Intel® Virtual RAID on CPU (Intel® VROC) for Windows\*

Release Notes for Intel® VROC 9.0

Revision 001

June 2024

1. You may not use or facilitate the use of this document in connection with any infringement or other legal analysis. You may not use or facilitate the use of this document in connection with any infringement or other legal analysis concerning Intel products described herein. You agree to grant Intel a non-exclusive, royalty-free license to any patent claim thereafter drafted which includes subject matter disclosed herein.
2. No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.
3. All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest Intel product specifications and roadmaps.
4. All product plans and roadmaps are subject to change without notice.
5. The products described may contain design defects or errors known as errata, which may cause the product to deviate from published specifications. Current characterized errata are available on request.
6. Intel technologies’ features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com.
7. Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade.
8. Altering clock frequency, voltage, or memory interface speeds may void any product warranties and reduce stability, security, performance, and life of the processor and other components. Intel has not validated processor running memory above Plan-Of-Record (POR) speed. DRAM/DIMM devices should support desired speed, check with DRAM/DIMM vendors for details. System manufacturers are responsible for all validation and assume the risk of any stability, security, performance, or other functional issues resulting from such alterations.
9. © Intel Corporation. Intel, the Intel logo, and other Intel marks are trademarks of Intel Corporation or its subsidiaries.
10. \*Other names and brands may be claimed as the property of others.
11. Copyright© 2024, Intel Corporation. All rights reserved.

Contents

[1 Introduction 7](#_Toc169268742)

[1.1 Overview 7](#_Toc169268743)

[1.2 Terminology 7](#_Toc169268744)

[1.3 Reference OEM Platform Documentation 9](#_Toc169268745)

[1.4 Supported Platforms, Chipsets and SKUs 10](#_Toc169268746)

[1.5 Supported Operating Systems 11](#_Toc169268747)

[1.6 Supported PCIe NVMe SSDs 12](#_Toc169268748)

[1.7 Intel SSD Only VROC Upgrade Key 12](#_Toc169268749)

[2 New Features 13](#_Toc169268750)

[2.1 New Features Introduced with Intel® VROC 9.0 Release 13](#_Toc169268751)

[2.1.1 Added SATA RAID Support on Montage IOH 13](#_Toc169268752)

[2.1.2 OOB for NVMe SSDs behind VMD via MCTP 13](#_Toc169268753)

[2.1.3 NPEM Support for CPU-Attached SSD 13](#_Toc169268754)

[2.2 New Features Introduced with Intel® VROC 8.6 Release 13](#_Toc169268755)

[2.2.1 Local Key Management Support (TPM) for SED Drives 13](#_Toc169268756)

[2.2.2 Enhanced Cryptographic Algorithm for Intel® VROC SED 13](#_Toc169268757)

[2.2.3 NVMe Secure Erase in Pre-OS Environment 14](#_Toc169268758)

[2.2.4 Intel® VROC OOB Integration with AMI BMC 14](#_Toc169268759)

[2.3 New Features Introduced with Intel® VROC 8.5 Release 14](#_Toc169268760)

[2.3.1 RAID 1 Only SKU 14](#_Toc169268761)

[2.3.2 Intel On Demand Licensing 14](#_Toc169268762)

[2.4 New Features Introduced with Intel® VROC 8.2 Release 14](#_Toc169268763)

[2.4.1 Pre-Boot DMA Protection Enablement with Intel® VROC 14](#_Toc169268764)

[2.4.2 NVMe Secure Erase Via OOB Support 15](#_Toc169268765)

[2.4.3 NVMe Pass-Thru PPI and Storage Security Command PPI Support in Intel® VROC 15](#_Toc169268766)

[2.4.4 PEIM Support (Update) 15](#_Toc169268767)

[2.5 New Features Introduced with Intel® VROC 8.0 Release 15](#_Toc169268768)

[2.5.1 LED Management on PCH-VMD 15](#_Toc169268769)

[2.5.2 Intel® VROC 8.0 New GUI Design 15](#_Toc169268770)

[2.5.3 Warning Message Displayed When GUI and Driver Version is Mismatching 15](#_Toc169268771)

[2.5.4 PEIM Support 15](#_Toc169268772)

[2.5.5 Physical Drive Location Information in UEFI 16](#_Toc169268773)

[2.6 New Features Introduced with Intel® VROC 7.7 Release 16](#_Toc169268774)

[2.6.1 Firmware Management Protocol Support 16](#_Toc169268775)

[2.6.2 Intel® VROC (SATA RAID) Support of EFI\_ATA\_PASS\_THRU\_Protocol 17](#_Toc169268776)

[2.6.3 Disable *Locate LED* within Intel® VROC LED Management 17](#_Toc169268777)

[2.7 New Features Introduced in the Intel® VROC 7.6 Release 18](#_Toc169268778)

[2.7.1 Intel® VROC PreOS Environment RAID Volume Failure Recovery 18](#_Toc169268779)

[2.7.2 Intel® VROC (SATA RAID) UEFI Support for EFI\_ATA \_PASSTHRU 18](#_Toc169268780)

[2.8 New Features Introduced in the Intel® VROC 7.5 Release 18](#_Toc169268781)

[2.8.1 Intel® VMD 2.0 Features 19](#_Toc169268782)

[2.8.2 Number of Intel® VMD Increased 21](#_Toc169268783)

[2.8.3 Native PCIe Enclosure Management (NPEM) 21](#_Toc169268784)

[2.8.4 Limited Out of Band Support 21](#_Toc169268785)

[2.8.5 Limited Self-Encrypted Drives 21](#_Toc169268786)

[2.8.6 Intel® VROC 7.5 GUI UWD Upgrade Limitations 21](#_Toc169268787)

[2.8.7 Intel® VROC 7.5 CLI 21](#_Toc169268788)

[2.8.8 Unsupported Drives 21](#_Toc169268789)

[2.9 New Features Introduced in the Intel® VROC 7.0 Release 22](#_Toc169268790)

[2.9.1 Removal of AHCI Mode Support 22](#_Toc169268791)

[2.9.2 Removal of Legacy Option ROM Support 22](#_Toc169268792)

[2.9.3 Removal of Windows\* 7 Support 22](#_Toc169268793)

[3 Drivers, Images and Utilities 23](#_Toc169268794)

[4 Intel® VROC Limitations 24](#_Toc169268795)

[4.1 Cannot Delete Non-System RAID Volume Behind Intel® VMD 24](#_Toc169268796)

[4.2 Microsoft .NET Framework Removal 24](#_Toc169268797)

[4.3 Surprise Hot Plug Limitations 24](#_Toc169268798)

[4.4 Expect Longer Rebuild Times for RAID 5 24](#_Toc169268799)

[4.5 Intel® VROC Command Line Interface (CLI) 24](#_Toc169268800)

[4.6 Intel® VROC Trial Version Limitations 25](#_Toc169268801)

[4.7 Intel® VROC PreOS UEFI Driver Uninstall Limitations 25](#_Toc169268802)

[4.8 Intel® NVMe Wear Leveling Recommendations 25](#_Toc169268803)

[4.9 Must Use F6 Install Method 26](#_Toc169268804)

[4.10 Intel® C620 and C422 Series Chipset Port Limitations 27](#_Toc169268805)

[4.11 Intel® VROC Key Removal/Upgrade Limitation 28](#_Toc169268806)

[4.12 NVMe Port Assignment by Intel® VROC 28](#_Toc169268807)

[4.13 Windows\* 10 RS5 & Windows\* Server 2019 28](#_Toc169268808)

[4.13.1 Idle Power Increased 28](#_Toc169268809)

[4.13.2 Intel® VROC Support for Windows\* 10 RS5 & Windows\* Server 2019 28](#_Toc169268810)

[4.14 Intel® VMD Support on 8 Socket Platforms 28](#_Toc169268811)

[4.15 Intel® VROC SATA LED Management 29](#_Toc169268812)

[4.16 Intel® VROC Creation Volume Sizes 29](#_Toc169268813)

[4.17 MCERR/P\_CATERR/Bus Uncorrectable Error with Intel® VMD Enabled 29](#_Toc169268814)

[4.18 NVMe Drive Model Number Does Not Display Properly in Device Manager 29](#_Toc169268815)

[4.19 Intel® VROC RAID Driver is not Producing AtaPassThru Protocol 30](#_Toc169268816)

[4.20 Intel® VROC 8.0 New GUI Design 30](#_Toc169268817)

[4.20.1 Warning Message Displayed When GUI and Driver Version is Mismatching 30](#_Toc169268818)

[4.21 Pre-Boot DMA Feature Needs to be Disabled 30](#_Toc169268819)

[4.22 Intel® Virtual RAID on CPU (VROC): Intel® VROC (SATA RAID) Compatibility Issue with Microsoft Windows\* Operating System Versions Released After June 2022 30](#_Toc169268820)

[4.23 RAID TRIM Disabled for This Version 30](#_Toc169268821)

[4.24 RAID 5 Boot or Data Volume in Rebuild State 31](#_Toc169268822)

[5 Intel® VROC Issues 32](#_Toc169268823)

[5.1 Known Issues in Intel® VROC 9.0 Release 32](#_Toc169268824)

[5.2 Resolved Issues in Intel® VROC 9.0 Release 33](#_Toc169268825)

[5.3 Resolved Issues in Intel® VROC 8.6 Release 34](#_Toc169268826)

[5.4 Resolved Issues in Intel® VROC 8.5 Release 35](#_Toc169268827)

[5.5 Resolved Issues in Intel® VROC 8.2 Release 35](#_Toc169268828)

[5.6 Resolved Issues in Intel® VROC 8.0 Release 38](#_Toc169268829)

[5.7 Resolved Issues in Intel® VROC 7.7 Release 39](#_Toc169268830)

[5.8 Resolved Issues in Intel® VROC 7.6 Release 41](#_Toc169268831)

[5.9 Resolved Issues in Intel® VROC 7.5 Release 41](#_Toc169268832)

[5.10 Resolved Issues in Intel® VROC 7.0.2 Release 43](#_Toc169268833)

[5.11 Resolved Issues in Intel® VROC 7.0 Release 43](#_Toc169268834)

[5.12 Resolved Issues in Intel® VROC 6.3 Release 44](#_Toc169268835)

[5.13 Resolved Issues in Intel® VROC 6.2 Release 45](#_Toc169268836)

Figures

[Figure 2‑1. Physical Drive Location Information in UEFI 16](#_Toc169268837)

[Figure 2‑2. Firmware Management Protocol Support Flow 17](#_Toc169268838)

Tables

[Table 1‑1. Terminology 7](#_Toc169268839)

[Table 1‑2. Supported Platforms for Intel® VROC (VMD NVMe RAID) 10](#_Toc169268840)

[Table 1‑3. Supported Chipsets for Intel® VROC (SATA RAID) 10](#_Toc169268841)

[Table 1‑4. Supported Operating Systems for Intel® VROC 11](#_Toc169268842)

[Table 2‑1. Firmware Management Protocol Support 17](#_Toc169268843)

[Table 3‑1. Components of the latest Intel® VROC Release Package 23](#_Toc169268844)

[Table 4‑1. Recommended Strip Size for Intel® NVMe SSDs for Optimal Wear Leveling 26](#_Toc169268845)

[Table 5‑1. Known Issues in Intel® VROC 9.0 Release 32](#_Toc169268846)

[Table 5‑2. Resolved Issues in Intel® VROC 9.0 Release 33](#_Toc169268847)

[Table 5‑3. Resolved Issues in Intel® VROC 8.6 Release 34](#_Toc169268848)

[Table 5‑5. Resolved Issues in Intel® VROC 8.5 Release 35](#_Toc169268849)

[Table 5‑6. Resolved Issues in Intel® VROC 8.2 Release 35](#_Toc169268850)

[Table 5‑7. Resolved Issues in Intel® VROC 8.0 Release 38](#_Toc169268851)

[Table 5‑8. Resolved Issues in Intel® VROC 7.7 Release 39](#_Toc169268852)

[Table 5‑9. Resolved Issues in Intel® VROC 7.6 Release 41](#_Toc169268853)

[Table 5‑10. Resolved Issues in Intel® VROC 7.5 Release 41](#_Toc169268854)

[Table 5‑11. Resolved Issues in Intel® VROC 7.0.2 Release 43](#_Toc169268855)

[Table 5‑12. Resolved Issues in Intel® VROC 7.0 Release 43](#_Toc169268856)

[Table 5‑13. Resolved Issues in Intel® VROC 6.3 Release 44](#_Toc169268857)

[Table 5‑14. Resolved Issues in Intel® VROC 6.2 Release 45](#_Toc169268858)

Revision History

|  |  |  |
| --- | --- | --- |
| Version | Description | Release Date |
| 001 | Initial public release | June 2024 |

§§

# Introduction

## Overview

The Intel® Virtual RAID on CPU (Intel® VROC) family of products provide enterprise RAID solutions for both NVMe SSD and SATA devices for the enterprise servers, workstations, and some high-end desktops.

1. Intel® Virtual RAID on CPU (Intel® VROC) provides an enterprise RAID solution on platforms that supports Intel® Volume Management Device (Intel® VMD) on Intel® Xeon® Scalable Processors.
2. Intel® Virtual RAID on CPU (Intel® VROC) SATA RAID provides an enterprise RAID solution for SATA devices connected to all SATA controllers on the Intel® Platform Control Hub (Intel® PCH) configured for RAID.

Intel® VROC is a high-level blanket product reference for Intel® VROC (VMD NVMe RAID) and Intel® VROC (SATA RAID).

## Terminology

Table 1‑1. Terminology

| **Term** | **Description** |
| --- | --- |
| AHCI | Advanced Host Controller Interface |
| API | Application Programming Interface |
| ASM | Intel® Accelerated Storage Manager (Intel® ASM) |
| BIOS | Basic Input/Output System |
| GB | Gigabyte |
| GUI | Graphical User Interface |
| HII | Human Interface Infrastructure |
| Hot-Plug | The unannounced removal and insertion of a drive while the system is powered on. |
| I/O | Input/Output |
| KB | Kilobyte |
| Matrix RAID | Two independent RAID volumes within a single RAID array. |
| MB | Megabyte |
| Member Disk | An NVMe drive used within a RAID array. |
| NVMe | Non-volatile Memory Express |
| OS | Operating System |
| POST | Power On Self-Test |
| PreOS | The Intel VROC images incorporated into the platform BIOS to access the drives and providing the interface to configure Intel VROC UEFI Drivers. |
| RAID | Redundant Array of Independent Disks: allows data to be distributed across multiple drives to provide data redundancy or to enhance data storage performance. |
| RAID 0 (striping) | The data in the RAID volume is striped across the array's members. Striping divides data into units and distributes those units across the members without creating data redundancy but improving read/write performance. |
| RAID 1 (mirroring) | The data in the RAID volume is mirrored across the RAID array's members. Mirroring is the term used to describe the key feature of RAID 1, which writes duplicate data from one drive to another; therefore, creating data redundancy and increasing fault tolerance. |
| RAID 5 (striping with parity) | The data in the RAID volume and parity are striped across the array's members. Parity information is written with the data in a rotating sequence across the members of the array. This RAID level is a preferred configuration for efficiency, fault-tolerance, and performance. |
| RAID 10 (striping and mirroring) | The RAID level where information is striped across two drive arrays for system performance. Each of the drive in the array has a mirror for fault tolerance. RAID 10 provides the performance benefits of RAID 0 and the redundancy of RAID 1. However, it requires four hard drives so it’s the least cost effective. |
| RAID Array | A logical grouping of physical drives. |
| RAID Volume | A fixed amount of space across a RAID array that appears as a single physical drive to the operating system. Each RAID volume is created with a specific RAID level to provide data redundancy or to enhance data storage performance. |
| RDC | The [Resource & Documentation Center (RDC)](https://www.intel.com/content/www/us/en/design/resource-design-center.html) is a section of Intel's [Developer Zone](https://www.intel.com/content/www/us/en/developer/overview.html) where users can find technical collateral, software, tools, and other developer resources.  Within the RDC, content is organized into [collections](https://edc.intel.com/content/www/us/en/resources-documentation/rdc-user-guide/navigating-collections/) based on topic, tool, product, or platform. |
| Spare | The drive that is the designated target drive in a RAID Volume recovery. The Spare drive is a global setting (not designated to a specific RAID volume). Spare drives on a SATA Controller are not available on the sSATA Controller (and visa-versa). Spare drives designated on Intel VROC (VMD NVMe RAID) are exposed and available on all Intel VMD domains. |
| Strip | The size of the data block that is to be written in each write cycle across the RAID array. |
| Stripe | Block size that is assigned to evenly distribute portions of the stripe across a designated number of drives within a RAID array. A collection of Strips is called a Stripe |
| Intel® RSTe | Intel® Rapid Storage Technology enterprise. |
| RWH | RAID Write Hole |
| SSD | Solid State Drive |
| TB | Terabyte |
| UEFI Mode | *Unified Extensible Firmware Interface*. Refers to the system setting in the BIOS |
| Intel® VMD | Intel® Volume Management Device |
| Intel® VROC | Intel® Virtual RAID on CPU |
| PEI | Pre-EFI Initialization |

## Reference OEM Platform Documentation

Refer to your OEM for a full list of available feature sets. If any of the information in this document conflicts with the support information provided by the platform OEM, the platform documentation and configurations take precedence.

Customers should always contact the place of purchase or system/software manufacturer with support questions about their specific hardware or software configuration.

## Supported Platforms, Chipsets and SKUs

The Intel® VROC package was designed to work on customer platforms that are based on the following Intel reference platforms:

Table 1‑2. Supported Platforms for Intel® VROC (VMD NVMe RAID)

| **CPU** | **Platform** | **VMD 1.0  Device ID** | **VMD 2.0/3.0/4.0 Device ID** | **# Of VMD** |
| --- | --- | --- | --- | --- |
| Intel® Xeon® Scalable Processor Family – W | Intel® Xeon® Scalable Processor family workstation† | 201D | N/A | 3 per CPU |
| Intel® Xeon® Scalable Processor Family – SP | Intel® Xeon® Scalable Processor family server and workstation† | 201D | 28C0 | 3 per CPU |
| Intel® Xeon® Processor D-2100 Product Family | Intel® Xeon® Processor D-2100 Product Family based platform† | 201D | N/A | 3 per CPU |
| Intel® Xeon® Processor Scalable Memory Family | Intel® Xeon® Scalable Processor family server and workstation† | 201D | 28C0 | 4 per CPU (VMD 1.0)  4 per CPU / 1 for PCH (VMD 2.0/3.0) |
| Intel® X299 High End Desktop | Intel® Xeon® Scalable Processor family server and workstation† | 201D | N/A | 3 per CPU |

† Unless otherwise specified in the Release Notes.

1. Intel® VROC (VMD NVMe RAID) support on the Intel® X299 High End Desktop platforms is restricted to Intel® NVMe SSDs only. This is a platform limitation. As a result, when Intel® VROC is installed onto an Intel® X299 High End Desktop platform, the customer will only see Intel® NVMe SSDs plugged into the platform.
2. Intel® VROC (Non-VMD NVMe RAID) is no longer included in the Intel® VROC package. If support for this product is required refer to the Intel® VROC 7.x based family of products.

Table 1‑3. Supported Chipsets for Intel® VROC (SATA RAID)

|  |  |  |  |
| --- | --- | --- | --- |
| **Chipset** | **Platform** | **RAID controller Device ID** | **# Of Ports** |
| Intel® C610 series chipset | Platforms containing the Intel® C610 series chipset† | 2826 (SATA)  2827 (sSATA) | 6 SATA  4 sSATA |
| Intel® C610 series chipset | Platforms Refreshes containing the Intel® C610 series chipset† | 2826 (SATA)   2827 (sSATA) | 8 SATA  6 sSATA |
| Intel® C220 series chipset | Platforms containing the Intel® C220 series chipset† | 2826 (SATA) | 6 SATA |
| Intel® C230 series chipset | Platforms containing the Intel® C230 series chipset Platform† | 2826 (SATA) | 8 SATA |
| Intel® C240 series chipset | Platforms containing the Intel® C240 Series Chipset† | 2826 (SATA) | 8 SATA |
| Intel® C620 series chipset | Platforms containing the Intel® 620 series chipset† | 2826 (SATA)   2827 (sSATA) | 8 SATA  6 sSATA |
| Intel® C422 series chipset | Platforms containing the Intel® C422 series chipset† | 2826 (SATA) | 8 SATA |
| Intel® C741 series chipset | Platforms containing the Intel® C741 series chipset† | 2826 (SATA)   2827 (sSATA)  282F (tSATA) | 8 SATA  6 sSATA  6 tSATA |

†Unless otherwise specified in the Release Notes.

## Supported Operating Systems

The latest version of Intel® VROC family of products was designed to work with, tested and validated on the following Windows\* operating systems.

1. Only 64-bit Windows\* operating system support is available.

Table 1‑4. Supported Operating Systems for Intel® VROC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Platform†** | **Windows\*10**  **(RS5††, 22H2, 21H2)** | **Windows\*11** | **Windows\* Server 2012-R2†††** | **Windows\* Server 2016, 2019,** **2022 and 2025 Enterprise** |
| Intel® C741 series chipset-based platforms | Y | Y | Y | Y |
| Intel® C610/C620 series chipset-based platforms | Y | Y | Y | Y |
| Intel® C220/C230/C240 series chipset-based platforms | Y | Y | Y | Y |
| Intel® Xeon® Scalable processor family-based platforms | Y | Y |  |  |
| Intel® Xeon® Scalable processor family Workstation based platforms | Y | Y |  |  |
| Intel® Xeon® Scalable processor family Server based platforms |  |  | Y | Y |
| Intel® Xeon® Processor   D-2100 product family-based platform |  |  | Y | Y |
| Intel® Xeon® Processor   W790 series chipset | Y | Y |  |  |

†Only 64-bit OS is supported on all platforms.  
††Introduces/Includes WinPE support for this version.

††† Although Microsoft announced the OS has reached its end of life, Microsoft still allows the purchase Extended Security Updates (ESU) until 2026.

1. Support for the operating system Windows\* Server 2012 R2 concluded with the Intel® VROC 8.2 release package.

## Supported PCIe NVMe SSDs

All shipping Intel® NVMe SSDs are supported by the latest version of Intel® VROC, except dual port NVMe SSDs. For the latest list of supported Non-Intel PCIe NVMe SSDs, refer to [Intel® Virtual RAID on CPU (Intel® VROC) Supported Configurations](https://www.intel.com/content/www/us/en/support/articles/000030310.html).

Platform providers are now allowed to self-validate their own list of NVMe SSDs for use with Intel® VROC (VMD NVMe RAID). For more details, contact your platform provider.

## Intel SSD Only VROC Upgrade Key

*Intel SSD Only* keys will no longer be supported on new platforms starting with 4th Gen Intel® Xeon® Scalable Processors based platforms. This feature has not been disabled due to legacy platform support. Any issues against 4th Gen Intel® Xeon® Scalable Processors based platforms using *Intel SSD Only* keys will not be supported.

**§§**

# New Features

## New Features Introduced with Intel® VROC 9.0 Release

### Added SATA RAID Support on Montage IOH

Intel VROC supports up to three IOH adapters but only one at a time. There is currently no support for splitting the drivers among more than one, so users can have up to three adapters connected but we have drivers only for 1 of them and for the 3 SATA controllers (SATA, sSATA, tSATA).

### OOB for NVMe SSDs behind VMD via MCTP

The manageability feature for VMD owned NVMe devices using NVMe Management Interface (NVMe-MI) over Management Component Transport Protocol (MCTP) over PCIe Vendor Defined Messages (VDM) enables robust out-of-band management. The feature allows for efficient monitoring, configuration, and control of NVMe devices via a standardized communication protocol that operates independently of the host operating system.

### NPEM Support for CPU-Attached SSD

The addition of NPEM Support allows users to use PCIe port standard bits to control LED blinking for each drive port of a system. This is platform specific feature for GNR based systems currently.

## New Features Introduced with Intel® VROC 8.6 Release

### Local Key Management Support (TPM) for SED Drives

Now with the Secure Encrypted Drive Key Management Support (SED TPM), integration questions and potential issues reported that will occur during implementation of TPM will be examined and allocated resources to root cause and fix.

### Enhanced Cryptographic Algorithm for Intel® VROC SED

Adjustments were made to the cryptographic algorithms to retain industry compliance. In addition, the removal of excess surplus in the solution was done, in which the result lowers the complexity and retains the security solution to SED overall improving support.

### NVMe Secure Erase in Pre-OS Environment

An interface protocol will provide an interface for sanitize command allowing only for pass-through NVMe drives (RAID Members excluded). In order to sanitize RAID member drive, the OEM implementation must firstly delete RAID volume, and then send sanitize command. Delete RAID volume functionality will be also provided by VROC Standard Storage Interface Protocol.

### Intel® VROC OOB Integration with AMI BMC

Intel® VROC OOB validation process will also be the standard procedure to also be done on AMI firmware as well. The same validation test cases that are Intel POR are also applied to AMI BMC validation.

***Note***: For detailed breakdown on OOB please refer to content ID 763354 on RDC (if access is denied to download documentation from RDC please contact your FAE) for the latest Intel® Virtual RAID on CPU (Intel® VROC) Production Version (PV) Out-of-Band (OOB) Release Notes

## New Features Introduced with Intel® VROC 8.5 Release

### RAID 1 Only SKU

Intel® VROC now offers a RAID 1 only SKU that allows the user to select a RAID 1 volume creation option for all applicable drives. This SKU is desirable for those users who are only in need of RAID 1 volume configurations.

### Intel On Demand Licensing

With release 8.5, Intel® VROC will support Intel® On Demand as an alternate license activation method alongside the license hardware key. Intel® On Demand activation model is a solution managed primarily by hardware providers to enable license-based activation of select CPU features and software throughout Intel® Xeon® CPU lifecycle. Depending on the hardware provider, licenses can be purchased to enable Intel® VROC (available with 5th Gen Intel® Xeon® Scalable Processors codenamed Emerald Rapids) during manufacturing or in field as an upgrade.

## New Features Introduced with Intel® VROC 8.2 Release

### Pre-Boot DMA Protection Enablement with Intel® VROC

A security feature limitation occurred when pre-boot DMA protection was enabled in BIOS while also Intel® VMD/VROC was enabled. This limitation no longer persists in Intel® VROC 8.2.0.1981 release version. Both Pre-Boot DMA and Intel® VROC can be enabled at the same time without error messages or interruptions occurring.

### NVMe Secure Erase Via OOB Support

Now with Secure Erase, users will be able to erase all data permanently off NVMe SSDs through OOB. When the action of secure erase is triggered on a drive through the OOB service, this drive during the sanitize process will change it state to *Standby* within the Intel® VROC GUI environment.

### NVMe Pass-Thru PPI and Storage Security Command PPI Support in Intel® VROC

When implementing a password security protection feature on NVMe drives, SSCP provides the required command set for this feature. This protocol will be used not only in DXE phase, but also in PEI phase (DXE and PEI are all required for S0, S3 and S4, power on, hibernation, and resume).

### PEIM Support (Update)

The limitation listed in Intel® VROC 8.0 release section has been implemented. Multiple Intel® VMD controllers are supported.

## New Features Introduced with Intel® VROC 8.0 Release

### LED Management on PCH-VMD

There are two PCIe ports designed and controlled under PCH, Emmitsburg, and this feature with LED management is implemented in the circuit and the on-board secondary CPLD. Designers need to implement the same or similar logic control as this CPLD does to control two LEDs designed on-board to represent the RAID status.

### Intel® VROC 8.0 New GUI Design

### Warning Message Displayed When GUI and Driver Version is Mismatching

When this warning message condition is detected from one major version or 2 minor versions difference, the Intel® VROC GUI will not allow to manage the storage controller but can provide a set of functionalities corresponding to the lowest driver version. The Intel® VROC GUI still can start even if there is no driver installed.

### PEIM Support

Intel® VROC is a software RAID solution for NVMe and SATA drives. Intel® VROC starting with version 8.0.1 introduces the *VROC Pre-EFI Initialization Module (PEIM)* to support the BIOS recovery scenario during boot.

The VROC PEI module for SATA provides access to RAID volumes and SATA drives connected to the Intel® SATA controller.

The VROC PEI module for VMD provides access to RAID volumes and NVMe drives connected to a single Intel® VMD controller.

Both modules have common code base with PEI interface implementation and RAID logic. The main difference between them is the different transport implementations (AHCI vs. VMD and NVMe). Every VROC PEI module installs two PEIM-to-PEIM interfaces (PPI), defined in the PI specification:

* **EFI\_PEI\_RECOVERY\_BLOCK\_IO\_PPI**
* **EFI\_PEI\_RECOVERY\_BLOCK\_IO2\_PPI**

These PPIs are used to read data from pass-through drives and RAID volumes, enumerated by VROC PEI modules.

Intel® VROC 8.0 PEI modules have several limitations:

* VROC VMD PEI module enumerates single VMD devices, regardless how many VMD devices are present in the system.
* RAID engine does not support RAID Write Hole protection mechanism for RAID 5. While RAID Write Hole condition occurs for RAID 5, the VROC UEFI PEI module will provide data access to this RAID volume without RAID Write Hole recovery procedure. The data read in PEI phase from RAID 5 may be affected by the RAID Write Hole scenario.
* RAID engine does not support drives with 4kiB block size – such drives will not be enumerated. Pass-through drives will not be exposed as block devices. RAID volumes consisting of such drives will also not be exposed.

### Physical Drive Location Information in UEFI

When the Intel® VROC product displays how the Intel® VMD controller enumerate the drives, the drive information is showing in VROC HII like in the below figure. The information is not straightforward and not easy to interpret. To present the drive location information in a user-friendly manner, Intel® VROC offers a protocol that will allow customers to report how the drives are connected and how customers would like the information reported in the customer platform.

Figure 2‑1. Physical Drive Location Information in UEFI



## New Features Introduced with Intel® VROC 7.7 Release

### Firmware Management Protocol Support

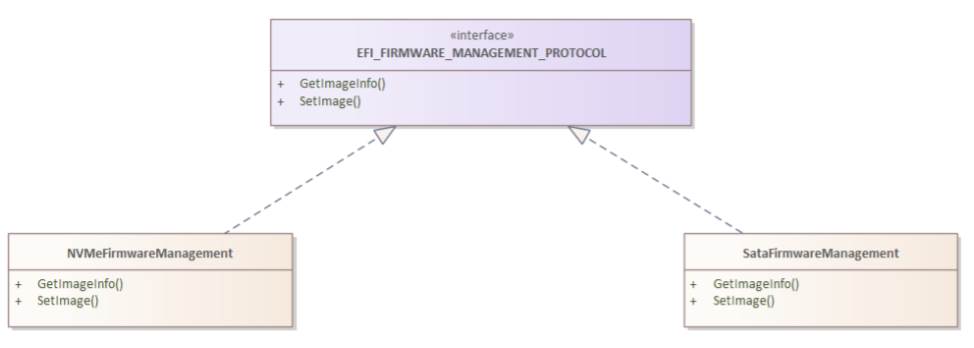
Intel® VROC 7.7 introduces limited support for the *UEFI Firmware Management Protocol (FMP)* as outlined in the UEFI Specification version 2.9. The Intel® VROC UEFI drivers will provide support for updating the drive firmware (through UEFI FMP) when the drive is managed by Intel® VROC. This includes both Intel® VROC (VMD NVMe RAID) and Intel® VROC (SATA RAID). The Intel® VROC UEFI driver has implemented a subset of protocol functions defined in the UEFI Specification, which is reflected in the below table.

Table 2‑1. Firmware Management Protocol Support

|  |  |
| --- | --- |
| **EFI Firmware Management Protocol Functions** | **Intel® VROC UEFI Implementation** |
| **GetImageInfo** | Supported |
| **SetImage** | Supported |

The following diagram highlights the process flow to support both NVMe and SATA drives.

Figure 2‑2. Firmware Management Protocol Support Flow



### Intel® VROC (SATA RAID) Support of EFI\_ATA\_PASS\_THRU\_Protocol

The Intel® VROC 7.7 release package introduces limited support for **EFI\_ATA\_PASS\_THRU\_PROTOCOL** commands to provide information on the SATA drives managed by Intel® VROC (SATA RAID).

### Disable *Locate LED* within Intel® VROC LED Management

Intel® VROC provides support for the OEM/ODMs to disable the *Locate LED* functionality within the Intel® VROC LED Management. By enabling the feature, the OEM/ODM can use their own tools to initiate a *Locate LED* functionality within their platform.

## New Features Introduced in the Intel® VROC 7.6 Release

The Intel® VROC 7.6 release package introduces two new features. These two features are the *Intel® VROC PreOS Failed RAID Volume (limited) Recovery* as well as the *UEFI ATA Passthrough Protocol Support* for Intel® VROC (SATA RAID).

### Intel® VROC PreOS Environment RAID Volume Failure Recovery

Intel® VROC 7.6 introduces a new feature in the VROC HII page that will allow the user to attempt to recover from a failed RAID volume. When a failed RAID volume is encountered during boot, the option is made available in the VROC HII page for which the user can select. This is a multi-step process.

The first step is to select the RAID volume in ‘Failed’ state and then select the option to force it to ‘Degraded’ state. This will expose the next option to specify the drive to enable this action.

Once the RAID volume is changed to ‘Degraded’ state, the standard RAID volume recovery process initiates the rebuilding process.

1. Intel makes no guarantee of successful recovery from a failed state using this option. This must be treated as a last chance effort and there is no guarantee that there won’t be some data loss. Intel always recommends recovering a failed RAID volume by recreating the RAID volume from scratch and restore the data from the latest platform image backup.

### Intel® VROC (SATA RAID) UEFI Support for EFI\_ATA \_PASSTHRU

Intel® VROC 7.6 (SATA RAID) introduces support for **EFI\_ATA\_PASS\_THRU** protocol by the Intel® VROC (SATA RAID) UEFI driver. The following specific options are supported in Intel® VROC 7.6:

* **PassThru;**
  + **IDENTIFY**
  + **ATA\_READ\_LOG\_EXT**
* **GetNextPort;**
* **GetNextDevice;**
* **BuildDevicePath;**
* **GetDevice;**

## New Features Introduced in the Intel® VROC 7.5 Release

The Intel® VROC 7.5 release package introduces several new features to support the latest Intel® platforms as well as improve the user experience. The key new features introduced are:

* Intel® VMD 2.0 support which includes:
  + Increase in MSIX vectors to 64.
  + Intel® VMD support for NVMe devices attached to the Platform Controller Hub (PCH).
  + Increase in the number of PCI-E lanes that can be controlled by VMD from 48 to 64.
  + Increase in the number of VMD devices from 3 to 5.

### Intel® VMD 2.0 Features

#### Increasing MSIX Vectors to 64

Intel® VROC 7.5 introduces support for customer configurations that can support 64 MSIX vectors. On platforms that support Intel® VMD 1.0, the MSIX support is limited to 32 MSIX vectors. For these (Intel® VMD 1.0) platforms, a single VMD domain can support up to 24 NVMe SSDs. This means that those 24 NVMe SSDs will share a single Intel® VMD MSIX vector. As the number of vectors, in newer NVMe devices, increase beyond 32, this can result in a platform performance impact. With the introduction of Intel® VMD 2.0, and Intel® VROC 7.5, this increases to 64 MSIX vectors which should help to alleviate this problem. This is because the average dual socket server will have between 48 and 64 cores, which limits the number of MSIX vectors on a given NVMe SSD to 64, for optimal usage.

#### Intel® VMD (PCH) Support

Intel® VROC 7.5 introduces support for the Intel® VROC (VMD NVMe RAID) management of NVMe SSDs connected to the Platform Controller Hub (PCH). Utilizing the Flex-IO capabilities of the PCH, Intel® VMD 2.0 technology can now take ownership of two of the slots allowing Intel® VROC (VMD NVMe RAID) to control and manage the NVMe SSDs attached to those slots. This is accomplished by utilizing the Function Level Assignment of the PCH PCI functions. Utilizing the BIOS setup menus, the user will be able to enable Intel® VMD on the designated slots, or PCH functions (depending on the BIOS implementation) and the PCH functions will be reassigned to an Intel® VMD (PCH) controller. To be able to accomplish this, there must be NVMe SSDs present on the slot(s) and the slots used must support Slot Implemented Capabilities. Otherwise, Intel® VMD (PCH) cannot be enabled.

When this feature is fully enabled, it will reassign sSATA ports 2-5 to be PCIe lanes managed by Intel® VMD (PCH). This is translated into PCIe root ports 8-11 and Flex I/O ports 14-17. The general configuration is 2 - X2 PCIe lanes.

This feature is intended for supporting a simple RAID 1 boot using two NVMe SSDs attached directly to the PCH. However, if the platform supports expanded configurations, using retimer or switch Add-In-Cards (AIC), full Intel® VROC (VMD NVMe RAID) support can be obtained. Intel® VROC (VMD NVMe RAID) was only validated with two NVMe SSDs directly attached to the PCH. Any configurations beyond two directly attached NVMe drives is not recommended.

1. With this new functionality, when Intel® VMD is enabled, a DUMMY function/device will be seen in the Windows\* Device Manager as a “Yellow Bang”. This function is the result of a PCIe requirement for a device with multiple functions. Once the Intel® VROC installation process is complete this DUMMY function/device will be hidden in the list of system functions.

##### Intel® VMD (PCH) PreOS Support

Intel® VMD (PCH) PreOS support is included in the Intel® VROC (VMD NVMe RAID) PreOS images, which is part of the Intel® VROC release package. There are no other PreOS images required.

##### Intel® VMD (PCH) Pass-Thru Boot Support

Intel® VROC 7.5 provides Intel® VROC (VMD NVMe RAID) PreOS support for NVMe SSDs attached to the PCH when Intel® VMD (PCH) is enabled. This will allow an OS to be installed onto and boot from an NVMe device managed by Intel® VROC (VMD NVMe RAID). No Intel® VROC upgrade key is required to utilize this feature.

##### Intel® VMD (PCH) RAID Boot Support

Intel® VROC 7.5 provides Intel® VROC (VMD NVMe RAID) PreOS support for NVMe SSDs attached to the PCH when Intel® VMD (PCH) is enabled. When an Intel® VROC upgrade key is present and Intel® VMD (PCH) is enabled, the user will be able to use the Intel® VROC (VMD NVMe RAID) PreOS HII to setup and manage a RAID volume using the NVMe SSDs attached to the PCH. This will allow an OS to be installed onto and boot from an Intel® VROC (VMD NVMe RAID) volume attached to Intel® VMD (PCH).

##### Intel® VMD (PCH) RAID Data Volume Spanning

Once Intel® VMD (PCH) is enabled, Intel® VROC (VMD NVMe RAID) will treat it like any other Intel® VMD controller. Spanning data RAID volumes are supported as they are currently outlined in this document. This applies to the Intel® VROC PreOS tools, the Windows\* OS GUI and the CLI tool. The option to span VMD controllers is supported, but not recommended.

1. This is supported but not recommended due to a performance penalty using the PCH.
2. Boot volume spanning is not supported. All devices used to create a boot volume must reside on the same controller (Intel® VMD controller domain or SATA controller).

##### Intel® VMD (PCH) Designations

The Intel® VROC (VMD NVMe RAID) management tools (PreOS tools, Windows\* GUI and CLI tool) are used to manage devices attached to the Intel® VMD (PCH) controller, the corresponding information displayed will indicate ‘PCH’ with any device or controller associated with Intel® VMD (PCH).

##### Intel® VMD (PCH) Hot Plug Support

Intel® VROC does not support Hot Plug when NVMe SSDs are attached to the Intel® VMD (PCH) controller.

### Number of Intel® VMD Increased

Intel® VMD 2.0 technology increased the number of PCIe lanes controlled by the Intel® VMD from 48 to 64. This, along with the Intel® VMD (PCH) support, increases the total amount of Intel® VMDs to 5.

* 4 Intel® VMDs off the CPU.
* 1 Intel® VMD of the PCH (Intel® VMD (PCH)).

### Native PCIe Enclosure Management (NPEM)

Intel® VROC 7.5 introduces support for the *Native PCIe Encloser Management (NPEM)* standard for LED management in a PCIe 4.0 based environment. This capability is discoverable in each switch-downstream-port. If it is discovered to be present, the Intel® VROC LED utility will use NPEM control, capability, and status registers to visually indicate the various drive and volume states.

### Limited Out of Band Support

Intel® VROC 7.5 introduces limited Out of Band support.

### Limited Self-Encrypted Drives

Intel® VROC 7.5 introduces Self-Encrypting Drive (SED) key management support. The implementation of key management is only in the UEFI environment but allows secure booting with SEDs into all Intel® VROC OS environments.

### Intel® VROC 7.5 GUI UWD Upgrade Limitations

Due to some updates required by the Intel® VROC 7.5 GUI, a platform with Intel® VROC 7.0 based drivers or Intel® VROC 6.x based driver won’t be able to upgrade to the Intel® VROC 7.5 GUI, from the Microsoft\* App Store, until after the drivers have been updated. This is due to the potential of not being able to properly manage the Intel® VROC RAID volumes already established in the system after the upgrade. Once the platform is upgraded to the Intel® VROC 7.5 drivers, the GUI can be updated.

### Intel® VROC 7.5 CLI

Intel® VROC 7.5 CLI tool now supports the creation of a RAID volume size down to two digits after the decimal point.

### Unsupported Drives

When an unsupported drive is encountered by the Intel® VROC 7.5 GUI and/or CLI, the displayed information will show the usage as 'Pass Through'.

## New Features Introduced in the Intel® VROC 7.0 Release

### Removal of AHCI Mode Support

With the release of the Intel® VROC 7.0 package, the package will no longer include drivers to support the PCH configured for AHCI mode. All support for this configuration will be via the Microsoft\* inbox AHCI driver.

* For fresh clean (OS installation) configurations, the Intel® VROC 7.0 installer will bypass the PCH if it is in AHCI mode.
* For existing platforms that has Intel® VROC AHCI driver installed, running the Intel® VROC 7.0 installer will remove/uninstall the Intel® VROC AHCI driver so the Microsoft\* inbox AHCI driver can be used. A message will be displayed to inform the user of the upcoming change.

### Removal of Legacy Option ROM Support

With the release of the Intel® VROC 7.0 package, the package will no longer include the Intel® VROC (SATA RAID) Legacy Option ROM PreOS components. All PreOS support for Intel® VROC (SATA RAID) will only be through the UEFI environment. If Intel® VROC (SATA RAID) support, through the Legacy Option ROM environment, is required continue using the Intel® VROC 6.3 release package.

### Removal of Windows\* 7 Support

With the release of the Intel® VROC 7.0 package, the package will no longer include support for Windows\* 7. All components and support for Windows\* 7 (Windows\* drivers and PreOS components) have been removed. If Windows\* 7 support is required, continue using the Intel® VROC 6.3 release package.

**§§**

# Drivers, Images and Utilities

The latest Intel® VROC release package is constructed of several components. The following is the list of those components and their corresponding version numbers.

1. Due to the components being different entities (but are required for the product to work properly), the component version number may not match and will be different from the package version number.

Table 3‑1. Components of the latest Intel® VROC Release Package

| Feature | Notes |
| --- | --- |
| **Intel® UEFI Drivers** | * Intel® VROC UEFI Driver version 9.0.0.1165   + VMDVROC\_1.efi (HW key enforcement in effect) * Intel® VMD UEFI version 4.0.0.1013   + VMDVROC\_2.efi   **Note:** All these images are required and intended to support Intel® VMD and Intel® VROC (SATA RAID) functionality as a combined installed package.   * Intel® VROC (SATA RAID) SATA / sSATA UEFI Driver version 9.0.0.1836   + SataDriver.efi   + sSataDriver.efi |
| **Intel® VROC Windows\* Drivers** | * Intel® VROC Windows\* GUI version 9.0.0.1837 * Intel® VROC Windows\* Installer Package version 8.6-8.6.29.0   + SetupVROC.exe (Multi-lingual) * Intel® VROC (VMD NVMe RAID) Windows F6 Driver version 9.0.0.1837 Win10 * Intel® VROC CLI version 9.0.0.1837 |
| **UEFI Based RAID Configuration Utility** | * Intel® VROC version 9.0.0.1165 * Intel® VROC SATA / sSATA version 9.0.0.1836   **Note:** Secure Boot must be disabled to use this tool. |
| **UEFI Based Comply Utility** | * Intel® VROC version 9.0.0.1165 * Intel® VROC SATA / sSATA version 9.0.0.1836   **Note:** Secure Boot must be disabled to use this tool. |
| **UEFI based SATA SGPIO/LED Test utility** | * Intel® VROC SATA / sSATA version 9.0.0.1836   **Note:** Secure Boot must be disabled to use this tool. |
| **UEFI based Intel® VROC LED Test utility** | * Intel® VROC version 9.0.0.1837   **Note:** This tool can be used to exercise LEDs for NVMe disks behind VMD. |
| **UEFI Based Clear Metadata Utility** | * Intel® VROC SATA / sSATA version 9.0.0.1836 |

**§§**

# Intel® VROC Limitations

## Cannot Delete Non-System RAID Volume Behind Intel® VMD

When a RAID volume is created with a drive that has an operating system on it (the system drive) and then migration is in progress, if a separate RAID volume is created shortly after, this new non-system RAID volume cannot be deleted within the Intel® VROC GUI or CLI tool. The user who attempts to do so will be greeted with an error pop-up in the Intel® VROC GUI or an error message: *Request is formatted correctly but failed to execute*, within the CLI tool.

## Microsoft .NET Framework Removal

The Intel® VROC product installation application does not include Microsoft .NET Framework. Visit Microsoft to download the latest version. Intel® VROC installation may not complete successfully without this feature.

## Surprise Hot Plug Limitations

Due to Microsoft Windows\* time restrictions for resuming from S3 and S4, and Intel® VMD device identification requirements, Hot Plug of Intel® VMD enabled NVMe devices is not supported during S3 and S4 states.

Surprise removal of multiple NVMe SSDs at one time are not supported. The user must wait until a device is reflected as removed/inserted in device manager for spacing surprise hot plug of Intel® VMD enabled PCIe NVMe SSDs in Microsoft Windows\*.

Due to these limitations, Intel strongly discourages performing Hot Plugs during an S3 power state change.

## Expect Longer Rebuild Times for RAID 5

On a RAID 5 volume, disk cache is being turned off when a volume is degraded. Due to this, the rebuilding times have increased expectedly until the rebuild is completed, and disk cache is enabled again.

This extends to drives being added to a RAID 5 volume as well.

## Intel® VROC Command Line Interface (CLI)

The Intel® VROC Command Line Interface (CLI) does not support the RAID volume name beginning with blank space.

## Intel® VROC Trial Version Limitations

1. While it’s possible to use bootable RAID volumes, it is highly recommended to use only data RAID volumes during the trial period. Having the operating system in a bootable RAID volume may cause users to be locked out completely from their system if the trial period runs out.
2. During trial period, it’s highly recommended to use data RAID volumes on same make/model of NVMe devices. This is the suggested configuration leading to less potential issues, although it’s possible to create volumes with different make/model drives.

Once an Intel® VROC upgrade key has been inserted into the system, the trial version is concluded. Removing the upgrade key does not re-enable the trial version. As a result, any existing RAID volumes present while the upgrade key was installed, won’t be seen and could be in an unknown state.

When creating a RAID volume using the trial version, don’t mix SSD NVMe vendors. Mixing vendors may result in unexpected behavior.

## Intel® VROC PreOS UEFI Driver Uninstall Limitations

The Intel® VROC UEFI RAID drivers comply with the UEFI Specifications for PCI Driver Model for PCI Device Drivers (Section 13.3.3) and may return the status code “access denied” from the **UninstallProtocolInterface** routine from boot services (spec. 6.3). This is expected behavior.

## Intel® NVMe Wear Leveling Recommendations

NVMe SSD Wear Leveling refers to techniques used to prolong the service life of NVMe drives. This section outlines the recommended configurations (number of drives vs strip size) to maximize Wear Leveling on Intel NVMe SSDs when configured as part of RAID 5 volume. When creating an Intel® VROC (VMD NVMe RAID) RAID 5 volume, several configuration parameters can be selected, and the number of drives used along with the strip size chosen can have an impact on the wear leveling. The following table outlines the different options for number of drives vs strip size to achieve the optimal wear leveling on Intel® NVMe SSDs.

Table 4‑1. Recommended Strip Size for Intel® NVMe SSDs for Optimal Wear Leveling

| Strip  Size  Drives | **4** | **8** | **16** | **32** | **64** | **128** |
| --- | --- | --- | --- | --- | --- | --- |
| **3** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **4** | Optimal | Optimal | Optimal | Optimal | Suboptimal | Suboptimal |
| **5** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **6** | Optimal | Optimal | Optimal | Optimal | Optimal | Suboptimal |
| **7** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **8** | Optimal | Optimal | Optimal | Suboptimal | Suboptimal | Suboptimal |
| **9** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **10** | Optimal | Optimal | Optimal | Optimal | Optimal | Suboptimal |
| **11** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **12** | Optimal | Optimal | Optimal | Optimal | Suboptimal | Suboptimal |
| **13** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **14** | Optimal | Optimal | Optimal | Optimal | Optimal | Suboptimal |
| **15** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **16** | Optimal | Optimal | Suboptimal | Suboptimal | Suboptimal | Suboptimal |
| **17** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **18** | Optimal | Optimal | Optimal | Optimal | Optimal | Suboptimal |
| **19** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **20** | Optimal | Optimal | Optimal | Optimal | Suboptimal | Suboptimal |
| **21** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **22** | Optimal | Optimal | Optimal | Optimal | Optimal | Suboptimal |
| **23** | Optimal | Optimal | Optimal | Optimal | Optimal | Optimal |
| **24** | Optimal | Optimal | Optimal | Suboptimal | Suboptimal | Suboptimal |

1. It is left to the customer to determine the most effective combination of parameters (number of drives vs strip size) to achieve their desired performance goals, usage models and drive endurance.
2. If a RAID volume is being migrated to RAID 5 (or a new RAID 5 volume is being created), the strip size chosen should be based off the most optimal performance as defined in the above table.

## Must Use F6 Install Method

The use of the included Intel® VROC F6 drivers are required to install an OS onto an Intel® VROC managed device(s). There is no Microsoft inbox driver that supports Intel® VROC 8.0.

The supported Microsoft operating systems for this product include inbox drivers that support the Intel® C620, C422 and C741 series chipset Platform Controller Hub (PCH) when configured for RAID mode. It is strongly recommended that the Intel® VROC (SATA RAID) F6 drivers included in this release are used instead of the available Microsoft inbox driver. The provided inbox driver is intended only for those customers who may not have the Intel® VROC (SATA RAID) F6 drivers readily available and ONLY for installing to a single drive (NOT to a RAID volume). Once the OS is installed, it is required for proper Intel® VROC support that the Intel® VROC 8.0 installer package is installed immediately. At that point, it will be safe to migrate the SATA system disk into a RAID volume (using the Intel® VROC GUI).

## Intel® C620 and C422 Series Chipset Port Limitations

This limitation is in reference to platforms having a PCH that supports more than 6 SATA ports. The Intel® C620 and C422 series chipset SATA controller supports 8 SATA ports. As referenced above, the Microsoft Windows\* operating systems that contain the inbox drivers for the Intel® C620 and C422 series chipset Platform Controller Hub (PCH) when configured for RAID mode, only support 6 ports. Drives on ports 7 and/or 8 are not enumerated. For this reason, Intel recommends not using these 2 ports as part of the Windows\* OS boot installation (as a pass-thru drive or as part of a RAID volume). However, if you do need to use these ports as part of your Windows\* boot volume, the steps below can be used as a workaround.

1. You will need a USB drive with the Intel® VROC IntelVROCCLI.exe utility.

Step 1: After you have created the desired RAID volume that includes ports 7 and/or 8 (which you intend to use as your Windows\* boot volume) in the PreOS environment, begin the Windows\* installation process. **Make note of the RAID volume name.**

Step 2: Navigate to the Windows\* disk selection window. At this point, select the *Load Driver* button and install the Intel® VROC F6 driver (included in this package).

Step 3: Attempt to continue installing the Windows\* OS onto the RAID volume. If the installation process does not continue, this error has been encountered.

Step 4: Press F10 to invoke a CMD window.

Step 5: If you have not already done so, insert the USB drive into the system. Navigate to your USB drive with the RSTCLI.exe utility.

Step 6: Run command: **IntelVROCCLI.exe --manage --normal-volume <volumeName>**

Step 7: This will reset the volume to a normal state.

Step 8: Close the CMD window.

Step 9: In the Windows\* disk selection window, reload the Intel® VROC F6 driver.

Step 10: Once completed, Windows\* should allow the installation on the RAID volume.

## Intel® VROC Key Removal/Upgrade Limitation

With Microsoft Windows\* 10 and Windows\* 11, *Fast Startup* is enabled by default. Disable *Fast Startup* prior to removing/upgrading the Intel® VROC hardware key, or alternatively, perform a complete reboot when removing/inserting a Intel® VROC hardware key when *Fast Startup* is enabled.

## NVMe Port Assignment by Intel® VROC

In Windows\* and UEFI, the port number shown in the Intel® VROC interfaces depends on the disk enumeration order by the Intel® VMD-enabled NVMe driver, which can be different on each platform. The port numbers shown does not reflect the physical PCIe slot. After each hot plug, there is an enumeration process which is NOT fixed.

## Windows\* 10 RS5 & Windows\* Server 2019

### Idle Power Increased

Installing Intel® VROC 8.0 onto a platform running Windows\* 10 RS5, in Windows\* and UEFI, the port number shown in the Intel® VROC interfaces depends on the disk enumeration order by the Intel® VMD-enabled NVMe driver, which can be different on each platform. The port numbers shown does not reflect the physical PCIe slot. After each hot plug, there is an enumeration process which is NOT fixed.

### Intel® VROC Support for Windows\* 10 RS5 & Windows\* Server 2019

Intel® RSTe 5.5.0.2013 introduces support for Windows\* 10 RS5 and Windows\* Server 2019.

1. There is a known issue trying to install Windows\* 10 RS5 or Windows\* Server 2019. Installing Windows\* 10 RS5 or Windows\* Server 2019 onto an Intel® VMD managed device is limited to a single CPU. For more information, see the *Known Issues* section in this document.
2. This limitation only applies to Intel® RSTe 5.5 and earlier releases. Intel® VROC 6.x and newer are not impacted.

## Intel® VMD Support on 8 Socket Platforms

Due to restrictions on NVM Express implementations that reside behind PCI compliant bridges, address space is limited to 32 bit assigned base address registers (for non-prefetchable memory). This means that there is only 4 Gigabytes of addressable (non-prefetchable) memory space available. This memory space must be shared between the entire platform. As a result, there is a limitation on the number of Intel® VMD controllers that can be enabled (due to these resource constraints). The following two configurations can be used without encountering memory restriction errors:

1. Three Intel® VMDs can be enabled on CPU0 up to CPU6. Intel® VMDs on CPU7 need to remain disabled. This results in a maximum of 21 Intel® VMDs that can be enabled in this configuration.
2. No more than two Intel® VMDs can be enabled on each CPU in an 8-socket platform. This results in a total of 16 Intel® VMD domains.
3. This limitation does not apply to 1, 2 or 4 socket platforms.

## Intel® VROC SATA LED Management

When designing a Hot Swap Backplane (HSBP) into a new platform, make sure that the backplane design supports the platform’s external design document specification for HSBP support.

The sSATA controller on the Intel® Cooper City and Wilson City Customer Reference Boards (CRBs) have very limited support for using and/or testing backplane management. Make sure to review all Intel® Cooper City or Wilson City CRB design documentation to understand how the sSATA controller is laid out.

## Intel® VROC Creation Volume Sizes

When creating a RAID volume, there will be a volume size difference seen when comparing a RAID volume created using the Intel® VROC PreOS HII environment and volumes created in the OS. This has to do with the way the size information is displayed and computed between the two environments.

## MCERR/P\_CATERR/Bus Uncorrectable Error with Intel® VMD Enabled

When CTO occurs, Intel® VMD must be chosen to handle these conditions when the root port of the Intel® VMD controller is enabled. This is accomplished by disabling IOMCA on the x16 Intel® VMD enabled lanes.

## NVMe Drive Model Number Does Not Display Properly in Device Manager

The NVMe device name in Device Manager is created by Microsoft.Within Device Manager, the model number of NVMe devices may not be completely displayed once Intel® VMD is enabled. A workaround with a new parameter in **UnitControl**, **ScsiUnitRichDescription** to show all model number in the device name. The workaround can only solve the problem when the drives have the same model number but different sizes.

## Intel® VROC RAID Driver is not Producing AtaPassThru Protocol

When using **AtaPassThru** protocol to get information on attached devices from the Intel® VROC PreOS, the value of **GetNextTargetLun** may not be successful. A workaround is to set the value of the "Timeout" field inside "Packet" to a larger value (e.g., 3 seconds).

## Intel® VROC 8.0 New GUI Design

### Warning Message Displayed When GUI and Driver Version is Mismatching

When this warning message condition is detected from one major version or two minor versions difference, the Intel® VROC GUI will not allow to manage the storage controller but can provide a set of functionalities corresponding to the lowest driver version. The Intel® VROC GUI still can start even if there is no driver installed.

## Pre-Boot DMA Feature Needs to be Disabled

RAID creations could not be done after enabling *Pre-Boot DMA Protection* and *DMA Control Opt-In Flag*. This feature enablement is targeted to be corrected by Eagle Stream Refresh (EGS-R) timeframe.

## Intel® Virtual RAID on CPU (VROC): Intel® VROC (SATA RAID) Compatibility Issue with Microsoft Windows\* Operating System Versions Released After June 2022

Beginning with Microsoft Windows\* 11 SV2 release timeframe, Microsoft has implemented a correctness fix to address a potential race condition that could result in a system failure (bugcheck). The issue corrected was in the device PnP removal process. This correctness fix has been backported to Microsoft Windows\* 11 SV from 2021.10C, Windows\* Server 2022 from 2021.08C and Windows\* 10 22H2. As a result of this Microsoft correction, one of the Windows inbox RAID drivers; the Intel® Rapid Storage Technology (Intel® RST) driver now fails the device PnP removal process. This process failure blocks the Intel® RST driver from being properly removed. As a result, a replacement driver cannot be installed. Long-term solutions to resolve this issue has been brought up to Microsoft to enact corrective measures.

## RAID TRIM Disabled for This Version

A potential silent data loss/corruption condition exists in all Intel® Rapid Storage Technology enterprise (Intel® RSTe) Windows\* drivers, beginning with version 5.4.0.1465, as well as all Intel® Virtual RAID on CPU (Intel® VROC) Windows\* driver versions (until Intel® VROC 7.x). This potential silent data loss/corruption condition occurs on Intel® VROC managed RAID 5 volumes, consisting of at least one SSD that supports TRIM/UNMAP commands, by methods other than the use of zeros.

## RAID 5 Boot or Data Volume in Rebuild State

A potential silent data loss/corruption condition (SDC) exists in all Intel® Virtual RAID on CPU (Intel® VROC) Windows\* driver versions beginning with the release package version 7.0.0.2291. The issue has been root caused to a very small timing window where a particular sequence of event occurs. A customer may be exposed to this SDC condition when all the following conditions have been met:

* The platform is configured with a RAID 5 volume, and it is in a Rebuild state.
* The platform is under very heavy I/O.
* The I/O operation generates a WRITE operation to a RAID volume stripe that is not being rebuilt yet.
* The I/O operation generates a READ operation to the RAID volume, in which the READ address range overlaps with two stripes: the stripe that is being rebuilt, and the next stripe that has yet to be rebuild.

If these conditions have been encountered in an operational environment, the platform may encounter the SDC condition.

Intel strongly recommends that customers, who may be exposed to this silent data loss condition, immediately update to the Intel® VROC 8.2 release package version.

**§§**

# Intel® VROC Issues

This chapter outlines the issues reported and internally found that customers need to be aware of. The issues are broken down into known issues and resolved issues.

## Known Issues in Intel® VROC 9.0 Release

Table 5‑1. Known Issues in Intel® VROC 9.0 Release

| **Issue ID** | **Description** |
| --- | --- |
| **14015389340** | When using **AtaPassThru** protocol to get information on attached devices from the Intel® VROC PreOS, the value of **GetNextTargetLun** may not be successful. |
| **18015334984** | Warning Message "*Warning: The AHCI driver will be updated to the latest Microsoft AHCI driver in the system*" does not occur when installing Intel® VROC in AHCI Mode using installer. |
| **18020541368** | While within SED Manager, unencrypted drives that are unplugged and then are selected to have a security key to be setup may experience a platform hang. |
| **15010088464** | When SATA controller is switched to RAID mode, SATA drive information will be displayed in Intel® VROC SATA HII instead. So, user can reference the device information in Intel® VROC SATA HII. |
| **18016767645** | Within Intel® VROC SED Manager, a physical drive may appear in twice. |
| **1805900436** | Intel® VROC F6 Drivers may not properly load, and a refresh may be required. |
| **15011986293** | When booting the platform with a degraded Intel® VROC RAID 1 data volume, the Intel® VROC 8.0 GUI may not properly display the RAID volume. |
| **18012869559** | Intel® VROC GUI And CLI may not forbid performing operations that use self-encrypting drives in locked state. Creating RAID volume with locked member may result in failed volume state. |
| **18022812016** | When the OS performs a TRIM command onto an Intel® VROC RAID 1 or RAID 10 comprised of drives that perform TRIM activities in different ways may encounter a data inconsistency on those areas that had been TRIMed. |
| **15012192390** | Intel® VROC SATA HDD may have a problem unlocking after sending the 0xf2 command. |
| **18024185962** | A RAID volume may become degraded after the Initialization process completes, if two of the drives encounter a Bad Block condition in the same sector. |
| **18027522818** | Specific code rework done as we do not support creating volumes with legacy values anymore. |
| **15013821671** | Windows GUI did not show "rebuilding" event as disk hot-plug and inserted when RAID member only 100 MB. |
| **18029487344** | Intel® VROC OS interfaces (Windows\* GUI CLI, Linux\* *mdadm*, Linux\*/Windows\* OOB) may not forbid performing operations that use self-encrypting drives in locked/foreign state.  RAID volume operations with locked / foreign device will be failed (e.g. RAID volume creation will be failed). |
| **18030259585** | State of drive resource for locked Opal drive is enabled where it should be *StandbyOffline* in which the RAID volume rebuild may not be blocked and hot-inserted device detection may be failed. |
| **18034442524** | Unlocked Opal drive is present alongside with hot plugged non-opal drives in OS in which the RAID volume rebuild may not be blocked and hot-inserted device detection may be failed. |
| **15014262993** | Windows\* OOB can't identify if pass/fail after patch successfully for disk set write cache on. |
| **18036343861** | Creating a RAID volume on disks that contains data and nonexistent **OdataId** may return an incorrect error or an invalid resolution message. |
| **18036610422** | **OperationName** may show an inconsistency between the RAID volume and member drive for a under the rebuild operation. |
| **18037125636** | Intel® VROC OS interfaces (Windows\* GUI CLI, Linux\* *mdadm*, Linux\*/Windows\* OOB) may not forbid performing operations on hot-inserted self-encrypting drives in locked/foreign state.  RAID volume hot-plug related operations with locked/foreign device will be failed (e.g. RAID volume rebuild may not be blocked, hot-inserted device detection will be failed). |

## Resolved Issues in Intel® VROC 9.0 Release

Table 5‑2. Resolved Issues in Intel® VROC 9.0 Release

| **Issue ID** | **Description** |
| --- | --- |
| **15014712764** | A Raid10 volume rebuild may fail while VROC was in use with a NVME drive with Windows OOB Driver. |
| **18036862050** | A variable may be read too early in the boot process by VROC UEFI SATA DXE drivers which may result in a Red Screen of Death (RSOD) |
| **15015886092** | A CPU exception affecting an unsupported configuration cause a BIOS boot hang when SATA RAID is enabled on two Montage IOH devices. |
| **18037206458** | A potential error may occur when changing RWH policy of encrypted RAID with using unencrypted drive. |
| **18037206493** | RAID creation with using locked drive may not have been blocked in UEFI HII Menu. |
| **18037985742** | A disk should be in normal state after a hotplug action is committed and the volume after migration should be in normal state. There was a possiblity that instead the disk could be marked as missing and volume could be degraded after migration. |

## Resolved Issues in Intel® VROC 8.6 Release

Table 5‑3. Resolved Issues in Intel® VROC 8.6 Release

|  |  |
| --- | --- |
| **Issue ID** | **Description** |
| **18033787199** | Renaming a RAID volume with background initialization may return internal error on Windows\*. |
| **18035022296** | Changed the library for unit tests to further enhance security and deter vulnerability concerns. |
| **18035042739** | **--xml** IntelVROCCLI.exe option from the CLI tool has been adjusted to work properly in the current release Intel® VROC 8.6 version. |
| **18035044826** | The incorrect value for SKU property for *RAID1 Only* license may have been displayed. |
| **18035522716** | UI includes .NET 7.0.0. |
| **15014353528** | The Intel® VROC driver might have hung due to the heavy IO workload on RAID 5 configurations. |
| **15014353528** | The Intel® VROC installer could possibly have shown an empty list of used third party software. |
| **18035464333** | Intel® VROC could be installed on unsupported platform. |
| **18037097526** | The Intel® VROC installer could put important files in the unprotected temporary directory of the current user. |

## Resolved Issues in Intel® VROC 8.5 Release

Table 5‑5. Resolved Issues in Intel® VROC 8.5 Release

| **Issue ID** | **Description** |
| --- | --- |
| **18032276087** | Windows\* agent may not respond after sending volume creation volume with 16 characters. |
| **15014295238** | **Operation** property may not show ongoing rebuild process. |
| **15014373112** | Some volume parameters provided during volume creation may be considered mandatory when they should have been optional. |
| **18033850568** | Awhile adding a disk, it may not be added to the existing RAID 0, and an **Internal error** message may also be returned. |
| **18031201791** | CLI may return wrong error message after stripe size change in RAID 0. |
| **18031659741** | The placeholder may have had incorrectly stored information. |
| **18033689418** | Data could be corrupted on RAID 5 under specific conditions.  This has been addressed in a technical advisory that can be provided by Intel. |
| **18033876218** | The trial notification at the start of the trial may display 0 days instead of 90. |

## Resolved Issues in Intel® VROC 8.2 Release

Table 5‑6. Resolved Issues in Intel® VROC 8.2 Release

| **Issue ID** | **Description** |
| --- | --- |
| **15012341358** | Wrong chipset number may be displayed incorrectly in the Intel® VROC GUI summary page. |
| **15012745887** | With the Micron M.2 SSD, there may be a disk error in which BurnIn test:Test file could not be created. |
| **18025836360** | With a SATA RAID 5, there may be an OS System Hang 72 during the period when a system enters into S4 hibernate state. |
| **15012158141** | Enable Intel® VMD may increase boot time by 15 sec without a hardware key plugged in. |
| **15012744995** | Page-Fault Exception may occur while calling **EfiNvmExpressPassThru** to send **EnableBlock** SID command after hot remove a NVMe SSD behind Intel® VMD. |
| **18023073780** | Migrating volume to another level may be impossible when user changes the name of volume. |
| **18022000029** | *VolumeDegraded* and *DriveRemoved* events may not be detected after unplugging volume member. |
| **18027972005** | The LED behavior between Linux\*, Windows\* and HII has been unified. It is now possible to turn off the LED manually in Windows\*. |
| **18030599433** | Secure erase feature for NVMe has been added. |
| **13010941224** | When creating volume with 16-character name, the last character was being cut. |
| **14019194649** | Missing disk used to have ID 0-255-0-0 after reboot. |
| **15012777627** | Event ID 4155 regarding CD/DVD rom used to show invalid serial number of the device. |
| **15012986924** | The SATA RAID 1 rebuild speed was slower than expected which was fixed from very slow rebuild speeds from baseline, to what it should be at. |
| **15013305559** | Error events used to appear while activating OOB agent with Intel® VMD disabled. |
| **15013356966** | After hot-unplug of RAID member, clear metadata with another platform and re-plug back, disk usage is displayed incorrectly. |
| **15013452250** | Disk usage is displayed as unknown, after creating RAID, deleting it, rebooting, setting disks to non-RAID, and checking usage in UI. |
| **15013631093** | Confusing message used to appear after RAID member hot unplug, and plug back in. |
| **18025145965** | Under specific circumstances journaling drive may be in incorrect state. |
| **18025342659** | Eject disk button was unintentionally enabled in UI, suggesting it is possible to perform illegal action. |
| **18025556051** | Under specific circumstances it was possible to fail spanned RAID 5 volume while updating Intel® VROC driver version. |
| **18025942408** | Once user invoked **SetEvetReceiver** command with value = disable, all events generated by Intel® VROC OOB were supposed to be cleared in the event queue, which was not implemented correctly. |
| **18030917271** | Volume name may not be shown fully and properly if it is equal to 16 characters. |
| **18031491855** | Smart App Control could block Intel® VROC driver actions. |
| **18025555817** | Volume state may be incorrect in HII during initialization process. |
| **18022848256** | Rebuild action may be very slow with some cache settings set incorrectly. |
| **18023423304** | System RAID 5 (with RWH JD) could not be created when other OS was present in machine. |
| **18023561138** | Unexpected event log could be seen after platform reboot during volume Rebuild action. |
| **18024043614** | Media errors could be counted incorrectly after Initialization. |
| **18024488340** | Volume type could be changed from RAID 0 to RAID 5 with x8 drive. |
| **18024577214** | Invalid RAID Write Hole Policy may return incorrect error for R0. |
| **18024662541** | Strip size of volume could be changed during adding disk in one command. |
| **18025418868** | "InitializeMethod" value could be set incorrectly. |
| **18025554947** | Creating volume may be impossible without stating optional parameters. |
| **18028910237** | Creating volume with invalid strip size value may be possible. |
| **18031169423** | Creating volume on disk with data and non-existing OdataId may return incorrect error. |
| **15013389958** | Optimize HW key detection, Upgrade key is changed from “premium” to “pass-thru” during running reboot stress in WIn10 22H2 OS with BCB VMD. |
| **18022969815** | User may be unable to choose strip size 128 for RAID 10 in PreOS. |
| **18023576509** | No warning about JD RWH not being supported for Linux\* may appear during RAID 5 creation in HII. |
| **18020894568** | While the disks are connected to PCH, migrating OS volume to RAID 5 with additional drive from the same domain as member drives may end with error in CLI/UI. |
| **18020894601** | While connected to disks under Intel® VMD domain, migrating OS volume to RAID 5 with additional drive from the same domain as member drives may end with error in CLI/UI. |
| **18024634800** | Spanning warning string may be incorrect during creating spanned RAID in EFI. |
| **18021555907** | "Increase Size" action could not be performed sometimes in GUI because of refreshing issue. |
| **18023113317** | When attempting to create a Matrix RAID volume, the Intel® VROC 8.0 GUI may become unresponsive or fail. |
| **18024874787** | Registers used for saving AVX instructions states could get corrupted during using RAID 5. |
| **15014154518** | When heavy IO is added onto a degraded RAID 5, there may be an experienced errors relating to data mis-compare failures. |

## Resolved Issues in Intel® VROC 8.0 Release

Table 5‑7. Resolved Issues in Intel® VROC 8.0 Release

| **Issue ID** | **Description** |
| --- | --- |
| **18015582447** | When attempting to rebuild a degraded RAID 10 matrix (second RAID volume is a RAID 5) with 2 drive failures (RAID 10 - Degraded; RAID 5 - Fail), the Intel® VROC driver may become unresponsive. |
| **1808018122** | Trying to clear a SMART event from a drive after a RAID volume is rebuilt (to another drive), may show up as a unknown disk. |
| **18010986194** | Intel® VROC PreOS may not properly show a boot RAID volume as bootable after the RAID volume encounters a FAIL condition. |
| **18012964787** | Number of media errors reported in Intel® VROC GUI may be different than expected after performing *Verify and Fix* on RAID 1. |
| **18016591025** | I/O may become unresponsive with NVMe VROC for Windows\* under heavy I/O while using matrix RAID. |
| **14014436257** | Exceptional boot delay with WD Gold HDD used as SATA data drive attached to RAID mode port, but not in a RAID volume. |
| **18011148984** | Intel® VROC GUI may not indicate which drives are connected to PCH for pass through system drives and system RAID volumes. |
| **18016453364** | When using the Intel® VROC HII to create a RAID volume, the warning message that all data on the member disks will be lost, may not be displayed. |
| **18023331378** | Intel® VROC Bad Block Management (BBM) logging may report the wrong drive serial number when logging BBM events. |
| **1808094827** | The Intel® VROC (VMD NVMe RAID) PreOS environment may only show 32 NVMe SSDs in the Intel® VROC HII. |
| **18012896024** | Intel® VROC GUI may not report proper number of media errors encountered during initialization of RAID 5. |
| **18010956435** | Output may not appear in Intel® VROC CLI after attempting to create RAID 1 volume from two parts of x8 drive. |
| **1508749788** | A second RAID volume may not rebuild to the hot-spare drive after resetting one member disk to non-RAID. |
| **18015729524** | Intel® VROC OOB Management may report wrong error message during the attempt to create RAID volume from third party vendor drives when using *Intel SSD Only* key. |

## Resolved Issues in Intel® VROC 7.7 Release

Table 5‑8. Resolved Issues in Intel® VROC 7.7 Release

| **Issue ID** | **Description** |
| --- | --- |
| **18016058101** | Intel® VROC bad block management process may take (3 to 4 times) longer than in previous versions. |
| **18014127243** | Performing an Intel® VROC (SDATA RAID) RAID 5 write hole recovery on a degraded SATA RAID 5 volume may not complete successfully. |
| **14014598311** | Intel® VROC SATA/sSATA RAID volumes may degrade or fail under high I/O load if an ATA pass through command is issued. |
| **14013794942** | The Intel® VROC CLI tool may terminate operation with an error if the user attempts to use the command with **-M** option, with a drive volume that does not exist. |
| **14013356415** | [CPX-6] Install Protocol Interface failure message after loading VMD UEFI driver. |
| **1508964983** | This issue is caused by unsigned iaNullVMD.inf. |
| **1508793548** | Fail to install Windows\* Server 2019 with QWMB CPU. |
| **1508747791** | Hot removal of a matrix RAID member may result in a system failure. |
| **22011598177** | NVMe drives connected to certain Icelake CPU SKU may not be accessible by Intel® VROC when VMD is enabled. |
| **18016895347** | Intel® VROC (SATA RAID) PreOS Health Protocol may not properly report the driver/controller information. |
| **18015474102** | Trying to clear a SMART event from a drive after a RAID volume is rebuilt (to another drive), may show up as a unknown disk. |
| **18014791546** | Using the Intel® VROC CLI tool to remove the metadata on all the specified drives may not complete successfully on drives identified as "unknown". |
| **18014524336** | When using the Intel® VROC CLI tool to identify the attached devices on the SATA/sSATA controller, attached ATAPI devices may not be properly reported. |
| **18013439721** | When running in a matrix RAID configuration (two RAID volumes in a single RAID array), the bad block management process may not properly detect bad blocks. |
| **18011530136** | The Intel® VROC RCfg tool may not properly display the warning message when trying to rebuild a volume to a drive that is at least 10% bigger than the largest member drive. |
| **1806564424** | System may fail to start after an unexpected power loss. |
| **18012842292** | An incorrect error message (“*REQUEST\_FAILED: Request is formatted correctly but failed to execute.*”) may be reported by the Intel® VROC CLI tool when trying to perform a migration to unsupported RAID level. |
| **18012255612** | The Intel® VROC CLI tool may return the wrong error message (“*INVALID\_DEVICE: Request not formatted correctly; device does not exist.*”) when trying to rebuild degraded RAID volume to drive in an incompatible state. |
| **18012236043** | The Intel® VROC CLI tool may report wrong error message (“*REQUEST\_FAILED: Request is formatted correctly but failed to execute.*”) when trying to remove member drive of system RAID volume. |
| **18011483476** | When using the Intel® VROC HII to create a RAID volume, the warning message that all data on the member disks will be lost, may not be displayed. |
| **1808963497** | RAID initialization may not be automatically performed when *Verify* or *Verify and Repair* is initiated by the Intel® VROC CLI tool on an uninitialized volume. |
| **18018934449** | On Wolfpass platform, NVMe RAID submenu is not available and RCFG needs to be used to manage RAID functionalities in UEFI. |
| **22011592946** | Intel® VROC (SATA RAID) PreOS Health Protocol may not properly report the driver/controller information. |
| **18016174423** | Performance issue may occur after switching from legacy to MSI-X interrupts mode on SATA RAID. |

## Resolved Issues in Intel® VROC 7.6 Release

Table 5‑9. Resolved Issues in Intel® VROC 7.6 Release

| **Issue ID** | **Description** |
| --- | --- |
| **22012232430** | Using the Intel® VROC CLI tool with the **-R** option may not properly result in the RAID volume rebuild occurring. |
| **14013209937** | Intel® VROC bad block management process may take (3 to 4 times) longer than in previous versions. |
| **1508906750** | [VROC] Drive failure messages seen on initiating IO. |
| **14012975200**  **1508768056**  **22011598177** | Not able to install Windows\* on Intel® VROC-managed NVMe or may not be able to access NVMe drives behind VMD with certain Icelake CPU SKUs. |
| **22011073918** | A potential silent data loss condition exists in both the Intel® VROC (SATA RAID) and the Intel® RSTe Windows-based products. The potential silent data loss condition exists when the Intel® VROC Read Patrol feature is enabled for redundant SATA RAID volumes (RAID 1, 5 or 10) and one of the RAID member drives is found to have a bad block condition. The Read Patrol process, of using the redundant data to correct the bad block, can result in invalid data being written. |
| **1509073224** | The Intel® VROC 7.5 installation application may not properly install the Null Driver to support Device ID 0x09AB. |
| **18016160241** | This issue is caused by unsigned iaNullVMD.inf. |
| **14012975200** | NVMe drives connected to certain Icelake CPU SKU may not be accessible by Intel® VROC when VMD is enabled. |
| **1508793548** | Fail to install Windows\* Server 2019 with QWMB CPU. |
| **1507753655** | when running stress testing on M.2 slots managed by the sSATA controller, an **isStorB** error may be logged. |

## Resolved Issues in Intel® VROC 7.5 Release

Table 5‑10. Resolved Issues in Intel® VROC 7.5 Release

| **Issue ID** | **Description** |
| --- | --- |
| **22011196948** | Intel® VROC may not properly calculate the LBA locations when performing the Read Patrol Bad Block Recovery process, inadvertently missing some bad blocks. |
| **22011073918** | A potential silent data loss condition exists in both the Intel® VROC (SATA RAID) and the Intel® RSTe Windows-based products. The potential silent data loss condition exists when the Intel® VROC Read Patrol feature is enabled for redundant SATA RAID volumes (RAID 1, 5 or 10) and one of the RAID member drives is found to have a bad block condition. The Read Patrol process, of using the redundant data to correct the bad block, can result in invalid data being written. |
| **14012886123** | Intel® VROC RAID Write Hole parity calculation may be computed incorrectly. |
| **22011547837** | NVMe drives listed in the Intel® VROC BIOS HII page may state incorrect CPU on which it is connected to. |
| **22010691032** | Intel® VROC Installer Help Dialog does not contain all available setup options. |
| **14011249412** | Activate LED option may not work for non-Intel drives when using *Intel SSD Only* license. |
| **14011049937** | The order of the SATA drives attached to the sSATA controller may not match that of how they may be reported in the SATA controller |
| **1808275753** | The wrong RAID volume state may be displayed after a dirty shutdown. |
| **1507753655** | When running stress testing on M.2 slots managed by the sSATA controller, an **isStorB** error may be logged. Expected under such heavy I/O loads. |
| **18012678098** | When installing Intel® VROC using installer with option **-nodrv** all drivers are uninstalled, and no driver is installed in replacement. This option may break operating system and it shall not be used. |
| **18011258092** | Clearing RAID metadata using the RCfg tool may result in a platform hang in UEFI and an ASSERT. |
| **18010905203** | Creating a RAID volume in Intel® VROC (VMD NVMe RAID) PreOS from drives connected through a JBOF may not succeed and result in error message: “*Create volume failed! Cannot write to disk*”. |
| **1806564424** | System may fail to start after an unexpected power loss. |
| **1508007585** | Intel® VROC HII may display the RAID volume capacity improperly when it is larger than 10000GB. |
| **1507520073** | Uninstall the Intel® VROC Windows\* driver may encounter an error when it is installed and uninstalled multiple times. |
| **1306412122** | Setting LED Configuration of Empty Slot as Fail may not show Fail when slot is empty. |
| **22011382393** | Locate LED may not work properly in VROC HII when using PCIe switch with NPEM support. |

## Resolved Issues in Intel® VROC 7.0.2 Release

Table 5‑11. Resolved Issues in Intel® VROC 7.0.2 Release

|  |  |
| --- | --- |
| **Issue ID** | **Description** |
| **22011071259** | With Read Patrol is enabled, recovering from a bad block could result in a data loss condition. |

## Resolved Issues in Intel® VROC 7.0 Release

Table 5‑12. Resolved Issues in Intel® VROC 7.0 Release

| **Issue ID** | **Description** |
| --- | --- |
| 14010261577 | Intel® VROC IAStorIcon Scheduled Task may be inadvertently removed during a package upgrade. |
| 22010314523 | Migration of one RAID 10 volume to a RAID 5 volume may cause another RAID 10 volume, in the system, to automatically re-initialize. |
| 18011792455 | When using a Hot Spare Back Plane from a Whitley platform in Cedar Island platform, the SATA LEDs may not work properly. This is not an Intel® VROC issue. |
| 14010852023 | Intel® VROC HII may not display RAID volume information correctly when the raid volume is greater than 10 Terabytes. |
| 1808514953 | Booting a platform with 48 NVMe drives may result in a system failure. |
| 1808389290 | The Intel® VROC Rebuild LED behavior may not operate properly when customized to blink all LEDs during a RAID rebuild. |
| 1806994368 | Performing Hot Plug drive replacement on a degraded RAID volume, with Rebuild on Hot Insert enabled, may not properly initiate an automatic RAID rebuild. |
| 1507501583 | When resuming from and S3 power state change, the "System" label may not be displayed properly in the Intel® VROC GUI. |
| 1409667894 | LED Locate from the HII BIOS VROC Menu causes page to exit prematurely. |
| 1808703820 | When Using the Intel® VROC CLI tool to add a drive to an existing array, the volume strip size may not be displayed properly. |
| 1808580403 | when performing a drive Hot Plug, the event logger may show other drives (not involved in the Hot Plug) having encountered hot plug events. |
| 1807170210 | An Intel® VROC GUI volume creation warning message may overlay on top of a submenu. |
| 1806564426 | Event Lot may not properly show “*RAID volume {VolumeName} is normal*” message after a rebuild completes. |
| 18011690000 | Activate LED Option may not work in Intel® VROC CLI and GUI, when using the *Intel SSD Only* license. |

## Resolved Issues in Intel® VROC 6.3 Release

Table 5‑13. Resolved Issues in Intel® VROC 6.3 Release

| **Issue ID** | **Description** |
| --- | --- |
| **14010267807** | Performing a Drive Surprise Hot Remove from a Matrix raid array may result in a platform failure. |
| **1507649523** | Using the **CC\_CSMI\_SAS\_GET\_DRIVER\_INFO** command may not report correct drive and driver information. |
| **18010792702** | Intel® VROC IAStorIcon Scheduled Task may be inadvertently removed during a package upgrade. |
| **1809577436** | An Intel® VROC spanned RAID 10 volume may not start rebuilding automatically after a rebuild on hot insert condition. |
| **1806397184** | In Intel® RSTe NVMe Pre-Purley platform with 48 NVMe drives and max volumes, degraded RAID volume may encounter a system failure while booting. |
| **1507369786** | Migrating a single NVMe boot drive to an Intel® VROC (VMD NVMe RAID) volume and perform a system sleep power state change may result in a system crash. |
| **1806411891** | RAID volume may become degraded after reboot. |
| **1806397164** | Intel® RSTe NVMe Pre-Purley Platform with 48 NVMe drives and 24 volumes may encounter a boot failure. |
| **1507522222** | Intel® VROC LED Management may illuminate the Locate LED option during another RAID operation and may not stop when the operation completes. |
| **1806930160** | An error message in event viewer “*The driver detected a controller error.*” may be displayed when performing platform power state changes with Intel® VROC installed. |
| **1806419240** | Intel® VROC (VMD RAID) NVMe drive may be marked as available after removal. |

## Resolved Issues in Intel® VROC 6.2 Release

Table 5‑14. Resolved Issues in Intel® VROC 6.2 Release

| **Issue ID** | **Description** |
| --- | --- |
| **1606900429** | System crash may occur when load Intel® VROC (VMD NVMe RAID) F6 driver while the Intel® VROC RAID is under an initialize state. |
| **1409230595** | Intel® VROC UEFI may not properly report the VMD controller BDF in the HII. |
| **1409017125** | UEFI driver hangs when the metadata is malformed. |
| **1408968353** | Intel® VROC (VMD NVMe RAID) UEFI HII Menu may cause the BIOS Setup Menu to be improperly displayed. |
| **1409194760** | Activity LED is not blinking when SATA drive in RAID mode. |
| **1808452676** | A system, with the OS installed onto a RAID volume, may not properly resume after several hybrid sleeps. |
| **1808377588** | A system running Intel® VROC, with the OS installed onto a RAID volume, may not properly resume from a hybrid sleep state, after performing multiple hybrid sleeps. |
| **1808060543** | The Intel® VROC 6.2 UWD UI application may not properly function on a platform with Intel® VROC 6.0 driver package. Make sure that when using the Intel® VROC UWD UI application, that the UI version matches the driver package (i.e. both should be Intel® VROC 6.0 or both should be Intel® VROC 6.2). |
| **1807345165** | The Intel® VROC CLI tool may not properly expand existing RAID volumes. |
| **1807107325** | When using the Intel® VROC CLI tool to create RAID volumes one of the disks may show a disk size of 0GB after the volume creation completes. |
| **1806677977** | Bad blocks may not be properly reported in a RAID 5 volume. |
| **1806534894** | The Intel® VROC CLI tool may allow data migration with a smaller drive. |
| **1806503629** | Creating a RAID 1 volume from an existing drive may result in a failed RAID volume. |
| **1507222187** | The Intel® VROC icon is missing in system tray in Windows\* 10. |
| **1409784946** | Hot Removal of a RAID 5 Write Hole (RWH) Journaling Drive may cause the platform to become unstable and may cause a system failure system instability and BSODs. |
| **1409371408** | Intel® VROC GUI may require the "Proceed with deleting data" box be selected when not expected. |
| **1407853994** | Degraded SATA RAID 5 may not boot if disk on SATA controller port 0 is removed or fails. |
| **1407801045** | The Intel® VROC RWH policy may inadvertently change from Journaling to Distributed if one member drive is missing. |
| **1407219909** | New VMDVROC\_1.efi and VMDVROC\_2.efi drivers will increase boot time around 4 seconds. |
| **1806782204** | Intel® VROC GUI may not properly open unless "Run as Administrator". |
| **1506398660** | RAID 10, hot-plug two member disks, re-plugged second disk can't rebuild. |
| **1409584095** | Event log error 4156/4155 seen during stress testing. |
| **1807977956** | The platform may encounter a system failure as a result of performing a hybrid sleep cycle on an Intel® VROC RAID 5 volume (the first hybrid sleep after running the Intel® VROC installation application). |
| **1807962656** | The Intel® VROC PreOS UEFI may not properly display the full serial number of a removed/offline volume member drive in the UEFI Health Protocol information. |
| **1807158496** | The Intel® VROC RWH policy may change from Journaling to Distributed after a Drive Hot Unplug. |
| **1806564409** | Platform may not properly boot after a dirty shutdown with I/O on a RAID 5 volume (RWH Distributed). |

**§§**