EMC XTREMIO EXECUTIVE OVERVIEW

COMPANY BACKGROUND

XtremIO develops enterprise data storage systems based completely on random access media such as flash solid-state drives (SSDs). By leveraging the underlying abilities of random access media, XtremIO delivers unparalleled levels of performance (hundreds of thousands to millions of IOPS and consistently low latency of under one millisecond, ease-of-use, operational efficiency (low physical space, power consumption, and heat generation), and advanced storage array features such as deduplication, thin provisioning, and snapshots that have significant benefits compared to traditional implementations. However, and most importantly, XtremIO storage systems dramatically lower the overall cost of IT infrastructure in virtual server, virtual desktop, database, analytics, and business intelligence environments by driving higher consolidation ratios and significantly improving the user experience at the application level.

The company was founded in 2009 and acquired by EMC in May of 2012.
THE XtremIO STORAGE SYSTEM

The XtremIO storage system is based on a scale-out architecture. The system begins with a single building block, called an "X-Brick". An X-Brick by itself is a high-availability, high performance SAN storage appliance containing SSDs, redundant storage processors, redundant power and cooling, four 8Gbps Fibre Channel and four 10Gbps iSCSI host ports. The logical amount of storage available is substantially higher than the physical flash in the system due to real-time, inline data reduction.

When additional performance or capacity is required, the XtremIO storage system scales-out. Additional X-Bricks may be added to an existing system, joined together over a redundant, high-availability, ultra-low latency network backbone (supplied by XtremIO). Performance scales linearly such that two X-Bricks will supply twice the IOPS and three X-Bricks will supply three times the IOPS. Latency remains consistently low as the system scales.

XtremIO KEY FEATURES & CAPABILITIES

XtremIO’s features are best described in five categories; achieving longevity of the flash media, lowering the effective cost of flash capacity, delivering performance and scalability, providing operational efficiency, and delivering advanced storage array functionality. Many features overlap these categories, providing benefits in several areas at once.

FLASH MEDIA LONGEVITY

Unlike hard drives, flash media has a limited write cycle life span. Also unlike hard drives, data stored on flash cannot be directly overwritten. Rather it must first be erased (which is very slow) and then reprogrammed with the new data. Thus, it is imperative to engineer the storage system to ensure that the flash media will last for the expected life span of the array under heavy enterprise workloads. XtremIO has developed several technologies that ensure our storage system will last for at least five years under constant, full speed write workloads.
• **Inline Data Reduction.** The XtremIO array automatically deduplicates data as it enters the system. This reduces the amount of data written to flash, thus extending the flash lifetime. XtremIO’s data reduction does not negatively affect performance of the array and is performed in real-time (not as a post-processing operation that would amplify the amount of flash operations, reducing flash longevity and available performance for host I/O).

• **Automatic Data Distribution.** The XtremIO system automatically spreads data out across the array, using all the SSDs evenly and providing perfect wear leveling. Even if the same logical block address (LBA) is repeatedly written by a host computer, each write is directed to a different location within the XtremIO array. If the host writes the same data over and over again, it will be deduplicated, resulting in no additional writes to the flash.

• **Flash-optimized Data Protection Algorithms.** XtremIO has developed patent-pending algorithms that provide the excellent data protection of RAID 6 with performance superior to any existing RAID algorithm, while demanding fewer writes to the flash to protect data. By protecting data with fewer write operations, XtremIO extends the life cycle of the flash media.

• **Static Data Placement.** When data is written to the XtremIO array, its location on disk never changes. By not relocating data, XtremIO reduces flash write cycles and increases flash endurance.

**LOWERING THE EFFECTIVE COST OF FLASH CAPACITY**

Flash storage is more expensive than hard disk based storage on a raw $/GB basis. However, because of the ability to randomly access flash media and its underlying high performance compared to hard drives, XtremIO has incorporated several innovations that make flash capacity far more cost competitive.

• **High Raw/Effective Capacity.** XtremIO’s array requires very little capacity overhead for data protection and metadata space. XtremIO arrays do not require spare drives that consume space and power, yet are only used for rebuilds. XtremIO arrays maintain their performance even as capacity utilization vastly exceeds the levels where typical arrays degrade. And XtremIO delivers its performance with minimal capacity overhead; not requiring mirroring schemes (and their associated 50% capacity overhead) in order to achieve the best performance. Perhaps best, with XtremIO there is no “stranded capacity” resulting from over provisioning drives to achieve performance levels. Capacity utilization on XtremIO is consistently high.

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<th>Capacity Overhead</th>
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XtremIO requires far less capacity overhead for data protection, metadata storage, snapshots, spare drives and performance, leaving much more space for user data. This lowers the cost per usable GB.
• **Data Reduction.** With data reduction, XtremIO’s effective system capacities can expand from 5:1 to over 30:1. Thus the effective logical capacity of a single X-Brick building block can be much more than it’s nominal flash capacity in environments that contain highly duplicate information, such as virtualization.

• **Thin Provisioning.** All volumes in the XtremIO array are thin provisioned, allowing capacity purchases to be deferred from the time of provisioning until the time data is actually written to the array. This increases the utilization rate of the storage system.

• **Space Efficient Snapshots.** XtremIO’s snapshot implementation is entirely metadata driven and leverages the array’s deduplication to ensure that data is never copied within the array. Thus many snapshots can be maintained without impacting performance or consuming space.

**PERFORMANCE & SCALABILITY**

XtremIO’s array architecture is specifically designed to deliver the full performance potential of flash, while linearly scaling all resources such as CPU, RAM, SSDs, and host ports in a balanced design that allows the array to achieve any desired performance level, while maintaining consistency of performance that is critical to predictable application behavior.

• **Scale-out Design.** While an XtremIO array may begin with a single X-Brick building block, the system can be expanded with additional X-Bricks. When the system expands, resources remain balanced, and data in the array is distributed across all building blocks to maintain consistent performance and equivalent flash wear levels. Performance scales linearly as building blocks are added and latency remains consistently low.

• **Low-latency Cluster.** XtremIO storage processors communicate with each other over a high-speed, ultra-low latency interconnect. This is crucial to the operation of the system, allowing data to be placed anywhere to ensure performance load balancing and consistent wear leveling of the flash.

• **Flash Drive Fault Handling.** XtremIO storage processors can dynamically route data around slow or failed SSDs. When an XtremIO storage processor detects a “hiccup” they can simply place data elsewhere, avoiding the problem. XtremIO arrays always deliver performance, flash endurance, and consistency that other designs cannot match.

**OPERATIONAL EFFICIENCY**

A high performance storage array is of limited value if it is complex to install, set up, tune, and maintain. XtremIO storage is just the opposite. It can be deployed quickly since XtremIO has taken great care to remove complexity from the administrator and make high performance easily accessible without expert knowledge.

• **Simple Setup** – Configuring an XtremIO array is as simple as creating volumes of the desired size and mapping them to hosts. None of the typical storage system parameters are required. There is no need to define which disk drives go into RAID groups, select a RAID level, choose a stripe size, create an aggregate volume, or any other such task.

• **No Tuning** – XtremIO storage simply performs out of the box. There is no need to ever think about how many spindles will be needed to achieve performance, restripe the storage, engineer around hot spots, think about caching or tiering, or other common practices to maintain application level performance over time.

• **High Performance Density** – XtremIO delivers high IOPS per rack unit and has a small data center footprint.
• **Low Power Consumption** – SSDs consume much less power than hard drives while delivering many times the performance. A single XtremIO X-Brick building block delivers hundreds of thousands of IOPS with 750W of power consumption.

**ADVANCED STORAGE ARRAY FUNCTIONALITY**

XtremIO has examined every facet of storage system design to bring new capabilities to traditional storage functions by leveraging the random access nature of flash storage.

• **Thin Provisioning.** XtremIO storage is natively thin provisioned using a small internal block size. This provides fine-grained resolution for allocated space from the thin provisioned capacity pool to host volumes and avoids the issues of thin provisioning “creep” and volume fragmentation over time. Furthermore, fragmentation as seen from the file system’s viewpoint on the host is not a problem for XtremIO, as there is no penalty for random access. In fact, defragmentation utilities need never be run on XtremIO. The performance delivered on a thin provisioned XtremIO volume will remain consistently high over time.

• **Snapshots.** Storage array snapshots have historically been either source volume clones, copy-on-write, or redirect-on-write designs. Each has limitations with respect to reserve space required, compromises to write or read performance, and metadata overhead that causes performance to degrade over time. XtremIO’s snapshots require no reserved snapshot space, allow for the creation of immutable copies and/or writable clones of the source volume, are created instantaneously, and do not affect the performance of either the source volume or the snapshot itself.

• **VMware VAAI Integration.** XtremIO is fully VAAI (vSphere Storage APIs for Array Integration) compliant, allowing the array to communicate directly with vSphere and provide accelerated Storage vMotion, VM provisioning, and thin provisioning functionality. For example, a VM image can be cloned instantaneously (even multiple times) using XtremIO storage.

**TARGET APPLICATIONS & USE CASES**

XtremIO is suitable for any application that requires high levels of IOPS performance and/or low latency. These include analytics, business intelligence, databases, high performance computing, and virtualization. However, XtremIO is best suited for and provides the highest return on investment in the following use cases:

**Databases, Analytics, Database Development & Test:** In Oracle and SQL Server environments, it is common for multiple copies of the same database to be created so that programmers each have a development sandbox. This multiplies the amount of storage needed and places a very high I/O load on the storage system. For example, a 2TB database copied 15 times requires 30TB of usable storage, which could easily equate to 60TB or more of required capacity.

With XtremIO, the 2TB database and its 15 copies will take up only slightly more than 2TB. The copies can be created instantaneously using XtremIO’s snapshots (rather than making full copies, which is time consuming), and each copy will have the full performance potential of the XtremIO array available to it.

Furthermore, absolutely no planning or tuning is required in order to make the database or any of its snapshot copies perform well.

**Virtual Servers:** Virtual server environments create high levels of random I/O that are difficult to handle well. Furthermore, performance sensitive applications are rarely virtualized, preventing organizations from achieving the same efficiencies for these applications that they have for others.
With XtremIO, even performance sensitive applications can be virtualized. Large-scale VMware environments operate more efficiently with XtremIO’s VAAI integration. And XtremIO’s real-time data reduction consolidates storage so effectively that XtremIO flash arrays can be deployed at reasonable cost levels.

**VDI (Virtual Desktop Infrastructure):** VDI places tremendously high loads on storage systems as the I/O from virtualized desktops is aggregated and randomized by the interleaving of requests. This creates an ideal set of circumstances for XtremIO—high volumes of small, random I/O requests. Furthermore, each desktop image is highly redundant, allowing high deduplication ratios that make XtremIO very cost effective.

Beyond the performance benefits XtremIO brings to VDI, there are several other ways in which XtremIO improves the overall VDI deployment.

- XtremIO’s high performance allows desktops to rapidly suspend and resume. Suspend/resume is typically disabled in VDI deployments because the underlying storage cannot meet the heavy demands of the operation. With XtremIO, suspend/resume operations are completed in a few seconds, even when hundreds of desktops perform them simultaneously. This capability allows fewer physical servers to be deployed, since at any given time 20-40% of desktops will be suspended due to people being away from their desks, out of the office, in meetings, or on breaks.

- XtremIO’s high performance and low latency allows the amount of memory allocated to each virtual desktop to be reduced since page file operations can be supported on the SAN. This reduces the cost of each physical server, or allows higher consolidation ratios.

- XtremIO improves the VDI user experience by providing an average of 100 IOPS or more to each desktop, with the ability for the desktop to burst to thousands of IOPS as needed. Typical VDI deployments deliver only 12 IOPS per desktop.

- XtremIO’s VAAI integration allows immediate copies of desktops to be provisioned and deployed.

- XtremIO works equally well for persistent desktops and non-persistent desktops and Linked Clones and Full Cone deployment models.

**SUMMARY**

XtremIO’s 100% flash-based scale-out enterprise storage array delivers not only high levels of performance and scalability, but also brings new levels of ease-of-use to SAN storage while offering advanced features that have never before been possible. This is achieved with a competitive cost of ownership. The product architecture addresses all the requirements for flash-based storage including achieving longevity of the flash media, lowering the effective cost of flash capacity, delivering performance and scalability, providing operational efficiency, and delivering advanced storage array functionality. XtremIO delivers value in any performance sensitive environment, but is particularly powerful for database, virtual server, and virtual desktop storage. And perhaps surprisingly, in many cases XtremIO proves to be the most cost effective alternative, allowing the enterprise to enjoy the performance benefits of flash without spending more.
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