Managing Dell EMC Hardware with the OpenStack Ironic iDRAC Driver

Abstract
This technical guide explains how to manage Dell EMC server hardware in an OpenStack environment, using OpenStack Ironic with the iDRAC driver.

October 2019
Revisions

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2019</td>
<td>Initial release</td>
</tr>
</tbody>
</table>

Acknowledgements

This guide was produced by the following:

Author: Dale McDonald, Christopher Dearborn
Support: Paul Dardeau, Kurt Hey, Arkady Kanevsky

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Executive summary

Cloud operators need to manage bare metal server hardware as it is brought into their environments. Ironic is an open source project within the OpenStack Foundation that provides all bare metal management needs for all platforms and workloads.

- See https://docs.openstack.org/ironic/train/ for more information about Ironic.

Ironic provides three drivers that can be used to manage Dell EMC hardware:

- iDRAC driver
- Redfish driver
- IPMI driver

These drivers have differing capabilities. See Hardware types on page 5 for more information.

The Ironic iDRAC driver is an open source Ironic sub-project that provides extended capabilities for managing Dell EMC hardware beyond that provided by the generic IPMI or Redfish drivers.

- See https://docs.openstack.org/ironic/train/admin/drivers/idrac.html for more information about the iDRAC driver.

The OpenStack Marketplace is a searchable, linked list of drivers that support managing Dell EMC hardware. You can filter your search by OpenStack project, vendor, and/or OpenStack release version.

- See https://www.openstack.org/marketplace/drivers to search for drivers.

Dell EMC provides third party continuous integration to ensure that all changes to Ironic work with PowerEdge server hardware.

- See http://ciwatch.mmedvede.net/project?project=ironic&time=7+days to view live, up-to-the-minute Ironic and iDRAC driver continuous integration test result data.
Getting started

Operators require some basic information before provisioning Dell EMC server hardware with the Ironic iDRAC driver, including supported hardware, hardware types, and firmware. The terms, *iDRAC driver* and *iDRAC hardware type*, are used interchangeably throughout this document.

This document assumes that Ironic has been installed. For information about installing Ironic, see [https://docs.openstack.org/ironic/train/install/index.html](https://docs.openstack.org/ironic/train/install/index.html).

1.1 Supported hardware

This solution supports the use of Dell EMC PowerEdge rack server solutions.

The iDRAC driver should support Dell EMC PowerEdge R720xd and R620 rack servers but is no longer actively tested. Dell EMC cannot guarantee performance and compatibility with the R720xd and R620.

Servers with a Chassis Management Controller (CMC) are incompatible with the iDRAC driver, since they lack an iDRAC.

Supported Dell EMC server hardware includes:

- PowerEdge R640
- PowerEdge R740
- PowerEdge R740xd
- PowerEdge DSS 9000
- PowerEdge R630
- PowerEdge R730
- PowerEdge R730xd

In addition, this solution utilizes the following storage controllers:

- BOSS
- HBA330
- PERC H730
- PERC H730P
- PERC H740P

1.2 Hardware types

Ironic supports the following hardware types shown in Table 1 for managing Dell EMC server hardware.

<table>
<thead>
<tr>
<th>Hardware type</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ipmi</td>
<td>Fewest features</td>
</tr>
<tr>
<td>redfish</td>
<td>More features. In active development, new features being added</td>
</tr>
</tbody>
</table>
### 1.2.1 Protocol comparison

Table 2 compares the benefits of using either the WSMAN or redfish protocols with the iDRAC driver.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>WSMAN</td>
<td>Extended support for deploying nodes using WSMAN, including:</td>
</tr>
<tr>
<td></td>
<td>• Power control</td>
</tr>
<tr>
<td></td>
<td>• Boot device management</td>
</tr>
<tr>
<td></td>
<td>• In-band inspection</td>
</tr>
<tr>
<td></td>
<td>• Out-of-band inspection</td>
</tr>
<tr>
<td></td>
<td>• RAID configuration</td>
</tr>
<tr>
<td></td>
<td>• BIOS configuration</td>
</tr>
<tr>
<td>Redfish</td>
<td>Basic support for deploying nodes using Redfish, including:</td>
</tr>
<tr>
<td></td>
<td>• Power control</td>
</tr>
<tr>
<td></td>
<td>• Boot device management</td>
</tr>
<tr>
<td></td>
<td>• In-band inspection</td>
</tr>
<tr>
<td></td>
<td>• Out-of-band inspection</td>
</tr>
</tbody>
</table>

The iDRAC driver team is actively working on upgrading Redfish support to parity with WSMAN support. New features will only support Redfish.

### 1.3 Supported firmware

The firmware used during validation of this solution includes those shown in Table 3 and Table 4.

<table>
<thead>
<tr>
<th>PowerEdge Servers</th>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSS 9000, R640, R740, R740xd</td>
<td>Lifecycle controller</td>
<td>3.30.30.30</td>
</tr>
<tr>
<td></td>
<td>BIOS</td>
<td>1.5.6</td>
</tr>
<tr>
<td>R630, R730, R730xd</td>
<td>Lifecycle controller</td>
<td>2.61.60.60, 2.63.60.61</td>
</tr>
<tr>
<td></td>
<td>BIOS</td>
<td>2.9.1, 2.10.5</td>
</tr>
</tbody>
</table>
The PowerEdge R630, R730, and R730xd do not currently support the Redfish driver or the idrac-redfish interfaces of the iDRAC driver. Their firmware does not yet have the same level of Redfish support as does the firmware for newer servers. Support for the Redfish driver and the idrac-redfish interfaces of the iDRAC driver for the R630, R730, and R730xd will be provided by a future firmware release.

Table 4: Supported storage controller firmware versions

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERC H730P RAID controller</td>
<td>25.5.5.0005</td>
</tr>
<tr>
<td>PERC H740P RAID controller</td>
<td>50.5.0-1750</td>
</tr>
<tr>
<td>HBA330 disk controller</td>
<td>16.17.00.03</td>
</tr>
<tr>
<td>BOSS-S1 RAID controller</td>
<td>2.5.13.3016</td>
</tr>
</tbody>
</table>
Provisioning Dell EMC hardware with the iDRAC driver

This chapter provides basic information that you will need to provision Dell EMC server hardware with the Ironic iDRAC driver.

2.1 Prerequisites

Some configuration of Ironic is required before provisioning bare metal nodes using the iDRAC driver. This includes:

1. Installing required libraries
2. Enabling the idrac hardware type
3. Enabling selected interfaces
4. For detailed instructions see the Enabling section of the iDRAC driver documentation, at https://docs.openstack.org/ironic/train/admin/drivers/idrac.html.

Be sure to restart the Ironic conductor service after making any changes to the ironic.conf file.

2.2 Enroll nodes

After the initial configuration of Ironic has been completed, nodes can be enrolled into Ironic.

1. Follow the general enrollment process specified at https://docs.openstack.org/ironic/train/install/enrollment.html.
2. Deviations from that process include:
   a. Create nodes on page 8
   b. Select interfaces on page 8
   c. Set iDRAC credentials on page 10

2.2.1 Create nodes

When creating a node in Ironic, the driver that Ironic should use to manage the node must be specified.

1. Pass --driver idrac to the openstack baremetal node create command to manage the node using the iDRAC hardware type.
2. See the Enrolling section of the iDRAC driver documentation located in the Ironic documentation, at https://docs.openstack.org/ironic/train/admin/drivers/idrac.html.

2.2.2 Select interfaces

Ironic defines a set of interfaces that every hardware type can implement. Some of these interfaces are required, while others are optional. The iDRAC driver supports the following interfaces:

- **Inspect** - Provides out-of-band inspection capabilities
- **Management** - Provides boot device management
- **Power** - Provides power control
- **RAID** - Provides RAID volume configuration
- **Vendor** - Provides BIOS settings configuration
WSMAN is supported for all these interfaces. The OpenStack Train release of the iDRAC driver adds Redfish support for the following interfaces:

- Inspect
- Management
- Power

By default, the iDRAC hardware type uses the WSMAN version of these interfaces to manage nodes.

The WSMAN management and power interfaces must be used as a pair. If you use WSMAN for one of these interfaces, then you must use WSMAN for the other.

Alternatively, Redfish can be used for the interfaces indicated above. To use Redfish for an interface:

1. Specify the following parameters to the openstack baremetal node create command:
   a. Inspect: `--inspect-interface idrac-redfish`
   b. Management: `--management-interface idrac-redfish`
   c. Power: `--power-interface idrac-redfish`

2. Alternatively, the interfaces to use on a node can be set after node creation.
   a. Get the UUID of the node in Ironic by running the following command:

   ```
   openstack baremetal node list
   --------------------------------------
   | UUID                                 | Name | Instance UUID | Power State |
   |--------------------------------------|
   | ad5bca80-2633-41e0-8ac5-b96f4f343f34  | None | None          | None        |
   | enroll False                         |
   --------------------------------------
   ```

   b. Set the interfaces by running the following command:

   ```
   openstack baremetal node set <uuid> --inspect-interface idrac-redfish
   ```

   c. Or, you can set multiple interfaces can be set at once by specifying `--xxx-interface` and a supported interface multiple times. For example:

   ```
   openstack baremetal node set <uuid> \ 
   --power-interface idrac-redfish \ 
   --management-interface idrac-redfish
   ```

   The WSMAN interface name can be explicitly specified as idrac-wsman.
2.2.3 Set iDRAC credentials

For Ironic to be able to access the iDRAC, the credentials for the iDRAC must be set on the node in Ironic:

- If using the WSMAN interfaces, the WSMAN credentials must be specified.
- If using the Redfish interfaces, the Redfish credentials must be specified.
- If using a mix of both the WSMAN interfaces and the Redfish interfaces, both sets of credentials must be specified.

The following parameters are used to specify the WSMAN credentials on the node in Ironic:

- **drac_username** - The WSMAN user name to use when communicating with the iDRAC. Usually `root`.
- **drac_password** - The password for the WSMAN user to use when communicating with the iDRAC.
- **drac_address** - The IP address of the iDRAC.

The following parameters are used to specify the Redfish credentials on the node in Ironic:

- **redfish_username** - The Redfish user name to use when communicating with the iDRAC. Usually `root`.
- **redfish_password** - The password for the Redfish user to use when communicating with the iDRAC.
- **redfish_address** - The URL to the Redfish service running on the iDRAC (https://<ip>),
- **redfish_system_id** - The Redfish ID of the server to be managed. This should always be: `/redfish/v1/Systems/System.Embedded.1`.

Credentials can be associated with the node in Ironic either when creating the node or by modifying the node after it has been created:

1. To specify the WSMAN credentials when creating a node in Ironic pass the following parameters to the `openstack baremetal node create` command:

```bash
--driver-info drac_username=<username> \ 
--driver-info drac_password=<password> \ 
--driver-info drac_address=<ip>
```

2. To specify the Redfish credentials when creating a node in Ironic, pass the following parameters to the `openstack baremetal node create` command:

```bash
--driver-info redfish_username=<username> \ 
--driver-info redfish_password=<password> \ 
--driver-info redfish_address=https://<ip> \ 
--driver-info redfish_system_id=/redfish/v1/Systems/System.Embedded.1
```

Alternatively, the credentials for Ironic to use can be set or modified after the node has been created.

1. Get the UUID of the node in Ironic by following Step 2a on page 9.
2. Set the desired parameters on the node by running the following command:

```bash
openstack baremetal node set <uuid> \ 
--driver-info <parameter_name>=<parameter_value>
```
Or, you can set multiple parameters at once by specifying --driver-info, and a parameter name and value, multiple times.

2.2.4 Node creation examples

To put it all together, create a node in Ironic as per the following examples:

- WSMAN example on page 11
- Redfish example on page 11
- Redfish and WSMAN example on page 11

2.2.4.1 WSMAN example

The following example creates a node in Ironic that is managed by the iDRAC hardware type and uses WSMAN for all interfaces:

```
openstack baremetal node create \
--driver idrac \
--driver-info drac_username=root \
--driver-info drac_password=1234 \
--driver-info drac_address=192.168.110.100
```

2.2.4.2 Redfish example

The following example creates a node in Ironic that is managed by the iDRAC hardware type and uses Redfish for all interfaces:

```
openstack baremetal node create \
--driver idrac \
--driver-info redfish_username=root \
--driver-info redfish_password=1234 \
--driver-info redfish_address=https://192.168.110.100 \
--driver-info redfish_system_id=/redfish/v1/Systems/System.Embedded.1 \
--inspect-interface idrac-redfish \
--management-interface idrac-redfish \
--power-interface idrac-redfish \
--vendor-interface no-vendor \
--raid-interface no-raid
```

Currently, Redfish support in the iDRAC driver does not include BIOS or RAID configuration.

2.2.4.3 Redfish and WSMAN example

The following example creates a node in Ironic that is managed by the iDRAC hardware type and uses Redfish for the power, management, and inspect interfaces, and WSMAN for the remaining interfaces:

```
openstack baremetal node create \
--driver idrac \
--driver-info redfish_username=root \
--driver-info redfish_password=1234 \
--driver-info redfish_address=https://192.168.110.100 \
--driver-info redfish_system_id=/redfish/v1/Systems/System.Embedded.1 \
--driver-info drac_username=root \
```

Provisioning Dell EMC hardware with the iDRAC driver

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```
--driver-info drac_password=1234 \
--driver-info drac_address=192.168.110.100 \n--inspect-interface idrac-redfish \n--management-interface idrac-redfish \n--power-interface idrac-redfish
```

2.2.5 Monitoring Ironic and iDRAC interactions

Once the node has been set up in Ironic, interactions between Ironic and the node can be seen by searching in `/var/log/ironic/ironic-conductor.log` for either the UUID or the IP address of the node.

2.2.6 Prepare nodes for deployment

Prior to deploying the nodes using Ironic Dell EMC recommends that you put the iDRACs into a known good state, by executing the manual `known_good_state` cleaning step against the node. This cleaning step currently resets the iDRAC and clears the Lifecycle Controller job queue on the targeted node. It may be extended in the future to perform other best practice operations to put the server into the best possible known good state.

These cleaning steps are only available on nodes whose management interface is set to `idrac-wsman`. Support for these cleaning steps in the `idrac-redfish` management interface will be added in a future release.

You can use this procedure to return a node to an initial clean state when returning a node to the unallocated bare metal pool.

To execute the `known_good_state` cleaning step:

1. Get the UUID of the target node by following Step 2a on page 9.
2. Run the following command:

   ```
   openstack baremetal node clean --clean-steps '[["interface": "management", \n   "step": "known_good_state"]]' <uuid>
   ```

3. Monitor the progress of the cleaning step by periodically running the following command, and then watching for the node exiting the cleaning state:

   ```
   openstack baremetal node list
   ```

   The cleaning step may take a few minutes to complete.

If you do not wish to reset the iDRAC and clear the job queue in the same operation, you can execute them separately.

To reset the iDRAC:

1. Get the UUID of the target node by following Step 2a on page 9.
2. Run the command in Step 2 above, substituting `reset_idrac` for the cleaning step name.
3. Run the command in Step 3 above.
To clear the Lifecycle Controller job queue:

1. Get the UUID of the target node by following Step 2a on page 9.
2. Run the command in Step 2 above, substituting `clear_job_queue` for the cleaning step name.
3. Run the command in Step 3 above.

### 2.2.7 Inspect nodes

You can inspect nodes using either in-band or out-of-band inspection:

- In-band inspection - Causes the node to PXE boot an inspection RAM disk hosted by Ironic.
- Out-of-band inspection - Ironic communicates directly with the iDRAC through the driver configured on the node.

Because out-of-band introspection does not require a server reboot, it executes much more quickly than in-band introspection.

To inspect a node using out-of-band inspection:

- Run the following command:

  ```bash
  openstack baremetal node inspect <uuid>
  ```

  If the `idrac-redfish inspect` interface is used, then you must PXE-enable the node port in Ironic that has the MAC address of the port set to PXE boot on the server. To do this, first determine the MAC address of the port on the server that is configured to PXE boot.

1. Log in to the server’s iDRAC GUI.
2. Navigate to **Configuration > BIOS Settings > Network Settings**.
3. Examine the **Current Value** setting for PXE Device1 through PXE Device4.
   a. Note the PXE device whose value is **Enabled**.
4. Expand the **PXE Device N** settings for that device.
5. The name of the PXE port is displayed in the **Interface** field.
6. Navigate to **System > Inventory > Hardware Inventory** to find the port with that name.

   **The CurrentMACAddress field displays the MAC address of the PXE port.**

7. Find the port associated with the node in Ironic that has that MAC address by running the following command:

   ```bash
   openstack baremetal port list --node <node_uuid> | grep -i \\ <MAC_address_found_above>
   ```

   This will give you the UUID of the port.

8. Enable PXE on the port by running the following command:

   ```bash
   openstack baremetal port set --pxe-enabled <port_uuid>
   ```

   **The idrac-wsman inspect interface automatically PXE enables the correct port.**

   Automatically enabling PXE on the port in the `idrac-redfish inspect` interface will be added in a future release.
3  **OpenStack Train release deliverables**

Dell EMC has added the following enhancements to the OpenStack Train release.

3.1 **Hybrid Redfish/WSMAN driver**

In the OpenStack Train release, Dell EMC has added to the iDRAC driver the ability to select Redfish or WSMAN for the protocol to use for the Ironic power, management, and inspect interfaces. For backwards compatibility the default, if not specified, is to use the WSMAN protocol.

Currently, the RAID and vendor passthru interfaces in the iDRAC driver only support the WSMAN protocol. The RAID interface is used for RAID volume configuration; the vendor passthru interface is used for BIOS configuration. Operators can optionally choose to use Redfish for power control, boot device management, and out-of-band inspection; while using WSMAN for RAID volume configuration and BIOS configuration.

Future iDRAC driver releases will add Redfish support for the Ironic RAID and BIOS interfaces.

3.2 **Hardware**

Dell EMC has added support for Dell EMC PowerEdge R640 and R740/740xd servers with 2nd Generation Intel® Xeon® Scalable Processors and DDR4 2933MHz memory DIMMs.

3.3 **Enhanced documentation**

Dell EMC has revised the upstream documentation for the iDRAC driver extensively and added content for the new Redfish support.

3.4 **RAID configuration enhancements**

Real-time mode is now used to create and delete RAID volumes when the controller supports it. This results in reduced time to create or delete RAID volumes, since rebooting is no longer necessary for RAID controllers that support real-time.

Table 5: Real-time mode support

<table>
<thead>
<tr>
<th>Component</th>
<th>Supports real-time mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERC H730P RAID controller</td>
<td>Yes</td>
</tr>
<tr>
<td>PERC H740P RAID controller</td>
<td>Yes</td>
</tr>
<tr>
<td>HBA330 disk controller</td>
<td>No</td>
</tr>
<tr>
<td>BOSS-S1 RAID controller</td>
<td>No</td>
</tr>
</tbody>
</table>

The RAID deletion cleaning step has been enhanced so that it now frees up all global and dedicated hot spares and reclains any foreign drives in addition to deleting all RAID volumes.
3.5 Cleaning steps enhancements

Dell EMC has added the following enhancements to the cleaning steps:

- Added the `clear_job_queue` cleaning step to clear the Lifecycle Controller job queue to purge both pending and completed configuration jobs
- Added the `reset_idrac` cleaning step to easily reset iDRACs
- Added the `known_good_state` cleaning step to put the iDRAC in a known good state prior to deployment
  - Currently, this includes resetting the iDRAC and clearing the Lifecycle Controller job queue.

These cleaning steps are only available in the `idrac-wsman` version of the management interface.
Summary

4 Summary

While the generic Ironic IPMI and Redfish drivers can be used to manage Dell hardware, the Ironic iDRAC driver provides more features and flexibility.

As the industry transitions to Redfish the Ironic iDRAC driver has begun transitioning to Redfish as well. The iDRAC driver now enables operators to select using the Redfish protocol for some Ironic interfaces, while continuing to use the existing WSMAN protocol for other Ironic interfaces. Operators can start using Redfish while still retaining access to the extended WSMAN RAID and BIOS configuration capabilities.

Future releases of the iDRAC driver will upgrade Redfish support to parity with WSMAN support.
A  Technical support and resources

You can obtain technical support for Dell EMC hardware solutions directly from Dell EMC. You can obtain Ironic and iDRAC driver software support from the OpenStack documentation.

A.1  Dell EMC hardware technical support

Dell.com/support is focused on meeting customer needs with proven services and support.

Storage technical documents and videos provide expertise that helps to ensure customer success on Dell EMC storage platforms.

A.2  Ironic and iDRAC driver software related resources

Please refer to the following resources for more information about Ironic and the iDRAC driver:

- Ironic documentation – https://docs.openstack.org/ironic/train/
- iDRAC driver documentation – https://docs.openstack.org/ironic/train/admin/drivers/idrac.html