Intel® Virtual RAID on CPU (Intel® VROC) and Intel Volume Management Device (Intel® VMD)

Supported Configurations

Revision 2.4

February 2023

Contents

Revision History

Revision Number	Description	Revision Date
1.0	• Initial release	May 2022
2.0	• Revision update	July 2022
2.3	• Updated for VROC 7.8.	October 2022
2.4	• Updated for VROC 8.0.	February 2023

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1 Introduction

Intel® VROC8.0

This document covers the NVMe* solid-state drives (NVMe* SSDs), operating systems (OS), and configurations supported by Intel® Virtual RAID on CPU (Intel® VROC). If any of this information conflicts with the support information provided by a platform OEM or ODM, the platform documentation and configurations should take precedent.

The support guidance is dependent on the Intel® VROC version being used. This document is for Intel® VROC8.0. If you are using another Intel® VROC version, reference the Supported Configurations guide for that version.

Intel® VROC includes functional sub-products for (VMD NVMe RAID) and (SATA RAID). This document covers Intel® VROC (VMD NVMe RAID) and (SATA RAID). Refer the Intel® VROC User Guide and Intel® VROC Name Change documents on the support page for more detail.

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2 Intel® Xeon Support List for Intel® VMD and Intel® VROC (VMD NVMe* RAID)

Intel® VROC has a hardware dependency on an Intel® Xeon feature known as Intel® Volume Management Device (Intel® VMD). Therefore, Intel® VROC is only supported on CPUs with this Intel® VMD technology. The below list of Intel Processor families supports Intel® VROC and Intel® VMD:

Intel® Xeon Processor Families that Support Intel® VROC with Intel VMD Generations

• Generation 1 Intel® Xeon Scalable Processors (-SP, -D, -W)
  • Intel® VMD 1.0 on all SKUs
• Generation 2 Intel® Xeon Scalable Processors (-SP, -D, -W)
  • Intel® VMD 1.0 on all SKUs
• Generation 3 Intel® Xeon Scalable Processors (-SP, -D, -W)
  • Intel® VMD 1.0 on all 4S/8S SKUs (-H)
  • Intel® VMD 2.0 on all 1S/2S SKUs
• Generation 4 Intel® Xeon Scalable Processors (-SP, -D, -W)
  • Intel® VMD 1.0 on all 4S/8S SKUs
  • Intel® VMD 2.0 on all 1S/2S SKUs
  • Intel® VMD 3.0 on all 1S/2S SKUs
• All SKU Levels: Platinum, Gold, Silver, and Bronze
This list identifies the processors that support Intel® VROC, but this functionality must be enabled by the OEM or ODM at the platform level. Just because a processor from one of these families is used, does no guarantee that the platform supports Intel® VROC. Confirm with platform provider.

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3 Intel® Platform Support Matrix[1]

Intel Xeon	VMD Generation	Chipset	Platform Type	Platform Codename	Intel® VROC Supporting Release[2]	VMD NVMe RAID	SATA RAID
Generation 1 Intel® Xeon -SP	1.0	C620 Series	Mainstream	Purley	Intel VROC 5.3	X	X
Intel® Xeon -W	1.0	C400 Series	Workstation	Basin Falls	Intel VROC 5.3	X	X
Intel® Xeon -E	N/A	C240 Series	Entry	Mehlow	Intel VROC 5.3		X
Generation 1 Intel® Xeon-D	1.0	Integrated in CPU	SOC	Bakerville	Intel VROC 5.3	X	X
Generation 2 Intel® Xeon -SP	1.0	C620 Series	Mainstream	Purley R	Intel VROC 6.0	X	X
Generation 3 Intel® Xeon -SP 4S/8S (-H)	1.0	C620 Series	Mainstream	Cedar Island	Intel VROC 7.0	X	X
Generation 3 Intel® Xeon -SP 1S/2S	2.0	C620 Series	Mainstream	Whitley	Intel VROC 7.5	X	X

Intel Xeon	VMD Generation	Chipset	Platform Type	Platform Codename	Intel® VROC Supporting Release[2]	VMD NVMe RAID	SATA RAID
Generation 3 Intel® Xeon-D	2.0	Integrated in CPU	SOC	Idaville	Intel VROC 7.7	X	X
Generation 4 Intel® Xeon -SP 2S/4S	3.0	C740 Series	Mainstream	Eagle Stream	Intel VROC 8.0	X	X
Generation 4 Intel® Xeon -SP 1S/2S	3.0	W790 Series	Mainstream	Fishhawk Falls	Intel VROC 8.0	X	X

[1]This matrix only covers platforms launched since Intel® VROC (VMD NVMe RAID) became available on Generation 1 Intel® Xeon Scalable Processors in 2017. Some legacy platforms prior to this were supported with the previous Intel RAID product: Intel® Rapid Storage Technology enterprise (Intel® RSTe). This support has been grandfathered into Intel® VROC but is not listed here.

[2]The 'Intel® VROC Supporting Release' column above identifies the Intel® VROC version introduced to support the corresponding platform. Once a supported platform is released, any following Intel VROC releases will be supported on that platform, because Intel® VROC releases are backwards compatible with previously released hardware.

Sub-Product	NVMe* SSD RAID	SATA RAID	Bootable RAID	Hot-Plug/ Surprise Removal	LED Management	3rd Party Drive Support
Intel® VROC (VMD NVMe RAID)	X		X	X	X	X
Intel® VROC (SATA RAID)		X	X	X	X	X

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4 Intel® VROC SKU and Licensing Detail

Intel VROC (VMD NVMe* RAID) is enabled on a platform through a license mechanism that is implemented by the platform provider. The license SKU used mainly impacts the RAID levels available and which NVMe* SSDs can be managed in RAID arrays. The below Intel® VROC License SKUs are available:

Intel® VROC License SKUs
Intel® VROC Pass-Thru
• No license needed
• No RAID supported; only pass-thru devices connected to Intel® VMD
Intel® VROC Standard
• STANDARD License needed
• RAID 0/1/10 supported
• Intel Branded NVMe* SSD support and NVMe* SSD support for NVMe* SSDs manufactured by other vendors (per below NVMe* SSD support list)
Intel® VROC Premium
• PREMIUM License needed
• RAID 0/1/10/5 supported
• Intel Branded NVMe* SSD support and NVMe* SSD support for NVMe* SSDs manufactured by other vendors (per below NVMe* SSD support List)
• Self-Encrypting Drive Key Management
Intel® VROC Intel® SSD Only
• INTEL SSD ONLY License needed
• RAID 0/1/10/5 supported
• Intel Branded NVMe* SSD Support only
• NVMe* SSDs manufactured by other vendors in pass-thru mode only (not in RAID arrays)
• Self-Encrypting Drive Key Management

No licensing is needed for Intel® VROC (SATA RAID). Functionality is included with Intel® Xeon and chipset purchase.

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5 NVMe* SSD Support List

This chapter covers the NVMe SSDs that are supported on the product Intel® VROC. This includes Intel® Branded NVMe* SSDs and NVMe* SSDs from other vendors. Drives are listed below by product name/family and support will exist for any form factor (e.g., M.2, U.2, U.3, EDSFF) within that product name/family. Support for NVMe SSDs in this list is also extended to all operating systems which are supported by Intel VROC. Depending on the Intel VMD version on the user's platform, the list of supported operating systems may differ (Refer Chapter 6). In addition, any non-Intel NVMe* SSDs not listed in the below list **may** still function with Intel VROC software, but support is not provided. Unsupported NVMe* drives may or may not behave properly with Intel VROC software and the use of those drives is not recommended.

Any platform level or form factor level limitations supersede Intel® VROC functionality. For example, M.2 devices do not support hot-plug or LED management, therefore, these Intel® VROC features are not supported with M.2 devices.

Once an NVMe SSD is on the support list, no further compatibility verification will be required. **Intel recommends that the latest available Intel® VROC software be used.**

Intel® NVMe* SSDs: *All* Intel® Branded NVMe* SSDs manufactured by Intel Corporation are supported by all versions of Intel VROC. Solidigm branded drives are not supported in this configuration. Such SSDs are specifically mentioned in the below list if they are supported.

Additional NVMe* SSDs: This NVMe* SSD list is supported on any Intel® VROC capable platform, provided the platform in use supports the Intel® VROC revision mentioned in the table (see chapter 3 for platform support). Additional NVMe* SSDs may be supported at the OEM or platform provider level. Contact your OEM or platform provider for a full list of non-Intel NVMe* SSDs supported for a given platform or Intel® VROC revision.

First Supported Intel® VROC Revision	Vendor	SSD Models
VROC 5.0	Samsung*	• SM961 • PM961
VROC 5.1	Micron*	• 9100 Series
	Samsung*	• SM951 • PM953
VROC 5.2	Huawei*	• ES3600P
	Lenovo*	• Atsani
VROC 5.4	Kioxia*	• PX04PMB (Toshiba)
	Samsung*	• PM963
VROC 5.6	Samsung*	• PM983
VROC 6.0	Micron*	• 9200 Series

First Supported Intel® VROC Revision	Vendor	SSD Models
	Western Digital*	• SN720
VROC 6.1	Huawei*	• ES3500P
VROC 6.2	UNIC*	• P8160 E/M
VROC 6.3	Samsung*	• PM9A3
VROC 7.5	Inspur*	• NS6510 G1 • NS8500 G1
	Kioxia*	• CD6 • CM6
	Micron*	• 7400 Series • 7450 Series • 9300 Series • 9400 Series
	Samsung*	• PM981a • PM1733
	Solidigm*	• Solidigm D5-P5430 • Solidigm D5-P5336 • Solidigm D7-P5520 • Solidigm D7-P5620 • Intel® D7-P5510 • Intel® D5-P5316 • Intel® D7-P5500 • Intel® D7-P5600
	Western Digital*	• SN640 • SN840
VROC 7.7	Western Digital*	• SN650
VROC 7.8	Kioxia*	• CD7 • CD8

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6 Intel® VROC OS Support Lists

This chapter covers the operating systems that are supported by the product Intel® Virtual RAID on CPU. This means the OS release can run on platforms with the given generation of Intel VMD. Other CPU level or OEM level limitations may apply that supersede this product level OS support.

For Platforms with VMD1.0
Linux*
Intel® VROC for Linux* is mostly delivered through open-source OS kernel and user space tools, with no additional software download required for specific Linux distribution releases. It is up to specific OSV's to pull-in Intel® VROC features and patches. The distributions below have Intel® VROC support, with newer releases being more complete. **RedHat Enterprise* Linux*:** • RHEL 7.3 (Requires additional download. See platform provider for details) • RHEL 7.4 (Requires additional download. See platform provider for details) • RHEL 7.5 and newer distribution (inbox) CentOS is a community supported OS and Intel VROC is limited in the support options for these distributions. • CentOS is not a validated distribution for Intel VROC • If CentOS issues can be reproduced using the corresponding RHEL release, then the issue can be addressed **SUSE Linux* Enterprise:** • SLES 12 SP3 • SLES 12 SP4 • SLES 12 SP5 • SLES 15 • SLES 15 SP1 • SLES 15 SP2 **Ubuntu* Server:** • Ubuntu* 18.04.3 • Ubuntu* 18.04.4 • Ubuntu* 18.04.5 • Ubuntu* 20.04.0 • Ubuntu* 20.04.1 See below link for full implementation details. https://www.intel.com/content/www/us/en/support/articles/000056229.html
Windows*
Intel® VROC for Windows* is delivered through separate software download (not in OS). Reference platform provider download resources for access. • Windows* 10 (RS3/RS4/RS5/19H1/19H2/20H1/20H2/21H1/21H2/22H1/22H2) • Windows* 11 (SV1, SV2) • Windows* 2012 R2 • Windows* 2016 • Windows* 2019

- Windows* 2022

For Windows* 7, Intel® VROC 5.6 was the last driver that supports this OS. The Intel® VROC5.6 package for Windows* 7 will be delivered through the newest Intel® VROC6.X installer, but the build is in sustaining mode. In the future with Intel® VROC7.5, this Windows* 7 driver will no longer be included.

VMWare*

The VMWare* ecosystem is supported with the same pre-OS driver that is used for Intel® VROC. In the OS/Hypervisor, Intel VMD is supported, plus additional support for RAID1 for boot volumes. No data RAID is supported.

- ESXi7.0 and update packages

NOTE: Exception to this list is applied for platforms based on Generation 3 Intel® Xeon 4S/8S (-H), platform codename Cedar Island. This contains VMD1.0 technology, but only supports ESXi7.0 and update packages

There are in-box and async driver options available for Intel® VMD in VMware. For the latest features and bug-fixes, get the async driver from either VMWare* or your platform provider.

For Platforms with Intel® VMD2.0

Linux*

Intel® VROC for Linux* is mostly delivered through open-source OS kernel and user space tool, with no additional software download required for specific Linux distribution releases. It is up to specific OSV's to pull-in Intel® VROC features and patches. The distributions below have Intel® VROC support, with newer releases being more complete.

RedHat Enterprise* Linux*:

- RHEL7.8 (out-of-box)
- RHEL7.9 (out-of-box)
- RHEL8.1 (out-of-box)
- RHEL8.2 and newer distribution (inbox)

CentOS is a community supported OS and Intel® VROC is limited in the support options for these distributions.

- CentOS is not a validated distribution for Intel® VROC
- If CentOS issues can be reproduced using the corresponding RHEL release, then the issue can be addressed.

SUSE Linux* Enterprise:

- SLES12 SP5 (out-of-box)
- SLES15 SP2 and newer distributions (inbox)

Ubuntu* Server:

- Ubuntu* 18.04.4 and newer distributions (inbox)Ubuntu* 20.04 (inbox)See below link for full implementation details.

https://www.intel.com/content/www/us/en/support/articles/000056229.html

Windows*

Intel® VROC for Windows* is delivered through separate software download (not in OS). Reference platform provider download resources for access.

- Windows* 10 (RS3/RS4/RS5/19H1/19H2/20H1/20H2/21H1/21H2/22H1/22H2)
- Windows* 11 (SV1, SV2)
- Windows* 2012 R2

• Windows* 2016 • Windows* 2019 • Windows* 2022 For Windows* 7, Intel® VROC 5.6 was the last driver that supports this OS. The Intel® VROC5.6 package for Windows* 7 will be delivered through the newest Intel VROC6.X installer, but the build is in sustaining mode. In the future with Intel VROC7.5, this Windows* 7 driver will no longer be included.
VMWare*
The VMWare* ecosystem is supported with the same pre-OS driver that is used for Intel® VROC. In the OS/Hypervisor, Intel VMD is supported, plus additional support for RAID1 boot and RAID1 data volumes. • ESXi7.0 and update packages There are inbox and async driver options available for Intel VMD in VMware. For the latest features and bug-fixes, get the async driver from either VMWare or your platform provider.

For Platforms with VMD3.0
Linux*
Intel® VROC for Linux is mostly delivered through open-source OS kernel and user space tool, with no additional software download required for specific Linux distribution releases. It is up to specific OSV's to pull-in Intel® VROC features and patches. The distributions below have Intel® VROC support, with newer releases being more complete. RedHat Enterprise* Linux: • RHEL8.2 (out-of-box) • RHEL8.3 (out-of-box) • RHEL8.4 (out-of-box) • RHEL8.5 (out-of-box) • RHEL8.6 (inbox only) • RHEL9.0 (inbox only) CentOS is a community supported OS and Intel® VROC is limited in the support options for these distributions. • CentOS is not a validated distribution for Intel® VROC • If CentOS issues can be reproduced using the corresponding RHEL release, then the issue can be addressed SUSE Linux* Enterprise: • SLES15 SP2 (out-of-box) • SLES15 SP3 (out-of-box) • SLES15 SP4 (inbox only)
Windows*
Intel® VROC for Windows* is delivered through separate software download (not in OS). Reference platform provider download resources for access. • Windows* 10 (RS3/RS4/RS5/19H1/19H2/20H1/20H2/21H1/21H2/22H1/22H2) • Windows* 11 (SV1, SV2) • Windows* 2012 R2 • Windows* 2016

• Windows* 2019 • Windows* 2022 For Windows* 7, Intel® VROC 5.6 was the last driver that supports this OS. The Intel VROC5.6 package for Windows* 7 will be delivered through the newest Intel VROC6.X installer, but the build is in sustaining mode. In the future with Intel VROC7.5, this Windows 7 driver will no longer be included.
VMWare*
The VMWare* ecosystem is supported with the same pre-OS driver that is used for Intel VROC. In the OS/Hypervisor, Intel VMD is supported, plus additional support for RAID1 boot and RAID1 data volumes. • ESXi7.0 and update packages • ESXi8.0 and update packages There are inbox and async driver options available for Intel VMD in VMware. For the latest features and bug-fixes, get the async driver from either VMWare or your platform provider.

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7 Supported HW Configurations

This chapter covers the configurations and platform limitations supported on the product Intel® Virtual RAID on CPU. This information covers what the Intel® VROC software can support. Platform level constraints may supersede the below:

Configurations	
Maximum x4 PCIe* SSD Totals Supported: • 4 Direct Attached SSDs per Intel® VMD domain • 24 SSDs per single Intel® VMD Controller when using switches • 24 SSDs per RAID 0/5 array • 4 SSDs per RAID10 array • 2 SSDs per RAID1 array • 48 SSDs per platform (may require switches)	Platform Considerations: • Up to 2 levels of switches • Up to 2 RAID volumes per array • Data volumes are supported to span across 1 or more Intel® Volume Management Device domain and CPUs Boot volumes may function when spanning Intel® Volume Management Device controllers, but this configuration is not supported

VMWare ESXi Specific Configuration Limitations
Currently supported RAID configurations are: • RAID1 boot volume. • RAID1 data volume. • Only 1 volume is supported on a given array of drives. Matrix RAID is not supported. • RAID 0/10/5 are currently not supported. • Boot device and data device may be attached to the same Intel® VMD Domain if vSAN IS NOT implemented. For example, if vSAN is not being used - plug in 4 drives behind 1 Intel® VMD. Make 2 RAID1 volumes. Install the OS on 1 and useother for data. If vSAN IS implemented: Boot volume must be on a separate Intel® VMD Domain/Controller from data volume. For example, boot volume (either a single device or 2 Disk RAID1 volume) is on a dedicated Intel® VMD Domain/Controller.

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8 Switch Support List

Intel has engaged with the switch vendors listed below to support Intel® VMD and therefore Intel® VROC functionality, such as NVMe SSD LED management with RAID. Contact your respective switch vendor to confirm the make/models that support Intel VMD.

Supporting Switch Vendors
• Broadcom* • Microsemi* • Pericom* • Semtech*

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