Executive Summary

High performance is a critical requirement for enterprise-class storage systems. Yet in recent years, maintaining consistent high performance for all applications over time has become especially challenging. This is because traditional storage system architectures have often failed to adapt to changing workloads and to scale performance in line with unprecedented growth rates in storage data.

With thousands of systems deployed across various industries and applications, the IBM® XIV® Storage System is a ground-breaking storage product widely recognized by users and analysts alike for its ability to provide consistent high performance in environments characterized by high data growth.

After interviewing a number of XIV customers, ESG acknowledged beyond a doubt that XIV storage delivers Tier 1 performance and availability to enterprises across industries, applications and workloads.¹

Another analyst, International Technology Group (ITG), echoes these reports, stating “XIV performance was superior to high-end arrays equipped with FC drives.”²

And according to IDC, IBM XIV is uniquely qualified for running Tier 1 enterprise application and meeting the needs of today’s mission-critical applications.³ It is able to do this through an exceptional mix of game-changing attributes and capabilities that enable high performance while minimizing the need for manual performance optimization and fine-tuning.
High performance in the XIV Storage System is enabled by:

- **Breakthrough architecture and design.** The revolutionary design of the XIV Storage System enables exceptional performance optimization typically unattainable by traditional architectures. XIV performance optimization results in superior utilization of system resources and automatic workload distribution across all system hard drives. The XIV system’s ability to maximize load distribution across all disks for all workloads, coupled with a powerful distributed cache implementation, facilitates high performance that scales linearly with added storage enclosures. And because this high performance is consistent—without the need for manual tuning—users can enjoy the same excellent performance during the typical peaks and troughs associated with volume and snapshot usage patterns, even after a component failure.

- **Resilience and self-healing.** The XIV Storage System maintains resilience during hardware failures, continuing to function with minimal performance impact. The system’s advanced self-healing capabilities allow it to withstand additional hardware failures once it recovers from the initial failure.

- **Optimized virtualization.** As virtualized storage, the XIV system is optimized for applications hosted on virtualized servers, integrating smoothly with VMware, Hyper-V and IBM PowerVM® solutions. The system tightly meshes with hypervisors, supporting APIs such as VMware VAAI to help ensure high performance for the concurrent, ever-changing workloads that characterize virtualized environments.

- **Performance management and monitoring.** XIV storage provides users with flexible performance management and monitoring options—from the ability to control the priority of performance given to applications to built-in, industry-leading management tools that facilitate administration to on-the-go monitoring capabilities via mobile devices such as the Apple iPhone and iPad.

- **Customer-validated performance.** Users attest to XIV high performance in environments with demanding application workloads, including large-scale ERP systems, virtualized server farms and email, in banking, healthcare, insurance, telecommunications, IT services and other industries.

*Figure 1: The XIV Storage System—components and connectivity*

XIV architecture helps ensure high performance. Every module includes disk drives and carefully matched amounts of processing power, cache and bandwidth to ensure that performance scales with capacity.
Defining performance objectives
A storage system must provide high performance throughout its lifetime. When choosing a system, administrators must ensure that the performance characteristics of a storage system meet their stringent objectives. The following table contains two columns: One with a list of performance goals that an administrator should consider carefully prior to choosing a system, and a second that allows readers to simply click and read how the XIV Storage System meets each objective.

<table>
<thead>
<tr>
<th>System architecture and design</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scalability</strong></td>
<td></td>
</tr>
<tr>
<td>The system is designed to scale performance as storage capacity increases.</td>
<td>Grid architecture delivers high performance</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
<td></td>
</tr>
<tr>
<td>The system offers high bandwidth that is used effectively.</td>
<td>Maximum utilization of extreme system bandwidth</td>
</tr>
<tr>
<td><strong>Hardware components</strong></td>
<td></td>
</tr>
<tr>
<td>Cost-effective hardware components provide high performance.</td>
<td>High performance with 7,200 RPM drives</td>
</tr>
<tr>
<td><strong>Elimination of hotspots and bottlenecks</strong></td>
<td></td>
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<tr>
<td>The system design prevents hotspots and bottlenecks even after addition, deletion or resizing of volumes, or as application data and usage patterns evolve over time.</td>
<td>Uniform workload distribution</td>
</tr>
<tr>
<td><strong>Caching</strong></td>
<td></td>
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<tr>
<td>Caching guarantees effective destaging and high cache-to-disk bandwidth at a reasonable price.</td>
<td>Distributed caching</td>
</tr>
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<td><strong>Solid state drive caching</strong></td>
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<tr>
<td>The system enhances performance by using solid state drives (SSDs) for caching.</td>
<td>Extended performance through SSD caching</td>
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<tr>
<td><strong>Resilience</strong></td>
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<td><strong>Upon component failure</strong></td>
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<tr>
<td>Consistent high performance is maintained, even after the failure of a drive, processors, motherboards, interconnects or other components.</td>
<td>High performance even when hardware fails</td>
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<td><strong>With snapshots and mirroring</strong></td>
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</tr>
<tr>
<td>Extensive snapshot use and mirroring do not affect high performance.</td>
<td>Snapshots without performance impact and High performance mirroring</td>
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<tr>
<td><strong>Optimization and flexibility</strong></td>
<td></td>
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<tr>
<td><strong>Optimal performance for virtualized environments</strong></td>
<td></td>
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<tr>
<td>The system integrates with hypervisors to offload host-side operations.</td>
<td>Virtualization affinity and improved VMware application performance</td>
</tr>
<tr>
<td><strong>Performance management and monitoring</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Quality of service</strong></td>
<td></td>
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<tr>
<td>The system provides easily defined priorities and assurance of quality of service for selected applications.</td>
<td>Optimizing applications with QoS Performance Classes</td>
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<tr>
<td><strong>Performance monitoring and reporting</strong></td>
<td></td>
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<tr>
<td>Performance monitoring is easy and transparent.</td>
<td>Performance monitoring</td>
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<td><strong>Proven success</strong></td>
<td></td>
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<tr>
<td><strong>Customer-validated performance</strong></td>
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<td>Numerous sites run the system in production environments and cite performance gains.</td>
<td>Customer-validated performance</td>
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Grid architecture delivers high performance

The XIV Storage System provides high performance without manual tuning as a result of its revolutionary design. This design empowers administrators by providing performance optimization that is typically unattainable with traditional storage. Performance optimization, in turn, enables superior utilization of system resources, superior workload distribution across all system drives and the freedom to employ full functionality without adversely affecting performance.

The XIV Storage System is a collection of modules—each module being an independent computer with multicore CPU processing, RAM, interconnects, disk drives and other components—that operate in parallel to service I/O. The XIV Storage System presents this collection as a large, elastic data store on the storage area network. XIV modules communicate with each other over an internal network based on InfiniBand.

Every data volume is randomly spread across all modules in the system (with up to 15 modules per rack), and the aggregate power of the entire system is available to service any application I/O when needed. The addition of modules includes an increase in storage capacity along with carefully matched amounts of processing power and cache, making the system simple to scale and reducing the need to balance and manage capacity, processing and cache.

The XIV architecture features a large number of CPUs distributed throughout the XIV grid modules, representing a powerful, scalable and cost-efficient alternative to the symmetric multiprocessing (SMP) approach used by some traditional solutions. A multicore processor from Intel Corp. powers each XIV module.

With 90 physical cores per rack (180 logical cores with Intel Hyper-Threading technology), XIV systems often have CPU power an order of magnitude higher than that of comparably priced traditional systems. High aggregate processing power enables high performance through, among other things, more efficient and intelligent caching.

Figure 2: XIV performance scales with capacity

XIV performance scales as modules and their components are added

Maximum utilization of extreme system bandwidth

Bandwidth between system components often constrains performance in traditional storage system architectures. System buses become choke points that limit throughput and scalability. By contrast, the XIV Storage System architecture features abundant aggregate bandwidth that results in high performance levels for both intermodule and intramodule communication.

Extreme bandwidth within a module

The distributed architecture of the XIV Storage System localizes operations within a single module to the greatest extent possible. For example, the data stored on the disks of a given module is cached using the RAM on that module.

Combining this with the enormous power of Intel processors and the tremendous bandwidth of the module bus results in extremely fast data operations inside the module such as data prefetching (i.e., requesting data before it is needed to increase performance), snapshot taking and data destaging (i.e., committing write operations from cache to disk).
Each XIV system module features up to 200 gigabits per second (Gbps) of CPU-to-memory bandwidth and 32 Gbps of CPU-to-disk bandwidth. This translates into a maximum system memory bandwidth of nearly three terabytes per second and a maximum disk bandwidth approaching 500 Gbps per rack. Such bandwidth allows the XIV Storage System to execute aggressive large-block prefetch operations without the back-end penalty often associated with traditional architectures. Unlike traditional modular and scale-out storage designs, XIV data never traverses a Fibre Channel loop, external bus or system backplane during prefetch or destage operations.

**Extreme bandwidth between modules**
XIV modules communicate with each other over a redundant internal network. XIV systems feature an InfiniBand network to deliver extreme bandwidth with ultralow latency. Each XIV module has 20 Gbps of bandwidth to the InfiniBand network, yielding 300 Gbps of intermodule bandwidth per XIV system rack. In addition, XIV systems employ IBM Research’s X-band protocol, which provides full bandwidth with microsecond latency.

**High performance with 7,200 RPM drives**
The XIV Storage System uses high density 7,200 RPM drives that can be dramatically less expensive per terabyte than 15,000 RPM drives. On the face of it, lower speed disks should provide lower system performance. However, XIV design enables the system to deliver Tier 1 performance levels through even distribution of data and consistent, concurrent utilization of a large number of spindles that scale to meet enterprise demands.

Individually, 15,000 RPM drives exhibit higher performance than 7,200 RPM drives resulting from their faster rotation speeds, faster average seek times and higher throughput. However, traditional solutions commonly configure the disk subsystem as a collection of small disk arrays. This approach often results in hotspots, where workloads are not distributed evenly across system disks and performance spikes must be addressed by a small number of disks.

In this situation it makes sense to use the fastest disks available so that spikes can be better absorbed. By distributing the workload over all available disks in the subsystem, XIV is able to reduce the workload to each individual disk enabling the system to absorb the spike without hitting the performance limit of any individual disk. This allows the XIV subsystem to use lower cost, higher capacity disks and still maintain excellent performance.

For XIV storage, the performance of an individual drive is not as pronounced as it is in traditional architecture solutions. The XIV system optimizes performance by maximizing the number of disk spindles that can be employed and, more importantly, the overall utilization of the disk spindles. XIV architecture distributes the I/O load across all disks, thereby eliminating hotspots and allowing the system to effectively use more spindles and reap higher performance, even from disk drives with lower rotation speeds. These factors, combined with the system’s sophisticated caching, prefetch and destaging algorithms, enable superior performance over competing systems using 15,000 RPM disks.

“XIV performance was superior to high-end arrays equipped with FC drives.”

— International Technology Group

“Performance was also reported to be more consistent and predictable than conventional disk systems, even when dealing with rapid workload growth (e.g., during quarterly closes and seasonal peaks) and unexpected spikes.”

— International Technology Group
Uniform workload distribution
Seamless accommodation of varying workloads
The XIV architecture can maintain consistent maximal performance regardless of a workload’s I/O distribution or profile. Whether peak demand is for virtual desktops, email applications or other workloads, every XIV system module and disk drive can shift accordingly in order to fully service the appropriate workload. No system configuration or management is required to accommodate such workload variation, and no form of reactive background optimization is run.

In dual controller RAID systems, frequent small changes applied to a database or application can cause an extreme shift in the I/O pattern. This may ultimately lead to hotspots and increased latency, which would be followed by a significant administrative effort to identify and solve the problem. The XIV Storage System spares administrators this chain of events by enabling all disk drives to share aggregate workload, instead of some disks being overutilized and others being underutilized.

Optimal workload distribution and no hotspots
With traditional storage architectures, application reads and writes are often concentrated on a limited, specific part of the volume, resulting in an application hotspot, which can become a storage hotspot as well, with certain disks under extreme stress relative to others. This can lead to—or hasten—disk failure.
The XIV architecture, with its even distribution of data across all disks in the system eliminates application and storage hotspots, minimizing the need for manual optimization. The XIV architecture does not use RAID groups which, in traditional storage, restrict applications to a subset of disk drives. As a result, the XIV system maintains optimal performance after new disk/module additions and even after drive or module failure. The system maintains load balancing regardless of the addition, deletion or resizing of volumes.

Uniform distribution after the addition of new modules
XIV storage maintains balanced data distribution at all times, even after modules are added or removed. Data is automatically redistributed across all modules when a new module is added. In this way, the system ensures that existing applications are not adversely impacted following the addition of new capacity. Instead, applications can take advantage of new resources in the form of additional cache, CPU and disk drives.

Distributed caching
A full XIV Storage System features hundreds of gigabytes of cache. Its caching design enables concurrent service by all cache units, resulting in higher cache-to-disk bandwidth. Each module caches data stored on its own disks, as opposed to a traditional central memory approach. The integration of cache and storage in each module enables high cache-to-disk bandwidth, paving the way for aggressive prefetching and powerful cache management.

The cache on each module operates independently of the cache on peer modules. Since the caches are independent, the XIV architecture eliminates the cache mirroring and global locking mechanisms required to maintain coherency between controllers of traditional storage systems. Instead, the system commits every application write to the cache memory of two modules before acknowledging the write back to the host.

Figure 4: Distributed caching, intermodule bandwidth and performance

Distributed and localized caching, high cache-to-disk bandwidth and InfiniBand backplane can enable high I/O operations per second (IOPS) and low latency (workload: 4 KB write hits)

The elimination of global cache locking allows for linear scalability, while the departure from global cache mirroring eliminates potential reliability problems and issues of performance degradation that are inherent in many clustered controller designs.

The XIV caching implementation also offers the combined value of large and small cache slots. The system aggressively prefetches large slots, yet can divide cached data into small-sized slots for efficient, flexible cache utilization, resulting in significant performance benefits for many applications.

Each XIV module maintains the location of all data on the system. Along with servicing reads and writes, each module dedicates CPU cycles for analyzing its stream of I/O requests and searching for patterns. Based on this analytic process, the modules send messages to each other about which partitions are likely to be accessed in the near future and should be pre-emptively fetched from disk to cache.
As workloads shift, the XIV Storage System reacts and responds accordingly to increase performance. This is possible because application data is broken into small partitions and spread across a large number of modules.

The XIV approach yields greater scalability because whenever new disk capacity is added, proportional amounts of cache and processing power are also added with the system’s interconnect, providing ample internal bandwidth to ensure that performance scales easily with capacity.

IBM XIV SSD Caching, on the other hand, brings improved performance to all applications served by the storage system without the planning complexities and resources required by SSD tiering.

Alongside intelligence, size matters, and with 6.0 TB of cache in a full rack, IBM XIV SSD Caching can provide significantly larger caching capacity than that of competing systems. IBM experience shows that, even for large databases, most activity is focused on a limited percentage of data, all of which can fit on the copious XIV SSD cache, typically with room to spare. In these cases all reads can be made from the cache, instead of from disks. This may not be the case with competing systems that offer smaller SSD cache memory.

Finally, the XIV SSD Caching design provides administrators with the flexibility to define the applications they would like to accelerate should they wish to single out particular workloads. Although by default the cache is made available to all applications, it may be easily restricted to select volumes if desired; volumes containing logs, history data, large images or inactive data can be excluded. Ultimately, this means that the SSD cache can store more dynamic data.

Furthermore, inherent redundancy allows the system to continue writing to the cache, eliminating the need for write-through mode upon module failure, even after UPS failure.

Extended performance through SSD caching

XIV Gen3 storage includes an expansion option of solid state drive (SSD) caching, which allows XIV Gen3 users to increase performance up to 4.5 times for database-like workloads.

It is important to understand the advantages of SSD caching over tiering with SSDs. Tiering with SSDs limits caching of datasets to specific applications, requires constant analysis and frequent writing from cache to disk and could involve rebalancing of SSD resources to suit evolving workloads.

Cache and carry: A caching crib sheet

- **Cache hits**: When requested data is served by the cache that already contains the desired data
- **Cache slots**: The blocks in the cache
- **Destaging**: Committing write I/Os from cache to disk
- **Prefetch**: When data is accessed or “fetched” from disk to cache before it is actually needed
- **Write-through mode**: Write operations done directly to disk without writing to cache

SSD caching gives an additional boost of up to 4.5x to XIV Gen3, accelerating access to data from all applications in the storage system.
In contrast, the XIV Storage System delivers very rapid disk rebuild due to its grid architecture. The XIV disk protection scheme uses a distributed rebuild mechanism in which all disks participate. If a disk drive fails, the system redistributes a copy of the relevant data across the system. This ensures an extremely short rebuild time—typically 39 minutes or less for a 3 TB disk under heavy load—with minimal impact on system service.

Furthermore, the overhead of the rebuild process is minimal since all disks participate in the rebuild. In other words, instead of writing to one disk that is rebuilt—leading to bottlenecks—XIV storage rebuilds data by distributing the work among a large number of non-affected disks (e.g. 179 disks in a full system). Rapid rebuild occurs since each one of these many disks needs to rebuild only a small portion; moreover, only data—not empty space—is rebuilt.

Finally, the system serves I/O operations during the rebuild process by reading the secondary copy. There is no need for any RAID calculations, and the XIV system’s protection scheme ensures that even while a rebuild is in progress, read requests are served with minimal performance impact.

High performance even when hardware fails

In many storage systems, including those classified as Tier 1 solutions, performance levels often degrade significantly when a hardware failure occurs. This is unacceptable in today’s data centers as reduced performance levels can impact service level agreements and degrade the user experience.

The XIV Storage System is designed to avoid such situations and to avert the consequences associated with hardware failure in traditional storage architectures.

Disk failure

In traditional storage systems, data redundancy mechanisms typically employ RAID approaches to help cope with failures that could result in data loss. In addition, one or more spare drives are allotted to replace drives that fail and to restore redundancy, a process called rebuild.

Disk rebuild time on traditional RAID systems that used to take several hours has increased dramatically as individual disk drive capacity has grown to multiple terabytes. During rebuild time the system can suffer from significant performance degradation due to the heavy I/O demands of the rebuild process focused on a small number of components.

In contrast, the XIV Storage System delivers very rapid disk rebuild due to its grid architecture. The XIV disk protection scheme uses a distributed rebuild mechanism in which all disks participate. If a disk drive fails, the system redistributes a copy of the relevant data across the system. This ensures an extremely short rebuild time—typically 39 minutes or less for a 3 TB disk under heavy load—with minimal impact on system service.

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Module failure
Module failure can seriously affect the performance of storage systems. Typical storage systems include a dual controller to ensure redundancy and availability. While availability is maintained when one controller fails, half of a system’s computing power dissipates with it. In contrast, when one XIV module fails, only one-fifteenth of a full system’s computing capacity is lost, and, as demonstrated above, the data on the module can be rebuilt rapidly.

Cache failure—a common by-product of module failure—is an acute issue that can impinge on performance. High-end storage systems typically acknowledge a write to the host only after the write is committed to two independent cache units. This is done to mitigate the risk of data loss in the event of cache failure. Additional protection of caches through redundant power supply units is also common.

In cases where one cache fails, many storage architectures cannot utilize the remaining cache. Administrators usually address cache failure by resorting to a write-through mode in which a host is acknowledged only after the information has been written to disks—rather than a cache. This mode has a severe impact on performance and usually means a slowdown or stoppage of service to the application.

The XIV Storage System never uses write-through mode. With the system’s massively parallel architecture, even after the failure of a module, a write request is written to the cache in two different modules.

Snapshots without performance impact
Many storage systems can provide high performance as long as snapshots are not defined. This is because inefficient snapshot implementation can lead to significant performance degradation. Some systems solve this problem by using full copies instead of differential snapshots or limiting the number of snapshots.

The XIV Storage System supports snapshots as a built-in feature. Innovative snapshot algorithms and massive CPU and cache power result in exceptionally high performance even with snapshots. Here’s how:

- The traditional copy-on-write technique is replaced by a highly efficient redirect-on-write technique that minimizes disk I/O.
- The redirect-on-write process is always performed within the same module where data is being copied, providing a huge performance boost over traditional models where data is copied between controllers.
- Snapshot write overhead does not depend on the number of snapshots or volume size.
High performance during mirroring

Enterprise-class data replication demands powerful asynchronous mirroring to accommodate low recovery point objective (RPO) mirroring requirements without impairing overall application performance. With the XIV Storage System, high performance during mirroring is made possible by the following:

- **Memory utilization.** With snapshot-based asynchronous mirroring, high performance is strongly tied to the system’s ability to read replicated data from memory rather than from disk. This minimizes disk access required by snapshot-related operations. The XIV Storage System maximizes memory utilization for asynchronous mirroring replication and minimizes disk access. Asynchronous mirroring is extremely efficient, replicating only actual data changes to maximize the network bandwidth available for mirroring applications.

- **Offline initialization.** This feature reduces mirroring initialization time and maximizes available network bandwidth for noninitialization replication traffic, resulting in pronounced performance gains through low-bandwidth mirroring links.

- **Multiple target connectivity.** XIV support for multiple target connectivity enables organizations to harness expanded connectivity bandwidth for mirroring instead of requiring all mirroring traffic to pass through a dedicated line.

**Figure 6: High performance during mirroring**

Mirroring impacts performance minimally even at long distances (workload: 4 KB database objects, 70 percent reads, 30 percent writes with 50 percent reads being cache hits)

- **Replication throttling.** XIV Storage Systems can examine the bandwidth and I/O latency of the mirroring link and send I/Os based on the estimated available bandwidth and latency. This allows the system to deal effectively with fluctuating bandwidth and to minimize potential replication disruptions that may degrade performance.
Virtualization affinity and improved VMware application performance

The XIV Storage System is virtualized storage and, therefore, has a special affinity for virtualized server environments and their concurrent, ever-changing workloads. Applying massive parallelism to diverse I/O streams, the XIV system delivers high performance for VMware vSphere, Microsoft Hyper-V and IBM PowerVM, as well as Xen, IBM z/VM® and ViOS for IBM Power Systems™ and the applications supported by these environments.

XIV storage and VMware offer particularly tight integration, and XIV storage fully supports VMware vStorage APIs for Array Integration (VAAI) to enable significantly improved scalability and performance for VMware applications. XIV support for VAAI includes:

- **VAAI hardware-assisted locking.** Allows selective locking of blocks in use and replacement of the SCSI-2 lock/reservation in a VMware Virtual Machine File System (VMFS). This prevents the locking of all the virtual machines during any operation that affects the data store (e.g., VM creation or deletion).
- **VAAI block zeroing.** Enables the offloading of block-level write operations within VMware Virtual Machine Disks (VMDKs) such as pre-zeroing blocks to yield dramatic performance improvements when provisioning a new virtual machine. The storage array receives a command to zero the block and update the metadata only, thus avoiding the potentially large workload that would have resulted if the block were not zeroed.
- **VAAI full copy.** Allows the offloading of copy operations from VMware ESX to the storage array. This facilitates virtual machine deployment by cloning a virtual machine template. The storage array will receive a command to perform the operation and will report back when the operation is complete. Such support leads to a considerable boost in system performance and rapid completion of copy operations, as well as minimized host processing and network traffic.

Optimizing applications with QoS Performance Classes

XIV Storage System resources constitute a virtualized environment that is shared by hosts and applications. The XIV approach can help ensure high performance for multiple applications with similar performance objectives as a result of the distribution of resource allocation.

When it comes to application performance, the XIV Storage System goes one step further. In environments with applications that have different performance objectives, the XIV Quality of Service (QoS) Performance Class feature helps users allocate processing power to specific hosts/applications:

- A host can be assigned to one of four Performance Classes. These classes are independent of the classes (groups) used for clustering.
- An independent maximum bandwidth threshold and a maximum I/O limit are defined for each Performance Class.
- By default, the host is not assigned to a Performance Class. The performance of such hosts is not restricted in any way.
Traditional storage solutions try to accommodate multiple application performance levels through tiering approaches that result in heavy movement of data in the background while the system may struggle to keep up with prioritized applications. This often results in a severe performance penalty.

The XIV QoS Performance Class feature imparts the same benefits of storage tiers without the need for data movement in the background. This enables the system to easily accommodate prioritized allocation of resources without the dramatic performance penalty associated with normal tiering or data migration approaches, maximizing processing power for applications that require high performance levels.

**Performance monitoring**

Unlike competing systems, XIV Storage Systems provide performance monitoring and reporting that is an inherent part of the system. External tools and add-ons are unnecessary with up to a year’s worth of data being stored in the system. This reduces the workload of an administrator who needs to monitor and understand system performance on an ongoing basis.

The XIV Storage System features comprehensive and user-friendly reporting of performance statistics. The easy-to-use GUI offers a clear and rich overview of the system’s performance that novice and seasoned administrators alike can appreciate.
The system facilitates reporting of read/write hits, misses and I/O size, filtered by specified components such as host, host port and volume. It also streamlines review of performance associated with mirrors and performance classes. And for administrators who would like to monitor XIV on the go, XIV offers anytime, anywhere performance monitoring via mobile devices such as the Apple iPhone and Apple iPad.

**Customer-validated performance**

Numerous customers have confirmed that the XIV Storage System provides consistent high performance. Below are case study examples reflecting the exceptional power and performance enabled by the XIV architecture and experienced by a multitude of customers around the world.

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**Enhancing performance with VMware**

*Leading professional services firm*

- Increases performance 300 percent, with 24x7 availability
- Provisions new storage within 30 minutes
- Integrates with VMware for an end-to-end solution

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“Initially, we thought the claims IBM was making about the XIV system were too good to be true—but then we saw it deliver a 300 percent improvement in performance.”

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**High performance with SAP**

*Large manufacturer of end-to-end customer solutions*

- The XIV Storage System achieved 65,000 IOPS, well exceeding the requirements and provided ample headroom for future growth
- Response times for end users were reduced from 4 to 5 seconds to less than two seconds
- The SAP system refresh (SAP Cloning) that had required eight hours is now completed in just 15 minutes
- SAP batch jobs run concurrently, rather than having to be scheduled according to disk array performance
- Backup time has been reduced by 50 percent
- Storage pools can be expanded rapidly, with no downtime

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“Since switching to IBM XIV as our exclusive SAP production storage platform, we have been able to achieve a significant performance increase in effective IOPS under load compared to our previous storage platform.”
Conclusion

With the unprecedented growth in organizational storage requirements and flat capital and operational budgets, IT departments face a gamut of challenges in managing their storage infrastructures. The breakthrough architecture and power of the IBM XIV Storage System are helping to address these challenges by providing the predictable and consistent high performance that enterprise-class applications require. Beyond driving superb performance, the XIV architecture eliminates the need for frequent and time-consuming performance tuning, thus reducing the burden on already-stretched IT resources.

XIV users have confirmed that achieving high performance across applications without having to constantly fine tune the system is invaluable, signifying a true breakthrough in the world of enterprise storage. It is no wonder, then, that a growing number of the world’s largest enterprises have chosen the XIV Storage System to support their extremely challenging application performance requirements.

For more information

To learn more about IBM XIV Storage System, contact your IBM representative or IBM Business Partner, or visit: ibm.com/xiv

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Somers, New York 10589

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Actual available storage capacity may be reported for both uncompressed and compressed data and will vary and may be less than stated.

4. Results were achieved in an OLTP workload test with 70 percent read, 30 percent write and 50 percent read hit operations. Results may vary depending on operating environment.