Hewlett Packard Enterprise

Technical white paper

Redfish API implementation on HPE servers with iLO RESTful API

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Executive summary

Managing heterogeneous scale-out cloud- and web-based data centers is challenging. Traditional interfaces, such as the Intelligent Platform Management Interface (IPMI), are outdated, complex, and vulnerable to security breaches. Systems managers prefer Representational State Transfer (REST) protocols because they provide an interface that adapts across a variety of server applications, enhances interoperability across multiple server environments, simplifies management, and leverages a single common language.

HPE Integrated Lights Out (iLO) uses a RESTful application programming interface (API) to provide robust control that benefits traditional IT architectures and simplifies management for administrators. To expand the potential of the iLO RESTful API, HPE has spearheaded the effort to create an industry standard for use across heterogeneous data centers via Redfish® API, an open, industry-standard specification and schema designed to provide simple and secure management for modern scale-out data centers. Together, Redfish and the iLO RESTful API create a powerful foundation for managing today's cloud- and web-based data center infrastructures with a new management standard for server management and monitoring as scale increases exponentially.

Document purpose: This document will help you understand the benefits of using Redfish, how it's connected to the iLO RESTful API, and why the industry is transitioning to Redfish. You will also understand how the technology works and integrates with multiple IT vendors. You will learn how you can become less dependent on existing protocols, such as IPMI. Finally, the document provides information on Redfish implementation in the iLO RESTful API on the iLO 4 v2.30, iLO 5, and later versions.

Redfish is sponsored and controlled by the Distributed Management Task Force, Inc. (DMTF), a peer-review standards body recognized throughout the industry. Some of the information in this document is based on DMTF documentation. Links to the DMTF Redfish Specification and other DMTF Redfish-related documentation can be found in the Resources section of this document.

Introduction

Managing scale-out cloud- and web-based data center infrastructures with large numbers of basic servers can be a challenge for data center planners and administrators. Today's systems managers find themselves in heterogeneous environments where they are unable to use a common language to monitor cloud- and web-based infrastructures. Traditional interfaces, like the IPMI tool, are outdated, complex, and vulnerable to security breaches. In addition, data center administrators, programmers, and software development/IT operations personnel (DevOps) must deal with a multitude of devices that didn't exist when the IPMI tool was created, which makes it very difficult to integrate these devices into their environments.

To meet these needs, HPE has developed the iLO RESTful API Ecosystem—based on the modern RESTful API approach—to provide robust control that benefits traditional IT architectures and simplifies management. HPE believes that the iLO RESTful API has tremendous potential for the industry, and that long-term vision requires an industry standard for use across heterogeneous data centers. That's why HPE, through the DMTF, became one of the founding members of the Redfish standard, driving the effort to make Redfish the common standard for managing systems and devices in scale-out environments. The effort now includes industry leaders such as Intel®, Dell EMC, Veritiv, Lenovo, and others.

The Redfish specification

Redfish is an open, industry-standard specification and schema, designed to provide simple and secure management of modern scalable hardware. Redfish is based on the tools and scripting environments most users already have, enabling feature-rich remote management compatible with existing toolsets. Redfish was built from the ground up to scale to the modern, multiple-server environments common in today's enterprise, hyperscale, and cloud infrastructures. Redfish defines the industry standard for the software-defined data center (SDDC), and the effort to modernize heterogeneous data centers.

Redfish and software-defined compute (SDC) provide the control plane for IT infrastructure, enabling users to program simple configuration and maintenance tasks that, until now, have been extremely complex, fragile, and time consuming at scale. Redfish also enables development of new higher-level automation and orchestration features, previously only possible in large-scale, highly customized service provider environments.

Millions of servers have already shipped with Redfish. With more and more hardware vendors supporting it, and as more organizations recognize the advantages of open source toolsets, the security advantages of IPMI, and the ability to manage and monitor more server devices from an API, that number will grow. In addition, HPE offers open source libraries and sample code to make Redfish even more appealing.

You can explore the complete DMTF Redfish specification at dmtf.org/standards/redfish.

Redfish and HPE ProLiant servers

HPE ProLiant servers provide iLO RESTful API extensions to Redfish, allowing you to take advantage of the full range of value-added API features. You can now benefit from adopting the Redfish standard into HPE ProLiant Gen8,[1] Gen9, and Gen10 servers, as well as on other non-HPE server products that implement to the standard. In fact, Redfish is capable of numerous implementations on a wide variety of system architectures, while maintaining a single-interface definition.

Together, Redfish and HPE create a powerful foundation for managing today's cloud- and web-based data center infrastructures, with a new management standard for system control that is scalable, easy to use, and secure.

Redfish features and benefits

To overcome the challenges of the modern data center, system administrators are seeking a modern interface which leverages APIs to use the protocols, structures, and security models that are common in emerging cloud interfaces. Specifically, they prefer RESTful protocols that express data in JavaScript Object Notation (JSON) formats. That's because RESTful protocols address common data center challenges with an interface that can adapt across a variety of server applications, enhance interoperability across multiple server environments, simplify management, and give systems administrators and DevOps a single common language.

As an open industry standard that meets scalability requirements in multi-vendor deployments, Redfish integrates easily with commonly used tools by specifying a RESTful interface and utilizing JSON and OData. HPE ProLiant Gen8, Gen9, and Gen10 servers with the iLO RESTful API offer many benefits over traditional server management technologies (see Table 1).

Table 1. Redfish and iLO RESTful API features and benefits

Lifecycle	Features	Benefits
General	• RESTful API • Add devices	• Pull data into tools that are already in use to shorten or eliminate the learning curve • Add new devices into the same management interface easily
Provisioning	• Retrieve server information details • UEFI BIOS configuration updated for Redfish conformance • Manage UEFI secure boot • Boot order management • HPE iLO configuration • Storage configuration • Find NIC MAC/networking details • HPE Smart Array provisioning • iLO user account management • Virtual media mount/unmount	• Access and configure via remote management • Manage server settings and deploy at scale • Use the Software Development Kit (SDK) available on GitHub to obtain libraries and sample code like Python to get started
Monitoring	• Diagnostics • System memory details • Smart Array and NIC inventory • UEFI BIOS • Get/clear iLO and IML logs • Get Active Health System (AHS) Logs • Get power detail	• Monitor servers remotely using commonly available tools or custom software • Engage with HPE support using AHS logs
Management	• Reset server • Reset iLO • Update firmware	• Secure your data and remove critical information prior to server retirement • For iLO 5 stage the FW on the NAND
Security	• OpenSSL • FIPS certification submitted	• Secure data with industry-standard encryption protocols • Comply with security regulations

[1] ProLiant Gen8 servers will experience reduced Redfish functionality.

Change overview

Recent changes for HPE Gen10 and iLO RESTful API fall into two categories: those designed to align iLO 5 with Redfish changes, and those designed to support HPE Gen10 feature additions.

Table 2. iLO RESTful API updates on HPE Gen10

Align with accumulated Redfish changes	Support Gen10 feature additions
• HPE rename • OData types • Standardized BIOS, Secure Boot, TPM • CPU and memory inventory and status	• HPE Smart Array configuration (see Table 3) • Smart Update using the iLO 5 Repository (see Figure 1) • NVMe and direct-attached storage • New privileges for finer-grain user management in iLO 5 • Individual enable/disable of iLO 5 interfaces such as RIBCL, IPMI • iLO 5 security mode management (production, high security, FIPS submitted, CNSA) • Certificate-based authentication

Table 3. HPE Smart Array configuration

Lifecycle	Features
Inventory and status	• Read controller inventory • Read current controller settings • Read disk inventory • Read logical drive inventory • HPE Smart Storage Battery status
Controller configuration	• Factory reset controller • Change controller settings • Clear controller configuration • Change controller power mode
Logical drive management	• Create logical drive(s) • Delete logical drive(s)
Drive erase/sanitize	• Physical drive erase and sanitation

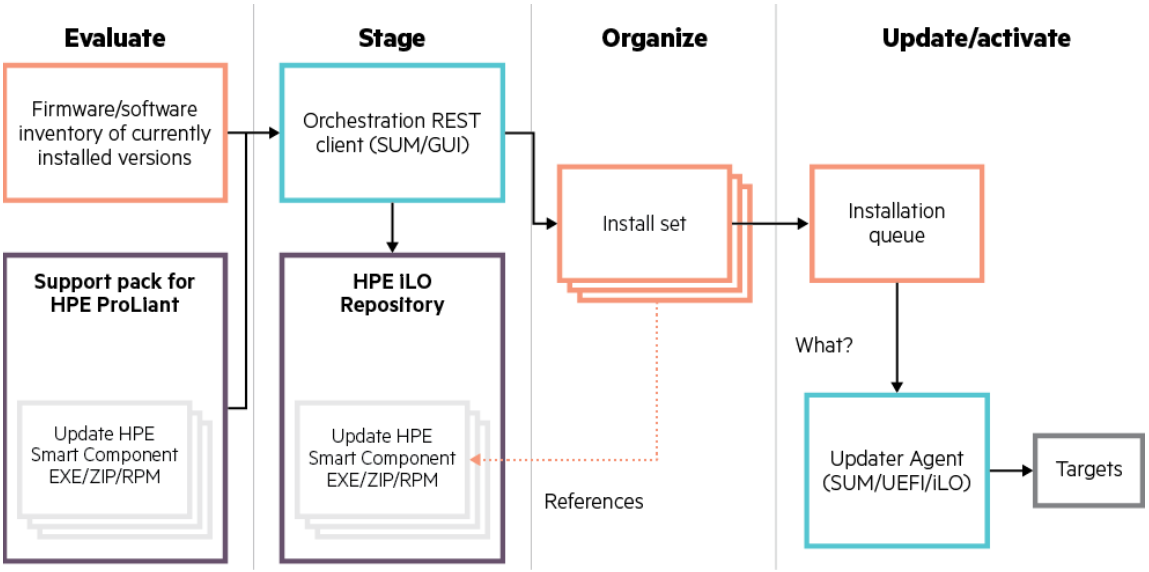

Figure 1. Smart Update using the iLO 5 Repository key concepts

Redfish vs. IPMI

IPMI is a broadly supported industry standard—that specifies a set of interfaces to provide out-of-band management and monitoring capabilities independent of the host system's CPU, firmware (legacy BIOS or UEFI), and operating system (OS). However, IPMI is now a nearly 20-year-old legacy interface that has not kept pace with today's functional and security needs.

Functionality

As an older standard for out-of-band management, IPMI is limited to a "least common denominator" set of commands (for example, power on/off, reboot, temperature readings, and fan speeds). As a result, users have been restricted to a reduced set of functionalities because vendor-specific extensions that attempt to increase the capabilities of IPMI are not common across platforms from different vendors. Meanwhile, users are increasingly developing their own tools for tight integration, often having to rely on in-band management software. The lack of standardized capabilities within IPMI, coupled with increasing amounts of fragmentation due to duplicate OEM extensions result in vendor-specific solutions that do not satisfy the needs of scale-out data center users.

As you can see from Table 1, Redfish offers an enhanced set of features and functionality compared to IPMI.

Security

According to industry watchdogs, IPMI is riddled with security vulnerabilities:

> "A world-wide scan of the Intelligent Platform Management Interface (IPMI) protocol identified over 230,000 Baseboard Management Controllers (BMCs) exposed to the internet, of which upwards of 90% could be compromised by just a handful of basic configuration and protocol weaknesses. The real exposure is even greater, as access to a BMC allows an attacker to compromise its host server as well as other BMCs within its management group, since they share common passwords."[2]

One of the principle motivations for the development of Redfish was to address security requirements that legacy IPMI cannot effectively resolve. For example, Redfish is based on the Hyper Text Transfer Protocol Secure (HTTPS)/Secure Sockets Layer (SSL) standard for its network transport protocol, which is far more prevalent, secure, and auditable than the unique IPMI network protocol.

HPE extensions to Redfish

The Redfish data model enables many common server management tasks but also provides a well-defined extension mechanism for implementers to define additional capabilities. HPE uses this extension mechanism to enable a large additional set of status, health, and configuration data. For example, the HPE extensions to Redfish include Smart Array status and configuration, plus additional actions that can be performed on HPE servers, and extended iLO management features.

[2] Dan Farmer, "Sold Down the River," June 2014

Redfish conformance

HPE was the first in the industry to provide a RESTful API interface for embedded management. And now HPE is first to implement Redfish conformance[3] in HPE ProLiant Gen9 and later servers already embedded with iLO RESTful APIs. The Redfish specification is ideal for enterprise environments and service providers that self-provision and automate their data centers, and for programmers or DevOps looking to enhance data center automations and adapt faster to different workloads.

iLO RESTful API is available in HPE ProLiant Gen8, Gen9, and Gen10 servers with iLO 4 FW v2.00 and later. HPE iLO 5 conformance changes and improvements from the last release include:

- Chunked transfer encoding
- The iLO RESTful API responds to HTTP operations using chunked transfer encoding
- URI remapping from /rest to /redfish
  - For iLO 5 all accesses of the /rest/v1/x URI pattern result in HTTP 308 redirect to /redfish/v1/x/.
  - Advice: Client code should access the API starting at /redfish/v1/ and should handle for HTTP 308 redirect.
- OEM extensions are now named “HPE”
- UEFI BIOS Conformance on iLO 5, moved from an OEM extension

Redfish mode

For iLO 4 and later generations, HPE recommends going directly to /redfish/v1/x/. Refer to the HPE documentation for more details.

With iLO 4 generation, whether a resource behaves in Redfish or legacy mode is not dependent upon the URI used to access the resource, but on the presence or absence of the HTTP OData-Version header. Since it is based on OData v4, Redfish implementation requires the starting metadata OData header to be version 4 (OData v4). This means that in HPE ProLiant Gen9 and later servers, the presence or absence of this OData header is the switch iLO uses to enter Redfish mode or remain in legacy RESTful mode. The URIs do not determine mode.

CLI and SDK options

HPE recognizes that users have different goals and abilities when using Redfish. That’s why we’ve developed two mainly different ways to interact with Redfish.

Redfish for DevOps

For DevOps and other users who are comfortable with writing scripts, HPE offers Python and other libraries on GitHub to help you get started. This will enable direct integrations with the API, access the full data model RAW for more depth of management, facilitate integrating and developing custom applications, open source projects, or other third-party software vendors. For more information, visit the HPE documentation or the library on GitHub.

Redfish for system administrators

For system administrators and other users who prefer to use a CLI tool to run commands, HPE has created an open source, extensible utility with all the scripting done for you. The utility still provides the ability to use commands that facilitate management, monitoring, and automation. The RESTful Interface Tool (iLOREST) also helps with the transition from traditional utilities like CONREP, enabling more manageability from a single tool instead of multiple utilities. Other benefits include:

- Use the scripting tool to view or manipulate data from the iLO RESTful API
- Change settings with a command line or interactively, no file needed
- Leverage the easy, human-readable file system if you want the same CONREP file based mode but now JSON files
- Update more easily, as all validation schemas are taken from the server, no need to get a new version utility for updated settings
- Use the remote capability to configure servers from your own laptop/desktop without the need to be on the server

[3] For further conformance details on Redfish standard, see the DMTF Specification release at dmtf.org/standards/redfish.

- Use one CLI to manage your server vs. multiple utilities:
  - BIOS configuration
  - iLO configuration
  - Hardware/firmware inventory
  - Boot order configuration
  - RAID configuration
  - Firmware updates

For more information, refer to the HPE documentation or the utility on GitHub.

HPE OneView

HPE OneView offers a uniform way of interacting with resources by providing a RESTful API for infrastructure management, and as a building block of the composable infrastructure in a Software Defined Data Center (SDDC) architecture. HPE OneView is the orchestration layer that allows you to use the iLO RESTful API to automate and effectively operate various components of the infrastructure from one location. To learn more, go to hpe.com/info/oneview.

Summary

Redfish is a new, industry-standard specification and schema with a fast industry adoption that meets the expectations of end-users for simple, modern, and secure management of scalable platform hardware. One of the significant benefits of Redfish is the potential for a secure, multi-node capable replacement for IPMI.

Redfish and HPE instrumentation of Software Defined Compute provides the control plane for IT infrastructure, enabling you to program simple configuration and maintenance tasks that have been extremely complex, fragile, and time consuming at scale. Redfish also allows you to develop higher-level automation and orchestration features, previously only possible in large-scale, highly customized service provider environments. Redfish lets server administrators, developers, and operations staff spend less time on day-to-day maintenance, and simplifies tools to develop the advanced next-generation capabilities required for the business. Redfish reduces vendor lock-in, increases productivity and security, lowers operating costs, and plays a crucial role in enabling next-generation infrastructures.

HPE is the first major system manufacturer to adopt the DMTF Redfish standard. The Redfish standard enjoys broad vendor endorsement and defines the industry standard for IT infrastructure management.

Resources

HPE Library entries for RESTful Interface Tool

DMTF Redfish documentation and specification

HPE Library

iLO RESTful API SDK on GitHub

- iLO RESTful API Resources
- Python library
- PowerShell cmdlets
- iLO RESTful API SDK Documentation
- JavaScript library

Tools

RESTful Interface Tool (scripting)

Community

Join the community at: HPE DEV

Learn more at

hpe.com/info/restfulapi

Sign up for updates

4AA6-1727ENW, December 2017, Rev. 2