HPE Storage Controllers: Management overview

Contents

Overview

This document provides a high-level summary on how to manage HPE Storage Controllers within HPE server

Storage Controller

Products

Prior to HPE ProLiant Gen10 servers, HPE only supported Microchip storage controllers branded as Smart Array. Today HPE and the industry support two main suppliers of storage controllers from Microchip SmartRAID (HPE SRXXX) and Broadcom MegaRAID (HPE MRXXX), which support both RAID and HBA functionality. HPE classifies storage controllers into five different series: Software RAID (100 series), Essential (200 series), Essential+ (300 series), Advanced (400 series), and Performance (900 series). The lower 2 digits of the series specifies the number of storage lanes which also represents the maximum number of drives without a SAS expander. The GenX value represents the generation of the controller and does not always imply which server generation the controller is compatible with. Check the HPE QuickSpecs (hpe.com/info/qs) for server compatibility.

Table 1. HPE Gen10 and Gen10+ Storage Controller products

Series	Form factor	Microchip SmartROC 3100	Microchip SmartROC 3200	Broadcom Aero-16
Essential	AROC[1]	HPE E208i-a SR Gen10	—	HPE MR216i-a Gen10+
	PCI Card	HPE E208i-p SR Gen10	—	HPE MR216i-p Gen10+
	PCI Card	HPE E208e-p SR Gen10	—	—
Advanced	AROC	HPE P408i-a SR Gen10 HPE P816i-a SR Gen10	— HPE SR416i-a Gen10+	— HPE MR416i-a Gen10+
	PCI Card	HPE P408i-p SR Gen10	—	HPE MR416i-p Gen10+
	PCI Card	HPE P408e-p SR Gen10	—	—
Performance	PCI Card	—	HPE SR932i-p Gen10+	—

Notes

– HPE MR Storage Controllers are not available for HPE Synergy.

– Additionally, Hewlett Packard Enterprise offers Intel® VROC SATA, Intel VROC NVMe, HPE NS204, and HPE SR100i Storage Controllers.

Table 2. HPE Gen11 Storage Controller products

Series	Form factor	Microchip SmartROC 3100	Microchip SmartROC 3200	Broadcom Aero-16
Essential	OROC[2]	—	—	HPE MR216i-o Gen11
	PCI Card	—	—	HPE MR216i-p Gen11
Advanced	OROC	—	—	HPE MR408i-o Gen11
		—	—	HPE MR416i-o Gen11
	PCI Card	—	—	HPE MR408i-p Gen11
		—	—	HPE MR416i-p Gen11
Performance	PCI Card	—	HPE SR932i-p Gen11	—

[1] AROC—Adaptive RAID on Chip. Also, referred to as Type A Modular.
[2] OROC—OCP RAID on Chip.

– HPE MR Storage Controllers are available for HPE Synergy.

– Additionally, Hewlett Packard Enterprise offers Intel VROC SATA, Intel VROC NVMe, HPE NS204

Features

Here's a comparison of the features across controllers:

Table 3. Hardware RAID controller features

Feature	Microchip SmartROC 3100	Microchip SmartROC 3200	Broadcom Aero-16
Firmware Stack	Microchip SmartRAID	Microchip SmartRAID	Broadcom MegaRAID
VMware vSAN™ Certified	Yes	Yes	Yes (MR216 only)
Microsoft Azure	Yes	Yes	Yes
Host interface	x8 PCIe 3.0	x16 PCIe 4.0 (SR932) x8 PCIe 4.0 (SR416)	x8 PCIe 4.0
Storage lanes	x16 (P816) x8 (E208/P408)	x32 (SR932) x16 (SR416)	x16 (MR416/MR216) 8 (MR408)
Max drives without expander	16 (P816) 8 (E208/P408)	32 (SR932) 16 (SR416)	16 (MR416/MR216) 8 (MR408)
Storage protocol	12G SAS, 6G SATA	24G SAS, 6G SATA, 16G NVMe	12G SAS, 6G SATA, 16G NVMe
Cache (FBWC)	72b DDR4-2100 N/A (E208)	144b DDR4-3200 (SR932) 72b DDR4-3200 (SR416)	72b DDR4-2667 N/A (MR216)
Read ahead caching	Yes	Yes	Yes
Write-back caching	Yes N/A (E208)	Yes	Yes N/A (MR216)
HPE Smart Storage Battery	Yes N/A (E208)	Yes	Yes N/A (MR216)
SSD caching	SmartCache	SmartCache	—
SSD accelerator	SmartPath	SmartPath	FastPath
Max volumes	64	64	240
RAID	0, 1, 5, 6, 10, 50, 60, 1T, 10T 0, 1, 5, 10 (E208)	0, 1, 5, 6, 10, 50, 60, 1T, 10T	0, 1, 5, 6, 10, 50, 60 0, 1, 10 (MR216)
Mixed Mode	RAID & HBA	RAID & HBA	RAID & HBA
Controller-based encryption	LKM RKM	LKM RKM	—
Self-Encrypting Drives (SED)	HKM LKM RKM	HKM LKM RKM	HKM (MR216) LKM RKM
Security Protocol and Data Model (SPDM)	No	Yes (Gen11 and forward)	Yes (Gen11 and forward)

Learn more about Storage Controller products

Table 4. Hardware RAID controller content

Content	Microchip SmartROC 3100	Microchip SmartROC 3200	Broadcom Aero-16
User Guide Gen10/10+	hpe.com/support/SR-Gen10-UG	hpe.com/support/SR-Gen10Plus-UG	hpe.com/support/MR-Gen10Plus-UG
User Guide Gen11	N/A	hpe.com/support/SR-Gen11-UG	hpe.com/support/MR-Gen11-UG
QuickSpecs Gen10/10+	hpe.com/psnow/doc/a00047736enw	hpe.com/psnow/doc/a50002562enw	hpe.com/psnow/doc/a50002563enw
QuickSpecs Gen11	N/A	hpe.com/psnow/doc/a50004312enw	hpe.com/psnow/doc/a50004311enw
GUI User Guide	hpe.com/support/SSA-UG	hpe.com/support/SSA-UG	hpe.com/support/MRSA
CLI User Guide	hpe.com/support/SSACLI-UG	hpe.com/support/SSACLI-UG	hpe.com/support/StorCLI

Table 5. Boot Devices and Virtual RAID content

Content	HPE NS204 Boot Device	Intel VROC
User Guide Gen10+/11	hpe.com/support/NS204-UG	intel.com/VROC hpe.com/support/IntelVROC-Gen10Plus-docs hpe.com/support/VROC-Gen11-UG
QuickSpecs Gen10+/11	hpe.com/psnow/doc/a00094638enw	hpe.com/psnow/doc/a50002570enw

Table 6. White papers and other references

Content	All
Management Overview	hpe.com/info/SCMO
Encryption Overview	hpe.com/info/SCEO
Security Reference	hpe.com/info/server-security-reference-en
HPE Smart Storage Batteries and Hybrid Capacitor	hpe.com/psnow/doc/a00028553enw
HPE QuickSpecs	hpe.com/info/qs
HPE Support	support.hpe.com
Troubleshooting Guide for HPE ProLiant Gen10 and Gen10 Plus Servers	hpe.com/info/gen10-troubleshooting
Troubleshooting Guide for HPE ProLiant Gen11 Servers	hpe.com/info/gen11-troubleshooting
HPE iLO 5 User Guide	hpe.com/support/ilo5-ug-en
HPE iLO 6 User Guide	hpe.com/support/ilo6-ug-en
HPE iLO 7 User Guide	hpe.com/support/ilo7-ug-en
UEFI User Guide for HPE ProLiant Gen10, Gen10 Plus, and HPE Synergy	hpe.com/support/UEFIGen10-UG-en
UEFI User Guide for HPE ProLiant Gen11 and HPE Synergy	hpe.com/support/UEFIGen11-UG-en
UEFI Deployment Guide for HPE Compute Gen12 Servers and HPE Synergy	hpe.com/support/UEFIGen12-UG-en

Table 7. Training videos

Content	All
Management of Redfish Device Enabled Storage Controllers	youtu.be/Ju-r-xhfzKU
How to Manage HPE SRXXX Gen10+ Storage Controllers	youtu.be/NsoDI9-FheU
How to Manage HPE MRXXX Gen10+ Storage Controllers	youtu.be/Xh5FA8YjgRk
How to Configure HPE MRXXX Storage Controllers using the MR Storage Administrator (MRSA) GUI	hpedemoportal.ext.hpe.com
How to Configure HPE MRXXX Storage Controllers using StorCLI	hpedemoportal.ext.hpe.com
How to Configure HPE MRXXX Storage Controllers using HPE UEFI/BIOS	hpedemoportal.ext.hpe.com
Automate the deployment of the HPE MRXXX Storage Controllers using the DMTF RDE Redfish APIs	hpedemoportal.ext.hpe.com
Automate the deployment of the HPE MRXXX Storage Controllers at scale	hpedemoportal.ext.hpe.com
Automate the deployment of the HPE MRXXX Storage Controllers using the HPE Deployment Automation solution with Ansible	hpedemoportal.ext.hpe.com
Install and boot VMware ESXi™ from Intel VROC RAID1 volume	hpedemoportal.ext.hpe.com
Boot Windows Operating System from Intel VROC RAID volume	hpedemoportal.ext.hpe.com
Automate the deployment of Intel VROC at scale using Redfish APIs on HPE Gen11	hpedemoportal.ext.hpe.com
Automate the deployment of Intel VROC using NSH and Intel VROC UEFI configuration tools	hpedemoportal.ext.hpe.com
Automate the deployment of Intel VROC using standard Redfish APIs on iLOREST	hpedemoportal.ext.hpe.com
Automate the deployment of Intel VROC at scale using customized ISO image	hpedemoportal.ext.hpe.com
The top key features of the 3rd Gen Intel® Xeon® Scalable processors on HPE ProLiant DL380 Gen10 Plus Server Demo 1: Intel Virtual RAID on CPU (Intel VROC) usage and benefits	hpedemoportal.ext.hpe.com

Firmware update

Before using the storage controller for the first time the server and controller firmware should be updated to the latest version. Hewlett Packard Enterprise distributes drivers, firmware, and other support software for servers through the Service Pack for ProLiant (SPP). Individual downloads are also available from support.hpe.com.

Note:
HPE does not publish the raw binary files that are required to use the flash options available in the storage controller GUI or CLI tools.

Table 8. Firmware updates

Device Type	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC
Storage Controller	FWPKG[3, 4, 7, 8]	FWPKG[5, 7, 8]	FWPKG[6, 7, 8]	(ROM)
Drive Backplane	FWPKG[3, 4, 7, 8]	FWPKG[5, 7, 8]	N/A	FWPKG[7, 8]
SAS, SATA, or NVMe Drives	FWPKG[3, 4, 7]/ Smart Component	FWPKG[5, 7]/ Smart Component	FWPKG[6, 7]/ Smart Component	Smart Component[9]

Firmware Package

Firmware Package (FWPKG) files are OS agnostic and can be updated using the HPE iLO GUI, RESTful Interface Tool (iLOREST), Redfish Firmware Update service, or Gen11 UEFI System Utilities.

```
ilorest flashfwpkg --url https://example.com -u {my user name} -p {my password} {Example.FWPKG}
```

Figure 1. iLOREST Flash FWPKG example

Smart Components

Drive Smart Components are OS specific self-executing files that support flashing drives behind any storage controller. They can also be deployed using the HPE iLO GUI Install Set or HPE iLO Redfish OEM Update Service. HPE is phasing out Smart Components and migrating to Redfish enabled FWPKG files.

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[3] Microchip SmartROC 3100 firmware version 5.61 or later.
[4] Microchip SmartROC 3200 firmware 3.01.14.062 or later.
[5] HPE MR Storage Controller firmware version 52.22.3-4650 or later.
[6] HPE NS204 Boot Device firmware version 1.0.14.1060 or later.
[7] HPE iLO 5 firmware version 2.72 or later.
[8] Earlier versions of firmware used a Smart Component.
[9] support.hpe.com/hpesc/public/docDisplay?docId=emr_na-a00114713en_us

Configuration

RAID volumes cannot be physically moved between storage controller families. For example, volumes from HPE SR Storage Controllers cannot be moved to HPE MR Storage Controllers.

Table 9. Hardware RAID controller tools

Description	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC
Storage administrator GUI	Smart Storage Administrator (SSA)	MR Storage Administrator (MRSA)	N/A	Intel VROC GUI for Windows
UEFI System Utilities	SSACLI	StorCLI	N/A	Intel VROC CLI for Windows Linux® (mdadm) ESXi (VMDRCLI)
CLI	Yes	Yes	N/A	Yes
HPE iLO GUI	Yes	Yes	Yes	Yes
Redfish	Yes	Yes[10]	Yes[11]	Yes[12] (Gen11 and Gen12)
HPE OneView	Managed	Managed[10, 13]	Monitored	Monitored
Intelligent provisioning	Yes	Yes[14]	N/A	Yes[15]

Storage administrator GUI

Smart Storage Administrator (SSA) is an application used to manage HPE SR Storage Controller products. MR Storage Administrator (MRSA) is a web-based application used to manage HPE MR Storage Controller products. These storage administrator tools allow you to configure, maintain, and troubleshoot storage controllers, volumes, and drives. The screenshots below show a side-by-side comparison of SSA and MRSA to view the physical controller or configure a RAID volume.
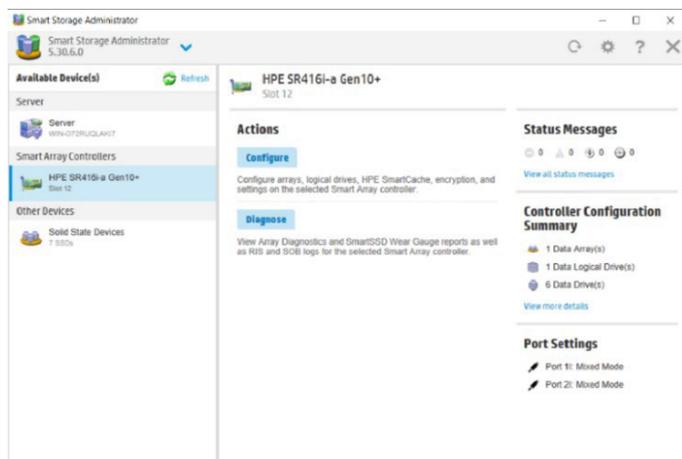

Figure 2. Smart Storage Administrator (SSA)—physical view

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[10] HPE MR Storage Controller firmware version 52.24.3-4948 or later to support Redfish POST, PATCH, and DELETE.
[11] HPE NS204 Boot Device firmware version 1.2.14.1010 or later to support Redfish POST and PATCH.
[12] Redfish is only supported on Gen11 and Gen12 with VROC NVMe and HPE iLO 6 v1.40 or later. Not supported on Gen10 Plus, VROC SATA, or VMware®.
[13] HPE OneView 8.4 or later for Gen10 Plus and Gen11. HPE OneView 8.6 or later for Gen10.
[14] Gen10/10 Plus requires IP 3.88. Gen11 requires IP 4.30 or later.
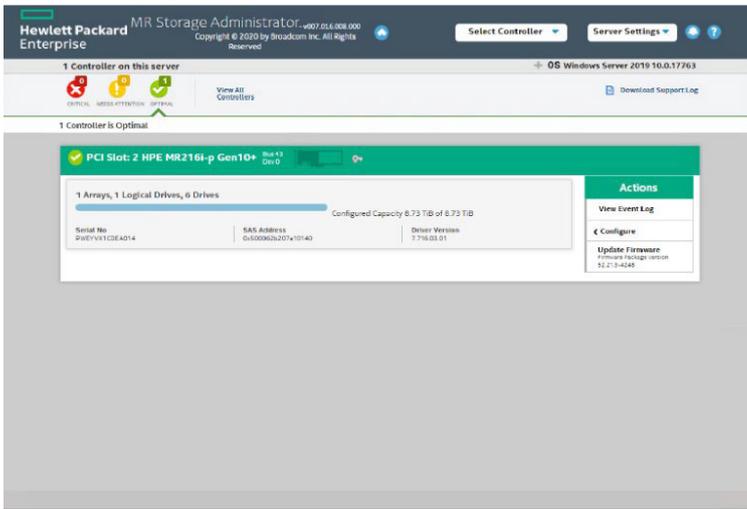[15] Not supported on Gen10+ Gen11 requires IP 4.41 Gen11 requires IP 4.41 or later.

Figure 3. MR Storage Administrator (MRSA)—physical view
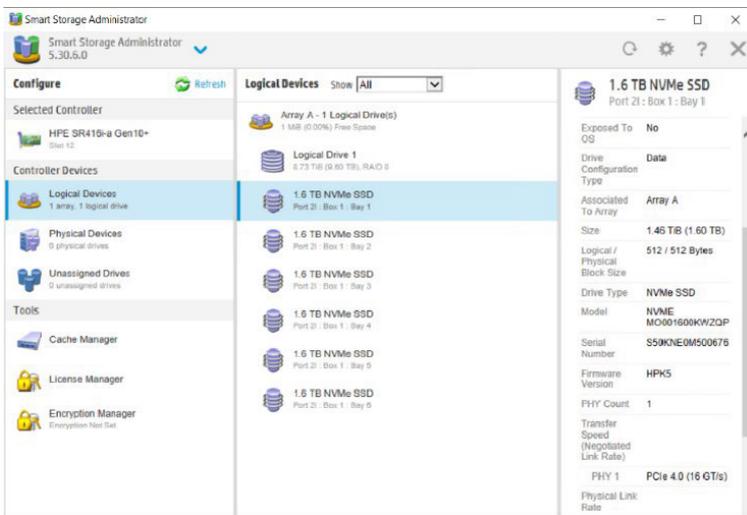
Figure 4. Smart Storage Administrator (SSA)—configuration
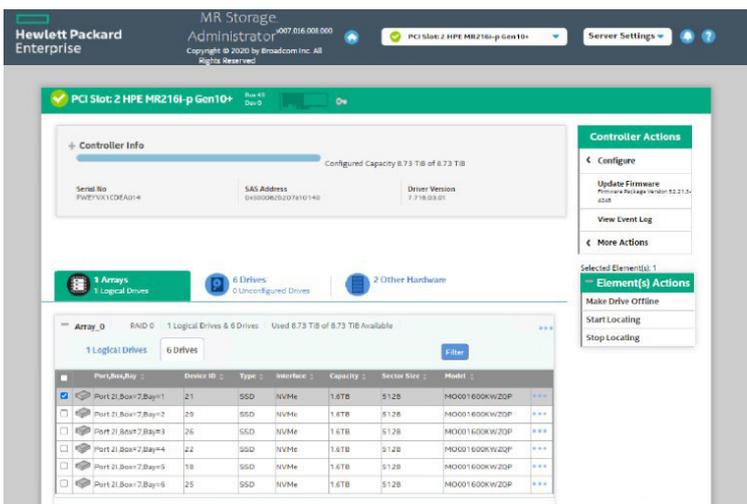
Figure 5. MR Storage Administrator (MRSA)—configuration

UEFI System Utilities

UEFI System Utilities is embedded in the controller firmware and accessed through the system ROM. Controller UEFI System utilities enable you to perform controller management, logical drive management, and drive management.
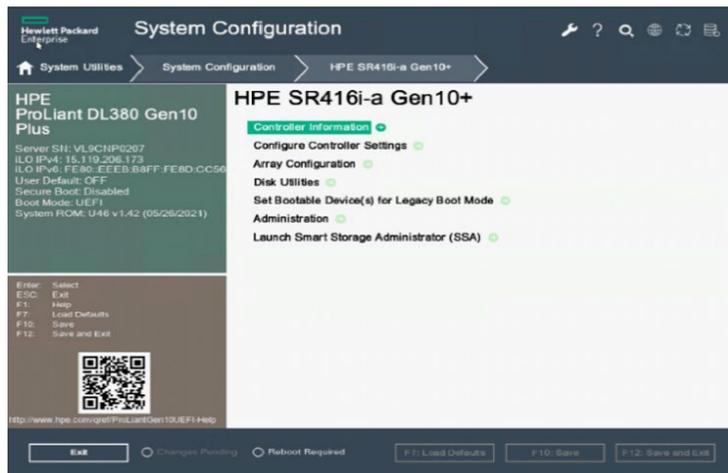
Figure 6. SR UEFI System Utilities—physical view
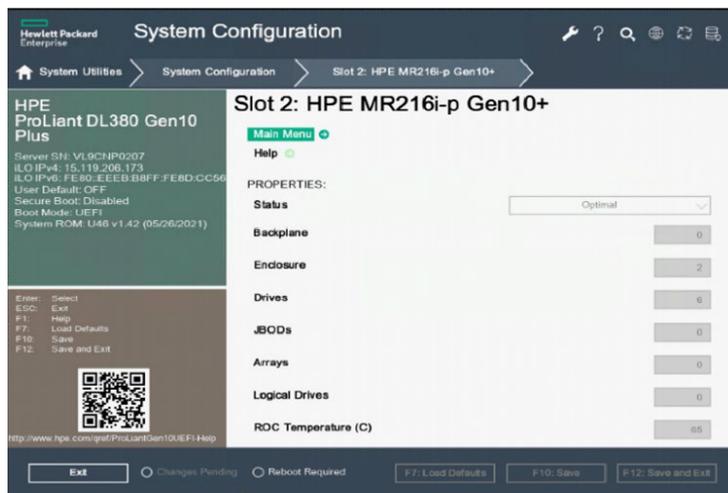
Figure 7. MR UEFI System Utilities—physical view
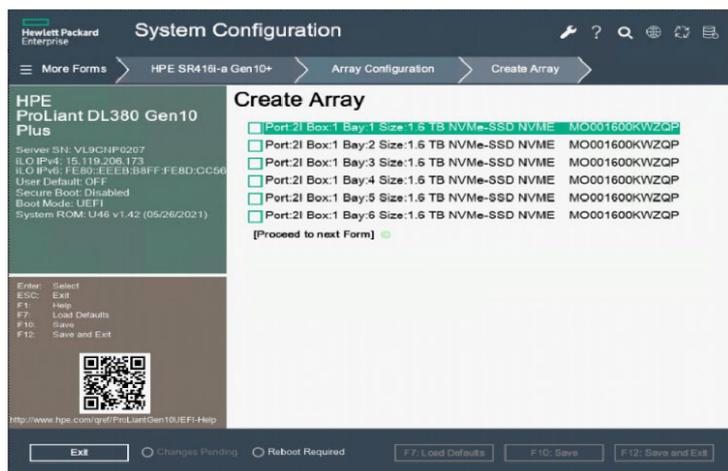
Figure 8. SR UEFI System Utilities—Create Volume

Figure 9. MR UEFI System Utilities—Create Volume

Command Line Interface (CLI)

SSACLI is a command line interface tool used to manage HPE SR Storage Controller products. StorCLI is a command line interface used to manage HPE MR Storage Controller products. These storage CLI tools support scripting for mass deployment of server storage.

Table 10. Hardware RAID controller common CLI commands

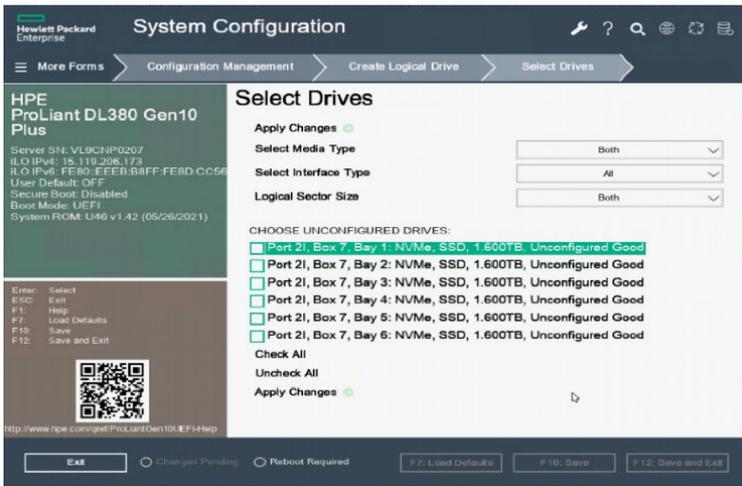| Description	HPE SR Storage Controller	HPE MR Storage Controller
Show controllers	ssacli ctrl all show	storcli show
Displaying all drives	ssacli ctrl slot=5 pd all show	storcli /c0/eall/sall show
Displaying drive details	ssacli ctrl slot=5 pd 1I:3:1 show	storcli /c0/e250/s1 show all
Displaying all volumes	ssacli ctrl slot=5 ld all show	storcli /c0/vall show
Deleting all volumes	ssacli ctrl slot=5 ld all delete forced	storcli /c0 delete config force
Creating a volume	ssacli ctrl slot=5 create type=ld drives=1I:1:1,1I:1:2 raid=1 forced	storcli /c0 add vd raid1 drives=250:1,250:2
Secure Erase Drive	ssacli ctrl slot=5 pd 1I:3:1 modify erase erasepattern=crypto unrestricted=on	storcli /c0/e250/s1 start sanitize cryptoerase

Redfish

HPE Storage Controllers support the Distributed Management Task Force (DMTF) standard known as Platform Level Data Model (PLDM) for Redfish Device Enablement (RDE). This open standard API allows HPE option cards (storage controllers, network adapters, and more) to host their own set of Redfish resources (redfish.dmtf.org/schemas/) which are rooted under HPE iLO's /redfish/v1 service root. As a result, the feature and capabilities are owned by the option card firmware and communicated directly to HPE iLO in real-time using an out of band interface.

The server must be powered on, and the BIOS must progress beyond the ready state before the Redfish resources appear. The ready state can be confirmed in /redfish/v1/Systems/1 [OEM][HPE][DeviceDiscoveryComplete][DeviceDiscovery] is vMainDeviceDiscoveryComplete. Optionally the Redfish ComputerSystem can be set with BootSourceOverrideTarget set to BiosSetup if the desire is to configure the server before booting into the operating system.
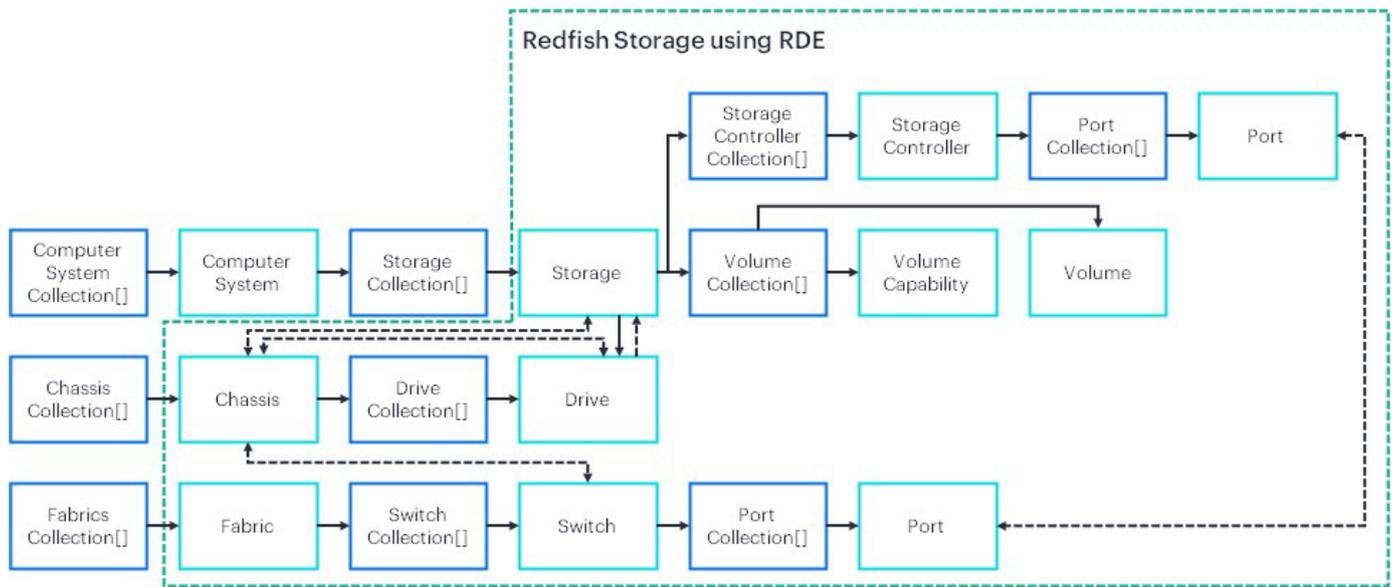
Figure 10. Redfish Storage Resources

Common properties

The following odata properties are common and can be found across all schemas. Redfish annotations allow clients to learn which PATCH properties are supported by the option card firmware. Redfish annotations for POST (create) are defined in the Collection Capabilities. Redfish annotations can also be found in the Actions object.

Table 11. Redfish Common properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	All Schemas	@odata.id	Yes	Yes	Yes	Yes
GET	All Schemas	@odata.etag	Yes	Yes	Yes	Yes
GET	All Schemas	@odata.type	Yes	Yes	Yes	Yes
GET	Array properties	@odata.count	Yes	Yes	Yes	Yes
GET	PATCH properties	@Redfish.WriteableProperties	Yes	Yes	Yes	—
GET	PATCH properties	@Redfish.AllowableValues	Yes	Yes	Yes	Yes
GET	PATCH properties	@Redfish.AllowableNumbers	Yes	Yes	Yes	—
GET	PATCH properties	@Redfish.AllowablePattern	Yes	Yes	Yes	—

Note:

DMTF did not define an annotation for Boolean. A Redfish client can GET the property and perform a type-check on the property value to learn that the patch operation is expecting a Boolean value.

Storage

DMTF defined Storage (redfish.dmtf.org/schemas/Storage.json).

Table 12. Redfish Storage properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	Storage	Id	Yes	Yes	Yes	Yes
GET	Storage	Name	Yes	Yes	Yes	Yes
GET	Storage	Status {} HealthRollup	Yes	Yes	Yes	Yes
GET	Storage	Status {} State	Yes	Yes	Yes	Yes
GET	Storage	AutoVolumeCreate	Yes	Yes	Yes	—
GET	Storage	BlockSecurityIDPolicy	—	—	—	—
GET	Storage	BlockSecurityIDUnsupportedDrives []	—	—	—	—
GET	Storage	BlockSecurityIDUpdateUnsuccessfulDrives []	—	—	—	—
GET	Storage	Controllers {}	Yes	Yes	Yes	Yes
GET	Storage	Drives []	Yes	Yes	Yes	Yes
GET	Storage	EncryptionMode	Yes	Yes	Yes	—
GET	Storage	HotspareActivationPolicy	Yes	Yes	N/A	Yes
GET	Storage	LocalEncryptionKeyIdentifier	Yes	Yes	N/A	—
GET	Storage	Links {} Enclosures []	—	Yes	N/A	Yes
GET	Storage	Volumes {}	Yes	Yes	Yes	Yes
PATCH	Storage	AutoVolumeCreate	—	Yes	N/A	N/A
PATCH	Storage	EncryptionMode	Yes	Yes	Yes	—
PATCH	Storage	BlockSecurityIDPolicy	—	—	—	—
PATCH	Storage	HotspareActivationPolicy	Yes	Yes	N/A	—
POST	Storage.ResetToDefaults	ResetType	Yes	Yes	Yes	Yes
POST	Storage. SetEncryptionKey	EncryptionKey, CurrentEncryptionKey, EncryptionKeyIdentifier	Yes	Yes	Yes	—
POST	Storage.RekeyExternalKey	{}	No	Yes	Yes	No

GET Storage

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}
{
  "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}",
  "@odata.type": "#Storage.v1_13_0.Storage",
  "Actions": {
    "#Storage.ResetToDefaults": {
      "target": "/redfish/v1/Systems/{ID}/Storage/{ID}/Actions/Storage.ResetToDefaults",
      "ResetType@Redfish.AllowableValues": [
        "ResetAll",
        "PreserveVolumes"
      ]
    }
  },
  "Id": "{ID}",
  "Name": "HPE Smart Array P408i-p SR
Gen10", "Status": {
    "HealthRollup": "OK",
    "State": "Enabled"
  },
  "Controllers": {
    "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers"
  },
  "Drives@odata.count": 2,
  "Drives": [
    {
      "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/0"
    },
    {
      "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/2"
    }
  ],
  "Volumes": {
    "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes"
  },
  "@odata.etag": "\"1B63AA65\""
}
```

Figure 11. GET Storage example

PATCH Storage.AutoVolumeCreate

This property determines how drives are automatically configured on introduction into the system.

For MR controller you can change between disabled and NonRAID. For MR2XX series cards NonRAID is default, and for MR4XX Disabled is default.

For SR it is set for NonRAID and cannot be changed at this time through redfish.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}

{

"Autovolume": "NonRaid" or "Disabled"

}
```

Figure 12. PATCH AutoVolumeCreate example

PATCH EncryptionMode

Used to modify the existing EncryptionMode on the storage controller.

HPE MR controllers

LKM to RKM mode

IF UseLocalKey is enabled on the controller and iLO has an HPE iLO Advanced license and is in RKM mode already, the controller can be transitioned to RKM mode. To start transition PATCH "EncryptionMode" with "UseExternalKey", then POST "SetEncryptionKey" with field "CurrentEncryptionKey" = "Existing LKM Encryption Key", do not populate fields "EncryptionKey" and "EncryptionKeyIdentifier", then reboot the system. On the next boot the controller and drives will be rekeyed from the LKM mode to RKM mode. See iLO userguide for configuring remote key manager.

HPE MR and SR controllers

Enable LKM mode:

IF EncryptionMode is set to Disabled see SetEncryptionKey for setting the controller to Local Key Management mode.

Enable RKM mode:

IF EncryptionMode is set to Disabled and iLO has an HPE iLO Advanced license and iLO has been configured for Remote Key Management mode, sending UseExternalKey and then rebooting will cause the system the controller and drives to be secured by the Remote Key Management. Reboot is needed after sending this command for the transition to complete. See iLO userguide for configuring remote key manager.

Disable LKM mode:

IF UseLocalKey/UserExternalKey is enabled on the controller sending Disable will delete the key and password on the controller. If there are secured drives at time of PATCH the Encryptionmode will not change, and operation will fail.

HPE NS controllers

Disable LKM mode:

To disable encryption you must reset the controller with Storage.ResetToDefaults.

Enable LKM mode:

Set EncryptionMode to UseLocalkey and then apply SetEncryptionKey to transition to LKM mode.

Enable RKM mode:

IF EncryptionMode is set to Disabled and iLO has an HPE iLO Advanced license and iLO has been configured for Remote Key Management mode, sending UseExternalKey and then rebooting will cause the system the controller and drives to be secured by the Remote Key Management. Reboot is needed after sending this command for the transition to complete. See iLO userguide for configuring remote key manager.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}

{

"EncryptionMode": "Disabled" or "UseExternalKey"

}
```

Figure 13. PATCH EncryptionMode example

PATCH HotspareActivationPolicy

Used to modify the Existing HotspareActivationPolicy currently active on storage controller.

HPE SR Storage Controller supports setting the HostspareActivationPolicy to either OnDriveFailure or OnDrivePredictedFailure. HPE VROC only supports OnDriveFailure option.

OnDriveFailure:

The hot spare drive will take over for the original drive when the original drive has been marked as failed by the storage domain.

OnDrivePredictedFailure:

The hot spare drive will take over for the original drive when the original drive has been predicted to fail in the future by the storage domain.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}

{

"HotspareActivationPolicy": "OnDriveFailure" or "OnDrivePredictedFailure"

}
```

Figure 14. PATCH HotspareActivationPolicy example

POST ResetToDefaults

This action is used to factory reset the storage controller and optionally delete any volumes. ResetType can either be set to PreserveVolumes or ResetAll. SR,MR, and NS non-SED controllers need to have POST Drive.SecureErase performed on their drives to sanitize them after POST ResetToDefaults completes if data needs to be erased. For NS SED controllers ResetToDefaults performs a cryptographic erase on the drives after the volumes are deleted.

HPE MR Storage Controllers require a server reboot after performing ResetToDefaults. The server reboot is necessary to erase config pages, initialize controller properties to default, and purge data from the on-board flash memory used by the write cache. Prior to the reboot, the storage controller blocks all POST, PATCH, and DELETE operations. Also prior to the reboot, GET is supported but since the controller is sanitized the property values may be incorrect.

```
POST https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Actions/Storage.ResetToDefaults

{

"ResetType": "ResetAll",

}
```

Figure 15. POST ResetToDefaults example

POST SetEncryptionKey

HPE SR and MR controllers.
This action is used to setup/Change the EncryptionKey of the storage controller and will change the EncryptionMode to "UseLocalKey".

The EncryptionMode property needs to be "Disabled" prior to this POST operation if setting for the first time and only fields "EncryptionKey" and "EncryptionKeyIdentifier" should be used

HPE NS controllers.
Unlike the SR and MR controllers.EncryptionMode needs to be set to "UseLocalKEy" prior to setting the encryption key for the controller with SetEncryptionKey

HPE MR/SR/NS controllers do not require a reboot after setting/changing the key on the system.

If the controller's EncryptionMode is already set to "UseLocalKey" and a key rotation is needed, the user must also populate "CurrentEncryptionKey" with the controllers existing key and "EncryptionKey" with the new security key and optionally a new "EncryptionKeyIdentifier".

CurrentEncryptionKey and EncryptionKey need to meet the following requirements for HPE SR and MR controllers

1. Contains at least one lowercase letter.

2. Contains at least one uppercase letter.

3. Contains at least one digit.

4. Contains at least one special character (e.g., !, #, $, %, etc.).

5. Has no spaces.

6. Is between 8 and 32 characters long

CurrentEncryptionKey and EncryptionKey need to meet the following requirements for HPE NS controllers

1. Is between 1 and 15 characters long

For HPE MR controllers, EncryptionKeyIdentifier can be between 1 and 255 ASCII characters.

For HPE SR controllers, EncryptionKeyIdentifier can be between 0 and 32 printable ASCII characters.

For HPE NS controllers, EncryptionKeyIdentifier can be between 1 and 15 ASCII characters

```
POST https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Actions/Storage.SetEncryptionKey

{

"CurrentEncryptionKey": "ZZZZZZZZ" "EncryptionKey": "YYYYYYYY", "EncryptionKeyIdentifier": "XXXXXXXXX"

}
```

Figure 16. POST SetEncryptionKey example

POST RekeyExternalKey

This action is used to set the storage controller to request a key exchange for a key that originates outside of the controller.

HPE MR and NS controllers require a reboot after this is set for the key exchange to occur. The request body can either be an empty JSON object "{}" or None.

HPE SR controllers do not support Rekey through redfish.

```
POST https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Actions/Storage.RekeyExternalKey
```

Figure 17. POST SetEncryptionKey example

Storage Controller Collection

DMTF defined Storage Controller Collection (redfish.dmtf.org/schemas/StorageControllerCollection.json).

Table 13. Redfish StorageControllerCollection properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	StorageControllerCollection	Name	Yes	Yes	Yes	Yes
GET	StorageControllerCollection	Members []	Yes	Yes	Yes	Yes

GET StorageControllerCollection

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers
{
  "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers",
  "@odata.type":
  "#StorageControllerCollection.StorageControllerCollection",
  "Name": "Storage Controller Collection",
  "Members@odata.count": 1,
  "Members": [
    {
      "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0"
    }
  ],
  "@odata.etag": "\"2BAC3612\""
}
```

Figure 18. GET StorageControllerCollection example

Storage Controller

DMTF defined Storage Controller (redfish.dmtf.org/schemas/StorageController.json).

Table 14. Redfish StorageController properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	StorageController	Id	Yes	Yes	Yes	Yes
GET	StorageController	Name	Yes	Yes	Yes	Yes
GET	StorageController	Status {} Health	Yes	Yes	Yes	Yes
GET	StorageController	Status {} State	Yes	Yes	Yes	Yes
GET	StorageController	AssetTag	Yes	Yes	—	N/A
GET	StorageController	CacheSummary {}	Yes	Yes	Yes	Yes
GET	StorageController	ControllerRates {}	Yes	Yes	Yes	Yes
GET	StorageController	FirmwareVersion	Yes	Yes	Yes	Yes
GET	StorageController	Identifiers []	Yes	Yes	Yes	Yes
GET	StorageController	Links {} Batteries []	—	—	N/A	N/A
GET	StorageController	Links {} PCIeFunctions {}	—	—	—	N/A
GET	StorageController	Location {} PartLocation {}	Yes	Yes	Yes	Yes
GET	StorageController	Manufacturer	Yes	Yes	Yes	Yes
GET	StorageController	Model	Yes	Yes	Yes	Yes
GET	StorageController	PartNumber	Yes	Yes	Yes	N/A
GET	StorageController	PCIeInterface {}	Yes	Yes	Yes	N/A
GET	StorageController	Ports {}	Yes	Yes	N/A	—
GET	StorageController	SerialNumber	Yes	Yes	Yes	N/A
GET	StorageController	SKU	Yes	Yes	Yes	Yes
GET	StorageController	SpeedGbps	Yes	Yes	—	N/A
GET	StorageController	SupportedControllerProtocols []	Yes	Yes	Yes	Yes
GET	StorageController	SupportedDeviceProtocols []	Yes	Yes	Yes	Yes
GET	StorageController	SupportedRAIDTypes []	Yes	Yes	Yes	Yes
PATCH	StorageController	AssetTag	Yes	Yes	—	N/A
PATCH	StorageController	ConsistencyCheckRatePercent	Yes	Yes	N/A	Yes
PATCH	StorageController	RebuildRatePercent	Yes	Yes	Yes	Yes
PATCH	StorageController	TransformationRatePercent	Yes	Yes	N/A	Yes

GET StorageController

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0
{
  "@odata.id":
  "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers
  /0", "@odata.type":
  "#StorageController.v1_5_0.StorageController",
  "Id": "0",
  "Name": "HPE SR416i-a Gen10+",
  "FirmwareVersion": "03.01.14.054",
  "Identifiers": [
    {
      "DurableName": "50123456789ABC00",
      "DurableNameFormat": "NAA"
}
]
,
  "Location": {
    "PartLocation": {
      "LocationType": "Slot",
      "ServiceLabel": "Slot=12",
      "LocationOrdinalValue": 12
}
},
  "Manufacturer":
  "HPE", "Model": "HPE
  SR416i-a Gen10+",
  "PartNumber": "",
  "SerialNumber": "XXXXXXXXXXX", "SpeedGpbs": 22.5,
  "SKU": "",
  "Status":
    {
    "Health":
    "OK",
    "State":
    "Enabled"
  },
  "SupportedDeviceProtocols":
    [
      "SAS",
      "SATA",
      "NVMe"
    ],
  "SupportedControllerProtocols": [ "PCIe"
],

  continued
```

Figure 19. GET StorageController example (1 of 2)

```
continued

  "CacheSummary": {
    "TotalCacheSizeMiB": 4096,
    "PersistentCacheSizeMiB":
    3644, "Status": {
      "Health": "OK",
      "State": "Disabled"
    }
  },
  "PCIeInterface": {
    "MaxPCIeType": "Gen4",
    "PCIeType": "Gen4",
    "MaxLanes": 8,
    "LanesInUse": 8
  },
  "SupportedRAIDTypes":
    [ "RAID0",
    "RAID1",
    "RAID10",
    "RAID5",
    "RAID50",
    "RAID6",
    "RAID60",
    "RAID1Triple",
    "RAID10Triple"
  ],
  "Ports": {
    "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0/Ports"
  },
  "@odata.etag": "\"388A5DDA\""
}
```

Figure 20. GET StorageController example (2 of 2)

PATCH AssetTag

Used to modify the asset tag., it may be empty before being set.

On HPE SR Storage controllers it can be set to a string that consists of 0 to 32 characters, where each character can be any printable character from – to ~ in the ascii table.

```
PATCh https://example.com/redfish/v1/Systems/{ID}Storage/{ID}/Controllers/0
{
  "AssetTag": "XXXXXXXXX"
}
```

Figure 21. PATCH AssetTag example

PATCH ConsistencyCheckRatePercent

Used to modify the consistency check rate percent (also known as background surface scan). This property may not appear until after a volume is present.

HPE SR Storage Controllers support either a value of 0 or 2–100 to patch and read ConsistencyCheckRatePercent. A value of 0 disables background consistency check. A value of 1 is invalid and will return an error.

For Intel VROC in Linux changing either Consistency, Rebuild, and Transformation sets all the others to the same as well. There can only be one controller rate can be sent per request. This is not supported under UEFI or Windows.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0
{
  "ControllerRates": {
    "ConsistencyCheckRatePercent": 50
  }
}
```

Figure 22. PATCH ConsistencyCheckRatePercent example

PATCH RebuildRatePercent

Used to modify the rebuild rate percent. This property may not appear until after a volume is present.

HPE SR Storage Controllers supports patching the full linear scale range from 0–100. However, a subsequent get will return one of four settings that are the closest match to the controller settings.

For Intel VROC in Linux changing either Consistency, Rebuild, and Transformation sets all the others to the same as well. There can only be one controller rate can be sent per request. This is not supported under UEFI or windows.

Table 15. HPE SR Storage Controller RebuildRatePercent

PATCH	GET
0–55	54
56–64	61
65–99	64
100	100

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0
{
  "ControllerRates": {
    "RebuildRatePercent": 54
  }
}
```

Figure 23. PATCH RebuildRatePercent example

PATCH TransformationRatePercent

Used to modify the transformation rate percent (also known as RAID migration, capacity expansion, etc.). This property may not appear until after a volume is present.

HPE SR Storage Controllers supports patching the full linear scale range from 0–100. However, a subsequent get will return one of three settings that are the closest match to the controller settings.

For Intel VROC in Linux changing either Consistency, Rebuild, and Transformation sets all the others to the same as well. There can only be one controller rate can be sent per request. This is not supported under UEFI or Windows.

Table 16. HPE SR Storage Controller TransformationRatePercent

PATCH	GET
0–54	0
55–99	54
100	100

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0
{
  "ControllerRates": {
    "TransformationRatePercent": 54
  }
}
```

Figure 24. PATCH TransformationRatePercent example

Storage Controller Port Collection

DMTF defined Port Collection (redfish.dmtf.org/schemas/PortCollection.json).

Table 17. Redfish PortCollection properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	PortCollection	Name	Yes	Yes	N/A	—
GET	PortCollection	Members []	Yes	Yes	N/A	—----

GET PortCollection

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0/Ports
{
  "@odata.id":
  "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0/Ports",
  "@odata.type": "#PortCollection.PortCollection",
  "Name":  "Port  Collection",
  "Members@odata.count":    2,
  "Members": [
    {
      "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0/Ports/{ID}"
    },
    {
      "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0/Ports/{ID}"
  }
],
  "@odata.etag": "\"4B6707FD\""
```

Figure 25. GET PortCollection example

Storage Controller Port

DMTF defined Port (redfish.dmtf.org/schemas/Port.json).

Table 18. Redfish Port properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	Port	Id	Yes	Yes	N/A	—
GET	Port	Name	Yes	Yes	N/A	—
GET	Port	Status {} Health	Yes	Yes	N/A	—
GET	Port	Status {} State	Yes	Yes	N/A	—
GET	Port	ActiveWidth	Yes	Yes	N/A	—
GET	Port	CurrentSpeedGbps	Yes	Yes	N/A	—
GET	Port	Links {} ConnectedPorts []	—	Yes	N/A	—
GET	Port	Location {} PartLocation {}	Yes	Yes	N/A	—
GET	Port	MaxSpeedGbps	Yes	Yes	N/A	—
GET	Port	PortId	Yes	Yes	N/A	—
GET	Port	PortProtocol	Yes	Yes	N/A	—
GET	Port	PortType	Yes	Yes	N/A	—
GET	Port	Width	Yes	Yes	N/A	—

GET Port

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0/Ports/{ID}
{
  "@odata.id":
  "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/0/Ports/{ID}",
  "@odata.type": "#Port.v1_6_0.Port",
  "Id": "0",
  "Name": "Port=1I",
  "Location": {
    "PartLocation": {
      "LocationType": "Connector",
      "ServiceLabel": "Slot=12:Port=1I",
      "LocationOrdinalValue": 1
    }
  },
  "MaxSpeedGbps": 180.0,
  "CurrentSpeedGbps": 70.0,
  "PortId": "1I",
  "PortProtocol":  "MultiProtocol",
  "PortType":  "BidirectionalPort",
  "Status": {
    "Health": "OK",
    "State": "Enabled"
  },
  "Width": 8,
  "ActiveWidth": 5,
  "@odata.etag": "\"4AB758D5\""
}
```

Figure 26. GET Storage Controller Port example

Volume Collection

DMTF defined Volume Collection (redfish.dmtf.org/schemas/VolumeCollection.json).

Table 19. Redfish VolumeCollection properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	VolumeCollection	Name	Yes	Yes	Yes	Yes
GET	VolumeCollection	Members []	Yes	Yes	Yes	Yes
GET	VolumeCollection	@Redfish.CollectionCapabilities {}	Yes	Yes	N/A	Yes
POST	VolumeCollection	See reference below	Yes	Yes	N/A	Yes

GET VolumeCollection

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes
{
  "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes",
  "@odata.type": "#VolumeCollection.VolumeCollection",
  "Name": "SR Volume Collection",
  "Members@odata.count": 0,
  "Members": [],
  "@Redfish.CollectionCapabilities":
  {
    "@odata.type":
    "#CollectionCapabilities.v1_1_0.CollectionCapabilities",
    "MaxMembers": 64,
    "Capabilities": [
      {
        "CapabilitiesObject": {
          "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/Capabilities"
        },
        "UseCase": "VolumeCreation",
        "Links": {
          "TargetCollection": {
            "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes"
          }
        }
      }
    ]
  },
  "@odata.etag": "\"AE1409E6\""
}
```

Figure 27. GET VolumeCollection example

POST VolumeCollection

Used to create a volume. The Volume Capabilities resource defines the required (Property@Redfish.RequiredOnCreate) and optional (Property@Redfish.OptionalOnCreate) properties along with the allowable values (Property@Redfish.AllowableValues) to include in the body of the POST request. MediaSpanCount is required for RAID50 and RAID60 and optional for RAID10. Typical StripSizeBytes are 16384, 32768, 65536, 131072, and 262144. The POST operation may complete immediately and return an HTTPS response of 201 Created, the new volume URI in the Location response header, and a message in the response body

See the following chapters for further restrictions.

– PATCH DisplayName

– PATCH Encrypted

– PATCH IOPerfModeEnabled

– PATCH ReadCachePolicy

– PATCH WriteCachePolicy

– POST Volume.Initialize

Valid Links to Drives or DedicatedSpareDrives require all conditions below:

– Drive[Status][Health] = "OK"

– Drive[Status][State] = "Enabled" (SR Only) or "StandbyOffline" (MR Only)

– Drive[Operations][] is empty or Drive[Operations][][PercentageComplete] = 100

- Drive[Links][Volumes] is allowed to be any of the following conditions
  - Empty
  - HEAD Volume[Allow] != "DELETE"
  - GET Volume[CapacityBytes] does not fully consume Drive[CapacityBytes] and Volume[Links][Drives] match the new volume
- Drive[Protocol] matches across all selected drives
- Drive[MediaType] matches across all selected drives
- Number of Volume[Links][Drives] is appropriate for the chosen RAIDType

---

Note:
HPE SR Storage Controllers return VolumeCollection[Name] = "SR Volume Collection".
HPE MR Storage Controllers return VolumeCollection[Name] = "MR Volume Collection".

HPE SR Storage Controllers supports volume creation with Volume[Links][Drives] that reference drives in JBOD mode (Drive[Status][State] = "Enabled"). After the volume is created, the selected drives will no longer be accessible in JBOD mode and will become members of the newly created RAID volume. An initial host write is required before background initialization begins. Creating JBOD, SmartCache using Redfish is not supported. Volume[CapacityBytes] represents the capacity available to the host OS for storing user data. It supports a minimum capacity of (16 MiB–64 KiB) and maximum capacity of Data drives * (Drive[CapacityBytes]–32 MiB).

- IF Volume[CapacityBytes] is not supplied, the new Volume will use maximum capacity.
- ELSE IF Volume[CapacityBytes] > maximum capacity, the request will be rejected with PropertyValueIncorrect.
- ELSE IF the requested Volume[CapacityBytes] >= (8,160 * 65,535 * Drive[BlockSizeBytes]), then Volume[CapacityBytes]will be rounded down to a multiple of Drive[BlockSizeBytes].
- ELSE Volume[CapacityBytes] = FLOOR (FLOOR (Volume[CapacityBytes] / Drive[BlockSizeBytes]) / 8,160) * 8,160 * Drive[BlockSizeBytes]

HPE MR Storage Controllers support volume creation with Volume[Links][Drives] that reference drives with Drive[Status][State] of "StandbyOffline" (unconfigured drives). Drives that are in Drive[Status][State] = "Enabled" (JBOD mode) will be a member of a volume with RAIDType of None. When creating a volume with RAIDType of None, Volume[Links][Drives] must only contain 1 drive and all other volume properties will be ignored. Deleting any volume will transition the member drives to the Drive[Status][State] of "StandbyOffline" (unconfigured state).

Intel VROC requires RAIDType when creating a volume. Name, CapacityBytes, InitializeMethod, and StripSizeBytes are optional. Maximum capacity is the default anytime CapacityBytes is 0. For RAID0, the only supported InitializeMethod is "Skip". For RAID5, WriteHoleProtectionPolicy is optional and can be set to Off, DistributedLog, or Journaling.

NS controllers automatically create a RAID1 configuration on the 2 drives available after reboot. There is no way to create a Volume through redfish.

```
POST https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes
{
  "Links": {
    "Drives": [
      {
        "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}"
      }
    ]
  },
  "RAIDType": "RAID0",
  "IOPerfModeEnabled": false,
  "WriteCachePolicy": "ProtectedWriteBack",
  "ReadCachePolicy": "ReadAhead",
  "DisplayName": "My Boot Volume"
}
```

Figure 28. POST VolumeCollection example (for SR Controller)

Volume Collection Capabilities

DMTF defined Collection Capabilities (redfish.dmtf.org/schemas/CollectionCapabilities.json).

Table 20. Redfish CollectionCapabilities properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	CollectionCapabilities	Id	Yes	Yes	N/A	Yes
GET	CollectionCapabilities	Name	Yes	Yes	N/A	Yes
GET	CollectionCapabilities	@Redfish.AllowableValues	Yes	Yes	N/A	Yes
GET	CollectionCapabilities	@Redfish.AllowableNumbers	Yes	Yes	N/A	—
GET	CollectionCapabilities	@Redfish.AllowablePattern	Yes	Yes	N/A	—
GET	CollectionCapabilities	@Redfish.OptionalOnCreate	Yes	Yes	N/A	Yes
GET	CollectionCapabilities	@Redfish.RequiredOnCreate	Yes	Yes	N/A	Yes
GET	CollectionCapabilities	@Redfish.UpdateableAfterCreate	Yes	Yes	N/A	Yes

GET CollectionCapabilities

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/Capabilities
{
  "@odata.id":
  "/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/Capabilities",
  "@odata.type": "#Volume.v1_6_2.Volume",
  "Id": "Capabilities",
  "Name": "Capabilities for the volume collection",
  "RAIDType@Redfish.RequiredOnCreate": true,
  "RAIDType@Redfish.AllowableValues": [
    "RAID0",
    "RAID1",
    "RAID10",
    "RAID5",
    "RAID50",
    "RAID6",
    "RAID60",
    "RAID1Triple",
    "RAID10Triple"
  ],
  "CapacityBytes@Redfish.OptionalOnCreate": true,
  "StripSizeBytes@Redfish.OptionalOnCreate": true,
  "IOPerfModeEnabled@Redfish.OptionalOnCreate": true,
  "IOPerfModeEnabled@Redfish.UpdatableAfterCreate": true,
  "MediaSpanCount@Redfish.OptionalOnCreate": true,
  "DisplayName@Redfish.OptionalOnCreate": true,
  "DisplayName@Redfish.UpdatableAfterCreate": true,
  "ReadCachePolicy@Redfish.OptionalOnCreate": true,
  "ReadCachePolicy@Redfish.AllowableValues": [
    "Off", "ReadAhead"
  ],
  "ReadCachePolicy@Redfish.UpdatableAfterCreate":
  true, "WriteCachePolicy@Redfish.OptionalOnCreate":
  true, "WriteCachePolicy@Redfish.AllowableValues":
  [
    "Off",
    "ProtectedWriteBack",
    "UnprotectedWriteBack"
  ],
  "WriteCachePolicy@Redfish.UpdatableAfterCreate": true,
  "VolumeUsage@Redfish.OptionalOnCreate": true,
  "VolumeUsage@Redfish.AllowableValues": [
    "Data"
  ],
  "InitializeMethod@Redfish.OptionalOnCreate": true,
  "InitializeMethod@Redfish.AllowableValues": [
    "Background", "Foreground"
  ],
  "Links@Redfish.RequiredOnCreate": true,
  "Links": {
    "Drives@Redfish.RequiredOnCreate": true,
    "DedicatedSpareDrives@Redfish.OptionalOnCreate": true,
    "DedicatedSpareDrives@Redfish.UpdatableAfterCreate": true
  },
  "@odata.etag": "\"3728EF03\""
}
```

Figure 29. GET CollectionCapabilities example

Volume

DMTF defined Volume (redfish.dmtf.org/schemas/Volume.json).

Table 21. Redfish Volume properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	Volume	Id	Yes	Yes	Yes	Yes
GET	Volume	Name	Yes	Yes	Yes	Yes
GET	Volume	Status {} Health	Yes	Yes	Yes	Yes
GET	Volume	Status {} State	Yes	Yes	Yes	Yes
GET	Volume	BlockSizeBytes	Yes	Yes	Yes	Yes
GET	Volume	CapacityBytes	Yes	Yes	Yes	Yes
GET	Volume	DisplayName	Yes	Yes	Yes	Yes
GET	Volume	Encrypted	Yes	Yes	Yes	—
GET	Volume	EncryptionTypes []	Yes	Yes	Yes	—
GET	Volume	Identifiers []	Yes	Yes	Yes	Yes
GET	Volume	InitializeMethod	Yes	Yes	Yes	Yes
GET	Volume	IOPerfModeEnabled	Yes	Yes	Yes	—
GET	Volume	Links {} DedicatedSpareDrives	Yes	Yes	Yes	Yes
GET	Volume	Links {} Drives	Yes	Yes	Yes	Yes
GET	Volume	Links {} JournalingMedia	N/A	N/A	N/A	Yes
GET	Volume	LogicalUnitNumber	Yes	Yes	Yes	—
GET	Volume	MediaSpanCount	Yes	Yes	N/A	Yes
GET	Volume	Operations [] OperationName	Yes	—	Yes	—
GET	Volume	Operations [] Operation	—	Yes	Yes	Yes
GET	Volume	OptimumIOSizeBytes	Yes	Yes	Yes	Yes
GET	Volume	RAIDType	Yes	Yes	Yes	Yes
GET	Volume	ReadCachePolicy	Yes	Yes	Yes	Yes
GET	Volume	StripSizeBytes	Yes	Yes	Yes	Yes
GET	Volume	VolumeUsage	Yes	Yes	Yes	Yes
GET	Volume	WriteCachePolicy	Yes	Yes	Yes	Yes
GET	Volume	WriteHoleProtectionPolicy	—	Yes	N\A	Yes
DELETE	Volume	N/A	Yes	Yes	N/A	Yes
PATCH	Volume	CapacityBytes	—	Yes	N/A	Yes
PATCH	Volume	DedicatedSpareDrives	—	Yes	N/A	—
PATCH	Volume	DisplayName	Yes	Yes	Yes	Yes
PATCH	Volume	Encrypted	Yes	Yes	N/A	—
PATCH	Volume	EncryptionTypes []	—	—	N/A	—

PATCH	Volume	IOPerfModeEnabled	Yes	N/A	N/A	N/A
PATCH	Volume	ReadCachePolicy	Yes	Yes	N/A	N/A
PATCH	Volume	WriteCachePolicy	Yes	Yes	N/A	N/A
PATCH	Volume	WriteHoleProtectionPolicy	N/A	N/A	N/A	Yes
POST	Volume.ChangeRAIDLayout	RAIDType, MediaSpanCount, StripSizeBytes, Drives	—	Yes	N/A	Yes
POST	Volume.CheckConsistency	{}	—	Yes	N/A	Yes
POST	Volume.ForceEnable	{}	—		N/A	Yes
POST	Volume.Initialize	InitializeMethod	N/A	Yes	N/A	Yes

GET Volume

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}",
  "@odata.type": "#Volume.v1_6_2.Volume",
  "Id": "{ID}",
  "Name": "SR Volume 1",
  "Status": {
    "Health": "OK",
    "State": "Enabled"
  },
  "Identifiers": [
    {
      "DurableName": "600508B1-001C-5366-C4BC-871056607C9E",
      "DurableNameFormat": "UUID"
    }
  ],
  "Encrypted": false,
  "EncryptionTypes": [],
  "CapacityBytes": 1920349855744,
  "BlockSizeBytes": 512,
  "OptimumIOSizeBytes": 131072,
  "StripSizeBytes": 131072,
  "DisplayName": "Logical Drive 1",
  "IOPerfModeEnabled": true,
  "ReadCachePolicy": "Off",
  "RAIDType": "RAID0",
  "VolumeUsage": "Data",
  "Operations": [],
  "LogicalUnitNumber": 1,
  "WriteCachePolicy": "Off",
  "Links": {
    "Drives@odata.count": 1,
    "Drives": [
      {
        "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}"
      }
    ],
    "DedicatedSpareDrives@odata.count": 0,
    "DedicatedSpareDrives": []
  },
  "@odata.etag": "\"8C72B922\""
}
```

Figure 30. GET Volume example

DELETE Volume

Used to delete a volume.

HPE SR Storage Controllers do not support DELETE on a JBOD volume (RAIDType is None) or SmartCache volume (VolumeUsage is Data or Cache). The SmartCache volumes can instead be deleted using the Storage.ResetToDefaults action with ResetType set to ResetAll. After a Volume delete the drive will transition to a JBOD.

HPE MR Storage Controller do not allow deleting a volume while an Operation[] is in progress (example a foreground initialization).

```
DELETE https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
```

Figure 31. DELETE Volume example

PATCH CapacityBytes

Used to expand the volume capacity (also known as capacity expansion) of an existing volume. This patch operation may complete immediately while the volume is still transforming. The volume State will change to Updating and Progress can be monitored by polling the Volume Operations array containing an object which includes an OperationName of Transforming (or Migrating) and PercentageComplete value. Completion occurs when PercentageComplete is 100 or when the operation is no longer listed in the Operations array.

Intel VROC supports this action under Linux or Windows. UEFI does not support this action. Maximum capacity is the default anytime CapacityBytes is 0. Switching the OS between Linux and Windows while a volume is being expanded is not supported.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "CapacityBytes": 1000000
}
```

Figure 32. PATCH CapacityBytes example

PATCH DedicatedSpareDrives

Used to modify the spare drives assigned to an existing volume. Spare drives need to be the same MediaType & Protocol with CapacityBytes equal or greater than the lowest drive capacity in the volume.

Patching the DedicatedSpareDrives array with items containing Null or empty objects is not supported.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "Links": {
    "DedicatedSpareDrives": [
      {
        "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}"
      }
    ]
  }
}
```

Figure 33. PATCH DedicatedSpareDrives example

PATCH DisplayName

Used to modify the display name of an existing volume. This will also change the Name property to match. Length and character limits may apply. Volume[DisplayName] cannot be changed when the Volume[RAIDType] is "None".

HPE SR Storage Controllers support a maximum of 64 characters. HPE MR Storage Controllers support a maximum of 15 characters. HPE NS Storage Controllers support a maximum of 15 characters.

Intel VROC Storage Controllers support a maximum of 16 characters with Linux or Windows. UEFI is not supported.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "DisplayName": "My Boot Volume"
}
```

Figure 34. PATCH DisplayName example

PATCH Encrypted

Used to modify the existing encryption policy for a volume. The only value that this can be set to is true.

HPE SR and MR Storage Controllers allow for the user to encrypted the existing volume if the Controllers Encryptionmode is in "UseLocalKey" or "UseExternalKey" mode and the drives that make up the volume are SEDs (Self Encrypting Drive).

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "Encrypted": "True"
}
```

Figure 35. PATCH Encrypted example

PATCH IOPerfModeEnabled

Used to modify the IO performance mode (also known as Smart Path or FastPath) of an existing volume containing drives with a MediaType of SSD. Set the value to true or false.

SR Storage Controllers requires an SSD volume and both the write cache policy and read cache policy set to Off. As a result, it is recommended to patch all 3 properties together.

MR Storage Controllers do not support setting IOPerfModeEnabled. It's read only. The controller drivers opportunistically enable or disable FastPath automatically based upon drive types and controller settings.

NS Storage Controllers do not support setting IOPerfModeEnabled. It's read only. The controller always operates in the IO performance mode.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "IOPerfModeEnabled": true,
  "ReadCachePolicy": "Off",
  "WriteCachePolicy": "Off"
}
```

Figure 36. PATCH IOPerfModeEnabled example

PATCH ReadCachePolicy

Used to modify the ReadCachePolicy of an existing data volume. Allowable values may include Off or ReadAhead.

HPE SR Storage Controllers requires IOPerfModeEnabled set to false when enabling ReadCachePolicy. As a result, it is recommended to patch both properties together. See PATCH WriteCachePolicy for further restrictions.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "ReadCachePolicy": "ReadAhead"
}
```

Figure 37. PATCH ReadCachePolicy example

PATCH WriteCachePolicy

Used to modify the WriteCachePolicy (also known as flash backed write cache) of an existing data volume. Allowable values may include Off, WriteThrough, ProtectedWriteBack, or UnprotectedWriteBack. Enabling ProtectedWriteBack requires a supported controller model and properly installed HPE Smart Storage Battery with the controller backup power cable.

HPE SR Storage Controllers requires IOPerfModeEnabled set to false when enabling WriteCachePolicy. When configuring multiple volumes, the ReadCachePolicy and WriteCachePolicy could either be set to Off or else they must be identical across all volumes. This will require a single patch operation using an object that contains ReadCachePolicy and WriteCachePolicy. When SmartCache is used, the ReadCachePolicy and WriteCachePolicy properties are not reported on the CacheOnly volume and used on the Data volume to reflect the SmartCache settings.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "WriteCachePolicy": "ProtectedWriteBack"
}
```

Figure 38. PATCH WriteCachePolicy example

PATCH WriteHoleProtectionPolicy

Used to assign a drive to be used as JournalingMedia to enable write hole protection. Write hole protection is a specific partial data loss scenario involving a double fault condition of a degraded parity volume and ungraceful shutdown while a host write operation is in progress. Some controllers support write-hole protection without needing a journaling media drive.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}
{
  "WriteHoleProtectionPolicy": "Journaling",
  "Links": {
    "JournalingMedia": {
      "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}"
    }
  }
}
```

Figure 39. PATCH WriteHoleProtectionPolicy example

POST Volume.ChangeRAIDLayout

This action is used to change the RAIDType, StripSizeBytes, or Drives (also known as RAID migration, stripe size migration, etc.) of an existing volume. This action may complete immediately while the volume is still transforming. The Volume[Status][State] will change to "Updating" and Progress can be monitored by polling the Volume Operations array containing an object which includes an OperationName of "Transforming" (or "ChangeRAIDLayout") and PercentageComplete value. Completion occurs when PercentageComplete is 100 or when the operation is no longer listed in the Operations array.

Intel VROC supports this action under Linux or Windows. UEFI does not support this action. The Drives array is required while RAIDType and StripSizeBytes are optional. If there are no drives to add, the Drives array should be

empty. Linux does not support changing the StripSizeBytes and RAIDType within a single action. Changing StripSizeBytes requires changing RAIDType within a single action under Windows.

```
POST
https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}/Actions/Volume.ChangeRAIDLayout
{
  "StripSizeBytes": 16384,
  "RAIDType": "RAID10",
  "Drives": [
      {
        "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}"
      }
    ]
}
```

Figure 40. POST ChangeRAIDLayout example

POST Volume.CheckConsistency

This action is used to run a consistency check of an existing volume. The request body can either be an empty JSON object "{}" or None. This action may complete immediately while the volume is still verifying. The volume State will remain as Enabled and Progress can be monitored by polling the Volume Operations array containing an object which includes an OperationName of "Verifying" (or "CheckConsistency") and PercentageComplete value. Completion occurs when PercentageComplete is 100 or when the operation is no longer listed in the Operations array. Intel VROC supports this action under Linux or Windows. UEFI does not support this action.

```
POST
https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}/Actions/Volume.CheckConsistency
```

Figure 41. POST CheckConsistency example

POST Volume.ForceEnable

This action is used to force enable an offline volume which may have encountered data loss. The request body can either be an empty JSON object "{}" or None. Intel VROC supports this action under UEFI or Windows. Linux does not support this action.

```
POST https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}/Actions/Volume.ForceEnable
```

Figure 42. POST ForceEnable example

POST Volume.Initialize

This action is used to initialize (add parity and mirroring) an existing volume and optionally delete data. The POST operation associated with the action may complete immediately even though the volume is still initializing. When using IntializeMethod of "Background", the Volume[Status][State] is "Enabled". When using InitializeMethod of "Foreground", the Volume[Status][State] is "UnavailableOffline". During Initialize, the method is reported using the InitializeMethod property which may disappear after completion. Progress can be monitored by polling the Volume Operations array containing an object which includes an OperationName of "Initializing" (or "Initialize") and PercentageComplete value. Completion occurs when PercentageComplete is 100 or when the operation is no longer listed in the Operations array.

HPE MR Storage Controllers support volume creation with an InitializeMethod of "Background" or "Foreground". When InitializeMethod is "Background" or not specified, the volume is created immediately but the initialization behavior is dependent upon the drive count.

Table 22. HPE MR Storage Controller Volume Initialize

InitializeMethod	InitializeType	POST create	POST action
Background (default)	Ignored	SV=No Initialize[16] LV=Initialize after 5 min[17]	Initialize immediately (Storcli/cx/vx start cc force)
Foreground	Fast	InitializeType is N/A Full erase and initialize while Volume is UnavailableOffline	Quick Erase and Initialize (Storcli/cx/vx start init force)
	Slow	InitializeType is N/A Full erase and initialize while Volume is UnavailableOffline	Full Erase (write 0) & Initialize (Storcli/cx/vx start init full force)

Intel VROC supports this action on Windows. Linux and UEFI do not support this action. RAID0 does not support this action.

```
POST https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}/Actions/Volume.Initialize
{
        "InitializeMethod": "Foreground",
        "InitializeType": "Slow"
}
```

Figure 43. POST Initialize example

Fabric

DMTF defined Drive (redfish.dmtf.org/schemas/Fabric.json).

Table 23. Redfish Fabric properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	Fabric	Id	—	Yes	N/A	N/A
GET	Fabric	Name	—	Yes	N/A	N/A
GET	Fabric	FabricType	—	Yes	N/A	N/A
GET	Fabric	Switches {}	—	Yes	N/A	N/A

[16] Small volume (SV) is a RAID5 volume with <5 drives or RAID6 volume with <7 drives
[17] Large volume (LV)

Get Fabric

```
GET https://example.com/redfish/v1/Fabrics/{ID}
{
  "@odata.etag": "\"4a2803bd\"",
  "@odata.id": "/redfish/v1/Fabrics/DE00B000",
  "@odata.type": "#Fabric.v1_3_0.Fabric",
  "Id": "{ID}",
  "Name": "8 SFF 32G x4NVMe/SAS UBM3 BC BP",
  "FabricType": "MultiProtocol",
  "Switches": {
    "@odata.id": "/redfish/v1/Fabrics/{ID} /Switches"
  }
}
```

Figure 44. GET Fabric example

Switch Collection

DMTF defined Drive (redfish.dmtf.org/schemas/SwitchCollection.json).

Table 24. Redfish SwitchCollection properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	SwitchCollection	Name	—	Yes	N/A	N/A
GET	SwitchCollection	Members []	—	Yes	N/A	N/A

Get SwitchCollection

```
GET https://example.com/redfish/v1/Fabrics/{ID}/Switches
{
  "@odata.etag": "\"ef73bec7\"",
  "@odata.id": "/redfish/v1/Fabrics/{ID}/Switches",
  "@odata.type": "#SwitchCollection.SwitchCollection",
  "Name": "Switch Collection",
  "Members@odata.count": 1,
  "Members": [
    {
      "@odata.id": "/redfish/v1/Fabrics/{ID}/Switches/{ID}"
    }
  ]
}
```

Figure 45. GET Switch Collection example

Switch

DMTF defined Drive (redfish.dmtf.org/schemas/Switch.json).

Table 25. Redfish Switch properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	Switch	Id	—	Yes	N/A	N/A
GET	Switch	Name	—	Yes	N/A	N/A
GET	Switch	DomainID	—	Yes	N/A	N/A
GET	Switch	FirmwareVersion	—	Yes	N/A	N/A
GET	Switch	Links {} Chassis {}	—	Yes	N/A	N/A
GET	Switch	Model	—	Yes	N/A	N/A
GET	Switch	Ports {}	—	Yes	N/A	N/A
GET	Switch	SupportedProtocols []	—	Yes	N/A	N/A
GET	Switch	SwitchType	—	Yes	N/A	N/A

Get Switch

```
GET https://example.com/redfish/v1/Fabrics/{ID}/Switches/{ID}
{
  "@odata.etag": "\"6e75eb7b\"",
  "@odata.id": "/redfish/v1/Fabrics/{ID}/Switches/{ID}",
  "@odata.type": "#Switch.v1_9_1.Switch",
  "Id": "{ID}",
  "Name": "Direct Attached",
  "DomainID": 0,
  ;
    "Chassis": {
      "@odata.id": "/redfish/v1/Chassis/{ID}"
  }
},
  "Model": "UBM3",
  "Ports": {
    "@odata.id": "/redfish/v1/Fabrics/{ID}/Switches/{ID}/Ports"
  },
  "SupportedProtocols":
    [
    "SAS",
    "SATA",
    "NVMe"
    ],
  "SwitchType": "MultiProtocol"
}
```

Figure 46. GET Switch example

Switch Port Collection

DMTF defined Port Collection (redfish.dmtf.org/schemas/PortCollection.json).

Table 26. Redfish PortCollection properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	PortCollection	Name	—	Yes	N/A	N/A
GET	PortCollection	Members []	—	Yes	N/A	N/A

GET PortCollection

```
GET https://example.com /redfish/v1/Fabrics/{ID}/Switches/{ID}/Ports
{
  "@odata.etag": "\"62774188\"",
  "@odata.id": "/redfish/v1/Fabrics/{ID}/Switches/{ID}/Ports",
  "@odata.type": "#PortCollection.PortCollection",
  "Name": "Port Collection",
  "Members@odata.count":  2,
  "Members": [
    {
      "@odata.id": "/redfish/v1/Fabrics/{ID}/Switches/{ID}/Ports/{ID}"
    },
    {
      "@odata.id": "/redfish/v1/Fabrics/{ID}/Switches/{ID}/Ports/{ID}"
    }
  ]
}
```

Figure 47. GET PortCollection example

Switch Port

DMTF defined Port (redfish.dmtf.org/schemas/Port.json).

Table 27. Redfish Port properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	Port	Id	—	Yes	N/A	N/A
GET	Port	Name	—	Yes	N/A	N/A
GET	Port	Status {} Health	—	Yes	N/A	N/A
GET	Port	Status {} State	—	Yes	N/A	N/A
GET	Port	ActiveWidth	—	Yes	N/A	N/A
GET	Port	CurrentSpeedGbps	—	Yes	N/A	N/A
GET	Port	Links {} ConnectedPorts []	—	Yes	N/A	N/A
GET	Port	Location {} PartLocation {}	—	Yes	N/A	N/A

GET	Port	MaxSpeedGbps	—	Yes	N/A	N/A
GET	Port	PortId	—	Yes	N/A	N/A
GET	Port	PortProtocol	—	—	N/A	N/A
GET	Port	PortType	—	—	N/A	N/A
GET	Port	Width	—	Yes	N/A	N/A

GET Port

```
GET https://example.com /redfish/v1/Fabrics/{ID}/Switches/{ID}/Ports/{ID}
{
  "@odata.etag": "\"2590b028\"",
  "@odata.id":
  "/redfish/v1/Fabrics/{ID}/Switches/{ID}/Ports/{ID}",
  "@odata.type": "#Port.v1_9_0.Port",
  "Id": "{ID}",
  "PortId": "2",
  "Name": "Connector 2",
  "ActiveWidth": 5,
  "CurrentSpeedGbps": 76.0,
  "Links": {
    "ConnectedPorts": [
      {
        "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Controllers/{ID}/Ports/{ID}"
      }
    ]
  },
  "Location": {
    "PartLocation": {
      "ServiceLabel":
      "Box=1:Connector=2",
      "LocationType": "Connector",
      "LocationOrdinalValue": 2
    }
  },
  "MaxSpeedGbps": 128.0,
  "Status": {
    "State": "Enabled",
    "Health": "OK"
  },
  "Width": 8
}
```

Figure 48. GET Switch Port example

Chassis

DMTF defined Drive (redfish.dmtf.org/schemas/Chassis.json).

Table 28. Redfish Chassis properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	Chassis	Id	—	Yes	N/A	N/A
GET	Chassis	Name	—	Yes	N/A	N/A
GET	Chassis	Status {} Health	—	Yes	N/A	N/A
GET	Chassis	Status {} State	—	Yes	N/A	N/A
GET	Chassis	ChassisType	—	Yes	N/A	N/A
GET	Chassis	Drives {}	—	Yes	N/A	N/A
GET	Chassis	Links {} ContainedBy []	—	Yes	N/A	N/A
GET	Chassis	Links {} Switches []	—	Yes	N/A	N/A
GET	Chassis	Links {} Storage []	—	Yes	N/A	N/A
GET	Chassis	Location {} PartLocation {}	—	Yes	N/A	N/A
GET	Chassis	Manufacturer	—	Yes	N/A	N/A
GET	Chassis	Model	—	Yes	N/A	N/A
GET	Chassis	PartNumber	—	Yes	N/A	N/A
GET	Chassis	SparePartNumber	—	Yes	N/A	N/A
GET	Chassis	SerialNumber	—	Yes	N/A	N/A
GET	Chassis	Version	—	Yes	N/A	N/A

GET Chassis

```
GET https://example.com "/redfish/v1/Chassis/{ID}
{
  "@odata.etag": "\"a7023f5e\"",
  "@odata.id": "/redfish/v1/Chassis/{ID}",
  "@odata.type": "#Chassis.v1_23_0.Chassis",
  "Id": "{ID}",
  "Name": "8 SFF 32G x4NVMe/SAS UBM3 BC BP",
  "Status": {
    "State": "Enabled",
    "Health": "OK"
  },
  "ChassisType": "StorageEnclosure",
  "Drives": {
    "@odata.id": "/redfish/v1/Chassis/{ID}/Drives"
  },
  "Links": {
    "Switches@odata.count": 1,
    "Switches": [
      {
        "@odata.id": "/redfish/v1/Fabrics/{ID}/Switches/{ID}"
      }
    ],
    "Storage@odata.count": 1,
    "Storage": [
      {
        "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}"
      }
    ]
  },
  "Location": {
    "PartLocation": {
      "ServiceLabel":
      "Slot=5:Port=2:Box=1",
      "LocationType": "Backplane",
      "LocationOrdinalValue": 1
    }
  },
  "Manufacturer": "HPE",
  "Model": "8 SFF 32G x4NVMe/SAS UBM3 BC BP",
  "PartNumber": "P40715-001",
  "SparePartNumber": "123456-001",
  "SerialNumber": "",
  "Version": "A"
}
```

Figure 49. GET Chassis example

Drive Collection

DMTF defined Drive (redfish.dmtf.org/schemas/DriveCollection.json).

Table 29. Redfish Drive Collection properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	DriveCollection	Name	Yes	Yes	N/A	N/A
GET	DriveCollection	Members []	Yes	Yes	N/A	N/A

GET DriveCollection

```
GET https://example.com "/redfish/v1/Chassis/{ID}/Drives
{
  "@odata.etag": "\"b238ef46\"",
  "@odata.id": "/redfish/v1/Chassis/{ID}/Drives",
  "@odata.type": "#DriveCollection.DriveCollection",
  "Name": "Drive Collection",
  "Members@odata.count": 4,
  "Members": [
    {
      "@odata.id": "/redfish/v1/Chassis/{ID}/Drives/{ID}"
    },
    {
      "@odata.id": "/redfish/v1/Chassis/{ID}/Drives/{ID}"
    },
    {
      "@odata.id": "/redfish/v1/Chassis/{ID}/Drives/{ID}"
    },
    {
      "@odata.id": "/redfish/v1/Chassis/{ID}/Drives/{ID}"
    }
  ]
}
```

Figure 50. GET Drive Collection example

Drive

DMTF defined Drive (redfish.dmtf.org/schemas/Drive.json).

Note:

If the storage controller transitions to supporting the Chassis & DriveCollection resources, the drive URL will also change to /redfish/v1/Chassis/{Id}/Drives/{Id}

Table 30. Redfish Drive properties

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	Drive	Id	Yes	Yes	Yes	Yes
GET	Drive	Name	Yes	Yes	Yes	Yes
GET	Drive	Status {} Health	Yes	Yes	Yes	Yes
GET	Drive	Status {} State	Yes	Yes	Yes	Yes
GET	Drive	BlockSizeBytes	Yes	Yes	Yes	Yes
GET	Drive	BlockSecurityIDEnabled	—	—	—	—
GET	Drive	CapableSpeedGbs	Yes	Yes	Yes	Yes
GET	Drive	CapacityBytes	Yes	Yes	Yes	Yes
GET	Drive	DriveFormFactor	Yes	Yes	Yes	—
GET	Drive	EncryptionAbility	Yes	Yes	Yes	Yes
GET	Drive	EncryptionStatus	Yes	Yes	Yes	Yes
GET	Drive	FailurePredicted	Yes	Yes	Yes	Yes
GET	Drive	HotspareReplacementMode	Yes	Yes	N\A	Yes
GET	Drive	Hardwareversion	—	—	—	—
GET	Drive	HotspareType	Yes	Yes	Yes	Yes
GET	Drive	Indentifiers []	Yes	Yes	Yes	Yes
GET	Drive	Links {} Chassis {}	Yes	Yes	N\A	Yes
GET	Drive	Links {} Storage {}	Yes	Yes	Yes	Yes
GET	Drive	Links {} Volumes []	Yes	Yes	Yes	Yes
GET	Drive	LocationIndicatorActive	Yes	Yes	Yes	Yes
GET	Drive	MediaType	Yes	Yes	Yes	Yes
GET	Drive	Model	Yes	Yes	Yes	Yes
GET	Drive	Multipath	Yes	Yes	Yes	Yes (FY2025)
GET	Drive	NegotiatedSpeedGbs	Yes	Yes	Yes	Yes
GET	Drive	Operations [] OperationName	Yes	—	Yes	—
GET	Drive	Operations [] Operation	—	Yes	—	Yes
GET	Drive	PhysicalLocation {} PartLocation {}	Yes	Yes	Yes	Yes
GET	Drive	PredictedMediaLifeLeftPercent	Yes	Yes	Yes	Yes

GET	Drive	Protocol	Yes	Yes	Yes	Yes
GET	Drive	Revision	Yes	Yes	Yes	Yes
GET	Drive	SerialNumber	Yes	Yes	Yes	Yes
GET	Drive	SlotCapableProtocols []	Yes	Yes	Yes	—
GET	Drive	StatusIndicator	Yes	Yes	Yes	Yes
GET	Drive	WriteCacheEnabled	Yes	Yes	Yes	Yes
PATCH	Drive	BlockSecurityIDEnabled	—	—	—	—
PATCH	Drive	HotspareReplacementMode	—	—	N/A	—
PATCH	Drive	HotspareType	N/A	Yes	N/A	Yes
PATCH	Drive	LocationIndicatorActive	Yes	Yes	Yes	Yes
PATCH	Drive	StatusIndicator	—	—	Yes	Yes
PATCH	Drive	WriteCacheEnabled	Yes	Yes	—	Yes
POST	Drive.Reset	ResetType	Yes	—	N/A	N/A
POST	Drive.SecureErase	{}	Yes	Yes	Yes	Yes

GET Drive

For SR controllers, DriveFormFactor is supported for SAS/SATA/NVME drives.

For MR controllers, DriveFormFactor is supported for SAS/SATA/NVME drives.

For NS Controllers, DriveFormFactor is supported for NVME drives.

```
   GET https://example.com/redfish/v1/Chassis/{ID}/Drives/{ID}
   {
     "@odata.etag": "\"4480e8b\"",
     "@odata.id":
     "/redfish/v1/Chassis/{ID}/Drives/{ID}",
     "@odata.type": "#Drive.v1_13_0.Drive",
     "Id": "{ID}",
     "Name": "800GB 64G NVMe SSD",
     "Status": {
       "State": "Enabled",
       "Health": "OK"
     },
     "Links": {
       "Chassis": {
         "@odata.id": "/redfish/v1/Chassis/{ID}"
       },
       "Volumes": [
         {
           "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Volumes/{ID}"
   }
],
       "Volumes@odata.count": 1,
       "Storage": {
         "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}"
   }
}
,
     "PhysicalLocation":
       {
       "PartLocation": {
       "ServiceLabel":
       "Slot=5:Port=2:Box=1:Bay=7",
       "LocationType": "Bay",
       "LocationOrdinalValue": 7
}
}
,
     "BlockSizeBytes": 512,
     "CapableSpeedGbs": 64.0,
     "CapacityBytes": 800166076416,
     "EncryptionAbility": "None",
     "FailurePredicted": false,
     "HotspareType": "None",
     "Identifiers": [
       {
         "DurableName": "AF:23:12:3D:01:75:A0:00",
         "DurableNameFormat": "EUI"
}
]
,
     "LocationIndicatorActive": false,
     "MediaType": "SSD",
     "Model": "MO000800KXNXH",
     "Multipath": false,
     "NegotiatedSpeedGbs": 64.0,
     "Operations": [],
     "PredictedMediaLifeLeftPercent": 100.0,
     "Protocol": "NVMe",
     "Revision": "HP01",
     "SerialNumber": "22483D1223AF",
     "StatusIndicator": "OK",
     "WriteCacheEnabled": false
   }
```

Figure 51. GET Drive example (1 of 2)

PATCH HotspareType

Used to configure a drive as a global spare. Allowable values may include None or Global. Alternatively, controllers may support adding a dedicated spare drive to one or more volumes (see POST VolumeCollection and PATCH DedicatedSpareDrives).

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}
{
  "HotspareType": "Global",
}
```

Figure 52. PATCH HotspareType example

PATCH LocationIndicatorActive

Used to enable or disable the drive locate LED. Set the value to true or false.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}
{
  "LocationIndicatorActive": true,
}
```

Figure 53. PATCH LocationIndicatorActive example

PATCH StatusIndicator

Used to force a drive failure and light the drive fault LED.

For VROC PATCH is supported only to set the status Indicator with value "OK" under UEFI and Windows. Intel considers this feature "Mark Drive as Normal".

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}
{
  "StatusIndicator": "Fail",
}
```

Figure 54. PATCH StatusIndicator example

PATCH WriteCacheEnabled

Used to enable drive write cache. Not supported by enterprise class NVMe drives. Set the value to true or false.

HPE SR Storage Controllers contain controller level drive write cache policies that are accessible through SSA or SSACLI. The policies for Configured Drives (RAID) are Default, Enable, Disable, and Unchanged. Redfish patch to WriteCacheEnabled is only allowed when the configured drive write cache policy is set to Unchanged. As a result, a Redfish patch to WriteCacheEnabled is not possible for a configured drive unless SSA or SSACLI is first used to change the policy to Unchanged. The policies for Unconfigured Drives (HBA) are Default, Enable, and Disable. Redfish patch to WriteCacheEnabled is only allowed when the unconfigured drive write cache policy is set to Default. As a result, a Redfish patch to WriteCacheEnabled is possible for an unconfigured drive assuming the default controller policy has not been modified.

HPE MR Storage Controllers support setting the drive write cache for either all drives within a volume (storcli /cx/vx set pdcache) or all JBOD drives (storcli /cx set jbodwritecache). However, Redfish supports the setting at an individual drive level. As a result, PATCH WriteCacheEnabled is only supported for single drive RAID0 volumes.

Intel VROC supports this action under Linux or Windows. UEFI does not support this action.

```
PATCH https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}
{
  "WriteCacheEnabled": true,
}
```

Figure 55. PATCH WriteCacheEnabled example

POST Drive.Reset

This action is used to re-enable a drive that is in the StandbyOffline State. Typically, after a secure erase operation.

```
POST https ://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}/Actions/Drive.Reset
{
  "ResetType": "ForceOn",
}
```

Figure 56. POST Reset example

POST Drive.SecureErase

This action is used to securely erase a drive using drive sanitize protocol. The request body can either be an empty JSON object "{}" or None. This action is not available if the drive is a member of a volume or a locked SED drive. The POST operation may complete immediately while the drive is still sanitizing. Progress can be monitored by polling the Drive Operations array containing an object which includes an OperationName of Sanitizing and PercentageComplete value. Completion occurs when PercentageComplete is 100 or when the operation is no longer listed in the Operations array.

HPE SR Storage Controllers will transition the sanitized drive to the StandyOffline State to prevent any further writes. A Drive Reset action is required to re-enable the drive.

HPE MR Storage Controller requires that the Drive[Status][State] is StandbyOffline before it advertises and supports the Drive SecureErase action. To enter this state, all volumes associated with the drive must first be deleted by performing a DELETE operation on each Volume resource.

HPE NS Storage Controller with non-SED drives requires that all volumes associated with the drive must first be deleted by performing the Storage ResetToDefaults action with a ResetType set to ResetAll. After completing the Drive SecureErase action, Drive[Status][State] is StandbyOffline. On the next server reboot, the drive state will return to enabled and the RAID1 volumes will be auto created. Some earlier firmware versions did not accept an empty JSON object {}.

For HPE NS Storage Controller with SED drives Storage ResetToDefaults clears the volumes, erases the keys, performs a crypto erase and restores the controller back to its defaults state. A separate secureerase is not needed.

```
POST https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}/Actions/Drive.SecureErase
```

Figure 57. POST SecureErase example

Monitoring

Redfish Events

HPE Storage Controllers support the Distributed Management Task Force (DMTF) standard known as Platform Level Data Model (PLDM) for Redfish Device Enablement in HPE ProLiant Gen10 servers and later. This open standard API allows HPE option cards (storage controllers, network adapters, and so on) to host their own set of DMTF defined Redfish Events. These events are accessed through the DMTF Redfish Event Service at /redfish/v1/EventService. HPE iLO 5 EventService supports an EventTypeForSubscription array with Alert. HPE iLO 6 EventService supports Subscriptions with a RegistryPrefixes array with StorageDevice.

Storage Controllers support the DMTF defined Storage Device Message Registry (redfish.dmtf.org/registries/StorageDevice.1.4.0.json)

Table 31. Redfish StorageDevice Registry events

Redfish Storage Device Registry	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
ControllerOK	—	—	—	—
ControllerFailure	Yes	Yes	Yes	—
DriveOK	Yes	Yes	Yes	—
DrivePredictiveFailure	Yes	Yes	Yes	Yes
DrivePredictedMediaLifeLow	—	—	—	—
DrivePredictiveFailureCleared	Yes	—	—	Yes
DriveFailure	Yes	Yes	Yes	Yes
DriveFailureCleared	Yes	Yes	Yes	—
DriveInserted	Yes	Yes	Yes	Yes
DriveRemoved	Yes	Yes	Yes	Yes
VolumeOK	Yes	Yes	Yes	Yes
VolumeDegraded	Yes	Yes	Yes	Yes
VolumeFailure	Yes	Yes	Yes	Yes
WriteCacheProtected	Yes	Yes	N/A	N/A
WriteCacheTemporarilyDegraded	Yes	Yes	N/A	N/A
WriteCacheDegraded	Yes	Yes	N/A	N/A
WriteCacheDataLoss	Yes	Yes	N/A	N/A
BatteryOK	Yes	Yes	N/A	N/A
BatteryCharging	Yes	Yes	N/A	N/A
BatteryMissing	Yes	Yes	N/A	N/A
BatteryFailure	Yes	Yes	N/A	N/A
BlockSecurityIDIssued	—	—	—	—

BlockSecurityIDFailed	—	—	—	—
BlockSecurityIDRemoved	—	—	—	—
ControllerDegraded	Yes	Yes	—	—
ControllerPreviousError	Yes	Yes	—	—
ControllerPasswordAccepted	Yes	Yes	N/A	N/A
ControllerPasswordRequired	Yes	Yes	N/A	N/A
ControllerPortOK	—	—	N/A	—
ControllerPortDegraded	—	—	N/A	—
ControllerPortFailure	—	—	N/A	—
DriveMissing	Yes	Yes	Yes	—
DriveMissingCleared	—	Yes	Yes	—
DriveOffline	Yes	Yes	Yes	—
DriveOfflineCleared	Yes	Yes	Yes	—
VolumeOffline	Yes	Yes	N/A	—
VolumeOfflineCleared	Yes	Yes	N/A	—

Simple Network Management Protocol

The OID's are defined in the [HPE Systems Insight Manager—MIB Kit](#) containing cpqida.mib definitions. HPE iLO logs the Redfish Events into the Integrated Management Log (IML) and uses these events to generate Simple Network Management Protocol (SNMP) Traps (also known as SNMP Alerts).

Table 32. Simple Network Protocol (SNMP) traps

SNMP Trap	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
cpqDa6CntlrStatusChange	Yes	Yes	—	—
cpqDa7PhyDrvStatusChange	Yes	Yes	Yes	Yes
cpqDa6LogDrvStatusChange	Yes	Yes	Yes	Yes
cpqDa6AccelStatusChange	Yes	Yes	N/A	N/A
cpqDa6AccelBadDataTrap	Yes	Yes	N/A	N/A
cpqDa6AccelBatteryFailed	Yes	Yes	N/A	N/A

HPE iLO services cpqDa SNMP MIB (also known as Management Information Base) requests using Redfish Get operations to the appropriate Redfish resource. HPE iLO 5 version 3.00 or later is required.

Table 33. Simple Network Protocol (SNMP) MIBs

SNMP MIB	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
cpqDaCntlrModel	Yes	Yes	Yes	Yes
cpqDaCntlrFWRev	Yes	Yes	Yes	Yes
cpqDaCntlrCondition	Yes	Yes	Yes	Yes
cpqDaCntlrHwLocation	Yes	Yes	Yes	Yes
cpqDaCntlrSerialNumber	Yes	Yes	Yes	Yes
cpqDaLogDrvCntlrIndex	Yes	Yes	Yes	Yes
cpqDaLogDrvIndex	Yes	Yes	Yes	Yes
cpqDaLogDrvSize	Yes	Yes	Yes	Yes
cpqDaLogDrvStripeSize	Yes	Yes	Yes	Yes
cpqDaLogDrvFaultTol	Yes	Yes	Yes	Yes
cpqDaPhyDrvModel	Yes	Yes	Yes	Yes
cpqDaPhyDrvFWRev	Yes	Yes	Yes	Yes
cpqDaPhyDrvStatus	Yes	Yes	Yes	Yes
cpqDaPhyDrvLocationString	Yes	Yes	Yes	Yes
cpqDaPhyDrvSerialNum	Yes	Yes	Yes	Yes
cpqDaPhyDrvSize	Yes	Yes	Yes	Yes
cpqDaPhyDrvMediaType	Yes	Yes	Yes	Yes
cpqDaPhyDrvType	Yes	Yes	Yes	Yes
cpqDaPhyDrvNegotiatedLinkRate	Yes	Yes	Yes	Yes
cpqDaPhyDrvPreFailMonitoring	Yes	Yes	Yes	Yes
cpqDaPhyDrvSSDPercntEndrnceUsed	Yes	Yes	Yes	Yes

Future dates are provided as guidance and subject to change without notice. "N/A" represents a feature that is not applicable. "—" represent a feature that is not available.

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