



AMD-RAIDXpert2 User Guide – Socket SP3 Compatible Processors

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|---------------|-----------------------|-----------|-------------|
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Revision History

| Date | Revision | Description |
|----------------|----------|--|
| September 2017 | 1.01 | NVME RAID validation update. |
| June 2017 | 1.00 | Initial Release. Information moved from 53987 for better manageability. |

Preface

This user guide:

- Provides information about arrays, disks, and RAID levels (RAID types).
- Describes how to improve storage system performance or reliability by understanding array and disk tasks and options.
- Describes how to acquire and load RAIDXpert2 drivers for Windows® 10: 64 bit and later operating systems.
- Describes the features and procedures for using RAIDXpert2, which is the RAIDXpert2 Web GUI.

Intended Audience

This user guide is intended for use by system administrators and technicians who are experienced with the following:

- Direct Attached Storage (DAS), Storage Area Network (SAN), or Network Attached Storage (NAS) operators
- Network administration
- Network installation
- Storage system installation and configuration

Prerequisites

Prerequisites for installing and configuring this product include familiarity with:

- Servers and computer networks
- RAID and input/output signal technology (such as SCSI, SATA, or NVME)
- Fibre Channel and Ethernet protocols

Document Conventions and Symbols

Table 1. Document Convention

| Convention | Element |
|---|--|
| Navy blue, underlined text (http://www.example.com) | Web site addresses |
| Bold font | Key names Text typed into a GUI element, such as into a box GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes |
| Italics font | Text emphasis |
| Monospace font | File and directory names System output Code Text typed at the command line |
| Monospace, Italic font | Code variables Command line variables |
| Monospace, bold font | Emphasis of file and directory names, system output, code, and text typed at the command line |

Customer Support

For customer support, contact your system supplier or motherboard vendor.

Glossary

Table 2. Glossary of Terms

| Term | Definition |
|-------------|--|
| readm | A command line interface (CLI) tool for managing RAID controllers on Windows®, and UEFI operating systems. It is used for creating, transforming, and deleting arrays; and adding and removing disks. |
| Legacy disk | Legacy disks include new or unrecognized disks which may contain data or even an operating system. Legacy disks appear in the BIOS Configuration Utility and in RAIDXpert2 as legacy arrays. When the legacy disk is initializing, configuration data is written to the disk. The legacy array then becomes an online disk usable in arrays. CAUTION: A legacy disk can contain valid data. When a legacy disk is initialized, all data on the disk is lost. |

Chapter 1 Safety Precautions

1.1 General

This section includes general safety precautions and specific RAIDXpert2 cautions. Read and keep this user manual for future reference.

1.2 Safety Definitions

CAUTION: Indicates that failure to follow directions could result in damage to equipment or data.

IMPORTANT: Provides clarifying information or specific instructions.

Note: Provides additional information.

TIP: Provides helpful hints and shortcuts.

1.3 Caution Messages

This section lists the Caution messages that appear in the book.

1.3.1 Caution Messages About Disks

CAUTION: Assigning a dedicated spare does not reserve space on the disk. Therefore, an automatic restore is not guaranteed if a disk fails. If a disk fails, make space on the disk for the fail-over to complete, or assign a different disk with enough space. If a dedicated spare is assigned and a disk fails, the restore process starts automatically, if there is enough space available on the dedicated spare.

CAUTION: If a disk is part of an AMD-RAID array, the disk cannot be selected for initialization. To initialize the disk anyway, delete the AMD-RAID array. Data on the disk is deleted during initialization so ensure the correct disks are chosen to initialize.

CAUTION: A legacy disk can contain valid data. When a legacy array is deleted, or when its corresponding legacy disk is initialized, the data is lost.

CAUTION: When a disk is initialized, all data on the disk is lost.

1.3.2 Caution Messages about Arrays

CAUTION: Deleting an array permanently destroys all data that is on the array. This action cannot be undone and it is very unlikely the data can be recovered.

CAUTION: Do not delete the first array listed in the Arrays section, if it is the AMD-RAID bootable array. Doing this deletes the operating system and AMD-RAID files.

CAUTION: Do not initialize a disk that is part of an array. Initializing a disk in a non-redundant array deletes the array and its data. The array no longer appears in Array View. This is especially true for a non-redundant bootable array. Initializing a disk in a non-redundant bootable array causes the array to Fail and deletes the operating system, AMD-RAID files, and device drivers.

CAUTION: Leaving Write Back Cache enabled can increase the likelihood of data being corrupted if the system experiences a power interruption or unexpected shutdown.

CAUTION: Prior to removing an array, remove its drive letter.

CAUTION: All data contained in a AMD-RAID array are lost if the RAIDXpert2 disks of the array are migrated to a non-AMD-RAID system.

CAUTION: When an array is securely erased, the data on the array is lost.

CAUTION: In some circumstances, more than eight arrays are possible. They might appear to function properly, but are not supported.

CAUTION: Creating a redundant array with Skip Initialization selected can result in data corruption.

CAUTION: Hot-Swapping is not recommend for disks that are part of AMD-RAID array.

CAUTION: Socket SP3 compatible processors supports maximum of 14 SATA ports on the system depending on customer platform design (8 from PT SATA controller, 6 from AMD SATA controller including devices connected to M.2 port).

CAUTION: Max port that can be used for Creating/Transforming a Volume, RAID-0 and RAID-10 arrays, is 8.

CAUTION: RAID on M.2 port supports both AMD SATA controller and PCIe M.2 NVME. At any given time each M.2 port can support either M.2 SATA or M.2 NVME, but not both.

CAUTION: Individual disks which are not part of a RAID array will not be listed in the Device Manager under the Disk Drive section. Individual Disks can be managed through RAIDXpert2 web utility, HII, efi shell.

Chapter 2 Getting Started

2.1 RAIDXpert2 Technology

RAIDXpert2 consists of (a) storage management and (b) a RAID controller and port virtualization. RAIDXpert2 runs on existing systems by using a motherboard's built-in SATA port, PCIe M.2 slots and PCIe NVME Addin-cards.

2.2 Who Should Use This Manual

Only trained, experienced, and authorized personnel should install RAIDXpert2 and use its features and capabilities.

All unit operators must be familiar with system hardware, data storage, RAID technology, input/output signal technology (such as SCSI, SAS, or SATA), and Direct Attached Storage (DAS), Network Attached Storage (NAS), and/or Storage Area Network (SAN) concepts and technology.

The intended user audience of this user manual is system administrators and experienced users.

2.3 System Requirements for Using RAIDXpert2

Make sure the systems that use RAIDXpert2 meet the requirements indicated in Table 3.

Table 3. System Requirements for RAIDXpert2

| Component | Requirements |
|--------------|--|
| Memory (RAM) | Minimum:8 GB. Recommended: 16 GB or higher. |
| Hard disk | 1–14 SATA or SSD or M.2 SATA drives or NVME M.2 or NVME HHHH. The number of disks depends on the number, type, and capacity of the arrays to be created. |

2.3.1 Supported Controllers

The following controller is supported by the current release of RAIDXpert2:

- AMD Socket SP3-Compatible Processors

2.3.2 Supported Operating Systems

RAIDXpert2 currently supports the following operating system:

- Microsoft Windows 10: 64 bit

2.4 Features of RAIDXpert2

The features of RAIDXpert2 described in this user manual apply to all license levels and supported operating systems.

Table 4 describes these features. Also see Table 5, on page 20, for a summary of features that are available with the RAIDXpert2 Basic license.

Table 4. Features of RAIDXpert2

| RAIDXpert2 Feature | Description |
|------------------------------|---|
| Arrays (general information) | <p>RAIDXpert2 allows:</p> <ul style="list-style-type: none">• Creating arrays of different RAID levels using the same disks.• Creating different RAID level arrays on the same disk, to adapt each array to the I/O that it processes.• Creating an array from a mix of different type disks. For example, a RAID10 array can be created from a group of disks that contain two SATA II HDDs and two SATA SSDs or only on NVME or group of SATA and NVME disks.• Migrating an existing array to another RAID level, if the type of array being used is not the optimal type for the application. This function depends on the array capacity, redundancy level and RAIDXpert2 license level.• An array refers to data storage created by RAIDXpert2 from one or more disks. Although an array can be created from several disks, it is seen by the operating system as a single disk. |
| Array Hiding | An array can be hidden from the operating system so that neither the software nor users can see or access it. |

Table 4. Features of RAIDXpert2 (Continued)

| RAIDXpert2 Feature | Description |
|---------------------------------------|--|
| Array Recovery | If an array is accidentally deleted, it might be recovered by creating a new array with the same properties as the deleted array. (This can occur only if disk Write Access operations are not in-progress.) |
| Background Array Initialization (BGI) | The background initialization of a redundant array creates the redundant data that allows the array to survive a disk failure. Background initialization allows a redundant array to be used immediately. Data is not lost if a disk goes offline prior to completion of the BGI process. |
| Cache Support for Arrays | Various array-caching options are supported: No Cache, Disk Read Ahead Cache, Write Back Cache, Read + Write Back Cache. <i>Note: For best performance on NVME array it is recommended to set Read Cache to No Cache while array creation.</i> |
| Cache Support for Disks | Various disk-caching options are supported: No Cache, Disk Read Ahead Cache, Disk Write Back Cache, Disk Read Ahead + Write Back Cache. <i>Note: As default setting, NVME Physical disk Read and Write cache is disabled always. User cannot enable the setting as it may impact the operational performance of the NVME disk</i> |
| Secure Erase | All data on an array can be erased and ensured it is unrecoverable, even with advanced data recovery techniques. |
| Consistency Check | A Consistency Check is a background operation that verifies and corrects the mirror or parity data for fault-tolerant disks. It is recommended that a Consistency Check be run periodically on an array. |
| Disk Roaming | With disk roaming, SATA cables can be disconnected from their disks and shuffled without confusing RAIDXpert2. <i>Note: Disconnect the SATA cables from the disks only when the system is shutdown.</i> Disk roaming also allows: <ul style="list-style-type: none"> • Disks to be moved to different slots in the backplane. RAIDXpert2 detects which disks belong to which arrays, regardless of where the disks are moved in the backplane. • Disk(s) to be moved between systems. <i>Note: It might not be possible to move disks between systems if they contain boot arrays.</i> |
| Fault Tolerance | The following fault tolerance features are available with RAIDXpert2, in order to prevent data loss in case of a failed disk. <ul style="list-style-type: none"> • Disk failure detection (automatic). • Array rebuild using hot spares (automatic, if the hot spare is configured for this functionality). • Parity generation and checking (RAID5 only). • Hot-swap manual replacement of a disk without rebooting the |

Table 4. Features of RAIDXpert2 (Continued)

| RAIDXpert2 Feature | Description |
|---|---|
| | <p>system (available only for systems with a backplane that supports hot-swapping) is not recommend for disks that are part of the Boot Virtual Disk.</p> <p>For example if a disk fails in RAID1, the array remains functional and data is read from the surviving mirrored disk.</p> |
| Mirror Rebuilding | A broken mirrored array can be rebuilt after a new disk is inserted and the disk is designated as a spare. The system does not have to be rebooted. |
| Multiple RAID Levels per Disk | Support for multiple array levels per disk allows the administrator to create arrays of different RAID levels using the same disks. |
| Native Command Queuing (NCQ) | Native Command Queuing is a command protocol of disks that are supported by RAIDXpert2. NCQ enables individual disks to internally optimize the order in which Read and Write commands are executed. RAIDXpert2 permits a queue depth of up to 32 read/write commands per disk. |
| Online Capacity Expansion (OCE) | <p>OCE is a process that allows the user to add storage capacity to an existing array, without taking the system offline. OCE enables the user to increase the total storage capacity of an array by integrating unused storage into the array.</p> <p>Data can be accessed while the disks are added and while data on the array is being redistributed.</p> |
| Online RAID Level Migration (ORLM) | With online RAID level migration, users can easily move an array from one RAID level to another. While the migration is taking place, data is accessible and protected to the lowest protection of either the source RAID level or the destination RAID level. |
| RAID Level Support | RAIDXpert2 supports RAID levels 0, 1, 10, Volume, and RAIDABLE. |
| Self-Monitoring Analysis and Reporting Technology (SMART) | SMART is a hard-disk-drive (HDD) capability which allows reporting of reliability information. If a drive anticipates there is a high likelihood of future failure it triggers a SMART error condition. RAIDXpert2 presents this error condition so the drive can be replaced before the predicted failure occurs. |

2.5 RAIDXpert2 Feature Set

IMPORTANT: The supported feature set for RAIDXpert2 Basic is determined by the license level that is included in the system BIOS

Table 5. Feature Set for RAIDXpert2: by RAIDXpert2 License Level

| | | License Level |
|------------------------------------|--|------------------|
| Features | Sub-Features | RAIDXpert2 Basic |
| UEFI Driver (BIOS) Support | Create array | Yes |
| | Delete array | Yes |
| | Raidxpert2 Configuration utility (HII) | Yes |
| | efi Shell utility | Yes |
| RAID Levels Supported ² | 0 | Yes |
| | 1 | Yes |
| | 5 | No |
| | 10 | Yes |
| | RAIDABLE | Yes |
| | Volume | Yes |

Table 5. Feature Set for RAIDXpert2: by RAIDXpert2 License Level (Continued)

| | | License Level |
|---|---------------------------|------------------|
| Features | Sub-Features | RAIDXpert2 Basic |
| Array Creation | No initialization | Yes |
| | Foreground initialization | Yes |
| | Background initialization | Yes |
| Array Deletion | | Yes |
| Array Transformation | | Yes |
| Sparing | Global | Yes |
| | Dedicated | Yes |
| Consistency Check | Background | Yes |
| | Scheduled | Yes |
| Online Capacity Expansion (OCE) ³ | | Yes |
| Online RAID Level Migration (ORLM) | | Yes |
| Drive/Disk Roaming ⁴ | Same-system support | Yes |
| | Between-systems support | Yes |
| RAIDXpert2 Web GUI (Management GUI) | | Yes |
| rcadm (management CLUI) | | Yes |
| Drive Interfaces Supported ⁵ | SATA (Gen1,Gen2,Gen3) | Yes |
| | SSD | Yes |
| | M.2 SATA SSD | Yes |
| | M.2 NVME SSD | Yes |
| | HHHL NVME SSD | Yes |
| Dissimilar Disk Support Within The Same Array | | Yes |

Table 5. Feature Set for RAIDXpert2: by RAIDXpert2 License Level (Continued)

| | | License Level |
|---|----------------------------|------------------|
| Features | Sub-Features | RAIDXpert2 Basic |
| Cache Support | No Cache | Yes |
| | Read Cache | Yes |
| | Write Back Cache | Yes |
| | Read with Write Back Cache | Yes |
| Create Array and Delete Array Functions Without Rebooting | | Yes |
| Restore (Rebuild) Priority | | Yes |
| Multiple RAID Levels per Disk ⁶ | | Yes |
| Touched Region Logging ⁷ | | Yes |
| E-mail Event Notification | | Yes |
| System Event Log Integration | | Yes |
| Instant Create Support ⁸ | | Yes |
| Hot-Swap Support ⁹ | | Yes |

Notes:

1. *At the AMD RAIDXpert2 Configuration Utility (HII) arrays can be created or deleted, Array or physical disk information can be displayed, assign Global or Dedicated spares and Critical or Offline arrays are indicated.*
2. *See Chapter 3, Arrays, Disks and RAID Levels, on page 24, for detailed information about understanding arrays, RAID levels, and performance and reliability considerations.*
3. *The unique ability of RAIDXpert2 to provide online expansion to RAID levels across multiple disks becomes extremely valuable when expanded storage is a requirement.*
4. *Disk roaming allows arrays to be moved from port to port, either within the same system or between systems.*
5. *See the system's motherboard specifications for the supported device interface.*
6. *Multiple RAID levels (array types) per disk allows the administrator to create different RAID levels on the same disks. For example: The administrator wants data redundancy for the user data, and creates a RAID5 set using part of the disks' data. At the same time the administrator wants performance for the swap spaces, and creates a RAID0 array using the rest of the disks' capacities (space). This feature is useful in collecting unused capacity from disks with different capacities. This feature increases data integrity for redundant array types, by logging areas of an array that have been written to. In the event of a system crash, the logged area's consistency is checked and/or corrected. Without this feature, data corruption might occur.*
7. *Arrays can be instantly created and used by skipping the background consistency check. For certain types of redundant arrays this is a viable option and has no data integrity drawbacks. A consistency check can always be done at a later time. If an initialization is skipped when using RAID5, the array is not redundant until a consistency check is performed.*
8. *It is not recommended to add a Disk to the system or array, while the system is operating.*

Chapter 3 Arrays, Disks and RAID Levels

3.1 Understanding Arrays

Arrays are several disks that are grouped together to improve either the performance or reliability of a storage system. Because some RAID levels enhance performance while others improve reliability, it is important to consider the user's needs when planning an array configuration.

***Note:** It is highly recommended that this user manual be reviewed in its entirety before configuring arrays. Some of the advanced features of RAIDXpert2 (such as sparing options) must be understood by the user before creating arrays.*

3.2 RAID Levels

RAIDXpert2 supports the RAID levels indicated in Table 6.

Table 6. RAID Levels – General Characteristics

| RAID Level | Main Characteristic | Use/Usefulness |
|-------------------|---|--|
| RAID0 (Striping) | <ul style="list-style-type: none">Provides the highest performance but no data redundancy. Data in the array is striped (distributed) across several disks.Supports 2-8 disks. | RAID0 arrays are useful for holding information, such as the operating system paging file, where performance is extremely important but redundancy is not. |
| RAID1 (Mirroring) | <ul style="list-style-type: none">Mirrors data on a partition of one disk to another.Supports 2 disks. | Useful when there are only two disks available and data integrity is more important than storage capacity. |

Table 6. RAID Levels – General Characteristics (Continued)

| RAID Level | Main Characteristic | Use/Usefulness |
|-------------------------------------|---|--|
| RAID10 (Striped RAID1 Sets) | <ul style="list-style-type: none"> Combines mirrors and stripe sets. RAID10 allows multiple disk failures, up to 1 failure in each mirror that has been striped. Supports 4, 6, or 8 disks. | <p>Offers better performance than a simple mirror because of the extra disks.</p> <p>Requires twice the disk space of RAID1 to offer redundancy.</p> |
| Volume (JBOD) | <ul style="list-style-type: none"> RAIDXpert2 treats one or more disks or the unused space on a disk as a single array. Supports 1 to 8 disks | <p>Provides the ability to link-together storage from one or several disks, regardless of the size of the space on those disks.</p> <p>Useful in scavenging space on disks unused by other disks in the array.</p> <p>Does not provide performance benefits or data redundancy. Disk failure will result in data loss.</p> |
| RAIDABLE (also known as RAID Ready) | <ul style="list-style-type: none"> Allows a RAIDABLE disk to be transformed later to RAID0 or RAID1. Supports one disk. | See RAID0 (Striping), on page 24 or RAID1 (Mirroring) on page 24 for post-transformation usefulness. |

3.3 Array States

Within the management applications, an array is a logical device that can exist in one of four states: Normal, Ready, Critical, or Offline.

- In RAIDXpert2, these states display in the Array List section in a column named State.
- Within the readm Command Line tool, these states also display in a column named State.

The array states are defined in Table 7, on page 26.

Table 7. Array States

| State | Description |
|----------|---|
| Normal | The Normal state is displayed when everything is functioning correctly. |
| Ready | The Ready state is displayed while an array is being created. |
| Critical | The Critical state is displayed when the array is no longer redundant (fault tolerant) because of one or more disk failures. Arrays can still be read and written to, but the data is no longer protected should another disk fail. |
| Offline | The Offline state is displayed when arrays cannot be read or written to because of one or more disk failures. |

Whether an array is marked as Critical or Offline depends upon what RAID level it is and how many disks within the array have failed. Note the changes in state in Table 8.

Table 8. Failure States by RAID Level

| RAID Level | This Failure State | Is Displayed Whenever |
|--|--------------------|---|
| RAID1 (Redundant Arrays) | Critical | A single disk fails. |
| | Offline | Two or more disks fail. |
| RAID10 (RAID Levels with Multiple Redundancies) | Critical | A single disk fails in any one of the sets. |
| | Offline | All disks in a set fail. |
| Volume and RAID0 | Offline | A single disk fails. |

More than one array can be created using the same set of disks. If a disk is disconnected that belongs to more than one array, only the arrays that try to access the disk and receive I/O errors report the failure. For example: there are two arrays, both of which are RAID5 sets, and both use disk 4. If a system that is being used by array 1 receives an I/O error when trying to communicate with disk 4, the state of array 1 changes to Critical. However, the state of array 2 using disk 4 does not change to Critical until an I/O error is reported. If systems using array 1 are not communicating with failed disk 4, the state of array 1 still displays as Normal.

If a rescan of all channels is performed after disconnecting a disk, the state of every array using the missing disk changes from Normal to either the Critical or Offline, depending on the RAID level.

See Section 3.9, Rescanning Disks for Changes in State, on page 30 for a discussion of when to rescan disks and the outcomes when doing so.

3.4 Creating Arrays: Future Expansion

When creating arrays, consider whether disk capacity needs to expand in the future. If the file system must be expanded, perform the tasks indicated in Table 8.

Table 9. Array Expansion Considerations

| Operating System | Do This... | And Consider This... |
|---------------------|--|--|
| Microsoft® Windows® | Format the arrays with NTFS. Microsoft Corporation provides a utility (Diskpart.exe) that can dynamically extend an NTFS file system onto any unused adjacent space. Note also that using a single partition per array makes expansion much easier. | 1. The Diskpart.exe utility version depends on which version of the Windows operating system is running. 2. The Diskpart.exe utility can be found on the CD for some versions of Windows operating systems, or on the Microsoft Corporation website (http://www.microsoft.com) for other versions. Use the correct version for the operating system. |

3.5 Expanding Disk Capacity Online: Using OCE

Online Capacity Expansion (OCE) allows:

- Adding disks to an array at any time to increase an array's capacity.
- Accessing the array data while it is being redistributed.

To increase the size and organization of an array, transform the array. For more information about transforming arrays, see Section 7.6.3, Transform Arrays on page 67.

3.6 Migrating RAID Levels Online: Using ORLM

Online RAID Level Migration (ORLM) allows an array to move from one RAID level to almost any other RAID level. This task includes migrating the array from a non-redundant RAID level to a redundant RAID level.

Prior to starting a RAID level migration/transformation, make sure that the disks selected for the destination array have sufficient capacity. RAID level migration/transformation can occur only when the destination array has the same or larger capacity as the source array.

While the migration/transformation is taking place, data is accessible and protected to the lowest protection of either the source RAID level or the destination RAID level.

The Transform task can also be used to expand the capacity of an array, by using OCE. It can also be used as part of the system backup and recovery strategy through the use of the RAID1 and RAID10 levels.

To perform this process, see Section 7.6.3, Transform Arrays on page 67.

3.7 Array Tasks: Starting and Stopping Tasks

Tasks are started when one of the following actions are performed:

- Create a redundant array.
- Transform an array.
- Restore an array.
- Securely erase an array.
- Check for consistency on redundant arrays.
- Verify that data was not corrupted after a system crash (Check_Bitmap performed automatically).

Full task control can be used on Create, Consistency Check and Bitmap Check tasks. On a Transform or Restore task for dedicated and global spares, task control can only pause/resume, but it cannot remove the task. To remove these types of tasks, pause and then remove them.

The tasks indicated in Table 10 on page 29, can be displayed for each array.

Table 10. Types of Tasks per Array

| Task | When Displayed |
|-------------------|---|
| Transform | While an array is being transformed. |
| Create | While an array is being created. |
| Consistency Check | While verifying that the parity (RAID5) or mirror disk (RAID1 or RAID10) consistency is correct. (For redundant type arrays only.) |
| Restore | While an array is being restored. |
| Secure Erase | While an array secure erase is being performed. |
| Check_Bitmap | While verifying that the parity on a RAID5 set, or the mirror halves on a RAID1 or RAID10 set, are consistent. This action is performed automatically to ensure that data is not corrupted whenever a system crashes. |
| Not_Active | When no other tasks are being performed. |

3.8 Understanding Disks

3.8.1 Disks States

Within the management applications, a disk can be part of one or more arrays and can exist in one of five states: Online, Offline, New, Legacy, or SMART Error.

- In RAIDXpert2, these states are displayed in the Disk List section in a column named State. See Table 15, on page 58, for additional information.
- Within the rcadm program, these states are also displayed in a column named State. See Table 28, on page 83, and Table 29, on page 84, for additional information.

The disk states are defined in Table 11.

Table 11. Disk States

| Disk State | When Displayed |
|------------|--|
| Online | Whenever the disk is connected, functioning correctly, and RAIDXpert2 can communicate with it. |

Table 11. Disk States (Continued)

| Disk State | When Displayed |
|-------------|--|
| New | Whenever an uninitialized, new disk is connected. |
| Legacy | Whenever a disk containing non-RAIDXpert2 configuration data is connected. |
| Offline | Whenever the disk fails and RAIDXpert2 detects an error condition on the disk. |
| SMART Error | Whenever the disk reports a SMART error(s) to RAIDXpert2. |

A disk can be a member of multiple arrays. A disk failure in one array doesn't necessarily mean it has failed in other arrays.

After a rescan is performed the following can occur:

- A disconnected disk no longer appears in the Disk List (although the disk appears as Missing in the Array View for the arrays to which it belonged).
- A disk that experiences a catastrophic failure appears in the Disk List as Offline and is highlighted in red. The disk appears as Failed for the arrays to which it belonged.
- A disk that has a SMART error appears in the Disk List as SMART Error. (A disk with a SMART error can't be used to create an array)
- A disk that experiences a software-related failure appears in the Disk List as Online and is highlighted in red. New arrays can be created with the disk.

Arrays that exist on a failed or disconnected disk might not be designated as Failed or Missing until the system attempts to communicate with the failed or disconnected disk.

3.9 Rescanning Disks for Changes in State

The information displayed in the Disk List section is the state of the disks when they were last scanned. If a rescan has not been performed, the information being displayed is the state of the disks at boot time.

Every time a disk is connected or disconnected while online, a message asks if the user wants to perform a rescan (of all SATA and PCIe channels). If Rescan is selected, the information in both the Array List and the Disk List is updated. This view might show arrays as being in a Critical or Offline state, if all disks have not been installed or removed.

Although it is highly recommended that the system be shut down before adding or removing disks, disks can be added or removed while the system is online ("hot-swapping"), if the system supports the hot-swapping function. This is not recommend for disks that are part of the Boot Virtual Disk.

Because of this function, RAIDXpert2 does not automatically perform a rescan when it detects that a disk has been added or removed. For example, to hot-swap a RAID5 set with six disks into a new system, do not perform a rescan until all six disks have been connected.

Arrays associated with the disks that are not yet connected change state to either Critical or Offline. In the example above, if the state of the RAID5 set changes to Offline, data is unavailable.

Rescanning can also result in the state of a disk being reported differently in the Array View and the Disk List. A disk within an array can have a state of Failed in the Array View field, while at the same time it can show a state of Online in the Disk List.

3.10 Sparing Options: Disks and Arrays

RAIDXpert2 supports multiple sparing options. Spares are restored in the order indicated in Table 12.

Table 12. Sparing Options

| Option | Description |
|-----------|--|
| Dedicated | A spare disk assigned to a specific redundant array. |
| Global | A spare disk that is shared by multiple arrays. |

Note: An array is marked Critical or Offline if a disk reports a Failed state to an I/O, or if the Disk or power cable is disconnected.

Note: One or more spares can be assigned to a redundant RAID level.

Note: Spare assignments do not apply to non-redundant RAID levels. To protect data, transform the array to a redundant RAID level. Spares can then be assigned.

3.11 Dedicated Sparing

A dedicated spare is a disk that is assigned as an alternate disk for a specific array. Should a disk fail in that array, the alternate disk is used to replace the failed disk and the array is rebuilt.

A dedicated spare can be assigned to any redundant array type, and up to four spares can be assigned to an array.

Note: Disk capacity of the Dedicated Spare must be greater or equal to the capacity of the smallest disk in the array.

CAUTION: *Assigning a dedicated spare does not reserve space on the disk. Therefore, an automatic restore is not guaranteed if a disk fails. If a disk fails, make space on the disk for the fail-over to complete, or assign a different disk with enough space. If a dedicated spare is assigned and a disk fails, the restore process starts automatically, if there is enough space available on the dedicated spare.*

For additional information, see Section 7.6.13, Add or Remove Dedicated Spares, on page 75.

3.12 Global Sparing

A global spare is a disk that is assigned as an alternate disk for multiple arrays, instead of associating it with only one array.

Many arrays can be restored using the global spare disk, as long as it is not already part of the array and it has enough space available. Unlike a dedicated spare, this type of spare can be assigned at any time, even while tasks are running on arrays.

Assigning a disk for use as a global spare does not reserve space on that disk. An automatic restore is not guaranteed if a disk fails.

If there is not enough disk space on the global spare, make room for the fail-over to complete, or assign a different disk with enough capacity as the spare. If there is enough space available on the global spare and a disk failure occurs, the restore process starts automatically.

For additional information, see Section 7.6.14, Add or Remove Global Spares, on page 76.

3.13 RAID Performance Considerations

With RAID technology, performance is based on the following considerations:

- The number and organization of disks in an array.
- Caching attributes used for the array.
- Application workload.

3.13.1 Number and Organization of Disks

RAID functions increase performance by putting more disks to work and by buffering data for the host.

Many disks can transfer data at greater than 100 MB per second. RAIDXpert2 can aggregate this bandwidth in an almost linear fashion, as more of the same disks are included in an array.

3.13.2 Caching Attributes

Arrays can also be configured to provide read and Write Back caching using RAIDXpert2, if desired. Write Back caching has a large effect on most workloads, but should be used with caution.

3.13.3 Application Workload

When configuring an array, workload is probably the most important performance variable. Most applications do many more reads than writes. The best performance is obtained with array types like RAID0, or RAID10.

3.14 RAID Reliability Considerations

RAID reliability is enhanced through data redundancy and backup.

3.14.1 Data Redundancy

RAID1, or RAID10 are necessary for redundancy. With redundancy, both capacity and performance are sacrificed for reliability. With RAIDXpert2, extremely high performance is obtained even with redundant-type arrays.

3.14.2 Backup

It is good practice to back up your data periodically in case of a catastrophic failure. Tape backup or other media can be used to secure your data.

3.15 Flexibility and Expansion Considerations

Before configuring an array, consider the following points to enhance the flexibility of the RAID system.

3.16 Multiple RAID Levels

With RAIDXpert2, different RAID levels can be created on the same disk, to adapt each array to the I/O that it processes. Also, more than one array can be created per disk.

Depending on the array capacity and redundancy level, an existing array can be transformed to another RAID level, if the level of the array being used is not the optimal RAID level for the application. Also, different arrays with different characteristics can be built for different applications.

3.17 RAIDABLE Arrays

RAIDABLE arrays (also known as RAID Ready) are a special type of Volume (JBOD) that allow the user to add more storage space or create a redundant array after a system is installed.

RAIDABLE arrays are created using HII, UEFI, or rcadm.

***Note:** The ability to create RAIDABLE arrays may not be available on your system.*

Chapter 4 RAIDXpert2 Configuration Utility (HII)

4.1 When to Use the RAIDXpert2 Configuration Utility (HII)

The RAIDXpert2 Configuration Utility is also known as the HII. Use the utility to accomplish the procedures indicated in Table 13.

Table 13. When to use the AMD-RAID RAIDXpert2 Configuration Utility. (HII)

| Procedure | Description | Find Information At |
|-------------------------|--|--|
| Initialize a new disk | To initialize a new disk drive for data storage. | Section 4.3, Initialize Disks, on page 36 |
| Create arrays | Create arrays at different RAID levels (depending on the license level for the system) | Section 4.4, Create Arrays, on page 36 |
| Delete Array | Delete an array. | Section 4.5, Delete Arrays, on page 40 |
| Manage hot spares | Allows selection of global and dedicated hot spares. | Section 4.6, Manage Spares, on page 41 |
| View Controller details | View information about each controller | Section 4.6, View Controller Details, on page 42 |
| View Disk details | View information about each disk. | Section 4.8, View Disk Details, on page 42 |
| View Array Details | View information about each array. | Section 4.9, View Array Details, on page 43 |
| Rescan all channels | Rescan all channels to detect new or removed disks and arrays. | Section 4.10, Rescan All Channels on page 44 |

4.2 Access the RAIDXpert2 Configuration Utility (HII)

Note: The step(s) mentioned below is specific to AMD NDA BIOS based on the AMI BIOS. For an Insyde/Other BIOS procedure, the step(s) are different.

When booting the system, press **Delete** key to enter into the BIOS configuration page-> select **Advanced** in Menu bar-> select **RAIDXpert2 Configuration Utility** to enter the RAIDXpert2 Configuration Utility (HII).

***Note:** Access to RAIDXpert2 Configuration Utility will be enabled only after configuring the BIOS as mentioned in Section 5.1, System Setup Process Overview.*

***Note:** If the AMD-RAID RAIDXpert2 Configuration Utility does not display, contact your system or motherboard supplier.*

4.3 Initialize Disks

New disks and legacy disks must be initialized before they can be used to create an AMD-RAID array. Initialization writes AMD-RAID configuration information (metadata) to a disk.

***CAUTION:** If a disk is part of an AMD-RAID array, the disk cannot be selected for initialization. To initialize the disk anyway, delete the AMD-RAID array. Data on the disk is deleted during initialization so ensure the correct disks are chosen to initialize.*

***CAUTION:** A legacy disk can contain valid data. When a legacy array is deleted, all data on the disk is lost.*

1. At the **RAIDXpert2 Configuration Utility's Main Menu**, use the **arrow keys** to select **Physical Disk Management**, then press **Enter**.
2. Use the arrow keys to select **Select Physical Disk Operations**, then press **Enter**.
3. Use the **arrow keys** to select **Initialize Disk**, then press **Enter**.
4. Select the disk(s) to initialize:
 - To select individual disks, highlight a disk with the **arrow keys** and press the **Space Bar** or **Enter**. Any number of disks may be selected using this method.
 - When the desired number have been selected, use the **arrow keys** to select **OK**, then press **Enter**.
 - Review the warning message, if you want to proceed, use the **arrow keys** to select **YES**, then press the **Enter** key, or press **ESC** to cancel the initialization.Initialization takes 10 to 15 seconds per disk. During initialization, a complete rescan of all channels is done automatically.

4.4 Create Arrays

Arrays can be created after the disks are initialized. See Section 3.2, RAID Levels, on page 24, for deciding what type of RAID levels to use for the array.

***TIP:** See also Section 7.6.1, Create and Format Arrays, on page 64, and Section 8.4, Create New Arrays: `rcadm --create`, on page 85.*

4.4.1 Before You Begin

- In some circumstances, more than eight arrays are possible. They might appear to function properly, but are not supported by AMD-RAID RAIDXpert2
- For redundant arrays, the Create process is not started until after the operating system and AMD-RAID OS drivers have been installed and the system has booted to the operating system. However, the arrays are immediately available to use for either a bootable array or a data array.
- Array numbers are valid only for a given boot, and might be different in the RAIDXpert2 Configuration Utility (HII) and RAIDXpert2. If a permanent label is required, use the RAIDXpert2 Web GUI Array Naming feature.
- At any point in the procedure, return to a prior window by pressing ESC.
- If the system is booted from an AMD-RAID bootable array, the first array in the Arrays section must be the bootable array. The system boots only from the first array in the Arrays section.

4.4.2 Create an Array

- Before proceeding with array create and manage System BIOS configuration should be setup as mentioned in Section 5.1, System Setup Process Overview for system RAID mode to be enabled
- To access RAIDXpert2 Configuration Utility (HII), at the system's Power-On Self-Test (POST) screen, press ESC / Del (or similar) for BIOS options menu. Under Advanced tab access the RAIDXpert2 Configuration Utility to create and manage arrays.
- The operating system and AMD-RAID RAIDXpert2 files can be installed to an AMD-RAID RAIDXpert2 bootable array. Ensure it is the first array listed in the Arrays section of the RAIDXpert2 Configuration Utility (HII).
- Using RAIDXpert2 Configuration Utility bootable array with levels Volume, Raidable, RAID0, RAID1 and RAID10 can be created by following the steps mentioned in following sections below.

To install the operating system and RAIDXpert2 files see Chapter 5, Software Installation, on page 45.

4.4.2.1 Create a RAIDABLE Array

Note: The ability to create RAIDABLE (also known as RAID Ready) arrays may not be available on your system. A RAIDABLE array consists of 1 physical disk and the size will default to the maximum size available.

1. At the RAIDXpert2 Configuration Utility's Main Menu, use the **arrow keys** to select **Array Management**, then press **Enter**.
2. Use the **arrow keys** to select **Create Array**, then press **Enter**.
3. Use the **arrow keys** to select **Select RAID Level**, then press **Enter**.

- From the **Select RAID Level Drop** down menu, use the **arrow keys** to select **RAIDABLE**, then press **Enter**.
4. Select the disks with which to create the array:
 - Use the **arrow keys** to select **Select Physical Disks**, then press **Enter**.
 - Select an individual disk, highlight a disk with the **arrow keys** and press the **Space Bar** or **Enter**.
 - Use the **arrow keys** to select **Apply Changes**, then press **Enter**.
 5. Using the **arrow keys** to select **Read Cache Policy**, then press **Enter**.
 - Select the desired **Read Cache Policy**, then press **Enter**.
 6. Using the **arrow keys** to select **Write Cache Policy**, then press **Enter**.
 - Select the desired **Write Cache Policy**, then press **Enter**.
 7. Use the **arrow keys** to select **Create Array**, then press **Enter**.

4.4.2.2 Create a VOLUME Array

Note: Refer to Table 6 for VOLUME array characteristics

1. At the RAIDXpert2 Configuration Utility's Main Menu, use the **arrow keys** to select **Array Management**, then press **Enter**.
2. Use the **arrow keys** to select **Create Array**, then press **Enter**.
3. Use the **arrow keys** to select **Select RAID Level**, then press **Enter**.
 - From the **Select RAID Level Drop** down menu, use the **arrow keys** to select **VOLUME**, then press **Enter**.
4. Select the disks with which to create the array:
 - Use the **arrow keys** to **Select Physical Disks**, then press **Enter**.
 - Select desired disks, highlight a disk with the **arrow keys** and press the **Space Bar** or **Enter**.
 - Use the **arrow keys** to select **Apply Changes**, then press **Enter**.
5. Using the **arrow keys** to select **Read Cache Policy**, then press **Enter**.
 - Select the desired **Read Cache Policy**, then press **Enter**.
6. Using the **arrow keys** to select **Write Cache Policy**, then press **Enter**.
 - Select the desired **Write Cache Policy**, then press **Enter**.
7. Use the **arrow keys** to select **Create Array**, then press **Enter**.

4.4.2.3 Create a RAID0 Array

Note: Refer to Table 6 for RAID0 array characteristics

1. At the RAIDXpert2 Configuration Utility's Main Menu, use the **arrow keys** to select **Array Management**, then press **Enter**.

2. Use the **arrow keys** to select **Create Array**, then press **Enter**.
3. Use the **arrow keys** to select **Select RAID Level**, then press **Enter**.
 - From the **Select RAID Level** Drop down menu, use the **arrow keys** to select **RAID0**, then press **Enter**.
4. Select the disks with which to create the array:
 - Use the **arrow keys** to **Select Physical Disks**, then press **Enter**.
 - Select desired disks, highlight a disk with the **arrow keys** and press the **Space Bar** or **Enter**.
 - Use the **arrow keys** to select **Apply Changes**, then press **Enter**.
5. Using the **arrow keys** to select **Read Cache Policy**, then press **Enter**.
 - Select the desired **Read Cache Policy**, then press **Enter**.
6. 6. Using the **arrow keys** to select **Write Cache Policy**, then press **Enter**.
 - Select the desired **Write Cache Policy**, then press **Enter**.
7. Use the **arrow keys** to select **Create Array**, then press **Enter**.

4.4.2.4 Create a RAID1 Array

Note: Refer to Table 6 for RAID1 array characteristics

1. At the RAIDXpert2 Configuration Utility's Main Menu, use the **arrow keys** to select **Array Management**, then press **Enter**.
2. Use the **arrow keys** to select **Create Array**, then press **Enter**.
3. Use the **arrow keys** to select **Select RAID Level**, then press **Enter**.
 - From the **Select RAID Level** Drop down menu, use the **arrow keys** to select **RAID1**, then press **Enter**.
4. Select the disks with which to create the array:
 - Use the **arrow keys** to **Select Physical Disks**, then press **Enter**.
 - Select desired disks, highlight a disk with the **arrow keys** and press the **Space Bar** or **Enter**.
 - Use the **arrow keys** to select **Apply Changes**, then press **Enter**.
5. Using the **arrow keys** to select **Read Cache Policy**, then press **Enter**.
 - Select the desired **Read Cache Policy**, then press **Enter**.
6. Using the **arrow keys** to select **Write Cache Policy**, then press **Enter**.
 - Select the desired **Write Cache Policy**, then press **Enter**.
7. Use the **arrow keys** to select **Create Array**, then press **Enter**.

4.4.2.5 Create a RAID10 Array

Note: Refer to Table 6 for RAID10 array characteristics

1. At the RAIDXpert2 Configuration Utility's Main Menu, use the **arrow keys** to select **Array Management**, then press **Enter**.
2. Use the **arrow keys** to select **Create Array**, then press **Enter**.
3. Use the **arrow keys** to select **Select RAID Level**, then press **Enter**.
 - From the **Select RAID Level** Drop down menu, use the **arrow keys** to select **RAID10**, then press **Enter**.
4. Select the disks with which to create the array:
 - Use the **arrow keys** to **Select Physical Disks**, then press **Enter**.
 - Select desired disks, highlight a disk with the **arrow keys** and press the **Space Bar** or **Enter**.
 - Use the **arrow keys** to select **Apply Changes**, then press **Enter**.
5. Using the **arrow keys** to select **Read Cache Policy**, then press **Enter**.
 - Select the desired **Read Cache Policy**, then press **Enter**.
6. Using the **arrow keys** to select **Write Cache Policy**, then press **Enter**.
 - Select the desired **Write Cache Policy**, then press **Enter**.
7. Use the **arrow keys** to select **Create Array**, then press **Enter**.

4.5 Delete Arrays

***CAUTION:** Deleting an array permanently destroys all data that is on the array. This action cannot be undone and it is very unlikely that the data can be recovered.*

***CAUTION:** Do not delete the first array listed in the Arrays section, if it is the AMD-RAID bootable array. Doing this deletes the operating system and AMD-RAID files.*

4.5.1 Delete an Array

1. At the RAIDXpert2 Configuration Utility's Main Menu, use the **arrow keys** to select **Array Management**, then press **Enter**.
2. Use the **arrow keys** to select **Delete Array**, then press **Enter**.
3. Select the array to delete:
 - Use the **arrow keys** to select **Select Array**, then press **Enter**.
 - Use the **arrow keys** to select the desired array, then press **Enter**.
 - Use the **arrow keys** to select **Delete Array**, then press **Enter**.
 - Review the warning message, if you want to proceed, press the **Space Bar** or **Enter**.
 - Use the **arrow keys** to select, **Yes** or press the **ESC** key to exit.

4.6 Manage Spares

This option allows the user to assign or unassign global or dedicated spares.

Note: In order to assign a physical disk as a Global Spare, it must not be part of any Array.

4.6.1 Assign Global Spares

1. At the **RAIDXpert2 Configuration Utility's Main Menu**, use the **arrow keys** to select **Physical Disk Management**, then press **Enter**.
2. Use the **arrow keys** to select **Select Physical Disk Operations**, then press **Enter**.
3. Use the **arrow keys** to select **Select Physical Disk**, then press **Enter**.
 - From the drop down menu, use the **arrow keys** to select the desired physical disk, then press **Enter**.
4. Use the **arrow keys** to select **Assign Global Hot Spare**, then press **Enter**.
5. Review the warning message, if you want to proceed, use the **arrow keys** to select **Yes** or press **ESC** or select **No**, to exit.

4.6.2 Assign Dedicated Spares

Note: Dedicated spares can only be assigned to redundant arrays and must the same size or larger than the other members of the redundant array.

1. At the **RAIDXpert2 Configuration Utility's Main Menu**, use the **arrow keys** to select **Array Management**, then press **Enter**.
2. Use the **arrow keys** to select **Manage Array Properties**, then press **Enter**.
3. Use the **arrow keys** to select **Select Array**.
 - From the drop down menu, select the desired array (must be a redundant array), then press **Enter**.
4. Use the **arrow keys** to select **Manage Dedicated Hot Spares**, then press **Enter**.
5. Select the disks to assign as dedicated spares.
 - To select the disk, use the **arrow keys** to highlight the disk and press the **Space Bar** or **Enter** to select it.
 - Use the **arrow keys** to select **Add Hot Spare Physical Disk**, then press **Enter**.
 - At the warning message, press the **space bar** or **Enter** to Confirm.
 - Use the **arrow keys** to select **Yes**, then press **Enter** or press the **ESC** key to exit adding the Dedicated Spare.

4.6.3 Unassign Spares

1. At the **RAIDXpert2 Configuration Utility's Main Menu**, use the **arrow keys** to select **Physical Disk Management**, then press **Enter**.
2. Use the **arrow keys** to select **Select Physical Disk Operations**, then press **Enter**.
3. Use the **arrow keys** to select **Select Physical Disk**, then press **Enter**.
4. From the drop down menu, use the **arrow keys** to select the **Global / Dedicated Spare**, then press **Enter**.
5. Use the **arrow keys** to select **Unassign Hot Spare**, then press **Enter**.
6. Review the warning message, if you want to proceed, select **Yes**, then press **Enter** or press the **ESC** key to exit.

4.7 View Controller Details

This option will display the details of the controllers. Nothing can be changed using this menu option; it is for informational purposes only.

1. At the **RAIDXpert2 Configuration Utility's Main Menu**, use the **arrow keys** to select **Controller Management**, then press **Enter**.
2. Use the **arrow keys** to select **Select View Controller Information**, then press **Enter**.
3. Use the **arrow keys** to select **Select Controller**, then press **Enter**.
4. From the drop down menu, select the desired controller, then press **Enter**.
5. Information about the controller is displayed below the **Select Controller** header:
 - PCI ID
 - Controller Physical Disk Count
 - Total Physical Disk Count
 - Total Array Count
 - UEFI Driver Version
 - Firmware Properties/Firmware Build Time
6. To view another controller, press **Enter** and from the drop down menu, select a different controller, then press **Enter**.
7. Press **ESC** to exit to the **Main Menu**.

4.8 View Disk Details

This option allows the user to view details about the physical disk(s). Nothing can be changed using this menu option; it is for informational purposes only.

1. At the **RAIDXpert2 Configuration Utility's Main Menu**, use the **arrow keys** to select **Physical Disk Management**, then press **Enter**.

2. Use the **arrow keys** to select **View Physical Disk Properties**, then press **Enter**.
3. Use the **arrow keys** to select **Select Physical Disk**, then press **Enter**.
4. From the drop down menu, select the physical disk you want more information about, then press **Enter**.
5. Information about the physical disk is displayed below the **Select Physical Disk** header:
 - Unique Disk ID
 - State
 - Size
 - Smart Status
 - Revision
 - Drive Type
 - Maximum Free Space
 - Used Space
 - Disk Protocol
 - Disk Speed
 - Associated Array, if part of one
 - Serial Number
 - Model Number
6. To view another physical disk, press **Enter** and from the drop down menu, select a different physical disk, then press **Enter**.
7. Press **ESC** to exit to the **Main Menu**.

4.9 View Array Details

This option will display the details of an array. Nothing can be changed using this menu option; it is for informational purposes only.

1. At the **RAIDXpert2 Configuration Utility's Main Menu**, use the **arrow keys** to select **Array Management**, then press **Enter**.
2. Use the **arrow keys** to select **Select Manage Array Properties**, then press **Enter**.
3. Use the **arrow keys** to select **Select Array**, then press **Enter**.
4. From the drop down menu, select the desired array, then press **Enter**.
5. Use the **arrow keys** to select **View Associated Physical Disks**, then press **Enter**.
6. Press the **Space Bar** to select one of the members of the Array
7. Use the **arrow keys** to select **View Physical Disk Properties**, then press **Enter**.
8. Information about the array is displayed below the **Select Array** header:
 - Array number
 - RAID level

- State
 - Size
 - Cache settings
 - Associated physical disks
9. To view another array, press **ESC** twice and perform steps 2 through 8 again.
 10. Press **ESC** to exit to the **Main Menu**.

4.10 Rescan All Channels

This option allows the user to rescan all channels to detect new or removed physical disks and arrays. It rereads the configuration information from each physical disk.

Sometimes when a disk is offline, it can be brought online through a rescan.

1. At the **RAIDXpert2 Configuration Utility's Main Menu**, use the **arrow keys** to select **Controller Management**, then press **Enter**.
2. Use the arrow keys to select **Rescan Disks**, then press **Enter**.
 - After a rescan completes, all of the physical disks will be displayed.
3. Use the **arrow keys** to select **OK**, then press **Enter**.

Chapter 5 Software Installation

This Installation Guide is designed to assist you with system setup, by performing these general procedures:

5.1 System Setup Process Overview

A generic system setup process follows these steps:

1. Copy the AMD-RAID drivers to a removable storage medium.

CAUTION: *Install the device drivers and applications on a system at the same time that the Windows operating system is installed.*

2. Power on the system.
3. Access the platform UEFI setup for the system. For supported AMD chipsets, refer to Section 5.4.1, UEFI Mode, to configure the System in RAID Mode. (This enables the loading of the RAIDXpert2 Configuration Utility - HII).
4. Initialize the disks using the AMD-RAIDXpert2 Array Configuration Utility.
5. Create arrays using the AMD-RAIDXpert2 Array Configuration Utility.
6. Install the AMD-RAID drivers on the system.
7. Load the operating system.
8. Install the OS RAID Management Suite (AMD RAIDXpert2) on the system.

Note: *To protect your data, always perform a backup prior to installing any new, major hardware or software.*

5.2 Before You Begin

Have the Windows® operating system software available and ready to install.

5.3 Copying AMD-RAID Drivers to Removable Storage

You need to copy the drivers to a removable storage medium before you begin the installation.

5.3.1 Copying AMD-RAID Drivers in a Microsoft® Windows® Environment

1. Power on the system.
2. Locate and use a system that is running a Windows operating system and has a CD DVD drive or an I/O port for removable storage media (such as a USB flash drive).
3. Go to a browser and access the web site of your system supplier or motherboard vendor.

4. Insert the storage medium into the system:
 - Connect a USB flash drive to a USB I/O port or insert a blank CD-DVD disk into the applicable drive.
5. Download the AMD-RAID drivers from the web site to the appropriate removable storage medium.

5.4 Pre-installation steps

Note: Steps to configure a machine to RAID mentioned here are specific to AMD NDA BIOS based out of AMI.

5.4.1 UEFI Mode

1. Power-on the system then press Delete or ESC key to enter the System BIOS setup page.
2. Under the Advanced menu:
3. Select **AMD PBS**, then press **Enter**.
 - a. Set **NVME RAID Mode** to **Enabled**, then press **Enter**.
 - b. Press **ESC** to **Advanced** menu
4. Select **AMD CBS**, then press **Enter**
 - c. Select **AMD FCH Common Options**, then press **Enter**.
 - d. Select **SATA Configuration Options**, then press **Enter**.
 - i. Set **SATA Controller** to **Enabled**, then press **Enter**.
 - ii. Set **SATA Mode** to **RAID**, then press **Enter**.
 - iii. Press **ESC** to **Advanced** menu
5. Under the **Advanced** menu:
6. Select **Promontory Common Options**, then press **Enter**.
 - a. Select **PT SATA Configuration Options**, then press **Enter**.
 - i. Set **PT SATA Mode** to **RAID**, then press **Enter**.
 - ii. Press **ESC** to **Advanced** menu
7. Under the **Advanced** menu:
8. Select the **CSM Configuration**.
 - a. To configure the machine to UEFI, the user may follow one of the two steps shared below.
 - i. Set CSM support is **Disabled** (Pure UEFI), then press **Enter**.
 - ii. If CSM support is set to **Enabled**, user will have to set the options as below
 1. Set **Boot Option Filter** to **UEFI only**
 2. Set all the below Option ROM execution settings to **UEFI**
 - a. Network

- b. Storage
 - c. Video
 - d. Other PCIe devices
 3. Press **ESC** to **Advanced** menu
9. Save the above settings
 - a. Press **F4**
 - b. Select **Yes** and Press **Enter** to Save configuration and exit
10. To create array using **RAIDXpert2 Configuration Utility (HII)**
 - a. At the system's **Power-On Self-Test (POST)** screen, press **ESC / Del** (or similar) for BIOS option menu
 - b. Under **Advanced** tab access the **RAIDXpert2 Configuration Utility** (also called UEFI Boot Manager or HII) to Create and manage arrays (Refer to Section 4.4, Create Arrays for array creation).
11. To create and manage arrays from EFI Command line interface
 - a. Boot to the EFI Internal shell
 - b. Enter fsx:, where x is the number of the UEFI Flash Drive.
 - c. Use rcadm to create the desired Boot Virtual Disk. Refer to Section 8.4, Create New Arrays: rcadm --create, on page 85 for more information.

5.5 Installing AMD-RAID drivers

Follow the procedures below for your Microsoft Windows installation.

5.5.1 Installing AMD-RAID Drivers while Installing Microsoft® Windows®

5.5.1.1 Installing the AMD-RAID UEFI Drivers during a Microsoft® Windows® 10 Installation

***Note:** The windows described in this guide are typical. Path names and text can vary, depending on user-designated selections and other parameters.*

***Note:** NVME devices are listed in the “Where do you want to install Windows?” do not delete any of the partitions or format the devices. Doing so will delete the AMD-RAID metadata and the desired RAID level will be deleted. After AMD-RAID drivers have been loaded, a valid AMD-RAID Virtual Disk appears.*

1. Power on the system.
2. Create a bootable array, refer to Section 4.4, Create Arrays, on page 36.
3. Insert the Microsoft Windows operating system installation media/disc into the system's Optical drive.

4. Boot the system and allow it to access the Microsoft Windows operating system installation media/disc.
 5. At the Windows setup window:
 - Select the language, time, and keyboard options
 - Click **Next**.
 - Click **Install Now** or similar.
 - If prompted, select the desired Operating System
 - Click **Next**.
 - Depending on the installation window observed, choose one of the methods below to load `rcbottom.inf`
 - If the window observed is **Select driver to install**
 - Insert the storage medium with the **AMD-RAID** drivers into the USB port or applicable system drive
 - Click **Browse**.
 - Navigate to the directory containing the saved **AMD-RAID** drivers
 - Click **OK**.
 - Select the first **rcbottom.inf** driver in the list
 - Click **Next**.
 - Else follow onscreen prompt until “Where to install Windows?” window observed
 - Select **Load driver**
 - Click **Browse**.
 - Navigate to the directory containing the saved **AMD-RAID** drivers
 - Click **OK**.
 - Select the first **rcbottom.inf** driver in the list
 - Click **Next**.
- Note:** If the installation has multiple controllers, there will be two or more `rcbottom.inf`'s listed, installation of `rcbottom.inf` is recommended only once.*
6. At the Load Driver Window:
 - Click **OK**
 - Click **Browse**.
 - Navigate to the directory containing the saved **AMD-RAID** drivers
 - Click **OK**.
 - Select the first **rcraid.inf** driver in the list
 - Click **Next**.
 7. Select (Check Mark) the **I Accept the License Terms**
 - Click **Next**.

- Select **Custom: Install Windows Only (advanced)** or similar.
8. After rcbottom and rcraid both drivers have been loaded, a valid Virtual disk appears in “Where do you want to install Windows?” window:
 - Click **Load Drivers**
 - Click **Browse**
 - Navigate to the directory containing the saved **AMD-RAID** drivers
 - Click **OK**
 - Select the **rccfg.inf** driver in the list
 - Click **Next**
 9. At the Where do you want to install Windows
 - Click **Next**
 10. Follow the on-screen instructions to complete the installation of the applicable Windows operating system.
 11. After the OS is installed, open Device Manager and verify the following:
 - Expand Storage Controllers: there are entry(ies) listed as **AMD-RAID Bottom Device**
 - Expand Storage Controllers: there are entry(ies) listed as **AMD-RAID Controller**
 - Expand System Devices: there are entry(ies) listed as **AMD-RAID Config Device**.
 12. Remove the storage medium and Microsoft Windows OS CD-ROM or DVD from the applicable drive(s) or port. Proceed to Section 5.6, Installing the AMD RAIDXpert2 Management Suite for Microsoft® Windows®, on page 49.

5.6 Installing the AMD RAIDXpert2 Management Suite for Microsoft® Windows®

5.6.1 Windows® – AMD-RAIDXpert2 Management Suite

1. Obtain the latest Catalyst executable file from your system supplier or motherboard vendor. Download the file to the system’s desktop, execute it and follow the on-screen prompts.
2. Click on the RAIDXpert2 Desktop Icon
 - Default credentials are:
 - i. Username – **admin**
 - ii. Password – **admin**
3. Change the credentials:
 - Create new username
 - Create new password
4. Re-log into the system with the new credentials.

5.6.2 Windows® – AMD RAIDXpert2 Management Suite Installation (Manually)

1. Obtain the AMD RAIDXpert2 Management Suite executable file (Setup.exe) from your system supplier or motherboard vendor. Download Setup.exe to the system's desktop.
2. Install AMD RAIDXpert2 (setup.exe) by typing:
 - a. Open a command prompt, must be run as Administrator
 - b. `cd C:\User\User_Name\Desktop`
 - c. `Setup.exe -I silent`

Note: For the Web GUI to function correctly, `rc_cgi` and `apache` must be running.

3. Turn off Windows Firewall (or unblock during step 2).
4. Click on the RAIDXpert2 Desktop Icon
 - Default credentials are:
 - i. Username – **admin**
 - ii. Password – **admin**
5. Change the credentials:
 - a. Create new username
 - b. Create new password
6. Re-log into the system with the new credentials.

See Section 7.1.1.1, Browser Setup, on page 54, for supported browsers and configurations.

Chapter 6 RAID Software Update

6.1 Purpose

This Chapter is designed to assist the user update their System to the latest released software.

This chapter describes the steps needed to update the AMD-RAID drivers installed on the following Operating Systems:

- Microsoft Windows 10 64 bit

6.2 System Overview Process

A generic System update process is described below.

1. Power-on the System.
2. Log into the System.
3. Copy the AMD RAIDXpert2 Installer to the Systems Desktop.
For Windows – Download Latest Catalyst from system supplier or motherboard vendor (to perform manually, use Setup.exe)
4. Run the AMD RAIDXpert2 Installer to update the AMD RAIDXpert2 Management Suite.
5. Update the AMD-RAID drivers.
6. Reboot the System.

IMPORTANT: To protect your data; always perform a backup prior to installing any new, major hardware or software.

6.3 Updating the AMD RAIDXpert2 Management Suite.

6.3.1 Copy the AMD RAIDXpert2 Installer to the Systems Desktop: Windows®

1. Power-on the System.
2. Obtain the latest Catalyst executable file from your system supplier or motherboard vendor.
Download the file to the Systems Desktop and execute it. Follow the on-screen prompts.

6.3.1.1 Steps to Update RAIDXpert2 Management Suite Manually

1. Open a browser and access the Web Site of your system supplier or motherboard vendor.

2. Download the AMD RAIDXpert2 Installer (**setup.exe**) from the web site and copy it to the Systems Desktop.
3. Open a Command Prompt terminal
Enter: `cd \Users\user_name\Desktop`
Enter: `setup.exe -I silent`

6.4 Updating the AMD-RAID Drivers

6.4.1 Windows® Drivers

1. Go to a browser and access the Web Site of your system supplier or motherboard vendor.
2. Download the AMD-RAID Drivers from the Web Site and copy it to the Systems C: drive.
3. **Open Computer Management -> Device Manager.**
4. Expand **Storage Controllers.**
5. Select the first **AMD-RAID Bottom Device**
 - **Right Click** and select **Update Driver Software**
 - Click **Browse my computer for driver software.**
 - Click **Browse**, set the path to the Systems C drive.
 - Click **OK.**
 - Click **Next**

Note: if a Window Security Window pops up, select Install this driver software anyways.

- Click **Close**
 - At System Settings Change pop up, Click **No.**
6. Select the first AMD-RAID Controller
 - **Right Click** and select **Update Driver Software**
 - Click **Browse my computer for driver software.**
 - Click **Browse**, set the path to the Systems C drive.
 - Click **OK**
 - Click **Next**

Note: if a Window Security Window pops up, select Install this driver software anyways.

- Click **Close.**
7. At System Settings Change pop up, Click **No**
 8. Expand **System Devices.**
 9. Select **AMD-RAID Config Device**
 - **Right Click** and select **Update Driver Software**
 - Click **Browse my computer for driver software.**

- Click **Browse**, set the path to the Systems C drive.
- Click **OK**
- Click **Next**

***Note:** if a Window Security Window pops up, select Install this driver software anyways.*

- Click **Close**

10. Reboot the System.

Chapter 7 AMD RAIDXpert2 Graphical User Interface (GUI)

7.1 Start RAIDXpert2

RAIDXpert2 can be accessed using a web browser or Windows shortcut.

7.1.1 Web-Browser Access

7.1.1.1 Browser Setup

- Use Chrome version 20, Firefox version 14, Internet Explorer 11, or Safari 6, or a greater version of each browser.
- To optimize the display, use a color monitor and set its color quality to the highest setting.
- To navigate beyond the Sign In page (with a valid user account):
 - Set the browser's local-intranet security option to medium or medium-low.
 - Verify that the browser is set to allow cookies at least for the IP address of the controller.
 - To see the help window in Microsoft Internet Explorer, you must enable pop-up windows.

7.1.1.2 Signing In Using a Web Browser

1. In the web browser's address field, type the IP address of a controller network port and press **Enter**.
2. The AMD RAIDXpert2 Management Tool Login is displayed. If the Login page does not display, verify that you have entered the correct IP address.
3. On the Login page, enter the name and password of a configured user. The default user name and password are admin and admin.

Note: Both usernames and passwords are case-sensitive.

4. Select a language at the drop-down menu.
5. Click Submit. If the system is available, the RAIDXpert2 GUI page is displayed; otherwise, a message indicates that the system is unavailable.

7.1.1.3 Tips for Signing In and Signing Out Using a Web Browser

- Do not include a leading zero in an IP address. For example, enter 10.1.4.33 not 10.1.4.033.
- Multiple users can be signed in to each controller simultaneously.

- For each active RAIDXpert2 session an identifier is stored in the browser. Depending on how your browser treats this session identifier, you might be able to run multiple independent sessions simultaneously. Internet Explorer can run separate RAIDXpert2 sessions if you select File > New Session. If you do not select a new session, all instances of Internet Explorer share the same session.
- End a RAIDXpert2 session by selecting Options > Logout. Do not simply close the browser window.

7.1.2 Desktop Shortcut Access

7.1.2.1 Signing In Using the RAIDXpert2 Desktop Shortcut

1. Launch the AMD RAIDXpert2 Management Tool using by double-clicking the RAIDXpert2 **desktop shortcut**.
2. The **AMD RAIDXpert2 Management Tool Login** is displayed. If the Login page does not display, verify that you have used the correct shortcut.
3. Select a language at the drop-down menu.
4. On the **Login** page, enter the name and password of a configured user. The default user name and password are admin and admin.

Note: Both usernames and passwords are case-sensitive.

5. Click **Submit**. If the system is available, the RAIDXpert2 GUI page is displayed; otherwise, a message indicates that the system is unavailable.

7.2 Password Protection

When the system displays a window that prompts you to choose a username and password, use the procedure below.

1. In the Username field, enter the new username.
2. In the Password field, enter the new password. Follow the guidelines in Section 7.2.1, Things to Know About Passwords, on page 55.
3. In the Confirm New Password field, re-enter the new password.

Note: Both usernames and passwords are case-sensitive.

4. Click **Submit**.

7.2.1 Things to Know About Passwords

- RAIDXpert2 cannot be opened without a password. Create a password that is easily remembered.
- The password must be 4 - 20 characters long.
- The password is case-sensitive.

- The application does not track previous passwords unless enabled through your web browser.
- To change an existing password, see Section 7.2.2, Change a Password at the Options Menu, on page 56.
- If a user forgets the username or password, delete rc_login.txt to restore the default user name and password (admin and admin).

7.2.2 Change a Password at the Options Menu

Note: Both usernames and passwords are case-sensitive.

1. At the Options menu, select **Password**.
2. The Choose a new Username and Password window displays.
3. In the Old Password field, enter the default password you used to login.
4. In the New Password field, enter the new password. Follow the guidelines in Section 7.2.1, Things to Know About Passwords, on page 55.
5. In the New Password field, re-enter the new password.
6. Click **Submit**.

7.3 Help and About Windows®

To view the software version and build number for the GUI, select About at the Help menu. The AMD RAIDXpert2 Driver Version and GUI Version displays.

For customer support, select **Help > User Guide**. A pdf version of this document will display. A pdf reader program will be necessary to view it.

For further customer support, contact your system supplier or motherboard vendor.

7.4 Reviewing the RAIDXpert2 GUI

7.4.1 The Array View Section of the Array Status Window

7.4.1.1 Elements of the Array View Section

The Array View section presents a graphical view of array properties. Table 14 provides information about the elements of the Array View section.

Table 14. Elements of the Array View Section, Array Status Window

| Element | Description |
|-------------------|--|
| Controller Name | The RAIDXpert2 controller for the arrays displayed below it. |
| Array | The number assigned to an array. |
| Array name | The name assigned to an array. |
| RAID Level | The RAID level of the array. |
| Disk Number | The number assigned to disks in an array. |
| Disk Manufacturer | The manufacturer of disks in an array. |
| Disk Model Number | The model number of the disks in an array. |

7.4.2 The Disk List Section of the Array Status Window

7.4.2.1 Elements of the Disk List Section

The Disk List section provides information about all disks assigned or available to arrays. Table 15 provides information about the elements of the Disk List section.

Table 15. Elements of the Disk List Section, Array Status Window

| Element | Description |
|-------------------|--|
| Disk | Disk number. |
| Capacity | Disk capacity: 1 MB = 1,000,000 bytes 1 GB = 1,000,000,000 bytes <i>Note: Because the ATA storage industry has standardized the meanings of MB as 1,000,000 bytes and GB as 1,000,000,000 bytes, RAIDXpert2 reports the same units</i> |
| Port Type | Type (SATA or NVME) and negotiated speed (not the speed of the port type). |
| GS | Indicates if the disk is assigned as a global spare. |
| State | State of the disk (Online, Offline, SMART Error). |
| Type | Disk type (Disk, Legacy, New). |
| Model | Disk manufacturer's model number. |
| Serial No. | Disk manufacturer's serial number. |
| Firmware | Disk manufacturer's firmware version. |
| Space Available | Total amount of space unused on the disk. |
| Largest Available | Largest contiguous unused space on the disk. |
| Features | Information about port communication and physical disk cache settings. |

If a disk is missing from the Disk List, the most likely cause is:

- A loose cable. Make sure that all disk cables are connected, then perform a rescan.
- A disk that is not fully seated in its bay or slot. Make sure that the disk is inserted completely in its bay or slot, then perform a rescan.

For more information, see Section 7.5.2, Rescan Disks, on page 62.

7.4.3 The Array List Section of the Array Status Window

7.4.3.1 Elements of the Array List Section

The Array List section provides information about the arrays. Table 16 provides information about the elements of the Array List section.

Table 16. Elements of the Array List Section, Array Status Window

| Element | Description |
|----------------|---|
| Device | The array number. |
| Partition | Drive letter that was assigned to this array during the partition process. (A blank space appears if the array has not been partitioned.) <i>Note: If a dynamic volume is created on an array, RAIDXpert2 cannot retrieve the volume's drive letter.</i> |
| Array Name | User-created name for the array. |
| Type | The RAID level (RAID type) or LEGACY. |
| Total Capacity | Total capacity: 1 MB = 1,000,000 bytes 1 GB = 1,000,000,000 bytes <i>Note: Because the ATA storage industry has standardized the meanings of MB as 1,000,000 bytes and GB as 1,000,000,000 bytes, RAIDXpert2 reports the same units.</i> |
| State | State of the array (NORMAL, CRITICAL, OFFLINE). |
| Task | Task type, if in progress (TRANSFORM, CHECK, CHECK_BITMAP, CREATE, RESTORE, ZERO, SECURE_ERASE). |
| Task State | The state of the task (STARTED, PAUSED, COMPLETED); the progress of the task is given in the Array View section. |
| Pri | Task priority if a task is in progress. |
| Scan | Background Array Scan enabled? (Yes/No). |
| Cache | Current cache setting (NC = No Cache, R = Read Cache, WB = Write Back Cache, RW = Read/Write Cache). |

7.4.4 The Event View Section of the Array Status Window

7.4.4.1 Elements of the Event View Section

The Event View section is an optional-view section. It can be displayed or hidden by selecting View > Event View.

The information in the Event View is linked to the View Log. The View Log displays user-initiated tasks or actions, and system-generated notifications and events. The View Log can be accessed by selecting View > Log.

The Event View provides information about the events. Table 17, on page 60, provides information about the elements of the Event View section.

Table 17. Elements of the Event View Section, Array Status Window

| Element | Description |
|----------|--|
| # | The number of the event. |
| Date | The date and time at which the event occurred. |
| Event | The RAIDXpert2 Asynchronous Event Notification (AEN) number of the event. |
| Priority | The notification priority of the event: Low, Informational, Warning, Critical, or Fatal. |
| Text | A brief description of the event. |

7.4.5 Array and Disk Commands

The Array and Disk menus of the Array Status window contain lists of commands. The commands allow the system user to initiate or modify array- and disk-related tasks.

Not all commands are available for an array or for the system. Availability depends on:

- The tasks that can be performed with the system's license level.
- The RAID level of an array. For example, a Consistency Check can be performed only on arrays at a redundant RAID level.
- The remaining capacity of the disk drives. For example, if a system has three disk drives and large arrays have used all of the capacity on two of the disks, only non-redundant Volume arrays can be created on the remaining disk. Certain commands are not available with a non-redundant array.

Table 18 provides page numbers for each command.

Table 18. Commands at the Array and Disk Menus

| Array Commands | See Detailed Information on this Page | Disk Commands | See Detailed Information on this Page |
|-----------------------|---------------------------------------|---------------|---------------------------------------|
| Create | page 64 | Initialize | page 61 |
| Name | page 66 | Rescan | page 62 |
| Transform | page 67 | Properties | page 62 |
| Prepare to Remove | page 70 | Options | page 63 |
| Delete | page 71 | | |
| Modify Cache Settings | page 72 | | |
| Task | page 73 | | |
| Check Consistency | page 73 | | |
| Background Array Scan | page 75 | | |
| Remove Spares | page 75 | | |
| Hide | page 76 | | |
| Secure Erase | page 76 | | |

7.5 Working with Disks

7.5.1 Initialize Disks

When a disk is initialized, RAIDXpert2 configuration information (metadata) is written to the disks. If a disk is new and has not been used before, or if it is a legacy disk, it must be initialized before it can be used in a RAIDXpert2 array. After a disk is initialized, it appears as Disk in the Disk List.

Note: All new disks and legacy disks will have an associated array. You must delete the array in order to initialize the disk.

7.5.1.1 To Initialize Disks

1. At the **Disk** menu, select **Initialize**. The Initialize Disk window displays.
2. Select the disk(s) to be initialized, by selecting the box next to the disk(s).
3. Click **Initialize Selected**.

7.5.2 Rescan Disks

The Rescan Command Performs the Following Actions:

- Rescans the SATA and PCIe channels that search for new, legacy, or removed disks.
- Rereads the configuration information from each disk.

When a disk is offline, it might be brought online by using a rescan. A rescan also stops and then automatically resumes all tasks.

To rescan disks, select **Rescan** at the **Disk** menu.

7.5.3 Change Cache Properties for Disks

The Read Ahead and Write Back Cache properties can be changed if the disks support this option. The default settings are:

- Read Ahead: enabled.
- Write Back Cache: enabled.

CAUTION: Leaving Write Back Cache enabled can increase the likelihood of data being corrupted if the system experiences a power interruption or unexpected shutdown.

Note: A disk's cache setting cannot be changed if a task is active for the array. The cache settings are enabled when the task is finished.

Note: As default setting NVME Physical disk Read and Write cache is disabled always. User cannot enable the setting as it may impact the operational performance of the NVME disk.

7.5.3.1 Change Disk Caching Properties

1. At the Disk menu, select **Properties**.
2. The Properties window opens.
3. Select the disks you want to change the properties of.
4. Click **Enable** or **Disable** for the desired settings.

Note: Each time Enable or Disable is clicked, the disk selection clears. To change multiple settings on one disk, select the disk before clicking each setting.

7.5.4 Assign Spares

Spare disks allow an array to be rebuilt when a disk fails. Global spares can be used in any array, while dedicated spares are assigned to a specific array.

7.5.4.1 Assign a Disk as a Dedicated or Global Spare

1. In the Disk List section, select a disk.
2. At the Disk menu, select **Options**.
3. Options for Disk Device displays in the Disk List panel.
4. Perform one of the following actions:
 - To use the disk as a dedicated spare, select **Assign as Dedicated Spare**.

***Note:** The capacity of a dedicated spare must be equal to or larger than the capacity of the smallest disk in the array.*

- To use the disk as a global spare, select Assign as Global Spare.
5. Click Confirm.

7.5.5 Legacy Disks

A legacy disk is a disk that contains valid data from a non-RAID controller.

A legacy disk appears in RAIDXpert2 (and in the BIOS Configuration Utility / RAIDXpert2 Configuration Utility (HII)) with a corresponding legacy array. When the legacy disk is initialized in RAIDXpert2 (or in the BIOS Configuration Utility / RAIDXpert2 Configuration Utility (HII)), the legacy array disappears.

***CAUTION:** A legacy disk can contain valid data. When a legacy array is deleted the data is lost.*

7.5.5.1 Legacy Disk and New Disk

Table 19 provides information on how disks appear in RAIDXpert2 web utility and in the BIOS Configuration Utility.

Table 19. New and Legacy Disks, as They Appear in the RAIDXpert2 Configuration Utility (HII) and RAIDXpert2

| Status of the Disk | RAIDXpert2 Web Utility | In the RAIDXpert2 Configuration Utility (HII) |
|---|--|--|
| New, un-initialized disk. | The disk appears as a new disk with a legacy array. When the new disk is initialized, its state changes to Online (or similar). | The disk appears as a new disk (the disk can appear with a legacy array). When the new disk is initialized, RAIDXpert2 configuration data is written to the disk. The disk state changes to Online. |
| A disk containing non-RAIDXpert2 configuration data. CAUTION: A legacy disk can contain valid data. When a legacy array is deleted, or when its corresponding legacy disk is initialized, the data is lost. | The disk appears as a legacy disk with a legacy array. When the legacy array is deleted, the legacy array disappears and the legacy disk type changes to Disk. The disk can now be used in RAIDXpert2 arrays. | The disk appears as a legacy disk with a legacy array. When the legacy array is deleted the state of the legacy disk changes to Empty. The disk can now be used in RAIDXpert2 arrays. |

See Chapter 7, AMD RAIDXpert2 Graphical User Interface (GUI), on page 54, for the disk initialization procedure and the appearance of legacy disks in the BIOS Configuration Utility.

7.6 Working with Arrays

7.6.1 Create and Format Arrays

RAIDXpert2 allows the partitioning and creation of as many as eight arrays across the system's disks. Portions of disks can be used to create arrays, at the same time that other arrays use different portions of the same disks.

7.6.1.1 Before You Begin...

Review the issues and recommendations indicated in Table 20.

Table 20. Creating Arrays: Issues and Recommendations

| Issues | Recommendations |
|------------------|---|
| Access to arrays | The creation of arrays, even redundant arrays, allows users immediate access to the arrays (unless the Zero Create option is used during the Create process). |
| Array numbers | Array numbers are valid only for a given boot, and can be different in the BIOS Configuration Utility and RAIDXpert2. If a permanent label is required, use the Array Naming feature described in Section 7.6.2, Name Arrays, on page 66. |
| Array size | The array size of the new array is limited to 2.199 TB on some versions of Windows. Refer to the operating system documentation for details on maximum array sizes. |
| Number of arrays | In some circumstances, more than eight arrays are possible. They might appear to function properly, but are not supported by AMD-RAID. |
| System reboot | When the system reboots, the creation process continues where it left off. |

7.6.1.2 Create an Array

7.6.1.2.1 Select an Array and Cache

- At the Array menu, select **Create**.
- Select the disk(s) to include in the array by checking the box next to the desired disk(s) in the **Select Active Disks:** field.

Note: Click **All** to select all disks, or click **Unused** to select disks that are not currently used in an array.

- Enter a name for the array in the **Array Name:** field.

Note: The following characters are not allowed in an array name

() ^ , | = “ ” .

- Select an array type at the **Array Type:** drop-down menu.
- At the **Organized As:** drop-down menu select an option.

Note: The **Organized As:** drop-down menu only displays options for advanced management of a RAID10 configuration if you selected RAID10.

- Enter the capacity in the **Capacity:** field. The maximum available capacity changes with:

- The disks that are selected.
 - The RAID level of the array.
7. Select a cache option at the Cache Options: drop-down menu. (The default is Read and Write Back Cache.)
 8. Check Background Array Scan to enable background array scanning. (A background array scan checks the sectors of the disks in an array for potential problems. A background array scan runs continuously, until the user stops it by accessing Array > Background Array Scan > Stop).

Note: See Section 7.6.12, *Scan an Array in the Background*, on page 75, for details.

9. Check Skip Initialize to skip initialization.

CAUTION: Creating a redundant array with Skip Initialization selected can result in data corruption.

10. Check Leave Existing Data Intact if an array is lost or deleted, and the user immediately creates a replacement array of the same characteristics. This leaves the data on the disks of the lost or deleted array untouched when the replacement array is created. See Table 39, on page 102, for additional information.
11. Check Zero Create to write zeros on the created array. If Zero Create is used, the array is not immediately available (the array is hidden from the operating system during the Create process).
12. Click Create to create the array.

7.6.1.3 Partition and Format an Array

Each operating system has different names and paths for partitioning and formatting arrays and as such are outside the scope of this document. For more information, see your operating system's user documentation.

7.6.2 Name Arrays

Naming an array can be useful when creating backups. It makes an array easy to identify in a list of arrays.

1. In the **Array View** section, select the array to name.
2. At the **Array** menu, select **Name**. The **Array Name** window displays.
3. Type the desired name in the blank field.

Note: The following characters are not allowed in an array name:

() ^ , | = “ ” .

4. Click **OK**. The array name appears in the Array List and in the BIOS Configuration Utility (only 17 characters of the name are displayed in the BIOS Configuration Utility).

7.6.3 Transform Arrays

With the Transform task, an array can be:

- Transformed from one RAID level to almost any other RAID level. This function is also referred to as Online RAID Level Migration (ORLM).
- Expanded dynamically, even under I/O load, by adding disks to the array to increase the capacity of the array. This function is also referred to as Online Capacity Expansion (OCE).

7.6.3.1 Before You Begin

Review the issues and recommendations indicated in Table 21.

Table 21. Transforming Arrays: Issues and Recommendations

| Issues | Recommendations |
|---------------------------------|--|
| Array size | An array cannot be transformed to a smaller-sized array. The transformed array must be the same size as or larger than the original array. |
| Array size limits | The array size of the transformed array is limited to 2.199 TB on some versions of the Windows operating system. Refer to the operating system documentation for details on maximum array sizes. |
| Disk failure during a Transform | If a disk fails while the Transform task is in progress, no data is lost as long as the source and destination RAID levels are redundant. If a spare has been assigned to the destination array, a fail-over task starts as soon as the Transform completes (if the spare is available after the Transform). |
| Multiple arrays | If there are multiple arrays, it might not be possible to transform some of the arrays to a larger size. If, in the future, an array needs to be expanded in size, it is best to configure the available space as a single array. |

Table 21. Transforming Arrays: Issues and Recommendations (Continued)

| Issues | Recommendations |
|----------------------------------|--|
| Task control commands | When using task control commands, a Transform task can only be paused or resumed but not removed. To end a Transform task, pause and delete it. <i>Note: If a task is paused and then deleted, the array is deleted. Deleting a task is the same as deleting an array. Data loss occurs when a task is deleted. Please ensure that data is backed up prior to deleting a task involving a Transform or a Restore.</i> |
| System reboot during a Transform | If the system reboots during a Transform, the Transform continues where it left off. |

7.6.3.2 Transform an Array

1. In the Array View section, select the array to transform.
2. At the Array menu, select Transform.

Note: If the system window is not wide enough, only the Destination View is displayed.

3. Select all the desired disks for the array (including disks that might be already in the array) by selecting the box next to the drive in the Disk List section.

*Note: Click **Same** to select all disks currently used in the array, **All** to select all disks, or **Unused** to select disks that are not currently used in an array.*

4. Select the RAID level to be transformed at the Array Type: drop-down menu.
5. At the Organized As: drop-down menu select an option.

Note: The Organized As: drop-down menu only displays options for advanced management of a RAID10 configuration if you selected RAID10.

6. Expand the array by entering the size of the new array in the Capacity: field. The maximum available capacity changes with:
 - The disks that are selected.
 - The RAID level of the array.

Note: If a Transform is not possible, the Commit option is not enabled. A typical reason preventing a Transform is insufficient available space on the disks.

7. Click Commit.

Note: Unless the transformation is instantaneous, the Array Status window updates to show the source and destination arrays, along with the progress of the transformation.

7.6.3.3 Access Additional Space

After an array has been transformed to a larger size, use the operating system tools to access the additional space.

There are several possible methods for expanding the existing file system on an array that has been transformed to a larger size:

- Microsoft® provides a command prompt utility called Diskpart.exe that can expand any NTFS file system without requiring a reboot. The Diskpart.exe utility version to use depends on the version of Windows being run. The Diskpart.exe utility can be found on the CD that comes with some versions of Windows, or at the Microsoft website (<http://www.microsoft.com>) for others. Use the correct version for the operating system.
- For arrays formatted with FAT32, use a third-party application, such as PartitionMagic from PowerQuest Corporation.

7.6.4 Restore (Rebuild) Arrays

With the Restore task, a redundant-type array whose state has changed to Critical can be restored (rebuilt) in one of two ways:

- By assigning a dedicated spare to the array.
- By creating a global spare or by using an existing global spare. (An existing global spare automatically starts restoring a redundant-type array after the array's state changes to Critical.)

An array in an Offline state cannot be restored. This means that non-redundant arrays (Volume, RAID0) cannot be restored: when a single disk in a non-redundant array fails, the array state changes to Offline.

***Note:** If a Critical redundant array that is being restored loses a second disk (RAID1 or RAID5), or loses a second disk in the same mirror set (RAID10), the Restore task fails. The array must be re-created from backup storage data.*

7.6.4.1 Before You Begin

- Make sure that the disk chosen as the dedicated spare or global spare has sufficient available capacity to restore the array. The capacity of the spare disk must be equal to or larger than the capacity of the smallest disk in the critical array.
- Know how to create a global or dedicated spare. See Section 7.6.13, Add or Remove Dedicated Spares, on page 75 or Section 7.6.14, Add or Remove Global Spares, on page 76.

7.6.4.2 Restore a Critical Array

1. In the Array View section, select the critical array.
2. At the Disk List section, select a disk.
3. At the Disk menu, select **Options**. Options for Disk Device displays in the Disk List panel. Perform one of the following actions:
 - To use the disk as a dedicated spare, select Assign as Dedicated Spare.
 - To use the disk as a global spare, select Assign as Global Spare.
4. Click **Confirm**.

7.6.5 Prepare to Physically Remove an Array

7.6.5.1 Physically Remove an Array

CAUTION: Prior to removing an array, remove its drive letter.

1. In the Array View section, select the array to remove.
2. At the Array menu, select Prepare to Remove.
3. At the Prepare to Remove window, click Yes. The array and all associated disks disappear from the Array Status window.
4. Remove the first disk from the system.
5. When the Drive Removed window displays, click Cancel.
6. Remove the remaining disks in the array.
7. When all disks in the array are removed from the system, select Rescan at the Disk menu.

7.6.5.2 Array Migration

The disks in an array, after being removed from one system with a RAIDXpert2 controller, can be migrated to another system with a RAIDXpert2 controller. The disks and array(s) appear in the second system, in Disk Management, the BIOS Configuration Utility, and RAIDXpert2, as normal RAIDXpert2 disks and array(s).

If the disks from a RAIDXpert2 system are migrated to a non-RAIDXpert2 Windows-based system, the disks appear in Disk Management of the second system as healthy, unknown partitions. To use the disks, use Disk Management to delete the RAIDXpert2-created partitions and to create Windows partitions on the disks.

CAUTION: All data contained in a RAIDXpert2 array are lost if the RAIDXpert2 disks of the array are migrated to a non-RAIDXpert2 system.

7.6.6 Delete Arrays

CAUTION: Deleting an array permanently destroys all data that is on the array. This action cannot be undone and it is very unlikely the data can be recovered.

7.6.6.1 Before You Begin

Review the issues and recommendations indicated in Table 22.

Table 22. Deleting Arrays: Issues and Recommendations

| Issue | Recommendation |
|-----------------------------------|---|
| Drive letters or partitions | Remove drive letters or partitions from the array using procedures in your operating system. Each operating system has different names and paths for removing drive letters or partitions and as such are outside the scope of this document. For more information, see your operating system's user documentation. |
| Operating system impact on arrays | If the array is not being used by the operating system, the array can be deleted at any time, even while tasks are running on the array. If the array is being used by the operating system, the array cannot be deleted. Therefore, a RAIDXpert2 bootable array cannot be deleted in RAIDXpert2. A RAIDXpert2 bootable array can only be deleted in the BIOS Configuration Utility. |

7.6.6.2 Delete an Array

1. In the Array Status window, select the array to delete.
2. At the Array menu, select Delete. A windows opens, warning about deleting the array.
3. Click **OK**. The array disappears from the Array View section.

Note: Also see Section 8.5, Delete Arrays: `rcadm --delete`, on page 86.

7.6.6.3 Recreate a Deleted Array

If an array is deleted, it might be possible to recreate the array. See

Table 39, Recreate a Deleted Array, on page 102.

7.6.7 Change Cache Settings for Arrays

Table 23 provides information about the four array-caching options available.

Table 23. Cache Array Options

| Option | Description |
|---|---|
| No Cache | I/O requests are translated and passed to the disks without keeping a cached copy of the data available for future requests |
| Read Cache | Data reads are cached, if appropriate. This option performs sequential Read Ahead, when necessary |
| Write Back Cache | Data writes are cached. This setting is intended for advanced users who understand the implications of Write Back caching |
| Read + Write Back Cache (default setting) | Both Read and Write Back Cache options can be selected |

Note: Cache options cannot be changed while a task is active on the array. They can be changed at any other time, including while I/O is running.

7.6.7.1 Change Cache Settings

1. In the **Array View** section, select the array on which to change caching options.
2. At the Array menu, select **Modify Cache Settings**.
3. Choose **No Cache**, **Read Cache**, **Write Back Cache**, or **Read + Write Back Cache**. The new cache setting displays in the Array List Cache information.

7.6.8 Change the Priority Level of a Task

The task priority command allows the user to speed up or slow down tasks being performed on arrays.

To decrease the amount of time it takes for a task to complete, set the task priority higher (10 is the highest).

Note: A task priority can only be changed after a task is running on the array.

7.6.8.1 Change a Task Priority

1. In the Array View section, select the array on which tasks are being performed.
2. At the Array menu, select **Task** and select **Priority**.

3. At the Task Priority window, change the task priority by moving the slide one way or the other.
4. Click **OK**.

7.6.9 Interrupt, Cancel, or Resume a Task

The task control commands allow the user to pause, resume, or cancel (remove) tasks being performed on arrays.

Full task control can be used on Create, Consistency Check, and Check Bitmap tasks. On Restores with dedicated or global spares the task can be removed, but the array returns to the Critical state.

***Note:** Task control can be used only when a task is running on an array.*

7.6.9.1 Interrupt, Cancel, or Resume a Task

1. In the **Array View** section, select the array on which a task is being performed.
2. At the **Array** menu, select **Task** then click:
 - **Pause** to interrupt the task.
 - **Remove** to cancel the task.
 - **Resume** to interrupt the task.

7.6.10 Check for Consistency

For redundant-type arrays only, the Consistency Check task is available at the Array menu. When this task is selected it starts the process of verifying that the parity (RAID5) or mirror drive consistency for fault-tolerant disks is correct. If inconsistent areas are found, they are corrected during this process.

Having consistent arrays is very important. If an array is inconsistent and a drive fails, data is lost. RAIDXpert2 is designed to maintain consistent arrays, but it is good practice to run frequent consistency checks. See Section 7.6.11, Schedule a Consistency Check, on page 74.

When a redundant array is created using the Create command, and the Skip Initialize option is not checked (the default setting), a Consistency Check is performed automatically. Although a Consistency Check that runs during a Create task can be removed (by highlighting the array and selecting **Task > Remove**), the array that is created is not redundant. Unless a Consistency Check runs from end-to-end, an array is not protected.

After a Consistency Check has been started, adjust the priority of the Consistency Check task relative to user I/O activity. Use the Task Priority option (see Section 7.6.8, Change the Priority Level of a Task, on page 72).

A Consistency Check task can be scheduled with the Schedule Consistency Check task (see Section 7.6.11, Schedule a Consistency Check, on page 74).

7.6.10.1 Before you Begin

- The Consistency Check command can be started at any time on a redundant-type array, as long as another task is not running on the array.
- The Consistency Check command can be started while under I/O load.
- If the array state is Critical, the Consistency Check fails.
- To estimate the remaining time for a Consistency Check, look at the percentage of the task that is completed (in hours: minutes: seconds). These details are displayed next to the array in the Array View section of the Array Status window.

7.6.10.2 Manually start a Consistency Check

1. In the Array View section, select the array on which to run the Consistency Check.
2. At the Array menu, select Check Consistency.
3. Click Start.

7.6.10.3 Manually stop a Consistency Check

1. In the Array View section, select the array on which to stop the Consistency Check.
2. At the Array menu, select Check Consistency.
3. Click Stop.

7.6.11 Schedule a Consistency Check

A Consistency Check task can be scheduled for later in the day or week. A Consistency Check task can be scheduled to run each week or each month.

Note: Schedule only one Consistency Check event on an array. This means that if a monthly check has been scheduled and a weekly check is desired, delete the monthly event and schedule the new event.

Table 24 provides information on the available scheduling options for a Consistency Check.

Table 24. Consistency Check Options

| Option | Description |
|---------------|---|
| One Time Only | Schedule the Consistency Check for the current day (“Today”) or up to seven days in the future. |
| Weekly | Events can be scheduled weekly. After it is selected, a Consistency Check runs on the specified array at the same time each week. |
| Monthly | Events can be scheduled to run once per month to run on the specified array at a specified time. |

7.6.11.1 Schedule a Consistency Check for Later

1. In the Array View section, select the array on which to run the Consistency Check.
2. At the **Array** menu, select **Check Consistency**.
3. Select **Schedule**.
4. At the Check Consistency window, select the **Frequency**, **Day**, and **Time**, then click **Confirm**.

7.6.11.2 Delete a Scheduled Consistency Check

1. In the Array View section, select the array to on which to delete the Consistency Check.
2. At the Array menu, select **Check Consistency**.
3. Select **Schedule**.
4. At the Consistency Check window, click **Remove**.

7.6.12 Scan an Array in the Background

A Background Array Scan task performs a continuous background read operation of an array, accessing at least one copy of every block of the array from beginning to end.

A Background Array Scan is manually started by the user and runs continuously until the user stops it.

Although a Background Array Scan can run while an array is engaged in other tasks, it is recommended that the Background Array Scan run while the array is idle (that is, when there is no I/O to or from the array).

7.6.12.1 Enable or Disable a Background Array Scan

1. In the Array View section, select the array to on which to run the Background Array Scan.
2. At the Array menu, select **Background Array Scan**.
3. Enabled or disable the Background Array Scan.
 - To enable a Background Array Scan, select **Start**.
 - To disable a Background Array Scan, select **Stop**.

Note: A Background Array Scan can also be enabled for an array when it is created.

7.6.13 Add or Remove Dedicated Spares

If a dedicated spare is added, make sure there is adequate space on the dedicated spare.

7.6.13.1 Add a Dedicated Spare

1. In the Array View section, select the array on which to assign a dedicated spare.
2. In the Disk List section, select the disk chosen as the dedicated spare.

3. At the **Disk** menu, select **Options**.
4. Select **Assign as Dedicated Spare**, then click **Confirm**.

7.6.13.2 Remove a Dedicated Spare Assignment

1. In the Array View section, select the array from which to remove a dedicated spare.
2. At the **Disk** menu, select **Options**.
3. Select **Remove as Dedicated Spare**, then click **Confirm**.

TIP: For additional information see Section 3.10, *Sparing Options: Disks and Arrays*, on page 31.

7.6.14 Add or Remove Global Spares

If a global spare is being added, make sure there is adequate space on the global spare.

7.6.14.1 Add a Global Spare

1. In the Disk List section, select the disk chosen as the global spare.
2. At the **Disk** menu, select **Options**.
3. Select **Assign as Global Spare**, then click **Confirm**.

7.6.14.2 Remove a Global Spare

1. In the Disk List section, select the disk to be removed as the global spare.
2. At the **Disk** menu, select **Options**.
3. Select **Remove as Global Spare**, then click **Confirm**.

7.6.15 Hide an Array

Hide allows the user to hide the array from the operating system.

7.6.15.1 Hide an Array

1. In the Array View section, select the array to hide.
2. At the **Array** menu, select **Hide**. The array will disappear from the Array View.

Note: If the array is currently hidden, select **Array > Un-hide** to display it.

7.6.16 Secure Erase

Secure Erase is used for erasing all data on an array and ensuring that it will be unrecoverable, even with advanced data recovery techniques.

Data is Securely Erased By:

- Hiding the array from the OS

- Writing over each region of the disk with 3 patterns (0xAA, 0x55, and random)
- Using a 4 pass with all zeros to ensure that a RAID1, or RAID5 will be consistent

After the secure erase is complete, a user can choose to manually delete the array or reuse it. If the user chooses to reuse it, it must be unhidden using the procedure in Section 7.6.15, Hide an Array, on page 76.

CAUTION: When an array is securely erased, the data on the array is lost.

7.6.16.1 Securely Erasing an Array

1. In the Array View section, select the array to erase.
2. At the Array menu, select **Secure Erase**, then click **OK**.

7.7 Working with Views

The View menu allows the user to:

- Display the event view.
- Display the event log.
- Refresh the display.

7.7.1 Display or Hide Controller Event Log Panel

To display or hide the Controller Event Log, select **Event View** at the View menu. When the Controller Event Log panel displays, a checkmark appears next to the **Event View** option at the View menu.

7.7.2 Log Window

The [system name]: View Log window displays all of the messages generated by RAIDXpert2. All messages are logged, not just the ones enabled at **Options > Notification**.

All messages received from the RAIDXpert2 driver are sent to a message log file. If desired, change the name of this file in the Notification window.

By default, notification events in Windows-based systems are saved to:

%Program Files%\RAIDXpert2\rc_service.log.

At the View menu, select Log to view the RAIDXpert2 messages.

7.7.3 Refresh the Display

To refresh the display, select Refresh at the View menu.

7.8 Working with Options

7.8.1 Change Password Settings

A password can be changed at the Options menu. See Section 7.2.2, Change a Password at the Options Menu, on page 56.

7.8.2 Set Event Notifications

With the Notification option, the user can manage event log and email notifications of events.

The Event View section of the Array Status window displays the priority listing. The event log priority levels, in ascending order, are indicated in Table 25.

Table 25. Event Log Priority Levels

| Event Priority | Description |
|----------------|---|
| Low | Displays messages for normal system operations. (This event is not displayed unless requested by the user.) |
| Informational | Displays information that might be useful to know. |
| Warning | The system user should to be informed about this event, but probably does not need to take action. |
| Critical | The system user must be informed about this event and should take action. |
| Fatal | The RAIDXpert2 driver is fatally damaged and the RAID subsystem has shut down. |

7.8.2.1 Set or Change Event Notifications

1. At the **Options** menu, select **Notification**. The Notification Setup window opens.
2. Specify the **Outgoing Mail Server (SMTP)** and **To Email Address**, to which e-mail messages are sent when an event occurs.
3. If the SMTP server requires a login, check the Server Required Login box and enter a valid Username and Password for the server.
4. Specify a user address as the sender of the e-mail notifications in From Email Address. (By default, the system on which RAIDXpert2 is installed is used.)
5. Click **Send Test Message** to verify that the e-mail notification works.
6. To disable messaging, uncheck the Enable Messaging check box in the Notification Events section.

7. Choose the types of notification events to use (Email or Event Log) for each event priority (Low, Informational, Warning, Critical, Fatal) by selecting the appropriate options.

Note: Warning, Critical, and Fatal events will always display in the Event Log.

7.8.3 Licensing

To display Licensing information, including available licensing levels, select **License** at the **Options** menu.

7.9 Add Spares Using a RAIDABLE Array

Note: RAIDABLE array is formerly known as RAID Ready array.

1. Install a new disk. After a rescan, a pop-up window opens.

Note: To create a redundant RAID1 array, the new disk must be the same size or greater than the RAIDABLE disk.

2. In the Select a Disk section, select the new disk.
3. In the Choose a Task section, select the desired option.

Note: Selecting any option first initializes the disk before the selected task is started.

- a. **Backup Array:** This option creates a backup of the RAIDABLE array on the new disk.
- a. **Transform Array:** This option allows the user to either add space to the RAIDABLE array or create a redundant array.
- b. **Initialize Disk for AMD-RAID:** This option allows the disk to be used when creating arrays.
- c. **Make disk a Global Spare:** This option assigns the new disk as a global spare.
4. In the Select a Source/Destination section:
 - a. Select the Source **RAIDABLE Array** from the drop-down menu.
 - b. Select the **Destination Array Type** from the drop-down menu.

Note: The Destination Array Type option is only available when either the Backup Array task or Transform Array task is selected. Only valid array types for the number of disks inserted will be displayed. For example, if one new disk is inserted, only RAID0 or RAID1 will display in the drop-down menu.

5. Click **Confirm**.

If either the Backup Array task or Transform Array task is selected, a Task Progress dialog box opens. To hide the dialog box while the task is executing, click Close.

Chapter 8 **rcadm Command Line Interface Tool**

8.1 **What is rcdm?**

The `rcadm` program is a command line interface (CLI) tool for managing RAIDXpert2 in the Windows or EFI operating system.

The `rcadm` program initiates RAIDXpert2 operations, such as:

- Manage RAIDXpert2, arrays and disks (see Section 8.2, Manage Arrays and Disks: `rcadm --manage`, on page 81).
- Create new arrays (see Section 8.4, Create New Arrays: `rcadm --create`, on page 85).
 - Delete arrays (see Section 8.5, Delete Arrays: `rcadm --delete`, on page 86).
- Transform arrays (see Section 8.6, Transform Arrays: `rcadm --transform`, on page 86).
- Follow or monitor arrays and disks (see Section 8.7, Follow or Monitor Arrays and Disks: `rcadm --follow`, on page 87).
- Information on drive and array states.

The `rcadm` program has five primary modes, with most primary modes having additional optional arguments. The five modes of operation are indicated in Table 39.

Table 26. Modes for the `rcadm` Program

| Mode | Usage |
|-----------|---|
| Manage | Uses the <code>rcadm --manage</code> command to manage and query RAIDXpert2, arrays, and disks. |
| Create | Uses the <code>rcadm --create</code> command to create a new array. |
| Delete | Uses the <code>rcadm --delete</code> command to delete arrays. |
| Transform | Uses the <code>rcadm --transform</code> command to transform an array. |
| Follow | Uses the <code>rcadm --follow</code> command to follow or monitor arrays and disks. |

Follow these instructions to issue the command on the operating system. Also, see Section 8.3, View Help from the Command Line, on page 85.

8.1.1 To Use rcadm with a Windows® Operating System

- Change directories to %Program Files%\RAIDXpert2.
- Run the `rcadm.exe` command from there.
- or
- Add %Program Files%\RAIDXpert2 to the system or user path environment variables.

8.2 Manage Arrays and Disks: `rcadm --manage`

The `rcadm --manage` or `rcadm -M` command allows the user to view information about RAIDXpert2 and manage the arrays and disks.

For example, the user can:

- Set cache attributes for arrays.
- Set priority levels for tasks on an array.
- Hide and unhide arrays.
- List arrays.
- Initialize disks.
- Query information about disks.
- Add and remove spares from an array.
- Set cache attributes for disks.

8.2.1 Understand Query Output

When the `rcadm --manage --query-all` command is used, information about the disks and arrays for the system is displayed.

To see information about a specific controller, disk, or array use the `rcadm --manage --query` command, in conjunction with the appropriate options.

8.2.2 rcadm Controller List Elements

Table 27. rcadm Controller List Elements

| Element | Description |
|--------------------|--|
| Number | Controller number assigned by RAIDXpert2 |
| Type | Model number of the controller |
| Serial Number | Serial number of the controller |
| Port Count | The number of ports supported by RAIDXpert2 |
| PCIe® Vendor ID | The PCIe vendor identification number |
| PCIe Device ID | The PCIe device identification number |
| PCIe SubVendor ID | The PCIe sub-vendor identification number |
| PCIe SubDevice ID | The PCIe sub-device identification number |
| SAS Address (WWID) | The SAS Address (world-wide identification number) |
| BIOS Version | The version of the AMD-RAID Configuration BIOS |

8.2.3 rcadm Disk List Elements

Table 28. rcadm Disk List Elements

| Element | Description |
|--------------------|---|
| Disk | Disk number assigned by RAIDXpert2, corresponding to the SATA channel ID. |
| State | State of the disk (Online, Failed, Unknown) |
| Disk Type | Disk type (Disk, Legacy, New, ATAPI) |
| Port Type | Port type (SATA I, SATA II, SATA III, SSD, NVME) <i>Note: for NVME the port type is always N/A.</i> |
| Port Speed | The negotiated speed of the port |
| Size | Total size of the disk: <ul style="list-style-type: none"> 1 MB = 1,000,000 bytes 1 GB = 1,000,000,000 bytes <i>Note: Because the ATA storage industry has standardized the meanings of MB as 1,000,000 bytes and GB as 1,000,000,000 bytes, RAIDXpert2 reports the same units.</i> |
| Free Space | Total amount of space unused on the disk |
| Largest Free Space | Largest contiguous unused space on the disk |
| GS | Indicates if the disk is assigned as a global spare |
| Ca | Current disk cache setting (NC = No Cache, R = Read Cache, W = Write Back Cache, RW = Read + Write Back Cache). |
| Ctrl Chan | Disk controller and channel number. |
| Vendor | Disk vendor |
| Model Number | Disk model number |
| Firmware Version | Disk firmware version |
| Serial Number | Disk serial number |

8.2.4 rcadm Array List Elements

Table 29. rcadm Array List Elements

| Element | Description |
|----------------------|---|
| A | Array number assigned by RAIDXpert2 |
| Type | RAID type. |
| O.S. Name | Name assigned by the operating system to the array. The name shows as “Hidden” if the array is hidden from the operating system. The name shows “??” if the array is Offline. |
| Sys or System Device | Indicates whether or not the array is being used as a system disk under Windows |
| State | State of the array (Normal, Critical, Offline) |
| Size or Capacity | Total size of the disk: <ul style="list-style-type: none"> 1 MB = 1,000,000 bytes 1 GB = 1,000,000,000 bytes <i>Note: Because the ATA storage industry has standardized the meanings of MB as 1,000,000 bytes and GB as 1,000,000,000 bytes, RAIDXpert2 reports the same units.</i> |
| Hide | Whether the array is hidden from the operating system |
| Id | Globally unique identifier for the array assigned by RAIDXpert2 |
| Task | Task type (Transform, Check, Check_Bitmap, Not_Active, Create, Restore) <i>Note: See Section 3.7, Array Tasks: Starting and Stopping Tasks, on page 28 for detailed definitions.</i> |
| Task State | The state of the task (Started, Paused, Completed) |
| % | The progress of a current array task, such as a Create or Transform, shown as percent complete |
| CA | Current array cache setting (NC=No Cache, R=Read Cache, W=Write Back Cache, RW=Read + Write Back Cache). |

Table 29. rcadm Array List Elements (Continued)

| Element | Description |
|-----------------|---|
| Scan | Background scan enabled (Yes/No) |
| Name | User-supplied name for the array |
| Dedicated Spare | Indicates the number of dedicated spares assigned to the array (<code>--verbose</code> mode only) |
| Disk | Listing of disks that are part of the array |
| Used | Capacity used of a specific disk |
| Offset | Location on the disk where the array begins |

8.3 View Help from the Command Line

8.3.1 To view a List of the Major Modes of Operation

Type: `rcadm --help` or `rcadm -?`

8.3.1.1 To View Help for a Specific Mode and its Options

Type: `rcadm <mode> --help` or `rcadm < mode> -?`

For example, typing `rcadm --manage --help` displays help and examples regarding that specific mode and its options.

8.4 Create New Arrays: `rcadm --create`

The `rcadm --create` or `rcadm -C` command allows new arrays to be created. As many as eight arrays can be partitioned and created across all disks.

Portions of disks can be used to create arrays, while other arrays are using different portions of the same disks. A maximum of eight arrays can be created.

8.4.1 Before You Begin...

Creation of arrays, even redundant arrays, allows users immediate access to the arrays. If the system reboots, the creation process continues where it left off.

CAUTION: In some circumstances, more than eight arrays are possible. They might appear to function properly, but are not supported.

Note: The array size of the new array is limited to 2.199 TB with some operating systems. Refer to the operating system documentation for details on maximum array sizes.

Note: The ability to create RAID10 or RAIDABLE arrays may not be available on your system.

8.4.2 Example

To create a 1 GB RAID5 array using disk members 1, 2, and 3, type: `rcadm -C -r5 -d 1 2 3 -s 1000`

To see more examples, type: `rcadm -C -?`

8.5 Delete Arrays: `rcadm --delete`

The `rcadm --delete` or `rcadm -D` command allows the user to delete one or more arrays.

CAUTION: Deleting an array permanently destroys all data that is on the array. This action cannot be undone and it is very unlikely the data can be recovered.

8.5.1 Before You Begin...

- If the operating system is using an array it cannot be deleted.
- If an array is accidentally deleted, and the user wants to try and recover the data, create an array using the same disks, same size, and same cache, and use the `--leave-existing-data` option. This option writes new configuration information to the array while trying to use the exact same disk space as before.

8.5.2 Example

To delete array 1, type: `rcadm -D -a 1`

To see more examples, type `rcadm -D -?`

8.6 Transform Arrays: `rcadm --transform`

The `rcadm --transform` or `rcadm -T` command allows the user to transform (migrate) an array from one RAID level to almost any other RAID level, and to expand the array dynamically, even under I/O load.

8.6.1 Before You Begin...

- An array cannot be transformed to a smaller-sized array. New arrays must be either the same capacity or larger.
- When using the task control option, a Transform can only be paused or resumed but not removed.
- If a spare has been assigned to the destination array, a fail-over task starts as soon as the Transform completes, provided the spare is available after the Transform.
- If there are multiple arrays on a single controller, it might not be possible to transform some of the arrays to a larger size. If the size of an array might be expanded in the future, it is best to configure the available space as a single array.
- The array size of the transformed array is limited to 2.199 TB on some operating systems.

8.7 Follow or Monitor Arrays and Disks: **rcadm --follow**

The `rcadm --follow` or `rcadm -F` command allows the user to follow or monitor arrays and disks. It polls the RAID subsystem for any changes in status and sends an e-mail notification and/or executes a specified program. The output of this command is logged to the System Event Log on Windows.

8.7.1 Before You Begin...

It is recommended that the user not run more than one instance of `rcadm --follow` at the same time. If the user runs more than one instance of the command, each instance captures some of the events but no single instance captures all events.

8.8 **rcadm.efi** Information

8.8.1 **rcadm -?**

`-?, --help`

Displays all primary `rcadm` commands, or if used after an option, displays help for that specific option.

`-log, --log-file`

Print output to a log file as well as standard output. Requires a log file name argument. Overwrites existing file. Only one occurrence of this option on the command line is allowed.

Example: `rcadm -M -qa -v -log status.txt`

-C, --create

Command for creating arrays. Array types include linear (JBOD), volume (JBOD), RAID0, RAID1, RAID1n, RAID10, RAID10n, RAID5, RAID50, RAID6, RAID60, and RAIDABLE. Some of the major functions include assigning spare disks; setting array size; setting the number of disks in each sub member of a RAID10n or RAID50 array; and setting cache attributes.

-D, --delete

Command for deleting arrays. This mode does not have any optional arguments.

-M, --manage

Commands for managing and querying controllers, arrays, and disks. Some of the major functions include querying for information, adding and removing dedicated and global spare disks, setting cache attributes for arrays and disks, performing consistency checks on redundant array types, initializing disks, prioritizing tasks for arrays, scanning arrays and disks for changes in status, and hiding or unhiding arrays.

8.8.2 rcadm -M

MANAGE

-a, --array

Used with certain options to specify arrays.

-as, --add-spare

Adds a dedicated spare disk to an array. No space is reserved on the disk selected.

-rs, --remove-spare

Removes a dedicated spare disk from an array.

-ras, --remove-all-spares

Removes any spares from an array.

-ags, --add-global-spare

Adds a disk as a global spare. No space is reserved on the disk selected.

-rgs, --remove-global-spare

Removes a global spare disk.

-ca, --cache-array

Sets the cache attributes for an array. Cache attributes include read cache (r), read and write-back cache (rw), write-back cache (w), and no cache (nc).

`-cd, --cache-disk`

Sets the cache attributes for a disk. Cache attributes include read cache (r), read and writeback cache (rw), write-back cache (w), and no cache (nc).

`-d, --disk`

A required qualifier used with certain options to specify disks.

`-h, --hide`

Hides an array from the operating system.

`-uh, --unhide`

Unhides an array, making it visible to the operating system.

`-id, --initialize-disk`

Initializes a disk. If the disk is new and has not been used, you must initialize it before you can create arrays.

`-n, --name`

Identifies an array with a user-supplied name. The name can be up to 30 characters, but only 17 of those characters display in the BIOS.

`-p, --priority`

Sets an array's task priority from 1-10, with 10 being the highest priority.

`-q, --query`

Lists information about specific controllers, arrays, and disks.

`-qa, --query-all`

Lists information about controllers, arrays, and disks.

`-v, --verbose`

Modifier of the `--query` and `--query-all` option. Specifies more detail for arrays and disks.

`-rsc, --rescan`

Rescans the serial ATA (SATA) and PCIe channels for new or removed disks.

`-sa, --scan-array <on|off>`

Specifies if background array scan scanning is on or off.

`-sp, --smart-poll`

Turns SMART polling on or off for the specified drive(s).

`-t, --task`

Used to pause, resume, and remove tasks.

`-ul, --unlink`

Unlinks two arrays linked through a create copy operation.

SYNTAX and EXAMPLES

ADD SPARE

```
--add-spare --array <list> --disk <list>  
-as -a <list> -d <list>
```

Examples: `rcadm --manage --add-spare --array * --disk 1`
`rcadm -M -as -a 1 2 -d 5 6`

REMOVE SPARE

```
--remove-spare --array <list> --disk <list>  
-rs -a <list> -d <list>
```

Examples: `rcadm --manage --remove-spare --array 5 --disk *`
`rcadm -M -rs -a * -d 5`

REMOVE ALL SPARES

```
--remove-all-spares --array <list>  
-ras -a <list>
```

Examples: `rcadm --manage --remove-all-spares --array 5`
`rcadm -M -ras -a *`

ADD GLOBAL SPARE

```
--add-global-spare --disk <list>  
-ags -d <list>
```

Examples: `rcadm --manage --add-global-spare --disk 1 2 3`
`rcadm -M -ags -d *`

REMOVE GLOBAL SPARE

```
--remove-global-spare --disk <list>  
-rgs -d <list>
```

Examples: `rcadm --manage --remove-global-spare --disk *`
`rcadm -M -rgs -d 5`

CACHE SETTINGS FOR ARRAYS

```
--cache-array <cache_attribute> --array <list>  
-ca <cache_attribute> -a <list>
```

Cache attributes: <r> for read cache

<rw> for read and write-back cache

<w> for write-back cache

<nc> for no cache

Examples: `rcadm --manage --cache-array rw --array *`
`rcadm -M -ca nc -a 1`

DISK SETTINGS (Advanced)

Disk cache:

```
--cache-disk <cache_attribute> --disk <list>  
-cd <cache_attribute> -d <list>
```

Cache attributes: <r> for read cache

<rw> for read and write-back cache

<w> for write-back cache

<nc> for no cache

Examples: rcadm --manage --cache-disk r --disk 1 2 3

```
rcadm -M -cd w -d *
```

HIDE ARRAY

```
--hide --array <list>  
-h -a <list>
```

Examples: rcadm --manage --hide --array 5 6

```
rcadm -M -h -a 4
```

UNHIDE ARRAY

```
--unhide --array <list>  
-uh -a <list>
```

Examples: rcadm --manage --unhide --array *

```
rcadm -M -uh -a 5
```

INITIALIZE DISK

```
--initialize-disk --disk <list>  
-id -d <list>
```

Examples: rcadm --manage --initialize-disk --disk *

```
rcadm -M -id -d 1 2 3
```

NAME ARRAY

```
--name "name" --array <list>  
-n "name" -a <list>
```

Examples: rcadm --manage --name "System Disk" --array 5

```
rcadm -M -n "Backup Disk" -a 4
```

QUERY

```
--query [--array <list>] [--disk <list>]
      [--verbose]
-q [-a <list>] [-ct <list>] [-d <list>] [-v]
```

Examples: `rcadm --manage --query --array 1 --disk --verbose`

```
rcadm -M -q -a 1 2 3 -d -v
```

QUERY ALL

```
--query-all
-qa
```

Example: `rcadm --manage --query-all`

RESCAN DISKS

```
--rescan
-rsc
```

Example: `rcadm --manage --rescan`

SCAN ARRAY

```
--scan-array <on|off> --array <array_number>
-sa <on|off> -a <array_number>
```

Example: `rcadm -M --array 1 --scan-array on`

```
rcadm -M -a 1 -sa off
```

SMART POLL

```
--smart-poll <on|off> --disk <list>
-sp <on|off> -d <list>
```

Example: `rcadm --manage --smart-poll on --disk`

```
rcadm -M -sp off -d 1 2 3
```

TASK CONTROL

```
--task <task_operation> --array <array_number>
-t <task_operation> -a <array_number>
```

Task Operation

<pause> to temporarily pause a task

<resume> to continue running a task

<remove> to permanently remove a task

Examples: `rcadm --manage --task pause --array 5`

```
rcadm -M -t remove -a 4
```

TASK PRIORITY

```
--priority <1..10> --array <list>  
-p <1..10> -a <list>
```

Examples: `rcadm --manage --priority 5 --array 6`
`rcadm -M -p 1 -a`

UNLINK ARRAY

```
--unlink --array <array_number>  
-ul -a <array_number>
```

Examples: `rcadm --manage --unlink --array 2`
`rcadm -M -ul -a 5`

8.8.3 rcadm -C**CREATE****Long form:**

```
rcadm --create <raid_type> --disk <list> [--size <size_mb>]  
      [--sub-member <num>] [--spare-disk <list>]  
      [--no-sync] [--d-spare] [--cache <r,rw,w,nc>]  
      [--max-size] [--name "name"] [--priority <1..10>]  
      [--zero] [--scan-array]
```

Short form:

```
rcadm -C <raid_type> -d <list> [-s <size_mb>] [-sub <num>]  
      [-sp <list>] [-ns] [-ds] [-ca <r, rw, w, nc>] [-ms]  
      [-n "name"] [-p <1..10>] [-z] [-sa] }
```

RAID Types:

```
--volume, -v Single disk or concatenation of disks (JBOD)  
--raidable, -ra Single disk, RAIDABLE  
--raid0, -r0 Stripe of two or more disks  
--raid1, -r1 Mirror of two disks  
--raid10, -r10 Stripe set of mirror sets  
--raid5, -r5 Stripe set with parity, three to sixteen disks
```

OPTIONS

`-sp, --spare-disk`

Specifies the dedicated spare disk or disks to assign, with a maximum of four. No space is reserved on the selected disks.

`-s, --size`

Specifies the size of the array in MBs. If you do not use this option, the largest possible size is used by default.

`-ns, --no-sync`

Disables background synchronization of redundant types when creating the array.

`-ca, --cache`

Specifies a cache setting for the array(s): read cache `<r>`, read and write-back cache `<rw>`, write-back cache `<w>`, or no cache `<nc>`. The default is read and write-back cache `<rw>`.

`-ms, --max-size`

Prints the maximum possible size for an array without actually creating an array.

`-n, --name`

Identifies an array with a user-supplied name. The name can be up to 30 characters, but only 17 of those characters display in the BIOS.

`-p, --priority`

Sets the background initialization task priority from 1 to 10, with 10 being the highest priority. For redundant array types only.

`-led, --leave-existing-data`

Leaves the existing data on the disks untouched after the array is created. This option can be used to try to recover user data when an array has been accidentally deleted or the configuration information is lost but the data is still intact. Unless you immediately recreate the array after deleting it and no other tasks have been performed, the likelihood of recovering data with this method is very low.

`-d, --disk`

A required qualifier used with the `--create` option to specify the disk or disks to be included in the array.

`-sa, --scan-array`

Specifies that a background array scan should be continuously run whenever the array is idle (Default is off).

`-z, --zero`

Zero the array in the foreground. This method is faster than doing a background consistency verifies if the array is a redundant type. For non-redundant types, the zero option can be used to verify all blocks in the array can be accessed.

EXAMPLES

Example: Create a RAID5 set of the maximum possible size using all disks.

```
rcadm -C --raid5 --disk *
```

Example: Create a RAID1 set of the maximum possible size, with a spare disk and without a background initialization task.

```
rcadm -C --raid1 --spare-disk 3 --disk 1 2 --no-sync
```

Example: Print the maximum size a RAID5 array could be using all disks without actually creating the array.

```
rcadm -C --raid5 --disk * --max-size
```

8.8.4 **rcadm -D**

DELETE

Long form:

```
--delete --array <list> [--no-ask]
```

Short form:

```
-D -a <list> [-na] [-cg <group number>]
```

OPTIONS

-na, --no-ask

If the no ask option is specified the array is deleted without confirmation.

EXAMPLES

Example: Delete arrays 1 and 2.

```
rcadm -D --array 1 2
```

Example: Delete all arrays.

```
rcadm -D --array
```


Chapter 9 Troubleshooting

9.1 Troubleshooting

The chapter discusses four major categories of troubleshooting:

- Problems with system startup.
- Warning messages that might appear at the Power-On Self-Test (POST) screen.
- Problems with arrays.
- Problems with disks.

9.2 System Startup Problems

- Table 30. The System Does Not Boot
- Table 31. The BIOS Configuration Utility Does Not Display

Table 30. The System Does Not Boot

| Possible Causes | Corrective Actions |
|---|--|
| Controller mode is set incorrectly during system startup | In the system's BIOS screen, ensure NVME RAID Mode is Enabled and SATA Mode set to RAID in System BIOS settings. |
| The system's boot mode or boot sequence retry mode is set incorrectly | In the system's BIOS screen, ensure that the bootable array is the first array listed. If not, use the Swap Two Arrays option to reposition the arrays. |
| A bootable array is in an Offline state | Restart the system. Enter the system's BIOS screen. Check the state of the bootable array. Check for missing or offline disks. |

Table 31. The BIOS Configuration Utility Does Not Display

| Possible Causes | Corrective Actions |
|---|---|
| The controller mode is set incorrectly in the system BIOS | In the system's BIOS screen, ensure the SATA and NVME settings are correct. |

Table 32. Username and Password

| Problem | Corrective Actions |
|--|---|
| A user forgets the username or password. | Reset the username and password by deleting <code>rc_login.txt</code> . This restores the default user name and password (<code>admin</code> and <code>admin</code>). |

9.3 Warning Messages: POST Screen

The POST screen is one of the first screens to appear during the system's boot sequence. If the system's arrays were in Normal or Ready state prior to a system boot, the boot sequence continues normally to the operating system.

But, if an array is in Critical or Offline state, or if specific options at Controller Options were changed previously at the BIOS Configuration Utility, the warning messages described in Table 33 appear during the boot sequence.

Table 33. POST Screen Warning Messages

| Warning Message | Additional Information | Corrective Action |
|--|--|--|
| WARNING: Found arrays that are Critical [or equivalent] | This warning message appears when at least one array is in a Critical state and Toggle Pause if Critical is set to ON at the BIOS Configuration Utility. The Critical state of an array depends on the RAID level of the array and the number of disks that have failed. See Section 3.3, Array States, on page 25, for information on criticality. If an array is Critical (even a bootable array), the system can continue through the boot process to the operating system. | See Section 9.5.1, Troubleshooting Disks, on page 103. |

Table 33. POST Screen Warning Messages (Continued)

| Warning Message | Additional Information | Corrective Action |
|--|--|--|
| WARNING: Found arrays that are Offline [or equivalent] | This warning message appears when at least one array is in an Offline state and Toggle Pause if Offline is set to ON at the BIOS Configuration Utility. If two or more disks in a redundant array have failed, or if a single or multiple disks in a non-redundant array have failed, data has been lost. In RAID10 array, if a single disk fails in each mirrored set, the redundant array goes to a Critical state but data is not lost. If two disks fail in one of the mirrored sets, the redundant array goes to an Offline state and data is lost. | See Section 9.5.1, Troubleshooting Disks, on page 103. If, after performing a rescan, the state remains Offline, the bootable array has suffered an unrecoverable failure. Create a new bootable array. Reinstall the operating system and drivers. |
| WARNING: Found arrays that are Critical and Offline [or equivalent] | A bootable array that is in an Offline state prevents the operating system from booting. | |
| BIOS NOT INSTALLED - User Disabled INT13 BIOS Load [or equivalent] | This warning message appears when Toggle INT13 Boot Support option has been set to OFF at the BIOS Configuration Utility and another boot device is not selected. Bootable devices do not function with the controller when Toggle INT13 Boot Support is set to OFF . The default setting is ON , which allows bootable devices to function with the controller. | Restart the system. Enter the system's BIOS screen. Select Main Menu > Controller Options > Toggle INT13 Boot Support . Change Toggle INT13 Boot Support from OFF to ON . Navigate to Main Menu. Select Continue to Boot . The system boot process continues to the operating system. |

9.4 Array-Related Errors

- Table 34. Cannot Create an Array, on page 100
- Table 36. An Array is in an Offline State, on page 101
- Table 35. An Array is in a Critical State, on page 101
- Table 37. Cannot Assign a Dedicated Spare to an Array, on page 101

- Table 38. Cannot Create a Global Spare, on page 102
- Table 39. Recreate a Deleted Array, on page 102

Table 34. Cannot Create an Array

| Possible Causes | Additional Information | Corrective Actions |
|---|---|---|
| The disk is not displayed. | The controller cannot communicate with the disks. | See Section 9.5.1, Troubleshooting Disks, on page 103. |
| Insufficient free space available on the selected disks | | Select a different combination of disks. |
| Incorrect number of disks selected for the desired RAID level | See 3.2, RAID Levels, on page 24, for a description of RAID levels and the allowable number of disks used with each RAID level. | Select the correct number of disks. |
| The desired disk is unavailable. | The disk is a dedicated spare for a different array. The disk is full. The disk's available capacity is insufficient. | Select a different disk. |
| The disk has SMART errors. | An array can be created with a disk that has SMART errors, but only if the array is created in the BIOS Configuration Utility. RAIDXpert2 cannot be used to create an array with a disk that has SMART errors. | Use the BIOS Configuration Utility to create the array. |
| The system already has a maximum of eight arrays | | Delete unused arrays. CAUTION: <i>Deleting an array permanently destroys all data that is on the array. This action cannot be undone and it is very unlikely the data can be recovered.</i> |

Table 35. An Array is in a Critical State

| Possible Causes | Additional Information | Corrective Actions |
|---|--|--|
| One or more disks in the array have failed or been removed. | Due to the failed disk or disks, the array is no longer maintaining redundant (mirrored or parity) data. The failure of an additional disk results in an Offline state and lost data. | See Section 9.5.1, Troubleshooting Disks, on page 103. |

Table 36. An Array is in an Offline State

| Possible Causes | Additional Information | Corrective Actions |
|--|---|--|
| The array has lost the maximum allowable disks per RAID level. | One or more disks have failed. <ul style="list-style-type: none"> If the array is non-redundant, the failure of a single disk causes the array to fail. If the array is redundant, the failure of two or more disks causes the array to fail. The array cannot be restored (rebuilt). | See Section 9.5.1, Troubleshooting Disks, on page 103. |

Table 37. Cannot Assign a Dedicated Spare to an Array

| Possible Causes | Additional Information | Corrective Actions |
|---|---|---|
| The RAID level does not allow dedicated spares. | Dedicated spares cannot be created for Volume or RAID0 arrays. | <ul style="list-style-type: none"> Create an array with a different RAID level and assign a dedicated spare. Create a global spare. |
| The designated disk does not have sufficient capacity to be a dedicated spare | The capacity of the disk selected to be a dedicated spare must be equal to or larger than the capacity of the smallest disk in the array. | Select a different disk. |

Table 38. Cannot Create a Global Spare

| Possible Causes | Additional Information | Corrective Actions |
|---|---|---|
| The disk is already part of an array | A global spare cannot be selected if it is already part of an existing array. | Select a different disk. |
| There are no empty disks available or the disks have not been initialized | A disk with a legacy state can be initialized, if desired, but it is no longer legacy (initialization adds RAIDXpert2 configuration information to the disk). | Install additional disks. Initialize the disks. CAUTION: When a disk is initialized, all data on the disk is lost. |
| The disk assigned as the global spare has failed or is missing. | | See Section 9.5.1, Troubleshooting Disks, on page 103. |

Table 39. Recreate a Deleted Array

| Possible Causes | Additional Information | Corrective Actions |
|--|---|---|
| An array(s) was accidentally deleted, or the wrong array was deleted | This procedure might recreate a deleted array and with its data intact. However, this is not guaranteed to occur. If I/O was running to the deleted array(s) just prior to it being deleted, there might be some data loss in the recreated array(s). If multiple arrays were deleted, all of the deleted arrays must be recreated in order to recover the desired array. | <ol style="list-style-type: none"> At the Array pop-up menu, select Create. Create a new array using the same settings as the deleted array. <ul style="list-style-type: none"> The same disks. The same RAID type (RAID level). The same capacity. The same cache options. Check Leave Existing Data Intact. Click Create. Ensure the settings are the same as the deleted array: <ul style="list-style-type: none"> The same drive letter. The same RAID type (RAID level). The same disks. The same capacity. The same cache option Check the data files of the array for corrupted or missing files, incorrect file extensions, and so on. |

9.5 Disk Related Errors

- Table 40. Disk Errors
- Section 9.5.1, Troubleshooting Disks, on page 103.

Table 40. Disk Errors

| Possible Causes | Additional Information | Corrective Actions |
|---|--|--|
| A disk has been removed from an array | | See Section 9.5.1, Troubleshooting Disks, on page 103. |
| A disk is not visible in the BIOS Configuration Utility or is offline | | |
| A disk is highlighted red at the BIOS Configuration Utility | The disk has failed. Depending on the RAID level of the array, data might be lost. | |
| RAIDXpert2 cannot communicate with the spare | The dedicated spare is not visible in the BIOS Configuration Utility or is offline. | |
| The disk cannot be initialized | Only disks that are Ready can be initialized. CAUTION: When a disk is initialized, all data on the disk is lost. | <ul style="list-style-type: none"> • Ensure the disk is not already a member of an array. • Ensure the disk is still assigned as a global or dedicated spare. • Ensure the disk is reporting a Ready state. |

9.5.1 Troubleshooting Disks

Perform the following actions when there may be a problem with a disk.

- Ensure there is no damage to the system's backplane.
- Ensure all cables are installed correctly.
- Ensure the disk is seated correctly in the backplane or bay and the latch is secured.
- Reinsert the disk.
- Replace the disk.
- After reconnecting, reseating, reinserting, or replacing a disk:
 - Perform a rescan.
 - Initialize the disk.

CAUTION: When a disk is initialized, all data on the disk is lost.

If problems with a disk have caused an array to go Critical, it may be necessary to also assign a dedicated or global spare for the array.

If problems with a disk have caused an array to go Offline, data may have been lost. Recover lost data from a backup storage source.

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