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White Paper

Introducing OCZ's New SATA-Based Enterprise-Class SSD Portfolio

Understanding the Key Capabilities of the Saber 1000 Series
and Intrepid 3000 Series

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1   Introduction

Over the past several years, OCZ has delivered a leading SATA-based SSD portfolio that supports both client and enterprise applications, and regarded by research firms as one of the leading SSD providers in this market space. The leading products in this portfolio are outlined in Figure 1.

OCZ-branded client drives cover the complete gamut of entry-level value, mainstream, enthusiast and power user solutions, and the performance they deliver are typically at the top of their respective classes with industry-leading throughput and I/O access, having received more industry awards than any other client SSD competitor.
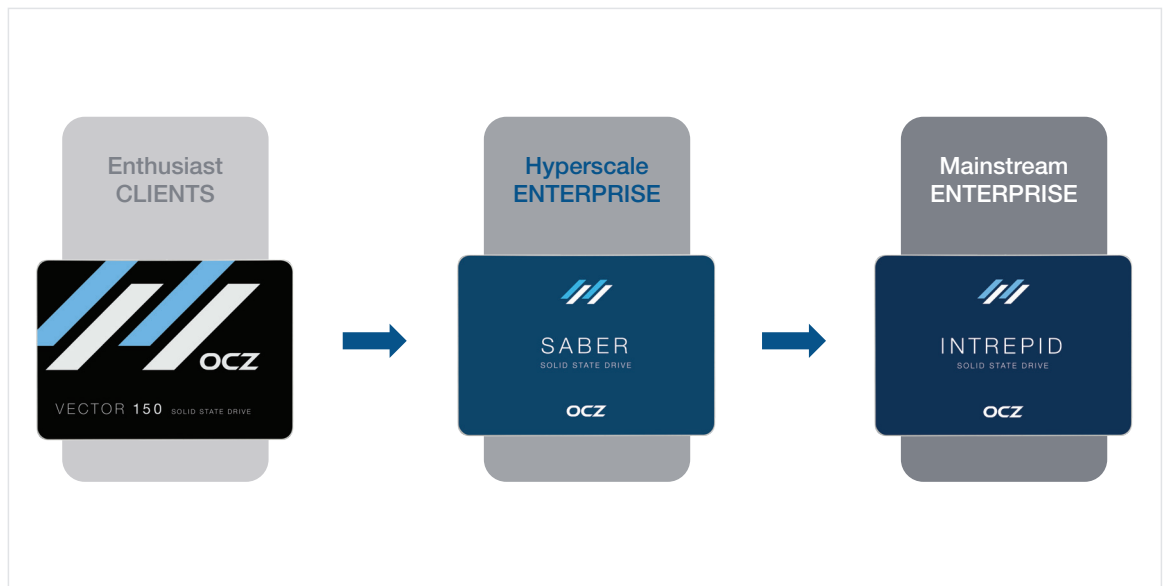

Figure 1 represents the key products in OCZ's SATA-based SSD portfolio

OCZ has developed and evolved its SATA-based enterprise SSD portfolio over the years to address varied workload requirements

Client SSDs are intended for personal computing applications and though they offer lower acquisition costs than enterprise SSDs, they are not designed for the datacenter. They are designed to support one client / single application I/O access where response time is critical especially for such applications as system boot-ups, file transfers and back-ups. The endurance and reliability typically built into client SSDs are not at an enterprise-class level, and replacing a single localized client SSD is a viable alternative.

As client SSDs do not handle mixed workloads very well, in comparison to performing 100% dedicated read or write operations, deploying them in the enterprise can put data at risk and run up datacenter costs dealing with problems and/or replacements. In understanding these dynamics, OCZ has developed and evolved its SATA-based enterprise SSD portfolio over the years to address varied workload requirements, deliver leading sustained performance with predictable, efficient and consistent latency responses, all supported by the endurance and reliability capabilities that IT managers expect from today's enterprise-class SSDs.

The purpose of this white paper is to introduce OCZ's SATA-based enterprise portfolio and provide product information so that prospective users can gain a better understanding regarding how these solutions are positioned in the enterprise and the key capabilities of each.

2 Enterprise Product Overview

With SATA's strong market position in SSD storage coupled with OCZ's successful record of developing award-winning SATA-based solid-state drives, the company introduces its portfolio of enterprise-class SATA-based solutions that includes the Saber 1000 SSD Series and Intrepid 3000 SSD Series.

The Saber 1000 SSD Series is designed for read-intensive applications such as media streaming, video on demand (VOD), virtual desktop infrastructure (VDI), online archiving and web browsing. It is also targeted for high-volume deployment hyperscale, web-hosting and distributed computing environments whereby the volume of data (and the demand for certain types of data) can increase exponentially but must still be accessed quickly. In these cases, hyperscale datacenters utilize virtual servers and accommodate increased processing demands typically through cloud computing without requiring existing physical space, cooling or power. Examples of large, distributed computing environments include Facebook, Google, and Amazon.

The Intrepid 3000 SSD Series is designed for mainstream enterprise applications, featuring more extensive endurance and reliability, and available in two distinct configurations -- the Intrepid 3600 for read-intensive applications such as those outlined above, and the Intrepid 3800 for write-intensive or mixed workload applications such as Big Data and analytics, OnLine Transaction Processing (OLTP), High Performance Computing (HPC), cloud computing, as well as a host of others.

The following chart are examples of recommended applications supported by the Saber 1000, Intrepid 3600 and Intrepid 3800, based on their I/O workload profiles, and outlined in Figure 2:

Application	Saber 1000	Intrepid 3600	Intrepid 3800
Boot Operations (WS and file server)	√	√	
Decision Support System (DSS)	√	√	
Customer Relationship Management (CRM)	√	√	
Enterprise Content Management (ECM)	√	√	
Media Streaming	√	√	
Photo Sharing / Video Editing	√	√	
Read Cache and Indexing	√	√	
Video on Demand (VOD)	√	√	
Virtual Desktop Infrastructure (VDI)	√	√	
Virtual Tape Library (VTL)	√	√	
Front-end Web Servers	√	√	
Database Servers	√	√	√
Cloud Computing (SaaS, PaaS, IaaS)	√	√	√
MS Exchange		√	√
SQL Database OLTP		√	√
High Performance Computing (HPC)		√	√
Professional Media Editing / Post Production			√
Database & Error Logging			√
Enterprise Resource Planning (ERP)			√

Figure 2 outlines recommended workload applications for OCZ's enterprise-class, SATA-based SSDs

5%

70%

25%

Read-Intensive

Mixed Use

Write-Intensive
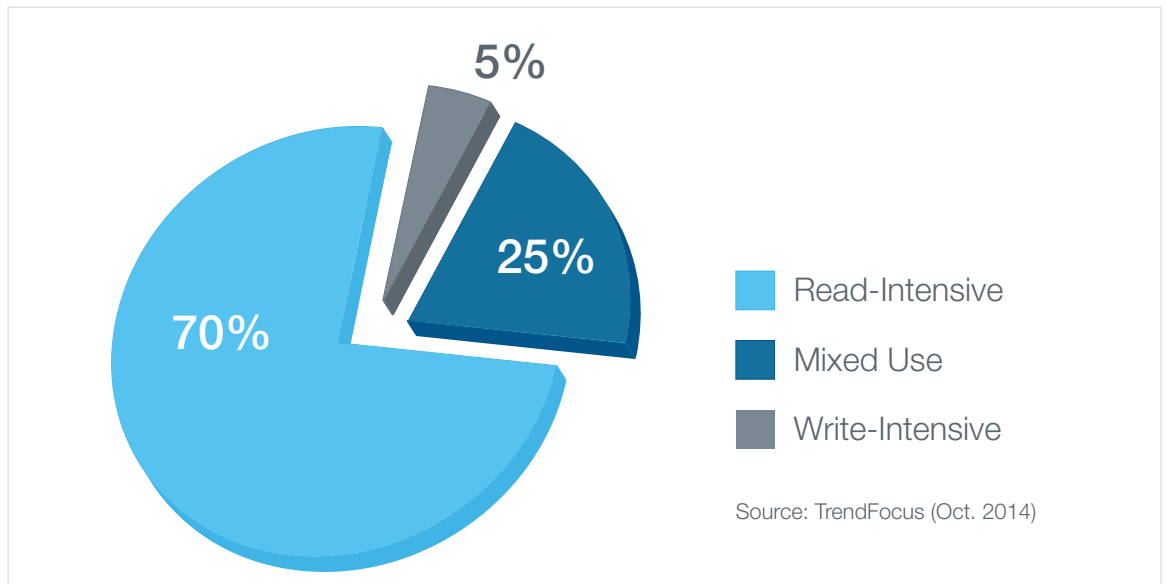
Source: TrendFocus (Oct. 2014)

Figure 3: SATA-based enterprise SSD workload splits

As not all SSDs and datacenters are created equal, the key to achieving increased data and system performance is to understand how the SSD performs under specific application workload requirements whether the workloads are read-intensive, write-intensive or mixed between the two. Based on research provided by TrendFocus (October 2014), SATA-based enterprise SSDs are currently used for read-intensive applications, equating to 70% usage, while mixed workloads represent 25% usage and write-intensive workloads represent 5% usage as outlined in Figure 3. As the volumes for read-intensive applications continue to grow, OCZ mirrors this industry trend with read-intensive solutions targeted for hyperscale workloads, as well as advanced solutions targeted for mainstream enterprise mixed workload applications.

Whether the workload is read-intensive, write-intensive, or mixed, efficient predictable performance is essential to the success of the enterprise so that connected users are provided with a faster, more responsive storage experience. Without this level of consistency, I/O response latency spikes become evident in the system requiring IT personnel to adjust application workload requirements accordingly, which in turn, increase maintenance and support costs, as well as overall total cost of ownership (TCO).

Saber 1000

The Saber 1000 SATA III SSD Series utilizes cutting-edge A19 nanometer (nm) NAND flash process geometry from Toshiba coupled with OCZ's internally-designed Barefoot 3 controller that enables full design control over the product roadmap while delivering high performance storage, and required endurance and drive reliability for enterprise hyperscale applications.

Designed to support 240GB, 480GB and 960GB usable capacities, the Saber 1000 Series delivers consistent sustained I/O performance across all capacities to accelerate enterprise applications. The performance metrics for a 960GB capacity Saber 1000 SSD include read bandwidth of up to 550 MB/s, write bandwidth of up to 470 MB/s, 4KB random read speed of up to 98,000 input/output operations per second (IOPS), and 4KB random write speed up to 20,000 IOPS.

As current market research indicates, there is demand for hyperscale enterprise and OEM applications and the Saber 1000 Series directly addresses these cost-sensitive, read-intensive focused customers.

Intrepid 3000

The Intrepid 3000 SSD Series is OCZ's mainstream enterprise-class SSD SATA III solution with a focus centered on high-performance and low-latency while endurance and reliability remain a significant metric so that the series is appealing to a broad range of OEM and enterprise-class customers whether the application is read-intensive, write-intensive or mixed.

In comparison to OCZ's previous generation Deneva 2 architecture, the Intrepid 3000 Series provides a 12x improvement in I/O response time delivering consistent and predictable latency over a sustained time period. The Intrepid 3000 Series delivers five times faster sustained performance for 4KB write operations and two times faster sustained performance for 4KB read operations versus the Deneva 2 as well. It also delivers predictable and consistent I/O access across the enterprise that not only reduces potential system and storage bottlenecks, but also helps to improve user productivity.

Supporting Toshiba's 19nm NAND flash and storage capacities up to 800GB, the Intrepid 3000 architecture is based on OCZ's Everest 2 platform with performance metrics that include read bandwidth of up to 540 MB/s, write bandwidth of up to 480 MB/s, 4KB random read speed of up to 91,000 IOPS, and 4KB random write speed up to 40,000 IOPS.

The Intrepid 3600 Series is designed to support similar read-intensive workloads as the Saber 1000 Series, while the Intrepid 3800 Series is specifically targeted for write-intensive and mixed workload applications making it ideally suited for OnLine Transaction Processing (OLTP), High Performance Computing (HPC), Big Data processing, email servers, professional media editing / post production, OnLine Analytical Processing (OLAP), to name a few.

Key Takeaway

The Intrepid 3600 Series and Saber 1000 Series are both targeted for read-intensive applications such as online archiving, web browsing, media streaming, and indexing, and both employ unique firmware features that enable heavy read queues to be prioritized in short bursts that literally allow the SSD to 'shovel' data at incredible speeds to clear the queue and return to normal housekeeping functions. Though the Intrepid 3600 and Saber 1000 offer comparable performance, the key differentials include acquisition cost, endurance and reliability, and data protection. If more endurance, data reliability and power fail protection is required, the Intrepid 3600 Series becomes a more viable product, and if the workload is more of a mixed requirement, the Intrepid 3800 Series is the recommended solution.

3 Endurance And Reliability

Saber 1000

The Saber 1000 SSD Series is engineered to provide endurance and data reliability tools through its powerful Barefoot 3 controller and associated firmware. This includes flash management tools that can analyze and dynamically adapt to increasing NAND vulnerabilities as flash cells wear and designed to overcome limitations associated with this wear. The endurance and reliability tools do not include the suite of capabilities available within the mainstream enterprise Intrepid 3000 Series.

In the event of a sudden power loss, the Saber 1000 Series uses a technique referred to as Power Failure Management Plus (PFM+) which holds up the SSD circuitry long enough to ensure the integrity of the device so that it can be fully operational again once power is restored. To achieve this, each Saber 1000 SSD uses an internal 16 Byte PFM+ log that describes a single action performed on the NAND and this log contains only the essential data needed to rescue the SSD from metadata corruption. As a result, the PFM+ logs are accumulated and saved frequently with no impact on overall SSD performance. As most enterprise and hyperscale datacenter servers are deployed in clusters,

PFM+ ensures that once the power is restored, and the server cluster stabilizes again, all Saber 1000 SSDs will return back to the condition they were in at the time of failure.

In the enterprise, it is imperative for in-flight write operations to complete during a power failure or data can be lost, corrupted or cause system errors. For read-intensive applications, such as hyperscale workloads, completing in-flight operations during a power loss is not as critical.

With support for Power Failure Management Plus (depicted in Figure 4), the Saber 1000 Series enables each connected SSD to remain operational post-outage preventing it from becoming a brick (which in simplest terms means it cannot be communicated with and data cannot be recovered). Since most servers are deployed in clusters, once the power is restored, and the server cluster comes back alive, the Saber 1000 SSD can be easily restored, data retrieved at the time of failure, and/or repopulated with data post outage. As a result, the endurance provided by the Saber 1000 Series is warranted to provide ½ complete Drive Writes Per Day (DWPD) for 5 years.
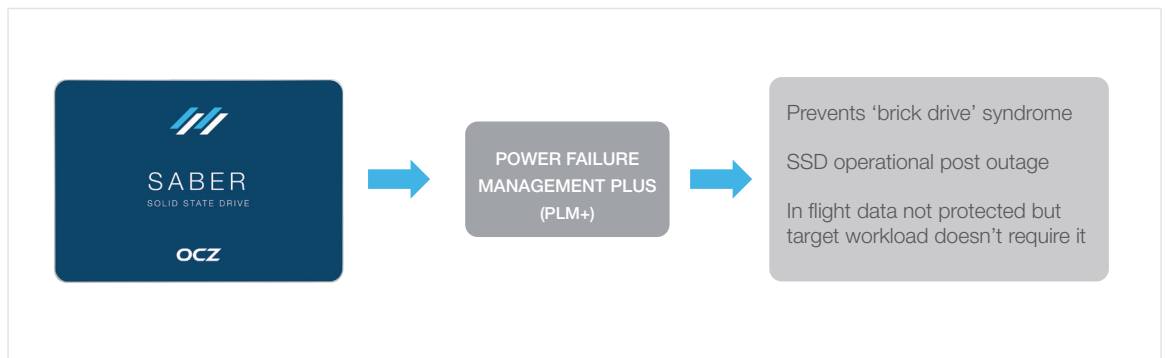

Figure 4 outlines Saber 1000 support for Power Failure Management Plus

Intrepid 3000

With a host of read-intensive, write-intensive and mixed workload applications driving the data center, enterprise SSDs are expected to always be available for moving data to new locations based on need or tier structure, for providing a performance boost to key applications, or simply for enabling 'real-time' data access. The life expectancy of an SSD is completely dependent on the endurance and reliability tools, techniques, algorithms and/or technologies implemented.

Enterprise SSD endurance is typically described as the built-in capabilities that enable the device to handle a constant workload without stress, malfunction or failure for a long period of operation with emphasis on those capabilities that extend NAND flash life and improve drive durability. Data reliability includes those attributes built within an SSD that enable consistent 'to-spec' performance and provide advanced data recovery, data integrity and power loss protection capabilities.

The Intrepid 3000 Series features OCZ-engineered proprietary firmware that works on top of the SSD controller to deliver a powerful suite of endurance and reliability tools that includes:

- Advanced ECC that detects and corrects a limited number of bit errors 'on-the-fly' and provides additional capabilities that further reduce uncorrectable bit error rates.
- End-to-end data path protection that performs data integrity checks at every juncture where data is transmitted and received ensuring that corrupted data is protected and not propagated.
- SSD RAID Redundancy that duplicates all data stored in an Intrepid 3000 SSD so if the SSD fails, back-up exists, the storage operation will not be adversely impacted, and data will be protected under most failures or duress.
- Power Loss Protection (PLP) so if a sudden power loss or failure occurs, and the primary power source drops below a pre-defined threshold, the Intrepid 3000 controller will no longer allow the drive to accept new commands from the host until the in-flight write operation completes. This built-in logic uses a super capacitor inside the SSD to commit any in-flight write cache data to flash as depicted in Figure 5:
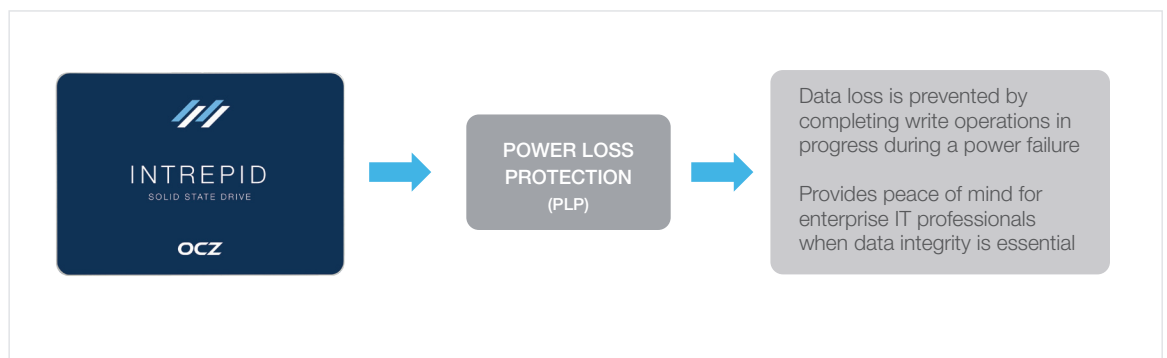

Figure 5 outlines Intrepid 3000 support for Power Loss Protection

This combination of endurance and data integrity provide the requirements that IT managers expect from their mainstream enterprise SSD solutions. As such, the Intrepid 3600 for read-intensive applications is warranted to provide 1 DWPD for 5 years while the Intrepid 3800 for write-intensive applications is warranted to provide 4 DWPD for 5 years.

OCZ's StoragePeak 1000 SSD Management System enables IT managers to centrally monitor and administer connected Saber 1000 and/or Intrepid 3000 Series resources from a web-based management interface

Key Takeaway

The Saber 1000 and Intrepid 3000 Series both implement endurance, reliability and advanced management tools expected by IT professionals in support of hyperscale enterprise and mainstream enterprise applications respectively. This includes advanced flash management capabilities that not only manage flash resources but perform operations that free up SSD resources such as:

- Wear-leveling that organizes data so the program cycles are evenly distributed amongst all flash cells, preventing the flash from being overused, which in turn, slows cell wear, and
- Garbage collection that determines which flash cells have unneeded data and either consolidates or erases those blocks to reclaim usable capacities, which in turn, reduce cell use that equates to improved drive life.

IIn those enterprise applications where drive endurance, data reliability, data integrity and data protection are at the forefront, such as OLTP, OLAP, HPC, Big Data, and cloud computing, the Intrepid 3000 SSD Series is well positioned. For read-intensive enterprise applications that support hyperscale, web hosting and distributed computing environments, the Saber 1000 provides the required endurance and reliability tools expected by IT managers.

4 Monitoring And Management Tools

Both the Saber 1000 and Intrepid 3000 SSD Series are supported by the industry-standard, self-monitoring analytical and reporting technology (SMART) that is implemented at the system level and based on past and present use-analysis it receives from either the Saber 1000 or Intrepid 3000 SSD controller. SMART initiates warning messages to the controller about potential drive failures enabling IT administrators to respond in a proactive manner.

This monitoring and management capability rises to new levels when used in combination with OCZ's StoragePeak 1000 SSD Management System that enables IT managers to centrally monitor and administer connected Saber 1000 and/or Intrepid 3000 Series resources from a web-based management interface. This network-accessible management system securely connects to multiple hosts (running Linux or Windows operating systems) providing a cross-platform view of the OCZ SSDs connected to servers, storage arrays or appliances, and includes a user configurable alerting systems that enables IT corrective actions to be initiated at an early stage.

StoragePeak 1000 simplifies network administration by allowing IT managers to connect the application to multiple hosts across the network via engine software that the user installs on each host (typically used as an interface or

communications link) as outlined in Figure 6. Once StoragePeak 1000 is added to the enterprise (the software is easily downloadable from OCZ's website), it continually monitors the environment and will discover new hosts when they are added. When a new host is discovered, a complete inventory of the individual OCZ SSDs associated with that host are provided while enabling quick access to the SSDs themselves.

Additional information on StoragePeak 1000 is available at:
http://ocz.com/enterprise/software/storage-peak-1000-flash-management

A StoragePeak 1000 introduction white paper is also available at:
http://ocz.com/enterprise/literature/white-papers/storage-peak-1000-ssd-management-software
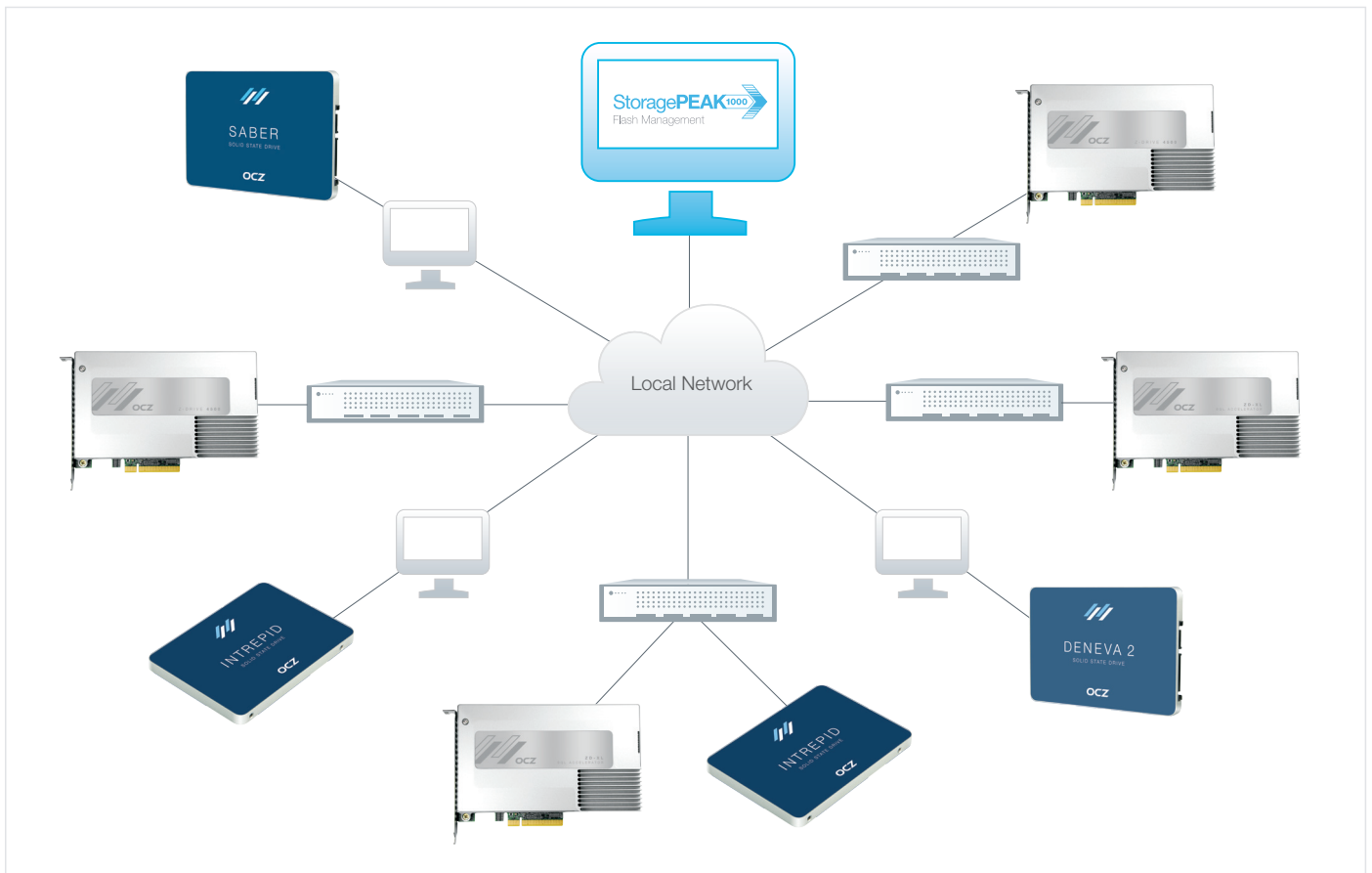
Figure 6 depicts StoragePeak 1000 remote access to multiple hosts

For IT departments adding SSDs to the enterprise, the ability to centrally manage and maintain them are crucial for this level of host and SSD management. OCZ's StoragePeak 1000 provides the advanced tools, system information and SSD health monitoring required by IT managers enabling them to perform mission-critical actions, extend drive and NAND flash life, and maximize data center ROI from their deployed OCZ flash-based storage resources.

5 Product Specifications

The key product specifications for the Saber 1000 SSD Series and Intrepid 3000 SSD Series are covered in Figure 7 below:

Specification	Saber 1000	Intrepid 3600	Intrepid 3800
NAND	A19nm MLC	19nm MLC	19nm eMLC
Interface	6Gb/s SATA III	6Gb/s SATA III	6Gb/s SATA III
Form Factor	2.5", 7mm	2.5", 9.5mm	2.5", 9.5mm
User Capacity (GB)	240/480/960	100/200/400/800	100/200/400/800
Max. Sequential Read	550 MB/s	540 MB/s	540 MB/s
Max. Sequential Write	500 MB/s	480 MB/s	480 MB/s
Sustained 4KB Random Read	95,000 IOPS	91,000 IOPS	91,000 IOPS
Sustained 4KB Random Write	23,000 IOPS	38,000 IOPS	40,000 IOPS
Endurance (DWPD)	0.5	1	4
Power Consumption	3.7 W (active)	3.4 W (active)	3.4 W (active)
Power Loss Protection	Power Failure Management Plus (PFM+)	Power Loss Protection (PLP) Full In-Flight	Power Loss Protection (PLP) Full In-Flight
MTBF	2 million	2 million	2 million

Figure 7 Product Specifications

6 Summary

OCZ developed its SATA-based SSD portfolio to address specific workload requirements, deliver leading sustained performance, as well as predictable, efficient and consistent latency responses, and provide the endurance and reliability tools expected by IT managers.

The Saber 1000 family is an enterprise SSD series designed specifically for read-intensive applications and hyperscale workloads, and provides enterprise-class performance, endurance and reliability at a low acquisition cost. The series is particularly well-suited for media streaming, video on demand, virtual desktop infrastructure, online archiving and web browsing applications. In the event of a power failure, its Power Failure Management Plus feature enables each connected drive to keep the data post-outage preventing the drive from becoming a brick and an ideal, cost-effective solution for hyperscale or web hosting environments.

The Intrepid 3000 Series leverages an impressive enterprise-class feature-set to enable customers with leading small block/large block random and sequential performance, advanced data management, and advanced endurance and reliability, all resulting in industry-leading mainstream enterprise flash-based storage solutions. Available in two distinct configurations, the Intrepid 3600 Series supports read-intensive workloads similar to the Saber 1000 Series, while the Intrepid 3800 Series supports the most compute-heavy write-intensive and mixed workload applications such as OLTP, HPC, Big Data processing, email servers, and OLAP, achieving exceptional SSD responsiveness regardless of data type or I/O pattern.

Additional information on OCZ's current SATA-based enterprise SSD portfolio covering the Saber 1000 Series and Intrepid 3000 Series, as well as OCZ's complete line-up of enterprise SSDs and software solutions are available at www.ocz.com/enterprise.

Saber 1000	**hyperscale enterprise** – for read-intensive applications
Intrepid 3600	**mainstream enterprise** – for read-intensive applications
Intrepid 3800	**mainstream enterprise** – for write-intensive or mixed workload applications

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