time. Use **Abort** and then **Delete** if you want the activity to never run again.
- 6 Click the **Watch** button to open a small window to monitor the selected, currently running activity. See the following section for more information.

Monitoring Activities that are Running

You can open one or more Watch windows to monitor currently-running array activities. You can leave these small windows open while you continue doing other work on the computer.

When a Verify operation completes, the Watch window shows the total number of mismatches. A *mismatch* occurs when some part of the data on a mirrored disk pair in a RAID 1 array does not match. If you checked the **Auto Correct** box in the Verify dialog box, the mismatches are automatically fixed.

Follow these steps to monitor activities that are running:

- 1 Select **Activities** from the View menu. The Array Activity Monitor window appears.
- 2 Select the icon of a currently-running activity from the scrollable list at the top of the window.
- 3 Click the **Watch** button. A small Watch window for this activity appears, as shown in Figure 6-3. Each window has a percent complete graph and a Status field (OK, Done, Failed). If a Verify operation is running, there is also a field listing the number of mismatches found. Click **Close** to close the Watch window after the activity has completed.

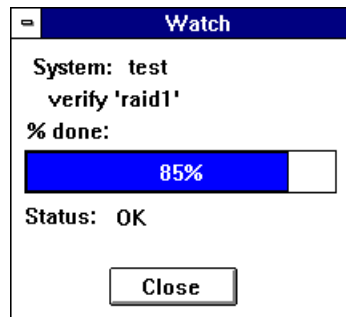
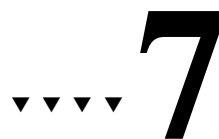


Figure 6-3. Watch Window





Optimizing and Monitoring System Performance

Using Read and Write Caching

Your Adaptec array card has a built-in, onboard Read/Write caching feature that allows faster data I/O to arrays controlled by the card. (Caching is done on the card itself, not on the arrays.)

- A **Read Cache** improves I/O performance by anticipating which data is likely to be read next and keeping that data in cache memory on the array card. When the application actually needs the data, it can read it in much faster from the onboard cache than from disk.
- A **Write Cache** improves I/O performance by temporarily storing data that needs to be written to disk in a cache on the adapter card and then writing it to disk moments later when there is less system activity. (Data can be written much faster to the cache than to the disk.) Moreover, the read performance improves if the application needs to immediately read the data that was just written to the write cache.

Adaptec CI/O Workstation Array Management Software automatically enables Read and Write caching for all arrays controlled by the array card. To achieve the best I/O performance, we recommend that you leave the caching options at their default settings. If you are an advanced user, read the information in this chapter to learn how to change the caching options. This may enable you to achieve additional I/O improvements. You can set the caching options individually for each array controlled by the adapter card.



Note: The Adaptec Web Site at <http://www.adaptec.com/RAID> has some specific tips for optimizing your system's caching configuration.

Follow these steps to enable or disable Read or Write caching for an array controlled by the Adaptec array card:

- 1 Select **Configuration** from the **View** menu. The Storage Configuration window appears.
- 2 Select an array icon and Click the **Operations** button.

Some RAID levels may not support Read/Write caching. Unsupported functionality is grayed out.

- 3 When the Array Operations dialog box appears, click the



button. The Optimize Performance dialog box appears, as shown in Figure 7-1.

Optimize performance - MYCOMPUTER

Total adapter cache:	3072 cache blocks (12288 KB)
Unused adapter cache:	0 cache blocks (0 KB)

Target device: Array1

☒ Caching Enabled

Cache Size:

Cache block size:	Device cache size:
4 KB	3071 cache blocks (12284 KB)

Caching policy:

<input checked="" type="checkbox"/> Read Caching	Advanced...
<input checked="" type="checkbox"/> Write Caching	Advanced...


OK Restore Defaults Cancel Help

Figure 7-1. Optimize Performance Dialog Box



Note: To get an overview of how much Read/Write cache is used and how much is available for *all* arrays controlled by an array card, select an array card icon.



Click the **Operations** button and the  button. (This button is grayed out if caching is not enabled for any arrays.) You will see a list of arrays for which caching is enabled and the cache settings for these arrays. Double-click any array name (or highlight it and click the **Caching...** button) to change its cache settings.

- 4 Read the general information at the top of the Optimize Performance dialog box. This includes the total cache available on the array adapter and the amount of cache that is currently available. (The *Target device* is the name of the array whose icon you chose.)
- 5 Select or deselect the **Caching Enabled** check box. This is the top-level control for all caching on this array. When you enable caching, Adaptec CI/O Workstation Array Management Software assigns default values to the Read and Write Cache.

You can click the **Restore Defaults** button to restore these defaults.
- 6 If you wish, select a Cache block size and a Device cache size in blocks. Read and Write caching options are defined in terms of blocks, not KBytes.
 - The *block* is the basic unit of measurement, in KBytes, for data stored in a cache.
 - The *Cache block size* is the unit of cache memory. The Cache size multiplied by the cache block size equals the physical amount of memory on the array adapter that is used for this system device. For example, if the cache block size is 4 KBytes and there are 256 blocks in the cache, the total cache size is 1024 KBytes.

- 7 If you enabled Caching, you can select or deselect the **Read Caching** and **Write Caching** check boxes. When you select one of these options, the Advanced button is enabled. (See the following two sections if you want to set advanced Read or Write caching options.)
- 8 Click **OK** to enter changes to the caching options.

Setting Advanced Read Caching Options

Do not change the Advanced Read Caching options unless you clearly understand how the changes will affect your system's performance. There are two Read caches: the Demand Cache and the Look-ahead Cache. Options for these caches can be adjusted separately for each array on your system.

- The **Demand Caching** setting defines the maximum Read command size (stated as a number of data blocks) that will be cached. Demand Caching can greatly improve I/O performance if your application typically reads data and then reads it again soon afterwards. For example, if Demand Caching is set to 4 blocks and the operating system issues a Read command for 4 blocks of data, all of the demand data is cached. However, if the operating system issues a Read command for 5 (or more) blocks of data, none of the demand data is cached.
- The **Look-ahead Caching** factor is a multiplier to the command size that defines the maximum number of data blocks that will be stored in the Look-ahead Cache in addition to the amount of data requested by the Read command. Look-ahead caching can greatly improve I/O performance if your application typically reads data in sequential blocks. For example, if Look-ahead caching is set to 16 and the operating system issues a read command, the demand data is cached if the command is less than or equal to 4 blocks, *and* the next (sequential) 16x4 blocks of data is stored in the Look-ahead Cache.

Setting Advanced Write Caching Options

Do not change the Advanced Write Caching options unless you clearly understand how the changes will affect your system's performance. There are two Write caches: the Write-back Cache and the Write-through Cache. Options for these caches can be adjusted separately for each array on your system.

- The **Write-back Caching** setting defines the maximum Write command size (stated as a number of data blocks) that will be cached in the Write-back Cache. When the Write command is issued, the data is quickly written to the cache. When the buffer is needed or when there is free time on the bus, the data is written from the cache to the disk. For example, if Write-back Caching is set to 4 blocks and the operating system issues a command to write up to 4 blocks of data, the data is stored in the Write-back Cache until it can be written to disk. However, if the operating system issues a Write command for 5 (or more) blocks of data, nothing is stored in the Write-back Cache.



Caution: It is possible for data to be lost if the power to the computer is interrupted while the data is in the Write-back Cache, before it is written to disk. To avoid this risk, set this parameter to zero. If you do use Write-back Caching, we recommend that you back up your system data regularly.




- **Write-through Caching** is the same as **Write-back Caching**, except that the data is immediately transferred from the cache to disk before sending the status to the host system. The difference between the Write-back Caching setting and the Write-through Caching setting defines the maximum Write command size beyond which the write data will not be cached at all. The data is written to disk *and* also stored in the cache. This enables faster I/O performance if the application needs to read the data that was recently written. The **Write-through Caching** setting must always be greater than the **Write-back Caching** setting.


Graphing System Performance


Adaptec CI/O Workstation Array Management Software allows you to view dynamically updated performance graphs for the Adaptec array card and for device that the card controls. You can use this information to evaluate your system's I/O performance and, possibly, to improve performance by changing the caching parameters or by distributing the workload between multiple servers.

Follow these steps to view a graph of system performance:

- 1 Open the Storage Configuration window and select the icon of

the array adapter , array , channel , or

disk  whose performance you want to graph. Click the **Operations** button.

- 2 When the Operations dialog box appears, click the  button. The CI/O Profiler window appears, as shown in Figure 7-2.

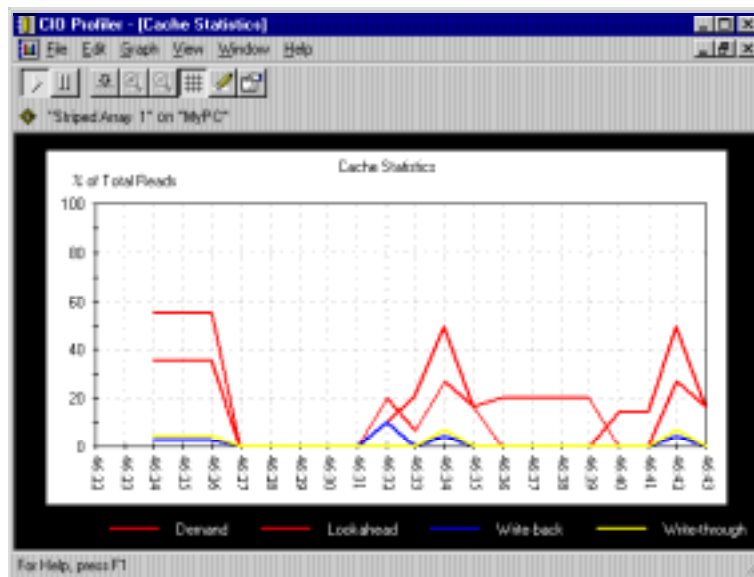










Figure 7-2. CI/O Profiler Window

- 3 View the information on the graph. If you selected an array card, the graph shows information for all devices controlled by the array card. Figure 7-2 shows an area graph for a selected array. The graph displays the percentage of total Read cache hits compared to the total number of read commands.
 - A **Read cache hit** occurs when the operating system issues a Read command for data that is in the Demand cache or the Look-ahead cache.
 - A **Write cache hit** occurs when the operating system issues a Read command for data that is in the Write-back or Write-through cache.
- 4 Perform any of the following operations on the graph (if the toolbar does not appear, select **Toolbar** from the View menu):
 - Pause the updating of the graph by clicking the  button on the toolbar.
 - Resume the updating of the graph by clicking the  button on the toolbar.
 - Toggle the auto-scaling feature on or off by clicking the  button on the toolbar.
 - Zoom in for a closer look at the graph data by clicking the  button on the toolbar, or zoom out by clicking the  button.
 - Toggle the horizontal and vertical graph grid on or off by clicking the  button on the toolbar. (You can toggle the horizontal and vertical grids separately in the **Show** section of the Profiler Graph Properties dialog box, as described on page 7-11.)


- Clear all data from the graph by clicking the  button on the toolbar. The graph will continue updating with new data.
 - Save a graphic image of the current graph to the Windows Clipboard by selecting **Copy Graph** from the Edit menu. You can then paste the image into another application and print it.
- 5 If you want to change the graphing options, such as the type of data displayed or the measurement scale of the data, click the  button on the toolbar and follow the directions in the next section.
- 6 Select **Exit** from the **File** menu to close the CIO Profiler. If you wish, you can select a different array or disk in the Storage Configuration window and open a new graph for that device.

CIO Profiler Performance Tips

CIO Profiler graphs will update more efficiently and use less memory if you follow these tips:

- Use Line and Area graphs with the Hybrid updating option
- Keep the profiler window small to reduce updating overhead.
- Change the display color palette to 256 colors or 16 colors.
- Increase the Update interval to 3, 4, or 5 seconds.

Changing the Graphing Options

To change the graphing options in the CI/O Profiler, click the  button on the toolbar. The Profiler Graph Properties dialog box appears, as shown in Figure 7-3.

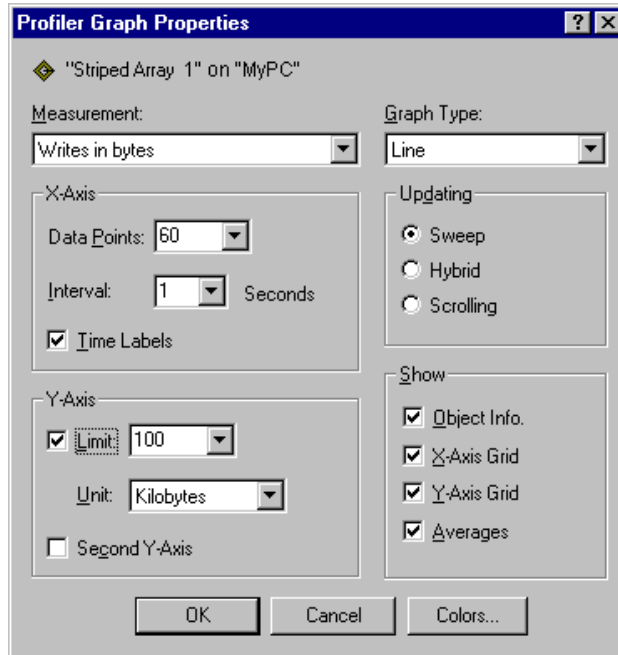


Figure 7-3. Profiler Graph Properties Dialog Box

Here is a brief description of the graph properties you can change in this dialog box.

- **Measurement:** You can select these options from the drop-down Measurements menu:
 - **Cache hits:** select this measurement to display the amount (or percentage) of total Cache hits compared to the total Read commands.
 - **Reads in bytes:** select this measurement to display the total number of Read commands, as measured in MBytes or KBytes, not as a percent.

- **Reads sorted by request size:** select this measurement to display a histogram of the total number of Read commands. The histogram has twelve data points along the horizontal axis (X-axis), ranging from 512 bytes to > 1 MByte. A dynamically changing bar of data above each data point shows the percentage of Read commands in each size category. By observing the histogram, you can see which sizes of Read commands are issued most often. You may be able to use this information to change the size of the Read/Write caches to enable more cache hits.
- **Writes in bytes:** select this measurement to display the total number of Write commands, as measured in bytes, not percent. (You can select either MBytes or KBytes as the scale of measurement.)
- **Writes sorted by request size:** select this measurement to display a histogram of the total number of Write commands. The histogram has twelve data points along the horizontal axis (X-axis), ranging from 512 bytes to > 1 MByte. A dynamically changing bar of data above each data point shows the percentage of Write commands in each size category. By observing the histogram, you can see which sizes of Write commands are issued most often. You may be able to use this information to change the size of the Write caches to enable more Write cache hits.
- **Graph Type:** Depending on which measurement you select, some of the following graph types are available (not all types are available for each measurement):
 - **Line:** shows a simple line graph with a data point every second.
 - **Cluster Bar:** shows a cluster of four small color-coded bars for each data point—one bar representing each of the four caches. (Supported by Cache Hits graph only.)
 - **Stacked Bar:** shows a bar graph with one composite bar for each data point. Data from each cache is represented as a separate, color-coded segment of the bar. (Supported by Cache Hits graph only.)
 - **Area:** (see Figure 7-2) Similar to a line graph, but with the area beneath the line filled in.

- **Histogram:** this is the only supported graph type for **Reads sorted by request size** or **Writes sorted by request size**. (Histograms are described above, under **Measurement**.)
- **Bar:** shows a single, non-composite bar for each data point, representing the total number of Reads and Writes.
- **X-Axis:** You can select these options for the X-Axis (horizontal axis):
 - **Data Points:** the number of data sampling points displayed across the X-axis of the graph. Select a number from the drop-down menu or type a whole number.



Note: The actual display of data points may vary somewhat, depending on the size of the graph on the screen. Data points are fixed at twelve for histograms and cannot be changed.

- **Update Interval:** The interval, in seconds, at which Read and Write data is sampled and updated. We recommend that you select a 2-second update interval. You can type a different whole number or select a number from the drop-down menu.
- **Time Labels:** select the check box to display the time labels below the graph or de-select it to hide them.
- **Show:** select or deselect the check boxes to display or hide the following:
 - **X-Axis grid:** the horizontal grid lines
 - **Y-Axis grid:** the vertical grid lines
 - **Object Info bar:** The Object Info bar, which appears below the toolbar (see Figure 7-2), lists information about the device that is being graphed.
 - **Averages:** only supported by bar graphs. When selected, this option displays a dotted-line, color-coded running average of the data that is displayed on bar graphs.

- **Y-Axis:** You can select these options for the Y-Axis (vertical axis). Not all options are supported for all types of graphs:
 - **Limit:** To limit the maximum range of the Y-axis, select the Limit check box and type or select a maximum number. If you do not set an upper limit, the scale of the axis changes dynamically to adjust to the peak data value shown on the graph. These data “spikes” may make the smaller data values on the graph more difficult to read, so you may wish to limit the upper range of data shown.
 - **Unit:** Specifies the unit of measurement used on the Y-Axis:

If the graph is displaying **Cache hits**, only Percent is supported.

If the graph is displaying **Reads in bytes** or **Writes in bytes**, you can select KBytes or MBytes.

If the graph is displaying **Reads sorted by request size** or **Writes sorted by request size**, only Percent is supported.
 - **Second Y-Axis:** If selected, this option displays a second set of Y-axis labels on the right side of the graph.
- **Updating Options:** You can select the following options to control how the selected graph is updated on the screen:
 - **Sweep:** When this option is selected, data on the graph is filled in starting from the left and moving to the right. When the entire graph is filled in, the data starts in again on the left, overwriting the previous data. A small vertical hash mark at the top of the graph marks the most recently updated data point.
 - **Scrolling:** When this option is selected, data on the graph is filled in starting from the right and scrolling to the left across the graph. Data then scrolls off the left side of the graph and disappears. New data continues to appear on the right.
 - **Hybrid:** This updating option combines elements of Sweep and Scrolling. Data fills in the graph starting from near the right edge, scrolls to the left, and disappears from the screen. The scrolling occurs in such a way that there is usually an open margin on the right side of the graph.

- **Colors:** Click this button to display the Graph Colors dialog box. You can change the background color of the window and the graph. You can also change the colors in which the various kinds of data are displayed in the graph.

Other Performance Tips

- To achieve the best array I/O performance, we recommend that you use disks of the same capacity and same model in an array.
- You can optimize array I/O performance by selecting a RAID level for the array that best meets your needs for data reliability, read/write performance, and capacity utilization. In general, you can achieve the best I/O performance by striping data across several disks in an array. (See *Selecting a RAID Level for an Array* on page 9-4 for more information.)
- You can achieve faster array I/O performance by not connecting slower devices such as tape drives and CD-ROM drives to the same SCSI channel as the array disks.




... 8

Setting Security Options

Adaptec CI/O Workstation Array Management Software has simple but effective password protection to prevent unauthorized changes to array configuration. Users who know the password can view array information *and* can issue commands to add and delete arrays, add and delete spares, and make other changes to array configuration. Users who do not know the password can view array configuration information but cannot change it.

Setting the Initial Password

Follow these steps to set the initial Adaptec CI/O Workstation Array Management Software password after installing the program:

- 1 Double-click the  icon in the Adaptec CI/O Workstation Array Management Software group to start the program.

- 2 Select **Change Password** from the View menu. The Change Password dialog box appears, as shown in Figure 8-1.

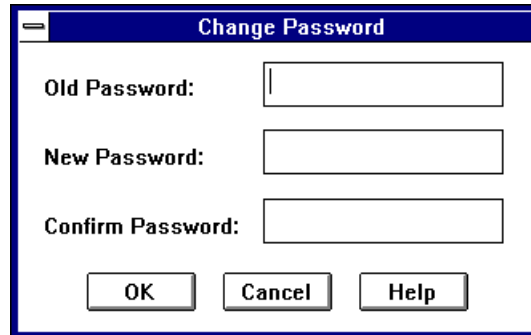
The image shows a 'Change Password' dialog box with a blue title bar. It contains three text input fields labeled 'Old Password:', 'New Password:', and 'Confirm Password:'. At the bottom, there are three buttons: 'OK', 'Cancel', and 'Help'.

Figure 8-1. Change Password Dialog Box

No Old Password is required, because none has yet been defined.

- 3 Type the new password in the New Password field.
Passwords are case sensitive and can be up to 16 characters long, including the characters A-Z, a-z, and 0-9. Spaces are not allowed. Long passwords with a mixture of numerals and letters provide better security. Do not use obvious passwords like your name, the name of a family member, your birthday, your social security number, etc.
- 4 Type the new password again in the Confirm Password field.
- 5 Click **OK** to register the initial password.

Changing the Password

Follow these steps to change the Adaptec CI/O Workstation Array Management Software password:

- 1 Select **Change Password** from the View menu. The Change Password dialog box appears, as shown in Figure 8-1.
- 2 Type the existing password in the Old Password field.
- 3 Type the new password in the New Password field.

Passwords are case sensitive and can be up to 16 characters long, including the characters A-Z, a-z, and 0-9. Spaces are not allowed.


- 4 Type the new password again in the Confirm Password field.
- 5 Click **OK** to accept the new password.

Setting Password Time-out Preferences

The password time-out preferences allow you to control the way in which users are prompted to enter the Adaptec CI/O Workstation Array Management Software password when they issue commands to change the system's array configuration.

Follow these steps to change the Adaptec CI/O Workstation Array Management Software password time-out preferences:



- 1 Click the  button on the toolbar. The Preferences dialog box appears.
- 2 Select one of the three Password Time-out preferences listed on the right of the dialog box. Here is a description:
 - **No Password Time-out:** Requires you to enter the password only the *first time* (during each session) that you issue a command to change array configuration. This option provides less security than the others: if you leave your workstation unattended after entering the password, another person can issue commands from the workstation without being prompted for the password.
 - **Always Require Password:** Requires you to re-enter the password *every time* you issue a command to change array configuration.
 - **Enter Password Time-out Interval:** Requires you to re-enter the password at the stated time-out interval, whenever you issue commands to change the array configuration. For example, suppose that the time-out interval is 10 minutes. You start the program at 9:00 and issue a command to create a new array. You are prompted to enter the password before the command is accepted. After entering the password, you issue a command at 9:05 to add spares

to the spare pool; no password is required. At 9:16 you issue a command to delete an array; since you are beyond the 10-minute interval, you are prompted again to enter the password before the command is executed.

- 3 Click **OK** to accept the password time-out change. You may be prompted to enter the password at this point.



▼▼▼▼ Part 3

Managing Arrays and Spares

Managing Arrays and Spares

This chapter has information on what to do when you need to replace a failed drive, physically reconfigure the disks in your computer, and perform other tasks.

Responding to a Critical Array



A fault-tolerant RAID 1 array enters Critical status if one disk in the array fails. The array continues to operate normally, but you will lose data if another disk in the array fails.


If a spare disk is available, the array management software will reconstruct the Critical array automatically. When the reconstruct is complete, the array returns to Fault-tolerant status. If no spare disk is available, you should respond immediately to minimize the possibility of data loss. The most effective strategy is prevention: be sure that arrays are always protected by a spare pool or by dedicated spares!


In addition, you should monitor the status of arrays at all times with Adaptec CI/O Workstation Array Management Software to detect arrays whose status is Critical. You can tell that an array is in critical status if its icon in the Storage Configuration window looks like this



Follow these steps to return a Critical array to Fault-tolerant status:

- 1 Click the array icon  and observe the disk icons of the array members on the left of the screen. One of the icons should look like this , indicating that the disk has failed.

- 2 Click the  icon and then click the **Operations** button.

- 3 When the Drive Operations window appears, click the  button to blink the drive light on the failed disk.

- 4 Observe which drive light is blinking. This is the disk that you need to replace. If no lights are blinking, this could mean one of the following:

- a The disk is still connected but has failed so badly that it cannot respond to the Blink command. Try blinking the drive lights of the array disks that have not failed. You may be able to determine by a process of elimination which disk has failed.
- b The disk has been removed or its power cord or SCSI cable has been disconnected.

If an array disk has been disconnected or removed but the computer has not been rebooted, the icon for this disk will still appear in the Storage Configuration window. If you know that the disk was disconnected accidentally and has not actually failed, reconnect the drive, issue a Rescan command, and reconstruct the array.

If the computer has been rebooted since the disk was disconnected, the disk icon will not appear. To determine if a disk is "missing" from an array, double-click the array icon, and read the Status field at the top of the Array Information dialog box. If this field says Missing member, a disk is missing from the array.

- c The disk does not have an LED that indicates I/O activity.


- 5 Pause I/O to the array before you continue.



Note: If the array disks are mounted inside the computer case, do not use the Pause I/O feature. Instead, shut down the computer and disconnect the power. Then open the computer, replace the bad disk, replace the computer cover, and reconnect the power.


- 6 Replace the failed disk with a good disk, or replace the missing disk. (If you paused I/O, be sure to complete this step before the pause period expires.
- 7 After I/O resumes automatically, select the icon of the new disk, and issue a Create a Spare command.
- 8 When the spare has been created, select the array icon and issue a Reconstruct command, if necessary (it is possible that the reconstruct will start automatically at this point).

When the reconstruct is completed the array is in Fault-tolerant sta-

tus again, and the array icon will look like this .

Responding to an Off-line Array

You can tell that an array is in off-line status if the array icon in the

Storage Configuration window looks like this: . There are several reasons for an array going off-line, as described below:

- Both disks of a mirrored pair in a Critical RAID 1 array have failed.

If this happens, delete the off-line array, create a new array, and restore the data from your most recent backup. You cannot recover the array data if a second disk fails.

- You were trying to replace a failed disk in a Critical RAID 1, array, but you mistakenly removed the wrong disk.

If this happens, reinsert the drive you mistakenly removed and issue the Reactivate Array command, which returns the array

to Critical status. Then replace the correct disk and reconstruct the array.

- A cable to a good drive in a RAID 1 array accidentally became disconnected, and the other disk of the mirrored pair had already failed.

If this happens, reconnect the cable, and use the Reactivate Array command to return the drive to Critical status. Then replace the failed disk and reconstruct the array.

Selecting a RAID Level for an Array

RAID means Redundant Array of Independent Disks. An *array* is a grouping of disks that, by means of array management software, appears to the computer's operating system as one large disk. Part of the storage capacity of most kinds of arrays contains redundant information about the user data on the array¹. If an array disk fails, the contents of the disk can be regenerated on a new disk from the redundant information on the other array disks.

Compared with single disks, arrays can provide one or more of these benefits:

- improved Read and Write I/O performance by striping data across the disks in the array. This allows data to be read from or written to two or more disks simultaneously.
- improved data reliability by storing redundant data to regenerate a failed array disk, as described above. (This applies to RAID 1 arrays; RAID 0 arrays do not store redundant data.)
- improved capacity utilization by allowing you to manage a large number of disks as if they were one large disk. This can simplify the tasks of backing up data, creating directories, etc.

All disks of an array (including spares) must be connected to SCSI channels controlled by the same Adaptec array card. You can create dedicated spare disks for each RAID 1 array. You can also create a pool of spares that can be used by any RAID 1 array controlled by the Adaptec array card.²

¹ RAID 0 arrays, which do not store redundant data, are an exception to this definition.

² A disk in a spare pool can only be used to replace a failed disk in an array if it is at least as large as the smallest disk in the array.

The array management software and firmware support RAID 0 and RAID 1 arrays. The advantages, disadvantages, and requirements of these RAID levels are as follows:

RAID 0 Arrays

Maximum Disks Allowed: 16³

Minimum Disks Allowed: 1⁴

In a RAID 0 array, data is distributed, or striped, across the disks in the array. The capacity of the array is approximately equal to the combined capacity of the physical disks. The I/O performance of a RAID 0 array is much better than that of a single physical disk because multiple reads and writes can be handled in parallel and because when large files are accessed the striped data is retrieved simultaneously from several disks.

RAID 0 arrays do not store redundant data and therefore are not true RAID applications. If one disk fails, the entire array fails and all data is lost. This means that the fault tolerance of a RAID 0 array is less than that of any single disk in the array. The term RAID 0 is widely used for these arrays, however, because they are conceptually similar to true RAID applications.

RAID 1 Arrays

Maximum Disks Allowed: 2

Minimum Disks Allowed: 2

RAID 1 arrays use a single pair of disks. They are called *mirrored* arrays because both disks in the pair contain the same data. When data is written to a RAID 1 array it is written to each disk in the pair. The read performance of a RAID 1 array can be much better than that of a single disk, while the write performance is slightly worse. Mirrored arrays are highly reliable because the data is still safe if one disk in the pair fails. They are more costly, however, because you only get one disk of actual storage capacity from the pair of disks.



³ The maximum would be 15 disks if the system has a single SCSI channel.

⁴ One-disk RAID 0 arrays are used only to control the virtual device order of single disks.



Configuration Settings

This appendix describes the configuration variables that control the appearance of the Adaptec CI/O Workstation Array Management Software user interface and the way in which array and system operations are carried out. The variables controlling the *ArrayConfig* program are the *arconfig.ini* file. The variables controlling the user interface appearance are in the Windows NT registry. The other variables are defined in a file called *iomgr.ini*.

Many of the variables are configured for you once you install the software or start the program. If you are an advanced user and you want to customize your settings, you can edit the variables in the NT registry, or you can open *iomgr.ini* or *arconfig.ini* in a text editor and manually make changes.

arconfig.ini

The *arconfig.ini* file is located on the ArrayConfigCA diskette. The variables in this file are described below. Variables and their values are not case-sensitive.

ExpressSetup=

When set to **Yes** (the default) this variable causes the Express Setup wizard to be displayed when ArrayConfigCA starts. When set to **No**, the Custom Setup Main Menu appears when ArrayConfigCA starts.

WriteSame=

This variable, when enabled, can speed up the formatting of array disks in some systems when you create a new array. By default, the line WriteSame=Yes is included in the arrayconfig.ini file, but it is remarked out and therefore disabled. If you want to enable WriteSame, open *arconfig.ini* in a text editor, delete the letters rem at the beginning of the line, and save the file. The next time you create an array, it should take less time to format the disks.

SparePool=

This variable enables or disables the option of creating a spare pool in ArrayConfigCA. This variable should be set to **No**, because this version of ArrayConfigCA does not support spare pools. (You can create a spare pool with Adaptec CI/O Workstation Array Management Software.)

iomgr.ini

The *iomgr.ini* file is located in the directory in which Adaptec CI/O Workstation Array Management Software is installed. The section name, for example [ARRAYOPERATIONS], and the variables under each section are described below.

[ARRAYOPERATIONS]

RecreatePriority=

This variable specifies the priority of the automatic Reconstruct operation. Valid values are Low, Medium, or High. The default is *Medium*.

VerifyIfDirty=

This variable specifies whether you want to start the Verify operation if the array is dirty (the array was not shut down properly). Valid values are Yes or No. The default value is *No*.

DriverMonitoringFrequencyInSecs=

This variable specifies the maximum interval in seconds before Adaptec CI/O Workstation Array Management Software polls the driver. Any number of seconds can be specified; small values may affect performance, large values (greater than 10 seconds) may affect responsiveness to problems. The default value is *5*.

[SYSTEM]

PauseEnabled=

This variable specifies whether the Pause I/O capability is enabled or disabled. Valid values are Yes and No. The default value is *Yes*.

ServerLogSizeInMegabytes=

This variable is used to limit the size of the Historical Log database file. The database will be truncated if it grows beyond the size specified by the parameter. The size can be specified in increments of 1 MByte, up to a maximum of 10 MBytes.

StatisticsCollectionInterval=

This variable specifies the interval at which system statistics will be collected, assuming that the driver supports statistics collection. Values must be entered as whole numbers. The default value is *1*.

WarnAfterFirstPFAEvent=

If set to **Yes**, this variable specifies that if SMART events (PFA) are received from any drive the first event will be reported as a Critical

event and all events after that will be reported as Warning events. If set to **No**, all SMART events will be reported as Critical. The default is **Yes**.

[TASKS]

TestAllSpares=

This variable schedules the TestAllSpares operation. These jobs are not written to the Scheduler Database and are scheduled every time *iomgr.exe* is started. The default setting is to test all spares at 2:00 A.M. daily. Valid values are

- **Yes,H**—Starts test every hour on the hour. For example, TestAllSpares=Yes,H
- **Yes,D,Time**—Starts test daily at a specified time, stated in 24-hour time format. For example, TestAllSpares=Yes,D,11:34.
- **Yes,W,Day of the week,Time**—Starts test weekly at a specified day and time (Day of the week: 0=Sun, 1=Mon, 2=Tues., etc.). For example, TestAllSpares=Yes,W,2,11:34 (starts every week on Tuesday at 11:34).
- **No**—No tests are scheduled. For example, TestAllSpares=No.

[CAPABILITIES]

EnableRAID5=

This variable enables or disables the option of creating RAID 5 arrays. This version of Adaptec CI/O Workstation Array Management Software does not support RAID 5 arrays, so this variable should always be set to **No**.

EnableRAID10=

This variable enables or disables the option of creating RAID 0/1 arrays. This version of Adaptec CI/O Workstation Array Management Software does not support RAID 0/1 arrays, so this variable should always be set to **No**.

User Interface Variables

The Adaptec CI/O Workstation Array Management Software user interface variables are located in the Windows NT registry under *HKEY_LOCAL_MACHINE\SOFTWARE\Adaptec\Adaptec CI/O Array Management Software*:

- Config Path: REG_SZ: configs.dat
This is the storage path for the configuration file.
- Display Activity: REG_DWORD: 0
If the value is non-zero, the application will display the Activity Monitor window on startup.
- Display Config: REG_DWORD: 0x2
If the value is non-zero, the application will display the Storage Configuration window on startup.
- Display Server Log: REG_DWORD: 0
If the value is non-zero, the application will display the Historic Event Log window on startup.
- Display Server View: REG_DWORD: 0
If the value is non-zero, the application will display the Server View window on startup. (This is not applicable to the desktop version of Adaptec CI/O Workstation Array Management Software.)
- End Date: REG_SZ: 12/31/1999
- End Time: REG_SZ: 23:59:59
- Notifications: REG_DWORD: 0
Popup Box is 0x1, Beep is 0x2, Flash Titlebar is 0x4, and None is 0x0. These values may be OR'ed together.
- Server Name: REG_SZ:
- Severity: REG_DWORD: 0xd
Informational is 0x1, Warning is 0x4, and Critical is 0x8. These values may be OR'ed together.
- Start Date: REG_SZ: 1/1/1990
- Start Time: REG_SZ: 00:00:00



▼▼▼▼ Index

(AC) = task done in *ArrayConfigCA*
(NT) = task done in Adaptec CI/O Workstation Array Management Software

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