Intel® Rack Scale Design (Intel® RSD) Conformance and Software Reference Kit

Getting Started Guide

Software v2.3.2

September 2018

Revision 003US

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Revision History

Revision	Description	Date
003US	Interim release of Intel® RSD Software v2.3.2	September 2018
002US	Interim release of Intel® RSD Software v2.3.1 • Resolved Cliffdale code name to Intel® SSD DC P4500/4600 Series Memory product name	July 2018
001US	Initial release for Intel® RSD Software release v2.3	May 2018

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1.0   *Introduction*

1.1   Scope

The *Intel® Rack Scale Design (Intel® RSD) Conformance and Software Reference Kit Getting Started Guide* covers implementing the required functions of the Intel® RSD reference architecture, including hardware, software, system setup, and standards-based APIs.

1.2   Intended Audience

This guide is the starting point for developers planning to work with Intel® RSD software and conformance testing. Intel recommends reading the entire guide before starting.

1.3   Background and Prerequisite Information

This guide provides background and prerequisite information for the Intel® RSD documentation and the Intel® RSD conformance process. This information ensures the process goes smoothly and efficiently.

Note: The Intel® RSD code is reference software only. Developers are expected to modify the software and make it their own. Additional releases are forthcoming.

The following steps outline a summary of all available Intel® RSD materials:

1. Read *Intel® Rack Scale (Intel® RSD) Design Architecture Specification* (refer to Table 2) to gain an understanding of the hardware and components, and learn how Intel® RSD software works with these components.

2. Read *Intel® Rack Scale Design (Intel® RSD) POD Manager (PODM) Representational State Transfer (REST) User Guide* and *Intel® Rack Scale Design (Intel® RSD) Pooled System Management Engine (PSME) User Guide* (refer to Table 2). These resources describe the core components and setup processes for the hardware and software components.

3. Read *Intel® Rack Scale Design (Intel® RSD) Conformance and Software Reference Kit Getting Started Guide* (this document) to start your design while keeping conformance testing in mind. This document covers design and test prerequisites to ensure smooth and efficient testing at the end of the development and validation processes.

4. Plan the configuration of the Intel® RSD software components across your hardware. Decide which servers in your rack configurations will run which PSME and PODM components (also known as agents). For example:

   - Dedicate an Ubuntu* v16.04 server with a Baseboard Management Controller (BMC); (for example, 1U on any rack) to run the PSME compute and core rest interface modules. For example, Dell PowerEdge* and HP ProLiant* have this capability.

   - Dedicate a 10 GbE Top of Rack (ToR) or other switch to run the PSME core and networking modules.

   - Dedicate another storage server (disk controller) to run the PSME core rest APIs and storage agents/modules. This storage server could be the same dedicated server (with BMC) above for compute, as the server could also have a storage controller and additional disks.

   Note: The Intel® RSD v2.3.2 reference software provides secure erase on decomposition security features. To support the features, the Intel® SSD DC P4500/4600 Series memory (previously known as Cliffdale) (4500/4600) or later solid-state drives (SSDs) are required.

5. Contact an Intel® RSD account representative or visit the Intel® RSD website (refer to Table 2) to acquire the required code.

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6. Read *Intel® Rack Scale Design (Intel® RSD) Generic Assets Management Interface (GAMI) API Specification*, *Intel® Rack Scale Design (Intel® RSD) POD Manager (PODM) Representational State Transfer (REST) API Specification*, *Intel® Rack Scale Design (Intel® RSD) Pooled System Management Engine (PSME) Representational State Transfer (REST) API Specification*, and *Intel® Rack Scale Design (Intel® RSD) Rack Management Module (RMM) Representational State Transfer (REST) API Specification* (refer to Table 2). These references will enable you to understand and work with the functional code provided, including:

   - Intel® RSD PDOM reference code includes a fully functional northbound interface exposing Redfish*-aligned APIs along with code to discover, compose, and manage Intel® RSD resources.
   - Intel® RSD PSME/RMM reference code provides fully functional implementation to communicate with PODM, northbound REST interface exposing Redfish*-aligned APIs, manage and report power/thermal data to the PODM, and RMM implementations. It also includes stubs for the PSME network, compute, and chassis agents.
   - Intel® RSD PSME Storage Service reference code includes fully functional remote storage service implementations with northbound REST APIs and creates initial internet Small Computer System Interface (iSCSI) targets on service initiation.

7. Build, install, and modify the PSME components on the hardware configuration (refer to the *Intel® Rack Scale Design (Intel® RSD) Pooled System Management Engine (PSME) User Guide* listed in Table 2). Modify the GAMI agents to interface with the hardware configuration.

8. Build, install, and modify the PODM components to talk with the PSME agents and manage the racks (refer to the *Intel® Rack Scale Design (Intel® RSD) POD Manager (PODM) Representational State Transfer (REST) User Guide* listed in Table 2).

9. Connect to an outside orchestration layer if one is used (for example, OpenStack*).

10. Read *Intel® Rack Scale Design (Intel® RSD) POD Manager (PODM) Release Notes* and *Intel® Rack Scale Design (Intel® RSD) Pooled System Management Engine (PSME) Release Notes* to be aware of potential issues.

Note: Contact an Intel® RSD account representative or visit the Intel® RSD website (refer to Table 2) if you run into issues, have questions, or want to provide general feedback.

1.4   Conventions

The key words/phrases "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in *Key Words for Use in RFCs to Indicate Requirement Levels, March 1997*, RFC 2119, refer to Table 2.

1.5   Notes and Symbol Convention

Symbol and note conventions are similar to typographical conventions used in the *Cloud Infrastructure Management Interface 6 (CIMI) Model and RESTful HTTP-based Protocol 7 An Interface for Managing Cloud Infrastructure,* DSP0263, refer to Table 2. Notation used in JSON* serialization description:

- Values in italics indicate data types instead of literal values.
- Characters are appended to items to indicate cardinality:
  - ? (0 or 1)
  - * (0 or more)
  - + (1 or more)
- Vertical bars, |, denote choice. For example, a|b means a choice between a and b.
- Parentheses, ( ), indicate the scope of the operators ?, *, +, and |.
- Ellipses, …, indicate points of extensibility. The lack of an ellipsis does not mean no extensibility point exists; rather, it is just not explicitly called out.

1.6   Terminology

Table 1.   Terminology

Term	Definition
ACL	Access Control List
BMC	Baseboard Management Controller
CA	Certificate Authority
CIMI	Cloud Infrastructure Management Interface
CTS	Conformance Test Suite
GAMI	Generic Assets Management Interface
IPMI	Intelligent Platform Management Interface
iSCSI	Internet Small Computer System Interface
ISV	Independent Software Vendor
LAG	Link Aggregation Group
NVMe*	Non-Volatile Memory express*
NVMe-oF*	NVMe over Fabrics*
OEM	Original Equipment Manufacturer
PCIe*	Peripheral Component Interconnect express*
PNC	Pooled NVMe Controller
POD	A physical collection of multiple racks
PODM	POD Manager
PSME	Pooled System Management Engine
RDMA	Remote Direct Memory Access
RMM	Rack Management Module
RSD	Rack Scale Design
SLED	Single Large Expensive Disk
SMBIOS	System Management BIOS
SSD	Solid-State Drive
ToR	Top of Rack

1.7   References

Table 2.   Reference Documents and Resources

Doc ID	Title	Location
337196	*Intel® Rack Scale Design (Intel® RSD) Pooled System Management Engine (PSME) User Guide Software v2.3.2*	*http://www.intel.com/intelRSD*
337197	*Intel® Rack Scale Design (Intel® RSD) Conformance and Software Reference Kit Getting Started Guide Software v2.3.2*	
337198	*Intel® Rack Scale Design (Intel® RSD) POD Manager (PODM) Release Notes Software v2.3.2*	
337199	*Intel® Rack Scale Design (Intel® RSD) POD Manager (PODM) Representational State Transfer (REST User Guide Software v2.3.2*	
337200	*Intel® Rack Scale Design (Intel® RSD) Pooled System Management Engine (PSME) Release Notes Software v2.3.2*	
337201	*Intel® Rack Scale Design (Intel® RSD) Firmware Extension Specification Software v2.3.2*	

| Doc ID	Title	Location
337202	*Intel® Rack Scale Design (Intel® RSD) Storage Services API Specification Software v2.3.2*	
337203	*Intel® Rack Scale Design (Intel® RSD) Architecture Specification Software v2.3.2*	
337204	*Intel® Rack Scale Design (Intel® RSD) POD Manager (PODM) Representational State Transfer (REST) API Specification Software v2.3.2*	
337205	*Intel® Rack Scale Design (Intel® RSD) Rack Management Module (RMM) Representational State Transfer (REST) API Specification Software v2.3.2*	
337206	*Intel® Rack Scale Design (Intel® RSD) Generic Assets Management Interface (GAMI) API Software v2.3.2*	
337207	*Intel® Rack Scale Design (Intel® RSD) Pooled System Management Engine (PSME) Representational State Transfer (REST) API Specification Software v2.3.2*	
DSP0263	*Cloud Infrastructure Management Interface 6 (CIMI) Model and RESTful HTTP-based Protocol 7 An Interface for Managing Cloud Infrastructure*	*https://www.dmtf.org/sites/default/files/standards/documents/DSP0263_2.0.0.pdf*
DSP8010	*Redfish Schema v2016.3 (Compute)*	*https://www.dmtf.org/sites/default/files/standards/documents/DSP8010_2016.3.zip*
DSP8010	*Redfish Schema v2017.3*	*https://www.dmtf.org/sites/default/files/DSP8010_2017.3.zip*
DSP0266	*Scalable Platforms Management API Specification v1.4.0*	*https://www.dmtf.org/sites/default/files/DSP0266_1.4.0.pdf.*
DSP8010	*Storage Networking Industry Association (SNIA) Swordfish* Version 1.4.0*	*https://www.dmtf.org/sites/default/files/DSP0266_1.4.0.pdf*
RFC2119	*Key Words for Use in RFCs to Indicate Requirement Levels, March 1997*	*https://ietf.org/rfc/rfc2119.txt*
N/A	*Hypertext Transfer Protocol - HTTP/1.1*	*https://dmtf.org/sites/default/files/standards/documents/DSP0266_1.1.0.pdf*
N/A	*NVM Express over Fabrics 1.0*	*http://nvmexpress.org/wp-content/uploads/NVMe_over_Fabrics_1_0_Gold_20160605-1.pdf*
N/A	*Intel® RSD v2.3.2 Conformance Test Suite (CTS) tool binary*	*https://github.com/intel/intelRSD/tree/master/CTS*

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2.0   Intel® RSD Conformance Overview

The *Intel® Rack Scale Design (Intel® RSD) Conformance and Software Reference Kit* covers implementing the required functions of the Intel® RSD reference architecture, including hardware, software, system setup, and standards-based APIs. Conformance drives alignment to industry standards (driving those standards into the market), builds the Intel® RSD ecosystem, builds end customer assurance, and reduces product development costs by improving time to market of new technologies.

Engagement with the Intel® RSD ecosystem, illustrated in Figure 1, involves the following:

- Releasing the feature complete "beta" Intel® RSD software to the open-source community.
- Supporting Original Equipment Manufacturer (OEM) Partners to complete development of the Intel® RSD software (PSME/RMM and PODM) with OEM hardware-specific code and optional OEM features.
- Supporting partners through conformance testing, which includes an automated Conformance Test Suite (CTS) tool, with manual checks.
- Working with third-party independent software vendors (ISVs) to enable orchestration solutions to work with the Intel® RSD software.

Figure 1.   Intel® RSD Co-Development Process and Conformance Process Flow
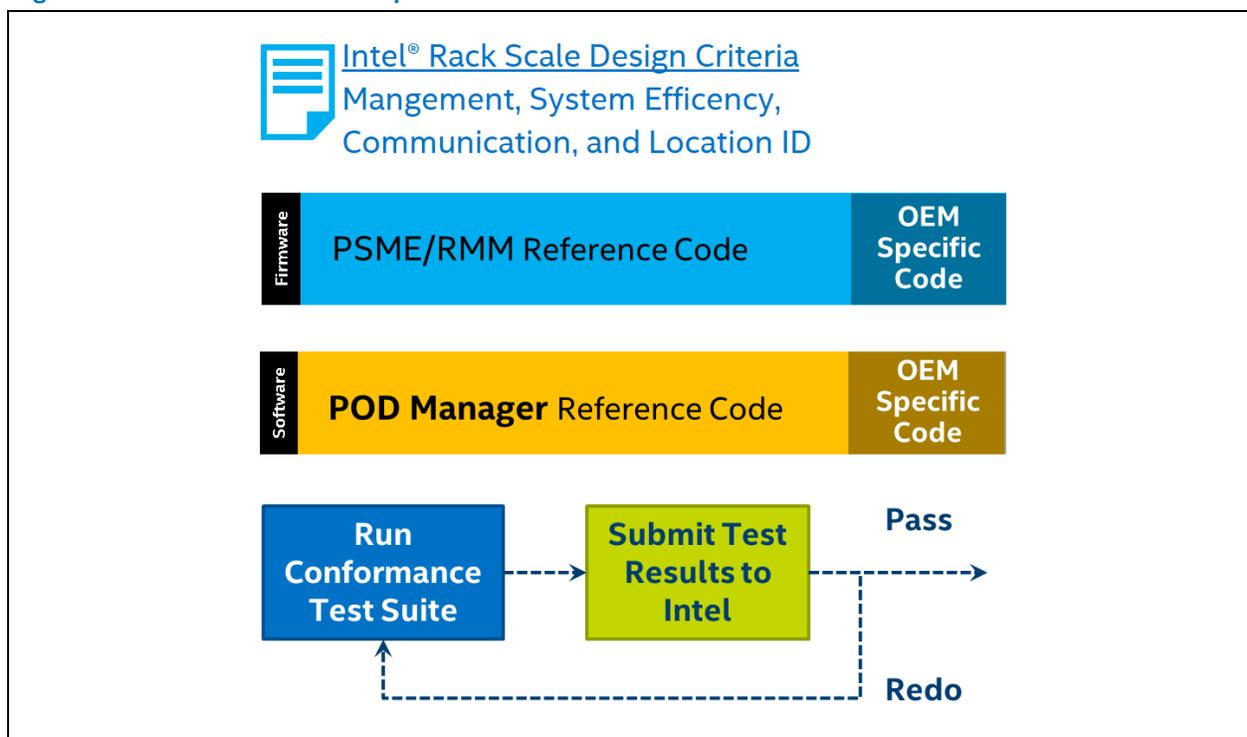
The Intel® RSD CTS tool verifies the northbound API schema conformance of the PSME/RMM and PODM through automated techniques. The tool can also test some hardware and software parameters. Intel recommends completing the full conformance testing process with a manual review of the remaining system and hardware parameters. In addition, validate the rack architecture to confirm the hardware implementation is completed, as described in the *Intel® Rack Scale Design (Intel® RSD) Architecture Specification* (refer to Table 2).

When discussing Intel® RSD conformance, many questions arise regarding how Intel® RSD APIs align with Redfish* APIs. Intel® RSD is mapped to the schema and models standardized by specific Redfish* versions. Figure 2 shows how Intel® RSD contributes to the Redfish* community and aligns with Redfish* releases.

Figure 2.   Intel® RSD Mapping to Redfish* Releases

- Redfish provides the schemas (general architecture)
- RSD provides a specific implementation of that architecture
  i.e. A set of profiles that map to the Redfish schemas

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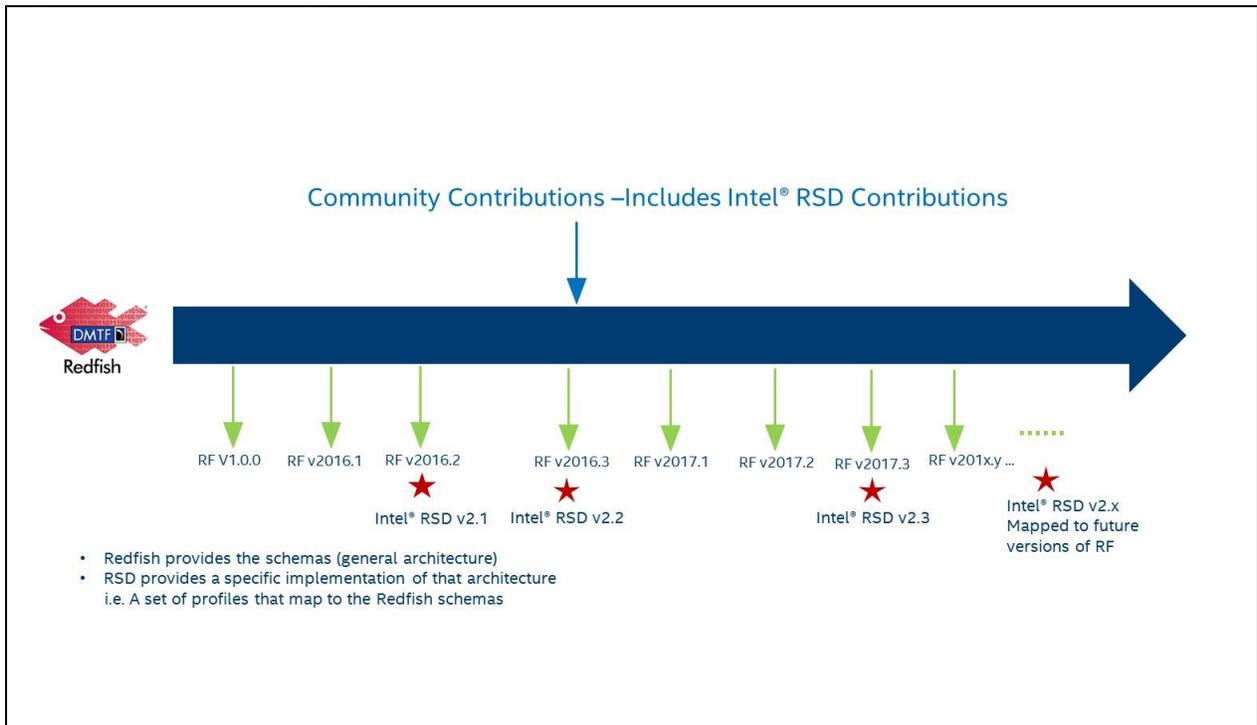
3.0 Intel® RSD Reference Code

Along with alignment to Redfish* schemas, Intel provides fully functional Intel® RSD reference code for the following items:

- Intel® RSD PODM:
  – Northbound REST interface to expose Redfish*-aligned APIs
  – Discover, compose, and manage Intel® RSD resources
- Intel® RSD Pooled System Management Engine (PSME)/Rack Management Module (RMM):
  – PSME implementation to communicate with the Intel® RSD PODM
  – Northbound REST interface to expose Redfish-aligned APIs
  – Manage and report the power and thermal matrix to the PODM
  – RMM Implementations
  – Firmware (FW) extensions (conversion of Intelligent Platform Management Interface)
  – Intelligent Platform Management Interface (IPMI) to Redfish
- Intel® RSD PSME Storage Service:
  – Remote storage service implementation with northbound REST APIs
  – Create initial Internet Small Computer System Interface (iSCSI) targets on service initiation
- Intel® RSD Reference code provides stubs for PSME Network, Compute, and Chassis agents

Note: The Intel® RSD Reference code does NOT include all **required** Intel® RSD elements noted in the *Intel® RSD Architecture Specification Software* (refer to Table 2). Contact your Intel account representative with questions regarding the Intel® RSD reference code and architecture requirements.

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4.0 Intel® RSD Product Design Prerequisites

This section reviews information to keep in mind at the start of the Intel® RSD product design process. This information is designed to help ensure smooth conformance testing at the end of the development cycle. Hardware, software, and API design prerequisites are covered.

For Intel® RSD hardware conformance, Intel engages with partners in the following ways:

- Architects from both Intel and partners collaborate and confirm the implementation of the Intel® RSD architecture.
- The Intel ecosystem engineers and partners collaborate to complete the Intel® RSD hardware checklist document. The checklist covers the required items from the *Intel® RSD Architecture Specification*. For example, Intel audits the power supply and fan numbering consistency, compute blade serviceability, node reset support, and so forth.

For Intel® RSD software setup conformance, Intel engages with partners in the following ways:

- **Software Architecture**: Architects from both Intel and partners collaborate and confirm the implementation of the Intel® RSD software architecture. Implementation details include (but are not limited to):
  - Where the PSME/RMM/BMC will reside in the rack
  - APIs the partner plans to provide in addition to the Intel® RSD APIs (needed extensions for a specific design)
- **Compute Single Large Expensive Disk (SLED) Telemetry:** For partners using Intel® RSD reference code, Intel includes a system management BIOS (SMBIOS) implementation to gather the needed telemetry data required for conformance (CPU, memory, BIOS, and network). For partners not using the Intel® RSD reference code, an equivalent implementation must be developed to report this data in order to pass conformance testing.
- **Location Hierarchy:** PDOM requires location hierarchy between the chassis and sled resources to locate composed node resources.
- **Power and Thermal Telemetry:** Functionality to display the power and thermal matrix must be implemented for conformance. The parameters in the power and thermal matrix include active power supplies, total watts consumed, and so forth.
- **PSME Network Functionality:** PSME networking conformance depends on the implementation of the required PSME network APIs.
- **Non-Volatile Memory Express* (NVMe*) over Fabric (NVMe-oF*):** Functionality depends on the implementation of the NVMe* PSME agent and NVMe discovery PSME agent. NVMe-oF* requires Ethernet as the fabric that uses Remote Direct Memory Access (RDMA) as the transport protocol between the compute and storages nodes.

A number of prerequisites are required to ensure Intel® RSD API conformance. Intel® RSD v2.3.2 includes required functionalities across the PDOM and PSME/RMM. Each required functionality may include the implementation of *one or more* APIs. To complete Intel® RSD conformance, all required APIs are expected to be implemented for all required functionality. Table 3 covers the most common issues with Intel® RSD APIs encountered during the conformance testing process.

Intel® RSD Product Design Prerequisites

Table 3.   Required Functionalities

PODM	PSME						
	Compute	**Network**	**Chassis**	**Storage**	**Pooled NVMe Controller) PNC**	**NVMe**	**NVMe Discover**
PSME and PSME storage resources	TPM configuration	Switch port configuration	Patching `locationID` for `ChassisType Chassis2`	Discover and report SATA-based storage volume	Graceful restart of the Peripheral Component Interconnect express* (PCIe*) switch	Manage the (storage) target host	Respond to queries from initiators about available NVMe volumes
Discovers rack resources	Discover BIOS/BMC, compute, memory, network matrix	`StaticMAC` configuration	Supports reporting OOB telemetry	`Create, Delete, Attach,` and `Detach` iSCSI targets	Triggering PCIe* switch port action	Gather detailed information about NVMe volumes	
Node composition	Event subscription	Binding/ Unbinding switch port to ACL	Rack-level power and thermal matrix		Create and patch PCIe* switch zones		
Support boot override operations		Associating VLAN with switch ports			Discovering logical system containing PCIe* devices (no CPU or memory)[3]		
Patching location ID for `ChassisType` rack1		LAG creation (static mode)			Patch PCIe system[4]		
VLAN operations with `GET, POST,` and `DELETE` methods for a node					`SecureErase` operation through `POST` method[5]		
Power and thermal zone attributes					`EraseOnDetach` attribute through Delete method[6]		
Attaching and detaching PCIe* endpoint (NVMe drives) to a composed node							

Notes:
1. Refer to Section 4.6.1.3 PODM v2.3.2 specification.
2. Refer to Section 4.8.1.3 PSME v2.3.2 specification.
3. Refer to Section 4.10.1.2 PSME v2.3.2 specification.
4. Refer to Section 4.10.1.4 PSME v2.3.2 specification.
5. Refer to Section 4.21.1.4 PSME v2.3.2 specification.
6. Refer to Section 4.21.1.3 PSME v2.3.2 specification.

Note: The functionalities shown in Table 3 do NOT cover all **required** Intel® RSD functions. Refer to the Intel® PSME/PODM API specifications for details on all required, recommended, and optional functionalities.

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5.0   Test for Intel® RSD Conformance

The next step is to test for Intel® RSD conformance. Some preparation is required before testing. To begin the process, complete the following tasks:

1. Download the Intel® RSD v2.3.2 Conformance Test Suite (CTS) tool binary from GitHub* (refer to Table 2).
2. Verify and validate the Intel® RSD architecture implementation in the hardware design checklist.
3. Populate the rack with the required hardware and software components:
   - **Hardware**: Compute blades, storage servers, PCIe* devices, ToR (Ethernet) switch, PCIe* switch, cables, and power and thermal units
   - **Software**: PDOM and PSME (network, compute, storage, RMM, PNC, and NVMe) agents.
4. Enable Certificate Authority (CA) Authentication to establish a secure communication connection between the PDOM and PSME/RMM.
5. Complete the PDOM and PSME/RMM conformance testing prerequisites described in this section.

For the CTS test to run successfully, a few setup tasks are required for both the PDOM and PSME/RMM prior to testing. These tasks streamline the testing and feedback processes for both partners and Intel engineers. Prior to running the CTS tool for PDOM, complete the following tasks:

1. Create an Intel® RSD node with remote storage (iSCSI targets and NVMe drives), associated NICs, and VLAN.
2. Create multiple logical nodes with the parameters defined in the PODM API specification, including CPU, memory, drive (local and remote), and Ethernet type parameters. Verify the nodes are populated.
3. Ensure Resource Hierarchy by completing the following tasks. Refer to Table 2, *Intel® RSD PDOM and Intel® RSD PSME API specifications* for details. CTS will need to be reinitiated to achieve the actions noted:
   a. Verify parent/child hierarchy (relationship in the rack).
   b. Patch rack **ID** through the PDOM API, and paste the snipped to show the **RackID** change is reflected in the Chassis **ParentID** field.
   c. Create a new Intel® RSD node, and verify that the new **RackID** is displayed in the **ParentID** field.
   d. Patch an existing node with an NVMe drive to verify that a new **RackID** is displayed in the **ParentID** field.
   e. Reinitiate CTS to achieve all actions listed.
   f. Provide CTS logs for each scenario.

4. Ensure location awareness by completing the following tasks. Refer to Table 2, *Intel® RSD PDOM and Intel® RSD PSME API specifications* for details. CTS will need to be reinitiated to achieve the actions noted:
   a. Create a new node, and verify that the node has a unique chassis ID and hierarchy.
   b. Patch an existing Intel® RSD node with an NVMe drive to verify that the node has a unique chassis location ID and hierarchy.
   c. Reinitiate CTS to achieve all actions listed above.
   d. Provide CTS logs for each scenario.

Before running the CTS tool for the PSME/RMM, complete the following tasks:

1. Create an access control list (ACL), and link the ACL rule to a switch port.
2. Create an Ethernet switch LAN, and associate an Intel® RSD logical node (or nodes) with the VLAN.
3. Create a link aggregation group (LAG), and verify the LAG information is visible through the Ethernet switch APIs and on the Ethernet switch ports.
4. Create a StaticMAC (Intel® RSD node MAC), and verify it's learned by the Ethernet switch port (`NeighborMAC`).
5. Demonstrate the PSME and RMM event service subscription to the PDOM.
6. **(Optional)** Support the required features for all connected switches for leaf and spine switch support, as mentioned in the PSME API.
7. **(Optional)** Implement the PSME task service APIs for Pooled NVMe functionality support.

When the tasks are competed, run the CTS tool and tests. Execute the GET, PATCH, and CRUD options with individual command and confirmation. Also, generate a separate log file for review through the CTS tool against the implemented Intel® RSD modules (PDOM, PSME, and RMM). Send the data and any support questions to an Intel® RSD representative.

Intel representatives review the Intel® RSD conformance test results and provide feedback and troubleshooting guidance. If you find any errors with the CTS tool or process, contact your Intel® RSD representative for troubleshooting and technical escalation.

As an exception, Intel does have an Intel® RSD conformance waiver process. Conformance waivers can be investigated on a case-by-case basis. Work with your Intel® RSD representative for waiver questions and support.

Once all conformance tests pass (manual and automated), Intel grants Intel® RSD Conformance!

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