



HP iLO Management Engine technologies

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Introduction

The HP iLO Management Engine is a suite of embedded management technologies that supports the complete lifecycle of all HP ProLiant Gen8 servers, from initial deployment to ongoing management and service alerting. The iLO Management Engine is a key component of the end-to-end HP Insight Management server management portfolio, along with HP Insight Control and HP Insight Online. Together they provide customers with the most comprehensive set of server management capabilities in the industry.

The iLO Management Engine includes:

- HP iLO 4 management processor that provides the foundation for other capabilities in iLO Management Engine
- HP Intelligent Provisioning that lets customers provision and configure a single server without any separate media
- HP Agentless Management that provides remote embedded server management without OS-based management software
- HP Active Health System that builds diagnostic support into the server

iLO Management Engine comes standard across the BL, DL, ML, and SL ProLiant Gen8 server lines. Customers will need an HP iLO Advanced License to take advantage of iLO 4 capabilities such as the Remote Console and Virtual Media. We assume that most readers are familiar with previous versions of iLO technology. If not, the following section contains a brief background.

HP iLO 4

iLO 4 simplifies server setup, provides health monitoring, power and thermal control, and lets you control your ProLiant Gen8 servers remotely. It builds on the legacy of trusted management hardware and firmware capabilities developed through generations of iLO. The iLO 4 subsystem includes a management processor, its firmware, secure memory, and a dedicated network interface. It has more memory, updated firmware, and supports faster network speeds than the iLO 3 processor. iLO 4 resides on the system board, uses auxiliary power, and operates independently of the system processor and OS. This means that iLO 4 has the following characteristics:

- Fully operational during a shutdown and server reboot because it doesn't depend on the server being powered on
- Autonomous from the server hardware and isolated from problems occurring with it
- Available for out-of-band management without assistance from the OS

An iLO processor lets you do things such as:

- Access a high-performance and secure Remote Console to the server from anywhere in the world if you have a network connection to the server
- Remotely mount Virtual Media devices to your server
- Securely and remotely control the power state of the managed server
- Use Virtual Power and Virtual Media from the GUI, CLI, or the iLO scripting toolkit for tasks such as automated deployment and provisioning
- Measure, report, and cap server power consumption
- Monitor server hardware health—including temperatures, fans, and power supplies—and receive an alert for abnormal conditions

These capabilities have been available with previous generations of iLO. For more information, see the paper called "Integrated Lights-Out 3 technology," at <http://h20000.www2.hp.com/bc/docs/support/SupportManual/c02714903/c02714903.pdf>.

iLO 4 builds on this legacy of iLO innovation and is the foundation for HP Agentless Management and Active Health System. iLO 4 manages some aspects of HP Intelligent Provisioning, even though HP Intelligent Provisioning does not reside on the iLO 4 processor or in its firmware.

iLO 4 also adds:

- Always-available access using the HP iLO Mobile App for smartphone and tablet devices
- Updated network speeds (1 Gb) for the dedicated network port
- Sea of Sensors 3D
- LOM (LAN-on-motherboard) and FlexibleLOM support with shared networks

HP iLO Mobile Application

We designed the HP iLO Mobile App for accessing ProLiant G7 and Gen8 servers from your iPhones, iPads, or Android smartphones and tablets.

It operates with iPhone 4, iPhone 4S, iPad, and iPad 2 devices running iOS 4.2 or greater. As of this writing, it also operates with the following devices running Android 2.3 and greater:

- Samsung Galaxy Tab
- Samsung Galaxy S II
- HTC Droid Incredible 2
- Motorola Droid 2
- Motorola Xoom 4G

Other Android devices may also function. We continue to test other devices; see the iLO Mobile App documentation at www.hp.com/go/ilo/mobileapp for the most up-to-date list of supported devices.

The iLO Mobile app does not support iLO 2 processors because they use a different underlying protocol for the remote console.

The iLO Mobile App provides the following capabilities:

- Integrated remote console
- Virtual media (URL-based)
- Virtual power
- Scripting
- Server health status
- QR code scanning

Porting the existing integrated remote console application to iOS and Android involved more than just recompiling code. For example, we made adjustments to accommodate the lack of a standard keyboard and a smaller view screen. We removed some function keys to make sure that you could use the app from a phone, not just with the larger screen of a tablet. The app recognizes whether it is running on a phone or a tablet and adjusts the functionality accordingly. The app uses common standard gestures that the industry has adopted, such as zoom and pinch gestures.

You can mount an ISO CD/DVD image through the virtual media access. The disk image, which is stored on a web server, is then available on the server as a USB CD/DVD drive. This lets you boot from the disk image and deploy an operating system.

Through the iLO Mobile App, you can also access the virtual power capabilities of iLO to operate the server power switch remotely.

To use scripting, the app acts as a “way station” between your web server that holds your script and the iLO device on the server. The app pulls the script from the web server and sends it to the iLO to run. In the future, we’re planning to have the capability to build a catalog of scripts resident in the app so that, for example, you could download a script from hp.com, change the username and password, and then run it from the tablet or smartphone.

The QR scanning lets you scan in QR codes with the same information that is currently contained in bar codes—the iLO network addresses, usernames, and passwords. The app builds a list of all the iLOs along with their associated information.

Note that for security reasons, the app holds addresses, login names, and passwords in cache memory that is not backed up to iTunes or the cloud. The OS may reclaim this memory in some situations, such as an OS upgrade. If this happens, all these settings will be lost.

HP Sea of Sensors 3D

Just like iLO 3, the iLO 4 processor monitors multiple temperature sensors throughout the server and then uses a proportional–integral–derivative (PID) control feedback algorithm to set and control the speed of each server fan. With the ProLiant Gen8 servers, we have added sensors to most HP option cards so that stand-up PCI cards can be effectively monitored. This makes iLO 4 even more effective at optimizing thermal control in your server.

Updated networking speeds

The iLO 4 processor now supports 1 Gb/s connections. The iLO 4 dedicated network interface in ProLiant Gen8 servers supports link speeds of 10, 100, and 1000 Mb/s and will auto-negotiate as needed. Although iLO 4 doesn't require the 1 Gb/s for performance reasons—throughput for a busy iLO is closer to 20 Mb/s—we made the change to offer increased compatibility with external networking hardware. Some customers lock in their networking switches to a single data rate, so this makes iLO 4 compatible with the standard 1 Gb/s. Most ProLiant Gen8 DL, ML, and SL servers have a 1 Gb dedicated NIC for iLO 4. ProLiant BL servers have iLO dedicated NICs that remain at 100 Mb/s inside the server, but the Onboard Administrator aggregates multiple iLO NICs and operates at 1 Gb/s.

FlexibleLOM capabilities

ProLiant Gen8 servers introduce a new networking capability, the FlexibleLOM. For the Gen8 models that support it, the FlexibleLOM is a daughterboard that lets you match the networking capabilities for your server with your networking infrastructure—for example, a FlexibleLOM with four 1 Gb/s ports or a FlexibleLOM with two 10 Gb/s ports. The iLO 4 firmware supports using its shared network port with the FlexibleLOM.

Some ProLiant Gen8 servers can have both a standard and FlexibleLOM. We modified the iLO 4 firmware so that it can use either the embedded LOM or the FlexibleLOM as its shared network port. When configuring iLO 4, you will need to select which NIC to use as your shared network port.

HP Intelligent Provisioning

HP Intelligent Provisioning takes our classic single-server deployment and configuration processes, embeds them into a NAND flash device, and wraps a seamless user interface around them. HP Intelligent Provisioning builds on our experience developing pioneering technology such as SmartStart, ProLiant Support Packs, and HP Smart Update Manager (HP SUM).

Even though iLO 4 enables and disables the NAND flash partitions, HP Intelligent Provisioning is not part of the iLO 4 firmware. The NAND flash is separate from the iLO subsystem. This means, for example, that updating iLO 4 firmware will not affect HP Intelligent Provisioning and vice versa.

The HP Intelligent Provisioning partition of the NAND flash contains next-generation OS provisioning (based on the previous HP SmartStart), portions of the HP Service Pack for ProLiant (HP SPP), Insight Diagnostics, and the Array Configuration Utility. It does not include any firmware files, but pulls these down from an external source such as ftp.hp.com or a local repository in the customer's network.

Embedding HP Intelligent Provisioning means that all the tools and drivers that you need to deploy and maintain your system are available from the moment you power on the server. You will only need your OS (which could be on physical media, iLO 4 virtual media, or a network share drive) to finish setting up your servers.

Because HP Intelligent Provisioning is embedded, you can boot into it during the server POST process, just like booting your server onto an OS that's on a USB key. Intelligent Provisioning works only when you're booted into that environment.

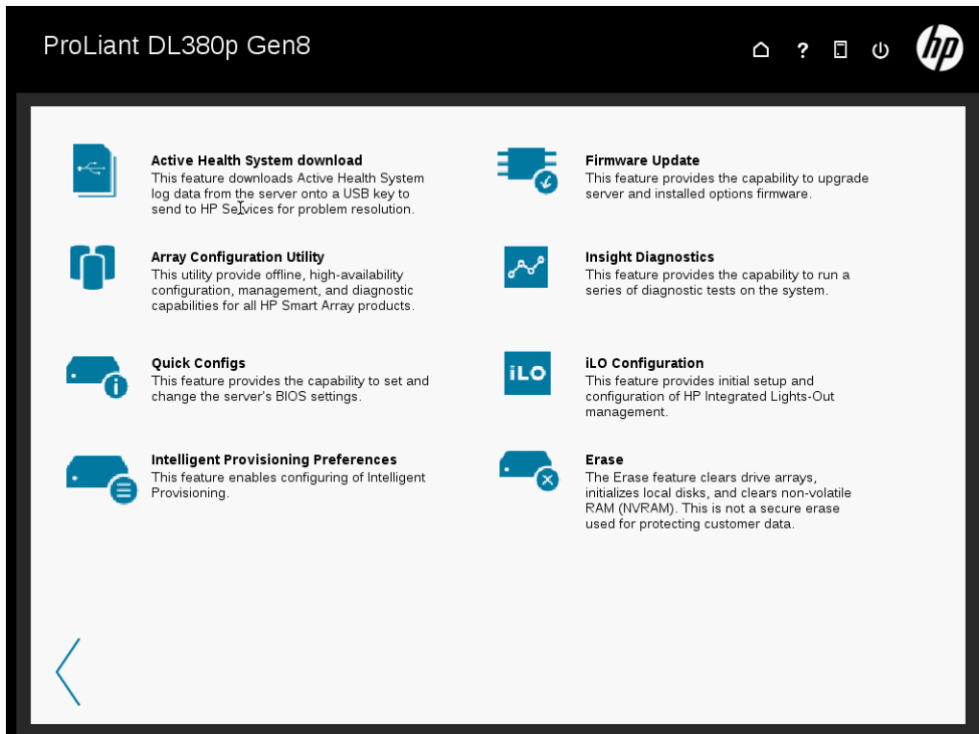
From the HP Intelligent Provisioning Main page, you can choose to perform installations or maintenance. You can do:

- Custom installation, which uses a wizard for complete server deployment, including network setup, remote support registration, drive configuration, and HP driver installation
- Recommended installation, which uses default settings that we've already optimized to configure server software and firmware, partition storage, and install the OS with HP drivers

- Manual installation, which provides critical boot drivers for a manual installation of the OS from vendor disks

The HP Intelligent Provisioning Maintenance page (Figure 1) shows similar configuration utilities for the user familiar with SmartStart, such as Array Configuration Utility (including Array Diagnostics), System Diagnostics, the ERASE tool, and iLO 4 configuration. It also includes the new capabilities to do Active Health System Log downloads and firmware updates.

Figure 1: The maintenance page gives you an easy way to get to multiple utilities



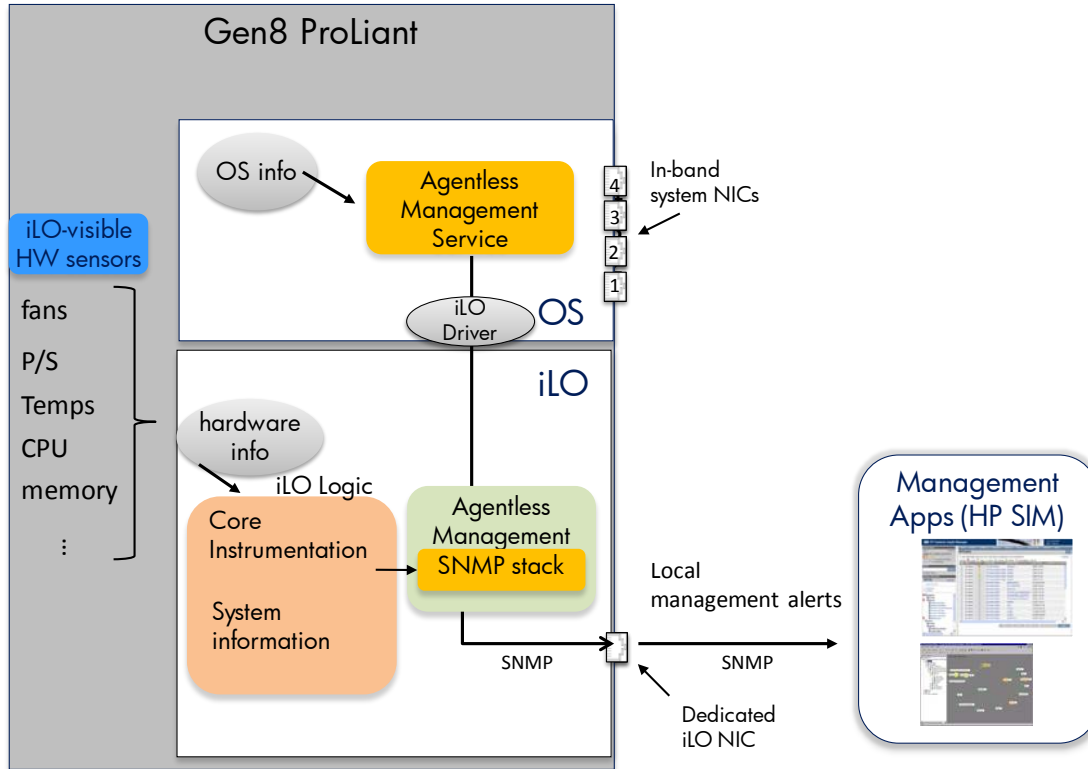
HP Agentless Management and Agentless Management Service

Until now, management applications such as HP Systems Insight Manager (HP SIM) could only manage servers through OS-based management agents such as SNMP or WBEM. The iLO 4 architecture in ProLiant Gen8 servers makes it possible to monitor the server hardware and manage alerts without OS-based agents. Customers can load an optional Agentless Management Service to gather OS-related information not available to iLO 4 from the system hardware.

HP Agentless Management depends upon these underlying technologies (see Figure 2):

- Core embedded health firmware—It monitors core platform hardware such as temperature sensors, power supplies, fans, memory, CPUs, and Smart Array storage. We incorporated health monitoring in the iLO firmware with the iLO 2 processors in the ProLiant G5 servers, so it is well established and robust. iLO 4 adds new capabilities such as giving details about Smart Array subsystems and monitoring firmware revisions.
- Embedded SNMP stack that resides in iLO 4 rather than in the host OS—This eliminates the need for the host CPU to use its processing cycles on SNMP management. It also increases security and stability because SNMP is embedded within iLO 4 rather than having SNMP loaded onto the host CPU.
- Out-of-band, dedicated iLO 4 NIC—It sends SNMP traps directly to management applications such as HP SIM without affecting system performance. You can configure iLO 4 to use a shared network port on the server if you want to reduce the number of cables coming from your server, but it's not necessary.

Figure 2: The iLO 4 subsystem includes the core instrumentation logic to monitor hardware. It also includes the embedded HP Agentless Management with its SNMP stack.



Hardware independence

Because we build iLO 4 and the hardware sensors into every ProLiant Gen8 server, the base hardware monitoring and alerting capability is independent of the OS. This means:

- Monitoring occurs regardless of the state of the OS. It can occur before you've deployed the server (pre-OS), when the OS is running, or after an OS crash. Even if the OS is not functioning, iLO 4 can send alerts to HP SIM or another SNMP-compliant management program.
- Monitoring occurs regardless of the OS vendor or version. This is important, for example, if you want to run an OS for which we have no agents. Embedding management software into iLO 4 lets you manage the server regardless of what OS you install.

HP Agentless Management operates from the moment you plug a power cord into the server because iLO 4 runs off the auxiliary power plane of the server. iLO 4 includes power and fault isolation logic that splits the iLO 4 functionality so that some functions operate under normal system power while the most critical functions connect to the auxiliary power plane of the server. The HP Agentless Management capabilities are available through the auxiliary power.

Embedded SNMP

The embedded SNMP management stack in iLO 4 includes an SNMP master service, or broker, that listens for SNMP traffic. When the SNMP service receives this traffic, it brokers the request for appropriate information inside iLO 4. The iLO 4 SNMP service logically manages the data in the Management Information Base (MIB) database. For hardware items that iLO 4 manages, iLO 4 can interpret SNMP traps and send the same trap that the OS-based SNMP would have sent.

We use SNMPv1 to be compatible with existing agents and HP SIM. SNMPv1 is also compatible with SNMPv2c, the standard SNMP stack used in Windows. For the majority of customers who are running a private management network (behind a firewall), this represents the optimal solution, because it's compatible with their existing environment.

Optional Agentless Management Service

iLO 4 cannot monitor OS-specific data directly. The Agentless Management Service solves this information gap by providing a lightweight service in the OS that feeds data to iLO 4. Its configuration is all done by iLO 4 and requires no OS setup.

It includes such information as:

- Host OS name and version
- Host network IP addresses
- Drivers and firmware versions of installed software
- Information about disk drives directly attached to the chipset (not using a Smart Array Controller)

We developed Agentless Management Service with security and reliability in mind:

- It is an optional service. iLO 4 provides significant management functionality (including full hardware management) even without the Agentless Management Service.
- It is more lightweight than full OS agents, using less memory and CPU time.
- It is not exposed to the system network (see Figure 2). It doesn't require any management software connections on the host OS.
- It communicates with iLO 4 using the HP iLO Channel Interface driver. This driver provides a private, fast, and reliable method to transfer large data blocks between the host OS and iLO 4.

There are differences in the information provided by the existing OS-based SNMP, the iLO 4-based HP Agentless Management, and the Agentless Management Service (see Table 1).

Table 1: Information supplied by SNMP agents, iLO firmware only, and iLO firmware plus the Agentless Management Service

	SNMP Agents (OS-based)	HP Agentless Management (in iLO firmware)	iLO firmware plus Agentless Management Service
Server Health	Fans Temps Power supplies Memory CPU	Fans Temps Power supplies Memory CPU	Fans Temps Power supplies Memory CPU
Storage	Smart Array SAS/SATA HBA/RAID Fibre Channel / iSCSI SMART drive monitoring External storage Tape	Smart Array Internal HDDs connected to Smart Array SMART drive monitoring	Smart Array SAS/SATA HBA* SMART drive monitoring
NIC	Internet standard MIB-II Compaq NIC MIB Link Up/Down traps Teaming VLAN	MAC Address	Internet standard MIB-II* Compaq NIC MIB* Link Up/Down traps*
Other	OS data iLO 4 data Firmware inventory Performance data User settable thresholds Logging to OS logs	iLO 4 data Firmware inventory	OS data* iLO 4 data Firmware inventory

SNMP Agents (OS-based)	HP Agentless Management (in iLO firmware)	iLO firmware plus Agentless Management Service
Event notification via Email		
Clustering info		

*The data supplied by HP Agentless Management is not as extensive as the data supplied by the SNMP agents

HP Agentless Management alone may not satisfy management needs for all customers. As noted in Table 1, some data, such as clustering information, is only available through the OS-based agents. We continue to provide SNMP agents and WMI providers for customers who need the full range of management functionality.

Accessing management information

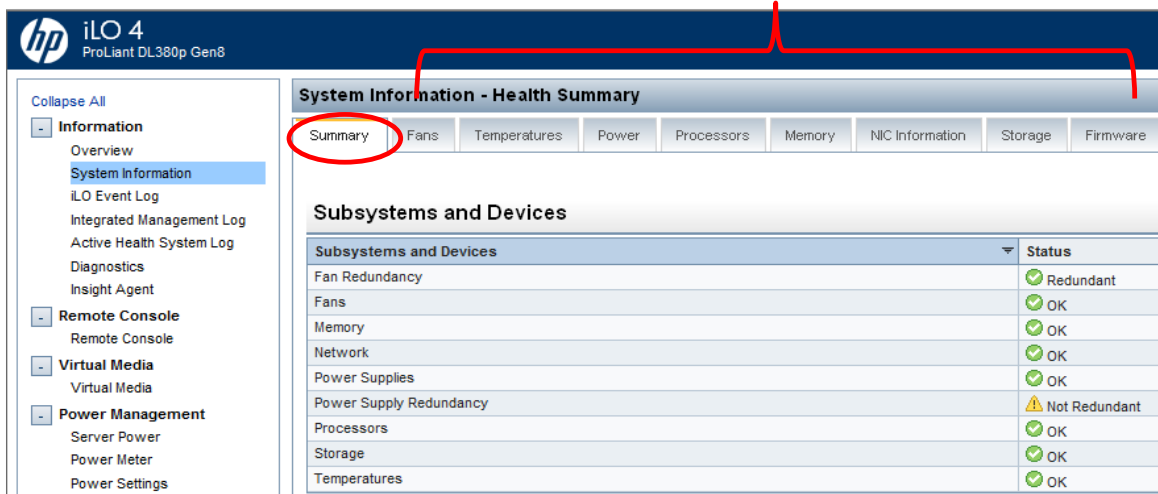
There are several ways to access the information from HP Agentless Management. The most common way is through the iLO 4 web GUI or HP SIM. The iLO 4 GUI provides a high-level health status on the System Summary page and detailed information on individual tabs (Figure 3), including:

- Fans
- Temperatures
- Power
- Processors
- Memory
- NIC information
- Smart Array controllers
- Drives (logical and physical)
- Firmware revisions

The NIC and firmware tabs in the iLO 4 web GUI include some information fed from the optional Agentless Management Service. Most of the NIC information comes through the OS-based Agentless Management Service; only NIC presence and MAC addresses come through iLO 4. While iLO 4 can gather most firmware information, some data can only come through AMS, such as revisions for installed software.

Figure 3: This screen shot shows the health summary information tab. Specific details are on the other tabs.

Individual subsystem tabs



Because we design our own Smart Array controller, iLO 4 is able to gather information about the logical drive and physical drive directly from the controller. We can show, for example, which internal drives are connected to the Smart Array, the logical and physical configurations, serial numbers, capacity and location of the drives, and so on (Figure 4).

Figure 4: Our integration with Smart Array Controllers lets iLO 4 gather information about the controller and the attached logical and physical drives.

System Information - Drives

Summary | Fans | Temperatures | Power | Processors | Memory | NIC Information | **Storage** | Firmware

Drive Arrays

Expand All

- ⚠ Controller in Slot 0

Status	⚠ Degraded
Serial Number	5001438013354190
Model	HP Smart Array P420i Controller
Firmware Version	0.03
Cache Module Status	❌ Failed
Cache Module Serial Number	PBKUD0XTA0P04Y
Cache Module Memory	2097152 KB

+ ✅ Logical Drive 01

- ⚠ Logical Drive 02

Status	⚠ Degraded
Capacity	186 GB

- ⚠ Physical Drive in Port 11 Box 2 Bay 4

Status	⚠ Degraded (Not authenticated)
Serial Number	00170200
Model	MOD200FBRWB
Capacity	186 GB
Location	Port 11 Box 2 Bay 4
Firmware Version	HPD1

HP SIM integration

You can use HP SIM 7.0 or greater to access the health data from HP Agentless Management and the Agentless Management Service. When iLO 4 first comes online and you configure it for SNMP, it automatically sends a coldStart trap—a broadcast message to the entire subnet—that signifies a change has occurred in the configuration or protocol implementation. HP SIM recognizes the coldStart trap and discovers the iLO 4 device. All this happens before you even power on the server, because iLO 4 runs off the server’s auxiliary power. By interfacing with the SNMP service in iLO 4, HP SIM accesses the data in the MIBs through the agent, and then provides the interface for you to manage and view it.

For more information about how HP SIM integrates with HP Agentless Management, see “Overview of HP Systems Insight Manager 7.0 with HP Agentless Management,” at

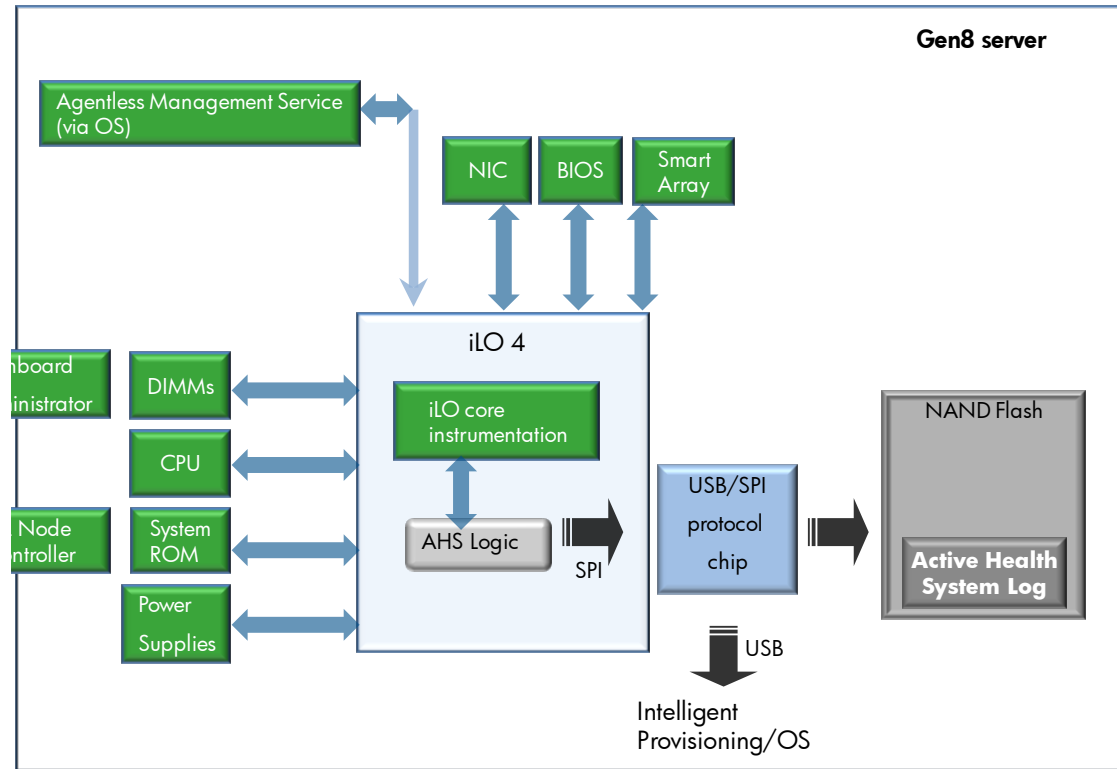
<http://h20000.www2.hp.com/bc/docs/support/SupportManual/c03306157/c03306157.pdf>

HP Active Health System

The Active Health System builds diagnostic support into the server itself. It assists our support personnel and engineering teams with problem diagnosis by recording changes in the server hardware and system configuration. It records the system configuration, status, event, and error data provided by various sub-systems of the server. Providing a detailed Active Health log to our support personnel for debugging purposes can potentially improve the accuracy of the diagnostics, and significantly reduce your issue-resolution time.

The Active Health System logic resides in the iLO 4 firmware (Figure 5). iLO 4 stores the data it collects in the NAND flash.

Figure 5: The Active Health System feeds data into iLO 4 from the hardware and from the optional Agentless Management Service.



Because it's built into iLO 4, all the benefits of iLO apply:

- It doesn't require additional drivers or agents.
- It is always running, as soon as you apply electricity to the server.
- There's nothing to find, download, or install.

Data collection and logging

As shown in Figure 5, the Active Health System collects data from iLO 4 itself, System ROM, Smart Array, NIC, and power supply firmware, hardware components, and optional OS agents. It collects approximately 1,600 unique data items.

Active Health System does not collect personally identifiable information, such as information about your operations, finances, customers, employees, partners, or data center (for example, IP addresses, host names, usernames, and passwords). While some data from third-party event logs might pass potentially sensitive information (such as host name) to Active Health System, there is no way for Active Health to recognize specifically when this data is included.

HP has obtained TRUSTe's Web Privacy – Cloud certification from TRUSTe. Before issuing this certification to HP, TRUSTe performed an independent audit of privacy and data management claims and practices for Insight Remote Support 7.x solution, including Active Health System. [Read more...](#)



The Active Health System logic collects the following types of data:

- Static—Data that is static between boots, such as configuration information like server model, serial number, processor model, and speed
- Periodically polled—Data sampled at predetermined intervals, such as system temperatures. Active Health System collects this periodic data at defined time intervals, depending on the device and the importance of the information.
- Event/Error—Data that is logged asynchronously when events happen, such as a Smart Array rebuild, power-supply status change, or fan failure

iLO 4 stores all the data in the Active Health System log. The Active Health System logic in iLO 4 determines the best way to log the data:

- Event data is logged as a “whole” data string, when the event happens.
- Active Health System records periodic data and then compares the new polling data to the previously recorded sample. It only logs a new sample when that data changes. For example, temperature data might remain constant for long periods, so Active Health only records when the temperature changes.
- Active Health System uses a hash technique when comparing large data samples. Active Health calculates the hash on newly polled data and compares it to the previous hash. If they are different, Active Health writes the data to the NAND and stores the updated hash. This reduces the number of writes to the NAND flash.

The Active Health System creates a base configuration file for each server boot on a new day. Then, the file contains items that change after that. As iLO 4 adds new files, it compresses the previous day's file in a background process to take up less space in the Active Health System log. iLO 4 runs the compression task only when there is spare idle time on iLO 4. The log holds up to 1 GB of data. We expect that this will store more than 1.5 years of telemetry data at an average growth rate of 1.5 MB/day. If the file reaches its 1 GB partition limit, the Active Health System logic will write new data over the oldest data in the log using a FIFO system.

Data extraction

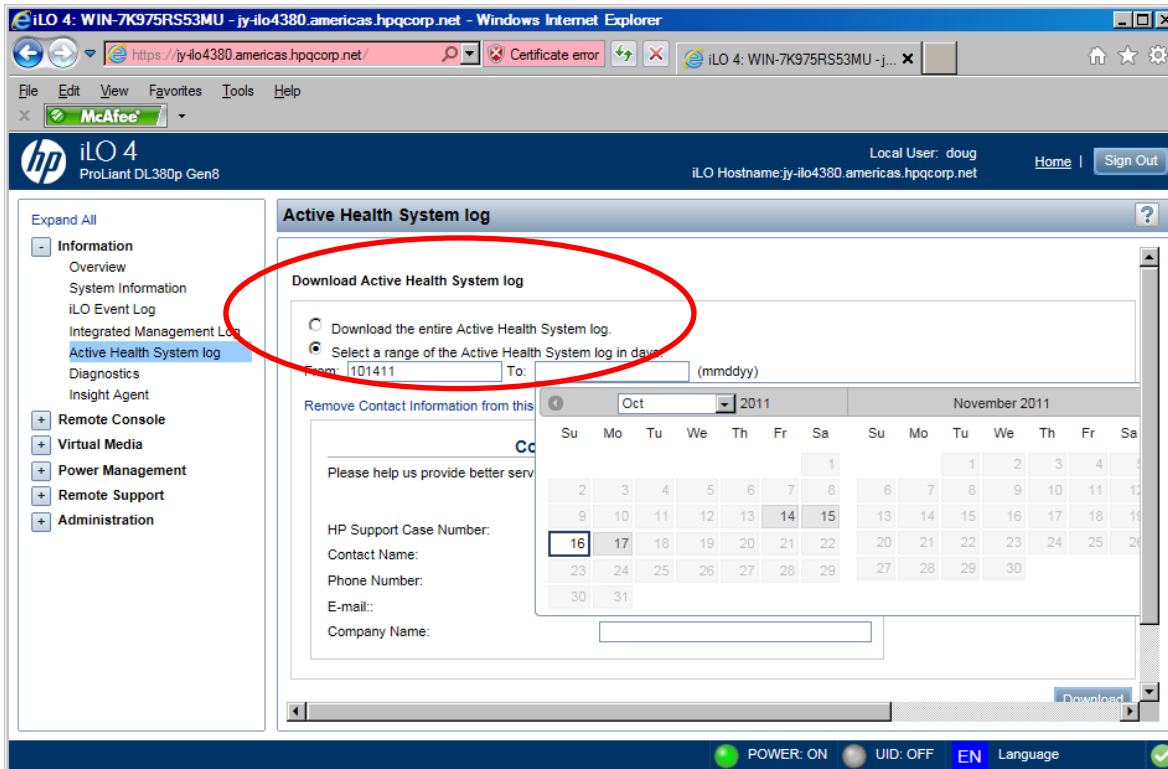
We designed the Active Health System so that it would be easy to extract the data. By downloading and sending the Active Health System data to HP, you agree to have HP use the data for analysis, technical resolution, and quality improvements. HP Support manages the data that iLO 4 collects according to the HP Privacy Statement. It is available at www.hp.com/go/privacy.

You can extract the data using the iLO 4 web interface or HP Intelligent Provisioning.

Figure 6 shows the iLO 4 web interface for downloading the Active Health System data. This method extracts the data across an SPI (serial peripheral interface) bus between iLO 4 and the NAND flash. Because this can be a slow process if you have a large file, we recommend extracting the data for only the last seven days. In most cases, this should give HP Support the data required to diagnose the issue. In some instances, HP Support may ask you to save the AHS log for a longer period.

Note that using the iLO 4 web interface is the only way to access the data if your server is down and won't boot.

Figure 6: Using the iLO 4 web GUI, you can download the entire Active Health System log or download the log for a specific date range.



You can also download the Active Health System log through the HP Intelligent Provisioning interface. The HP Intelligent Provisioning interface uses USB 2.0, which is faster than using the iLO 4 web GUI. If you have large files to extract (more than seven days), it is more efficient to download the Active Health System log through HP Intelligent Provisioning. You can use the HP Intelligent Provisioning interface to gather the Active Health System log even if you don't have iLO 4 configured for remote control. Using HP Intelligent Provisioning, however, means you must shut down your server OS and boot into the HP Intelligent Provisioning partition. Downloading through the iLO GUI allows you to keep your server up.

You can send the data to HP Support using secure HTTPS (SSLv3 or TLS). We store it in a secure data facility in one of our corporate data centers. Customer data stored at HP is labeled as "HP Private" and is managed in accordance with HP Data Handling guidelines.

Conclusion

The HP iLO Management Engine brings a level of embedded management features to ProLiant Gen8 servers that is unmatched by our competitors. It includes several new technology innovations that improve the management of your ProLiant servers independent of the host OS environment. The foundation of iLO Management Engine is the iLO 4 processor and firmware that lets you easily manage a server through its entire lifecycle, from initial deployment, through ongoing management and service alerting.

For more information

Visit the URLs listed below if you need additional information.

Resource description	Web address
Integrated Lights-Out 3 technology	http://h20000.www2.hp.com/bc/docs/support/SupportManual/c02714903/c02714903.pdf
HP Integrated Lights-Out security	http://h20000.www2.hp.com/bc/docs/support/SupportManual/c00212796/c00212796.pdf
HP ProLiant Integrated Lights-Out 3 v1.20 Scripting and Command Line Guide	http://h20000.www2.hp.com/bc/docs/support/SupportManual/c02774508/c02774508.pdf
HP iLO Mobile Application User Guides	www.hp.com/go/ilo/mobileapp
HP iLO Management Engine information library	www.hp.com/go/ilomgmtengine/docs

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Current HP driver, support, and security alerts delivered directly to your desktop

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