

HPE Smart Array Controllers

User Guide



Abstract

This document includes feature, installation, and configuration information about Hewlett Packard Enterprise Smart Array Controllers and is for the person who installs, administers, and troubleshoots servers and storage systems. Hewlett Packard Enterprise assumes you are qualified in the servicing of computer equipment and trained in recognizing hazards in products with hazardous energy levels.

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Contents

Component identification	5
Mezzanine controllers	5
HPE Smart Array P440ar Controller	5
HPE Smart Array P840ar Controller	7
Standup controllers	8
HPE Smart Array P440 Controller	8
HPE Smart Array P441 Controller	10
HPE Smart Array P741m Controller	11
HPE Smart Array P840 Controller	12
HPE Smart Array P841 Controller	14
FBWC LEDs	15
P440ar FBWC LEDs	15
P840ar FBWC LEDs	16
Standup controller FBWC LEDs	16
FBWC LEDs illumination patterns	16
Controller features	18
Basic features	18
HPE SmartCache	18
HPE SSD Smart Path	18
HPE Secure Encryption	19
HBA mode	19
Supported servers	19
Specifications	20
Memory and storage capacity conventions	20
RAID conventions	20
Controller specifications	21
P440ar controller specifications	21
P840ar controller specifications	21
P440 and P441 controller specifications	21
P741m controller specifications	22
P840 controller specifications	22
P841 controller specifications	22
HPE Smart Storage Battery and cache specifications	23
Drive specifications	23
Environmental specifications	23
Installation	24
Procedures for installing the controller in a server	24
Installing a controller in an unconfigured server	24
Installing a controller in a previously configured server	24
Installing a controller board	25
Flexible Smart Array controller board	25
Standup Smart Array controller board	26
Connecting storage devices	28
Connecting internal storage	28
Connecting external storage	28
Cable part numbers	29
Configuration	30
HPE Smart Storage Administrator	30
HPE UEFI System Utilities	30
Using HPE UEFI System Utilities	31
Intelligent Provisioning	31

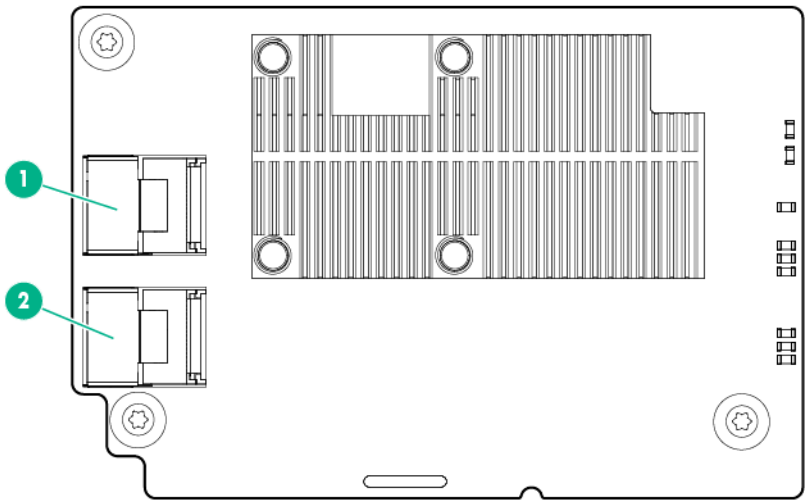
Configuration procedures	31
Powering on and selecting boot options in UEFI Boot Mode	32
Configuring an array	32
System maintenance tools	32
Updating firmware	32
Installing device drivers	32
Managing servers with Insight Agents	33
Diagnostic tools	33
Additional hardware and options	34
HPE Smart Storage Battery	34
HPE 12G SAS Expander Card	34
Drive procedures	35
Identifying the status of an HPE SmartDrive	35
Recognizing drive failure	35
Effects of a hard drive failure on logical drives	36
Compromised fault tolerance	36
Recovering from compromised fault tolerance	37
Moving drives and arrays	37
Replacing drives	38
Before replacing drives	38
Automatic data recovery (rebuild)	39
Upgrading drive capacity	41
Adding drives	41
Warranty and regulatory information	43
Warranty information	43
Regulatory information	43
Safety and regulatory compliance	43
Belarus Kazakhstan Russia marking	43
Turkey RoHS material content declaration	44
Ukraine RoHS material content declaration	44
Acronyms and abbreviations	45
Documentation feedback	47
Index	48

Component identification

Mezzanine controllers

HPE Smart Array P440ar Controller

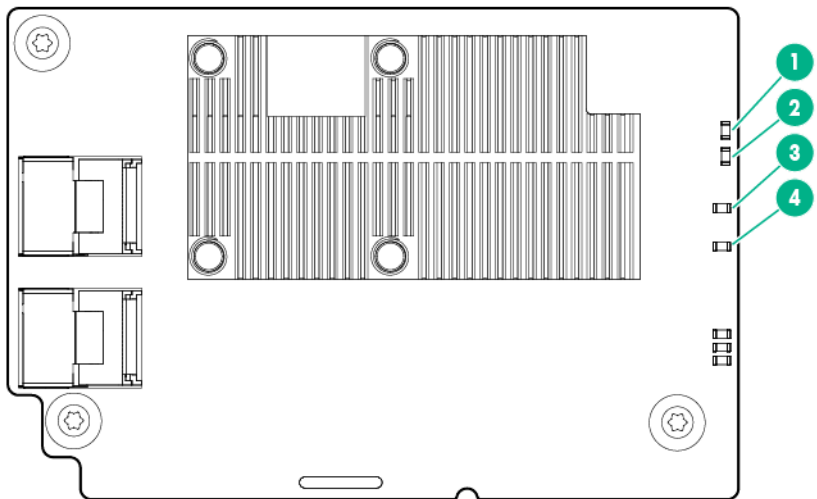
P440ar controller components



Item	Description
1	Internal SAS port 1I
2	Internal SAS port 2I

P440ar controller LEDs

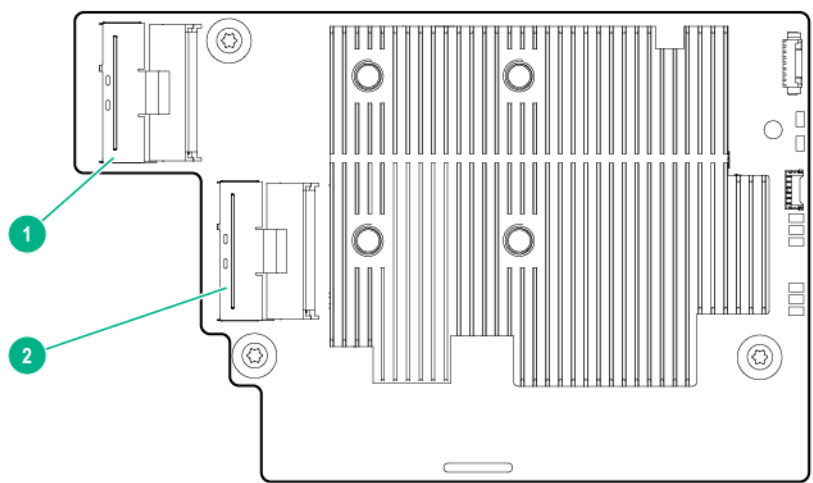
Immediately after you power up the server, the controller runtime LEDs illuminate briefly in a predetermined pattern as part of the POST sequence. At all other times during server operation, the illumination pattern of the runtime LEDs indicates the status of the controller.



Item	Color	Name	Interpretation
1	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
2	Amber	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Green	Crypto	On = All attached volumes are encrypted. Off = All attached volumes are plaintext. Flashing = Both encrypted and plaintext volumes are present.
4	Amber	Debug	On = Controller is in reset state. Off = Controller is in an idle or runtime state. Flashing 5 Hz = Controller and cache are performing a backup.

HPE Smart Array P840ar Controller

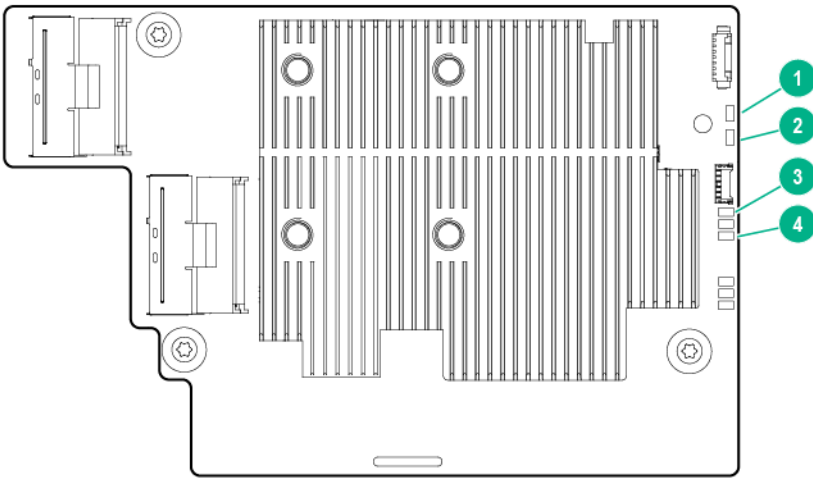
P840ar controller components



Item	Description
1	Internal SAS port 1I
2	Internal SAS port 2I

P840ar controller LEDs

Immediately after you power up the server, the controller runtime LEDs illuminate briefly in a predetermined pattern as part of the POST sequence. At all other times during server operation, the illumination pattern of the runtime LEDs indicates the status of the controller.



Item	Color	Name	Interpretation
1	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.

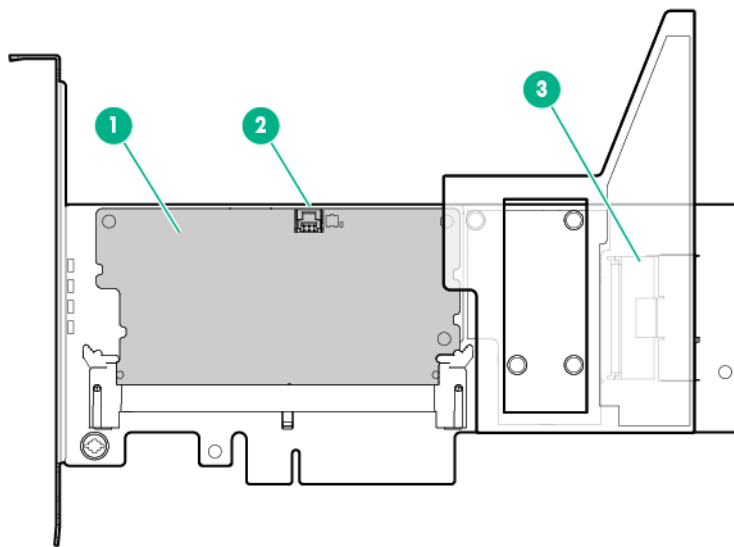
Item	Color	Name	Interpretation
2	Amber	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Green	Crypto	On = All attached volumes are encrypted. Off = All attached volumes are plaintext. Flashing = Both encrypted and plaintext volumes are present.
4	Amber	Debug	On = Controller is in reset state. Off = Controller is in an idle or runtime state. Flashing 5 Hz = Controller and cache are performing a backup.

Standup controllers

HPE Smart Array P440 Controller

If installing the HPE Smart Array P440 controller into a PCI Low Profile Only slot, the scoop can be removed. To ensure no additional PCI slot restrictions exist for your storage controller, see the system's cabling matrix.

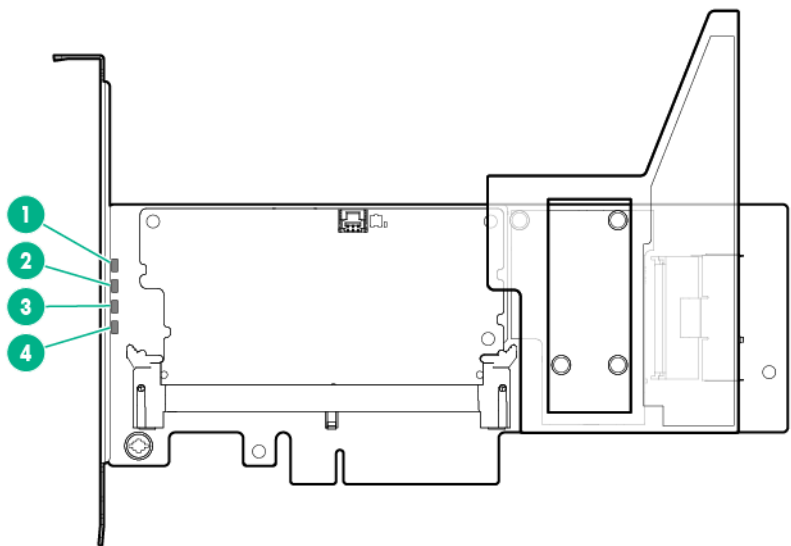
P440 controller components



Item	Description
1	Cache module
2	FBWC module backup power connector
3	Internal SAS port 1I

P440 controller LEDs

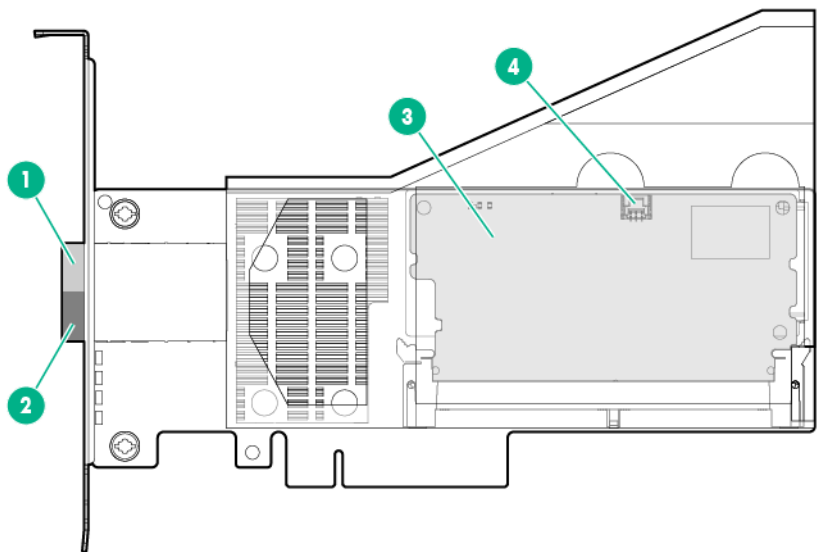
Immediately after you power up the server, the controller runtime LEDs illuminate briefly in a predetermined pattern as part of the POST sequence. At all other times during server operation, the illumination pattern of the runtime LEDs indicates the status of the controller.



Item	Color	Name	Interpretation
1	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
2	Amber	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Green	Crypto	On = All attached volumes are encrypted. Off = All attached volumes are plaintext. Flashing = Both encrypted and plaintext volumes are present.
4	Amber	Debug	On = Controller is in reset state. Off = Controller is in an idle or runtime state. Flashing 5 Hz = Controller and cache are performing a backup.

HPE Smart Array P441 Controller

P441 controller components



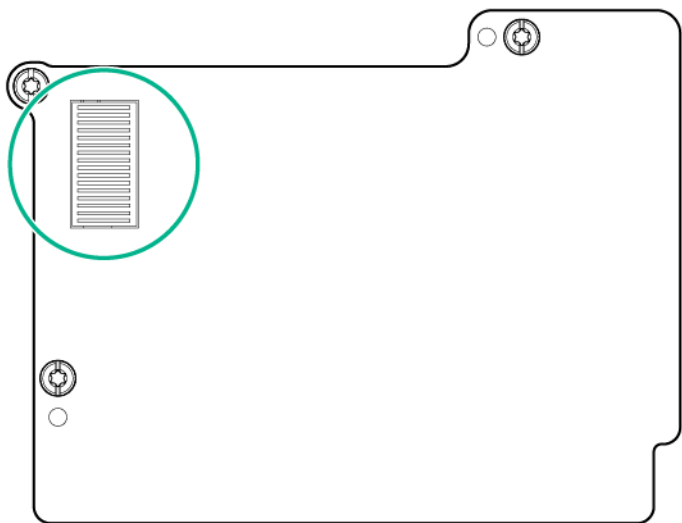
Item	Description
1	External SAS port 1E*
2	External SAS port 2E*
3	Cache module
4	FBWC module backup power connector

*External SAS ports 1E and 2E comprise the single Mini-SAS HD receptacle connector, which can accept either two Mini-SAS HD 4x plug connectors or a single Mini-SAS HD 8x plug connector.

HPE Smart Array P741m Controller

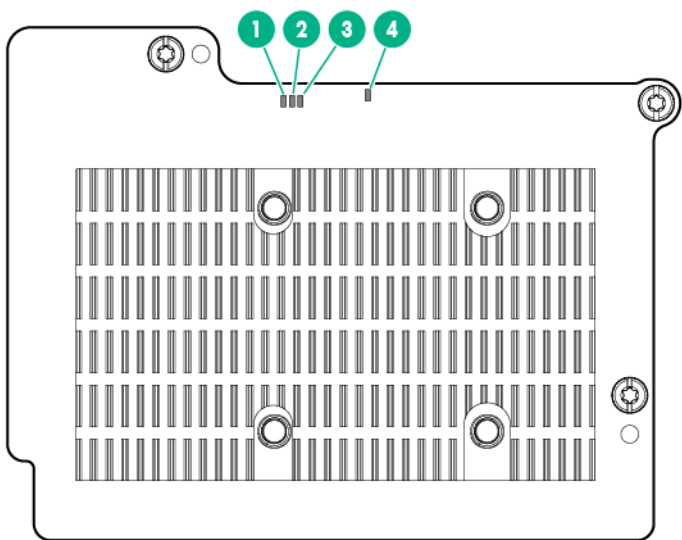
P741m controller components

The connector highlighted in the following illustration is the mezzanine connector to the system board.



P741m controller LEDs

Immediately after you power up the server, the controller runtime LEDs illuminate briefly in a predetermined pattern as part of the POST sequence. At all other times during server operation, the illumination pattern of the runtime LEDs indicates the status of the controller.

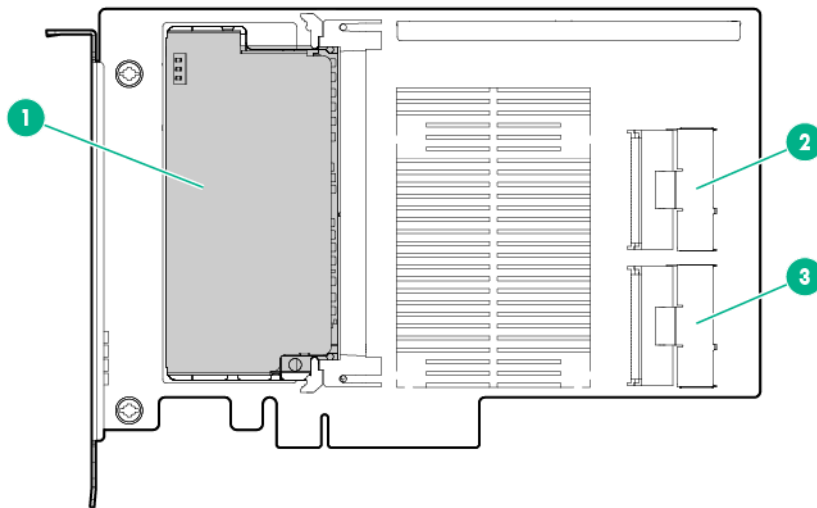


Item	Color	Name	Interpretation
1	Green	Crypto 1	On = All attached volumes are encrypted. Off = All attached volumes are plaintext. Flashing = Both encrypted and plaintext volumes are present.
2	Amber	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.

Item	Color	Name	Interpretation
3	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
4	Amber	Debug	On = Controller is in reset state. Off = Controller is in an idle or runtime state. Flashing 5 Hz = Controller and cache are performing a backup.

HPE Smart Array P840 Controller

P840 controller components

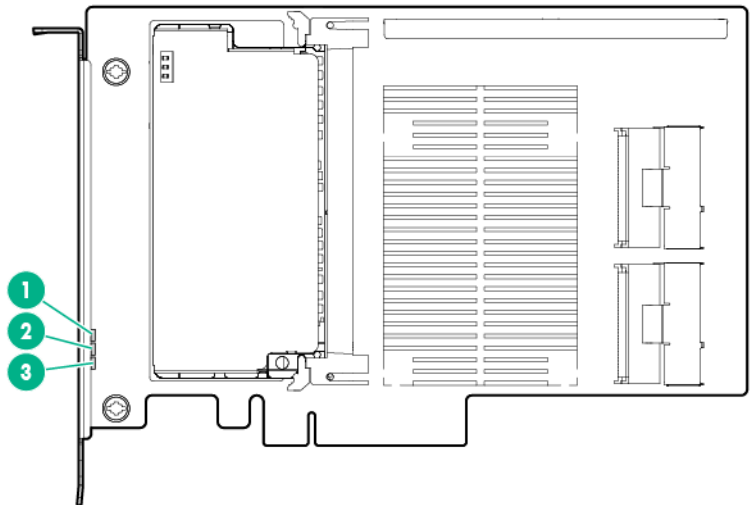


Item	Description
1	Cache module
2	Internal SAS port 1I
3	Internal SAS port 2I
—	FBWC module backup power connector*

* Not shown. The connector is located on the other side of the FBWC module.

P840 controller LEDs

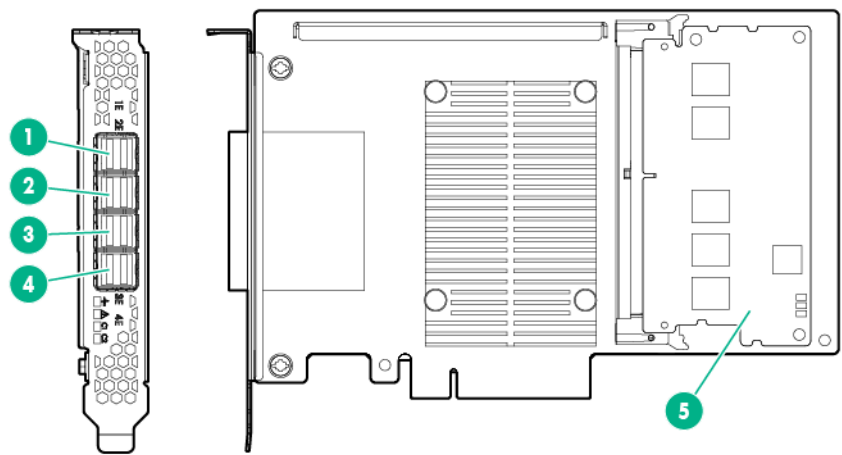
Immediately after you power up the server, the controller runtime LEDs illuminate briefly in a predetermined pattern as part of the POST sequence. At all other times during server operation, the illumination pattern of the runtime LEDs indicates the status of the controller.



Item	Color	Name	Interpretation
1	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
2	Amber	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Green	Crypto	On = All attached volumes are encrypted. Off = All attached volumes are plaintext. Flashing = Both encrypted and plaintext volumes are present.

HPE Smart Array P841 Controller

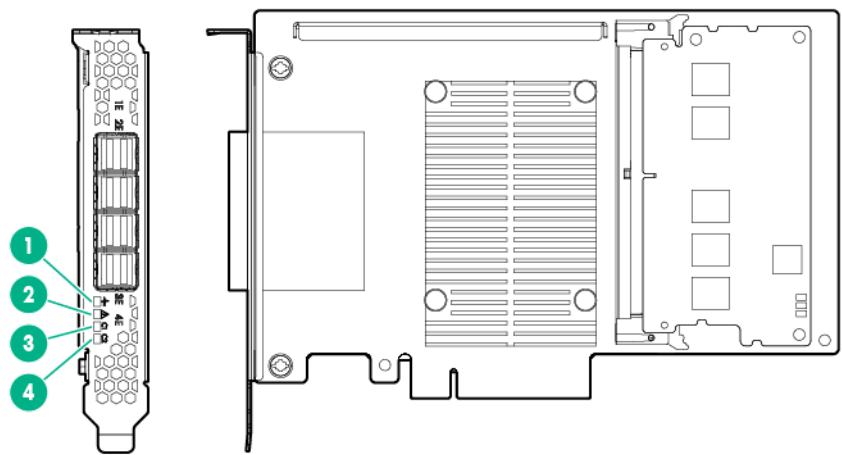
P841 controller components



Item	Description
1	External SAS port 1e
2	External SAS port 2e
3	External SAS port 3e
4	External SAS port 4e
5	Cache module

P841 controller LEDs

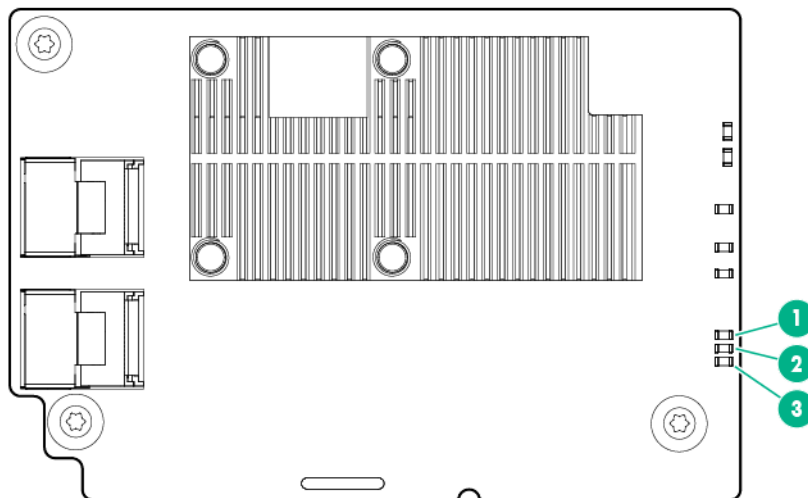
Immediately after you power up the server, the controller runtime LEDs illuminate briefly in a predetermined pattern as part of the POST sequence. At all other times during server operation, the illumination pattern of the runtime LEDs indicates the status of the controller.



Item	Color	Name	Interpretation
1	Green	Heartbeat	When the controller is in good health, this LED flashes at 1 Hz. During power up, this LED is solid for up to 2 seconds.
2	Amber	Fault	When an error occurs, this LED is on. During power up, this LED is solid for up to 2 seconds.
3	Green	Crypto	On = All attached volumes are encrypted. Off = All attached volumes are plaintext. Flashing = Both encrypted and plaintext volumes are present.
4	Green	Reserved	Reserved for future use

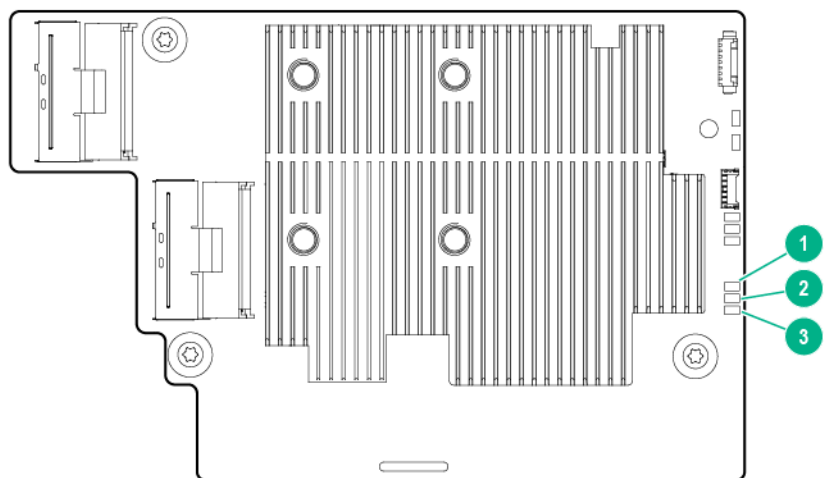
FBWC LEDs

P440ar FBWC LEDs



For an explanation of each of the identified components and their illumination patterns, see "FBWC LEDs illumination patterns (on page 16)."

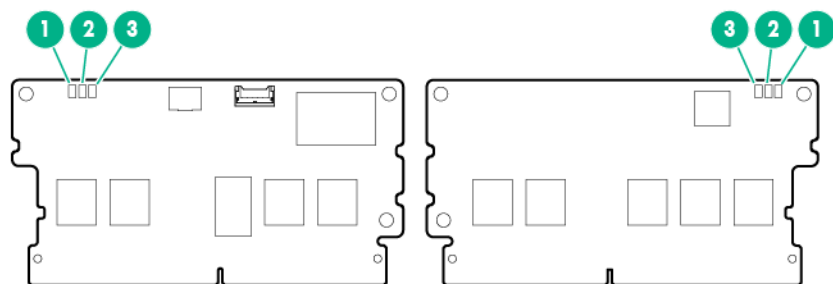
P840ar FBWC LEDs



For an explanation of each of the identified components and their illumination patterns, see "FBWC LEDs illumination patterns (on page 16)."

Standup controller FBWC LEDs

The FBWC module has three single-color LEDs (one amber and two green). The LEDs are duplicated on the reverse side of the FBWC module to facilitate status viewing.



For an explanation of each of the identified components and their illumination patterns, see "FBWC LEDs illumination patterns (on page 16)."

FBWC LEDs illumination patterns

1 - Amber	2 - Green	3 - Green	Interpretation
Off	Off	Off	The FBWC module is not powered.
Off	Flashing once every 2 seconds	Flashing once every 2 seconds	The cache microcontroller is executing from within its boot loader and receiving new flash code from the host controller.
Off	Flashing once per second	Flashing once per second	The FBWC module is powering up, and waiting for backup power.
Off	Off	Flashing once per second	The FBWC module is idle, and waiting for backup power.
Off	Off	On	The FBWC module is idle, and backup power is ready.

1 - Amber	2 - Green	3 - Green	Interpretation
Off	On	On	The FBWC module is idle, the backup power is ready, and the cache contains data that has not yet been written to the drives.
Off	Flashing once per second	Off	A backup of the DDR content on the FBWC module is in progress.
Off	On	Off	The current backup is complete with no errors.
Flashing once per second	Flashing once per second	Off	The current backup failed, and data has been lost.
Flashing once per second	Flashing once per second	On	A power error occurred during the previous or current boot. Data may be corrupt.
Flashing once per second	On	Off	An overtemperature condition exists.
On	On	Off	The current backup is complete, but power fluctuations occurred during the backup.
On	On	On	The FBWC module microcontroller has failed.

Controller features

Basic features

The Smart Array controllers described in this guide have the following basic features:

- Supports RAID 0, 1, 10, 1 (ADM), 10 (ADM), 5, 50, 6, and 60
- Advanced Capacity Expansion
- Mirror splitting and recombining in offline mode
- Drive Erase
- Performance optimizations for video on demand
- Capability for moving and deleting individual LUNs
- Split mirror backup and rollback of RAID 1, 10, 1 (ADM) and 10 (ADM) mirrors
- Heal Array

For more information, see the *HPE Smart Storage Administrator User Guide* on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/smartstorage-docs>).

HPE SmartCache

SmartCache is an advanced feature that enables solid state drives to be used as caching devices (for reads and writes) for bulk storage. Data can be accessed and written to and from the solid state drive instead of bulk storage. SmartCache provides the following features:

- Accelerates application performance
- Provides lower latency for transactions in applications
- Supports all operating systems, without the need for changes

Use the HPE SSA utility to configure support for SmartCache.

This feature requires a license key.

For more information, see the *HPE Smart Storage Administrator User Guide* on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/smartstorage-docs>).

HPE SSD Smart Path

HPE SSD Smart Path enables an optimized data path to high performance solid state drives. The optimized path bypasses the controller's RAID processing components and sends I/O directly to the drives. For more information, see the Hewlett Packard Enterprise website (<http://www.hpe.com/info/serversoftware>).

For more information on enabling or disabling SSD Smart Path, see the *Smart Storage Administrator User Guide* on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/smartstorage-docs>).

This feature is only available when the controller is configured to run in RAID mode.

HPE Secure Encryption

HPE Secure Encryption is a controller-based, enterprise-class data encryption solution that protects data at rest on bulk storage hard drives and SSDs attached to a compatible HPE Smart Array Controller or HPE Smart HBA. The solution is compatible with Hewlett Packard Enterprise key manager products and can operate with or without the presence of a key manager in the environment, depending on individual customer settings.

HPE Secure Encryption provides encryption for data at rest as an important component for complying with data privacy requirements found in government regulations like HIPAA and Sarbanes-Oxley. HPE Secure Encryption secures any data deemed sensitive and requiring extra levels of protection through the application of XTS-AES 256-bit data encryption. Many companies under government regulations require that sensitive privacy data must be secured and uncompromised using NIST-approved algorithms and methodologies for key management. As a result, Hewlett Packard Enterprise has applied for FIPS-140-2 Level 2 validation for controllers supporting encryption. For more information, see the *Cryptographic Module Validation Program* (CMVP) on the National Institute of Standards and Technology (<http://csrc.nist.gov/groups/STM/cmvp>) website.

This feature is only available when the controller is configured to run in RAID mode.

HBA mode

HPE Smart Array controllers support HBA mode. In HBA mode, all physical drives are presented directly to the operating system and the hardware RAID engine is disabled.

To enable HBA mode, see the *Smart Storage Administrator User Guide* on the Hewlett Packard Enterprise website. (<http://www.hpe.com/info/smartstorage-docs>)

Supported servers

For more information on installing the controller in a supported server, see the server user guide.

For the latest support information, see the controller QuickSpecs on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/qs>).

Specifications

Memory and storage capacity conventions

Memory capacities are specified using binary prefixes:

- KiB = 2^{10} bytes
- MiB = 2^{20} bytes
- GiB = 2^{30} bytes
- TiB = 2^{40} bytes

Storage capacities are specified using SI prefixes:

- KB = 10^3 bytes
- MB = 10^6 bytes
- GB = 10^9 bytes
- TB = 10^{12} bytes

Older, and other, documentation may use SI prefixes for binary values.

Actual available memory capacity and actual formatted storage capacity for devices are less than specified values.

RAID conventions

Hewlett Packard Enterprise uses the following naming convention for RAID levels:

- RAID 0
- RAID 1
- RAID 10
- RAID 5
- RAID 50
- RAID 6
- RAID 60
- RAID 1 (ADM)
- RAID 10 (ADM)

RAID 50 and RAID 60 are also known in the industry as RAID 5+0 and RAID 6+0, respectively.

Controller specifications

P440ar controller specifications

Feature	Description
Board type	Custom form factor
Dimensions, cm	8.89 cm x 15.24 cm
Dimensions, in	3.5 in x 6 in
I/O connection to the system board	x8 PCIe Gen3
Maximum power required (approximate)	18 W
Internal SAS connector life expectancy	250 connect/disconnect cycles

P840ar controller specifications

Feature	Description
Board type	Custom form factor
Dimensions, cm	8.89 cm x 15.24 cm
Dimensions, in	3.5 in x 6 in
I/O connection to the system board	x8 PCIe Gen3
Maximum power required (approximate)	18 W
Internal SAS connector life expectancy	250 connect/disconnect cycles

P440 and P441 controller specifications

Feature	Description
Board type	Low-profile, PCIe stand-up board
Dimensions, cm	16.8 x 6.9 x 1.7
Dimensions, in	6.6 x 2.7 x 0.6
I/O connection to the system board	PCIe Gen3 x8 edge connector
Maximum power required (approximate)	18 W
Internal SAS connector life expectancy	250 connect/disconnect cycles

P741m controller specifications

Feature	Description
Controller	
Board type	Type B, 4-port, PCIe mezzanine board
Dimensions, cm*	11.3 x 10.0 x 2.0
Dimensions, in*	4.5 x 4.0 x 0.8
I/O connection to the system board	Grid array mezzanine connector
Maximum power required (approximate)	14.5 W
Mezzanine connector life expectancy	50 connect/disconnect cycles

P840 controller specifications

Feature	Description
Board type	Full-height, 1/2 length, PCIe stand-up board
Dimensions, cm	16.8 x 11.1 x 1.8
Dimensions, in	6.6 x 4.4 x 0.7
I/O connection to the system board	PCIe Gen3 x8 edge connector
Maximum power required (approximate)	24 W
Internal SAS connector life expectancy	250 connect/disconnect cycles

P841 controller specifications

Feature	Description
Board type	Full-height, 1/2 length, PCIe stand-up board
Dimensions, cm	16.8 x 11.1 x 1.8
Dimensions, in	6.6 x 4.4 x 0.7
I/O connection to the system board	PCIe Gen3 x8 edge connector
Maximum power required (approximate)	24 W
Internal SAS connector life expectancy	250 connect/disconnect cycles

HPE Smart Storage Battery and cache specifications

Feature	Description
Cache	4 GiB FBWC A small portion of the FBWC module is required to run the controller firmware. The remainder of the available space can be configured for read-ahead or write back caching.
Time required to recharge Smart Storage Battery	96 W: 2 hours (For maximum load of 24 devices) 12 W: 1 hour (For maximum load of 3 devices)
Duration of Smart Storage Battery backup	150 seconds (maximum support) The Smart Storage Battery provides a sufficient duration to transfer the cached data from DDR memory to flash memory, where the data remains indefinitely or until a controller retrieves the data.

Drive specifications

Feature	Description
Supported drive types*	• 12 Gb/s SAS • 6 Gb/s SAS • 6 Gb/s SATA
Maximum number of logical drives	64
Maximum number of physical drives	See the product QuickSpecs on the Hewlett Packard Enterprise website (http://www.hpe.com/info/qs).
RAID levels	RAID 0, 1, 10, 5, 50, 6, 60, 1 (ADM), and 10 (ADM)

*Not all servers support all drive types. For more information, see the server QuickSpecs on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/qs>).

Environmental specifications

Feature	Description
Temperature range	Operating, 10° to 55°C (50° to 131°F) Storage, -30° to 60°C (-22° to 140°F)
Relative humidity (noncondensing)	Operating, 10% to 90% Storage, 5% to 90%

Installation

Procedures for installing the controller in a server

To install a controller in a server, use one of the following procedures:

- Installing a controller in an unconfigured server (on page 24)
- Installing a controller in a previously configured server (on page 24)

Installing a controller in an unconfigured server



IMPORTANT: Do not power up the server until the hardware configuration is satisfactory, as described in the procedure given in this section.

To install the controller in an unconfigured server:

1. Install the controller hardware ("[Flexible Smart Array controller board](#)" on page 25). For server-specific procedures, see the server user guide.
2. Install physical drives, as needed.
3. Power up the server.
4. Verify the server firmware is the latest revision. If necessary, update the server firmware ("[Updating firmware](#)" on page 32).
5. Verify the controller firmware is the latest revision. If necessary, update the controller firmware ("[Updating firmware](#)" on page 32).
6. Verify the drive firmware is the latest revision. If necessary, update the drive firmware ("[Updating firmware](#)" on page 32).
7. Verify the iLO firmware is the latest revision. If necessary, update the iLO firmware ("[Updating firmware](#)" on page 32).
8. If expanders are present, verify the expander firmware is the latest revision. If necessary, update the expander firmware ("[Updating firmware](#)" on page 32).
9. Install the operating system and device drivers ("[Installing device drivers](#)" on page 32). Instructions are provided with the CD that is supplied in the controller kit.
10. (Optional) Create additional logical drives ("[Configuring an array](#)" on page 32).

The server is now ready for use.

Installing a controller in a previously configured server

1. Back up data on the system.
2. Close all applications.
3. Verify the server firmware is the latest revision. If necessary, update the server firmware ("[Updating firmware](#)" on page 32).
4. Do one of the following:
 - If the new controller is the new boot device, install the device drivers ("[Installing device drivers](#)" on page 32).

- If the new controller is not the new boot device, go to the next step.
5. Power down the server.



CAUTION: In systems that use external data storage, be sure that the server is the first unit to be powered down and the last to be powered back up. Taking this precaution ensures that the system does not erroneously mark the drives as failed when the server is powered up.

6. Power down all peripheral devices that are attached to the server.
7. Disconnect the power cord from the power source.
8. Disconnect the power cord from the server.
9. Disconnect all peripheral devices.
10. Install the controller hardware ("[Flexible Smart Array controller board](#)" on page 25). For server-specific procedures, see the server user guide.
11. Connect storage devices to the controller ("[Connecting internal storage](#)" on page 28).
12. Connect peripheral devices to the server.
13. Connect the power cord to the server.
14. Connect the power cord to the power source.
15. Power up all peripheral devices.
16. Power up the server.
If running the server in UEFI Boot Mode, power on and select boot options ("[Powering on and selecting boot options in UEFI Boot Mode](#)" on page 32).
17. Verify the controller firmware is the latest revision. If necessary, update the controller firmware ("[Updating firmware](#)" on page 32).
18. Verify the drive firmware is the latest revision. If necessary, update the drive firmware ("[Updating firmware](#)" on page 32).
19. (Optional) If running the server in Legacy Boot Mode, set the controller as the boot controller.
20. (Optional) If running the server in Legacy Boot Mode, change the controller boot order.
21. If the new controller is not the new boot device, install the device drivers ("[Installing device drivers](#)" on page 32).
22. If new versions of the Management Agents are available, update the Management Agents ("[Managing servers with Insight Agents](#)" on page 33).
23. (Optional) Create additional logical drives ("[Configuring an array](#)" on page 32).

The server is now ready for use.

Installing a controller board

Flexible Smart Array controller board



WARNING: To reduce the risk of personal injury or damage to the equipment, consult the safety information and user documentation provided with the server before attempting the installation.

Some servers contain high energy circuits, high current circuits, moving parts (such as fan blades), or any combination of these hazards, that may be exposed if covers and access panels are removed while the product is connected to a power source. These products are intended to be serviced only by qualified personnel who have been trained to deal with these hazards. Do not remove enclosures or attempt to bypass any interlocks designed to guard against these hazardous conditions.



CAUTION: Hewlett Packard Enterprise recommends performing a complete backup of all server data before performing a controller or adapter installation or removal.



IMPORTANT: If installing a P440ar controller in an ProLiant DL360 Gen9 Server, you must install the specific model intended for that server. The DL360-specific P440ar controller has a shorter heatsink that allows it to be installed in the DL360 Gen9 server.

1. Remove or open the access panel.



WARNING: To reduce the risk of personal injury from hot surfaces, allow the drives and the internal system components to cool before touching them.

2. If required for installation, remove the controller board air baffle.
3. Install the controller by aligning the board with the alignment pins, pressing down and tightening the thumbscrew. For more information, see the server user guide.
4. Connect storage devices to the controller. For more information, see "Connecting internal storage (on page 28)."
5. Close or install the access panel.



CAUTION: Do not operate the server for long periods with the access panel open or removed. Operating the server in this manner results in improper airflow and improper cooling that can lead to thermal damage.

Before powering on the system, be sure the Smart Storage Battery is installed. For more information, see the server user guide.

Standup Smart Array controller board



WARNING: To reduce the risk of personal injury or damage to the equipment, consult the safety information and user documentation provided with the server before attempting the installation.

Some servers contain high energy circuits, high current circuits, moving parts (such as fan blades), or any combination of these hazards, that may be exposed if covers and access panels are removed while the product is connected to a power source. These products are intended to be serviced only by qualified personnel who have been trained to deal with these hazards. Do not remove enclosures or attempt to bypass any interlocks designed to guard against these hazardous conditions.



CAUTION: Hewlett Packard Enterprise recommends performing a complete backup of all server data before performing a controller or adapter installation or removal.

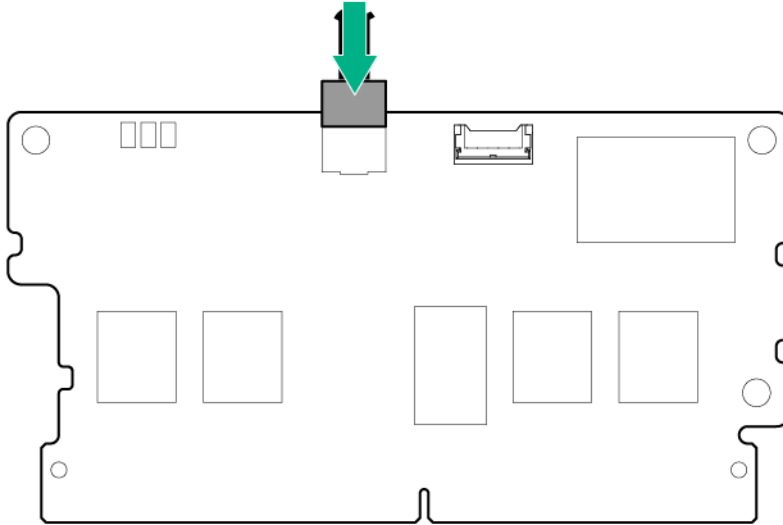
1. Remove or open the access panel.



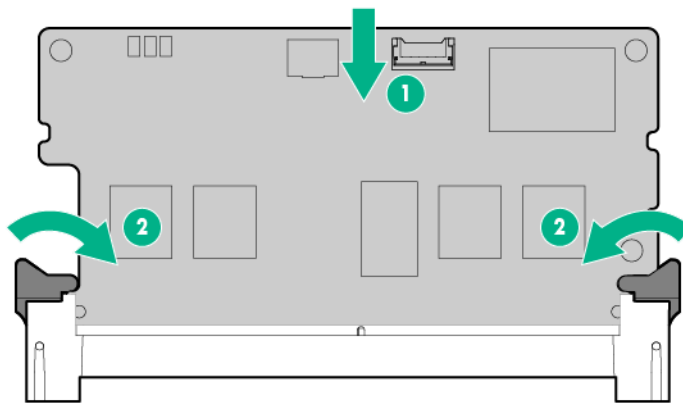
WARNING: To reduce the risk of personal injury from hot surfaces, allow the drives and the internal system components to cool before touching them.

2. Select an available x8 or larger PCIe expansion slot.
A x8 physical size slot is required, even though the slot width may be electrically x4 or x1. Hewlett Packard Enterprise recommends using a slot that is electrically x8.
3. Remove the slot cover. Save the retaining screw, if one is present.
4. Install the cache module, if needed:

- a. Connect the cache module backup power cable to the module.



- b. Install the FBWC module.



5. If installing a P440 or P441 controller board in a low profile slot, remove the controller board air baffle.
6. Slide the controller board along the slot alignment guide, if one is present, and then press the board firmly into the expansion slot so that the contacts on the board edge are seated properly in the slot.
7. Secure the controller board in place with the retaining screw. If the slot alignment guide has a latch (near the rear of the board), close the latch.
8. Connect the Smart Storage battery cable from the FBWC module to the connector on the system board or PCI riser cage. To determine the location of the connector, see the server user guide.
9. Connect storage devices to the controller:
 - o Connecting internal storage (on page 28)
 - o Connecting external storage (on page 28)
10. Close or install the access panel.



CAUTION: Do not operate the server for long periods with the access panel open or removed. Operating the server in this manner results in improper airflow and improper cooling that can lead to thermal damage.

Before powering on the system, be sure the Smart Storage Battery is installed. For more information, see the server user guide.

Connecting storage devices

You can connect SAS or SATA drives to the controller internally ("[Connecting internal storage](#)" on page 28) or externally ("[Connecting external storage](#)" on page 28).

For information about supported drive models, see the controller-specific page on the Hewlett Packard Enterprise website (<http://www.hpe.com/servers/smartarray>).

Connecting internal storage

1. Power down the server.
2. Install drives, if necessary. For drive requirements when configuring arrays, see "Configuring an array (on page 32)."
Hewlett Packard Enterprise recommends drives of similar type. All drives grouped in a logical drive must meet the following criteria:
 - They must be either SAS or SATA.
 - They must be either all hard drives or all solid state drives.
 - For the most efficient use of drive space, the drives must have comparable capacity.For more information about drive installation, see the following resources:
 - Drive procedures (on page 35)
 - Server documentation
 - Drive documentation
3. Use the internal SAS cable provided with the server to connect the controller to the drives:
 - If the drives are hot-plug capable, connect the internal connector of the controller to the SAS connector on the hot-plug drive cage.
 - If the drives are not hot-plug capable, connect the internal connector of the controller to the non-hot-plug drives.
4. Close or install the access panel, and secure it with thumbscrews, if any are present.

**CAUTION:** Do not operate the server for long periods with the access panel open or removed. Operating the server in this manner results in improper airflow and improper cooling that can lead to thermal damage.
5. Power up the server.

Connecting external storage

1. Power down the server.
2. Connect an external SAS cable to the external port of the controller:
 - a. Pull back the tab on the Mini SAS 4x connector on the cable.
 - b. Insert the cable connector into the external port of the controller.
 - c. Release the tab.
3. Connect the other end of the cable to the SAS input connector of the external storage enclosure.
4. Power up the enclosure.
5. Power up the server.

Cable part numbers

For more information on cables, see the server QuickSpecs on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/qs>).

Configuration

HPE Smart Storage Administrator

HPE SSA is the main tool for configuring arrays on Smart Array controllers and Smart HBAs. It exists in three interface formats: the HPE SSA GUI, the HPE SSA CLI, and HPE SSA Scripting. All formats provide support for configuration tasks. Some of the advanced tasks are available in only one format.

The diagnostic features in HPE SSA are also available in the standalone software HPE Smart Storage Administrator Diagnostics Utility CLI.

Starting with HPE SSA and ProLiant Gen8 servers and server blades, HPE SSA is accessible both offline (either through HPE Intelligent Provisioning or as a standalone bootable ISO image) and online:

- Accessing HPE SSA in the offline environment



IMPORTANT: If you are updating an existing server in an offline environment, obtain the latest version of HPE SSA through Service Pack for ProLiant before performing configuration procedures.

Using one of multiple methods, you can run HPE SSA before launching the host operating system. In offline mode, users can configure or maintain detected and supported ProLiant devices, such as optional Smart Array controllers and integrated Smart Array controllers. Some HPE SSA features are only available in the offline environment, such as setting the boot controller and boot volume.

For more information, see "Accessing HPE SSA in the offline environment" in the Smart Storage Administrator User Guide.

- Accessing HPE SSA in the online environment

This method requires an administrator to download the HPE SSA executables and install them. You can run HPE SSA online after launching the host operating system.

For more information, see "Accessing HPE SSA in the online environment" in the Smart Storage Administrator User Guide.

HPE UEFI System Utilities

The UEFI System Utilities is embedded in the system ROM. The UEFI System Utilities enable you to perform a wide range of configuration activities, including:

- Configuring system devices and installed options
- Enabling and disabling system features
- Displaying system information
- Selecting the primary boot controller
- Configuring memory options
- Selecting a language
- Launching other pre-boot environments such as the Embedded UEFI Shell and Intelligent Provisioning

For more information on the UEFI System Utilities, see the *HPE UEFI System Utilities User Guide for HPE ProLiant Gen9 Servers* on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/uefi/docs>).

Scan the QR code located at the bottom of the screen to access mobile-ready online help for the UEFI System Utilities and UEFI Shell. For on-screen help, press **F1**.

Using HPE UEFI System Utilities

To use the System Utilities, use the following keys:

Action	Key
Access System Utilities	F9 during server POST
Navigate menus	Up and Down arrows
Select items	Enter
Save selections	F10
Access Help for a highlighted configuration option	F1

Default configuration settings are applied to the server at one of the following times:

- Upon the first system power-up
- After defaults have been restored

Default configuration settings are sufficient for typical server operations; however, you can modify configuration settings as needed. The system prompts you for access to the System Utilities each time the system is powered up.

Intelligent Provisioning

Intelligent Provisioning is a single-server deployment tool embedded in ProLiant Gen8 and later servers that simplifies ProLiant server setup, providing a reliable and consistent way to deploy ProLiant server configurations:

- Intelligent Provisioning assists with the OS installation process by preparing the system for installing "off-the-shelf" and Hewlett Packard Enterprise branded versions of operating system software and integrating optimized ProLiant server support software.
- Intelligent Provisioning provides maintenance-related tasks using the Perform Maintenance window.
- Intelligent Provisioning provides installation help for Microsoft Windows, Red Hat and SUSE Linux, and VMware operating systems. For specific OS support, see the *Intelligent Provisioning Release Notes* on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/intelligentprovisioning/docs>).

For more information about Intelligent Provisioning software, see the Hewlett Packard Enterprise website (<http://www.hpe.com/servers/intelligentprovisioning>). For Intelligent Provisioning recovery media downloads, see the Resources tab on the Hewlett Packard Enterprise website (<http://www.hpe.com/servers/intelligentprovisioning>). For consolidated drive and firmware update packages, see the Smart Update: Server Firmware and Driver Updates page on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/SmartUpdate>).

Configuration procedures

Depending on whether the server is running in UEFI Boot Mode or in Legacy Boot Mode, use the following procedures:

- UEFI Boot Mode—"Powering on and selecting boot options in UEFI Boot Mode (on page 32)"
- Legacy Boot Mode:
 - "Setting the boot controller in Legacy Boot Mode"
 - "Setting the controller order in Legacy Boot Mode"

Powering on and selecting boot options in UEFI Boot Mode

On servers operating in UEFI Boot Mode, the boot controller and boot order are set automatically.

1. Press the Power On/Standby button.
2. During the initial boot:
 - o To modify the server configuration ROM default settings, press the **F9** key in the ProLiant POST screen to enter the UEFI System Utilities screen. By default, the System Utilities menus are in the English language.
 - o If you do not need to modify the server configuration and are ready to install the system software, press the **F10** key to access Intelligent Provisioning.

For more information on automatic configuration, see the UEFI documentation on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/ProLiantUEFI/docs>).

Configuring an array

To configure an array on an Smart Array controller, use HPE SSA. For more information, see the *HPE Smart Storage Administrator User Guide*.

Remember the following factors when you build an array:

- All drives grouped in a logical drive must be of the same type (for example, either all SAS or all SATA and either all hard drives or all solid state drives).
- For the most efficient use of drive space, all drives within an array should have approximately the same capacity. Each configuration utility treats every physical drive in an array as if it has the same capacity as the smallest drive in the array. Any excess capacity of a particular drive cannot be used in the array and so is unavailable for data storage.
- The more physical drives that there are in an array, the greater the probability that the array will experience a drive failure during any given period.
- To guard against the data loss that occurs when a drive fails, configure all logical drives in an array with a suitable fault-tolerance (RAID) method.

System maintenance tools

Updating firmware

Server and controller firmware should be updated before using the controller for the first time, unless any installed software or components require an older version. For system software and firmware updates, download the SPP from the Hewlett Packard Enterprise website (<http://www.hpe.com/info/spp/docs>).

Installing device drivers



IMPORTANT: Always perform a backup before installing or updating device drivers.

Hewlett Packard Enterprise now distributes drivers and other support software for servers and server blades through Service Pack for ProLiant, or SPP, which you can download from the Hewlett Packard Enterprise website (<http://www.hpe.com/servers/spp/download>). Be sure to use the latest SPP version for the server or server blade.

If you installed an OS by using the Intelligent Provisioning software, its Configure and Install feature may have provided the latest driver support.

To directly locate the OS drivers for a particular server, enter the following web address into the browser:

<http://www.hpe.com/support/<servername>>

In place of <servername>, enter the server name.

For example:

<http://www.hpe.com/support/dl360gen8>

Managing servers with Insight Agents

When using Insight Agents to manage ProLiant Gen8 servers and later, Hewlett Packard Enterprise recommends that you clear the selection for Agentless Management Service, and then select Insight Agents for installation to take place.

You can update the Management Agents by using the latest versions of the agents provided in the Intelligent Provisioning software ("[Intelligent Provisioning](#)" on page 31).

Diagnostic tools

To troubleshoot array problems and generate feedback about arrays, use the following diagnostic tools:

- **HPE SSA**

HPE SSA can be accessed offline with Intelligent Provisioning, during POST, or from an ISO image. It can also be accessed online by downloading the HPE SSA executables. For more information on accessing and using HPE SSA, see the *HPE Smart Storage Administrator User Guide*.

- **Event Notification Service**

This utility reports array events to the server IML and the Microsoft Windows system event log, and records the Smart Array serial log, which includes detailed diagnostic information of the most recent events encountered by the controller. You can obtain the utility from the Hewlett Packard Enterprise website (<http://www.hpe.com/support/hpesc>). When prompted for product information, enter the server model name.

- **Insight Diagnostics**

Insight Diagnostics is a tool that displays information about the system hardware configuration and performs tests on the system and its components, including drives if they are connected to Smart Array controllers. This utility is available on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/InsightDiagnostics>).

- **POST messages**

Smart Array controllers produce diagnostic error messages (POST messages) at reboot. Many POST messages suggest corrective actions. For more information about POST messages, see *The ProLiant Gen9 Troubleshooting Guide, Volume II: Error Messages*:

- English (http://www.hpe.com/support/Gen9_EMG_en)
- French (http://www.hpe.com/support/Gen9_EMG_fr)
- Spanish (http://www.hpe.com/support/Gen9_EMG_es)
- German (http://www.hpe.com/support/Gen9_EMG_de)
- Japanese (http://www.hpe.com/support/Gen9_EMG_ja)
- Simplified Chinese (http://www.hpe.com/support/Gen9_EMG_zh_cn)

Additional hardware and options

HPE Smart Storage Battery

The Smart Storage Battery is a centralized backup source and is required to back up Gen9 P-series Smart Array controllers. A single 96W battery can support up to 24 devices, while a single 12W battery can support up to 3 devices. To determine the battery version supported, see the server documentation.

For more information on installing a Smart Storage Battery, see the server documentation.

HPE 12G SAS Expander Card

The HPE 12G SAS Expander connects to a Smart Array Gen9 controller. Depending on the server configuration, the expander may support up to a maximum of 28 drives.

For more information about the 12G SAS Expander Card, see the Hewlett Packard Enterprise website (<http://www.hpe.com/info/enterprise/docs>).

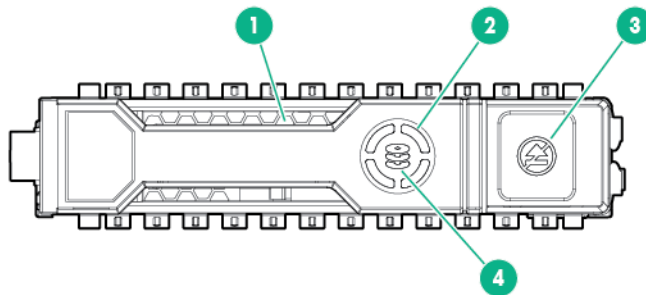
To install the 12G SAS Expander Card, see the server-specific documentation that ships with the card.

Drive procedures

Identifying the status of an HPE SmartDrive

HPE SmartDrives are the latest Hewlett Packard Enterprise drive technology, and they are supported beginning with ProLiant Gen8 servers and server blades. The SmartDrive is not supported on earlier generation servers and server blades. Identify a SmartDrive by its carrier, shown in the following illustration.

When a drive is configured as a part of an array and connected to a powered-up controller, the drive LEDs indicate the condition of the drive.



Item	LED	Status	Definition
1	Locate	Solid blue	The drive is being identified by a host application.
		Flashing blue	The drive carrier firmware is being updated or requires an update.
2	Activity ring	Rotating green	Drive activity
		Off	No drive activity
3	Do not remove	Solid white	Do not remove the drive. Removing the drive causes one or more of the logical drives to fail.
		Off	Removing the drive does not cause a logical drive to fail.
4	Drive status	Solid green	The drive is a member of one or more logical drives.
		Flashing green	The drive is rebuilding or performing a RAID migration, strip size migration, capacity expansion, or logical drive extension, or is erasing.
		Flashing amber/green	The drive is a member of one or more logical drives and predicts the drive will fail.
		Flashing amber	The drive is not configured and predicts the drive will fail.
		Solid amber	The drive has failed.
		Off	The drive is not configured by a RAID controller.

The blue Locate LED is behind the release lever and is visible when illuminated.

Recognizing drive failure

If any of the following occurs, the drive has failed:

- The drive status LED illuminates amber.

- When failed drives are located inside the server or storage system and the drive LEDs are not visible, the Health LED on the front of the server or server blade illuminates. This LED also illuminates when other problems occur such as when a fan fails, a redundant power supply fails, or the system overheats.
- A POST message lists failed drives when the system is restarted, as long as the controller detects at least one functional drive.
- HPE SSA lists all failed drives, and represents failed drives with a distinctive icon.
- Systems Insight Manager can detect failed drives remotely across a network. For more information about Systems Insight Manager, see the documentation on the Insight Management DVD or on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/insightmgmt>).
- The System Management Homepage (SMH) indicates that a drive has failed.
- On servers with Windows operating systems, the Event Notification Service posts an event to the server IML and the Microsoft Windows system event log.
- On servers with Linux operating systems, Linux agents log the event, create an IML entry, and update `/var/log/messages`.

For more information about diagnosing drive problems, see *ProLiant Gen9 Troubleshooting Guide, Volume I: Troubleshooting*.



CAUTION: Sometimes, a drive that has previously been failed by the controller may seem to be operational after the system is power-cycled or (for a hot-pluggable drive) after the drive has been removed and reinserted. However, continued use of such marginal drives may eventually result in data loss. Replace the marginal drive as soon as possible.

Effects of a hard drive failure on logical drives

When a drive fails, all logical drives that are in the same array are affected. Each logical drive in an array might be using a different fault-tolerance method, so each logical drive can be affected differently.

- RAID 0 configurations do not tolerate drive failure. If any physical drive in the array fails, all RAID 0 logical drives in the same array also fail.
- RAID 1 and RAID 10 configurations tolerate multiple drive failures if no failed drives are mirrored to one another.
- RAID 5 configurations tolerate one drive failure.
- RAID 50 configurations tolerate one failed drive in each parity group.
- RAID 6 configurations tolerate two failed drives at a given time.
- RAID 60 configurations tolerate two failed drives in each parity group.
- RAID 1 (ADM) and RAID 10 (ADM) configurations tolerate multiple drive failures if no more than two drives, mirrored to one another, fail.

Compromised fault tolerance



CAUTION: When fault tolerance is compromised, data loss can occur. However, it may be possible to recover the data. For more information, see "Recovering from compromised fault tolerance (on page 37)."

If more drives fail than the fault-tolerance method can manage, fault tolerance is compromised, and the logical drive fails. If this failure occurs, the operating system rejects all requests and indicates unrecoverable errors.

For example, fault tolerance might occur when a drive in an array fails while another drive in the array is being rebuilt.

Compromised fault tolerance can also be caused by problems unrelated to drives. In such cases, replacing the physical drives is not required.

Recovering from compromised fault tolerance

If fault tolerance is compromised, inserting replacement drives does not improve the condition of the logical volume. Instead, if the screen displays unrecoverable error messages, perform the following procedure to recover data:

1. Power down the entire system, and then power it back up. In some cases, a marginal drive will work again for long enough to enable you to make copies of important files. If a 1779 POST message is displayed, do the following:
 - a. Press the **F2** key and select Device Health Status.
 - b. Select 1779 from the list of errors.
 - c. Use the actions on the submenu to re-enable the logical volumes.
Remember that data loss has probably occurred and any data on the logical volume is suspect.
2. Make copies of important data, if possible.
3. Replace any failed drives.
4. After you have replaced the failed drives, fault tolerance may again be compromised. If so, cycle the power again. If the 1779 POST message is displayed:
 - a. Press the **F2** key and select 1779 from the list of errors. Then, use the actions on the submenu to re-enable the logical drives.
 - b. Recreate the partitions.
 - c. Restore all data from backup.

To minimize the risk of data loss that is caused by compromised fault tolerance, make frequent backups of all logical volumes.

Moving drives and arrays

You can move drives to other ID positions on the same array controller. You can also move a complete array from one controller to another, even if the controllers are on different servers.

Before moving drives, you must meet the following conditions:

- If moving the drives to a different server, be sure the new server has enough empty bays to accommodate all the drives simultaneously.
- The array does not have failed or missing drives.
- No spare drive in the array is acting as a replacement for a failed drive.
- The controller is not performing capacity expansion, capacity extension, or RAID or strip size migration.
- The controller is using the latest firmware version.
- The server is powered down.

Before you move an array to another controller, you must meet the following conditions:



CAUTION: If the number of physical or logical drives exceeds the limit for the controller model and firmware version, then the controller may recognize an unpredictable subset of the drives, possibly resulting in failed arrays and data loss.

- If the other controller is connected already to one or more arrays of configured logical drives, the total number of logical drives on the controller after the drives have been moved must not exceed the number of logical drives that the controller supports. This number depends on the controller model and on the controller firmware version.
- The total number of physical drives on the other controller after the drives have been moved must not exceed the maximum number of supported physical drives for that controller model and firmware version.
- All drives in the array must be moved at the same time.

When all the conditions have been met, move the drives:

1. Back up all data before removing any drives or changing configuration. This step is **required** if you are moving data-containing drives from a controller that does not have a cache module.
2. Power down the system.
3. Move the drives.
4. Power up the system.
5. Observe the POST messages:
 - If a 1785 POST message appears, the drive array did not configure properly. Continue with step 6.
 - If a 1724 or 1727 POST message appears, drive positions were changed successfully and the configuration was updated. Continue with step 7.
6. If the array did not configure properly, do the following:
 - a. Power down the system immediately to prevent data loss.
 - b. Return the drives to their original locations.
 - c. Restore the data from backup, if necessary.
7. Verify the new drive configuration by running HPE SSA ("[Configuring an array](#)" on page 32).

Replacing drives

The most common reason for replacing a drive is that it has failed. However, another reason is to gradually increase the storage capacity of the entire system ("[Upgrading drive capacity](#)" on page 41).

For systems that support hot-pluggable drives, if you replace a failed drive that belongs to a fault-tolerant configuration while the system power is on, all drive activity in the array pauses for 1 or 2 seconds while the new drive is initializing. When the drive is ready, data recovery to the replacement drive begins automatically.

If you replace a drive belonging to a fault-tolerant configuration while the system power is off, a POST message appears when the system is next powered up. This message prompts you to press the **F1** key to start automatic data recovery. If you do not enable automatic data recovery, the logical volume remains in a ready-to-recover condition and the same POST message appears whenever the system is restarted.

Before replacing drives

- Open Systems Insight Manager, and inspect the Error Counter window for each physical drive in the same array to confirm that no other drives have any errors. For more information about Systems Insight Manager, see the documentation on the Insight Management DVD or on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/insightmgmt>).
- Be sure that the array has a current, valid backup.
- Confirm that the replacement drive is of the same type as the degraded drive (either SAS or SATA and either hard drive or solid state drive).

- Use replacement drives that have a capacity equal to or larger than the capacity of the smallest drive in the array. The controller immediately fails drives that have insufficient capacity.

In systems that use external data storage, be sure that the server is the first unit to be powered down and the last unit to be powered up. Taking this precaution ensures that the system does not, erroneously, mark the drives as failed when the server is powered up.

In some situations, you can replace more than one drive at a time without data loss. For example:

- In RAID 1 configurations, drives are mirrored in pairs. You can replace two drives simultaneously if they are not mirrored to other removed or failed drives.
- In RAID 10 configurations, drives are mirrored in pairs. You can replace several drives simultaneously if they are not mirrored to other removed or failed drives.
- In RAID 50 configurations, drives are arranged in parity groups. You can replace several drives simultaneously, if the drives belong to different parity groups. If two drives belong to the same parity group, replace those drives one at a time.
- In RAID 6 configurations, you can replace any two drives simultaneously.
- In RAID 60 configurations, drives are arranged in parity groups. You can replace several drives simultaneously, if no more than two of the drives being replaced belong to the same parity group.
- In RAID 1 (ADM) and RAID 10 (ADM) configurations, drives are mirrored in sets of three. You can replace up to two drives per set simultaneously.

To remove more drives from an array than the fault tolerance method can support, follow the previous guidelines for removing several drives simultaneously, and then wait until rebuild is complete (as indicated by the drive LEDs) before removing additional drives.

However, if fault tolerance has been compromised, and you must replace more drives than the fault tolerance method can support, delay drive replacement until after you attempt to recover the data (refer to ["Recovering from compromised fault tolerance"](#) on page 37).

Automatic data recovery (rebuild)

When you replace a drive in an array, the controller uses the fault-tolerance information on the remaining drives in the array to reconstruct the missing data (the data that was originally on the replaced drive) and then write the data to the replacement drive. This process is called automatic data recovery or rebuild. If fault tolerance is compromised, the controller cannot reconstruct the data, and the data is likely lost permanently.

If another drive in the array fails while fault tolerance is unavailable during rebuild, a fatal system error can occur, and all data on the array can be lost. However, failure of another drive does not always lead to a fatal system error in the following exceptional cases:

- Failure after activation of a spare drive
- Failure of a drive that is not mirrored to any other failed drives in the following configurations:
 - RAID 1
 - RAID 10
 - RAID 1 (ADM)
 - RAID 10 (ADM)
- Failure of a second drive in a RAID 50 or RAID 60 configuration if the two failed drives are in different parity groups
- Failure of a second drive in a RAID 6 configuration

Time required for a rebuild

The time required for a rebuild varies, depending on several factors:

- The priority that the rebuild is given over normal I/O operations (you can change the priority setting by using HPE SSA)
- The amount of I/O activity during the rebuild operation
- The average bandwidth capability (MBps) of the drives
- The availability of drive cache
- The brand, model, and age of the drives
- The amount of unused capacity on the drives
- For RAID 5 and RAID 6, the number of drives in the array
- The strip size of the logical volume



CAUTION: Because data rebuild time operates at the rate of 200GB/15 minutes, the system could be unprotected against drive failure for an extended period during data recovery or a drive capacity upgrade. When possible, perform rebuild operations only during periods of minimal system activity.

When automatic data recovery has finished, the drive status LED changes from flashing green to solid green.

If the drive status LED on the replacement drive changes to flashing or solid amber, the rebuild process has terminated abnormally.

If an abnormal termination of a rebuild occurs, identify the cause and appropriate corrective steps in "Abnormal termination of a rebuild (on page 40)."

Abnormal termination of a rebuild

If the activity LED on the replacement drive permanently ceases to be illuminated even while other drives in the array are active, the rebuild process has terminated abnormally. The following table indicates the three possible causes of abnormal termination of a rebuild.

Observation	Cause of rebuild termination
None of the drives in the array have an illuminated amber drive status LED.	One of the drives in the array has experienced an uncorrectable read error.
The replacement drive has an illuminated amber drive status LED.	The replacement drive has failed.
One of the other drives in the array has an illuminated amber drive status LED.	The drive with the illuminated amber LED has now failed.

Each of these situations requires a different remedial action.

Case 1: An uncorrectable read error has occurred.

1. Back up as much data as possible from the logical drive.



CAUTION: Do not remove the drive that has the media error. Doing so causes the logical drive to fail.

2. Restore data from backup. Writing data to the location of the unreadable sector often eliminates the error.
3. Remove and reinsert the replacement drive. This action restarts the rebuild process.

If the rebuild process still terminates abnormally:

1. Delete and recreate the logical drive.
2. Restore data from backup.

Case 2: The replacement drive has failed.

Verify that the replacement drive is of the correct capacity and is a supported model. If these factors are not the cause of the problem, use a different drive as the replacement.

Case 3: Another drive in the array has failed.

A drive that has recently failed can sometimes be made temporarily operational again by cycling the server power.

1. Power down the server.
2. Remove the replacement physical drive (the one undergoing a rebuild), and reinstall the drive that it is replacing.
3. Power up the server.

If the newly failed drive seems to be operational again:

1. Back up any unsaved data.
2. Remove the drive that was originally to be replaced, and reinsert the replacement physical drive. The rebuild process automatically restarts.
3. When the rebuild process has finished, replace the newly failed drive.

However, if the newly failed drive has not recovered:

1. Remove the drive that was originally to be replaced, and reinsert the replacement physical drive.
2. Replace the newly failed drive.
3. Restore data from backup.

Upgrading drive capacity

To upgrade drive capacity:

1. Back up all user data.
2. Delete the existing drive configuration.
3. Remove the existing unconfigured drives, and then install the new unconfigured drives.
For more information on removing and installing drives, see the server user guide.
4. Create configurations on the new drives.
5. Restore user data.

You can use the extra capacity to either create new logical drives or extend existing logical drives. For more information, see the *HPE Smart Storage Administrator User Guide* on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/smartstorage-docs>).

Adding drives

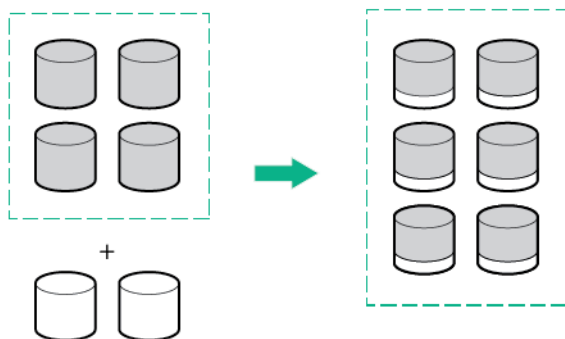
You can add drives to a system at any time, if you do not exceed the maximum number of drives that the controller supports. You can then either build a new array from the added drives or use the extra storage capacity to expand the capacity of an existing array.

If the drives that you intend to add to the system are already configured into logical drives, you must meet certain conditions before adding drives to the system. For more information, see "Moving drives and arrays (on page 37)." When you have successfully added the drives, reset the server so that the controller can recognize the logical drives.

To perform an array capacity expansion, use HPE SSA. If the system uses hot-pluggable drives and HPE SSA runs in the same environment as the normal server applications, you can expand array capacity

without shutting down the operating system. For more information, see the *HPE Smart Storage Administrator User Guide* on the Hewlett Packard Enterprise website (<http://www.hpe.com/info/smartstorage-docs>).

The expansion process is illustrated in the following figure, in which the original array (containing data) is shown with a dashed border, and the newly added drives (containing no data) are shown unshaded. The array controller adds the new drives to the array and redistributes the original logical drives over the enlarged array one logical drive at a time. This process liberates some storage capacity on each physical drive in the array. Each logical drive keeps the same fault-tolerance method in the enlarged array that it had in the smaller array.



When the expansion process has finished, you can use the liberated storage capacity on the enlarged array to create new logical drives. Alternatively, you can use HPE SSA to enlarge (extend) one of the original logical drives.

Warranty and regulatory information

Warranty information

HPE ProLiant and x86 Servers and Options

(<http://www.hpe.com/support/ProLiantServers-Warranties>)

HPE Enterprise Servers (<http://www.hpe.com/support/EnterpriseServers-Warranties>)

HPE Storage Products (<http://www.hpe.com/support/Storage-Warranties>)

HPE Networking Products (<http://www.hpe.com/support/Networking-Warranties>)

Regulatory information

Safety and regulatory compliance

For important safety, environmental, and regulatory information, see *Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products*, available at the Hewlett Packard Enterprise website (<http://www.hpe.com/support/Safety-Compliance-EnterpriseProducts>).

Belarus Kazakhstan Russia marking



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Manufacturing date:

The manufacturing date is defined by the serial number.

CCSYWWZZZZ (serial number format for this product)

Valid date formats include:

- YWW, where Y indicates the year counting from within each new decade, with 2000 as the starting point; for example, 238: 2 for 2002 and 38 for the week of September 9. In addition, 2010 is indicated by 0, 2011 by 1, 2012 by 2, 2013 by 3, and so forth.
- YYWW, where YY indicates the year, using a base year of 2000; for example, 0238: 02 for 2002 and 38 for the week of September 9.

Turkey RoHS material content declaration

Türkiye Cumhuriyeti: EEE Yönetmeliğine Uygundur

Ukraine RoHS material content declaration

Обладнання відповідає вимогам Технічного регламенту щодо
обмеження використання деяких небезпечних речовин в
електричному та електронному обладнанні, затвердженого
постановою Кабінету Міністрів України від 3 грудня 2008 № 1057

Acronyms and abbreviations

ADM

Advanced Data Mirroring

CSR

Customer Self Repair

FBWC

flash-backed write cache

FCC

Federal Communications Commission

FIPS

Federal Information Processing Standard

HPE SSA

HPE Smart Storage Administrator

IML

Integrated Management Log

LFF

large form factor

NIST

National Institute of Standards and Technology

POST

Power-On Self Test

RBSU

ROM-Based Setup Utility

SAS

serial attached SCSI

SATA

serial ATA

SFF

small form factor

SMH

System Management Homepage

SPP

Service Pack for ProLiant

UEFI

Unified Extensible Firmware Interface

Documentation feedback

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Index

A

adding drives 41
array, configuring 32
automatic data recovery (rebuild) 39

B

battery replacement notice 43
battery warranty 43
boot options 30, 32
BSMI notice 43

C

cable part numbers 29
Canadian notice 43
components 5
components, controller 5, 8, 10, 11, 12, 14
compromised fault tolerance 36
configuration procedures 31
configuring an array 32
connecting internal storage 28
connectors 5
controller board, installing 25, 26
controller components 5, 8, 10, 11, 12, 14
controller LEDs 6, 7, 9, 11, 13, 14, 15
controller runtime LEDs 6, 13, 14

D

data recovery 37, 39
Declaration of Conformity 43, 44
device drivers, installing 32
documentation feedback 47
drive capacity, upgrading 41
drive failure, detecting 37
drive failure, effects of 36
drive, failure of 35, 36, 37
drives, adding 41
drives, determining status of 35
drives, installing 28
drives, moving 37

E

European Union notice 43
expansion boards 34
external drives, installing 28

F

failure, drive 35
fault tolerance, compromised 36, 37
FBWC module LEDs 15
features 5
Federal Communications Commission (FCC)
notice 43
firmware, updating 32

G

guidelines, replacing drives 38

H

HBA mode 19
HPE SmartCache 18
HPE SSD Smart Path 18
HPE UEFI System Utilities 30, 31

I

Insight Agents 33
Insight Management Agents 33
Insight Management Agents requirements 33
installation instructions 24
installation overview 24
installing device drivers 32
installing drives 28
internal drives, installing 28
internal storage, connecting 28

J

Japanese notice 43

L

LEDs, controller 6, 9, 11, 13, 14
LEDs, FBWC module 15
limited warranty 43
load protection guarantee 43

M

memory capacity convention 20
methods for updating firmware 32
modifications, FCC notice 43
moving an array 37
moving drives 37

P

POST error messages 37
previously configured server, installation in 24

R

RAID levels 20
rebuild, abnormal termination of 40
rebuild, description of 39
rebuild, time required for 39
regulatory compliance notices 43, 44
replacing drives 37, 38
requirements, Insight Management Agents 33
RoHS 44

S

SAS replacement 38
SATA replacement 38
Secure Encryption 19
Smart Array controller, installing 24
Smart Storage Battery 34
specifications, controller 21, 22
specifications, drives 23
specifications, environmental 20, 23
stand-up controller, installing 24
storage capacity convention 20
storage devices, connecting 28
supported servers 19
system maintenance tools 32

T

Taiwan battery recycling notice 43

U

unconfigured server, installation in 24
updating firmware 32
upgrading drive capacity 41
used server, installation in 24

W

warranty information 43