



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

Supported Configurations

Revision 3.1

September 2023

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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
2.5	• Minor updates for VROC 8.0	May 2023
3.0	• Revision update	August 2023
3.1	• Minor updates for VROC 8.2	September 2023

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1 Introduction

Intel® VROC8.2; Intel® VMD 3.0

This document covers the NVMe* solid-state drives (NVMe* SSDs), operating systems (OSes), and configurations supported by Intel® Virtual RAID on CPU (Intel® VROC). If any of the support information presented in this document 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 and Intel® VMD versions being used. This document is up to date for Intel® VROC revisions up to and including Intel® VROC8.2 and Intel® VMD revisions 1.0, 2.0, and 3.0.

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 to the [Intel® VROC User Guides](#) on the Intel® VROC support webpage for more detailed Intel® VROC use-case instructions for Windows*, Linux*, and VMware* ESXi*.



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 the Intel® VMD technology. The below set of Intel Processor families support Intel® VROC and Intel® VMD:

Intel® Xeon® Processor Families that Support Intel® VROC with Intel® VMD
<ul style="list-style-type: none"> • Intel® Xeon® Scalable Processors (-SP, -D, -W) <ul style="list-style-type: none"> • Intel® VMD 1.0 on all SKUs • 2nd Generation Intel® Xeon® Scalable Processors (-SP, -D, -W) <ul style="list-style-type: none"> • Intel® VMD 1.0 on all SKUs • 3rd Generation Intel® Xeon® Scalable Processors (-SP, -D, -W) <ul style="list-style-type: none"> • Intel® VMD 1.0 on 4S/8S (-H) • Intel® VMD 2.0 on all other SKUs • 4th Generation Intel® Xeon® Scalable Processors (-SP, -D, -W) <ul style="list-style-type: none"> • Intel® VMD 3.0 on all SKUs • All SKU Levels: Platinum, Gold, Silver, and Bronze <p>This list identifies the processors that support Intel® VROC with Intel® VMD, 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 not guarantee that the platform supports Intel® VROC with Intel® VMD. Confirm the support with the platform provider.</p>



3 Intel® Platform Support Matrix¹

Intel® Xeon®	VMD Generation	Chipset	Platform Type	Platform Codename	Intel® VROC Supporting Release ²	VMD NVMe RAID	SATA RAID
Intel® Xeon® Scalable Processors	1.0	C620 Series	Mainstream	Purley	Intel® VROC 5.3	X	X
Intel® Xeon® W Processor	1.0	C400 Series	Workstation	Basin Falls	Intel® VROC 5.3	X	X
Intel® Xeon® E Processor	N/A	C240 Series	Entry	Mehlow	Intel® VROC 5.3		X
Intel® Xeon® D Processor	1.0	Integrated in CPU	SOC	Bakerville	Intel® VROC 5.3	X	X
2 nd Generation Intel® Xeon® Scalable Processors	1.0	C620 Series	Mainstream	Purley R	Intel® VROC 6.0	X	X
3 rd Generation Intel® Xeon® Scalable Processors 4S/8S (-H)	1.0	C620 Series	Mainstream	Cedar Island	Intel® VROC 7.0	X	X
3 rd Generation Intel® Xeon® Scalable Processors 1S/2S	2.0	C620 Series	Mainstream	Whitley	Intel® VROC 7.5	X	X
Intel® Xeon® D Processor	2.0	Integrated in CPU	SOC	Idaville	Intel® VROC 7.7	X	X
4 th Generation Intel® Xeon® Scalable Processors 2S/4S	3.0	C741 Series	Mainstream	Eagle Stream	Intel® VROC 8.0	X	X
4 th Generation Intel® Xeon® Scalable Processors 1S/2S	3.0	W790 Series	Mainstream	Fishhawk Falls	Intel® VROC 8.0	X	X

¹This 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.



²The '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 as well. Intel recommends contacting your platform provider before performing a significant upgrade ≥ 1 major version (such upgrading VROC 6.X to VROC 7.X or from VROC 7.X to VROC 8.X).

Sub-Product	NVMe* SSD RAID	SATA RAID	Bootable RAID	Hot-Plug/ Surprise Remova	LED Management	3 rd 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. The below Intel® VROC License SKUs are available:

Intel® VROC License SKUs
<p>Intel® VROC Pass-Thru</p> <ul style="list-style-type: none"> • No license needed • No RAID supported; only pass-thru devices connected to Intel® VMD <p>Intel® VROC Standard</p> <ul style="list-style-type: none"> • 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 chapter 5 NVMe* SSD support list) <p>Intel® VROC Premium</p> <ul style="list-style-type: none"> • 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 chapter 5 NVMe* SSD support List) • Self-Encrypting Drive Key Management

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

Due to the fact that the Intel NAND business was acquired by SK Hynix* (Solidigm*), the Intel® SSD Only VROC SKU has been removed from this list. Contact your Intel FAE or platform vendor if you have additional questions on this change.



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 (For example: 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 compatible Intel® Xeon® Processor in the user's platform, the list of supported operating systems may differ based on the Intel® VMD generation the processor uses (see chapter 6). 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. Additionally, the latest available SSD firmware must be used for all environments.**

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. Solidigm* 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 user's platform is running the Intel® VROC revision mentioned in the table, or any newer version (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*	<ul style="list-style-type: none"> • SM961 • PM961
VROC 5.1	Micron*	<ul style="list-style-type: none"> • 9100 Series
	Samsung*	<ul style="list-style-type: none"> • SM951 • PM953
VROC 5.2	Huawei*	<ul style="list-style-type: none"> • ES3600P
	Lenovo*	<ul style="list-style-type: none"> • Atsani
VROC 5.4	Kioxia*	<ul style="list-style-type: none"> • PX04PMB (Toshiba)



First Supported Intel® VROC Revision	Vendor	SSD Models
	Samsung*	• PM963
VROC 5.6	Samsung*	• PM983
VROC 6.0	Micron*	• 9200 Series
	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
	SK Hynix*	• SK HYNIX PE8000 series • PE8110 • PE8130 • PE8111 • PE8010 • PE8030

First Supported Intel® VROC Revision	Vendor	SSD Models
	Samsung*	• PM1733a ¹
VROC 8.0	Western Digital*	• SN740
	Union Memory*	• UH711a
	Micron*	• 6500 ION

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¹ Contact Samsung* if you have a configuration requiring full hotplug support.

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 these particular OS releases can run on platforms with the given generation of Intel® Xeon® Scalable Processors (Or an Intel® Xeon® D or W Processor using the same VMD revision – check the table in [Chapter 3](#)). Other CPU level or OEM level limitations may apply that supersede this product-level OS support.

Note: Intel® VROC OOB support: Intel® VROC OOB (out-of-band) management is a new feature introduced with Intel® VROC revision 8.0 for use with enterprise servers, which is now supported on Windows and select Linux* distributions. Contact your Intel AE or system OEM for more information about this feature.

For Platforms with 1st and 2nd Generation Intel® Xeon® Scalable Processors (Using VMD 1.0)
Linux*
<p>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.</p> <p>Red Hat Enterprise* Linux*:</p> <ul style="list-style-type: none"> • RHEL 7.3 (Requires additional download. Contact platform provider for details) • RHEL 7.4 (Requires additional download. Contact platform provider for details) • RHEL 7.5 and newer distribution (inbox) <p>CentOS* Linux*:</p> <p>CentOS is a community-supported OS and Intel® VROC is limited in the support options for these distributions.</p> <ul style="list-style-type: none"> • CentOS is not a validated distribution for Intel® VROC • If a CentOS issue can be reproduced using the corresponding RHEL (Red Hat Enterprise* Linux) release, then the issue can be addressed <p>SUSE Linux* Enterprise:</p> <ul style="list-style-type: none"> • SLES 12 SP3 • SLES 12 SP4 • SLES 12 SP5 • SLES 15 • SLES 15 SP1 • SLES 15 SP2 <p>Ubuntu* Server:</p> <ul style="list-style-type: none"> • Ubuntu 18.04.3 • Ubuntu 18.04.4 • Ubuntu 18.04.5 • Ubuntu 20.04.0 • Ubuntu 20.04.1 <p>See below link for full implementation details. https://www.intel.com/content/www/us/en/support/articles/000056229.html</p>

Windows*
<p>Intel® VROC for Windows is delivered through separate software download (not in OS). Reference platform provider download resources for access.</p> <ul style="list-style-type: none"> • Windows* 10 (RS4/RS5/19H1/19H2/20H1/20H2/21H1/21H2/22H1/22H2) • Windows* 11 (SV1, SV2) • Windows* 2012 R2 • Windows* 2016 • Windows* 2019 (19H1, 19H2, 20H2, 21H1, 21H2) • Windows* 2022 <p>For Windows* 7, Intel® VROC 5.6 was the last driver that supports this OS. The Intel® VROC5.6 package for Windows* 7 is delivered through the Intel® VROC6.X installer, but the build is in sustaining mode. As of Intel® VROC7.5 release, this Windows 7 driver is no longer included.</p>
<ul style="list-style-type: none"> • VMware*
<ul style="list-style-type: none"> • 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. • ESXi 7.0U3D and update packages • ESXi 8.0 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 3rd Generation Intel® Xeon® Scalable Processors (Using VMD 2.0)²
Linux*
<p>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.</p> <p>Red Hat Enterprise* Linux:</p> <ul style="list-style-type: none"> • RHEL7.8 (out-of-box only) • RHEL7.9 (out-of-box only) • RHEL8.1 (out-of-box only) • RHEL8.2 and newer distribution (inbox, out-of-box package available upon request) <p>CentOS* Linux:</p> <p>CentOS is a community supported OS and Intel® VROC is limited in the support options for these distributions.</p> <ul style="list-style-type: none"> • CentOS is not a validated distribution for Intel® VROC • If a CentOS issue can be reproduced using the corresponding RHEL (Red Hat Enterprise* Linux) release, then the issue can be addressed <p>SUSE Linux* Enterprise:</p>

² An exception to this list applies for platforms using **3rd Generation Intel® Xeon® Scalable 4S/8S (-H) Processors**. These platforms use VMD 1.0 technology, and OS support for these processors coincides with the OS support outlined for 1st and 2nd Generation Intel® Xeon® Scalable Processors in the previous table.



<ul style="list-style-type: none"> • SLES12 SP5 (out-of-box only) • SLES15 SP2 and newer distributions (inbox, out-of-box package available upon request) <p>Ubuntu Server:</p> <ul style="list-style-type: none"> • Ubuntu 18.04.4 and newer distributions (inbox) • Ubuntu 20.04 (inbox) <p>See below link for full implementation details. https://www.intel.com/content/www/us/en/support/articles/000056229.html</p>
Windows*
<p>Intel® VROC for Windows is delivered through separate software download (not in OS). Reference platform provider download resources for access.</p> <ul style="list-style-type: none"> • Windows* 10 (RS3/RS4/RS5/19H1/19H2/20H1/20H2/21H1/21H2/22H1/22H2) • Windows* 11 (SV1, SV2) • Windows* 2012 R2 • Windows* 2016 • Windows* 2019 (19H1, 19H2, 20H2, 21H1, 21H2) • Windows* 2022 <p>For Windows* 7, Intel® VROC 5.6 was the last driver that supports this OS. The Intel® VROC5.6 package for Windows* 7 is delivered through the Intel® VROC6.X installer, but the build is in sustaining mode. As of Intel® VROC7.5 release, this Windows 7 driver is no longer included.</p>
<ul style="list-style-type: none"> • VMware* <p>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.</p> <ul style="list-style-type: none"> • ESXi 7.0U3D and update packages • ESXi 8.0 and update packages <p>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.</p>

For Platforms with 4th Generation Intel® Xeon® Scalable Processors (Using VMD 3.0)
Linux*
<p>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.</p> <p>Red Hat Enterprise* Linux:</p> <ul style="list-style-type: none"> • RHEL8.2 (out-of-box only) • RHEL8.3 (out-of-box only) • RHEL8.4 (out-of-box only) • RHEL8.5 (out-of-box only) • RHEL8.6 (inbox only) • RHEL8.7 (inbox only) *RHEL8.7 must use latest zstream patches as of August 2023*

<ul style="list-style-type: none"> • RHEL8.8 (inbox only) • RHEL9.0 (inbox only) *RHEL9.0 must use latest zstream patches as of August 2023* • RHEL9.1 (inbox only) • RHEL9.2 (inbox only) <p>CentOS* Linux: CentOS is a community supported OS and Intel® VROC is limited in the support options for these distributions.</p> <ul style="list-style-type: none"> • CentOS is not a validated distribution for Intel® VROC • If a CentOS issue can be reproduced using the corresponding RHEL (Red Hat Enterprise* Linux) release, then the issue can be addressed <p>SUSE Linux* Enterprise:</p> <ul style="list-style-type: none"> • SLES15 SP2 (out-of-box only) • SLES15 SP3 (out-of-box only) • SLES15 SP4 (inbox only) • SLES15 SP5 (inbox only) <p>Ubuntu Server:</p> <ul style="list-style-type: none"> • Ubuntu 20.04.3 (out-of-box only)
Windows*
<p>Intel® VROC for Windows is delivered through separate software download (not in OS). Reference platform provider download resources for access.</p> <ul style="list-style-type: none"> • Windows* 10 (RS4/RS5/19H1/19H2/20H1/20H2/21H1/21H2/22H1/22H2) • Windows* 11 (SV1, SV2) • Windows* 2012 R2 • Windows* 2016 • Windows* 2019 (19H1, 19H2, 20H2, 21H1, 21H2) • Windows* 2022 <p>For Windows* 7, Intel® VROC 5.6 was the last driver that supports this OS. The Intel® VROC5.6 package for Windows* 7 is delivered through the Intel® VROC6.X installer, but the build is in sustaining mode. As of Intel® VROC7.5 release, this Windows 7 driver is no longer included.</p>
VMWare*
<ul style="list-style-type: none"> • 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. • ESXi 7.0U3D and update packages • ESXi 8.0 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.





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	
<p>Maximum SSD Totals Supported:</p> <ul style="list-style-type: none">• 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• 96 NVMe SSDs per platform (may require switches)	<p>Platform Considerations:</p> <ul style="list-style-type: none">• 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 <p>Boot volumes may function when spanning Intel® Volume Management Device controllers, but this configuration is not supported</p>

VMWare* ESXi Specific Configuration Limitations

Currently, supported RAID configurations are:

- RAID 1 boot volume.
- RAID 1 data volume.
- Only 1 volume is supported on a given array of drives. Matrix RAID is not supported.
- RAID 0/10/5 are not currently supported.
- Boot device and data device may be attached to the same Intel® VMD Domain if vSAN is NOT implemented. Example: If not using vSAN, plug in 4 drives behind one Intel® VMD Domain/Controller. Make two RAID 1 volumes. Install the operating system on one and use the other for data.
- If vSAN is implemented: Boot volume must be on a separate Intel® VMD Domain/Controller from data volume. Example: Boot volume (either a single device or 2-disk RAID 1 volume) is on a dedicated Intel VMD Domain/Controller.
- Additional scenario clarifications:
 - A disk can only be used in one RAID array. If you only use part of the disk in the raid array, the rest of the disk cannot be used. (i.e. no Matrix RAID)
 - There can be more than one vSphere configured datastore on a single RAID array, but there cannot be more than one RAID array using the same disks (no Matrix RAID)
 - If vSAN is used, you cannot have both a boot datastore AND any other datastore on the same VMD controller. In other words, if you are using vSAN, you cannot have the boot datastore and a "data" datastore on the same RAID1 array (since that requires use of the same VMD controller)
 - If vSAN is not used, you can have a boot datastore AND any other "data" datastores under the same VMD controller, i.e., you can have multiple datastores on the same RAID1 Array)



8 Switch Support List

Intel has engaged with the switch vendors listed below in order 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
<ul style="list-style-type: none">• Broadcom*• Microsemi*• Pericom*• Semtech*

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