Hewlett Packard Enterprise

Technical white paper

HPE Storage Controllers: Management overview

Contents

Overview

This document provides a high-level summary on how to manage HPE Storage Controllers within HPE Gen10 servers and later.

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+	—

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

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 MR416i-p Gen11
Performance	PCI Card	—	HPE SR932i-p Gen11	—

[2] OROC — OCP RAID on Chip.

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 (2H 2023)	HKM LKM RKM (2H 2023)	HKM (MR216) LKM RKM
Security Protocol and Data Model (SPDM)	No	Yes (Gen11)	Yes (Gen11)

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 iLO 5 User Guide	hpe.com/support/ilo5-ug-en
HPE iLO 6 User Guide	hpe.com/support/ilo6-ug-en
UEFI Gen10 User Guide	hpe.com/support/UEFIGen10-UG-en
UEFI Gen11 User Guide	hpe.com/support/UEFIGen11-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 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
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, 8]	FWPKG	FWPKG[6, 8]	(ROM)
Drive Backplane	FWPKG[3, 4, 7, 8]	FWPKG[5, 7]	N/A	FWPKG
SAS, SATA, or NVMe Drives	Smart Component	Smart Component	Smart Component	Smart Component[9]

[3] Microchip SmartROC 3100 firmware version 5.32 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

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.

Figure 1. iLOREST Flash FWPKG example

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

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.

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	Yes	Yes
HPE iLO GUI	Yes	Yes	Yes	Yes
Redfish	Yes	Yes[10]	Yes[11]	Yes[12] (Gen11)
HPE OneView	Managed	Monitored[13]	Monitored	Monitored
Intelligent provisioning	Yes	Yes[14]	N/A	—

[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 with VROC NVMe and HPE iLO 6 v1.40 or later. Not supported on VROC SATA or VMware®.
[13] HPE OneView Managed mode targeting 3Q 2023.
[14] IP 3.85 or later for Gen10/10 Plus or IP 4.30 or later for Gen11.

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

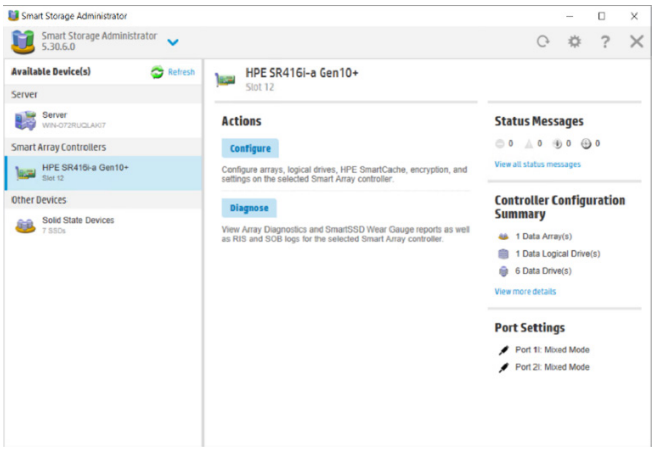


Figure 3. MR Storage Administrator (MRSA) — physical view

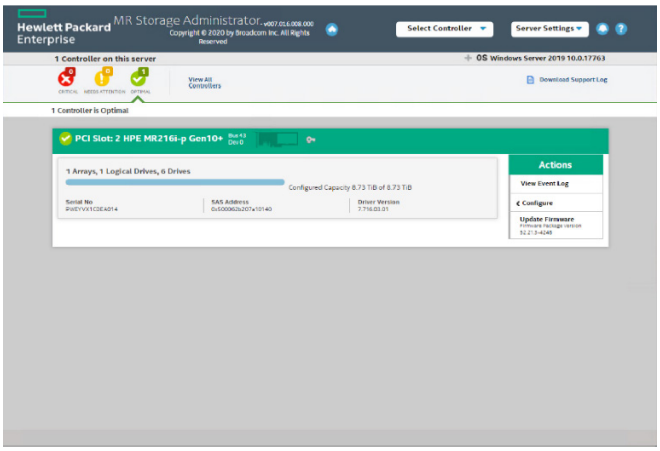


Figure 4. Smart Storage Administrator (SSA) — configuration

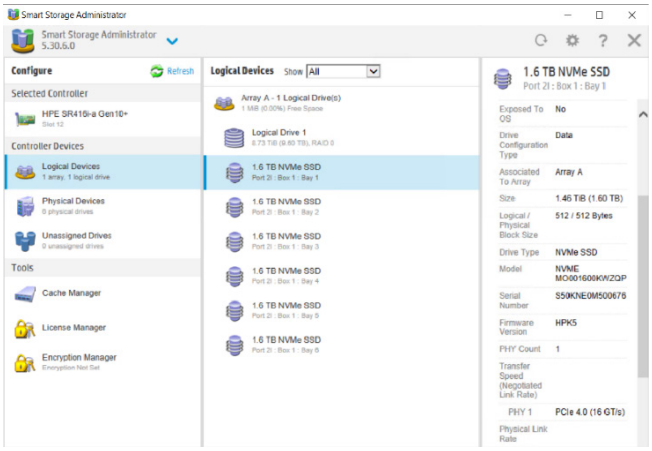
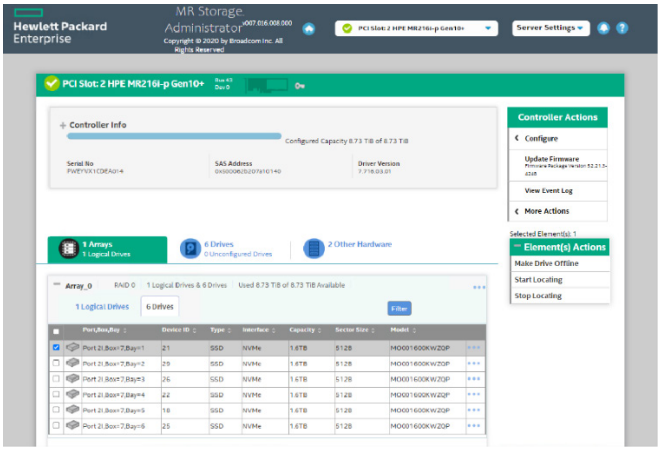


Figure 5. MR Storage Administrator (MRSA) — configuration



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

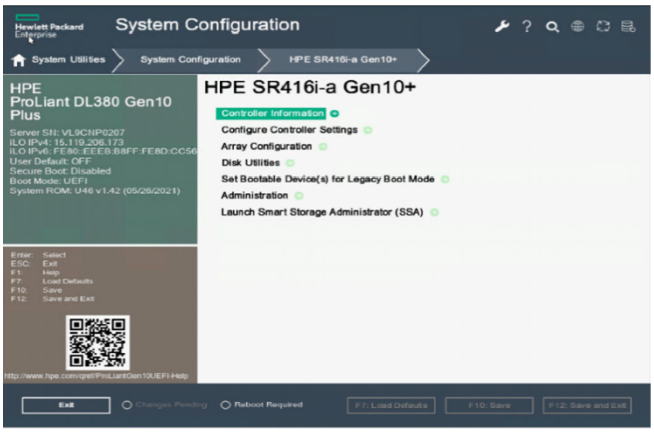


Figure 7. MR UEFI System Utilities — physical view

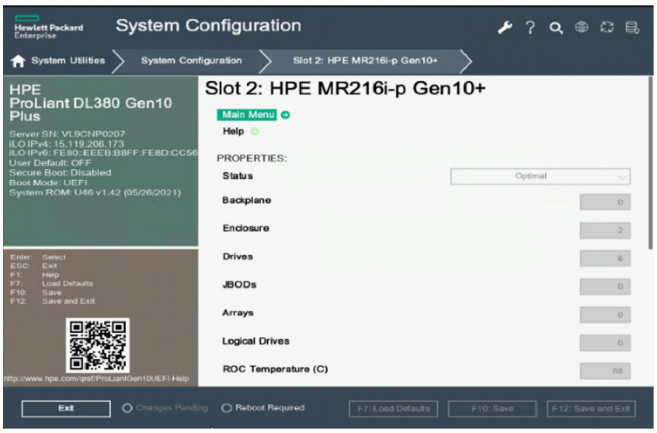


Figure 8. SR UEFI System Utilities — Create Volume

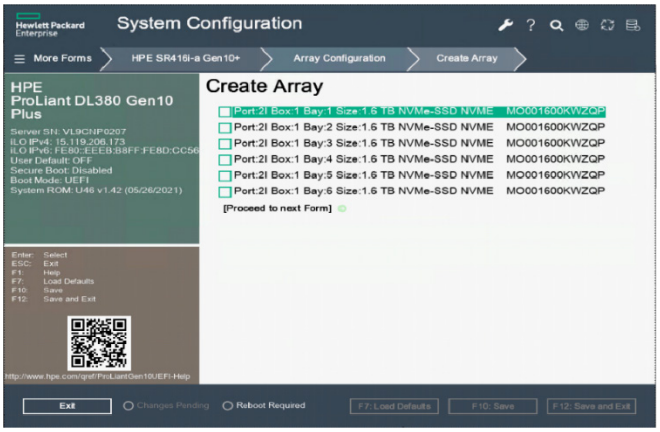
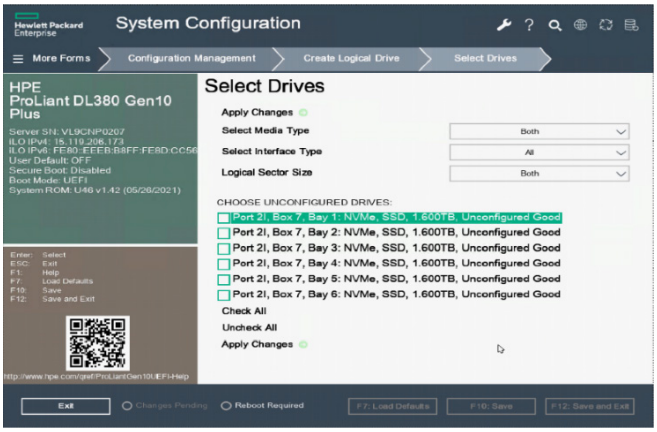


Figure 9. MR UEFI System Utilities — Create Volume



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

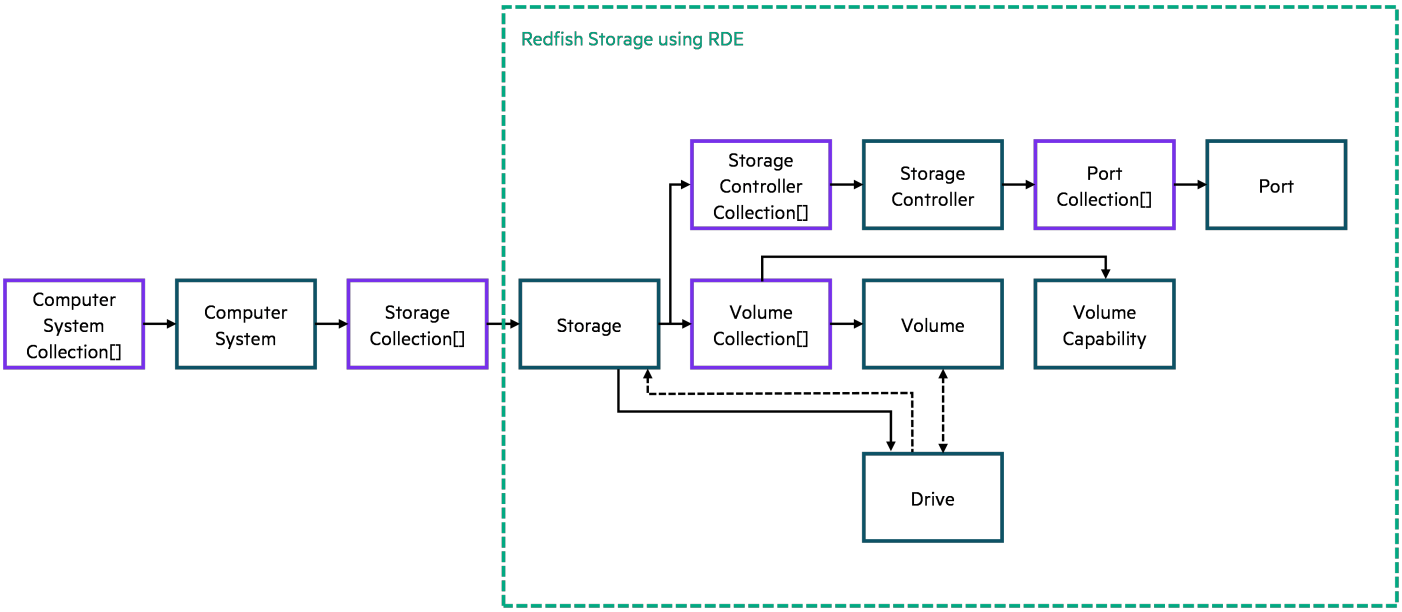
Description	HPE SR Storage Controller	HPE MR Storage Controller
Show controllers	ssacli ctrl all show	storcli show
Displaying all drives	ssacli ctrl slot=5 pd all show	storcli /c0/eall/sall show
Displaying drive details	ssacli ctrl slot=5 pd 1I:3:1 show	storcli /c0/e250/s1 show all
Displaying all volumes	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	3Q 2023	—	—	—
GET	PATCH properties	@Redfish.AllowableValues	3Q 2023	—	N/A	—
GET	PATCH properties	@Redfish.AllowableNumbers	3Q 2023	—	N/A	—
GET	PATCH properties	@Redfish.AllowablePattern	3Q 2023	—	N/A	—

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	—	—	—	—
GET	Storage	Controllers {}	Yes	Yes	Yes	Yes
GET	Storage	Drives []	Yes	Yes	Yes	Yes
GET	Storage	EncryptionMode	3Q 2023	—	N/A	N/A
GET	Storage	HotspareActivationPolicy	—	—	N/A	—
GET	Storage	LocalEncryptionKeyIdentifier	3Q 2023	—	N/A	N/A
GET	Storage	Links {} Enclosures []	—	—	N/A	Yes
GET	Storage	Volumes {}	Yes	Yes	Yes	Yes
PATCH	Storage	AutoVolumeCreate	—	—	N/A	N/A
PATCH	Storage	EncryptionMode	—	—	N/A	—
PATCH	Storage	HotspareActivationPolicy	—	—	N/A	—
POST	Storage. ResetToDefaults	ResetType	Yes	Yes	Yes	2H 2023
POST	Storage. SetEncryptionKey	EncryptionKey, CurrentEncryptionKey, EncryptionKeyIdentifier	—	—	N/A	N/A

GET Storage

Figure 11. GET Storage example

```
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\""
}
```

POST Storage.ResetToDefaults

This action is used to factory reset the storage controller and optional delete any volumes. ResetType can either be set to PreserveVolumes or ResetAll. Clients will need to perform additional actions to POST Drive.SecureErase to sanitize data on the drives.

HPE SR Storage Controllers will reject ResetAll if there are encrypted volumes present.

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.

Figure 12. POST Actions ResetToDefaults example

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

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

Figure 13. GET StorageControllerCollection example

```
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\""
}
```

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	—	—	—	N/A
GET	StorageController	CacheSummary {}	Yes	Yes	Yes	Yes
GET	StorageController	ControllerRates {}	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

Table 14. Redfish StorageController properties (continued)

Method	Resource	Property	HPE SR Storage Controller	HPE MR Storage Controller	HPE NS204 Boot Device	Intel VROC NVMe
GET	StorageController	SupportedControllerProtocols []	Yes	Yes	Yes	Yes
GET	StorageController	SupportedDeviceProtocols []	Yes	Yes	Yes	Yes
GET	StorageController	SupportedRAIDTypes []	Yes	Yes	Yes	Yes
PATCH	StorageController	AssetTag	—	—	—	N/A
PATCH	StorageController	ConsistencyCheckRatePercent	Yes	—	—	—

GET StorageController

Figure 14. GET StorageController example (1 of 2)

```
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": "                ",
  "SpeedGbps": 22.5,
  "SKU": "",
  "Status": {
    "Health": "OK",
    "State": "Enabled"
  },
  "SupportedDeviceProtocols": [
    "SAS",
    "SATA",
    "NVMe"
  ],
  "SupportedControllerProtocols": [
    "PCIe"
  ],

continued
```

Figure 15. GET StorageController example (2 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\""
}
```

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.

Figure 16. PATCH ConsistencyCheckRatePercent example

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

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.

Table 15. HPE SR Storage Controller RebuildRatePercent

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

Figure 17. PATCH RebuildRatePercent example

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

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.

Table 16. HPE SR Storage Controller TransformationRatePercent

PATCH	GET
0–54	0
55–99	54
100	100

Figure 18. PATCH TransformationRatePercent example

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

Port Collection

DMTF defined Port Collection (https://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

Figure 19. GET PortCollection example

```
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\""
}
```

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	Location {} PartLocation {}	Yes	Yes	N/A	—
GET	Port	MaxSpeedGbps	Yes	Yes	N/A	—
GET	Port	PortId	Yes	Yes	N/A	—
GET	Port	PortProtocol	Yes	—	N/A	—
GET	Port	PortType	Yes	—	N/A	—
GET	Port	Width	Yes	Yes	N/A	—

GET Port

Figure 20. GET Port example

```
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\""
}
```

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

Figure 21. GET VolumeCollection example

```
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\""
}
```

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. MediSpanCount 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 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 Only1) or “StandbyOffline” (MR Only1)
- Drive[Operations][] is empty or Drive[Operations][][PercentageComplete] = 100
- Drive[Links][Volumes] is allowed to be any of the following conditions
  - empty
  - 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 Drive[Status][State] of “Enabled” (JBOD mode). 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 SmartCache or Encrypted volumes 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 Name, RAIDType, CapacityBytes, InitializeMethod, and StripSizeBytes when creating a volume. Maximum capacity is the default anytime CapacityBytes is 0. For RAID0, the only supported InitializeMethod is "Skip". For RAID5, WriteHoleProtectionPolicy is required and can be set to Off, DistributedLog, or Journaling.

Figure 22. POST VolumeCollection example (for SR Controller)

```
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"
}
```

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	3Q 2023	—	N/A	—
GET	CollectionCapabilities	@Redfish.AllowablePattern	3Q 2023	—	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

Figure 23. GET CollectionCapabilities example

```
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\""
}
```

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	N\A	—
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 []	Yes	Yes	Yes	Yes
GET	Volume	OptimumIOSizeBytes	Yes	Yes	Yes	2H 2023
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	2H 2023
GET	Volume	WriteHoleProtectionPolicy	—	Yes	N\A	Yes
DELETE	Volume	N/A	Yes	Yes	N/A	Yes
PATCH	Volume	CapacityBytes	—	—	N/A	Yes
PATCH	Volume	DedicatedSpareDrives	Yes	Yes	N/A	Yes
PATCH	Volume	DisplayName	Yes	Yes	—	Yes
PATCH	Volume	Encrypted	—	—	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	—	—	N/A	Yes
POST	Volume. CheckConsistency	{}	—	—	N/A	Yes
POST	Volume.ForceEnable	{}	—	—	N/A	Yes
POST	Volume.Initialize	InitializeMethod	N/A	Yes	N/A	Yes

GET Volume

Figure 24. GET Volume example

```
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\""
}
```

DELETE Volume

Used to delete a volume.

HPE SR Storage Controllers do not support out of order DELETE Volume. If multiple volumes are present, you must delete the highest Volume Collection members first. These controllers also do not support using Redfish DELETE Volume to delete a SmartCache volume (data or cache volume). The volumes can instead be deleted using the Storage.ResetToDefaults action with ResetType set to ResetAll.

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

Figure 25. DELETE Volume example

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

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.

Figure 26. PATCH CapacityBytes example

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

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.

Figure 27. PATCH DedicatedSpareDrives example

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

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.

HPE SR Storage Controllers support a maximum of 64 characters.

HPE MR Storage Controllers support a maximum of 15 characters. Volume[DisplayName] cannot be changed POST or PATCH when the Volume[RAIDType] is “None”.

Intel VROC supports this action under Linux or Windows. UEFI does not support this action. The maximum supported length is 16 characters.

Figure 28. PATCH DisplayName example

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

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.

Figure 29. PATCH IOPerfModeEnabled example

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

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.

Figure 30. PATCH ReadCachePolicy example

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

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.

Figure 31. PATCH WriteCachePolicy example

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

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.

Figure 32. PATCH WriteHoleProtectionPolicy example

```
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}"
    }
  }
}
```

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.

Figure 33. POST ChangeRAIDLayout example

```
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}"
      }
    ]
```

POST Volume.CheckConsistency

This action is used to run a consistency check of an existing volume. The request body can either be "{}" 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.

Figure 34. POST CheckConsistency example

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

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 "{}" or None. Intel VROC supports this action under UEFI or Windows. Linux does not support this action.

Figure 35. POST ForceEnable example

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

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[15] LV=Initialize after 5 min[16]	Initialize immediately (Storcli/cx/vx start cc force)
Foreground	Fast	N/A	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)

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

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

Figure 36. POST Initialize example

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

Drive

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

Table 23. 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	CapableSpeedGbs	Yes	Yes	Yes	Yes
GET	Drive	CapacityBytes	Yes	Yes	Yes	Yes
GET	Drive	DriveFormFactor	—	—	—	—
GET	Drive	EncryptionAbility	Yes	Yes	Yes	—
GET	Drive	EncryptionStatus	Yes	Yes	Yes	—
GET	Drive	FailurePredicted	Yes	Yes	Yes	Yes
GET	Drive	HotspareReplacementMode	Yes	Yes	N\A	Yes
GET	Drive	HotspareType	Yes	Yes	Yes	Yes
GET	Drive	Indentifiers []	Yes	Yes	Yes	Yes
GET	Drive	Links {} Chassis {}	—	—	N\A	—
GET	Drive	Links {} Storage {}	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	—
GET	Drive	NegotiatedSpeedGbs	Yes	Yes	Yes	Yes
GET	Drive	Operations []	Yes	Yes	Yes	Yes
GET	Drive	PhysicalLocation {} PartLocation {}	Yes	Yes	Yes	Yes
GET	Drive	PredictedMediaLifeLeftPercent	Yes	Yes	Yes	2H 2023
GET	Drive	Protocol	Yes	Yes	Yes	Yes
GET	Drive	Revision	Yes	Yes	Yes	Yes
GET	Drive	SerialNumber	Yes	Yes	Yes	Yes
GET	Drive	SlotCapableProtocols []	—	—	—	—
GET	Drive	StatusIndicator	Yes	Yes	Yes	Yes
GET	Drive	WriteCacheEnabled	Yes	Yes	Yes	Yes
PATCH	Drive	HotspareReplacementMode	—	—	N/A	—
PATCH	Drive	HotspareType	N/A	Yes	N/A	Yes
PATCH	Drive	LocationIndicatorActive	Yes	Yes	Yes	Yes
PATCH	Drive	StatusIndicator	—	—	—	—
PATCH	Drive	WriteCacheEnabled	Yes	Yes	Yes	Yes
POST	Drive.Reset	ResetType	Yes	—	N/A	N/A
POST	Drive.SecureErase	{}	Yes	Yes	Yes	2H 2023

GET Drive

Figure 37. GET Drive example (1 of 2)

```
GET https://example.com/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}
{
  "@odata.id": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}",
  "@odata.type": "#Drive.v1_14_0.Drive",
  "Actions": {
    "#Drive.SecureErase": {
      "target": "/redfish/v1/Systems/{ID}/Storage/{ID}/Drives/{ID}/Actions/Drive.SecureErase"
    }
  },
  "Id": "{ID}",
  "Name": "1.92TB 64G NVMe SSD",
  "Status": {
    "State": "Enabled",
    "Health": "OK"
  },
  "LocationIndicatorActive": false,
  "Model": "VOOO192OKWZQR",
  "Revision": "HPK5",
  "Protocol": "NVMe",
  "MediaType": "SSD",
  "CapacityBytes": 1920383410176,
  "BlockSizeBytes": 512,
  "SerialNumber": "S51ANEOM5OOO6O",
  "FailurePredicted": false,
  "PredictedMediaLifeLeftPercent": 100.0,
  "StatusIndicator": "OK",
  "Identifiers": [
    {
      "DurableName": "OO:25:38:95:91:OO:O9:6E",
      "DurableNameFormat": "EUI"
    }
  ],

continued
```

Figure 38. GET Drive example (2 of 2)

```
continued

  "PhysicalLocation": {
    "PartLocation": {
      "LocationType": "Bay",
      "ServiceLabel": "Slot=12:Port=1I:Box=3:Bay=2",
      "LocationOrdinalValue": 2
    }
  },
  "HotspareType": "None",
  "EncryptionAbility": "None",
  "WriteCacheEnabled": false,
  "CapableSpeedGbs": 64.0,
  "NegotiatedSpeedGbs": 64.0,
  "Operations": [],
  "Multipath": false,
  "Links": {
    "Volumes@odata.count": 0,
    "Volumes": []
  },
  "@odata.etag": "\"5B473C1F\""
}
```

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).

Figure 39. PATCH HotspareType example

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

PATCH LocationIndicatorActive

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

Figure 40. PATCH LocationIndicatorActive example

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

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.

Figure 41. PATCH WriteCacheEnabled example

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

POST Drive.Reset

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

Figure 42. POST Reset example

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

POST Drive.SecureErase

This action is used to securely erase a drive using drive sanitize protocol. The request body can either be "{}" 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 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. The RAID1 volume will auto create on the next server reboot.

Figure 43. POST SecureErase example

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

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.1.1.0.json)

Table 24. 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	2H 2023
DrivePredictiveFailureCleared	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	2H 2023	N/A	N/A
BatteryCharging	Yes	2H 2023	N/A	N/A
BatteryMissing	Yes	2H 2023	N/A	N/A
BatteryFailure	Yes	2H 2023	N/A	N/A
ControllerDegraded	Yes	2H 2023	—	—
ControllerPreviousError	Yes	2H 2023	—	—
ControllerPasswordAccepted	Yes	2H 2023	N/A	N/A
ControllerPasswordRequired	Yes	2H 2023	N/A	N/A
ControllerPortOK	—	—	N/A	—
ControllerPortDegraded	—	—	N/A	—
ControllerPortFailure	—	—	N/A	—
DriveMissing	Yes	2H 2023	2H 2023	—
DriveMissingCleared	—	2H 2023	2H 2023	—
DriveOffline	Yes	2H 2023	2H 2023	—
DriveOfflineCleared	Yes	2H 2023	2H 2023	—
VolumeOffline	Yes	2H 2023	N/A	—
VolumeOfflineCleared	Yes	2H 2023	N/A	—

Simple Network Management Protocol

The OID's are defined in the HPE Systems Insight Manager — MIB Kit containing cpqida.mib definitions (hpe.com/info/sim). 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 25. 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 6 services cpqDa SNMP MIB (also known as Management Information Base) requests using Redfish Get operations to the appropriate Redfish resource. HPE iLO 5 is limited to servicing SNMP MIB requests with HPE SR Storage Controllers.

Table 26. 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	2H 2023

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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