

Intel® Virtual RAID on CPU (Intel® VROC)

6.3 PV Windows Customer Release Notes

February 2020



Revision History

External Version	Internal Version	Description	Date
001	1.0	Initial Intel VROC 6.3 PV release.	February 2020

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1 Introduction

The Intel® Virtual RAID on CPU (Intel® VROC) 6.3 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 VROC (VMD NVMe RAID) provides enterprise RAID solution on platforms that supports Intel® Volume Management Device (Intel® VMD) on Intel® Xeon® Scalable Processors.
2. Intel VROC (SATA RAID) provides an enterprise RAID solution for SATA devices connected to SATA/sSATA ports of the Intel® Platform Controller Hub (Intel PCH) configured for RAID Mode.
3. Intel VROC (NonVMD NVMe RAID) provides an enterprise RAID solution for Intel NVMe SSDs attached to PCIe slots managed by the platform's Intel Xeon Processor (see [Supported Platforms](#)). Intel VROC (NonVMD NVMe RAID) is not intended for, nor supported on platforms with Intel® Xeon® Scalable Processors.

Note: Intel VROC 6.3 is a high-level blanket product reference for the family of products that include Intel VROC (VMD NVMe RAID), Intel VROC (SATA RAID) and Intel VROC (NonVMD NVMe RAID).

Please see the [Supported Platforms](#) section for additional information on older platforms supported with this release.

Note: It is always recommended to update your system BIOS to the included PV release of PreOS images to take advantage of the most optimal and updated features of each Production Version release

1.1 Terminology

Table 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.



Term	Description
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	A BIOS option to configure Intel VROC UEFI Drivers for Intel VMD and the platform PCH in RAID mode.
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 a 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.
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 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.



Term	Description
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	<i>Unified Extensible Firmware Interface</i> . Refers to the system setting in the BIOS
Intel® VMD	Intel® Volume Management Device
Intel® VROC	Intel® Virtual RAID on CPU

1.2 Defect Submission Support

With this release, Intel will accept, and process issues reported by customers via the Intel Premier Support (IPS) portal.

To submit an issue, please use the Intel Premier Support (IPS) tool. Information, training and details can be found at the below website. Your local Intel FAE can also provide you the necessary requirements to enable you to submit an IPS issue (also known as a "case") including an account setup if you do not already have one.

<http://www.intel.com/content/www/us/en/design/support/ips/training/welcome.html>

When submitting a case, please include the following Fields in order to flag Intel VROC AE support for Intel® Xeon® Scalable platforms.

- Case Information -> Product = Purley
- Case Details -> Subject= <Add short title summary of issue>
- Case Details -> Case Description = <add description and how to reproduce error>
- Case Details -> Case Type = <fill in type of request>
- Case Details -> Severity = <fill in severity of issue>
- Case Details -> End Customer = <name of OEM>
- Case Details -> Issue Source = IPS Cloud
- Case Details -> Severity
- Product/Project Info -> Case Category = TechnologyInitiative
- Product/Project Info -> Case Subcategory = Intel® Rapid Storage Technology enterprise (Intel® RSTe)
- Environment Details -> Purley-PCH = lbg-4
- Environment Details -> Purley-CPU = skx-2s (or skx 4s)
- Environment Details -> BKC or SW Version = <applicable versioning information>



1.3 Supported Operating Systems

Only 64bit OS support is available for the following OS versions

- Windows Server 2012 R2 Enterprise (supported on Server platform only)
- Windows 10 RS3 / RS4 / RS5 / 19H1 (supported on Workstations platforms only)
- Windows Server 2016 Enterprise (supported on Server platform only)
- Windows Server 2019 Enterprise (supported on Server platform only)

1.4 Supported Platforms

- Intel® Xeon® Scalable Processor base platforms
 - Intel® C620 series chipset
 - Intel® C422 series chipset family
- Intel® Xeon® Processor D-2100 Product Family
- Intel VROC (NonVMD NVMe RAID) support on the following platforms:
 - Intel® Xeon® Processor E5 v3, v4 Families with the Intel® C610 series chipset
 - Intel® Xeon® Processor Families with the Intel® C220 series chipset
 - Intel® Xeon® Processor E3 v5 Families with the Intel® C230 series chipset
 - Intel® Xeon® E Processor Family with the Intel® C240 series Chipset

Note: It is strongly recommended to update your system BIOS to the PreOS images included in this package.

Please see the Intel VROC Technical Product Specification included in this release for specific details

Note: For answers to questions concerning the Intel PCH series chipsets support and/or to obtain other technical collateral, please contact your local Intel FAE.



2 Supported PCIe NVMe SSDs List

All shipping Intel® Data Center and Professional NVMe* SSDs are supported by Intel® VROC 6.3 PV, except dual port NVMe* SSDs. For the latest list of supported Non-Intel PCIe NVMe SSDs, please visit [Intel® Virtual RAID on CPU \(Intel® VROC\) Supported Configurations](#)

2.1 Non-Intel PCIe NVMe SSDs supported as of Intel VROC 6.3:

Vendor	Model
Lenovo*	Atsani
Huawei*	ES3600P
Samsung*	SM951
Samsung*	SM961
Samsung*	PM961
Samsung*	PM953
Samsung*	PM963
Samsung*	PM983
Toshiba*	PX04PMB
Toshiba*	XG3
Toshiba*	XG5
Micron*	9100 Series
Micron*	9200 Series
Western Digital*	DC SN200
Western Digital*	PC SN720



3 New Features

3.1 New Features in Intel VROC 6.3 PV

There are no new features included in the Intel VROC 6.3 PV release package.

3.2 New Features in Intel VROC 6.2 PV

3.2.1 Intel VROC Installer AHCI Driver Option

The installation application for the Intel VROC 6.2 based family of products includes the option to choose to install the Intel VROC 6.2 AHCI based driver. When the Intel VROC 6.2 installation application is executed, it identifies how the Intel PCH (SATA and/or sSATA) is configured. When configured for AHCI mode it will present this option to the user. If the user does not make this selection, the installation of the Intel VROC AHCI driver is bypassed/“not” installed. The option is provided because Intel recommends using the Microsoft AHCI driver under these conditions.

Note: Intel recommends that the Microsoft inbox AHCI driver be used when the SATA controllers are in AHCI mode.

3.3 New Features in Intel VROC 6.1 PV

3.3.1 Microsoft* .NET and Intel ASM No Longer Included

To address functional and security updates, this version of the Intel® Virtual RAID on CPU (Intel® VROC) 6.1 PV Release Package has removed the Microsoft .NET Framework as well as the Intel Acceleration Storage Manager (ASM). Users should update to the latest version.

For the customer's convenience, the Intel VROC product installation application was designed to automatically install the Microsoft .NET Framework and provide an option to install the Intel Acceleration Storage Manager (ASM).

The .NET Framework was included because the Intel VROC user interface relies on the .NET Framework to operate properly. To ensure that customers can get the latest version available, Intel is no longer including .NET Framework in the Intel VROC production package. This is not needed because the supported Windows operating systems already include a version of .NET Framework. If the latest version of the .NET Framework is not installed, it can be obtained/downloaded either via a Web update or offline directly from <https://dotnet.microsoft.com/>.

In addition to removal of the .NET Framework installation, this release also removes the Intel ASM component. The Intel ASM installer has some dependencies on 3rd party libraries and Intel would like to reduce or eliminate these dependencies. Until this is accomplished, the Intel ASM component is being removed. Please contact your Intel FAE for future release details.

For more information please refer to Technical Advisory Reference Number 610700.



3.3.2 Windows* 7-64bit Support

The Intel VROC 6.1 release package includes targeted support for Windows* 7-64bit. Within this package, is included Intel RSTe 5.6 specifically for Windows* 7-64bit. This was added back into the product packaging to support the older platforms.

On platforms that are installing Windows* 7-64bit, the Intel RSTe 5.6 driver from the F6 directory should be used. Once the OS is successfully installed, running the Intel VROC 6.1 installation application will install the Intel RSTe 5.6 GUI and middleware and update/install the driver.

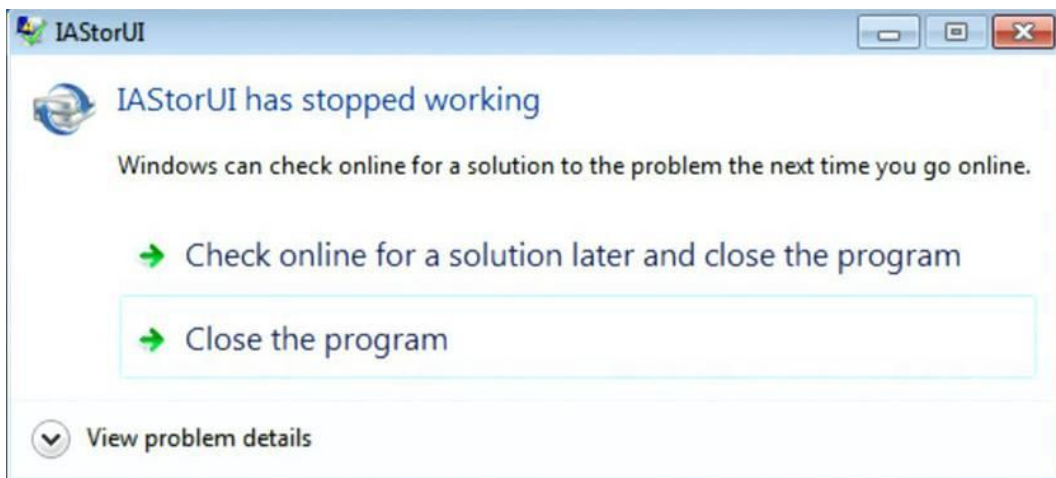
This configuration is the exception to the backwards compatibility of the Intel VROC PreOS. Meaning, that after the platform BIOS has been updated to include the Intel VROC 6.1 PreOS, the Intel RSTe 5.6 package (for Windows 7-64bit) will be supported. Table 1 shows the Intel VROC PreOS versions to Intel RSTe 5.6 OS version support.

Table 12: Intel VROC Compatibility Matrix

	Intel VROC PreOS 5.5	Intel VROC PreOS 6.0	Intel VROC PreOS 6.1	Intel VROC PreOS 6.2	Intel VROC PreOS 6.3
Intel RSTe 5.6 Win7-64bit	Supported	Not Supported	Supported	Supported but not Validated	Supported but not Validated

3.3.3 Windows* 7-64bit .NET Limitations

When installing Intel VROC 6.1 onto a platform with Win7 the following message may be displayed after the package installation reboot:



To resolve this issue, the Microsoft .NET Framework needs to be updated to version 4.5.1. The following link can be used to download:

<https://www.microsoft.com/en-us/download/details.aspx?id=40779>

Note: For all other supported operating systems, please download the latest version of .NET Framework.



3.4 New Features in Intel VROC 6.0 PV

3.4.1 Intel VROC 6.0.0.1359 Release Package

To address functional and security updates, this version of the Intel® Virtual RAID on CPU (Intel® VROC) 6.0.0.1359 PV Release Package has been updated to remove the Microsoft .NET Framework as well as the Intel Acceleration Storage Manager (ASM). Users should update to the latest version.

For the customer's convenience, the Intel VROC product installation application was designed to automatically install the Microsoft .NET Framework and provide an option to install the Intel Acceleration Storage Manager (ASM).

The .NET Framework was included because the Intel VROC user interface relies on the .NET Framework to operate properly. To ensure that customers can get the latest version available, Intel is no longer including .NET Framework in the Intel VROC production package. This is not needed because the supported Windows operating systems already include a version of .NET Framework. If the latest version of the .NET Framework is not installed, it can be obtained/downloaded either via a Web update or offline directly from <https://dotnet.microsoft.com/>.

In addition to removal of the .NET Framework installation, this release also removes the Intel ASM component. The Intel ASM installer has some dependencies on 3rd party libraries and Intel would like to reduce or eliminate these dependencies. Until this is accomplished, the Intel ASM component is being removed. Please contact your Intel FAE for future release details.

For this release, the device drivers and internal tools have not been updated.

For more information please refer to Technical Advisory Reference Number 610700. For information on how to manage the impacts of these changes, please refer to section [Microsoft .NET Framework Removal](#) in this document.

3.4.2 Introduced in Intel® VROC 6.0.0.1357 is the support for the Purley Refresh platform

This section features Intel's commitment to excellence; always improving and listening to our customers' needs.

3.4.3 Intel RSTe Name Changes

The Intel VROC 6.0 family of products provide enterprise RAID solutions for both NVMe SSD and SATA devices for enterprise servers and workstations. The product family includes the following three products.

1. Intel VROC (VMD NVMe RAID) – This product provides an enterprise RAID solution on Intel® Xeon® Scalable Family Platforms that support the Intel VMD technology. In previous releases, this was simply referred to as Intel VROC.
2. Intel VROC (SATA RAID) – This product provides an enterprise RAID solution for SATA devices connected to SATA/sSATA the Intel Platform Control Hub (PCH) configured for RAID mode. In previous releases, this was simply referred to as Intel Rapid Storage Technology enterprise (Intel RSTe).
3. Intel VROC (NonVMD NVMe RAID) – This product provides an enterprise RAID solution for Intel NVMe SSDs attached to PCIe slots managed by the Platform CPU. Intel VROC (NonVMD NVMe RAID) is not intended for, nor supports:
 - a. Non-Intel NVMe SSDs.
 - b. Platforms that have on Intel® Xeon® Scalable Family Platforms CPUs that contain Intel VMD technology (weather enabled or disabled).



In previous releases, this was simply referred to as Intel RSTe NVMe.

3.4.4 Intel VROC Support for Windows 10 RS5 / Server 2019

Intel VROC 6.0.0.1357 release package includes support for Windows* 10 RS5 and Windows* Server 2019.

Note: There is a known issue trying to install Windows* 10 RS5 / Server 2019. Installing Windows* 10 RS5 or Server 2019 onto an Intel VMD managed device is limited to a single CPU. For more information please see the Known Issues section below.

Note: It may be noticed that installing Intel VROC 6.0 when installing or using Windows* 10 RS5 /Server 2019 that installation may take longer than previous OS versions. This is being investigated.

3.5 New Features in Intel RSTe 5.5

3.5.1 Intel VROC and Intel RSTe SATA LED Management in HII BIOS

LED management support is now available in the Intel Virtual RAID on CPU UEFI HII BIOS Menu and in the PCH Intel RSTe HII BIOS menu. The LOCATE option is functional for each NVMe SSD with VMD enabled on its root port. A list of drives behind VMD is visible in a table to the user. The desired device can be selected to blink the LOCATE LED. When the drive is deselected, then the Blink pattern for this drive will be OFF.

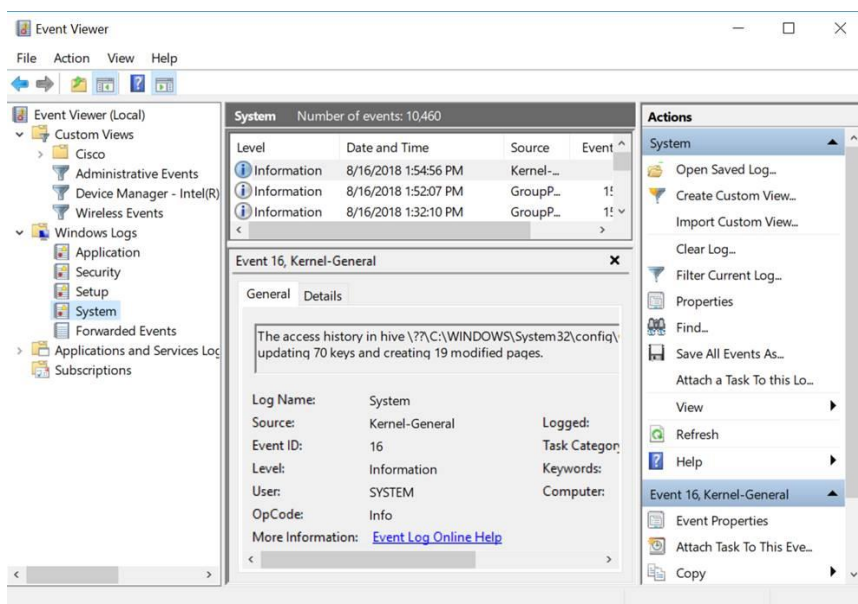
Upon boot into the RSTe UEFI BIOS HII, each drive discovered by the driver should be ON. Otherwise, the indicator LED should be OFF.

3.5.2 Intel VMD Advanced Error Reporting (AER) Logging for Windows

The Intel VMD component of the Intel VROC Windows Driver will log the following Non-fatal (0b) AER Errors:

- Poisoned TLP
- Completion Timeout
- Completer Abort
- Unexpected Completion
- ECRC Error
- Unsupported Request Error
- ACS Violation
- MC Blocked TLP
- Atomic Op Egress Blocked
- TLP Prefix Blocked

Example: Windows event viewer -> Windows Logs -> System and choose to save all events to a file. Optionally choose to filter on "iavroc.sys" to see any VMD AER reporting events.



3.5.3 New Fields added for UEFI Intel VROC Device Info Protocol

Intel VROC UEFI Drivers add the following new fields to the UEFI Intel VROC Device Info Protocol to assist in device recognition during factory process when Intel VMD root port is enabled on NVMe SSDs.

- Deviceld
- SubsystemVendorId
- SubsystemId
- ClassCode
- RevisionId
- FirmwareRev
- OptionROMBar
- RootPortBusNum
- RootPortDeviceNum
- RootPortFunctionNum
- SegmentNum

Please see the [Intel\(R\)_VROC_UEFI_DEVICE_INFO_PROTOCOL.pdf](#) for implementation details and API.

3.5.4 Support of Older Platforms

Beginning with Intel RSTe version 5.5 PV, support for older platforms has been introduced. Except for platforms with the Intel C600 or C200 series chipset and includes the support for the Intel RSTe NVMe product as well.



3.5.5 Intel VROC UEFI Driver Backward Compatibility for Microsoft* Windows* 8.1 and newer OS

Beginning with the Intel RSTe 5.5 PV package, older UEFI Driver versions of 5.X will be compatible with Intel RSTe Windows 5.5PV and newer. The exception will be Microsoft* Windows* 7, which must use the Intel RSTe UEFI driver version 5.4 or newer on Intel Xeon® Scalable Platforms with switch attached NVMe SSDs.

3.5.6 Ability to Change Controller Default Values

Intel RSTe 5.5 PV release package introduces the ability to change controller default values for the following settings:

- Read Patrol
- Rebuild on hot insert

3.5.7 Warning Message added for RAID Volume Creation

Intel RSTe 5.5 PV introduces a warning message if a RAID volume is created when:

- Drive size differences are greater than 10%
- Volume includes mix of SSDs and HDDs

3.5.8 Support for UEFI Driver Health Protocol

In the UEFI environment, the Intel VROC and Intel RSTe SATA UEFI drivers will support warning messages during system boot through UEFI Driver Health Protocol, when at least one of the following conditions is met:

- At least one RAID volume is degraded
- At least one RAID volume is failed
- At least one drive is in 'RAID unsupported' state (Intel VROC UEFI only)
- At least one drive is in 'Incompatible' state
- At least one drive is in 'Offline' state
- At least one drive is in 'Unknown' state

3.6 New Features in Intel RSTe 5.4

3.6.1 Intel VMD and Intel VROC Surprise Hot Plug for Microsoft* Windows* Operating Systems

Intel VMD surprise hot plug for Windows enhancements in this Intel VROC 5.4 release will see improved times for hot insertion and hot removal for Intel VMD enabled NVMe devices. It is recommended to wait until device is reflected as removed / inserted in device manager for spacing surprise hot plug of devices in Windows.

3.6.2 Continuous IO during Hot Plug

With this release of Intel RSTe 5.4 users will see that IO is continuous during hot plug when using Windows performance tools. When an NVMe device is removed or inserted, IO will be continuous to the remaining VMD enabled NVMe devices.



3.6.3 Increase the number of NVMe devices supported to 48

Intel RSTe 5.4 has increased the number of devices supported on one platform from 24 to 48 NVMe devices supported. Please refer to the Intel VROC Technical Product Specification for changes to RAID volume and RAID arrays allowed with this change.

3.6.4 New API for the Private UEFI Intel VROC Device Info Protocol with new field for BLOCKIO Protocol for Pass Thru devices

Allows UEFI applications to retrieve information about each NVMe device on Intel VMD-enabled lanes

- Bus/device/function
- Socket Number
- VMD Domain
- Root Port Number
- Slot Number
- Vendor Id
- Serial Number
- Model Number
- Total Blocks
- Block Size
- Raid Device Member
- Root Port Offset
- BLOCKIO Protocol (NEW in Intel VROC 5.4)

Please refer to the Intel VROC UEFI Device Info Protocol document for structure API changes, included in the Intel RSTe 5.4 release kit.

3.6.5 Customizable LED Management

Customers can customize LED management by modifying registry keys to change behavior for the following Blinking patterns:

- Locate – Blinking pattern time can be lengthened or shortened (default 12 seconds)
- FAIL – Blinking pattern can continue until another good drive is inserted, or stop when failed drive is removed (default is 0 – stop when drive is removed)
- Rebuild initializing - Blinking pattern on all drives in RAID volume (until initialization/verify/verify and fix finishes) – enable (0x1 default) or disable
- Rebuild – Blinking pattern on 1 drive or all drives in RAID volume – 0x0(default – 1 drive) or 0x1
- Rebuild Migration– Blinking pattern on all drives when migration occurs from one RAID type to another RAID type – enable (default = 0x01) or disable

Note: Please reference the Intel® VROC Technical Product Specification for details

3.6.6 Performance Improvements for 4K Queue Depth

Intel VROC has optimized performance for 4K queue depth by adding Storage Request Block for performance improvement in Intel VROC 5.4 release.



Intel VROC supports both STORAGE_REQUEST_BLOCKS and SCSI_REQUEST_BLOCKS. This is designed for implementation on windows OS \geq Microsoft* Windows* 8 and allows device queue depth to 4k; delivering better performance for massive workloads with many concurrent workers.



4 Drivers, Images and Utilities

List of Modules supported on Intel® Xeon® based platforms delivered with Intel® VROC 6.3.0.1031 Release Package.

Feature	Notes
Intel UEFI Drivers	<ul style="list-style-type: none"> • Intel® VROC UEFI Driver version 6.3.0.1005 <ul style="list-style-type: none"> ○ VMDVROC_1.efi (HW key enforcement in effect) • Intel® VMD UEFI version 1.8.0.1001 <ul style="list-style-type: none"> ○ VMDVROC_2.efi <p>Note: All these images are required and intended to support Intel VMD and Intel VROC (SATA RAID) functionality as a combined installed package.</p> <ul style="list-style-type: none"> • Intel® VROC (SATA RAID) SATA / sSATA UEFI Driver version 6.3.0.1005 <ul style="list-style-type: none"> ○ SataDriver.efi ○ sSataDriver.efi
Legacy OROM Images	<ul style="list-style-type: none"> • Intel® VROC (SATA RAID) SATA OROM pre-OS image version 6.3.0.1005 <ul style="list-style-type: none"> ○ SataOrom.bin ○ sSataOrom.bin



Feature	Notes
Intel® VROC Windows* Drivers	<ul style="list-style-type: none"> • Intel® VROC Windows GUI version 6.3.0.1030 • Intel® VROC Windows GUI for Win7 version 5.6.0.1018 • Intel® VROC Windows Installer Package version 6.3_4.0.21 <ul style="list-style-type: none"> ○ SetupVROC.exe (Multi-lingual) • Intel® VROC (VMD NVMe RAID) Windows F6 Driver version 6.3.0.1022 Win8 (Includes Intel VMD enabled NVMe Driver version 1.8.0.1002) <ul style="list-style-type: none"> ○ \iaVROC.free.win8.64bit.6.3.1022\iaVROC • Intel® VROC (VMD NVMe RAID) Windows F6 Driver version 5.6.0.1016 – Win7 (Includes Intel VMD enabled NVMe Driver version 1.8.0.1002) <ul style="list-style-type: none"> ○ \iaVROC.free.win7.64bit.5.6.0.1016\iaVROC • Intel® VROC (SATA RAID) Windows F6 Driver version 6.3.0.1022 - Win8 <ul style="list-style-type: none"> ○ \iaStorE.free.win8.64bit.6.3.0.1022\iaStorE (SATA) ○ \iaStorE.free.win8.64bit.6.3.0.1022\iaStorB (sSATA) • Intel® VROC (SATA RAID) Windows F6 Driver version 5.6.0.1006 – Win7 <ul style="list-style-type: none"> ○ \iaVROC.free.win7.64bit.5.6.0.1006\iaStorE (SATA) ○ \iaVROC.free.win7.64bit.5.6.0.1006\iaStorB (sSATA) • Intel® VROC (NonVMD NVMe RAID) Windows F6 Driver version 6.3.0.1022– Win8 <ul style="list-style-type: none"> ○ \iaRNVMe.free.win8.64bit.6.3.0.1022\iaRNVMe ○ \iaRNVMe.free.win8.64bit.6.3.0.1022\iaRNVMeVirt • Intel® VROC (NonVMD NVMe RAID) Windows F6 Driver version 5.6.0.1006 – Win7 <ul style="list-style-type: none"> ○ \iaRNVMe.free.win7.64bit.5.6.0.1006\iaRNVMe ○ \iaRNVMe.free.win7.64bit.5.6.0.1006\iaRNVMeVirt • Intel VROC CLI version 6.3.0.1030 • Intel VROC CLI (Win7) version 5.6.0.1018
UEFI Based RAID Configuration Utility	<ul style="list-style-type: none"> • Intel® VROC version 6.3.0.1005 <ul style="list-style-type: none"> ○ RCfgVROC.efi • Intel® VROC SATA / sSATA version 6.3.0.1005 <ul style="list-style-type: none"> ○ RCfgSata.efi ○ RCfgsSata.efi • Note: Secure Boot must be disabled to use this tool
DOS Based RAID Configuration Utility	<ul style="list-style-type: none"> • Intel® VROC SATA / sSATA version 6.3.0.1005 <ul style="list-style-type: none"> ○ RCfgSata.exe • RCfgsSata.exe



Feature	Notes
UEFI Based Comply Utility	<ul style="list-style-type: none"> • Intel® VROC version 6.3.0.1005 <ul style="list-style-type: none"> ○ RcmpVROC.efi • Intel® VROC SATA / sSATA version 6.3.0.1005 <ul style="list-style-type: none"> ○ RCmpSata.efi ○ RCmpsata.efi • Note: Secure Boot must be disabled to use this tool
DOS Based Comply Utility	<ul style="list-style-type: none"> • Intel® VROC SATA / sSATA version 6.3.0.1005 <ul style="list-style-type: none"> ○ RCmpSata.exe • RCmpsata.exe
UEFI based SATA SGPIO/LED Test utility	<ul style="list-style-type: none"> • Intel® VROC SATA / sSATA version 6.3.0.1005 <ul style="list-style-type: none"> ○ LedToolSata.efi ○ LedToolsata.efi • Note: Secure Boot must be disabled to use this tool
UEFI based Intel VROC LED Test utility	<ul style="list-style-type: none"> • Intel® VROC version 6.3.0.1005 <ul style="list-style-type: none"> ○ LedToolVROC.efi • Note: This tool can be used to exercise LEDs for NVMe disks behind VMD
UEFI Based Clear Metadata Utility	<ul style="list-style-type: none"> • Intel® VROC SATA / sSATA version 6.3.0.1005 <ul style="list-style-type: none"> ○ RClrSata.efi • RClrsata.efi
UEFI Based Intel VROC HW Key Checker	<ul style="list-style-type: none"> • Intel® VROC Activation Key Checker <ul style="list-style-type: none"> ○ HWKeyCheckVROC.efi • Note: This tool will check for the presence and type of the HW key



5 Intel VROC Limitations

5.1 Microsoft .NET Framework Removal

As previously described, the Intel VROC product installation application has removed the Microsoft .NET Framework as well as the Intel ASM component.

The following table shows how the removal of the Microsoft .NET Framework may impact the launching of the Intel VROC GUI, based off the Windows operating system installed:

	Server 2k12 R2	Server 2k16	Windows 2k19	Win 10 RS3	Win 10 RS4	Win 10 RS5	Win10 19H1
Intel VROC 6.X Versions	Install Latest .NET Framework	Install Latest .NET Framework	No Impact	Install Latest .NET Framework	No Impact	No Impact	No Impact

If the system configuration requires the .NET Framework version to be updated and the system has internet access, a web installer can be used, which should go out and install the latest version. For example: (<https://support.microsoft.com/en-us/help/4054531/microsoft-net-framework-4-7-2-web-installer-for-windows>).

If the system is not connected to the Internet, then an offline version must be downloaded, moved to and installed on the system. The following are some additional instruction to help in this process:

1. Download the latest version of .NET Framework from Microsoft
2. Compress the downloaded image (to avoid potential undesirable side effect as outlined in <https://docs.microsoft.com/en-us/dotnet/framework/install/troubleshoot-blocked-installations-and-uninstallations#compat>)
3. Copy the compressed file to a USB drive
4. Copy the compressed file from the USB drive to the Download directory of the platform being configured
5. Uncompressed the file
6. Run the executable file as administrator

For more information please refer to <https://dotnet.microsoft.com/>.

Once the latest version of the .NET Framework is installed, rerun the Intel VROC product installation application. This helps ensure that all components will start properly.

5.2 Intel VROC (NonVMD NVMe RAID) Support

Intel VROC (NonVMD NVMe RAID) support is included in the Intel VROC 6.0 release package. This package supports only Intel NVMe SSDs and does not support (nor can be installed on) platforms that support Intel VMD. Intel VROC (NonVMD NVMe RAID) supports DATA RAID. Boot support is not available. For more information, please refer to the Intel VROC TPS included with this package.



NOTE: This functionality is not supported on Purley Refresh platforms

5.3 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.

5.4 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.

5.5 Intel VROC Command Line Interface

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

5.6 Intel VROC Trial Version Limitations

Data RAID Only (No Boot Support)

Data RAID must be installed on same make/model of NVMe devices

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 NVMe vendors. Mixing vendors may result in unexpected behavior.

Please refer to the Intel VROC Trial Version section in the Intel VROC Technical Product Specification for 5.4PV for more details

5.7 Intel VROC PreOS UEFI Driver Uninstall limitations

The Intel VROC UEFI RAID drivers comply with UEFI Specifications for PCI Driver Model for PCI Device Drivers (Section 13.3.3) and may return Status Code "access denied" from UninstallProtocolInterface routine from Boot services (spec. 6.3). This is expected behavior.



5.8 Intel NVMe Wear Leveling Recommendations

NVMe SSD Wear Leveling refers to techniques used to prolong the service life of NVMe drives. This section outlines recommendations to maximize Wear Leveling on RAID 5 volumes.

Strip Size No of 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



Note: 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.

5.9 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 6.0.

The supported Microsoft Operating Systems for this product include inbox drivers that support the Intel® C620 and C422 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 be used instead of the available "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 strongly recommended that the Intel VROC 6.0 installer package be installed immediately. At that point, it will be safe to migrate the SATA system disk into a RAID Volume (using the Intel VROC GUI).

5.10 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.

Note: you will need a USB drive with the Intel VROC IntelVROCCLI.exe utility.

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.**
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).
3. Attempt to continue installing the Windows OS onto the RAID volume. If the installation process does not continue, this error has been encountered.
4. Press f10 to invoke a CMD window.
5. If you have not already done so, please insert the USB drive into the system. Navigate to your USB drive with the RstCLI.exe utility.
6. Run command: IntelVROCCLI.exe --manage --normal-volume <volumeName>
7. This will reset the volume to a normal state.
8. Close the CMD window.
9. In the Windows* disk selection window, reload the Intel VROC f6 driver.
10. Once completed, Windows* should allow installation on the RAID volume.

5.11 Intel VROC Key Removal/Upgrade Limitation

With Microsoft* Windows* 10, Fast Startup is enabled by default. Disable Fast Startup prior to removing/upgrading the Intel VROC HW key. OR, perform a complete reboot when removing/inserting a HW key when Fast Startup is enabled.



5.12 NVMe Port Assignment by Intel VROC

In Windows and UEFI, the port number shown in the Intel VROC interfaces depends on 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.

Please see the **Intel® VROC Windows Technical Product Specification** for information on the new Intel VROC UEFI Device Info Protocol for unique NVMe physical slot locations.

5.13 Windows* 10 RS5/Server 2019

5.13.1 Idle Power increased

Installing Intel VROC 6.0 PV onto a platform running Windows* 10 RS5. In Windows and UEFI, the port number shown in the Intel VROC interfaces depends on 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.

Please see the **Intel® VROC for Windows Technical Product Specification** for information on the new Intel VROC UEFI Device Info Protocol for unique NVMe physical slot locations.

5.13.2 Intel VROC Support for Windows 10 RS5 / Server 2019

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

Note: There is a known issue trying to install Windows* 10 RS5 / Server 2019. Installing Windows* 10 RS5 or Server 2019 onto an Intel VMD managed device is limited to a single CPU. For more information please see the Known Issues section below.

Note: This limitation only applies to Intel RSTe 5.5 and earlier releases. Intel VROC 6.X are not impacted.

5.14 Intel VROC 6.X on Windows* Server 2012 R2

When installing Intel VROC 6.X family of products onto Windows* Server 2012 R2, the following Microsoft* updates must first be applied:

1. KB4054566
2. KB2999226
3. KB2919355
4. KB3172729

5.15 Intel VROC Support Concluded with Intel VROC 6.X

This section outlines the supported features that will conclude with Intel VROC 6.X based family of products.



5.15.1 Microsoft Windows 7 Support

The Intel VROC 6.X based family of products will continue to contain support for Microsoft Windows 7 via Intel RSTe 5.6 (which is included in the package for the Intel VROC 6.X based family of products). When the Intel VROC 7.X based family of products is release, it will not contain support for Windows 7.

5.15.2 AHCI Mode Support

The installation application for the Intel VROC 6.X based family of products includes the option to choose to install the Intel VROC 6.X AHCI based driver. When the Intel VROC 6.X installation application is executed, it identifies how the Intel PCH (SATA and/or sSATA) is configured. When configured for AHCI mode it will present this option to the user. If the user does not make this selection, the installation of the Intel VROC AHCI driver is bypassed/ "not" installed. The option is provided because Intel recommends using the Microsoft AHCI driver under these conditions. When the Intel VROC 7.X based family of products is release, the package will not include any Intel VROC AHCI drivers to support the platform's PCH (SATA and/or sSATA) configured for AHCI mode. Customers will need to continue to use the Microsoft AHCI driver.



6 Intel VROC Issues

This section 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”.

6.1 Intel VROC Known Issues

This section identifies known Intel VROC issues that are being worked on and are planned to be fixed in a future release.

Internal Reference Number	IPS Reference Number	Issue Title
14010852023	00492469	Intel VROC HII may not Display RAID Volume Information Correctly When the RAID Volume is Greater than 10 Terabytes.
1808452676	Internally Found	A system, with the OS installed onto a RAID volume, may not properly resume after several Hybrid Sleeps
Internally Found	Internally Found	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
1507753655	486129	When Running Stress Testing on M.2 Slots Managed by the sSATA Controller, an "isStorB" Error may be Logged.
1507710434	486813	When using the Intel VROC Legacy Option ROM, RAID Volume may not be Displayed Properly when a RAID Volume is Greater than 10 Terabytes.
1407347823	266468	RSTe RCfgRSTeRS.efi Disk IDs are not consistent and RAID 5 create with journaling drive hangs.



6.2 Resolved Issues in Intel VROC 6.3 PV

This section identifies those issues that have been resolved in the Intel VROC 6.3 PV release.

Internal Reference Number	IPS Reference Number	Issue Title
1507649523	0482474	Using the CC_CSMI_SAS_GET_DRIVER_INFO Command May Not Report Correct Drive and Driver information.
1809577436	Internally Found	An Intel VROC spanned RAID10 Volume may not Start Rebuilding Automatically after a Rebuild on Hot Insert Condition.
1806397184	Internally Found	Intel RSTe NVMe Pre-Purley Platform with 48 NVMe Drives and Max Volumes. Degraded RAID Volume May Encounter a System Failure While Booting
1507369786	Internally Found	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	Internally Found	RAID Volume May Become Degraded After Reboot
1806397164	Internally Found	Intel RSTe NVMe Pre-Purley Platform with 48 NVMe Drives and 24 Volumes May Encounter a boot Failure
1507522222	00473612	Intel VROC LED Management may Illuminate the Locate LED Option During Another RAID Operation and may not stop when the Operation Completes.
1806930160	Internally Found	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	Internally Found	Intel VROC (VMD RAID) NVMe Drive May be Marked as Available After Removal

6.3 Resolved Issue in Intel VROC 6.2 PV

This section identifies those issues that have been resolved in the Intel VROC 6.2 PV release.

Internal Reference Number	IPS Reference Number	Issue Title
1409230595	424290	Intel VROC UEFI May Not Properly Report the VMD Controller BDF in the HII
1409784946	455468	Hot Removal of a RAID 5 RAID Write Hole (RWH) Journaling Drive may cause the platform to become unstable and may cause a system failure
1606900429	405188	System Crash May Occurred when load Intel VROC (VMD NVMe RAID) F6 driver while the Intel VROC RAID is Under an Initialize State.
1507222187	438747	VROC icon is missing in system tray
1409017125	416904	"UEFI Driver Hangs When the Metadata is Malformed"
1408968353	404672	Intel VROC (VMD NVMe RAID) UEFI HII Menu May Cause the BIOS Setup Menu to be Improperly Displayed



Internal Reference Number	IPS Reference Number	Issue Title
1409194760	424543	Activity LED is not blinking when SATA drive in RAID mode
1808060543	Internally Found	The Intel VROC 6.2 UWD UI Application may not properly function on a platform with Intel VROC 6.0 driver package. Please 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	Internally Found	The CLI Tool May Not Properly Expand Existing RAID Volumes
1807107325	Internally Found	When using the Intel VROC CLI Tool to Create RAID Volumes One of the Disks May Show a Disk Size of 0 GB after the Volume Creation Completes.
1806677977	Internally Found	Bad Blocks May Not be Properly Reported in a RAID 5 Volume
1806534894	Internally Found	The Intel VROC CLI Tool May Allow Data Migration with a Smaller Drive
1806503629	Internally Found	Creating a RAID 1 Volume from an Existing Drive May Result in a Failed RAID Volume
1409371408	Internally Found	Intel VROC GUI May Require the "Proceed with deleting data" Box be Selected when not Expected.
1407853994	325087	Degraded SATA RAID 5 may not boot if disk on SATA controller port 0 is removed or fails
1407801045	325604	The Intel VROC RWH Policy May inadvertently Change from Journaling to Distributed if one-member drive is missing
1407219909	246717	New VMDVROC_1.efi / VMDVROC_2.efi driver will increase boot time around 4 seconds
1806782204	429264	Intel VROC GUI may not Properly Open Unless "Run as Administrator"
1506398660	281938	RAID10, hot-plug two member disks, re-plugged second disk can't rebuilding.
1409584095	445268	Event Log Error 4156/4155 Seen during stress testing
1807977956	Internally Found	The platform may encounter a system failure as a result of performing a Hybrid Sleep cycle on an Intel VROC RAID5 Volume (the first Hybrid Sleep after running the Intel VROC installation application).
1807962656	Internally Found	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	Internally Found	The Intel VROC RWH Policy May Change from Journaling to Distributed after a Drive Hot Unplug
1806564409	Internally Found	Platform May Not Properly Boot After a Dirty Shutdown with I/O on a RAID 4 volume (RWH Distributed)
14010267807	471069	Performing a Drive Surprise Hot Remove from a Matrix RAID Array May Result in a Platform Failure.



6.4 Resolved Issue in Intel VROC 6.1 PV

This section identifies those issues that have been resolved in the Intel VROC 6.1 PV release.

Internal Reference Number	IPS Reference Number	Issue Title
1806588250	Internally Found	Creating a RAID5 System volume from a Pass-through System Disk (Windows 10 RS5/Server 2019) May Fail
1506951451	398919	BSOD 0x50 occurred sporadically when system run Win10 HLK test item "PNP/Sleep with IO Before and After"
1407931496	387136	Intel VROC RAID Volumes May Not Properly Show in the BIOS
1806476161	Internally Found	Intel VROC GUI May Allow a Missing Disk to be Removed.
1506852286	391651	BSOD randomly occurs during RAID CFG migrating via Intel VROC APP
1407996572	389468	The unit of RAID volume capacity may not display properly when creating SATA RAID in legacy SATA OROM
1409419926	438361	The Intel VROC 6.1 UI may not properly start when installed on platforms with Windows 10 19H1.



6.5 Resolved Issue in Intel VROC 6.0 PV

This section identifies those issues that have been resolved in the Intel VROC 6.0 PV release.

Internal Reference Number	IPS Reference Number	Issue Title
1507139562	428846	System May Encounter a System Failure Resuming from S3/S4 Power Management While a Migrating a RAID Volume
1807073364	Internally Found	Intel VROC GUI May Show a Pop-up Unknown Error Message when a RAID Volume Migration Begins
1807067297	391651	BSOD randomly occurs during RAID CFG migrating via RSTe APP
1805474763	Internally Found	Intel VROC Driver Upgrade May Mark Volume as Initialized
1606761987	394460	BSOD occurred after loading F6 driver during Win10 RS5 installation
1506077912	249189	Intel VROC Negotiated Link Rate Reported May Not be Accurate
1406945370	225547	NVMe LED blinking Issue on RAID when Locate sent after Rebuild
1806420960	Internally Found	Intel RSTe NVMe 5.5 on a Windows 7 64-bit Platform May Report the Incorrect Filter Driver Version Number
1506226285	276220	Intel VROC mismatch error after changing RAID 5 RWH Values in BIOS setup
1504750338	223047	Can Not Disable All RAID Levels in BIOS Setup

6.6 Resolved Issue in Intel RSTe 5.5 PV

This section identifies those issues that have been resolved in the Intel RSTe 5.5 PV release.

Internal Reference Number	IPS Reference Number	Issue Title
1406789629	217206	Repeated System Restarts May Result in a 0x9F System Error
1505288506	238095	The issue was failing to create SATA HDD RAID via Intel RSTe CLI command, there was no response after executed CLI command.



Internal Reference Number	IPS Reference Number	Issue Title
1407167497	Internally Found	Intel VROC UEFI HII Menu may appear in BIOS when VMD is Disabled
1407138251	239590	Data Loss May Occur if Writing to Disk During S4
2203448525	239322	Intel SSD will have two duplicated HII entry created in F1 setup "System Settings -> Storage" page
1806291543	Internally Found	Intel VROC Enabled Platform May Not Properly Generate a System Failure memory.dmp File
1805624457	Internally Found	Performing an S4 on a degraded RAID 5 Volume May Result in a System Crash
1805245743	168685	Windows 7 BSE When ODD is attached Resuming from S3/S4
1507160299	431427	When the attached ODD has a whitespace in the serial number, it may cause the Intel VROC UI to crash.
1506414153	290919	All Applications are gone after resume from S4
1506153616	266134	Hot Removal of a Matrix RAID Member May Result in a System Failure
1505203256	238409	Intel P905 NVMe SSD drive can't be recognized by 5.4 CLI tool
1504716895	216590	CC_CSMI_SAS_GET_RAID_CONFIG cannot return correct information about RAID
1504685173	209118	Black screen and 0x1E BSOD entering s4 via S3
1407931617	387598	BSOD occurred after loading F6 driver during Win10 RS5 installation
1407320372	259697	System Disk not Marked as System Volume in RSTe GUI
1406977947	224577	SATA Disk May Disappear after S3 When OS Installed on NVMe
1406654647	209082	Hot Inserting a Drive into a RAID Volume with many ECC Errors May Cause a RAID Volume to Fail
1406579985	201604	System May Reset When Running a Stress, I/O While RAID Volume is Rebuilding
1305232413	184823	Platform May hang Entering S4 if eSATA Device Connected
1806088107	00220903	Intel VROC UEFI Driver May Return Incorrect Values for SCT HII Test Case



Internal Reference Number	IPS Reference Number	Issue Title
<u>1805901301</u>	Internally Found	NVMe System Disk can be Selected as RAID 5 RWH Journaling Disk Drive After Hot Plug
<u>1604699889</u>	217373	Removing a Drive from a Spanned RAID Volume May Not be Properly Handled