DapuStor | 大普微

DapuStor BootRAID Card User Guide

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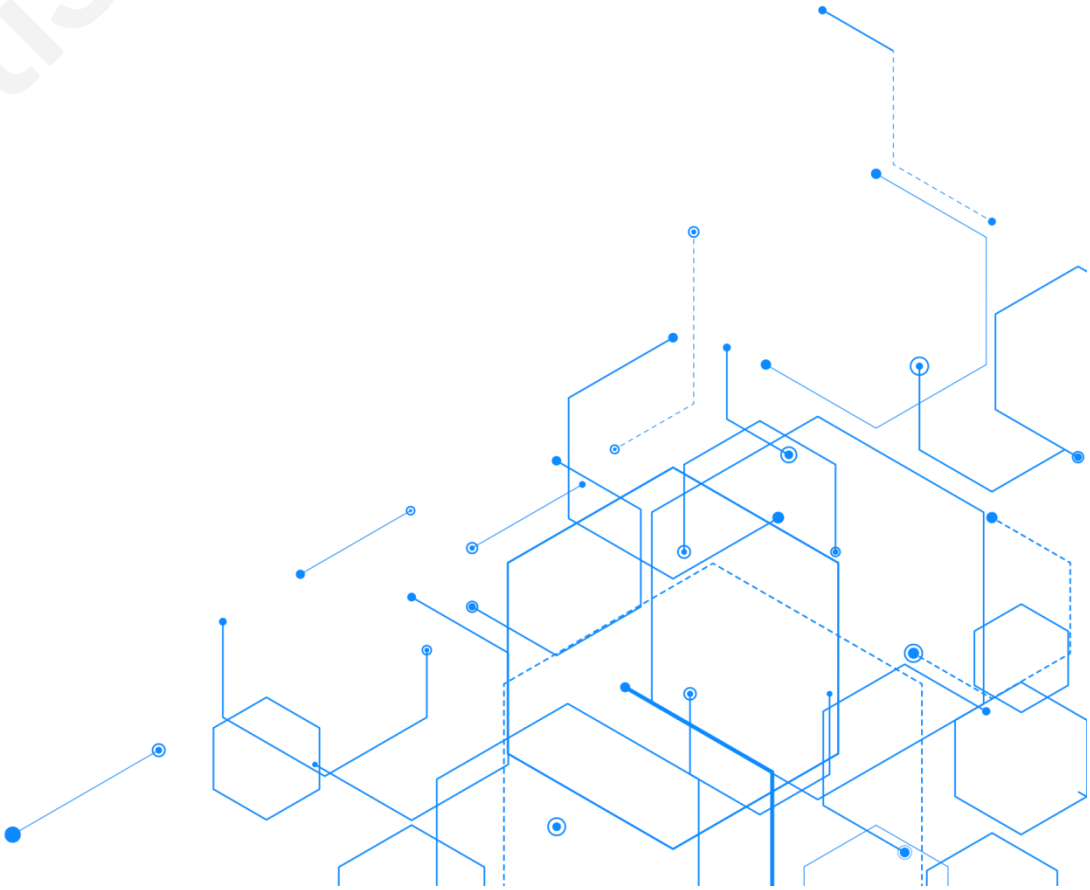
User Guide



Reversion History

Reversion NO.	Date	Description
1.0	Dec, 2024	Preliminary Version
1.1	Dec, 2024	Updated description of hot-plug and hot-swap

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Contents

1 Product Overview

DapuStor Flexraid series BootRAID card for server boot disk group RAID, the card adopts self-developed main control chip, adapted to the PCIe 4.0x4 interface, the disk end supports M.2 ports, support for hot-swap.

The card supports data center BootRAID applications, offering platform stability and security. It is suitable for use in data centers, telecommunications operators, network security, and edge computing scenarios as a server boot disk RAID solution. This card provides safe and reliable system disk data protection, delivering faster, better, and more economical value for customers. Meanwhile, it has SSD hot-plug function and adopts the design of puller bar rail structure on the baffle strip, which can realize the installation and removal of SSD from the outside without opening the chassis, which improves the availability and maintenance efficiency of the system.

2 Product Features

2.1 Features List

Supported Interfaces and Protocols:

- Half-height and half-length PCIe 4.0 x 4 standard card with optional half-height or full-height Pull-tabs for flexible configurations and a wide range of application scenarios.

Array Card Characteristics:

- Support NVMe Device for Host
- Support SATA 6Gps Device interfaces
- Support Dual PCIE 5.0x2 Device interfaces
- Support RAID 0/1
- Supports non-RAID modes: physical disk pass through, spanning volumes (Spanning)
- Support Hot-Plug and Hot-Swap
- Support S.M.A.R.T.
- Support Read Patrol
- Support Online Rebuild
- Support Check consistency for background data integrity

Safety Features:

- Optional support for AES/RSA/SHA/TRNG
- Support for Secure Boot

Other:

- For RAID features, see the RAID Card Feature Description.

2.2 Environmental Conditions

Table 2-1: Application Environmental Conditions

Specification	Description
Physical slot	AIC half-length, half-height(HLHH)
Temperature	● Operating temperature: 0°C to 55°C ● Non-operating temperature: -40°C ～70°C
Altitude	● Working condition: -305m～5418m ● Non-operating condition: -305m～12192m **Note**: Starting at 1800m, the operating temperature decreases by 1°C for every 220m of ascent.
Humidity	● Operating condition humidity: 5% to 95% (non-condensing) ● Storage humidity: 5% to 95% (non-condensing)

2.3 Standards Compliance

For details about the standards of the product, see the Table 2-2.

Table 2-2: Standards References

Protocol Standards	Description
NVME 2.0	Non Volatile Memory Host Controller Interface Specification
NVMe MI 1.4	NVM Express Management Interface
SATA 3.1	Serial Advanced Technology Attachment Specification

3 Hardware Architecture

3.1 Hardware Specifications

Table 3-1: Hardware specifications

Item	Specifications
Dimensions (L x W x H)	168.5 × 68.9 × 18.9 (MAX value)
Weight	TBD (MAX value)
Maximum power consumption	TBD
PCIe Bandwidth	64Gbps (PCIe 4.0 X4)
Storage port speed	SATA 6Gbps or PCIE 5.0x2 32Gbps
Quantities of storage ports	2
Storage port protocol	SATA/PCIe
Storage port format	M.2 2230/2242/2280
Chip model	DP808AL

3.2 Overall Dimension

Detailed dimensions and weight specifications are shown below.

Table 3-2: Detailed Dimensions

X-Length (mm)	Y-Width (mm)	Z-Height (mm)
1 68.5max	68.9 max	18.9max

Figure 3-1: Dimensional Drawing (all values in millimeters)

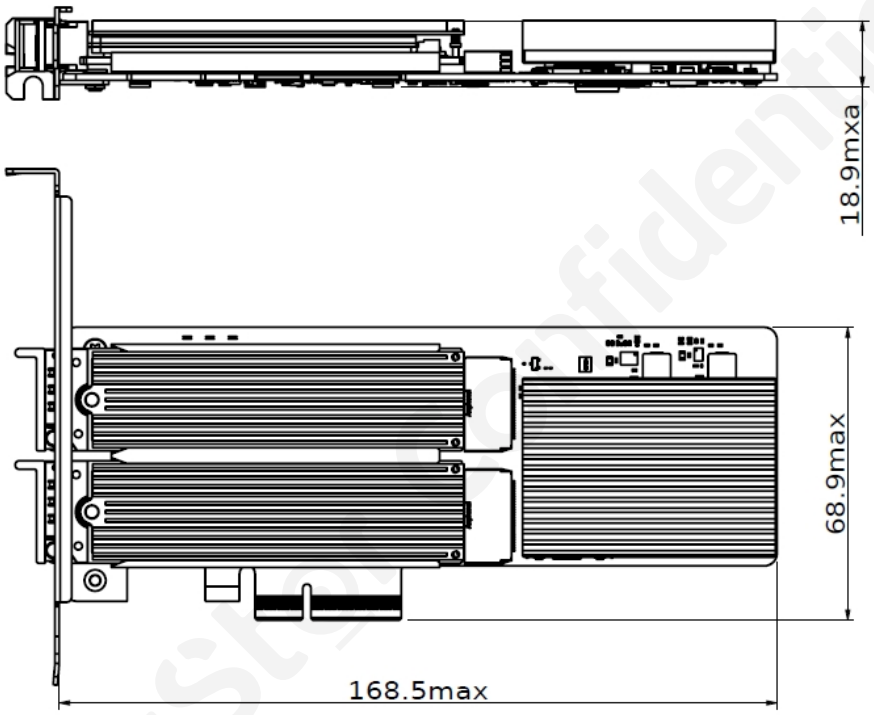
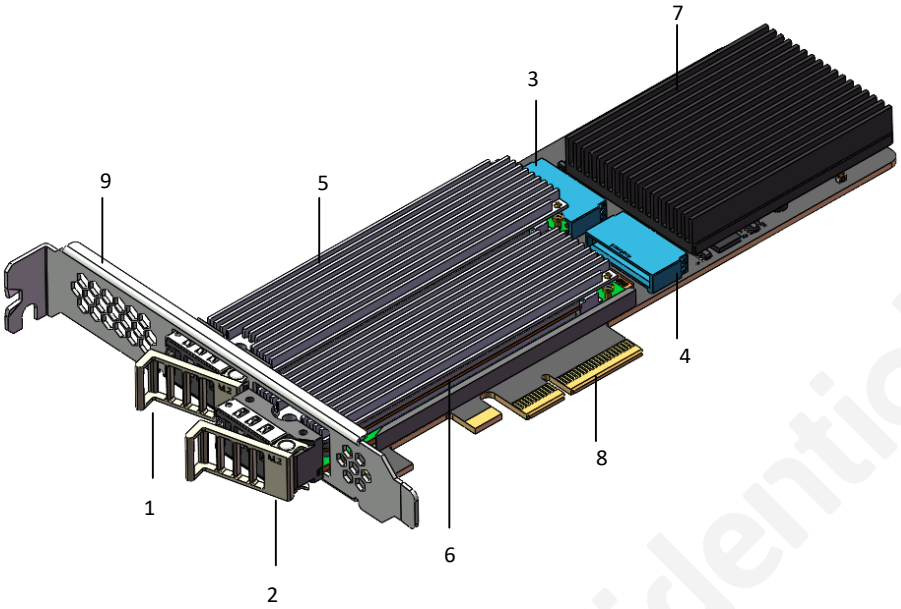


Table 3-3: Weight

Bracket Height	Full Height
Weight (g)	TBD (MAX)

Figure 3-2: Appearance Introduction



Note: Pictures are for illustration only

Table 3-4: Appearance Introduction

Number	Description	Number	Description
1	M.2 Carrier Slot 1 Bracket	2	M.2 Carrier Slot 2 Bracket
3	Tray 1 Carrier Connector	4	Tray 2 Carrier connector
5	M.2 Drive 1 heat sink (optional)	6	M.2 Drive 2 heat sink (optional)
7	Chip (DP808AL) + Heat Sink	8	PCIe Connector
9	Baffle		

3.3 Panel Description

Figure 3-3: Interface Schematic

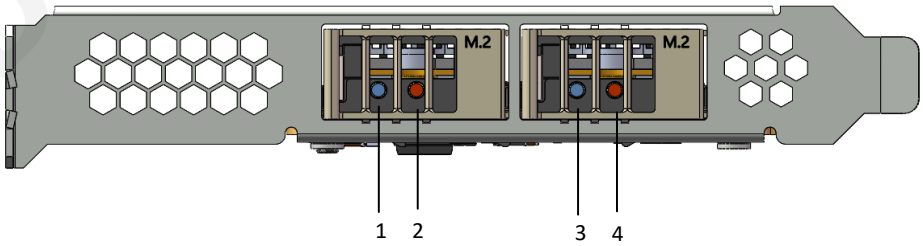


Table 3-5: Panel Descriptions

Number	Description	Number	Description
1/2	Bay 1 LED	3/4	Bay 2 LED

3.4 Indicator Light Description

Table 3-6: Indicator Description

Indicator Name	Hidden Meaning	Color	State
Type LED	Disk Connection Status Indicator	Red/Green	● Red: PCIe SSD ● Green: SATA SSD
Active LED	Disk Data Transfer Indicator	Blue	● Blinking: data read/write ● Out: no data transmission

4 RAID Card Function Description

4.1 RAID Feature List

Number	Features	BootRAID Card
1	Hot Swap Drive	Supported
2	Driver LED indication	Supported
3	Security Firmware Updates	Supported
4	RAID levels	RAID0/1 and non-RAID
5	Stripe Size	8KB~1024KB
6	Battery Backup Unit	Not Supported
7	Non-Volatile Cache	Not Supported
8	Virtual Disk Cache	Write-through
9	Number of virtual disks	1 under RAID, 2 in pass-through mode
10	Maximum number of supported drives	2
11	Support for non-RAID disks	Supported
12	Drive Types	SATA/PCIe
13	TRIM	Supported
14	Configuration (HII)*	Supported
15	Full initialization	Supported
16	Fast Initialization	Supported
17	Background initialization	Not Supported
18	Single non-RAID	Supported
19	Dual non-RAID	Supported
20	Foreign import	Supported
21	Consistency check	Supported
22	Patrol Read	Supported
23	Load balancing	inapplicable
24	Online Rebuild	Supported
25	Hot-spare	Not Supported
26	Change rebuild priority/speed	Supported
27	DDF Compatible Configuration (COD)	Supported
28	Online Capacity Expansion (OCE)	Supported
29	Virtual Disk Write Back	Not Supported
30	Virtual Disk Read-ahead Cache Policy	Not Supported
31	Battery Support	inapplicable
32	Non-RAID Disk Caching Policy	Supported
33	S.M.A.R.T	Supported
34	Physical Disk Hot-Swap	Supported
35	Virtual Disk Expansion	Supported only in pass-through mode
36	virtual disk slicing	Not Supported
37	Virtual Disk Migration	Supported
38	Split mirror	Not Supported
39	Non-RAID Migration	Supported

Number	Features	BootRAID Card
40	Degraded RAID1 and non-RAID	Supported
41	Legacy BIOS Mode	Not Supported
42	Attachment drivers for data paths	Not Supported
43	4K native drive support	Supported
44	TRIM and UNMAP virtual disks	Supported
45	TRIM and UNMAP non-RAID physical Disk	Supported
46	Self-Encrypting Drive (SEDs) Support	Supported
47	Cryptographic Erase (Sanitize)	Supported

*Note: Traditional BIOS development support as required.

4.2 Operating System Support List

Operating System	Bootraid Card
Microsoft Windows	TBD
VMware vSphere/ESX	Supported
Red Hat Enterprise Linux	Supported
SuSE Linux	Supported
Citrix XenServer	Supported
CentOS Linux	Supported
Debian Linux	Supported
Oracle Enterprise Linux	Supported
Fedora	Supported
FreeBSD	Supported

4.3 Application Tool Sheet

Artifact	BootRaid Card
FW update for single driver	Supported
CLI (dpraid cli)	Supported
HII (UEFI Human Interface Infrastructure）	Supported

4.4 Command Reference

This section provides references to commonly used commands. If you have any questions, please consult DapuStor's FAE engineers.

4.4.1 Help Command

Command Function

Queries all supported commands.

Command format

dpraid [command] -help

Parameter description

Parameters	Description	Value
/cx	controller x	0-n
/cx/vx	a virtual drive x on controller x	0-n
/cx/vall	all virtual drives on controller x	0-n
/cx/ex/sx	slot x on enclosure x on controller x	0-n
/cx/ex/sall	all the drives on enclosure x on controller x	0-n
show	Displays AD,VD,PD information.	-
add	Creates a new element to controller like VD	-
delete	Deletes an element like VD	-
start	Start background operation	-
stop	Stop background operation	-

```
[root@localhost /]# dpraid
--help      lists all the commands with their usage. dpraid --help

List of commands:

Commands    Description
-----------------------------------------------------------------
show        Displays AD,VD,PD information
add         Creates a new element to controller like VD
delete      Deletes an element like VD
start       Start background operation
stop        Stop background operation
/cx         Controller specific commands
/ex         Enclosure specific commands
/sx         Slot/PD specific commands
/vx         Virtual drive specific commands
/dx         Disk group specific commands

Use a combination of commands to filter the output of help further.
E.g. 'dpraid show --help' displays all the show operations.


Command options must be entered in the same order as displayed in the help of
the respective commands.
```

Detailed instructions for individual commands: dpraid show --help

```
[root@localhost /]# dpraid show --help
Usage: dpraid /cx show
Example: dpraid /c0 show
Usage: dpraid /cx/vx show
Example: dpraid /c0/v0 show
Usage: dpraid /cx/vx/vx show
Example: dpraid /c0/eall/sall show
Usage: dpraid /cx[/ex]/sx show rebuild
Example: dpraid /c0/eall/s1 show rebuild
Usage: dpraid /cx show patrolread
Usage: dpraid /cx[/ex]/sx show patrolRead
Usage: dpraid /cx/vx show cc
Usage: dpraid /cx show cc
Usage: dpraid /cx/vx show erase
Usage: dpraid /cx[/ex]/sx show erase
```

4.4.2 Show Command

4.4.2.1 Querying RAID Card Information

Command Format

dpraid /cx show

Example.

dpraid /c0 show

The command displays information about the current system raid card 0.

```
[root@localhost ~]# dpraid /c0 show
Operating system = Linux 4.18.0-348.7.1.el8_5.x86_64
Controller = 0
Status = Success

Product Name = DAPU_800_TEST
Serial Number = 12345678
PCI Address = 0000:08:00.4
System Time = 10/28/2024 16:14:22
Vendor Id = 0x1e3b
Device Id = 0x0001
SubVendor Id = 0x1e3b
SubDevice Id = 0x0001
Bus Number = 8
Device Number = 0
Function Number = 4
Domain ID = 0
Controller Time = 2024-10-28 16:14:21.788.409 (utc+8)
BIOS Version =  BOOT_RAID v0.4.0 (project/boot_raid e5e9d19b) (2024-10-24/11:28:57) (PN: 3)
 RELEASE=0 LTO=1 PGO=0 DEFS="PCFG_PLATFORM=PLATFORM_RAID_COMBO"

Virtual Drives :
==============

------------------------------------------------------------------------------------------
   Virtual ID               : State    TYPE   Intf          Size   SeSz
------------------------------------------------------------------------------------------
   Virtual 0                : -        RAID1  nvme        223 GB 4096 B

Intf=Interface|SeSz=Sector Size
------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------
Drive Information :
=================

------------------------------------------------------------------------------------------
EID:Slt DID State DG     Size Intf Med   SeSz Model                 FwVer
------------------------------------------------------------------------------------------
  0:0    0   -     0    223 GB sata SSD  512 B KINGSTON SA400S37240G SBFK66.5
  0:1    1   -     0    223 GB sata SSD  512 B KINGSTON SA400S37240G SBFK66.5

EID=Enclosure Device ID|Slt-Slot No.|DID=Device ID|DG-DriveGroup
Intf=Interface|SeSz=Sector Size|SN=Serial Number|FwVer=Firmware Version
Med-Media Type|
------------------------------------------------------------------------------------------
------------------------------------------------------------------------------------------

Command completed successfully.
```

4.4.2.2 Checking Virtual Disk Information

Command Format

dpraid /cx/vx show

Example.

dpraid /c0/v0 show: show current system raid card 0 information all VD information

dpraid /c0/vall show: show current system raid card 0 information VD 0 information

```
[root@localhost /]# dpraid /c0/vall show
Operating system = Linux 4.18.0-348.7.1.el8_5.x86_64
Controller = 0
Status = Success

Virtual Drives :
==============

------------------------------------------------------------------------------
   Virtual ID                : State    TYPE   Intf          Size   SeSz
------------------------------------------------------------------------------
   Virtual 0                 : -        RAID1  nvme        223 GB 4096 B

Intf=Interface|SeSz=Sector Size
------------------------------------------------------------------------------
------------------------------------------------------------------------------
```

4.4.2.3 Querying Physical Disk Information

Command Format

dpraid /cx/ex/sx show

Example.

dpraid /c0/eall/sall show: : displays the current system raid card 0 information all PD information

dpraid /c0/eall/s1 show: displays the current system raid card 0 information PD 1 information

```
[root@localhost /]# dpraid /c0/eall/sall show
Operating system = Linux 4.18.0-348.7.1.el8_5.x86_64
Controller = 0
Status = Success

Drive Information :
=================

------------------------------------------------------------------------------
EID:Slt DID State DG      Size Intf Med   SeSz Model                  FwVer
------------------------------------------------------------------------------
  0:0    0   -     0     223 GB sata SSD  512 B KINGSTON SA400S37240G SBFK66.5
  0:1    1   -     0     223 GB sata SSD  512 B KINGSTON SA400S37240G SBFK66.5

EID=Enclosure Device ID|Slt-Slot No.|DID=Device ID|DG-DriveGroup
Intf=Interface|SeSz=Sector Size|SN=Serial Number|FwVer=Firmware Version
Med-Media Type|
------------------------------------------------------------------------------
------------------------------------------------------------------------------
[root@localhost /]#
```

4.4.3 Add Command

4.4.3.1 Creating Virtual Disks

Command Format

Usage: dpraid /cx add vd=x r= [0|1|31|15] Size=all/xGB/xTB Strip=[8|16|32|64|128|256|512|1024] drives=s-x,y,z

Parameter Description

Parameters	Description	Value
/cx	controller x	0-n
vd	Add a virtual drive x on controller x	0-n
r	Sets the RAID level of the configuration	[0|1|31|15]
Size	Maximum size based on the physical drives and RAID level	0-n
Strip	stripsize	[8|16|32|64|128|256|512|1024]
drives	the range convention used to represent slots s to x	valid slot numbers

Example.

dpraid /c0 create vd=0 r=0 Size=all Strip=128 drives=0-1 : create raid card

```
[root@localhost /]# dpraid /c0 add vd=0 r=0 Size=all Strip=128 drives=0-1
Are you sure want to continue?
Press y, then ENTER to continue or press ENTER to abort:y
Operating system = Linux 4.18.0-348.7.1.el8_5.x86_64
Controller = 0

Command completed successfully.
```

4.4.4 The Delete Command

4.4.4.1 Deleting Virtual Disks

Usage: dpraid /cx/vx delete

Example: dpraid /c0/v0 delete : delete current system raid card 0 virtual disk vd0

```
[root@localhost ~]# dpraid /c0/v0 delete
Are you sure want to continue?
Press y, then ENTER to continue or press ENTER to abort:y
Operating system = Linux 4.18.0-348.7.1.el8_5.x86_64
Controller = 0

Command completed successfully.
```

4.4.5 Start Command

```
[root@localhost /]# dpraid start --help
Usage: dpraid /cx/ex/sx start locate
Example: dpraid /c0/eall/s1 start locate
Usage: dpraid /cx/vx start locate
Example: dpraid /c0/v0 start locate
Usage: dpraid /cx/vx start migrate vd_level option=add|remove physical_id physical_id.....
Example: dpraid /c0/v0 start migrate r=0 option=add drives=0-2,5
```

Parameter Description

Parameters	Description
locate	activate the physical disk activity LED
migrate	starts the reconstruction on a virtual drive to the specified RAID level by adding or removing disks from the existing virtual drive

4.4.5.1 Illuminates the hard disk positioning indicator

Usage: dpraid /cx/ex/sx start locate
Example: dpraid /c0/eall/sall start locate
dpraid /c0/eall/sall start locate: Lights all physical disk locate indicators for the current system raid card 0.
dpraid /c0/eall/s0 start locate: lights the current system raid card 0 physical disk 0 locate indicator.

4.4.5.2 Illuminates the corresponding vd positioning indicator

Usage: dpraid /cx/vx start locate
Example: dpraid /c0/vall start locate
dpraid /c0/vall start locate: Lights up all physical disk locate indicators for the current system raid card vd=0.
dpraid /c0/vall start locate : Lights the physical disk locate indicator for all vd contained in the current system raid card.

4.4.5.3 Add Expansion Disk

Usage: dpraid /cx/vx start migrate vd_level option=add|remove drives=s-x,y,z
Example: dpraid /c0/v0 start migrate r=0 option=add drives=0-2,5
Add new disks 0, 1, 2, and 5 to vd0.

4.4.5.4 Removable Disk

Usage: dpraid /cx/vx start migrate vd_level option=remove physical_id physical_id.....
Example: dpraid /c0/v0 start migrate r=0 option=remove drives=1
Remove the disk with slot 1 from vd0.

4.4.6 Stop Command

4.4.6.1 Extinguish The Hard Disk Positioning Indicator

Usage: dpraid /cx/ex/sx stop locate
Example: dpraid /c0/eall/sall stop locate
dpraid /c0/eall/sall stop locate: extinguishes all physical disk locate indicators for the current system raid card 0.

dpraid /c0/eall/s0 stop locate: extinguishes the current system raid card 0 physical disk 0 locate indicator.

4.4.6.2 Extinguish the corresponding vd positioning indicator

Usage: dpraid /cx/vx stop locate

Example: dpraid /c0/vall stop locate

dpraid /c0/vall stop locate: extinguishes all physical disk locate indicators for the current system raid card vd=0.

dpraid /c0/vall stop locate : Extinguishes the physical disk locate indicator for all vd contained in the current system raid card.

```
[root@localhost /]# dpraid stop --help
Usage: dpraid /cx/ex/sx stop locate
Example: dpraid /c0/eall/s1 stop locate
Usage: dpraid /cx/vx stop locate
Example: dpraid /c0/v0 stop locate
```

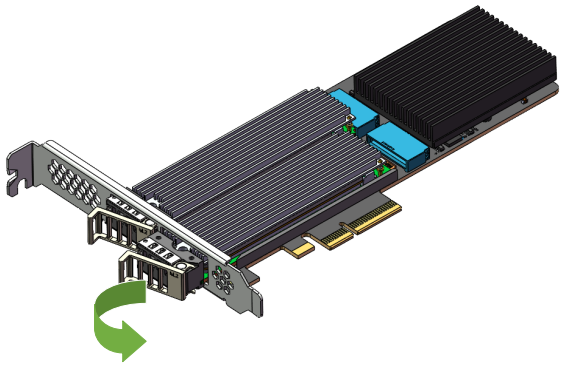
5 Hardware Installation

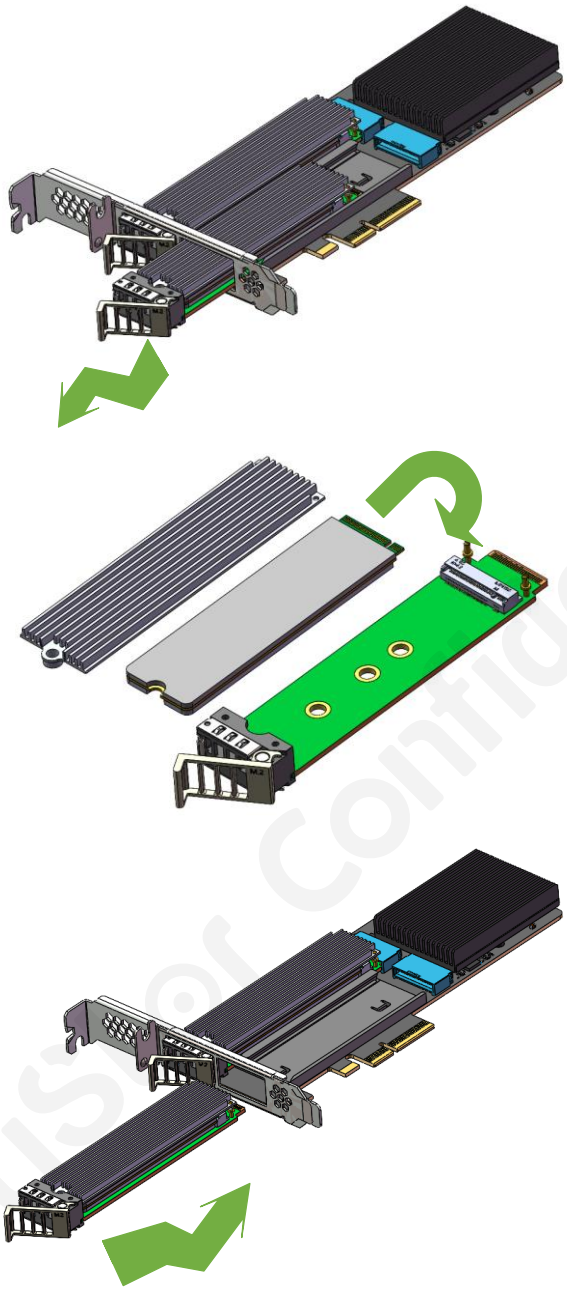
The BootRAID card is a half-height, half-length PCIe 4.0x4 standard card. For hardware installation, please refer to the "Installing PCIe Cards" section of the Server Application Guide.

6 Hot-Plug and Hot-Swap Operation

Supports hot-plug with power on, enabling both surprise hot-plug and notification hot-plug (remove the M.2 disk by command and then plug and unplug it).

The M.2 disk hot-swap operation is shown below, open the pull handle bar, pull out to replace and install the M.2 disk, and re-insert to complete the hardware replacement. The Firmware of RAID Card can detect the M.2 disk is pulled out and installed, and the online rebuild will complete automatically because the replacement is detected.





7 Compatibility

For servers and operating systems supported by BootRAID cards, please consult DapuStor's FAE engineers.

8 Drivers and Firmware Management

8.1 Obtain Packages

The driver of this product uses the native NVME driver for the supported operating systems. By default, the native NVME driver is built-in and installed in OS.
Before updating the Firmware, please contact DapuStor FAE to obtain the necessary accompanying software package.

8.2 Check Driver and Firmware Versions

8.2.1 Check BootRaid Drivers and Firmware

BootRaid is presented as a standard nvme device that can be managed using the system's own nvme cli tool. The dpraid tool is also provided for RAID volume management.

```
root@dapu-Z690-GAMING-X:~# nvme list
Node             SN                   Model                                    Namespace Usage                      Format           FW Rev
---------------- -------------------- ---------------------------------------- --------- -------------------------- ---------------- --------
/dev/nvme0n1     SN-0000              BOOT_RAID-INFA_RAID_M2                   1         999.65  GB / 999.65  GB      4 KiB +  0 B   v0.4.1
root@dapu-Z690-GAMING-X:~#
```

8.3 Manage Driver

8.3.1 Array Card Driver Installation or Upgrade

The array function of this product uses the native NVME driver for the supported operating systems.
Windows Driver Installation - By default, the native NVME driver is built-in and installed.

Caution:
The Management Console driver is required to support the command line interface for this array card in a Windows driver installation.

Linux Driver Installation - By default, the native NVME driver is built-in and installed.
ESXi Driver Installation - By default, the native NVME driver is built-in and installed.

8.3.2 Array Card Driver Uninstallation

The array function driver is built-in driver of the operating system, please refer to the guide of the built-in driver of the operating system for uninstallation.

8.4 Manage Firmware

8.4.1 Array Card Firmware Upgrade

Step 1: Log in to the server OS.
Step 2: Place the firmware file to be upgraded (e.g. boot_raid.fwpkg.bin) in the current directory.

```
dapu@dapu:~$ ls -l boot_raid.fwpkg.bin
-rw-rw-rw- 1 dapu dapu 482832 Oct 29 01:35 boot_raid.fwpkg.bin
```

Step 3: Execute ls -l /dev/nvme* to view the nvme character device for the array card.

```
dapu@dapu:~$ ls -l /dev/nvme*
crw------- 1 root root 239,   0 Oct 29 02:48 /dev/nvme0
```

Step 4: Use the following command to perform the firmware upgrade.

nvme fw-download /dev/nvme0 -f boot_raid.fwpkg.bin

```
dapu@dapu:~$ sudo nvme fw-download /dev/nvme0 -f boot_raid.fwpkg.bin
Firmware download success
```

Step 5: Take effect the firmware.

nvme fw-activate -s 1 -a 3 /dev/nvme0

```
dapu@dapu:~$ sudo nvme fw-activate -s 1 -a 3 /dev/nvme0
Success committing firmware action:3 slot:1
Multiple Update Detected (MUD) Value: 0
```

Step 7: Reboot the host computer and the array card with the new firmware works.