INTEL® VIRTUAL RAID ON CPU (INTEL® VROC) FAQ
FOR INTEL® XEON® PROCESSOR SCALABLE FAMILY LAUNCH

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Q1: What is Intel® VROC?

A1: Intel VROC stands for Intel® Virtual RAID on CPU. It is an enterprise RAID solution specifically designed for NVMe*-based Solid State Drives (SSDs).

Q2: What is the biggest advantage of Intel VROC?

A2: The biggest advantage of Intel VROC is the ability to directly connect NVMe-based SSDs to the new Intel Xeon™ Scalable processor PCIe* lanes, then make RAID arrays using those SSDs without using a RAID host bus adapter (HBA). As a result, Intel VROC unleashes NVMe SSD performance potential without the complexity and power of a traditional Hardware RAID HBA.

Q3: Since Intel VROC can RAID SSDs directly connected to the CPU, does that mean hardware RAID HBA is no longer needed?

A3: Hardware RAID HBAs have been serving the RAID industry for dozens of years in support of legacy SATA and SAS HDDs and SSDs, and are evolving to add NVMe functionality. Intel VROC does not need a hardware RAID HBA for NVMe-based SSDs, but this does not mean this industry does not need it. Intel VROC provides a compelling alternative way to RAID NVMe SSDs. Our goal is to migrate SSDs from the legacy SATA/SAS interfaces that were designed for much slower HDDs to the modern NVMe protocol.

Q4: How is Intel VROC performance and CPU utilization compared to a hardware RAID HBA solution?

A4: Intel VROC is a data center quality product with performance and CPU Utilization metrics befitting such applications. New NVMe enabled hardware RAID HBAs are new to the market as well. Performance does vary depending on configuration and testing parameters, but generally, data transfer rates are comparable between the two technologies. HBAs do have on-card silicon to perform RAID calculations, so typically they use fewer CPU cores. However, from a system perspective, Intel Xeon Scalable processors are efficient CPUs and RAID calculations with VROC typically use a small fraction of the total cores available. Additionally, it is important to look at the work those cores are doing while being utilized, such as IOPS/CPU utilization.

Q5: Which platform will support Intel VROC?

A5: Intel VROC is primarily targeted to professional workstations and server platforms. It requires the Intel® Volume Management Device (Intel® VMD), a hardware feature only available on the new Intel® Xeon® Scalable processors. Because the types of RAID support are very specific to the OEM platform configuration, it is up to OEM/ODM to decide whether to offer Intel VROC. Please consult your server or workstation provider for specific information. There is also limited support on X299 systems on High End Desktops. See Q6.

Q6: We saw Intel VROC on an Intel Core processor and X299 chipset -based high-end desktop motherboard shown at Computex 2017. Will Intel VROC be supported by this platform?

A6: Intel VROC is primarily targeted to professional workstations and server platforms at launch, but can be enabled on any platform with the Intel Volume Management Device (Intel VMD) feature. Starting Sept. 25, 2017, Intel VROC will be supported on X299 high end desktop platforms (HEDT) as well. Please check HEDT marketing team for specific Intel VROC support on X299 platforms.

Q7: Is Intel VROC software or hardware RAID?

A7: Intel VROC is a hybrid RAID solution.
It has attributes like hardware RAID because of the key silicon feature called Intel Volume Management Device (Intel VMD) which is offered with the new Intel Xeon™ Scalable processors. Intel Virtual RAID on CPU (VROC) utilizes Intel VMD to aggregate NVMe SSDs allowing bootable RAID. Intel VROC also has attributes like software RAID. For instance: it uses some of the CPU cores to calculate the RAID logic. Because of this combination of software and silicon, Intel VROC is called a hybrid RAID solution.

Q8: Does Intel VROC support 3rd party SSDs?

A8: Intel VROC supports both Intel® SSDs and selected 3rd party SSDs. Please see the Product Brief for supported 3rd party SSDs.

Q9: What is the Intel VROC hardware key?

A9: Intel VROC is a licensed product for sale through the OEMs or ODMs with a support service level agreement. The Intel VROC hardware key is the mechanism to obtain a license to the Intel VROC software. Certain OEMs/ODM have built servers and workstations that support Intel VROC by adding a key header to their motherboards. The Intel VROC hardware key is required to be inserted into that motherboard to enable the RAID license. Only one key is needed per system (i.e. per server or per workstation).

Q10: Where can I get an Intel VROC hardware key?

A10: End users can expect the hardware keys to be installed by their OEMs in their servers, as long as end users request a server with a complete Intel VROC solution. OEMs obtain the keys from Intel or Intel's distributors. If an end user decides to upgrade to Intel VROC after purchasing a platform, they can purchase an Intel VROC key from their specific server OEM website. In this way, end users can get proper support for Intel VROC from the platform supplier. Occasionally, Intel may promote the Intel VROC Hardware Key and Intel SSDs together in a bundle. These bundles will be sold through various distribution channels.

Q11: What are the different Intel VROC SKUs?

A11: Intel VROC has three different SKUs:

- **Intel VROC Pass-Through:** No RAID support, just stand alone NVMe-based SSDs connected to Intel VMD enabled PCIe lanes. No hardware key needed.
  License included in Platform Control Hub (PCH).
- **Intel VROC Standard:** RAID 0/1/10 support. Standard hardware key needed.
- **Intel VROC Premium:** RAID 0/1/5/10 support. Premium hardware key needed.
- **Intel VROC Intel SSD Only:** RAID 0/1/5/10 support. Intel SSD Only hardware key needed. No 3rd Party SSD support. Only functional with Intel brand SSDs.

Q12: How is Intel VROC different from Intel® RSTe?

A12: Intel VROC is under the umbrella of the Intel Rapid Storage Technology Enterprise (RSTe) product family. The SATA RAID portion of Intel RSTe is still the same, however, the NVMe RAID is replaced by Intel VROC. For NVMe RAID, Intel VROC is architected to use Intel VMD to provide the following new features that Intel RSTe legacy NVMe RAID does not have:

- Bootable RAID
- Surprise hot-plug
- LED management
- RAID 5 Double Fault Protection
- Support for 3rd party SSDs

In the future, Intel VROC will add SATA functionality and RSTe will be phased out.

Q13: What is RAID 5 Double Fault Protection?

A13: Intel VROC can protect RAID 5 data even when both unexpected power loss and RAID volume degradation occur at the same time. This double fault condition is, at times, referred to as the RAID 5 Write Hole (R5WH). Many RAID solutions have dealt with this challenge by acquiring a backup power unit. Intel VROC addresses this problem by using patent-pending journaling.

Q14: What is LED management?

A14: The LED management feature supports SSD indicator lights by using the Status LED on the server enclosure that blinks different patterns to indicate the different status of each SSD in the RAID array. LED management provides easier maintenance and helps avoid accidental human errors. Intel VROC follows the blinking patterns defined by the International Blinking Pattern Interpretation standard.

Q15: I am an end user, how can I try or buy VROC?

A15: Intel VROC is a high platform integrated feature. There is deep enabling work required on platform BIOS, Hardware as well as drivers. Please ask your server provider for an Intel VROC capable server to try or buy. Intel PCSD (Platform Collaboration and Systems Division) also provides servers with Intel VROC capability.

Q16: Which OEM or ODM has designed in Intel VROC?

A16: Several OEMs and ODMs have designed Intel VROC into appropriate server and workstation platforms. We can provide guidance after the OEMs and ODMs launch their products, but at this moment, please query your server or workstation provider directly.

Q17: I found RAID 0 works without Intel VROC Hardware key. But the product brief says I need VROC Hardware key for RAID 0. What should I do?

A17: An Intel VROC Hardware (HW) Key is required to use RAID 0/1/5/10 for most SSDs. However, Intel VROC is also designed to provide RAID0 for Intel PCIe Gen3 x8 SSDs without requiring a HW key. For instance: Intel DC P3708. For any other regular x4 SSDs, without HW key, RAID 0 might work, might not work. In short, an Intel VROC HW Key is required for official support for RAID 0 with regular PCIe Gen3 x4 SSDs. Operating RAID 0 in this situation is done at the risk of the user.

Q18: What is the difference between Intel VROC and Microsoft Spaces*?

A18: Intel VROC supports the following features that Microsoft Spaces does not:

- Bootable RAID
- Linux* Support
- RAID Management in pre-OS environment
- Support LED Status indicator on SSDs in RAID arrays

Q19: What is the difference between Intel VROC and Linux MD* RAID?

A19: Intel VROC for Linux is built upon MD RAID, and Intel VROC team has an MD RAID maintainer on the team. However, Intel VROC has the following extra features:

- Provides UEFI HII and UEFI Shell command line RAID management
- Provides webpage based, remote RAID management and RESTful APIs
- Fully validated and supported with Purley platform and industry-select SSDs
- Provides hotfix/patch to specific customer issue on supported OS

Q20: How is Intel VROC performance different for Linux* compared to Microsoft Windows*?

A20: Intel VROC for Windows and Linux are implemented in two separate architectures and implementations so they present different performance. For instance, we are able to achieve 2.4M read IOPS in 4 disk RAID0 in Linux, but only 1.1M IOPS in Windows. We are continuously working on performance improvement. To achieve better performance in Windows for now, user can aggregate performance across multiple RAID arrays from different Intel VMD. Please be aware, only 1 VROC license is required for the whole server and VROC can support up to 12 RAID arrays per server.