

NVMe SSDs with RAID Offload for the Data Center: Testing Activities & Performance Results

Presented By:

Thomas Paquette, Senior VP & General Manager, Graid Technology Inc.

August 10, 2023

DCTR-303-1: Enterprise Storage Part 1

Agenda

- Data Center Storage Trends
- NVMe Technology In A Server
- NVMe & RAID
- Testing Activities & Setup
- Results: Sequential Reads/Writes
- Results: Random Reads/Writes
- Conclusions
- Sources



Data Center Storage Trends

SSD Storage Adoption

- The IT industry has been shifting from HDDs to SSDs for better speed and performance

SSD Growth

- Worldwide SSD industry revenues are expected to grow at a CAGR of 9.6% until 2026
- Increasing application requirements demand faster storage, lower power consumption, and shorter latency



Data Center Storage Trends

continued

Protocol Advancement

- Data centers and enterprises are moving away from older SATA and SAS SSDs to NVMe technology

Performance Selection Criteria

- NVMe SSDs offer operational advantages & lower latency compared to legacy storage technologies
- Recent price drops have made NVMe SSDs competitive with SATA SSDs, encouraging migration



NVMe Technology In A Server

Architecture Criteria

- NAND Flash memory performance is optimized by freeing it from limitations and burdens

NVMe Protocol

- NVMe protocol is specifically designed for Flash memory-based storage components
- NVMe is a light and efficient standard tailored to meet the high-performance requirements of cloud data centers and enterprises



NVMe Technology In A Server

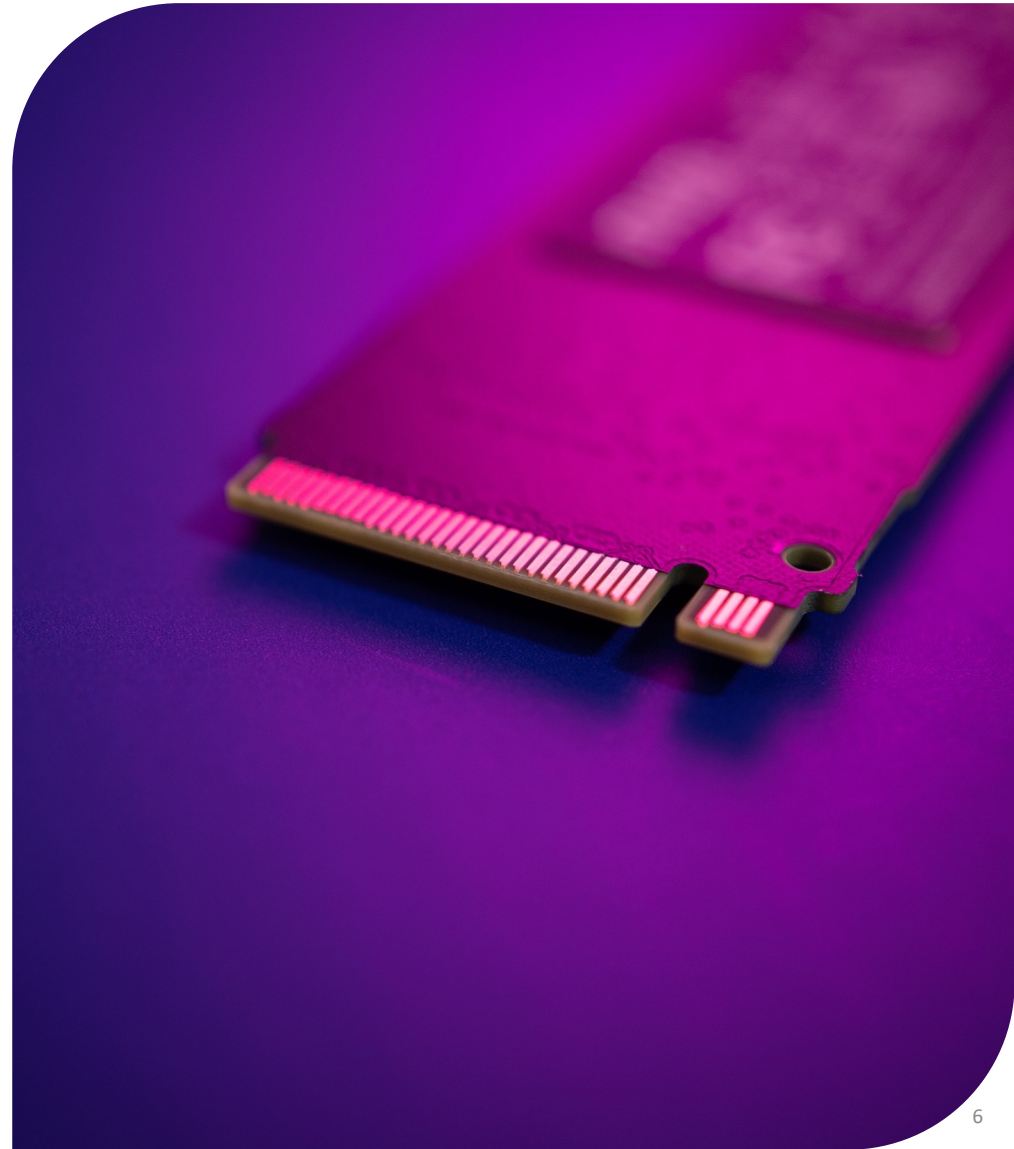
continued

Latency Consideration

- Connecting SSDs directly to the CPU via the PCIe interface eliminates latency introduced by SATA and SAS controllers

Future-Proof Strategies

- PCIe interface provides a future-proof specification roadmap aligned with upcoming data transfer standards
- SSDs connected via PCIe offer fast, low-latency, and non-volatile data interconnection to applications



NVMe & RAID

Reliability & Availability Consideration

Redundant Array of Independent Disks (RAID) technology is commonly used in the IT industry to ensure data resilience

RAID Selection – Hardware vs Software

- **Hardware RAID** setups introduce performance restrictions and increased latency due to the RAID controller
- **Software RAID** uses the CPU for controller tasks but consumes significant CPU resources and may require a more expensive CPU



NVMe & RAID

continued

Dedicated RAID Card Advantages

- A dedicated card like SupremeRAID™ can handle RAID control tasks and **eliminate performance bottlenecks**
- Dedicated RAID cards allow for the **utilization of NVMe speed and capacity**
- The SupremeRAID™ card can support up to 32 NVMe SSDs and brings high performance and increased capacities to servers

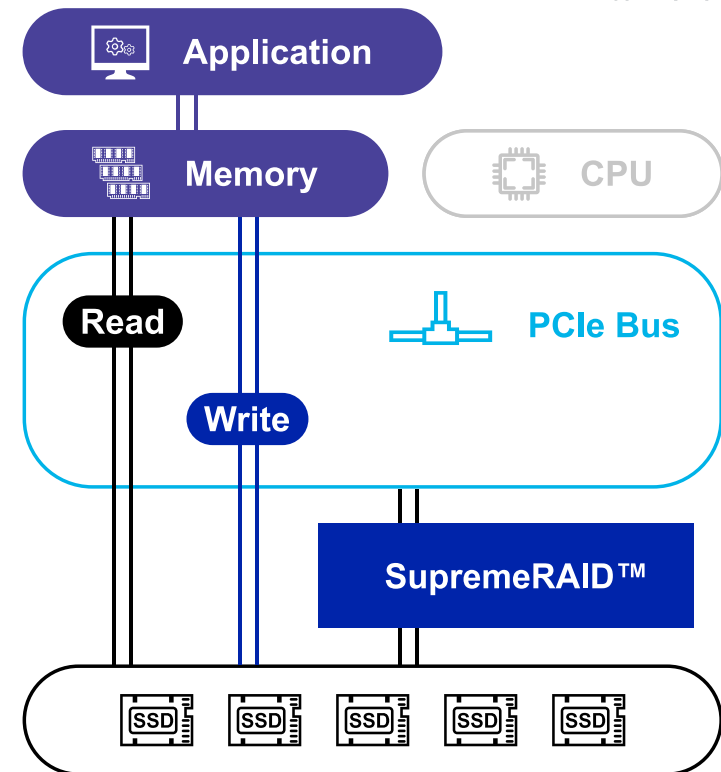


NVMe & RAID

continued

NVMe SSDs & SupremeRAID™ Performance Advantages

- **The NVMe SSDs** connect directly to a PCIe bus (as shown) for no bottleneck or compromise in performance. A single SupremeRAID™ card supports 19 M IOPS and 220 GB/s throughput
- **The NVMe RAID Card** manages storage, freeing up the CPU for other important tasks and enables a less complicated server setup
- The card can simply be plugged into any one of the PCIe slots without extra cables to connect with NVMe SSDs, thus reducing the total cost of ownership (TCO) when building a server



SupremeRAID™ by Graid Technology enables high performance with low CPU load

Testing Activities & Setup

The KIOXIA team implemented a test system that simulates real-world conditions of RAID storage:

- **OS:** Ubuntu 20.04, with FIO 3.16 performance benchmarking tool
- **Modes:** RAID 10, RAID 5, and RAID 6, representing commonly used modes in real-world applications
- **SSD:** CD6-R from KIOXIA, optimized for read-intensive data center scale-out and cloud applications
- **CD6-R Series** is compliant with PCIe 4.0 and NVMe 1.4 specifications, providing consistent performance up to 1 M IOPS (random read) and 85 K IOPS (random write)
- **SupremeRAID™** supports RAID levels 0/1/10/5/6/JBOD and accommodates up to 32 native NVMe drives



KIOXIA CD6-R Data center NVMe SSD and SupremeRAID™ SR-1010 by Graid Technology

Testing Activities & Setup

continued

The system set-up described in the white paper is suitable for various applications such as:

- **AI/machine learning**
- **Cache servers**
- **Streaming, simulation, and virtualization platforms**
- **Cloud solutions**

Specific apps have a unique set of demands. Selecting the right SSD and RAID architecture can meet workload requirements:

- **Low latency for databases**
- **High bandwidth for data analytics**



Flash Memory Summit



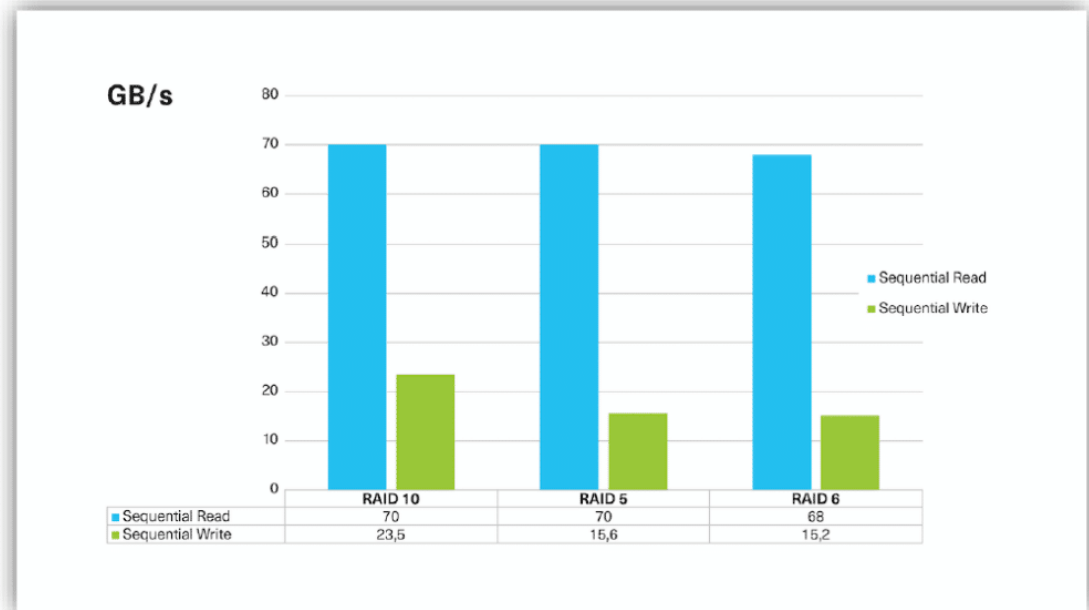
Results: Sequential Reads & Writes

Sequential Performance Results

- The testing achieved very high performance for both reads and writes, which can be considered a maximum level that might be reached in a real-world scenario using the SupremeRAID™ cards with SSDs

Scalability Consideration

- These tests used only 20 SSD drives with the SupremeRAID™ card, while it has a max capacity of 32 SSDs
- This means that higher performance could be obtained by adding extra drives



RESULTS: RAID Performance, Sequential Reads & Writes

Results: Random Reads & Writes

Random Performance Results

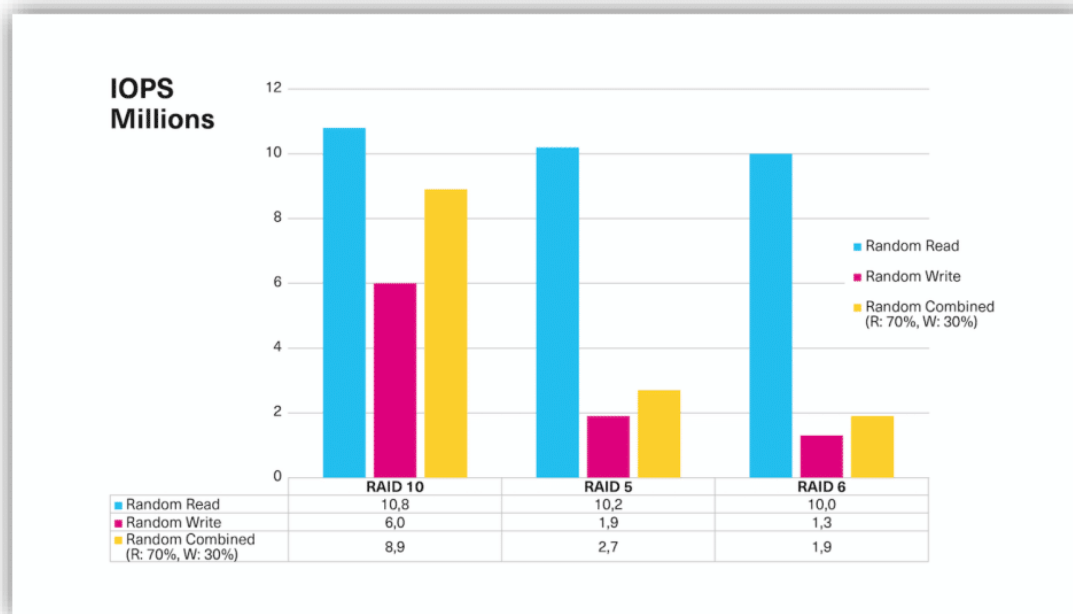
- Performance figures were lower than for the optimal use cases yet still achieve excellent results

Considerations

- As with the sequential results, 20 drives were used in the test where SupremeRAID™ supports 32 drives in a single server. Adding additional drives increases aggregate performance

In Closing

- Many applications have highly predictable workloads to ensure maximum performance; the right combination of SSDs and RAID methodology can effectively match demands



RESULTS: RAID performance, Random Reads & Writes

White Paper Conclusions



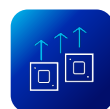
NVMe SSDs offer a cost-effective, scalable, and flexible solution for achieving high-performance levels in enterprises and data centers



NVMe SSDs provide operational improvements over legacy designs while remaining competitively priced



NVMe SSDs are future-proof technology that can adapt to evolving application requirements



The combination of KIOXIA SSDs and SupremeRAID™ enables customers to maximize the performance potential of their NVMe drives while simplifying installation and freeing up CPU resources



It is an opportune time for businesses to migrate to NVMe SSDs as they have become the standard in new platform and system designs, and SupremeRAID™ enhances the appeal of NVMe SSDs even further

Learn More!

Download the white paper
from KIOXIA and primeLine
Solutions GmbH, featuring
SupremeRAID™

www.graidtech.com/category/whitepapers/

