TECHNOLOGY BRIEF

Client RAID and Data Center Solutions

Intel® RAID Solutions Meet the Needs of Enterprise and Client Platforms

Two Optimized Products Designed for IT Computing Platforms While Reducing Costs and Accelerating Performance

TWO TAILORED INTEL® RAID SOLUTIONS

Based on past RAID usage and continued customer interest in innovative RAID products, Intel has built two solutions to support OEMs who wish to provide RAID-capable platforms to their end-users. Why two RAID solutions? The answer lies in what Intel has learned over three decades of engagement with both client PC and enterprise server/workstation markets, guiding Intel to optimize different RAID solutions targeted at the two distinct usage models:

1. Intel® Rapid Storage Technology (Intel® RST) for client PCs including desktop PC, notebook PC, 2-in-1's, laptops, etc.
2. Intel® Virtual RAID on CPU (Intel® VROC) for Intel® Xeon® Scalable processor-based server and workstations

Intel® RST and Intel® VROC support NVMe* and SATA based storage devices. However, Intel VROC was designed specifically for NVMe SSDs. Intel VROC has SATA support based on the legacy functions it inherited from Intel® Rapid Storage Technology enterprise (Intel® RSTe). Intel RSTe no longer exists as it was absorbed into the Intel VROC product.

RAID Remains Popular and Software-based RAID Usage is Growing

Redundant arrays of independent disks (RAID) continues to be a popular solution for different types of IT computing platforms, from local servers to client PCs. RAID solutions provide the advantage of being flexible and configurable to improve performance and provide enhanced data protection. Even with the growth of new cloud-based storage architectures, local server "in-the-box" RAID remains in demand. Intel sponsored a survey of 451 enterprise end-users and it was noted that over 50%[4] of the respondents use a combination of hardware and software RAID, with 68%[4] of the enterprise end-users expecting to increase their use of software-based RAID in the next two years. Enterprise-class RAID solutions have historically used hardware host-based adaptors (HBA).

Optimizing Intel® RAID Solutions for Targeted Usage Models

Enterprise servers and workstations: Intel® Virtual RAID on CPU (Intel® VROC) is an enterprise RAID solution for NVMe* SSDs directly attached to Intel® Xeon® Scalable processors. Intel has optimized the RAID architecture for multi-user and multi-thread workloads. The performance goal was anchored on low latency and high IOPS when I/O queue depth is high (QD = 4 or higher). Intel built the RAID engine to be scalable allowing it to span across multiple controllers. Intel VROC also supports attachment via PCIe* re-timer cards, PCIe switches and external JBOFs (Just a Bunch of Flash). Intel VROC uses a new technology, Intel® Volume Management Device (Intel® VMD) from the Intel Xeon processor Scalable family, to provide hot-plug, surprise removal, and LED management of NVMe SSDs for server usage. Additionally, Intel VROC adds a critical capability called power loss protection for degraded RAID-5.

By utilizing the power loss imminent (PLI) feature of enterprise SSDs, Intel VROC provides a journaling function that facilitates the recovery of data after an unexpected power loss event. This has been a gap for software RAID solutions in the past and makes Intel VROC a complete solution for enterprise storage. Intel VROC supports Microsoft* Windows* Server and Linux* operating systems.

Client PCs: Intel® Rapid Storage Technology (Intel® RST) is a set of solutions optimized for single user PC clients, focusing on system responsiveness, application load time and system boot time while being conscious of overall power usage. It focuses on low latency at low I/O queue depths (QD1-QD2) and power-state transitions, while being highly responsive in a challenging battery-operated environment and greatly enhancing mobile environments. Intel RST has been extended to embrace Intel® Optane™ memory technology, enabling a smart, adaptable system accelerator that delivers a fast, smooth, and amazingly responsive computing experience for frequently executed tasks, such as everyday PC use, content creation, and gaming. Intel RST supports Microsoft* Windows* operating systems.

Summary

RAID continues to be important to OEMs and their end users. Intel's two RAID solutions meet the needs of specific platforms and user demand profiles. Intel VROC excels at the higher queue depths and thread counts frequently seen in enterprise level, transaction heavy environments. The low latency and high IOPS needed to improve business functions. Alternatively, Intel RST focuses on single user client platforms looking to accelerate daily operations with faster access to data derived from a low latency solution at low queue depths. Please see www.intel.com or your OEM to identify which platforms support Intel® Rapid Storage Technology or Intel® Virtual RAID on CPU RAID solution technology.

Description	Intel® Rapid Storage Technology (Intel® RST)	Intel® Virtual RAID on CPU (Intel® VROC)
Target market segment[1]	Client PCs (Gaming/Enthusiast, Desktop, AiO, Notebook, 2:1 Laptop, Convertibles, etc.)	Enterprise and Data Center (Server and Workstations)
Target Microprocessors[2]	Intel® Core™, Pentium® and Celeron® processors	Intel® Xeon® processors For full functional NVMe* SSD support: Intel Xeon Scalable processors with Intel® VMD
Target Operating Systems[2]	• Microsoft* Client O/S 32-/64- bit, including Windows* 10, 8.1, 7 • Windows Server x64	• Linux* O/S • Microsoft* Windows* Server O/S • Microsoft* Windows 7, 10
Key Features[2, 3]	• Bootable RAID 0/1/5/10 • CPU Attached storage up to 4 NVMe* SSD (Intel only) • Bootable RAID up to 6 drives • Surprise hot-plug of SATA SSDs • Auto rebuild • Advanced power management features • Application and file pinning • Bad block management • SSD Host memory buffer support • Opal support	• Bootable RAID 0, 1, 5, 10 • CPU attached storage up to • 48 NVMe* SSD (with 3rd party SSD support) • Surprise hot-plug • Status LED indicator • Hot-spare and auto rebuild • Degraded RAID5 power loss protection • Bad block management • Remote webpage management • Email notification • PCIe* retime, switch and JBOF support
SSD/HDD support[2]	• Intel® Optane® Memory • Intel® Optane® SSD Single User • NVMe* and SATA Client SSDs • SATA HDD, SSHD	• Intel® Optane™ Data Center SSD • NVMe* Data Center SSD • SATA SSD and HDD (currently with RSTe)
Workload optimizations[1]	1. Single user with applications anchored on latency at low Queue Depth (QD1-QD4)	2. Multiple users ("workers") and/or multi-depth workloads with Queue depth (QD4+)

Resources

Intel® Virtual RAID on CPU (VROC Software: http://intel.com/vroc

Intel® Rapid Storage Technology Software: https://www.intel.com/content/www/us/en/support/articles/000005610/technologies.html?wapkw=rst

Intel® Volume management Device (VMD): http://intel.com/VMD

Intel® Optane™ Memory: http://intel.com/OptaneMemory

Intel® Optane™ Solid State Drives: http://intel.com/Optane

Intel® SSD product specifications: http://www.intel.com/content/www/us/en/solid-state-drives/solid-state-drives-ssd.html

1 To support customer choice, some platforms might support combinations of Intel RST and Intel VROC. For example, platforms based on the X299 chipset, which supports Intel® Core™ X – series processor family, does support both RAID solutions.
2 Intel RST and Intel VROC need OEM platform enablement. Not all features, OS and storage devices are available on all platforms. Please query your platform provider for supported features
3 For a complete list of the supported features and limitations of Intel RAID solutions, please consult your OEM or intel.com.
4 451 Research*, "Athena* SSD custom Study", Q1'2017. "Quantitative survey of 1500 storage-familiar IT decision makers. This primary research was sponsor by Intel® Corporation.