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Intel® Xeon® Scalable Processors Improve Reliability, Availability, and Manageability of NVMe* SSDs

Intel® Volume Management Device (Intel® VMD) and Intel® Virtual RAID on CPU (Intel® VROC) Make Life Easier for Data Center Administrators.

As an IT manager, you've been more than happy with the investments you've made in Non-Volatile Memory Express* (NVMe*) solid state drives (SSDs). Storage performance has improved dramatically. Teams are reporting faster development cycles. All indications are that the new drives are supporting the strategic goal of strengthening the operational agility of your organization.

But you might have also noticed some new and unforeseen difficulties. More than once, for example, you've received late-night messages from admins who can't locate a failed NVMe SSD because its LED fault light wasn't operating. Other admins have sought your permission to shut down a mission-critical server just to switch out one of these drives because they weren't confident that hot-swap behavior was supported. And beyond these new management challenges, you've also learned of an unexpected performance obstacle: some hardware RAID controllers seem to be preventing your NVMe SSDs from reaching their full potential for data throughput. How do you resolve these issues?

An Easier, More Cost-Effective Way

Now, your admins can manage NVMe SSDs as easily as any other drives in your data center because of Intel® Volume Management Device (Intel® VMD), a feature of Intel® Xeon® Scalable processors. Intel VMD enables hot-plug, hot-unplug, and LED status-light management for NVMe SSDs—whether from Intel or another manufacturer—to give you and your admins standard manageability features across the entire ecosystem.

Intel VMD also enables a compelling bootable RAID solution for NVMe SSDs—Intel® Virtual RAID on CPU (Intel® VROC). Intel VROC unleashes the performance potential of NVMe without the complexity, cost, and backup power requirements of a RAID host bus adapter (HBA).

NVMe SSD Manageability before Intel VMD

NVMe SSDs have introduced unparalleled input/output performance and have quickly become critical components of storage and hyperconverged infrastructures. They have also presented some administrative challenges until now.

With Serial ATA (SATA) and Serial Attached SCSI (SAS) SSDs, the HBA serves as the control point that, along with the driver, manages hot-plug events, hot-unplug events, and LED status-light management—making the drives easy and intuitive for admins to service. With NVMe SSDs, the control point is inside the drive. Removing an NVMe SSD automatically removes the drive's control point. Once the control point is removed, the system has to rely on other means—such as the Peripheral Component Interconnect Express* (PCIe*) bus driver, the BIOS, the operating system (OS), or the system firmware—to handle storage-bus events.

The lack of a dedicated control point outside of the drive means that hot-plug and hot-unplug events for these drives are not supported in a consistent and reliable way.

For the same reason, NVMe SSDs also lack reliable support for LED status-light management. These LED lights provide crucial information to data center admins when a drive fails.

Intel VMD: A PCIe* Control Point on Intel Xeon Scalable Processor–Based Servers

Intel VMD brings reliable management features to NVMe SSDs. Intel VMD is a hardware element integrated into the PCIe root complex of Intel Xeon Scalable processor–based servers. This new feature makes NVMe SSDs every bit as manageable as SAS and SATA drives. One Intel VMD instance is present in each of the three PCIe root ports that connect a CPU to the PCIe lanes and NVMe SSDs, which essentially enables the CPU to act as the control point for NVMe SSDs. Intel VMD detects and redirects storage-bus events to Intel VMD–aware drivers that then gracefully handle those events.

Figure 1 shows a comparison of error handling on SATA/SAS drives, NVMe drives without Intel VMD, and NVMe drives with Intel VMD.

Intel VMD Benefits

By enabling hot-plug, hot-unplug, and LED status-light management for NVMe SSDs, Intel VMD improves the reliability, availability, and serviceability of NVMe storage systems. With Intel VMD, administrators can be confident that managing NVMe SSDs can be done effectively and in a standards-based way. And by allowing data center admins to respond quickly and effectively to NVMe drive failures, Intel VMD improves operational efficiency and server availability by reducing downtime due to drive-management errors.

LED Support

Most drives, whether hard disk drives (HDDs) or solid state drives (SSDs), have two LEDs: "activity," which is controlled by the drive itself and blinks to indicate I/O, and "status," which visually communicates the drive's status and is controlled by the system. The status LED has four states: OK, Fault, Rebuilding, and Locate, which are communicated by blinking patterns specified in the International Blinking Pattern Interpretation (IBPI) standard, or SFF-8489.

Before Intel® Xeon® Scalable processors, LED status-light behavior on NVMe* SSDs was sometimes not supported at all, and when it was supported, it was not always IBPI compliant. Now, with Intel® VMD, NVMe SSDs' status-light behavior is fully compliant with the IBPI standard.

Intel VROC: An Enterprise RAID Solution for NVMe SSDs

Intel VROC is a feature available with Intel Xeon Scalable processors and Intel VMD. Intel VROC uses Intel VMD as an integrated RAID controller for newer NVMe SSDs to provide a new and compelling RAID solution for these drives.

Enjoy NVMe Speed While Keeping Data Protected

Enterprises are migrating their data storage solutions to higher-bandwidth and lower-latency NVMe SSDs to address the performance bottlenecks of legacy SATA and SAS interfaces. With this transition, enterprises also require RAID data protection for NVMe SSDs.
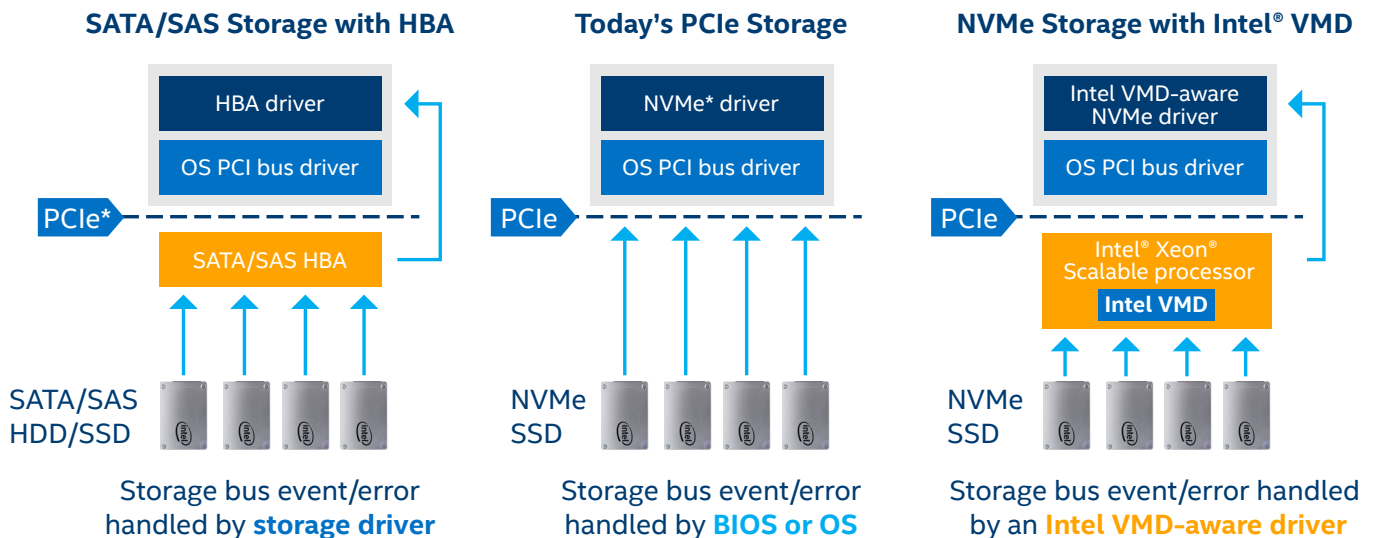

Figure 1. Error handling on SATA/SAS drives, NVMe* drives without Intel® VMD, and NVMe drives with Intel VMD

Intel VROC is a new enterprise RAID solution designed specifically for NVMe SSDs. It provides all the reliability expected of a RAID solution while unleashing the performance of NVMe SSDs. Because NVMe SSDs are directly connected to the CPU via Intel VMD, Intel VROC allows their performance potential for reduced latency and increased bandwidth to be realized in a RAID array. Intel VROC provides these benefits without the complexity, cost, and power consumption of traditional hardware RAID HBA cards that are placed between the drives and the CPU.

Compared to the traditional RAID alternatives for NVMe SSDs, Intel VROC offers an enterprise-grade RAID solution that is scalable, flexible, reliable, and cost-effective. Intel VROC:

- Eases maintenance with surprise hot-plug support and LED management

- Protects RAID 5 data through unplanned power loss— without relying on a battery backup—even in the presence of concurrent RAID volume degradation

- Offers a choice of management interfaces, including a command-line interface, interfaces in both pre-OS and OS environments, and a remote web-administration interface

- Improves reliability and manageability through hot-spare support, automated rebuild, and email notification

Intel® SSDs with NVMe* Are Optimized for Intel® VMD and Intel® VROC

The new Intel SSD DC P4500 Series and Intel SSD DC P4600 Series SSDs are optimized for the Intel® Xeon® Scalable processor platform and fully support Intel VMD and Intel VROC features.

For more information on these and other Intel SSDs, visit **intel.com/ssd**.

Intel VROC Requirements

Intel VROC must be enabled by the OEM at the system level. Intel has already worked with multiple OEMs to enable Intel VROC on their systems.

Other requirements for Intel VROC include the following:

- **Processor**: Intel Xeon Scalable processor with Intel VMD and Intel VROC enabled

- **BIOS**: Must support Intel VMD

- **License**: Intel VROC hardware key required

- **Motherboard**: Must include a header for an Intel VROC hardware key

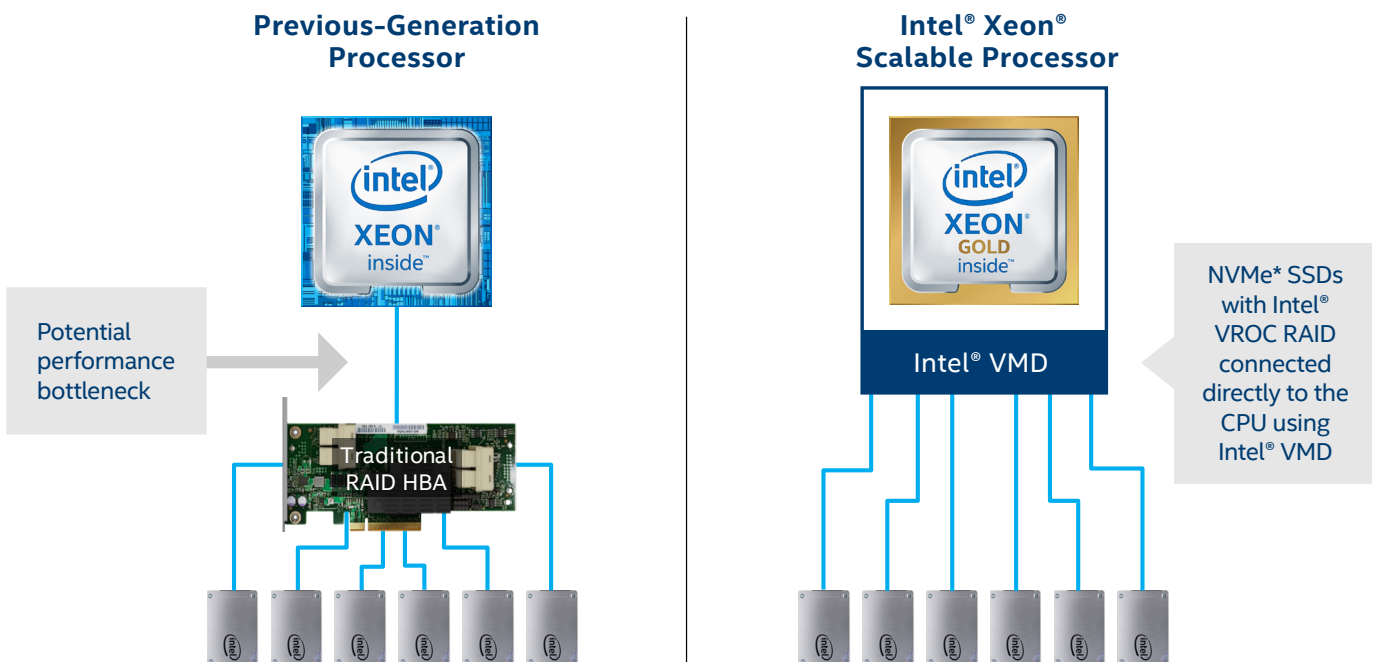- **Software**: Intel VROC software package

Figure 2. Using Intel® VROC removes the need for a hardware RAID controller and enables a data center to take full advantage of NVMe* technology's performance abilities

Intel VMD and Intel VROC: Improved Manageability for the Modern Data Center

The Intel VMD and Intel VROC features available with Intel Xeon Scalable processors can reduce downtime and improve manageability for high-performance storage in your data center. Intel VMD makes NVMe SSDs as easy to service without disruption as any other drives, and Intel VROC offers an easy-to-manage enterprise RAID solution with a compelling benefit-cost ratio for these same drives. Together, these features show Intel's overall commitment to high performance with NVMe SSDs in the data center while preserving high system availability, reliability, and serviceability.

Learn More

Intel® Xeon® Scalable processors:
intel.com/scalable

Intel® SSDs with NVMe*:
intel.com/ssd