

Roealsen5 Enterprise NVMe SSD Series

User Guide

DapuStor

Version and Modification

Version No.	Date	Modification Description
1.0	2022.02	Preliminary Version
1.1	2022.05	Added Appendix D
1.2	2022.06	Updated Appendix D
1.3	2022.08	Updated 2.3, 5.1 and Appendix D

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Test result might be different in your system hardware, configuration or software.

Contact your local sales/ marketing or your distributor to obtain the latest spec, this document contains information on products in design stage.

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Preface

This document provides the product information about DapuStor Roealsen5 Enterprise NVMe SSD series (referred to as "Roealsen5 series") and describes how to install, configure, operate, and maintain the Roealsen5 series.

Notice before Use

The operation instructions and commands provided in this document are used to debug and maintain storage devices. You are advised to perform the operations by experienced engineers or under the guidance of engineers.

1. Safety

This section describes the safety precautions during installation, operation and maintenance of Roealsen5 series products.

1.1 General Safety Notice

1. To ensure safety of humans and the equipment, pay attention to the safety symbols on the equipment and all the safety instructions in this document.
2. The "DANGER", "CAUTION", and "WARNING" marks in other documents do not represent all the safety instructions. They are only supplements to the safety instructions.
3. When operating DapuStor equipment, you must follow the local laws and regulations. The safety instructions in this document are only supplements to the local laws and regulations.
4. Only trained personnel should install, operate, or maintain DapuStor equipment, and they must understand safety precautions and correct operation methods.
5. Only trained and qualified personnel should install, operate, or maintain DapuStor equipment.
6. Only qualified professional engineers can remove security facilities and troubleshoot equipment.
7. Only personnel certified or authorized by DapuStor should replace or change DapuStor equipment or components (including software).
8. Operators must notify relevant parties immediately of anything that may cause safety problems.

1.2 Labels on SSDs

1. The following label indicate the risk of high temperature scalds. When solid-state disks (SSDs) are running with power on, human skin may suffer from high temperature scalds.



2. The following labels indicate that the SSD meets the WEEE recyclable requirements.



3. The following marks indicate that the SSD complies with ROHS requirements.



1.3 Electrical Safety

This section describes safety notice about power, ground, electrostatic discharge, and temperature.

1.3.1 Power

Ensure that the host power supply that works with SSDs meets product power specifications. For details, see section 2.3.

Do not forcibly insert the connector or use the power connector that does not meet the product specifications.

1.3.2 Ground

Ground the host that works with the SSD before powering it on.

1.3.3 Electrostatic Discharge

- Human body movement, friction between human bodies and clothes, friction between shoes and floors, or handling of plastic articles causes static electromagnetic fields on human bodies. These static electromagnetic fields cannot be eliminated until the static is discharged.
- To prevent electrostatic-sensitive components from being damaged by the static on human bodies, you must wear a well-grounded ESD wrist strap when touching the device or handling boards or application-specific integrated circuits (ASICs).
- To transport and store SSDs, users use an ESD-Preventive package, which complies with the ESD-Preventive Requirements for Electronic Packaging

Materials SJ T 11587-2016.

- This label indicates a static sensitive area. Do not touch the golden finger of the SSD connector with your hands. Otherwise, the SSD may be damaged by electrostatic discharge.



1.3.4 Temperature

- When the SSD is working, the surface gets heated, risking burns if human skin comes into contact with the surface.
- Do not touch the SSD surface with human hands or skin when the SSD is being powered on. To hot-swap the SSD, use the hard disk tray to insert and remove the SSD. After the SSD is powered off, cool it down and touch it with human hands.
- Ensure that the SSD is always in the operating temperature range required by the product (see Section 2.4.4); otherwise, there is a risk of functional failure.

2. Product Introduction

2.1 Overview

Built with the latest KIOXIA 112L 3D eTLC NAND and professional enterprise controller, DapuStor Roealsen5 NVMe SSD Series (referred to as "Roealsen5 series") supports up to 15.36TB enterprise SSD. In the era of digital transformation and data explosion, we provide enterprise and data center customers complete solutions with higher performance, lower power consumption and easier maintenance.

Figure 2-1 shows the appearance diagram of Roealsen5 series products.

Figure 2-1: 2.5 inches SSD



The key features including:

- Support PCIe Gen4x4
- Low latency, high performance, high consistency
- Flash Raid 2.0, supporting multiple die failure without affecting service and performance
- Latest NVMe 1.4a key features
- Support online upgrade
- Advanced power lose protection
- Enterprise features, end to end data protection, VSS, Multi namespace, NVMe MI, etc.
- Multi-level adjustable power consumption
- High reliability, MTBF 2 million hours

2.2 Security

This section describes the information security features of the Roealsen5 series.

Roealsen5 series provides the following security features based on the security hardening measures taken according to the minimum permission security rules:

- **Rights control:** The Roealsen5 series allows only system administrators to use its device maintenance management tools.
- **Operation logs:** All operation logs are logged on the Roealsen5 series. System logs and critical logs are stored separately.
- **Security assurance:** A complete data clearance tool is provided to destroy data at the NAND flash memory chip level, preventing data leakage.
- **End-to-end data protection:** The Roealsen5 series adopts end-to-end data verification to ensure consistency of user data and supports T10 DIF standard.
- **Device management:** The Roealsen5 series uses out-of-band management based on I2C channels. Management functions support only query, preventing malicious and illegal write operations.
- **Firmware upgrade:** Firmware can be loaded only after it is authenticated.

2.3 Specifications

Table 2-1 shows the list of Roealsen5 series products described in this document.

Table 2-1: The list of Roealsen5 series

NO.	Sub-Series	Form Factor	Capacity (TB)	Product No.
1	R5100	U.2	7.68	DPRD3108T0T507T6000
2			15.36	DPRD31016TT515T3000
3	R5100D	U.2	3.84	DPRD3104T0T503T8010
4			7.68	DPRD3108T0T507T6010
5	R5300	U.2	6.4	DPRD3108T0T506T4000
6			12.8	DPRD31016TT512T8000
7	R5300D	U.2	3.2	DPRD3104T0T503T2010
8			6.4	DPRD3108T0T506T4010
9	R5101	U.2	1.92	DPRD3102T0T601T9000
10			3.84	DPRD3104T0T603T8000
11	R5301	U.2	1.6	DPRD3102T0T601T6000
12			3.2	DPRD3104T0T603T2000
13	R5102	U.2	3.84	DPRD3104T0T303T8000
14	R5302	U.2	3.2	DPRD3104T0T303T2000

The following describes SSD specifications such as capacity, power consumption, reliability, environmental conditions, and interface electrical characteristics.

2.3.1 Capacity

Table 2-2: User Addressable Sectors of R5100/R5101/R5100D

Capacity (TB ²)	Unformatted Capacity (Total User Addressable Sectors in LBA Mode) ¹
1.92	3,750,748,848
3.84	7,501,476,528
7.68	15,002,931,888
15.36	30,005,842,608

Note:

1. The total usable capacity of the SSD may be less than the total physical capacity because a small portion of the capacity is used for NAND media management and maintenance. JESD218B standard is used. User-addressable logical block count = 21168 + (1953504 x SSD Capacity in Gbytes).

2. 1TB=10¹² bytes, 1 sector=512 bytes, LBA count shown represents total user storage capacity and will remain the same throughout the lifespan of the drive.

Table 2-3: User Addressable Sectors of R5300/R5301/R5300D

Capacity (TB ²)	Unformatted Capacity (Total User Addressable Sectors in LBA Mode) ¹
1.6	3,125,627,568
3.2	6,251,233,968
6.4	12,502,446,768
12.8	25,004,872,368

Note: Please refer to the Note of the Table 2-2.

2.3.2 Power Consumption

Table 2-4 lists the power consumption specifications for the Roalsen5 series.

Table 2-4: Power consumption specifications for the Roalsen5 series

PCN	Capacity (TB)	MAX ¹ (W)	TYP ² (W)	IDLE ³ (W)	Sequential Read ⁴ (W)	Sequential Writes ⁴ (W)
PCIe Gen4						
R5100	7.68	22.5	19.5	6.5	14.5	22.5
	15.36	23.0	22.0	6.5	14.5	23.0
R5100D	3.84	15.0	13.5	6.0	13.5	15.0
	7.68	22.5	19.5	6.5	14.5	22.5
R5300	6.4	22.5	19.5	6.5	14.5	22.5
	12.8	23.0	22.0	6.5	14.5	23.0

R5300D	3.2	15.0	13.5	6.0	13.5	15.0
	6.4	22.5	19.5	6.5	14.5	22.5
R5101	1.92	14.5	12.0	6.0	12.0	14.5
	3.84	21.0	17.5	6.0	13.5	21.0
R5301	1.6	14.5	12.0	6.0	12.0	14.5
	3.2	21.0	17.5	6.0	13.5	21.0
R5102	3.84	20.0	18.0	6.0	14.0	20.0
R5302	3.2	19.5	18.0	6.0	14.0	19.5

Note:

1. Typical power Consumption is measured with 4 workers*Queue Depth 64*4096 bytes for random read/write ratio (7/3);
2. Max power Consumption is measured with 1 worker* Queue Depth 128*131,072 bytes for sequential write.

2.3.3 Reliability Specifications

Table 2-5: Reliability specifications for the Roelsen5 series

Parameter	Specifications
Mean time between failures (MTBF)	2 million hours
Bit error rate (BER)	$<10^{-17}$
Data protection	Three months on a powered-off SSD when the temperature is lower than 40°C

2.2.4 Environmental Specifications

Table 2-6: Environmental Specifications for the Roelsen5 series

Environment index	Description
Operating temperature	Case temperature: 0°C to 70°C
Storage temperature	-40°C to 85°C
Operating Altitude	-305m to 5418m
Non- Operating Altitude	-305m to 12192m
Operating humidity	5% RH to 95% RH
Storage humidity	5% RH to 95% RH
Operating shock	1500G at 0.5ms half sine
Non-operating shock	1500G at 0.5ms half sine
Operating vibration	2.17 G _{RMS} (5 Hz to 700 Hz)
Storage vibration	3.13 G _{RMS} (5 Hz to 800 Hz)

2.2.5 Electrical Characteristics

Table 2-7: Input Supply Rails – 2.5 inches SSD – the Roealsen5 series

Electrical Characteristics	12V Host	3.3Vaux
Tolerance	+10% ~ -10%	+9% ~ -9%
Inrush Current (Typical Peak)	<3.0A	-
Max Average Current	<2.1A	10mA
Min Off-Time	5s	5s
Rising Slew Rate	5ms~50ms	5ms~50ms
Falling Slew Rate	<5s	<5s
Shutdown Undershoot	0V	0V
Noise 10Hz-100kHz	1000mv	300mv
Noise 100kHz-20MHz	50mv	50mv

2.4 System Requirements

This section describes the the Roealsen5 series requirements for server software and hardware.

- Hardware Requirements

The minimum requirements for server hardware are as follows:

- 2 GB memory
- To use the Roealsen5 series 2.5-inch SSD, the server must provide at least one 2.5-inch SSD disk slot that supports the PCIe SFF-8639 connector.

- Software Requirements

Roealsen5 series supports CentOS, Suse, ESXi, Windows server, Ubuntu, Redhat oss. To obtain the list of OSs that can be installed on the Roealsen5 series, see **Function and Interoperability Test** in Roealsen5 Enterprise NVMe SSD White Paper.

3. Installation and Configuration

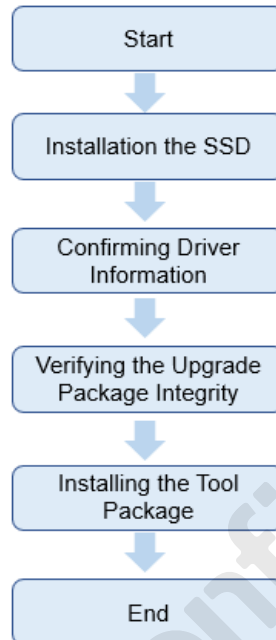
3.1 Installation and Configuration Process

The installation and configuration process includes the overall procedures for installing and configuring the Roealsen5 series. You can learn about Roealsen5 series installation

and configuration logic.

The flowchart for installing and configuring Roealsen5 series is shown in Figure 3-1.

Figure 3-1: Installation and configuration flowchart



3.2 Installing SSD Hardware

3.2.1 Preparations

Before installing SSDs, refer to the following items to prepare the devices.

- Stop all services on the server and backup data.
- Tools: ESD gloves and screwdriver.

3.2.2 Caution before Installation in Linux

Pay attention to the following in Linux:

- Do not perform direct read or write operations on a raw SSD to avoid processing the wrong SSD due to a changed drive letter.
- Restarting the server, installing or uninstalling the SSD driver, inserting and removing the SSD may change the SSD drive letter.
- If you have to perform direct read or write operations on a raw SSD, use the **nvme list** command to check the SSD information and confirm the drive letter through the SSD SN.
- It is recommended that you use the **mount** command to mount the SSD partitions to a specified path before performing read and write operations.
- To ensure normal release of system resources, use the **umount** command to cancel the mounted SSD partitions before installing or uninstalling the driver, and inserting or removing the SSD.

- You can also add information to the /etc/fstab file so that SSD partitions are automatically mounted during system startup, driver installation and uninstallation, and SSD insertion and removal. For details, run the **manfstab** command to view help information.
- After enabling the automatic mounting of SSD partitions, you do not need to run the **unmount** command before installing or uninstalling the driver, and inserting or removing the SSD.

3.2.3 Procedure

Step 1 Wear ESD gloves.

Step 2 Take out the SSD from the packing box, locate the handle of the server, and insert it into the corresponding slot of the server using four screws.

Step 3 Power on the server on which SSD are installed. After powering on the server, wait about 30 seconds for SSD to start.

3.3 Confirming Driver Information

The NVMe driver is not required for Roeadsen5 series products by default. You can use the OS driver. For example, in Windows 2008R2 or Windows2012, if patch KB2990941 has been installed, the NVMe driver is provided with the OS.

The following OSs are also integrated with the NVMe driver:

- Windows Server 2012 R2 or later
- ESXi 6.0 or later
- RHEL 6.5 or later
- CentOS 6.5 or later
- OEL 6.5 or later
- Ubuntu 14.04 or later
- SUSE Linux Enterprise Server (SLES) 11 SP4 or later

3.4 Verifying the Upgrade Package Integrity

Verify the obtained upgrade package to ensure that it is consistent with the original package on the web site.

Use the Winrar or 7z tool to calculate the MD5 value of the downloaded package, and compare it with the MD5 on the Internet to ensure that the results are consistent.

3.5 Installing Tool Package

After installing SSD hardware, you need to install the tool package for the operating system (Linux, Windows, and ESXi) to facilitate SSD management.

3.5.1 Preparations

Before installing the tool package (which can be obtained by contacting FAE), start winscp and use WinSCP to transfer the tool package file to the server where the SSD is located.

Note:

You can also use other software to upload the tool package file to the server.

The following information is required before using WinSCP transfer tool package.

- The server on which an SSD runs a virtual tunnel starts the file transfer service.
- To connect to a network, you need an IP address, user name, and password for the server to connect to.
- Winscp.exe is installed.

Use WinSCP to upload the tool package to a directory (for example, /root) on the server, as follows:

1. Open the **WinSCP** folder, and double-click **WinSCP.exe**.
2. Set the login parameters, enter the user name and password, and click **Login**.
 - **Host name**: Enter the IP address of the remote host to be connected.
 - **Port number**: The default value is 22.
 - **user**: Enter the user name (for example, **admin**).
 - **password**: Enter the password.
3. In the right pane, choose a directory of the remote host for storing files, (for example, /root/).
4. In the left pane, select a directory for storing files on the local computer (for example, E:\ Tools), and then select the tool package file to be transferred.
5. Choose **File > Copy**. The **Copy** dialog box is displayed.
6. Confirm the file to be copied and the directory of the remote host, and click **Copy**.
The system starts to copy the file from the local PC to the remote host.

3.5.2 Procedure

Step 1 Confirm that the SSD has been correctly installed on the server.

Step 2 Upload the tool package through a shared directory (for example, /root) and verify its integrity, or log in to the remote desktop and directly upload the tool package to the server.

Step 3 Log in to the operating system (OS) as an administrator.

Step 4 Run the following commands to go to the root directory, decompress the NVMe tool package.

```
cd /root
unzip nvme-FF00XXXX.zip -d nvme-cli
cd nvme-cli
make install
```

Step 5 Query the version number and execute the following command.

```
nvme --version
```

The execution results are similar:

```
nvme version FF00XXXX
```

4. Hot Plug

This section describes how to hot-plug a PCIe SSD.

Read the following information before hot swap.

Hot plug description of Roealsen5 series products:

- Support hot plug: R5100/R5100D/R5101/R5300/R5300D/R5301 U. 2 SSD.
- Do not support hot plug: R5100/R5100D/R5101/R5300/R5300D/R5301 AIC SSD.

Hot plug includes the following two types:

1. Notification hot-plug: users can directly insert the SSD device into the host when it is already power on; before pulling out the SSD device, it is necessary for users to complete the corresponding preparation steps for operating.
2. Surprise hot-plug: Users can directly insert and pull out the SSD device.

Application notes:

- Swap only one Roealsen5 series SSD at a time, otherwise, system anomalies may occur. After one Roealsen5 series SSD is removed or inserted, wait for at least 3 seconds before swapping or inserting another SSD.
- SSD hot swap may affect services running on the SSD. Before performing a hot swap, notify system maintenance personnel to ensure service security.
- If you insert the Roealsen5 series SSD when it is not installed on a drive tray, it may fail to be detected.
- After the Roealsen5 series SSD is removed, wait for at least 3 seconds before inserting it again. If you insert the Roealsen5 series SSD again when it is halfway removed, it may fail to be detected.
- Do not pause when inserting the Roealsen5 series SSD, otherwise, it may fail to be detected and leads to system exceptions. If the SSD cannot be detected or system exceptions occur, power cycle the server after the SSD is properly installed. If the Roealsen5 series fails to be detected due to improper insertion, remove and insert it again.

4.1 System Requirements For Hot Plug

Before hot plug, ensure that the server and BIOS support hot plug.

Table 4-1 lists the Operating systems for Roealsen5 series that support hot plug.

Limitations:

Only SSDs that serve as data disks can be hot- plug, SSDs that serve as system boot disks cannot be hot- plug.

Table 4-1: Operating systems for Roealsen5 series that support hot plug

Hot plug type	Operating systems
Notification hot-plug	<ul style="list-style-type: none"> ● Lent Red Hat: Version 7.0 and later ● CentOS: 7.0 or later ● Anyway Ubuntu: 16.04LTS, 18.04LTS, 20.04Its

Hot plug type	Operating systems
Surprise hot-plug	<ul style="list-style-type: none"> ● Costing Red Hat: Versions 7.2, 7.3, 7.4, 7.5 and later ● CentOS 7.0, 7.1, 7.2 or later versions ● Anyway Ubuntu: 16.04LTS, 18.04LTS, 20.04LTS

4.2 Notification hot-plug

4.2.1 Notification hot-plug a Drive in Linux

Operation Scenario

In Linux, perform the operations described in this section before performing an orderly hot swap of an Roealsen5 series SSD.

Preparations

You have correctly installed the Roealsen5 series on the server.

You have installed the Linux tool package. For details, see Installing the Tool Package in Linux.

Configuring Linux Kernel Parameters

In Linux, such as Red Hat Enterprise Linux (RHEL) 7.0, hot swap of the Roealsen5 series SSD disk will cause unmatched maximum payload size, I/O write errors, and other issues. This is because Linux does not fully support hot swap. To avoid this issue, make changes to the Linux kernel file. The changes vary with the Linux OS type.

The Linux kernel parameter configurations also vary depending on OS types:

- RHEL 7.0 / 7.1 / 7.2 and CentOS 7.0 / 7.1 / 7.2
- RHEL 7.3 or later and CentOS 7.3 or later
- Ubuntu 16.04 / 18.04 / 20.04

RHEL 7.0 / 7.1 / 7.2 and CentOS 7.0 / 7.1 / 7.2

The following procedure uses CentOS 7.0 as an example.

Step 1 Log in to the operating system (OS) as the root user.

Step 2 In different installation modes, run commands to open the startup configuration file.

- Non-EFI installation mode: Run the **vim /boot/grub2/grub.cfg** command to

open the boot configuration file.

- EFI installation mode: Run the **vim /boot/efi/EFI/redhat/grub.cfg** command to open the boot configuration file.

Step 3 Enter i.

Step 4 In the boot configuration file, add **pciehp.pciehp_force=1**

pci=pcie_bus_perf to the boldface part shown in the following:

Note: Between the added content and its preceding content, a space is required and no line feed is allowed.

```

...(Some code omitted.)
### BEGIN /etc/grub.d/10_linux ###
menuentry 'Red Hat Enterprise Linux Server (3.10.0-1062.el7.x86_64) 7.2
(Maipo)' --class red --class gnu-linux --class gnu --class os --unrestricted
$menuentry_id_option
'gnulinux-3.10.0-327.el7.x86_64-advanced-d399f2ab-2af6-4a37-8a4b-bbb7e06a6d
a1' {
    load_video
    set gfxpayload=keep
    insmod gzio
    insmod part_gpt
    insmod xfs
    set root='hd0,gpt2'
    if [ x$feature_platform_search_hint = xy ]; then
        search --no-floppy --fs-uuid --set=root --hint-bios=hd0,gpt2
--hint-efi=hd0,gpt2 --hint-baremetal=ahci0,gpt2
a4f26d4e-c893-49fa-8ddc-9070181997c3
    else
        search --no-floppy --fs-uuid --set=root
a4f26d4e-c893-49fa-8ddc-9070181997c3
    fi
    linuxefi /vmlinuz-3.10.0-1062.el7.x86_64 root=/dev/mapper/rhel-root ro
crashkernel=auto rd.lvm.lv=rhel/root rd.lvm.lv=rhel/swap rhgb quiet
LANG=en_US.UTF-8 pciehp.pciehp_force=1 pci=pcie_bus_perf
    initrdefi /initramfs-3.10.0-1062.el7.x86_64.img
}
menuentry 'Red Hat Enterprise Linux Server (5.10.13-1.el7.elrepo.x86_64) 7.2
(Maipo)' --class red --class gnu-linux --class gnu --class os --unrestricted
$menuentry_id_option
'gnulinux-3.10.0-327.el7.x86_64-advanced-d399f2ab-2af6-4a37-8a4b-bbb7e06a6d
a1' {
    load_video
    set gfxpayload=keep
    insmod gzio
    insmod part_gpt
    insmod xfs

```

```

set root='hd0,gpt2'
if [ x$feature_platform_search_hint = xy ]; then
    search --no-floppy --fs-uuid --set=root --hint-bios=hd0,gpt2
--hint-efi=hd0,gpt2 --hint-baremetal=ahci0,gpt2
a4f26d4e-c893-49fa-8ddc-9070181997c3
else
    search --no-floppy --fs-uuid --set=root
a4f26d4e-c893-49fa-8ddc-9070181997c3
fi
linuxefi /vmlinuz-5.10.13-1.el7.elrepo.x86_64
root=/dev/mapper/rhel-root ro crashkernel=auto rd.lvm.lv=rhel/root
rd.lvm.lv=rhel/swap rhgb quiet LANG=en_US.UTF-8 pciehp.pciehp_force=1
pci=pcie_bus_perf
initrdefi /initramfs-5.10.13-1.el7.elrepo.x86_64.img
}
menuentry 'Red Hat Enterprise Linux Server (3.10.0-327.el7.x86_64) 7.2 (Maipo)'
--class red --class gnu-linux --class gnu --class os --unrestricted
$menuentry_id_option
'gnulinux-3.10.0-327.el7.x86_64-advanced-d399f2ab-2af6-4a37-8a4b-bbb7e06a6d
a1' {
    load_video
    set gfxpayload=keep
    insmod gzio
    insmod part_gpt
    insmod xfs
    set root='hd0,gpt2'
    if [ x$feature_platform_search_hint = xy ]; then
        search --no-floppy --fs-uuid --set=root --hint-bios=hd0,gpt2
--hint-efi=hd0,gpt2 --hint-baremetal=ahci0,gpt2
a4f26d4e-c893-49fa-8ddc-9070181997c3
    else
        search --no-floppy --fs-uuid --set=root
a4f26d4e-c893-49fa-8ddc-9070181997c3
    fi
    linuxefi /vmlinuz-3.10.0-327.el7.x86_64 root=/dev/mapper/rhel-root ro
crashkernel=auto rd.lvm.lv=rhel/root rd.lvm.lv=rhel/swap rhgb quiet
LANG=en_US.UTF-8 pciehp.pciehp_force=1 pci=pcie_bus_perf
initrdefi /initramfs-3.10.0-327.el7.x86_64.img
}
menuentry 'Red Hat Enterprise Linux Server
(0-rescue-b1d71ede7b394463be1d5376c56629d2) 7.2 (Maipo)' --class red --class
gnu-linux --class gnu --class os --unrestricted $menuentry_id_option
'gnulinux-0-rescue-b1d71ede7b394463be1d5376c56629d2-advanced-d399f2ab-2af
6-4a37-8a4b-bbb7e06a6da1' {

```

```

load_video
insmod gzio
insmod part_gpt
insmod xfs
set root='hd0,gpt2'
if [ x$feature_platform_search_hint = xy ]; then
    search --no-floppy --fs-uuid --set=root --hint-bios=hd0,gpt2
--hint-efi=hd0,gpt2 --hint-baremetal=ahci0,gpt2
a4f26d4e-c893-49fa-8ddc-9070181997c3
else
    search --no-floppy --fs-uuid --set=root
a4f26d4e-c893-49fa-8ddc-9070181997c3
fi
linuxefi /vmlinuz-0-rescue-b1d71ede7b394463be1d5376c56629d2
root=/dev/mapper/rhel-root ro crashkernel=auto rd.lvm.lv=rhel/root
rd.lvm.lv=rhel/swap rhgb quiet pciehp.pciehp_force=1 pci=pcie_bus_perf
initrdefi /initramfs-0-rescue-b1d71ede7b394463be1d5376c56629d2.img
}

### END /etc/grub.d/10_linux ###
...(Some code omitted.)

```

Step 5 Press Esc, enter :wq, and press Enter to save the edits.

Step 6 Restart the OS for the settings to take effect.

Step 1 Go to notifying the OS. For details, see **4.2.2 Notifying the OS**.

----End

RHEL 7.3 or later and CentOS 7.3 or later

The following procedure uses CentOS 7.5 as an example.

Step 1 Log in to the operating system (OS) as the root user.

Step 2 In different installation modes, run commands to open the startup configuration file.

- Non-EFI installation mode: Run the **vim /boot/grub2/grub.cfg** command to open the boot configuration file.
- EFI installation mode: Run the **vim /boot/efi/EFI/redhat/grub.cfg** command to open the boot configuration file.

Step 3 Enter i.

Step 4 In the boot configuration file, add **pciehp.pciehp_force=1**

pci=pcie_bus_perf to the boldface part shown in the following:

Note: Between the added content and its preceding content, a space is required and no line feed is allowed.

```

...(Some code omitted.)
### BEGIN /etc/grub.d/10_linux ###

```

```

menuentry 'CentOS Linux (3.10.0-862.el7.x86_64) 7 (Core)' --class centos --class
gnu-linux --class gnu --class os --unrestricted $menuentry_id_option
'gnulinux-3.10.0-862.el7.x86_64-advanced-9f9b036d-d1d8-4a84-9683-86c3fa1237
75' {
    load_video
    set gfxpayload=keep
    insmod gzio
    insmod part_msdos
    insmod xfs
    set root='hd0,msdos1'
    if [ x$feature_platform_search_hint = xy ]; then
        search --no-floppy --fs-uuid --set=root --hint-bios=hd0,msdos1
--hint-efi=hd0,msdos1 --hint-baremetal=ahci0,msdos1 --hint='hd0,msdos1'
33e4d589-9518-4b2c-931a-e5ea368a1b9e
    else
        search --no-floppy --fs-uuid --set=root
33e4d589-9518-4b2c-931a-e5ea368a1b9e
    fi
    linux16 /vmlinuz-3.10.0-862.el7.x86_64 root=/dev/mapper/centos-root
ro crashkernel=auto rd.lvm.lv=centos/root rd.lvm.lv=centos/swap rhgb quiet
LANG=en_US.UTF-8 pciehp.pciehp_force=1 pci=pcie_bus_perf
    initrd16 /initramfs-3.10.0-862.el7.x86_64.img
}
menuentry 'CentOS Linux (0-rescue-61317b4da8b14a5ab6706439c05f29eb) 7
(Core)' --class centos --class gnu-linux --class gnu --class os --unrestricted
$menuentry_id_option
'gnulinux-0-rescue-61317b4da8b14a5ab6706439c05f29eb-advanced-9f9b036d-d1
d8-4a84-9683-86c3fa123775' {
    load_video
    insmod gzio
    insmod part_msdos
    insmod xfs
    set root='hd0,msdos1'
    if [ x$feature_platform_search_hint = xy ]; then
        search --no-floppy --fs-uuid --set=root --hint-bios=hd0,msdos1
--hint-efi=hd0,msdos1 --hint-baremetal=ahci0,msdos1 --hint='hd0,msdos1'
33e4d589-9518-4b2c-931a-e5ea368a1b9e
    else
        search --no-floppy --fs-uuid --set=root
33e4d589-9518-4b2c-931a-e5ea368a1b9e
    fi
    linux16 /vmlinuz-0-rescue-61317b4da8b14a5ab6706439c05f29eb
root=/dev/mapper/centos-root ro crashkernel=auto rd.lvm.lv=centos/root
rd.lvm.lv=centos/swap rhgb quiet pciehp.pciehp_force=1 pci=pcie_bus_perf

```

```
initrd16 /initramfs-0-rescue-61317b4da8b14a5ab6706439c05f29eb.img
}
```

```
### END /etc/grub.d/10_linux ###
```

...(Some code omitted.)

Step 5 Press **Esc**, enter **:wq**, and press **Enter** to save the edits.

Step 6 Restart the OS for the settings to take effect.

Step 7 Go to notifying the OS. For details, see **4.2.2 Notifying the OS**.

---End

Ubuntu 16.04 / 18.04 / 20.04

The following procedure uses Ubuntu 18.04.5 LTS as an example.

Step 1 Log in to the operating system (OS) as the root user.

Step 2 Run the **vim /boot/grub/grub.cfg** command to open the boot configuration file.

Step 3 Enter **i**.

Step 4 In the boot configuration file, add **pciehp.pciehp_force=1**

pci=pcie_bus_perf to the boldface part shown in the following:

Note: Between the added content and its preceding content, a space is required and no line feed is allowed.

...(Some code omitted.)

```
### BEGIN /etc/grub.d/10_linux ###
```

```
function gfxmode {
```

```
    set gfxpayload="${1}"
```

```
    if [ "${1}" = "keep" ]; then
```

```
        set vt_handoff=vt.handoff=7
```

```
    else
```

```
        set vt_handoff=
```

```
    fi
```

```
}
```

```
if [ "${recordfail}" != 1 ]; then
```

```
    if [ -e ${prefix}/gfxblacklist.txt ]; then
```

```
        if hwmatch ${prefix}/gfxblacklist.txt 3; then
```

```
            if [ ${match} = 0 ]; then
```

```
                set linux_gfx_mode=keep
```

```
            else
```

```
                set linux_gfx_mode=text
```

```
            fi
```

```
        else
```

```
            set linux_gfx_mode=text
```

```
        fi
```

```
    else
```

```
        set linux_gfx_mode=keep
```

```

fi
else
    set linux_gfx_mode=text
fi
export linux_gfx_mode
menuentry 'Ubuntu' --class ubuntu --class gnu-linux --class gnu --class os
$menuentry_id_option
'gnulinux-simple-01e7ea6a-96cd-44b3-83ad-394b43d386f8' {
    recordfail
    load_video
    gfxmode $linux_gfx_mode
    insmod gzio
    if [ x$grub_platform = xxen ]; then insmod xzio; insmod lzopio; fi
    insmod part_gpt
    insmod ext2
    if [ x$feature_platform_search_hint = xy ]; then
        search --no-floppy --fs-uuid --set=root
01e7ea6a-96cd-44b3-83ad-394b43d386f8
    else
        search --no-floppy --fs-uuid --set=root
01e7ea6a-96cd-44b3-83ad-394b43d386f8
    fi
    linux      /boot/vmlinuz-4.4.0-131-generic.efi.signed
    root=UUID=01e7ea6a-96cd-44b3-83ad-394b43d386f8 ro pciehp.pciehp_force=1
pci=pcie_bus_perf
    initrd     /boot/initrd.img-4.4.0-131-generic
}
submenu 'Advanced options for Ubuntu' $menuentry_id_option
'gnulinux-advanced-01e7ea6a-96cd-44b3-83ad-394b43d386f8' {
    menuentry 'Ubuntu, with Linux 4.4.0-131-generic' --class ubuntu --class
gnu-linux --class gnu --class os $menuentry_id_option
'gnulinux-4.4.0-131-generic-advanced-01e7ea6a-96cd-44b3-83ad-394b43d386f8' {
        recordfail
        load_video
        gfxmode $linux_gfx_mode
        insmod gzio
        if [ x$grub_platform = xxen ]; then insmod xzio; insmod lzopio; fi
        insmod part_gpt
        insmod ext2
        if [ x$feature_platform_search_hint = xy ]; then
            search --no-floppy --fs-uuid --set=root
01e7ea6a-96cd-44b3-83ad-394b43d386f8
        else
            search --no-floppy --fs-uuid --set=root

```

```

01e7ea6a-96cd-44b3-83ad-394b43d386f8
    fi
    echo    'Loading Linux 4.4.0-131-generic ...'
    linux   /boot/vmlinuz-4.4.0-131-generic.efi.signed
root=UUID=01e7ea6a-96cd-44b3-83ad-394b43d386f8 ro
pciehp.pciehp_force=1 pci=pcie_bus_perf
    echo    'Loading initial ramdisk ...'
    initrd   /boot/initrd.img-4.4.0-131-generic
}
menuentry 'Ubuntu, with Linux 4.4.0-131-generic (recovery mode)' --class
ubuntu --class gnu-linux --class gnu --class os $menuentry_id_option
'gnulinux-4.4.0-131-generic-recovery-01e7ea6a-96cd-44b3-83ad-394b43d386f8' {
    recordfail
    load_video
    insmod gzio
    if [ x$grub_platform = xxen ]; then insmod xzio; insmod lzopio; fi
    insmod part_gpt
    insmod ext2
    if [ x$feature_platform_search_hint = xy ]; then
        search --no-floppy --fs-uuid --set=root
01e7ea6a-96cd-44b3-83ad-394b43d386f8
    else
        search --no-floppy --fs-uuid --set=root
01e7ea6a-96cd-44b3-83ad-394b43d386f8
    fi
    echo    'Loading Linux 4.4.0-131-generic ...'
    linux   /boot/vmlinuz-4.4.0-131-generic.efi.signed
root=UUID=01e7ea6a-96cd-44b3-83ad-394b43d386f8 ro recovery nomodeset
dis_ucode_ldr pciehp.pciehp_force=1 pci=pcie_bus_perf
    echo    'Loading initial ramdisk ...'
    initrd   /boot/initrd.img-4.4.0-131-generic
}
}

### END /etc/grub.d/10_linux ###
...(Some code omitted.)

```

Step 5 Press Esc, enter `:wq`, and press Enter to save the edits.

Step 6 Restart the OS for the settings to take effect.

Step 7 Go to Notifying the OS. For details, see **4.2.2 Notifying the OS**.

----End

4.2.2 Notifying the OS

After notifying the operating system, you can hot plug a disk.

Step 1 Log in to the OS as the root user.

Step 2 Stop all services accessing the Roealsen5 Series SSD.

Step 3 If you have used the **mount** command to attach the SSD partitions to certain paths, use the **umount** command to detach the partitions.

Step 4 Notify the OS to take power off the device.

- a) Run the **ls -l /sys/class/block** command to obtain the disk's BDF.
- b) Run the **lspci -s \$bdf -vvv |grep "Physical Slot"** to obtain the actual number of the slot where the disk is attached.
- c) Run the **echo 0 > /sys/bus/pci/slots/\$slot/power** command to take power off the device.
\$slot in the commands indicates the actual number of the slot where the device is attached.

Step 5 If the OS uses the **irqbalance** service to balance CPU interrupts, restart the service by using one of the following commands after performing a hot swap:

- For RHEL 7 or Oracle 7, run **systemctl restart irqbalance.service**.
- To configure the irqbalance service in other OSs, refer to documents related to the OSs.

----End

4.3 Surprise Hot Swap

For details about surprise hot swap operations, see the server version requirements and operation guide of each vendor.

5. Maintenance and Upgrade

5.1 Upgrading the Firmware

5.1.1 Upgrading the SSD Firmware in Linux

Operation Scenario

You can upgrade the controller firmware when a new version is released.

Preparations

Before upgrading the firmware, check that:

- Stop or exit the Roealsen5 Series SSD applications or services, and unmount the file system that uses the SSD device.
- The firmware upgrade does not damage data on SSDs. However, you are advised to back up important data on SSDs.
- You have obtained the **nvme-cli** tool package from **FAE**.
- You have downloaded the firmware package to the server, and verified the package integrity.

- You have uploaded the firmware file and **nvme-cli** tool package to the server.

Procedure

Step 1 Log in to the operating system (OS) as the root user.

Step 2 Run the following command to view the firmware version of the SSD. (**nvme0** is used as an example, and the firmware used by **afi** is **fw slot=1**):

```
root@dapu-System-Product-Name:~# nvme fw-log /dev/nvme0
Firmware Log for device:nvme0
afi   : 0x1
frs1  : 0x3132303230304646 (FF002020)
```

Step 3 Run the following command to query whether the firmware package exists in the directory and download.

```
root@dapu-System-Product-Name:~# ls *. image
package_compress.image
root@dapu-System-Product-Name:~# nvme fw-download /dev/nvme0 -f /root/
package_compress.image
Firmware download success
```

Step 4 Upgrade firmware. The following two activation modes are available.

- Reset activation mode:

After the upgrade (**-s=1/2/3, -a=1**), Restarts the system for the upgrade to take effect. The following version FF002021 is only for reference, and the actual version depends on the actual environment.

```
root@dapu-System-Product-Name:~# nvme fw-commit /dev/nvme0 -s 2 -a 1
Success committing firmware action:1 slot:1
```

```
root@dapu-System-Product-Name:~# nvme reset /dev/nvme0
```

After power-on, check firmware information . The firmware is successfully upgraded. (the afi firmware is **fw slot=2**):

```
root@dapu-System-Product-Name:~# nvme fw-log /dev/nvme0
Firmware Log for device:nvme0
afi   : 0x2
frs1  : 0x3132303230304646 (FF002021)
frs2  : 0x3132303230304646 (FF002021)
```

- Immediate activation mode:

Run the following command to activate the firmware immediately after the upgrade. The I/O is affected during the activation. Check the firmware version after the upgrade. The following version **FF002021** is only for reference, and the actual version depends on the actual environment.

```
root@dapu-System-Product-Name:~# nvme fw-commit /dev/nvme0 -s 3 -a 3
```

```
Success committing firmware action:3 slot:3
```

```
root@dapu-System-Product-Name:~# nvme fw-log /dev/nvme0
```

```
Firmware Log for device:nvme0
```

```
afi   : 0x3
frs1  : 0x3132303230304646 (FF002021)
```

frs2 : 0x3132303230304646 (FF002021)

frs3 : 0x3132303230304646 (FF002021)

Note: If an exception occurs in Step 3 or Step 4 and the upgrade fails, please contact DapuStor FAE.

---End

5.1.2 Upgrading the SSD Firmware in Windows

Operation Scenario

You can upgrade the controller firmware when a new version is released.

Preparations

Before upgrading the firmware, check that:

- Stop or exit the Roeadsen5 Series SSD applications or services, and unmount the file system that uses the SSD device.
- The firmware upgrade does not damage data on SSDs. However, you are advised to back up important data on SSDs.
- You have obtained the **nvme-cli** tool package from **FAE**.
- You have downloaded the firmware package to the server, and verified the package integrity.
- You have uploaded the firmware file and **nvme-cli** tool package to the server.

Procedure

Step 1 Log in to the Windows as an administrator. The following uses Windows 10 as an example.

Step 2 Choose **Start > Windows PowerShell**. The **Windows PowerShell** is displayed.

Step 3 Run the following command to view the name of the SSD to be upgraded.

```
PS C:\Users\Administrator> Get-PhysicalDisk
```

FriendlyName	SerialNumber	MediaType	CanPool	OperationalStatus	HealthStatus	Usage	Size
DAPUSTOR	DPRD3108T0T306T4000	6D4C_528B_B4F9_8EC4_D8BC_591E_3B06_0001	SSD	True	OK	Healthy	Auto-Select 5.82 TB

Step 4 Run the following command to view the controller firmware version of the SSD. (DAPUSTOR DPRD3108T0T306T4000 is used as an example, the **afi** firmware is **fw**

slot=1).

```
PS C:\Users\Administrator> Get-PhysicalDisk -FriendlyName "DAPUSTOR
DPRD3108T0T306T4000" | Get-StorageFirmwareInformation
```

```
Object                : MSFT_PhysicalDisk (ObjectId =
"{1}\DESKTOP-SM79CIF\root\Microsoft\Win...)
SupportsUpdate        : True
NumberOfSlots         : 3
ActiveSlotNumber      : 1
SlotNumber            : {1, 2, 3}
IsSlotWritable        : {True, True, True}
FirmwareVersionInSlot : { FF002021, FF002021, FF002021 }
```

Step 5 Run the following command to upgrade the firmware and check whether the firmware version is **slot=2**.

```
PS C:\Users\Administrator> Get-PhysicalDisk -FriendlyName "DAPUSTOR
DPRD3108T0T306T4000" | Update-StorageFirmware -ImagePath "C:\
package_compress.image" -SlotNumber 2
PS C:\Users\Administrator> Get-PhysicalDisk -FriendlyName "DAPUSTOR
DPRD3108T0T306T4000" | Get-StorageFirmwareInformation
```

```
Object                : MSFT_PhysicalDisk (ObjectId =
"{1}\DESKTOP-SM79CIF\root\Microsoft\Win...)
SupportsUpdate        : True
NumberOfSlots         : 3
ActiveSlotNumber      : 2
SlotNumber            : {1, 2, 3}
IsSlotWritable        : {True, True, True}
FirmwareVersionInSlot : { FF002021, FF002021, FF002021 }
```

If **slot=2**, the firmware is successfully upgraded, otherwise restart the OS after the upgrade.

Step 6 Wait until it is powered on and check again. If the query fails, please contact DapuStor **FAE**.

More information, see [Update-StorageFirmware](#).

5.1.3 Upgrading the SSD Firmware in VMware

Operation Scenario

You can upgrade the controller firmware when a new version is released.

Preparations

Before upgrading the firmware, check that:

- Stop or exit the Roelsen5 Series SSD applications or services, and unmount the file system that uses the SSD device.
- The firmware upgrade does not damage data on SSDs. However, you are advised to back up important data on SSDs.
- You have obtained the **nvme-cli** tool package from **FAE**.
- You have downloaded the firmware package to the server, and verified the package integrity.
- You have uploaded the firmware file and **nvme-cli** tool package to the server.

Procedure

Step 1 Log in to ESXi over SSH. The following uses ESXi 6.7 as an example.

Step 2 Run the following command to view the firmware version of the SSD to be upgraded (the active fw slot is 1).

```
[root@localhost-host:~] esxcli nvme device list
HBA Name  Status  Signature
-----
vmhba0    Online  nvmeMgmt-nvme00010000
[root@localhost-host:~] esxcli nvme device log fwslot get -A vmhba0
Firmware Slot Info:
  Firmware Slot to Be Activated at Next Controller Reset: 0
  Firmware Slot Being Activated: 1
  Firmware Revision for Slot 1: FF002021
  Firmware Revision for Slot 2:
  Firmware Revision for Slot 3:
  Firmware Revision for Slot 4:
  Firmware Revision for Slot 5:
  Firmware Revision for Slot 6:
  Firmware Revision for Slot 7:
```

Step 3 Run the following command to download firmware package.

```
[root@localhost-host:~] ls /tmp/*.image
/tmp/package_compress.image
[root@localhost-host:~]
[root@localhost-host:~]
[root@localhost-host:~] esxcli nvme device firmware download -A vmhba0 -f
/tmp/package_compress.image
Download firmware successfully.
```

Step 4 Upgrade firmware. The following two activation modes are available.

- Reset activation mode:
After the upgrade (**-s=2, -a=1**), Restarts the system for the upgrade to take effect. The following version FF002021 is only for reference. The actual version depends on the actual environment.
[root@localhost-host:~] esxcli nvme device firmware activate -a 1 -s 2 -A vmhba0

Success committing firmware action:1 slot:1.

```
[root@localhost-host:~] esxcli nvme device log fwslot get -A vmhba0
```

Firmware Slot Info:

Firmware Slot to Be Activated at Next Controller Reset: 2

Firmware Slot Being Activated: 1

Firmware Revision for Slot 1: FF002021

Firmware Revision for Slot 2: FF002021

Firmware Revision for Slot 3:

Firmware Revision for Slot 4:

Firmware Revision for Slot 5:

Firmware Revision for Slot 6:

Firmware Revision for Slot 7:

```
[root@localhost-host:~] reboot
```

- Immediate activation mode:

Run the following command to activate the firmware immediately after the upgrade. The I/O is affected during the activation. Check the firmware version after the upgrade. The following version **FF002021** is only for reference. The actual version depends on the actual environment.

```
[root@localhost-host:~] esxcli nvme device firmware activate -a 3 -s 3 -A vmhba0
```

Commit firmware successfully.

```
[root@localhost-host:~] esxcli nvme device log fwslot get -A vmhba0
```

Firmware Slot Info:

Firmware Slot to Be Activated at Next Controller Reset: 0

Firmware Slot Being Activated: 3

Firmware Revision for Slot 1: FF002021

Firmware Revision for Slot 2: FF002021

Firmware Revision for Slot 3: FF002021

Firmware Revision for Slot 4:

Firmware Revision for Slot 5:

Firmware Revision for Slot 6:

Firmware Revision for Slot 7:

Note: If an exception occurs in Step 3 or Step 4 and the upgrade fails, please contact DapuStor FAE.

5.2 Querying Health Status of an SSD

The Rocealsen5 Series SSDs support the query SMART attribute in the NVMe 1.4a protocol.

Operation Scenario

Check the SSD health status.

Procedure

Step 1 Log in to the OS as an administrator or a member in the administrator group.

Step 2 Run the following command to query the health status of the SSD controller (such as nvme0):

```
nvme smart-log /dev/nvme0n1
```

This command complies with the NVMe 1.4a protocol. The value of the **critical_warning** item in the system echo message indicates the controller health status of the SSD device.

- The value of **critical_warning** is **0**, it indicates that the SSD is normal.
- The value of **critical_warning** is non-0, it indicates that the SSD is abnormal.
- The return value is defined as Table A-1 of Annex A.

5.3 Information Collection

5.3.1 Collecting SSD Information

Operation Scenario

Collect SSD information when maintaining SSDs.

Procedure

Step 1 Log in to the OS as an administrator or a member in the administrator group.

Step 2 Run the following command to query general information about the SSD controller (such as nvme0):

```
nvme dapu get-fwVerInfo /dev/nvme0n1 -H
```

The command output is similar to the following:

```
root@tester:~# nvme dapu get-fwVerInfo /dev/nvme0n1 -H
commit_id   : 1e646c
ddrType      : NY1X16
compileTime: NIDT-2021-08-25/11:25:02
vendorSpecific: 0x65416059
fwVer: 0x50002021
RESULT: DAPU: Success(0)
```

Step 3 Run the following command to query the SMART information of the SSD controller (such as nvme0):

```
nvme dapu get-selfDefineSmartInfo /dev/nvme0n1 -H
```

The vendor smart is defined as Table A-2 of Annex A.

5.3.2 Collecting SSD Logs

Operation Scenario

Collect SSD logs when maintaining SSDs.

Procedure

Step 1 Log in to the OS as an administrator or a member in the administrator group.

Step 2 Run the following command to collect the SSD controller (such as nvme0) log information:

```
nvme dapu get-dialog /dev/nvme0n1
```

The command output is similar to the following:

```
root@tester:~# nvme dapu get-dialog /dev/nvme0n1
```

```
RESULT: get clog Success(0)
```

```
RESULT: get dfx Success(0)
```

```
RESULT: get coredump Success(0)
```

```
RESULT: get vsmart Success(0)
```

```
RESULT: get smart Success(0)
```

```
RESULT: get syslog Success(0)
```

```
RESULT: get mlog Success(0)
```

```
RESULT: DAPU: Success(0)
```

The SSD Logs are stored in the current directory.

Log format : **Driver lever_date_DiaLog**, for example,

nvme0n1_20210402_171531_DiaLog

5.4 Securely Erasing SSD Data

The Roeadsen5 Series SSDs support optional NVMe 1.4a Sanitize management commands.

NVMe 1.4a provides three types of data destruction: **crypto erase**, **block erase**, and **overwrite**.

The Current version of Roeadsen5 Series supports **block erase** and **overwrite**.

All destruction actions are performed in the background. **sanitize -log** is supported to query the status and progress of **sanitize**.

5.4.1 Sanitize data destruction operation

Function

This command is used to perform data destruction on the specified SSD device.

Format

`nvme sanitize $dev [-d no-deallocate] [-i oipbp] [-n owpass] [-u ause] [-a sanact] [-p ovrat]`

Parameters

Parameter	Description	Value
\$dev	Indicates the name of an SSD.	Example: <code>/dev/nvme0</code>
no-deallocate	Indicates whether to reassign logical blocks after the sanitize operation is completed successfully.	<ul style="list-style-type: none"> ● 0: Reallocate, default is 0. ● 1: no-deallocate. ● The default value is 0. Note: If the sanact type is 1 , that is, exit Failure mode , this parameter is ignored.
oipbp	Indicates whether the overwrite mode is inverted between two overwrites.	<ul style="list-style-type: none"> ● 0: The overwrite mode is not inverted. ● 1: The overwrite mode is inverted. Note: This parameter is available only when sanact is 3 (overwrite operation). In other cases, this parameter is ignored.
owpass	Indicates the number of overwrite operations.	<ul style="list-style-type: none"> ● Specifies the number of data overwrites. ● The value ranges from 1 to 16. ● If this parameter is not specified or 0 is specified, the number of overrides is 16. Note: This parameter is available only when sanact is 3 (overwrite operation). In other cases, this parameter is ignored.
ause	Indicates restriction mode.	<ul style="list-style-type: none"> ● 0: restricted completion mode ● 1: unrestricted completion mode
sanact	Indicates operation type.	<ul style="list-style-type: none"> ● 0: reserved ● 1: exit failure mode ● 2: block erase operation ● 3: overwrite operation ● 4: crypto erase operation

		Note: Rocalsen5 Series supports type 1, 2 and 3
ovrpat	Indicates the overwrite pattern.	<ul style="list-style-type: none"> • A 32-bit value is used for overwriting. Note: This parameter is available only when sanact is 3 (overwrite operation). In other cases, this parameter is ignored.

Usage Guidelines

None

Example

```
# Perform data destruction operation on /dev/nvme1
[root@localhost ~]# nvme sanitize /dev/nvme1 -a 3 -d -i -n 1 -u -p 0x12345678
[root@localhost ~]#
```

5.4.2 Query the status and progress of **Sanitize** operations

Function

This command is used to query the status and progress of data destruction on a specified SSD.

Format

```
nvme sanitize-log $dev -H
```

Parameters

None

Usage Guidelines

None

Example

```
# Query the data destruction progress on /dev/nvme1
```

```
[root@localhost ~]# nvme sanitize-log /dev/nvme1 -H
Sanitize Progress (SPROG) : 1145 (1.747131%)
Sanitize Status (SSTAT) : 0x102
[2:0] Sanitize in Progress.
[7:3] Number of completed passes if most recent operation was overwrite: 0
[8] Global Data Erased set: NVM storage has not been written
Sanitize Command Dword 10 Information (SCDW10): 0x31b
Estimated Time For Overwrite : 2534400
Estimated Time For Block Erase : 60
Estimated Time For Crvpto Erase : 4294967295
```

5.5 Querying SSD Lifespans

Operation Scenario

Query the lifespan of an SSD.

Procedure

Step 1 Log in to the OS as an administrator or a member in the administrator group.

Step 2 Run the following command to query the SMART information of the SSD controller (such as nvme0):

```
nvme smart-log /dev/nvme1
```

The command output is similar to the following:

```
root@dapu-System-Product-Name:~# nvme smart-log /dev/nvme1
```

```
Smart Log for NVME device:nvme1 namespace-id:ffffffff
```

```
critical_warning           : 0
temperature                : 37 C
available_spare            : 100%
available_spare_threshold  : 10%
percentage_used             : 0%
data_units_read            : 8
data_units_written         : 85
host_read_commands        : 182
host_write_commands       : 335
controller_busy_time      : 0
power_cycles               : 4
power_on_hours             : 320
unsafe_shutdowns          : 0
media_errors               : 0
num_err_log_entries       : 0
Warning Temperature Time   : 0
Critical Composite Temperature Time : 0
Temperature Sensor 1      : 60 C
Temperature Sensor 2      : 38 C
```

Temperature Sensor 3	: 31 C
Temperature Sensor 4	: 32 C
Temperature Sensor 5	: 34 C
Thermal Management T1 Trans Count	: 0
Thermal Management T2 Trans Count	: 0
Thermal Management T1 Total Time	: 0
Thermal Management T2 Total Time	: 0

Step 3 The percentage used parameter displays the used lifespan percentage of the SSD. 0% represents the new disk.

If the value of percentage used exceeds 100%, the SSD lifespan has expired, and DapuStor warranty service is unavailable. You need to back up data on the SSD as soon as possible and replace the SSD.

5.6 Common Faults

5.6.1 Hardware Connection Faults or Other Faults

Hardware connection faults are mostly identified by indicators. If the yellow indicator of a device is on and the green indicator is off 30 seconds after a new drive is installed or during proper operating, hardware faults occur.

Typical fault causes are as follows:

- The drive is not securely installed.
- The drive is installed in a non-NVMe slot.
- A drive hardware port fault occurs.

5.6.2 Drive Identification Faults or Other Faults

Drive identification faults indicate scenarios where the host OS disk manager (for example, fdisk-l in Linux and the device manager in Windows) cannot properly identify Roceans5 Series SSDs when hardware connections are correct. If drive identification faults occur, collect all logs.

Typical fault causes are as follows:

- The NVMe driver is not installed on the OS.
- OS driver loading fails.
- The link is abnormal and the disk is isolated by the OS.

5.6.3 Drive Internal Faults or Other Faults

Drive internal faults indicate scenarios where drive internal alarms occur while the OS can properly identify drives. If such faults occur, the drives do not function properly or cannot be used. This section uses an example to describe how to identify such faults.

Step 1 Query smart information about the SSD, and **critical_warning = 0**, which indicates that the disk is healthy.

```
[root@localhost ~]# nvme smart-log /dev/nvme2
Smart Log for NVME device:nvme2 namespace-id:ffffff
critical_warning           : 0
temperature                : 35 C
available_spare            : 100%
available_spare_threshold  : 10%
percentage_used            : 0%
data_units_read           : 99,165
data_units_written        : 329,232
host_read_commands        : 769,206
host_write_commands       : 3,613,633
controller_busy_time      : 11
power_cycles              : 12
power_on_hours            : 387
unsafe_shutdowns         : 9
media_errors              : 2
num_err_log_entries       : 2
Warning Temperature Time   : 0
Critical Composite Temperature Time : 0
Temperature Sensor 1      : 56 C
Temperature Sensor 2      : 35 C
Temperature Sensor 3      : 32 C
Temperature Sensor 4      : 31 C
Temperature Sensor 5      : 32 C
Thermal Management T1 Trans Count : 0
Thermal Management T2 Trans Count : 0
Thermal Management T1 Total Time : 0
Thermal Management T2 Total Time : 0
```

If **critical_warning** is another value, it indicates that the disk is abnormal, such as overtemperature and insufficient redundant space.

Typical fault causes are as follows:

- The available space is lower than the threshold, or too many damaged blocks.
- The temperature is excessively high, for example, exceeding 78 ° C.
- An internal fault occurs, a capacitor fails, and the backup power fails (see Table A-2 for systemWarning1 and systemWarning2).

Critical Warning parameters are shown below:

Bit	Description
0	1: The available space is smaller than the threshold.
1	1: The temperature above the overtemperature threshold or below the undertemperature threshold: Causes include drive temperature below 0°C or above 78°C.
2	1: The reliability of the device has been reduced due to a critical media error.
3	1: The medium is read-only.
4	1: An internal error downgrades the NVM subsystem reliability.
7:5	The reserved.

Step 2 If the **nvme list** cannot find block devices, run the following command to query the NVMe list and collect logs. For details, see **6.3**.

```
[root@localhost ~]# ls /sys/block/ -l|grep nvme
lrwxrwxrwx 1 root root 0 Mar 26 13:56 nvme0n1
-> ../devices/pci0000:00/0000:00:01.0/0000:01:00.0/nvme/nvme0/nvme0n1
lrwxrwxrwx 1 root root 0 Mar 26 13:56 nvme2n1
-> ../devices/pci0000:00/0000:00:1c.4/0000:09:00.0/nvme/nvme2/nvme2n1
[root@localhost ~]# nvme list
Node          SN                      Model
Namespace Usage          Format          FW Rev
-----
/dev/nvme0n1    A23UE0A218001QWM    DAPUSTOR DPRD3104T0T503T8000
1              3.84 TB / 3.84 TB    512    B+    0 B    FF002021
/dev/nvme2n1    B0031EB014EBA      DAPUSTOR DPRD3108T0T507T6000
1              7.68 TB / 7.68 TB    512    B+    0 B    FF002021
[root@localhost ~]# ls /dev/nvme*
/dev/nvme0  /dev/nvme0n1  /dev/nvme1  /dev/nvme2  /dev/nvme2n1
/dev/nvme2n1p1
[root@localhost ~]# nvme id-ctrl /dev/nvme1
NVME Identify Controller:
vid      : 0x1e3b
ssvid    : 0x1e3b
sn       : JR5U31A218001QJ6
mn       : DAPUSTOR DPRD3108T0T507T6000
fr       : FF002021
rab      : 4
ieee     : d8bc59
cmic     : 0
```

```
mdts      : 5
cntlid    : 1
ver       : 10400
.....
```

5.7 Indicator Status Description

The indicators on the front panel of the drive bay display the working status of the Roelsen5 Series.

The following is the description of SSD indicators (AIC only has failure indicators).

Activity Indicator (Green)	Fault Indicator (Amber/Blue)	Description
OFF	OFF	The SSD cannot be detected.
ON	OFF	The SSD is detected and working properly.
2 Hz	OFF	Data access to the SSD is in progress.
OFF	ON	The SSD is faulty.

5.8 Removing an Roelsen5 Series SSD

Removing an Roelsen5 Series SSD disk

Do not remove the 2.5-inch SSD shell and label without approval. Otherwise, the DapuStor is not responsible for after-sales and maintenance. During the maintenance period, if you encounter functional problems, please contact after-sales service personnel for replacement and repair.

Removing an Roelsen5 Series SSD card

Do not remove the Card SSD (AIC) without approval. Otherwise, the DapuStor is not responsible for after-sales and maintenance. During the maintenance period, if you encounter functional problems, please contact after-sales service personnel for replacement and repair.

6. Command Description

6.1 Querying the firmware version of an SSD

Function

This command is used to query the firmware version of an SSD.

Format

```
nvme dapu get-fwVerInfo devicename -H
```

Parameters

None

Usage Guidelines

None

Example

```
# Query the firmware version information about an SSD
root@ubuntu-Super-Server:~# nvme dapu get-fwVerInfo /dev/nvme0n1 -H
commit_id   : a78f1b
ddrType      : NY1X16
compileTime: NIDT-2021-08-26/16:56:26
vendorSpecific: 0xb1275d9c
fwVer: 0x50002021
RESULT: DAPU: Success(0)
```

6.2 Querying the SMART Information About an SSD

Function

This command is used to query the SMART (Self-Monitoring, Analysis and Reporting Technology) information about an SSD (SSD controller).

Format

```
nvme dapu get-selfDefineSmartInfo devicename -H
```


Parameters

None

Usage Guidelines

None

Example

Query the SMART (Self-Monitoring, Analysis and Reporting Technology) information about an SSD (SSD controller)

```
root@ubuntu-Super-Server:~# nvme dapu get-selfDefineSmartInfo /dev/nvme0n1 -H
```

```
switchOpTimes           : 0
ctrlBusyTimeS           : 0
powerOnTimeS            : 0
flashOverTemperatureCount : 0
flashPeakTemperature     : 41 (C)
flashOverTemperatureTime : 0 (S)
peakTemperature          : 43 (C)
overTemperatureCount     : 0
overTemperatureTime      : 0 (S)
controllerPeakTemperature : 71 (C)
controllerOverTemperatureCount : 0
controllerOverTemperatureTime : 0 (S)
capacitorVolume          : 1659 (uF)
capacitorVoltage         : 27909 (mV)
capacitorCycle           : 1
capacitorHealth          : 0
capacitorFlashOff        : 0
faultCENumber            : 0
totalBlockCount          : 1519616
totalBadBlockCount       : 387009
onflyBadBlockCount       : 0
totalPageCount           : 583532544
lostDiskVolume           : 0 (Byte)
FTLDirtyRebuildCount     : 0
FTLDeepRebuildCount      : 0
sysWLReadCount           : 0
usrWLReadCount           : 0
sysWLReadSizeKB          : 0
usrWLReadSizeKB          : 0
sysFgWLMoveCount         : 0
```

usrFgWLMoveCount	: 0
sysBgWLMoveCount	: 0
usrBgWLMoveCount	: 0
deepRebuildMark	: 0
factoryBadBlockCount	: 387009
programBadBlockCount	: 0
eraseBadBlockCount	: 0
uncBadBlockCount	: 0
IOWriteCount	: 120
IOWriteFailCount	: 0
metaGCWriteCount	: 0
sysGCWriteCount	: 0
usrGCWriteCount	: 0
metaGCReadCount	: 0
sysGCReadCount	: 0
usrGCReadCount	: 0
metaGCReadSizeKB	: 0
sysGCReadSizeKB	: 0
usrGCReadSizeKB	: 0
sysCriGcMoveCount	: 0
usrCriGcMoveCount	: 0
forceMoveCount	: 0
sysRDAReadCount	: 0
sysRDAReadSizeKB	: 0
sysRDAMoveCount	: 0
usrRDAReadCount	: 0
usrRDAReadSizeKB	: 0
usrRDAMoveCount	: 0
sysDataRetentionReadCount	: 0
sysDataRetentionReadSizeKB	: 0
usrDataRetentionReadCount	: 0
usrDataRetentionReadSizeKB	: 0
RentionCheckMoveCnt	: 0
RberCheckMoveCnt	: 0
rootTotalWrSizeKB	: 256
rootFgWrSizeKB	: 256
usrTotalWrSizeKB	: 0
usrFgWrSizeKB	: 0
userRemapBlkCnt	: 0
metaRemapBlkCnt	: 0
usrWriteWA	: 0.00
userAvailibleBlockNum	: 691
userFreeBlockNum	: 691
userFreeCapacityMB	: 2122752

sysAvalibleBlockNum	: 18
sysFreeBlockNum	: 16
sysFreeCapacityMB	: 24576
metaAvalibleBlockNum	: 8
metaFreeBlockNum	: 7
metaFreeCapacityMB	: 5376
averageECCnt	: 0
maximumECCnt	: 0
minimumECCnt	: 0
systemTimeInSeconds	: 1629980801
port0RxErrCnt	: 0
port0BadTlpCnt	: 0
port0LcrcErrCnt	: 0
port0BadDllpCnt	: 0
port0RepNumRolloverCnt	: 0
port0RepToCnt	: 0
port0PoisTlpCnt	: 0
port0EcrcErrCnt	: 0
port0UnsReqCnt	: 108
port0CompAbortCnt	: 0
port0CompToCnt	: 0
pf0CrcErrCnt	: 0
port1RxErrCnt	: 0
port1BadTlpCnt	: 0
port1LcrcErrCnt	: 0
port1BadDllpCnt	: 0
port1RepNumRolloverCnt	: 0
port1RepToCnt	: 0
port1PoisTlpCnt	: 0
port1EcrcErrCnt	: 0
port1UnsReqCnt	: 0
port1CompAbortCnt	: 0
port1CompToCnt	: 0
pf1CrcErrCnt	: 0
unalignedHostWritePowerOnCount	: 0
unalignedHostWriteTotalCount	: 0
systemWarning1	: 0
systemWarning2	: 0
historyWarning1	: 0
historyWarning2	: 0
ControllerReset	: 1
SubSystemReset	: 0
pcie0Reset	: 0
pcie1Reset	: 0

```

i2cDropForce          : 0
powerConsumptionLevel : 0
firmwareHealthStatus  : 0
diskStatus             : 0
ddrUncErrCnt           : 0
ddrEccErrCnt           : 0
fcrErr                 : 0
trimPadReadErr        : 0
WrPadReadErr           : 0
dppGuardErr           : 0
dppLbaRefErr           : 0
dppLbaAppErr           : 0
raidRecoverSuccCnt     : 0 0
raidRecoverFailCnt     : 0 0
beReadCnt              : 1065
beReadFail             : 0
beProgCnt              : 266
beProgFail             : 0
beEraseCnt             : 832
beEraseFail            : 0
beUncCnt               : 0
beVttCnt               : 0
beVttResumeCnt         : 0
beTimeoutCnt           : 0
uncHostRdErrCnt        : 0
uncUsrBgRdErrCnt       : 0
uncSysRdErrCnt         : 0
uncSysBgRdErrCnt       : 0
uncOtherRdErrCnt       : 0
sscanMetaErrBm         : 0
sscanSysErrBm          : 0
sscanUserErrCnt        : 0
ftlBgRdaCnt            : 0
ftlBgDrCnt             : 0
ftlBgDpCnt             : 0
RESULT: DAPU: Success(0)

```

6.3 Obtaining logs of a specified SSD

Function

This command is used to Obtain logs of a specified SSD.

Format

nvme dapu get-dialog devicename -n 1

Parameters

Parameter	Description	Value
--value=<NUM>, -n <NUM>	Whether the folder is compressed	0: not compressed Others: compression

Usage Guidelines

The generated log folder is stored in the current path in the format of device **name _ date _dialog.tar.gz**. Such as: **nvme0n1_20210402_171531_DiaLog. Tar. Gz**.

The following information is displayed in the decompressed folder:

Log type	Log folder or file name
Persistent syslog log folder	nvme0n1_20210402_180846_SysLog
Unpersisted syslog folder	nvme0n1_20210402_180859_MlogMem.log
critical log files	nvme0n1_20210402_180846_c.log
Core Dump log files	nvme0n1_20210402_180846_CoreDump.log
DFX log files	nvme0n1_20210402_180846_dfx.log
Standard SMART information file	smart.log
Vendor Unique SMART Log	vsmart.log

Example

```
# Obtain logs of a specified SSD
root@tester:~# nvme dapu get-dialog /dev/nvme0n1
RESULT: get clog Success(0)
RESULT: get dfx Success(0)
RESULT: get coredump Success(0)
RESULT: get vsmart Success(0)
RESULT: get smart Success(0)
RESULT: get syslog Success(0)
RESULT: get mlog Success(0)
RESULT: DAPU: Success(0)
```

6.4 Querying the WWN of an SSD

Function

This command is used to query the WWN of an SSD.

Format

`nvme dapu get-equipWwn devicename -H`

Parameters

None

Usage Guidelines

None

Example

```
# Query query the WWN of an SSD
root@ubuntu-Super-Server:~# nvme dapu get-equipWwn /dev/nvme0n1 -H
WWN      : 5D8BC59030000032
RESULT: DAPU: Success(0)
```

6.5 Setting Time Synchronization of a specified SSD

Function

This command is used to set time Synchronization of a specified SSD.

Format

`nvme dapu set-sysCurTime devicename`

Parameters

None

Usage Guidelines

```
nvme dapu set-sysCurTime /dev/nvme0n1
```

Example

```
# Set time Synchronization of a specified SSD
root@tester:~# nvme dapu set-sysCurTime /dev/nvme0n1
RESULT: DAPU: Success(0)
```

7. Acronym or Abbreviation

CLI	Command-Line Interface
CRC	Cyclic Redundancy Check
CCC	China Compulsory Certification
DWPD	Drive Writes Per Day
ECC	Error Checking and Correction
IOPS	Input/Output Operations Per Second
LBA	Logical Block Address
LDPC	Low Density Parity Check Code
MTBF	Mean Time Between Failures
MLC	Multi Level Cell
MTBDL	Mean Time Between Data Loss
NVMe	Non-Volatile Memory Express
PCIe	Peripheral Component Interconnect Express
SSD	Solid State Disk
UBER	Uncorrectable Bit Error Rate
VPD	Vital Product Data

Appendix A Supported Command Sets

The DapuStor Roealsen5 NVMe SSD Series support all mandatory Admin and I/O commands defined in NVMe (Non-Volatile Memory Express) revision 1.4a.

A.1 NVMe Admin Command Set

All mandatory NVMe commands supported by the DapuStor NVMe SSD Series are as follows:

- Abort Command
- Asynchronous Event Request Command
- Create I/O Submission Queue
- Create I/O Completion Queue
- Delete I/O Submission Queue
- Delete I/O Completion Queue
- GET Features Command
- Get Log Page Command
- Identify Command
- SET Features Command

The following optional Admin commands defined in NVMe revision 1.4a are also supported by the DapuStor NVMe SSD Series:

- Firmware Commit
- Firmware Image Download
- Format NVM
- Device Self-test
- Namespace Management (Create and Delete) Command
- Namespace Attachment (Controller Attach and Controller Detach)
- Sanitize

NOTES: Please refer to Product Features and Availability .
when these features would be supported on DapuStor Roealsen5 NVMe SSD Series.

A.2 NVMe I/O Command Set

All of the following mandatory NVMe I/O commands set defined in NVMe 1.4a specification are supported by the DapuStor Roealsen5 NVMe SSD Series:

- Flush Command
- Write Command

- Read Command

In addition, the following optional I/O commands are supported by the DapuStor Roealsen5 NVMe SSD Series:

- Write zeroes Command
- Compare Command
- Dataset Management Command (De-allocate only)
- Verify
- Reservation Register
- Reservation Report
- Reservation Acquire
- Reservation Release

Note: when some of these features are supported in Roealsen5 Series, check out product features and usability.

A.3 Get Log Page Command Set

The SSD supports all required logs specified by the NVMe 1.4a protocol as follows:

- Error Information (Log Identifier 01h)
- Smart/Health Information (Log Identifier 02h)
- Firmware Slot Information (Log Identifier 03h)
- Changed Namespace List (Log Identifier 04h)
- Commands Supported and Effects (Log Identifier 05h)
- Device Self-test (Log Identifier 06h)
- Telemetry Host-Initiated (Log Identifier 07h)
- Telemetry Controller-Initiated (Log Identifier 08h)
- Persistent Event Log (Log Identifier 0Dh)
- Reservation Notification (Log Identifier 80h)
- Sanitize Status (Log Identifier 81h)

Note: For details, see the Get Log Page Command of NVMe 1.4a.

In addition, vendor custom log pages are supported.

A.5 Set Features Identifiers

The DapuStor Roealsen5 NVMe SSD Series not only has the feature of the SMART attribute structure, but also has the features that its operation and health information can be reported to the host on request through the Get Features command. By using SET Features on the following items defined in NVMe 1.4a specification, users can change settings according to the business requirements.

For more detailed information of following Set features, users can refer to NVMe 1.4a

specification:

- Arbitration (Feature Identifier 01h)
- Power Management (Feature Identifier 02h)
- Temperature Threshold (Feature Identifier 04h)
- Error Recovery (Feature Identifier 05h)
- Number of Queues (Feature Identifier 07h)
- Write Atomicity (Feature Identifier 0Ah)
- Asynchronous Event Configuration (Feature Identifier 0Bh)
- Autonomous Power State Transition (Feature Identifier 0Ch)
- Timestamp (Feature Identifier 0Eh)
- Host Controlled Thermal Management (Feature Identifier 10h)
- Sanitize Config (Feature Identifier 17h)
- Host Identifier (Feature Identifier 81h)
- Reservation Notification Mask (Feature Identifier 82h)
- Reservation Persistence (Feature Identifier 83h)

Appendix B RoHS Statement

Equipment Name: Solid state drive (SSD)

Equipment Model (Type): DPRD3102T0 / DPRD3104T0 / DPRD3108T0 / DPRD31016T / DPRD4204T0 / DPRD4208T0

Unit	Restricted substances and its chemical symbols					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium Cr(VI)	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Case	○	○	○	○	○	○
PCB	○	○	○	○	○	○
Colloid/ Plastic	○	○	○	○	○	○
Metal	○	○	○	○	—	—
Parts (Solid, Ceramic)	○	○	○	○	○	○

Note 1: “Exceeding 0.1 wt %” and “exceeding 0.01 wt %” indicate that the percentage content of the restricted substance exceeds the reference percentage value of presence condition.

Note 2: “○” indicates that the percentage content of the restricted substance does not exceed the percentage of reference value of presence.

Note 3: The “—” indicates that the restricted substance corresponds to the exemption.