Hewlett Packard
Enterprise

HPE Dynamic Smart Array B140i RAID Controller
User Guide

Abstract

This document 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.

Contents

Overview

About the HPE Dynamic Smart Array B140i RAID controller

The HPE Dynamic Smart Array B140i RAID controller is a RAID solution combining SATA ports and proprietary software components. Eliminating most of the hardware RAID controller components, and relocating advanced RAID algorithms from a hardware-based controller into device driver software lowers the total solution cost, while still maintaining comparable RAID protection and full compatibility with Smart Array disk format, configuration utilities, and management/monitoring software.

The Dynamic Smart Array controllers share the same easy and consistent UI with standup Smart Array controllers, thus making storage management and deployment easier for IT workers.

Features

The B140i controller has the following features:

- RAID 0, 1, 10, 5
- Maximum drives supported—10
- Maximum LUNs supported—10
- Active Health Support
- iLO Management support
- Drive temperature reporting via iLO
- HPE SSA support
- UEFI BIOS
- Smart Carrier support ("Drive LEDs" on page 15)
- Hot-plug and non-hot-plug configurations
- SATA hard drive, SATA SSD, and SATA M.2 drive support
- Work load logging
- SSD Wear Gauge
- SMART
- Drive rebuild
- Online spares
- Predictive spare activation

> **IMPORTANT:**   The Dynamic Smart Array B140i Controller supports UEFI Boot Mode only. It does not support Legacy BIOS Boot Mode.

For more information about product features, specifications, options, configurations, and compatibility, see the product QuickSpecs on the Hewlett Packard Enterprise website (**http://www.hpe.com/info/qs**).

Enabling and configuring the controller

Boot mode

Use this option to set the boot mode for the system. HPE ProLiant Gen9 servers provide two boot mode configurations: UEFI Mode and Legacy BIOS Mode. Certain boot options described in this guide require that you select a specific boot mode.

By default, the boot mode is set to UEFI Mode. The system must boot in UEFI Mode to use the following options:

- Secure Boot, UEFI Optimized Boot, Generic USB Boot, IPv6 PXE Boot, iSCSI Boot, and Boot from URL

- Fibre Channel/FCoE Scan Policy

- Embedded User Partition

- BL140i Smart Array SW RAID controller

> **NOTE:**   The boot mode you use must match the operating system installation. If not, changing the boot mode can impact the ability of the server to boot to the installed operating system.

To select a Boot Mode:

1. From the **System Utilities** screen, select **System Configuration** → **BIOS/Platform Configuration (RBSU)** → **Boot Options** → **Boot Mode** and press the **Enter** key.
2. Select a setting and press the **Enter** key:
   o UEFI Mode (default)—Configures the system to boot to a UEFI-compatible operating system.

   > **NOTE:**   Configure the system to use native UEFI graphic drivers when booting to the UEFI Mode.

   o Legacy BIOS Mode—Configures the system to boot to a traditional operating system in Legacy BIOS compatibility mode.

3. Press the **F10** key to save your selection.
4. Reboot the server for the change to take effect.

Enabling the controller

The SATA chipset used by the HPE Dynamic Smart Array B140i RAID controller may be configured as a SATA AHCI controller, or it may be configured as a B140i controller. On some platforms, SATA AHCI mode is the default, and the B140i controller may need to be enabled before use.

To enable the B140i controller:

1. Reboot the server.

   The server starts up and the HPE ProLiant POST screen appears within a few minutes.
2. Press the **F9** key in the ProLiant POST screen. The System Utilities screen appears.
3. From the System Utilities screen, select **System Configuration** → **BIOS/Platform Configuration (RBSU)** → **System Options** → **SATA Controller Options** → **Embedded SATA Configuration** → **Enable HPE Dynamic Smart Array RAID Support**, and then press the **Enter** key.

4. Ensure that you are using the correct AHCI or RAID system drivers for your SATA option.

5. Select a setting and press **Enter**:

   a. Enable SATA AHCI Support—Enables the embedded chipset SATA controller for AHCI.

   b. Enable HPE Dynamic Smart Array RAID Support—Enables the embedded chipset SATA controller for Dynamic Smart Array RAID.

6. Press the **F10** key to save your selection.

Configuring an array

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. Therefore, the capacity is unavailable for data storage.

The more physical drives that are in an array, the greater the probability that the array will experience a drive failure during any given period. To reduce the risk of data loss that might occur when a drive fails, configure all logical drives in an array with a suitable fault-tolerance (RAID) method.

To configure an array, use Intelligent Provisioning (on page 24) to enter HPE SSA ("HPE Smart Storage Administrator" on page 23). For more information about using HPE SSA to configure an array, see the *Smart Storage Administrator User Guide* on the Hewlett Packard Enterprise website (**http://www.hpe.com/info/smartstorage/docs**).

Setting the controller read cache

HPE Dynamic Smart Array RAID controllers can use a configurable amount of main system memory for read caching. The default amount of memory used is 64 MB. However, this value can be set to 0, 64, or 128 MB.

Use HPE SSA ("HPE Smart Storage Administrator" on page 23) in **offline mode** to configure the amount of read cache. For more information, see the *Smart Storage Administrator User Guide* on the Hewlett Packard Enterprise website (**http://www.hpe.com/info/smartstorage/docs**).

Installing device drivers

Hewlett Packard Enterprise product QuickSpecs

For more information about product features, specifications, options, configurations, and compatibility, see the product QuickSpecs on the Hewlett Packard Enterprise website (**http://www.hpe.com/info/qs**).

Device drivers overview

> 📝 **IMPORTANT:** If necessary, enable the controller before installing device drivers. For more information, see "Enabling the controller."

A device driver is required for the operating system to communicate with the disk drive controller. For more information on supported operating systems, see the product page for the appropriate controller on the Hewlett Packard Enterprise website (**http://www.hpe.com/info/dynamicsa**).

The device drivers are provided with Service Pack for ProLiant (on page 23). Use Intelligent Provisioning (on page 24) to install the controller drivers.

Driver updates are posted to the Hewlett Packard Enterprise website (**http://www.hpe.com/support/hpesc**). When prompted for product information, enter the appropriate server model name or controller model.

VMware ESX operating systems

To obtain the device drivers you must obtain the Hewlett Packard Enterprise custom image for VMware. To obtain the custom image, see the Hewlett Packard Enterprise website (**http://www.hpe.com/software/softwaredepot**) and select the **Virtualization Software/Server Virtualization** category. For more information on supported servers, see the HPE ProLiant Gen9 server compatibility matrix for HPE Smart Array controllers on the Hewlett Packard Enterprise website (**http://www.hpe.com/info/smartstorage/docs**).

You can obtain the device driver for VMware in one of the following two ways:

- By purchasing a VMware license from Hewlett Packard Enterprise. If you purchase a license from Hewlett Packard Enterprise, the device driver will already be installed. The HPE Dynamic Smart Array driver (hpdsa) is installed on ESXi custom images by default. For more information and to obtain the images, see the Hewlett Packard Enterprise website (**http://www.hpe.com**).

- By installing the device driver as an update (on page 8)

Installing the device driver as an update

1. On the ESXi system console, press the **F2** key.
2. Log in as root.
3. Select **Troubleshooting Options**.
4. Select **Enable ESXi Shell,** and then **Enable SSH**.
5. Press the **Escape** key twice to return to the main screen.
6. Press the **Alt-F1** key to log in to the ESXi system console as root.
7. To copy the new hpdsa driver to the target system, enter:

```
scp <IP Addr of location with VIB>:<Path to VIB>/<VIB filename> <IP Addr of
ESXi server>:<location>
```

Example:
```
scp 10.10.10.20:/scsi-hpdsa-5.0.0.12-1OEM.500.0.0.406165.x86_64.vib
10.10.10.25:/tmp
```

8. At the esxcli, enter:
```
esxcli software vib install -v <Full patch to VIB> --force --no-sig-check
--maintenance-mode
```

Example:
```
esxcli software vib install -v
/tmp/scsi-hpdsa-5.0.0.12-1OEM.500.0.0.406165.x86_64.vib --force
--no-sig-check --maintenance-mode
```

If the installation is successful, the following message appears.

9. Reboot the server for the update to take effect.

Installing Linux device drivers

To obtain the following Linux operating systems, use the driver updated diskette (DUD) images located on the Service Pack for ProLiant (SPP) DVD or the .Hewlett Packard Enterprise website (**http://www.hpe.com/info/hpesc**).

- Red Hat Enterprise Linux

- SUSE Linux Enterprise

For Ubuntu disc images, see the Hewlett Packard Enterprise website (**http://downloads.linux.hpe.com/SDR/project/ubuntu-hpdsa/**).

Before installing the device drivers, observe the following conditions:

- Be sure you have already created a logical volume using the Intelligent Provisioning software ("Intelligent Provisioning" on page 24) or HPE SSA ("HPE Smart Storage Administrator" on page 23).

- Be sure you have a USB device containing the DUD image.

The readme file provided on the DUD image provides detailed instructions for installing device drivers on specific versions of the Linux operating system. For general installation instructions, see the following sections:

- "Installing device drivers (Red Hat Enterprise Linux 6) (on page 9)"

- "Installing device drivers (Red Hat Enterprise Linux 7)"

- "Installing device drivers (SUSE Linux Enterprise Server)"

- "Installing device drivers (Ubuntu Server Linux)"

Installing device drivers (Red Hat Enterprise Linux 6)

To install the device drivers for Red Hat Enterprise Linux:

1. Enable the controller, if necessary.

2. Reboot the server.

3. Mount the RHEL DVD ISO to iLO virtual media, or insert other installation media.

4. Press the **F11** key to manually select the iLO virtual media or other installation media to boot.

5. When the grub entry with a countdown appears, press the **ESC** key.

6. To edit the grub entry, press the **E** key.

7. Press the **E** key again, and then append `blacklist=ahci dd` to the kernel boot line as shown below.

```
[ Minimal BASH-like line editing is supported.  For the first word, TAB
  lists possible command completions.  Anywhere else TAB lists the possible
  completions of a device/filename.  ESC at any time cancels.  ENTER
  at any time accepts your changes.]

grub edit> kernel /images/pxeboot/vmlinuz blacklist=ahci dd█
```

8. Insert the USB device containing the DUD image or mount the driver update diskette as "Virtual Image File (Removable Media)" in iLO.

9. To boot the modified grub entry, press the **Enter** key and then press the **B** key.

10. When the driver disk prompt appears, select **Yes**.

11. Load additional driver disks, if preferred.

12. Continue installing the operating system as normal.

Installing device drivers (Red Hat Enterprise Linux 7)

To install the device drivers for Red Hat Enterprise Linux 7:

1. Enable the controller, if necessary.

2. Reboot the server.

3. Mount the RHEL 7 DVD ISO to iLO virtual media, or insert other installation media.

4. Press the **F11** key to manually select the iLO virtual media or other installation media to boot.

5. Press the **E** key to edit the grub entry, appending `modprobe.blacklist=ahci inst.dd` as shown below. This causes the line to wrap. The editor adds the "\" automatically.

```
setparams 'Install Red Hat Enterprise Linux 7.0'

        linuxefi /images/pxeboot/vmlinuz inst.stage2=hd:LABEL=RHEL-7.0\x20Server.x86_64 quiet modp\
robe.blacklist=ahci inst.dd_
        initrdefi /images/pxeboot/initrd.img
```

6. Insert the USB device containing the DUD image or mount the driver update diskette as "Virtual Image File (Removable Media)" in iLO.

7. Press **Ctrl-X** to boot the newly modified grub entry.

   The installer presents the driver (hpdsa rpm) for installation.

```
Page 1 of 1
Select drivers to install
  1) [ ] /media/DD//rpms/x86_64/kmod-hpdsa-1.2.0-110.rhel7u0.x86_64.rpm

# to toggle selection, 'n'-next page, 'p'-previous page or 'c'-continue:
```

8. To select the driver update, press the **1** key, and then press the **Enter** key.

9. Press the **C** key to continue.

Hewlett Packard Enterprise recommends that you remove the USB device or clear the Virtual media driver check box as soon as the driver update has been extracted.

10. At the language select screen, you can switch to a back terminal to verify the B140i controller logical volume. Press **Ctrl-Alt-F2** to enter the back terminal.

11. At the prompt, enter `cat proc/scsi/scsi`. You should see model entries for "B140i-Virt" and "LOGICAL VOLUME," both indicating the same "host:" (In the following example, the host is scsi3).

12. To return to the installer from the back terminal, press **Alt-F6**.

13. Continue installing the operating system as normal.

Installing device drivers (SUSE Enterprise Linux)

> 📝 **IMPORTANT:** Before installing SUSE Linux Enterprise 11 SP3, you must mount the Gen9 kISO boot image and then insert the SUSE Linux Enterprise 11 SP3 DVD when prompted. To obtain the kISO image, see the SUSE SolidDriver Search website (**http://drivers.suse.com/hp/HP-ProLiant-Gen9**).

To install the device drivers for SUSE Enterprise Linux:

1. Enable the controller, if necessary.
2. Reboot the server.
3. Mount the SLES DVD ISO to iLO virtual media, or insert other installation media.
4. Press the **F11** key to manually select the iLO virtual media or other installation media to boot.
5. To edit the grub entry, press the **E** key.
6. Append `broken_modules=ahci driverupdate=1` as shown below.

7. Insert the USB device containing the DUD image or mount the driver update diskette as "Virtual Image File (Removable Media)" in iLO.
8. Press **Ctrl-X** to boot the newly modified grub entry.

9. The hpdsa driver installs automatically. "HP LOGICAL VOLUME" and "HP B140i" should appear in the "Please choose the Driver Update medium" dialog.
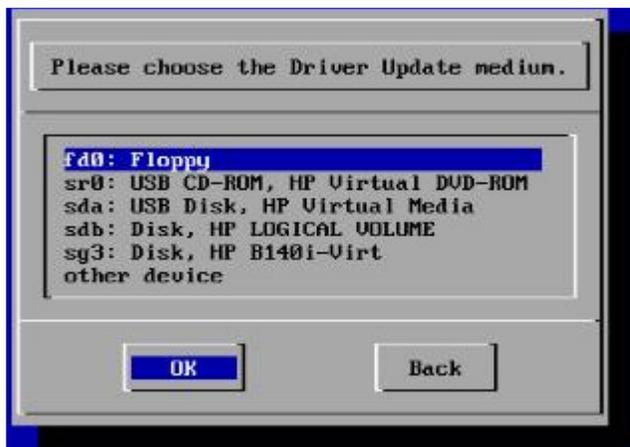
10. To view "insmod hpdsa.ko" in the F3 back terminal, press **Alt-F3**.

11. To view references to "HP LOGICAL VOLUME" and "HP B140i" in the F4 back terminal, press **Alt-F4**.

12. To return to the installation screen, press **Alt-F1**.

    Hewlett Packard Enterprise recommends that you remove the driver update USB device or clear the Virtual Media device check box at this time.

13. Select **Back** to continue.

14. Continue installing the operating system as normal.

Installing device drivers (Ubuntu Server Linux)

> 📝 **IMPORTANT:** Ubuntu does not recognize driver update images via iLO virtual media. Use a USB key with a partition, and then enter the `dd` command to copy the driver update image to the USB-key. (`dd if=hpdsa-1.2.0-185.ubuntu1404.x86_64.img of=/dev/sdc1`)

To install the device drivers on Ubuntu Server Linux:

1. Flash a USB key with a Ubuntu Server Linux disk image, using `/dev/sdc1` as the example USB partition:
   ```
   gunzip hpdsa-1.2.4-140.ubuntu14.04.2.x86_64.img.gz
   dd if=hpdsa-1.2.4-140.ubuntu14.04.2.x86_64.img of=/dev/sdc1
   ```

2. Enable the Smart Array controller in the BIOS/Platform Configuration (RBSU) screen from the UEFI System Utilities.

3. Insert the USB key which contains the driver update image (above).

4. Mount the Ubuntu Server DVD ISO image via the iLO virtual media.

5. Reboot the server.

6. Press the **F11** key to manually select the iLO virtual media to boot.

7. Boot the installation media.

8. When prompted, select **[English]**.

9. Press the **F6** key and then select **Expert mode**, followed by the **ESC** key.

10. In the kernel command line, enter "`--`" and a space then enter the following:

    `modprobe.blacklist=ahci`

11. Press **Ctrl-X** or **F10** to confirm the kernel command line and boot the installation kernel.

12. Continue the installation. When prompted by the installer to load drivers from internal virtual driver disks, select **Yes**.

13. At the "Finish the installation" screen, press **Alt-F2** to access a virtual console and issue the following commands:

    a. `chroot /target`

    b. `echo "blacklist ahci" > /etc/modprobe.d/install-hpdsa.conf`

    c. `depmod `uname -r``

    d. `update-initramfs -u`

    e. `exit`

14. Press **Alt-F1** to return to the Finish screen.

15. Press the **Enter** key to complete the installation and reboot the server.

16. After complete the installation and reboot the server, and then append DKMS module to the errata kernel.

    ```
    #apt-get update
    #apt-get install build-essential dkms
    #dpkg -i hpdsa-dkms_1.2.4.140d_all.deb
    #reboot
    ```

Windows operating systems

The device driver for the HPE Dynamic Smart Array B140i RAID controller is not included with the off-the-shelf Microsoft Windows operating system media. If you are installing the operating system to a logical volume managed by the B140i controller, then you must ensure that the device driver is installed so that the Windows installation will recognize the logical volume.

If you install the operating system using the assisted installation option in the Intelligent Provisioning software ("Intelligent Provisioning" on page 24), the driver is added automatically during installation. No further action is required.

If you install the operating system without Intelligent Provisioning, you must do one of the following:

- Select the driver from the Virtual Install Disk (VID). This option requires that VID is enabled in System Utilities.

  From the System Utilities screen, select System Configuration → BIOS/Platform Configuration (RBSU) → System Options → USB Options → Virtual Install Disk. Then, press the Enter **key**.

- Manually inject the driver during the OS installation from a USB flash drive ("Manually injecting the device driver during OS installation" on page 13).

- Select **Enabled** and press the **Enter** key.

- Press the **F10** key to save your selection.

Manually injecting the device driver during OS installation

To manually inject the driver during Windows OS installation:

1. Obtain the drivers and extract them to a USB drive. The drivers for the B140i controller can be obtained from either the Service Pack for Proliant (on page 23) or from the Hewlett Packard Enterprise website. (**http://www.hpe.com/support/hpesc**) The option to extract the files is presented when running the driver installation component.

2. For installations using a SATA optical drive to load the Windows installation media, Windows provides an early prompt for the optical device driver in order to continue installation. Insert the USB drive containing the driver, and then click **Browse**. This loads the driver for the SATA optical device

and also automatically loads the driver for the SATA hard drives or SATA SSDs connected to the B140i controller.
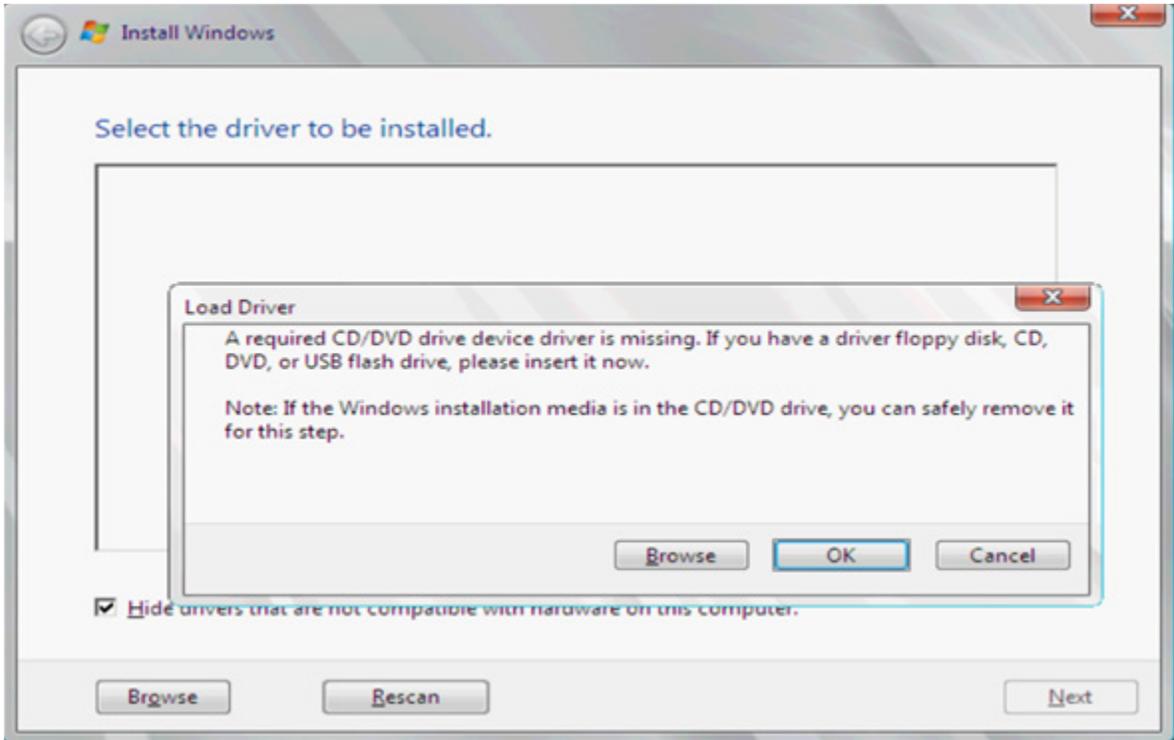
3. For installations that do not use the SATA optical drive to load the Windows installation media, when the "Where do you want to install Windows?" screen appears, click **Load driver**, and then point to the extracted HPE Dynamic Smart Array B140i RAID controller driver folder.
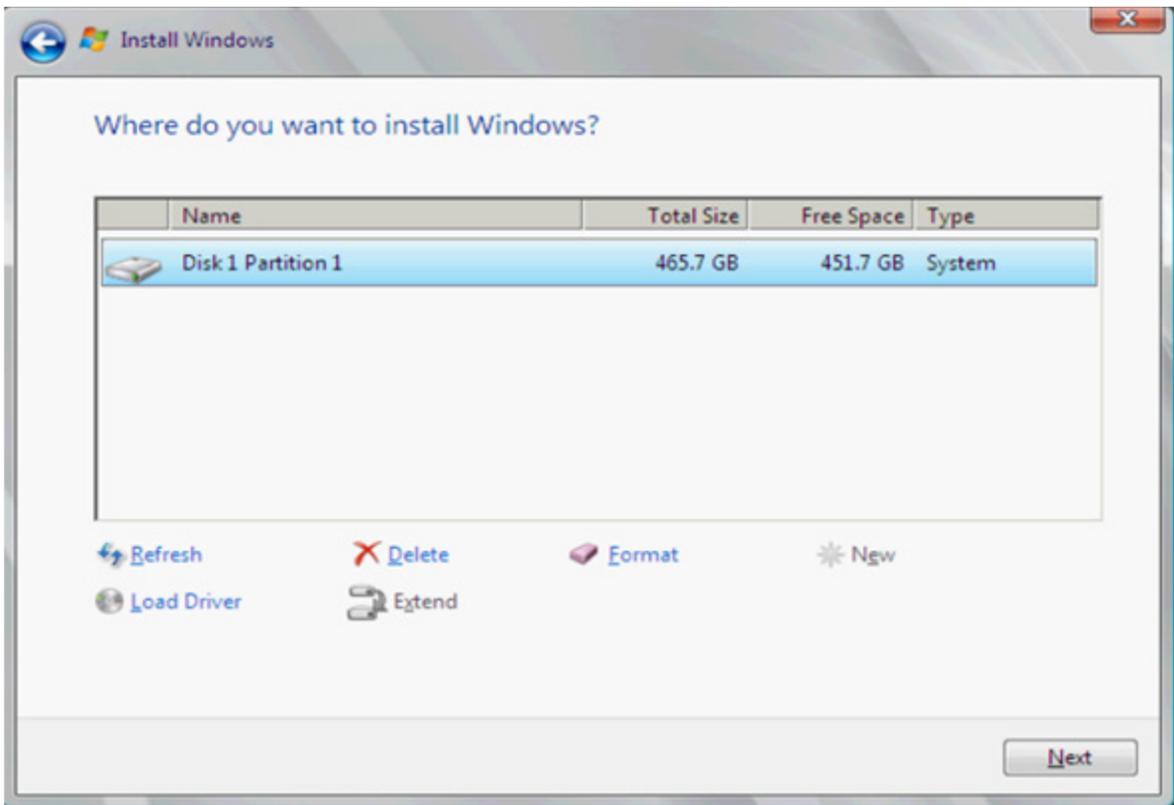
Replacing, moving, or adding hard drives

Drive LEDs

Dynamic Smart Array RAID controllers support drive LED illumination only on systems with backplane support for drive LEDs.

In addition, Dynamic Smart Array RAID controllers support HPE Smart Carrier LED illumination. However, LED functionality is provided only if the drives are authenticated through   Smart Carrier.
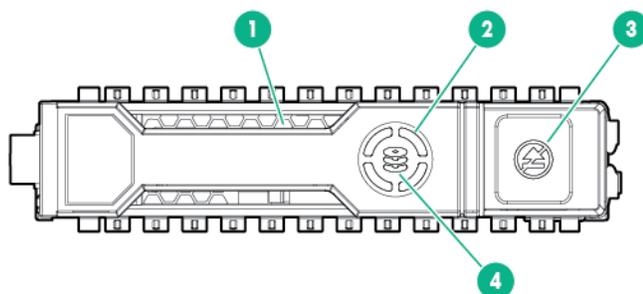
Item	LED	Status	Definition
1	Locate	Solid blue	The drive is being identified by a host application.
		Flashing blue	The drive carrier firmware is being updated or requires an update.
2	Activity ring	Rotating green	Drive activity
		Off	No drive activity
3	Do not remove	Solid white	Do not remove the drive. 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 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.

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

When a hard 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. Therefore, each logical drive can be affected differently.

- RAID 0 configurations cannot tolerate drive failure. If any physical drive in the array fails, all RAID 0 logical drives in the same array also fail.

- RAID 1 configurations can tolerate one drive failure. If one physical drive in a RAID 1 configuration fails, the RAID volume is still intact as a degraded RAID 1.

- RAID 1+0 configurations can tolerate up to two drive failures as long as no failed drives are mirrored to one another.

  A RAID 1+0 configuration of four drives consists of two RAID 1 volumes of two drives each. One drive from each RAID 1 volume can fail for a total of two failed drives. If both drives in one RAID 1 volume fail, the entire RAID 1+0 volume fails.

- RAID 5 configurations can tolerate up to one drive failure. Data protection is provided by **parity data**. This parity data is calculated stripe by stripe from the user data that is written to all other blocks within that stripe. The blocks of parity data are distributed evenly over every physical drive within the logical drive.

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 17)."

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 may be compromised 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.

Replacing hard drives

If you are replacing a drive in a fault-tolerant configuration while the system is powered down, a POST message appears when the system is powered up. When this message appears, press the **F2** key and select **Device Health Status**. Then, select the POST message and use the actions on the submenu to enable 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 when the system is restarted.

In RAID 1 configurations, you can replace one failed drive.

In RAID 1+0 configurations, drives are mirrored in pairs. If drives are not mirrored to removed or failed drives, you can replace them simultaneously.

In RAID 5 configurations, you can replace one failed drive. When a physical drive fails, data that was on the failed drive can be calculated from the remaining parity data and user data on the other drives in the array. This recovered data is usually written to an online spare in a process called a **rebuild.**

Guidelines

Before replacing hard drives, observe the following guidelines:

- Be sure that the array has a current, valid backup.
- Confirm that the replacement drive is a SATA or SATA SSD drive

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

- After removing a drive, wait 3 seconds. After 3 seconds, the firmware generates an event indicating that the drive has been removed. You can now safely install a new drive.

To replace more drives in an array than the fault tolerance method can support, follow the previous guidelines for replacing several drives simultaneously. Wait until rebuild is complete, as indicated by HPE SSA, before replacing additional drives.

If you need to replace more drives than the fault tolerance method can support because fault tolerance has been compromised, back up the data before replacing any drives. For more information, see "Recovering from compromised fault tolerance (on page 17)."

Data recovery (rebuild)

When you replace a hard drive in an array, the controller uses the fault-tolerance information on the remaining drives in the array to reconstruct the data from the original drive and write it to the replacement drive. This process is called automatic data recovery or rebuild. If fault tolerance is compromised, this data cannot be reconstructed and, likely, is lost permanently.

Rebuilding an array requires that you either be in offline HPE SSA or booted into the operating system with the driver installed.

The operating system must be running for the rebuild to occur.

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 is then lost. In exceptional cases, however, failure of another drive does not always cause a fatal system error. These exceptions include the following:

- Failure after activation of a spare drive

- Failure of a drive that is not mirrored to any other failed drives (in a RAID 1+0 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
  Change the priority setting with HPE SSA ("HPE Smart Storage Administrator" on page 23).

- The amount of I/O activity during the rebuild operation

- The rotational speed of the hard drives

- The brand, model, and age of the drives

- The amount of unused capacity on the drives

- In RAID 5 configurations, the time required for a rebuild may be affected by data parity initialization.

Allow approximately 15 minutes per gigabyte for the rebuild process to complete.

System performance is affected during the rebuild, and the system is unprotected against further drive failure until the rebuild has finished. Therefore, replace drives during periods of low activity, when possible.

When automatic data recovery has finished, the state of the logical volume is updated in HPE SSA/SSA-CLI/agents, and an event is posted to the system event log indicating that the rebuild is complete.

If HPE SSA or the posted event indicates that the rebuild has terminated abnormally, determine the appropriate course of action. See "Abnormal termination of a rebuild (on page 19)."

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 LED.	One of the drives in the array has experienced an uncorrectable read error.
The replacement drive has an illuminated amber LED.	The replacement drive has failed.
One of the other drives in the array has an illuminated amber 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.

Moving hard drives and arrays

When moving drives, observe the following guidelines:

- You can move drives to other ID positions on the same array controller.

- You can move drives from a B-series controller to a P-series controller.

  > ⚠ **CAUTION:**   Back up all data before moving drives from a B-series controller to a host bus adapter. Otherwise, data will be lost.

- You can move drives from a B-series controller to a host bus adapter. However, any volume configuration will not be migrated to the new HBA.

- You cannot move drives from a P-series controller to a B-series controller.

Observe the following conditions for moving drives:

- Power down the server.

- If moving the drives to a different server, confirm that the new server has empty bays to accommodate all the drives simultaneously.

- Confirm that the array has no failed or missing drives.

- Confirm that no spare drive in the array is acting as a replacement for a failed drive.

- If moving the drives to a different server, confirm that the new server has the latest system ROM and drivers. For more information, see the Hewlett Packard Enterprise website (**http://www.hpe.com/support/hpesc**).

Observe the following conditions for moving an array to another controller:

- If the other controller is connected 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.

- If moving the logical volume to a hardware-based Smart Array controller that is connected to one or more logical drives, confirm that the total number of logical drives does not exceed the number of logical drives that the controller supports.

- If moving the logical volume to an controller in another server, remove all physical drives from the other server.

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 ("HPE Smart Storage Administrator" on page 23).

After the drives have been moved, confirm that the total number of hard drives on the new controller does not exceed the maximum number of supported hard drives for that controller model and firmware version.

Adding drives

You can add hard drives to a system at any time if you do not exceed the maximum number of drives that the controller supports. You can then build a new array from the added drives.

If the hard drives that you intend to add to the system are configured into logical drives, you must meet certain conditions before adding the hard drives to the system. For more information, see "Moving hard drives and arrays (on page 20)."

Migrating hard drives to an optional Smart Array controller

1. Install the optional controller. To install an optional Smart Array controller, see the server user guide.

2. Do one of the following:
    o Migrate the hard drives (Windows).
    o Migrate the hard drives (Linux).

Migrating hard drives to an optional Smart Array controller (Windows)

This section provides instructions to migrate hard drives from an embedded Dynamic Smart Array RAID controller to an optional Smart Array controller in a server with a Microsoft Windows operating system.

Installing the Smart Array driver (Windows)

To install the driver from the Hewlett Packard Enterprise website (**http://www.hpe.com/support/hpesc**):

1. When prompted for product information, enter the Smart Array controller model number in the product field.

2. Select **Download drivers and software**.

3. Select the appropriate operating system.

4. Download the HPE ProLiant Smart Array SAS/SATA Controller Driver package.

5. To install the driver, run the Smart Array Controller Driver package.

When the driver is installed, complete the migration procedure ("Completing the migration to an optional Smart Array controller (Windows)" on page 21).

Completing the migration to an optional Smart Array controller (Windows)

To complete the migration to the Smart Array controller:

1. Back up all data.

2. Access the **Device Manager** menu:
    a. Right-click **My Computer.**
    b. Select **Manage**.

3. In the Storage Controller section, verify that the system recognizes the Smart Array controller.
4. Power down the server.
5. Remove the access panel.
6. Remove components and cables as needed.
7. Disconnect the existing data cable from the hard drive backplane.
8. Connect the SAS cable to the controller and hard drive backplane.

   This action replaces the SATA connection.
9. Install components and cables removed previously.
10. Install the access panel.

    a. Power up the server.

Migrating drives to an optional host bus adapter

For information on installing an optional host bus adapter and migrating the drives, see the appropriate host bus adapter user guide on the Hewlett Packard Enterprise website (**http://www.hpe.com/info/smartstorage/docs**).

Software and configuration utilities

HPE Smart Storage Administrator

HPE SSA is the main tool for configuring arrays on Smart Array controllers. 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 HPE ProLiant Gen8 servers and server blades, HPE SSA is accessible both offline 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 *HPE 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 *HPE Smart Storage Administrator User Guide*.

Service Pack for ProLiant

The SPP is a comprehensive systems software (drivers and firmware) solution delivered as a single package with major server releases. This solution uses HP SUM as the deployment tool and is tested on all supported ProLiant servers including ProLiant Gen8 and later servers.

SPP can be used in an online mode on a Windows or Linux hosted operating system, or in an offline mode where the server is booted to an operating system included on the ISO file so that the server can be updated automatically with no user interaction or updated in interactive mode.

For more information or to download SPP, see one of the following pages on the Hewlett Packard Enterprise website:

- Service Pack for ProLiant download page (**http://www.hpe.com/servers/spp/download**)
- Smart Update: Server Firmware and Driver Updates page (**http://www.hpe.com/info/SmartUpdate**)

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**).

HPE UEFI System Utilities

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

- Displaying system information

- Selecting the primary boot controller

- Launching other pre-boot environments such as the Embedded UEFI Shell

For more information on the UEFI System Utilities, see the *HPE UEFI System Utilities User Guide for HPE ProLiant m400 Server Cartridges* on the Hewlett Packard Enterprise website (**http://www.hpe.com/info/uefi/docs**).

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.

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:*

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

Keeping the controller current

B-series controllers have no firmware to be updated but are instead maintained through UEFI and the OS drivers. Be sure to update the system ROM, OS drivers, and drive firmware regularly.

Support and other resources

Support and training information

Hewlett Packard Enterprise offers a number of additional software support services, many of which are provided to customers at no additional charge:

- **Software Technical Support and Update Service**—Insight Control and select Insight Management software products include one year of 24 x 7 Hewlett Packard Enterprise Software Technical Support and Update Service. This service provides access to Hewlett Packard Enterprise technical resources for assistance in resolving software implementation or operations problems. The service also provides access to software updates and reference manuals in electronic form as they are made available from Hewlett Packard Enterprise. With this service, Insight Control and Insight Management customers will benefit from expedited problem resolution as well as proactive notification and delivery of software updates. For more information about this service, see the Hewlett Packard Enterprise website (**http://www.hpe.com/services/insight**).

- **Registration for Software and Technical Support and Update Services**—If you received a license entitlement certificate, registration for this service occurs following online redemption of the license certificate/key.

- **How to Use Your Software Technical Support and Update Service**—Once you are registered, you will receive a service contract in the mail containing the Customer Service phone number and your Service Agreement Identifier. You will need your SAID when calling for technical support. Using your SAID, you can also use your SAID to view your contract on the Hewlett Packard Enterprise Support Center (**http://www.hpe.com/support/hpesc**) website.

- **Warranty**—Hewlett Packard Enterprise   will replace defective delivery media for a period of 90 days from the date of purchase. This warranty applies to all Insight Software, HPE Systems Insight Manager, and Insight Management products.

- **Join the discussion**—The Hewlett Packard Enterprise Support Center is a community-based, user-supported tool for Hewlett Packard Enterprise customers to participate in discussions amongst the customer community about Hewlett Packard Enterprise products. For discussions related to Insight Control and Insight Management software, see the "Community forums" area of the Hewlett Packard Enterprise Support Center website (**http://www.hpe.com/support/hpesc**).

- **Contact** Hewlett Packard Enterprise Worldwide Customer Service contact numbers are available on the Hewlett Packard Enterprise website (**http://www.hpe.com/contact**). For U.S. customers, say "Insight Manager" when prompted for the product name.

Electrostatic discharge

Preventing electrostatic discharge

To prevent damaging the system, be aware of the precautions you must follow when setting up the system or handling parts. A discharge of static electricity from a finger or other conductor may damage system boards or other static-sensitive devices. This type of damage may reduce the life expectancy of the device.

To prevent electrostatic damage:

- Avoid hand contact by transporting and storing products in static-safe containers.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free workstations.
- Place parts on a grounded surface before removing them from their containers.
- Avoid touching pins, leads, or circuitry.
- Always be properly grounded when touching a static-sensitive component or assembly.

Grounding methods to prevent electrostatic discharge

Several methods are used for grounding. Use one or more of the following methods when handling or installing electrostatic-sensitive parts:

- Use a wrist strap connected by a ground cord to a grounded workstation or computer chassis. Wrist straps are flexible straps with a minimum of 1 megohm $\pm$10 percent resistance in the ground cords. To provide proper ground, wear the strap snug against the skin.
- Use heel straps, toe straps, or boot straps at standing workstations. Wear the straps on both feet when standing on conductive floors or dissipating floor mats.
- Use conductive field service tools.
- Use a portable field service kit with a folding static-dissipating work mat.

If you do not have any of the suggested equipment for proper grounding, have an authorized reseller install the part.

For more information on static electricity or assistance with product installation, contact an authorized reseller.

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

Manufacturer and Local Representative Information

Manufacturer information:

Hewlett Packard Enterprise Company, 3000 Hanover Street, Palo Alto, CA 94304 U.S.

Local representative information Russian:

* **Russia:**

  ООО «Хьюлетт Паккард Энтерпрайз», Российская Федерация, 125171, г. Москва, Ленинградское шоссе, 16А, стр.3, Телефон/факс: +7 495 797 35 00

* **Belarus:**

  ИООО «Хьюлетт-Паккард Бел», Республика Беларусь, 220030, г. Минск, ул. Интернациональная, 36-1, Телефон/факс: +375 17 392 28 18

* **Kazakhstan:**

  ТОО «Хьюлетт-Паккард (К)», Республика Казахстан, 050040, г. Алматы, Бостандыкский район, проспект Аль-Фараби, 77/7, Телефон/факс: + 7 727 355 35 52

Local representative information Kazakh:

- **Russia:**

  ЖШС "Хьюлетт Паккард Энтерпрайз" Ресей Федерациясы, 125171, Мәскеу, Ленинград тас жолы, 16А блок 3, Телефон/факс: +7 495 797 35 00

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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

Communications interference

Hewlett Packard Enterprise system compliance tests are conducted with Hewlett Packard Enterprise supported peripheral devices and shielded cables, such as those received with the system. The system meets interference requirements of all countries in which it is sold. These requirements provide reasonable protection against interference with radio and television communications.

Installing and using the system in strict accordance with Hewlett Packard Enterprise instructions minimizes the chances that the system might cause radio or television interference. However, Hewlett Packard Enterprise does not guarantee that the system does not interfere with radio and television reception.

Take these precautions:

- Use only shielded cables.

- Install and route the cables according to the instructions provided.
- Ensure that all cable connector screws are firmly tightened.
- Use only Hewlett Packard Enterprise supported peripheral devices.
- Before system operation, ensure that all panels and cover plates are in place and secure.

Acronyms and abbreviations

ADM

Advanced Data Mirroring

AHCI

Advanced Host Controller Interface

CSR

Customer Self Repair

FBWC

flash-backed write cache

FCC

Federal Communications Commission

FIPS

Federal Information Processing Standard

HPE SSA

HPE Smart Storage Administrator

iLO

Integrated Lights-Out

IML

Integrated Management Log

LFF

large form factor

LUN

logical unit number

NIST

National Institute of Standards and Technology

POST

Power-On Self Test

RBSU

ROM-Based Setup Utility

SATA

serial ATA

SFF

small form factor

SMART

self-monitoring analysis and reporting technology

SMH

System Management Homepage

SPP

Service Pack for ProLiant

SSD

solid-state drive

UEFI

Unified Extensible Firmware Interface

Documentation feedback

Hewlett Packard Enterprise is committed to providing documentation that meets your needs. To help us improve the documentation, send any errors, suggestions, or comments to Documentation Feedback (**mailto:docsfeedback@hpe.com**). When submitting your feedback, include the document title, part number, edition, and publication date located on the front cover of the document. For online help content, include the product name, product version, help edition, and publication date located on the legal notices page.

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