Blue skies for your cloud
with IBM XIV storage

IBM

Contents

Executive summary

Clouds are all the rage these days. Call it hype, but look again. The benefits of cloud computing are increasingly proving themselves in deployments in just about every sector. IDC has found abundant compelling reasons why organizations are adopting cloud solutions, among them: to improve IT infrastructure utilization, boost operational efficiency and decrease capital spending.[1]

This white paper focuses on storage as an essential cornerstone to a private cloud environment and proposes the key elements to successful implementation. It describes the IBM® XIV® Storage System as a highly strategic general purpose storage solution for private cloud environments, as well as an essential component of the IBM private cloud portfolio.

This paper also highlights, through documented customer cloud stories, how XIV storage lends itself to easy creation of a well-balanced cloud ecosystem and how its proven attributes of powerful virtualization, performance, and elasticity, and advanced features, help in accelerating implementations and meeting tenant service level goals while minimizing costs.

Cloud computing for protected shared resources

The definition of cloud computing, which differs across the IT industry, has been finely tuned by the US National Institute of Standards and Technology as follows:

"Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

Key cloud objectives

Why a cloud? Organizations have several objectives when driven to implement a private cloud or purchase cloud services, among them:

- Reduce IT complexity, development and costs by outsourcing IT systems and services
- Accelerate the realization of results and gain immediate access to resources using implementation-ready delivery models
- Enable re-focus on the core business by offloading specific IT overhead
- Reduce the risk inherent in large-scale IT management
- Achieve economies of scale through resource consolidation
- Enable end-user self service
- Scale workloads quickly and smoothly without complex overhead or costly development

The bright forecast is "cloud"

Reports indicate that 84 percent of cloud users are experiencing reduced costs when moving applications to the cloud.[2] With such compelling advantages, small wonder that CDW predicts that 34 percent of company IT budgets will be allocated to cloud services by 2015.[3] In describing infrastructure-related cloud computing, Gartner states, "This is a rapidly evolving market that represents the transformation of IT infrastructure over 10 to 20 years."[4]

It's worth pausing for a moment to review the different kinds of cloud services that are taking shape in this evolving space.

Models for delivering ready resources

Cloud services are typically defined by a spectrum of delivery models—from basic infrastructure to turnkey services.

Infrastructure as a Service (IaaS)

In the Infrastructure as a Service delivery model, organizations outsource computer equipment to support their operations, including servers, storage, networking components and other hardware. The service provider owns, houses, operates and maintains the infrastructure.

Platform as a Service (PaaS)

The PaaS model offers a complete environment to develop and deploy applications, including hardware and software, such as operating system, hosting services, database services and application program interfaces. This model frees up application developers from infrastructure management, letting them focus on business logic and configuring applications.

Software as a Service (SaaS)

In the SaaS model, customers have complete ready-to-use application functionality, without application development or maintenance overhead. The user is unaware of the underlying hardware and software or its location. SaaS offers the most expedient time to results, but application flexibility can be limited.

Seeding the cloud: Storage

Storage is a key component in a cloud computing foundation —and not just any storage, but storage capable of integrating effectively with virtual server technologies. A recent IDC survey confirmed that after server virtualization, storage virtualization is the technology that plays the most critical role in deploying a private cloud.[5] Storage plays a role in a complete cloud solution by serving specific purposes:

- **General purpose storage:** Multi-purpose on-line data storage for day-to-day or periodic use
- **Archive and records management:** Available and recoverable long-term immutable data retention supporting compliance and litigation
- **Data protection:** Data replication, backup and restore for business and data continuity
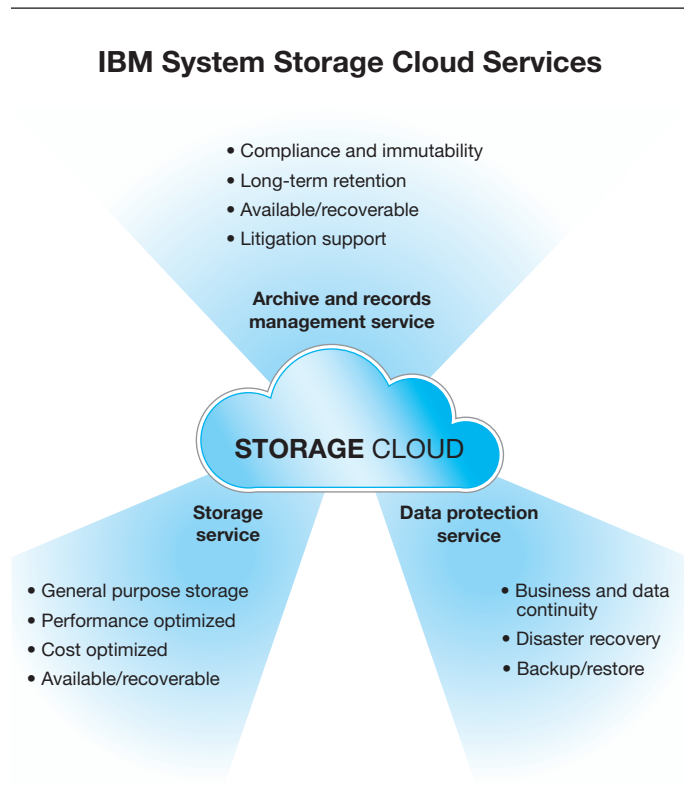
IBM System Storage Cloud Services

- Compliance and immutability
- Long-term retention
- Available/recoverable
- Litigation support

Archive and records management service

STORAGE CLOUD

Storage service

Data protection service

- General purpose storage
- Performance optimized
- Cost optimized
- Available/recoverable

- Business and data continuity
- Disaster recovery
- Backup/restore

Figure 1: Storage serves multiple purposes within a cloud environment.

Storage requirements for the cloud

Any cloud, regardless of its intended use, has the same requirements of the storage layer—derived from the previously cited definition of cloud computing—namely:

- Effective resource sharing
- Optimized interoperability with virtualized servers
- Simple, rapid provisioning
- Simple, automated management
- High elasticity for transparent scaling and service to on-demand requests
- High availability and robust data protection to help promote business continuity
- Comprehensive reporting and flexible integration with billing and chargeback systems

Why XIV storage is an excellent fit for cloud environments

The IBM XIV Storage System is a high-end general purpose disk storage series with a revolutionary design that is an ideal match with cloud delivery models. Its massively paralleled grid architecture allocates system resources evenly at all times and scales performance with capacity, transparently providing the elasticity so critical to cloud infrastructures.

The XIV series offers highly affordable storage suitable for even the most demanding and highly fluctuating workloads, providing tier 1 consistent high performance and high reliability at tier 2 costs. The system scales seamlessly without the need for complex, time-consuming tuning, provisioning or configuration.

Figure 2: IBM XIV Gen3 Storage System.

Providing exceptional levels of integration with cloud platform technologies, such as VMware server virtualization solutions and IBM Tivoli® products, XIV storage offers outstanding agility for accommodating growth. The XIV system sets a new standard for ease of use with benchmark enterprise storage manageability, including the automation of most tasks and a highly intuitive user interface that is customer-acclaimed for its simplicity.

Effective resource sharing

Predictable performance with heterogeneous workloads
Storage in the cloud is shared between diverse systems, supporting numerous tenants—each unaware of the others. Each cloud customer has a service level agreement (SLA) that defines the performance, quality and other standards with which the cloud provider must comply—regardless of service level commitments to other tenants.

XIV storage provides consistent and predictable performance for heterogeneous workloads that allows the sharing of storage resources without impact across users. The XIV system supports a wide range of simultaneous workload needs, from capacity-hungry to ultra-high performance. These features translate into more effective resource consolidation and reliable scalability. Inherent load balancing of all system resources (such as CPU, cache and disk) gives the XIV system a powerful ability to meet diverse SLAs, even as workloads fluctuate in the dynamic cloud environment and evolve over time.

Quality of Service (QoS)

A major challenge for cloud providers is to share a huge pool of resources on demand according to each contracted service level while preventing the heavy loads of some customers from affecting others.

The XIV Quality of Service feature places bandwidth limits on each storage volume to ensure that extreme loads on some volumes don't starve or degrade performance for others. Enabling total customer control over QoS parameters, XIV storage simultaneously supports multiple lines of service, promoting effective and efficient managed services for storage.

Motionless tiering for RAID-free virtual prioritization

With traditional storage tiering technologies, not only do high-performance disk systems require expensive outlays, they also demand precious processing power, overhead and time to physically move data to the appropriate tier.

The groundbreaking IBM XIV architecture enables tier 1 storage performance using commodity disk drives. To manage the priority of specific data volumes, the XIV system provides "motionless" storage tiering—highly efficient virtual storage prioritization without the need to copy or move data. In addition, upgraded quality of service and lowered priority are effective immediately, obviating the need for financial outlays and bulk data movement, and eliminating performance impact.

Virtualization for demanding dynamic environments

The cloud computing resource-sharing model uses large pools of virtual servers and storage, requiring tight integration between servers and storage. IBM XIV storage supports numerous hypervisors, including VMware, IBM PowerVM™, Microsoft Hyper-V and Xen. With its inherent design and certified VMware interoperability, XIV storage is the ideal storage-architecture complement to VMware platforms.

Storage architecture for agile virtualization

All too often organizations deploying server virtualization don't take into account the storage that underlies their virtual IT systems. The resulting challenges quickly become evident in the form of unevenly distributed workloads, performance degradation and compromised reliability.

The XIV architecture inherently lends itself to optimizing server-storage environments. Native XIV features, detailed below, bring powerful performance, consolidation and scalability value to the dynamic system environments that virtualization typically demands.

Robust XIV storage integration with VMware

The XIV Storage System provides best-in-class virtual storage architecture for virtual servers. The combination of its optimal resource use and hotspot-free server-storage performance makes for exceptional synergy with the VMware server infrastructure and products. Inherently promoting optimized server-storage environments, the XIV architecture leverages the range of interoperability features provided by VMware, delivering the following features for cloud virtualization:

- Storage capability transparency to support policy-based storage deployment—via a provider for vSphere APIs for Storage Awareness (VASA)
- The ability for VMware administrators to manage and provision storage through a VMware vCenter plug-in, with controlled storage delegation
- Improved VMware performance and scalability with vStorage API for Array Integration (VAAI) hardware support
- Automated storage replication and failover functionality via the XIV Storage Replication Adapter (SRA) for VMware Site Recovery Manager (SRM)

In order to balance workloads across multiple storage systems, administrators can use VMware Storage vMotion to manually move virtual disks nondisruptively from one physical XIV Storage System to another.

XIV storage: Proven Hyper-V cloud integration
The XIV Storage System is a foundation of IBM's contribution to the Microsoft Hyper-V Cloud Fast Track Program, a joint effort between Microsoft and its OEM partners to help organizations accelerate the development and implementation of private clouds. This program provides a proven, end-to-end, ready cloud solution based on Microsoft Hyper-V server virtualization, IBM XIV virtualized storage and other essential technologies. This modular, extensible and flexible format can help optimize value, to ease deployment as well as administration, support and expansion. The integration, provisioning and management are performed centrally by Microsoft System Center Virtual Machine Manager (SCVMM).

Instantaneous copying for ready-to-use storage
To keep up with dynamic cloud demands, the cloud environment needs to enable the provisioning of fully functional virtual machines in a very short timeframe. The virtual machine must include the operating system and business applications installed and ready to go. XIV Volume Copy instantaneously creates a full volume replica. By cloning a template volume previously installed, XIV storage enables immediate provisioning of virtual machines and applications.

Minimal management to save time and effort
In-balance virtualized capacity with no tuning required
Resource virtualization promotes cloud objectives of achieving a low-touch system that maintains and manages itself while maximizing resource utilization.

In PaaS and IaaS cloud models, the cloud provider typically does not have visibility into the specific usage of the storage or business application. Therefore, the provider cannot tune storage for specific application needs, fluctuations in demand, or other variables, which can cause suboptimal application performance.

The autonomic XIV Storage System is always optimally tuned by design; it automatically maintains optimal performance with no tuning or management throughout an application's lifetime, regardless of workload growth or fluctuation.
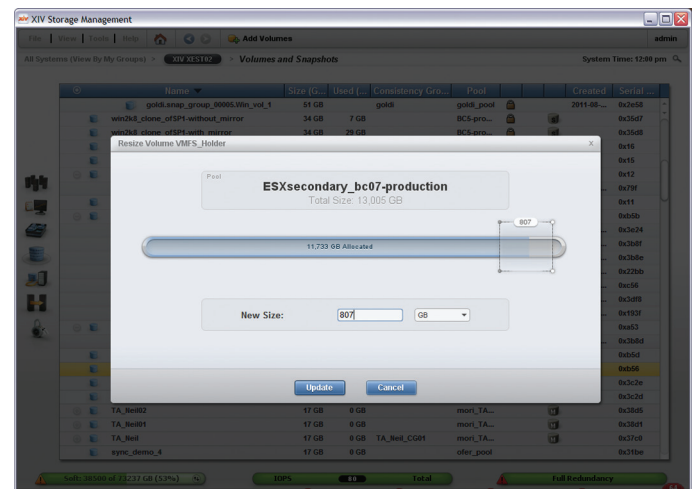

Figure 3: IBM XIV storage provides effortless provisioning with GUI-based volume resizing.

Rapid storage provisioning and decommissioning
Due to its dynamic nature, the cloud environment should enable simple, rapid self-service provisioning and decommissioning of virtual servers and their associated storage volumes. For most storage systems, the tasks of provisioning new LUNs, adding them to host clusters and decommissioning resources are relatively complicated, non-automated and time-consuming, and performed by trained technicians. This approach often does not keep pace with the dynamic demands, minimal intervention and maximized economies of scale required with cloud management.

The XIV Storage System can provision and decommission storage almost instantly with no configuration effort, making storage immediately available to new and existing virtual machines in the cloud, while automatically ensuring optimal storage array load balancing. With this immediate resource availability, organizations can cut their implementation times and maximize resource utilization, achieving results more quickly and preventing unnecessary additional storage investments.

Thin allocation for conservative capital outlays
Disk storage supports multiple concurrent cloud consumers. In many cases, customers request or reserve more disk space than actually needed. Supplying the capacity requested by each tenant—with breathing room—can require a major investment in storage hardware that will never, in fact, be utilized. In this case, thin storage allocation can prevent major over-investment in storage, helping keep storage acquisition in line with actual usage.

The XIV Storage System inherently allocates data "thinly," using physical capacity only when the data is actually written. This ensures that space allocation facilitates rather than hinders system elasticity. The XIV system also offers built-in thin provisioning, which cloud providers can leverage to create and provision virtual volumes that are larger than the actual physical storage to fulfill the demands of all cloud users.

Automatic reconfiguration that preserves performance and capacity utilization
In traditional storage systems, frequent configuration changes often have negative side effects—reducing performance and wasting capacity. The XIV grid architecture is designed to handle rapidly evolving environments, retaining great performance and using storage capacity efficiently, and helping maximize effective resource usage.

Cloud product integration for maximum functionality and efficiency
IBM XIV storage is a keystone in the comprehensive private cloud offering by IBM, which includes:

Hardware
- **IBM Power Systems™:** Enterprise servers and software
- **IBM XIV Storage System series:** High-end disk storage with exceptional performance, TCO and ease of use
- **IBM SAN Volume Controller (SVC):** Simplified and centralized storage infrastructure management
- **IBM Scale Out Network Attached Storage (SONAS):** Scale-out storage featuring IBM Active Cloud Engine file management
- **IBM ProtecTIER®:** Data deduplication
- **IBM backup and recovery systems**

Software
- **IBM PowerVM:** Robust server virtualization
- **IBM Tivoli storage software family:** Tivoli Storage Manager, Tivoli Storage FlashCopy® Manager, Tivoli Storage Productivity Center and Tivoli Usage and Accounting Manager

CIBER creates a next-generation IT infrastructure solution

CIBER Managed Services GmbH built a dynamic cloud infrastructure for SAP landscapes, based on a combination of IBM server, storage, database and system management software. The new storage infrastructure, which consists of the IBM XIV Storage System and IBM SAN Volume Controller (SVC), offers individual service classes to suit different customer needs, maximizing operational efficiency and minimizing expenses. The SAP application landscapes run on both IBM Power Systems servers and IBM System x® blade server technologies. See case study.

Benefits:
- Ability to provide faster and more flexible and scalable SAP hosting services to businesses, with 99.9 percent VMware-based virtualization and improved service level agreements
- Improved business continuity and higher availability even across two locations, using IBM SVC storage virtualization and the IBM XIV Storage System
- Reduced workload for IT staff through simplified setup and administration of the XIV Storage System
- Reduced operating costs with improved service quality supported by three levels of storage service classes, an integrated and virtualized storage architecture, and new server hardware
- Reduced time for provisioning and deployment of new systems from weeks to hours with the new storage solution

Elasticity for maximum agility

Scalability in capacity and performance
Typical cloud requirements dictate that storage has the ability to scale dynamically up and down according to user demands. However, downward elasticity is less common since most organizations continually add data while purging very little. On the chance that one tenant frees up capacity, it will, most likely, be swallowed up by other demand for more storage. In most cases, when more capacity is needed, scaling up by deploying additional hardware on the storage network is only part of the solution; a major issue with expanding storage is reconfiguring it to make the capacity usable.

The modular XIV architecture simplifies capacity expansion by enabling the nondisruptive addition of storage modules into the system grid. Newly added capacity is not only immediately and fully usable, the system automatically redistributes data among all modules to optimize utilization.

Performance that scales along with capacity
Capacity elasticity alone is not sufficient to satisfy cloud computing requirements. Storage for clouds must also offer consistent I/O performance as capacity grows or shrinks; if not, cloud customers will not receive their contracted service quality level.

Since every XIV module contains the computing power and necessary cache to support its capacity, the system maintains its high and consistent performance as it scales up. The XIV Storage System is scalable in all key elements, including disk capacity, interfaces, cache and CPU power, enabling system performance to grow proportionally with capacity.

This dependable scalability in resources makes the IBM XIV system low-risk storage for meeting service commitments.

Steadfast performance during virtual machine growth
In virtualized cloud environments, as the number of virtual machines per host increases, storage access increases. In conventional storage solutions, an increase in storage access typically results in degraded system performance.

The XIV Storage System is fully and automatically distributed, with random I/O optimized, advanced caching algorithms and optimal I/O levels. The system architecture dramatically reduces random seek times—offering granular and efficient caching that results in powerful performance at all times.

Technische Universität München enables cloud-ready SAP business

The University implemented a fully cloud-enabled infrastructure based on the IBM Power Systems platform that automates many administration tasks and greatly accelerates preparation for the new semester. The virtualization solution allows for a fast and flexible deployment of new SAP systems and software on IBM POWER7® and Intel processor-based systems accessing IBM XIV Storage System. See case study.

Benefits:
TU München can provision a new server in 30 minutes (a 90 percent reduction) and provision a new SAP instance in less than half a day. Data was migrated to the XIV storage systems, resulting in balanced performance and capacity utilization as well as simplified management. The University replaced 150 Sun servers with two IBM Power® servers and two IBM BladeCenter® systems, cutting 13 full racks to four half-racks, a savings of 85 percent, and cut energy usage by around 80 percent. Migration to IBM DB2® resulted in a database size of 63 GB, a 40 percent reduction.
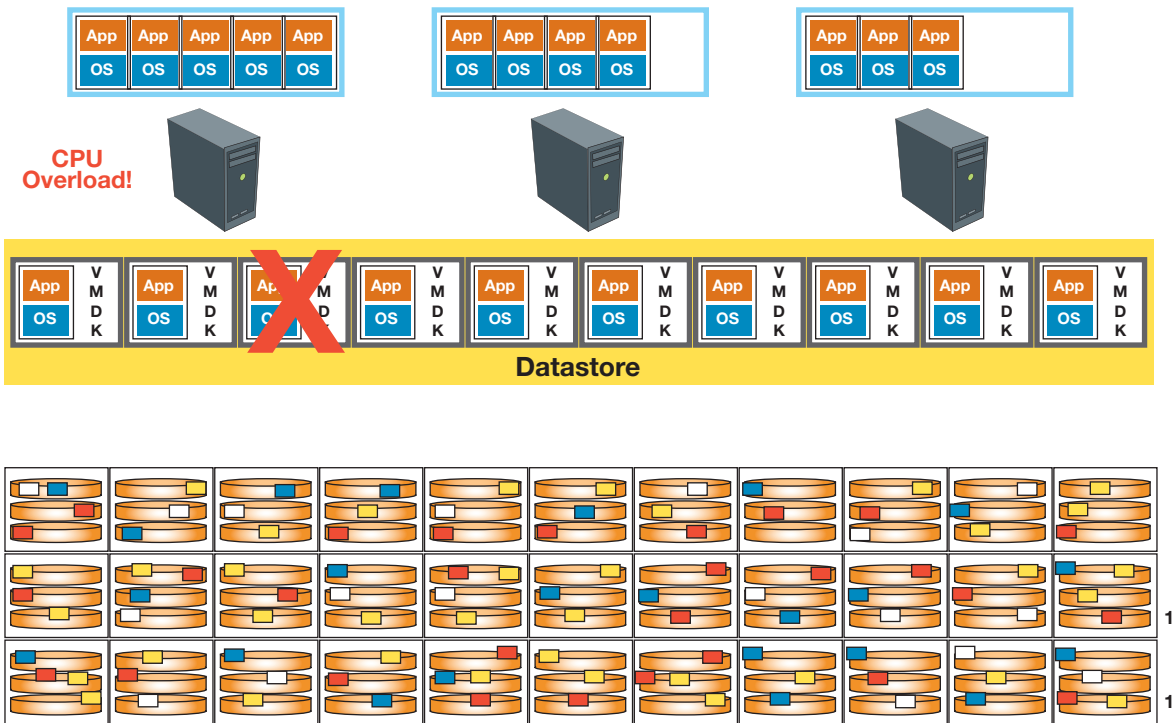
Figure 4: IBM XIV storage accommodates peak demand through optimized distribution.

Hotspot-free load balancing
The XIV Storage System is inherently load balanced at all times, actively distributing data and processing evenly across all spindles, providing hotspot-free storage that requires no tuning.

Centralized multi-system management
Cloud environments can expand to numerous XIV systems. To support this level of scalability, XIV storage provides central management for multiple systems. The ability to centrally manage local or geographically distributed XIV systems and group systems by geography or other parameters promotes flexible, efficient management, such as control over primary and disaster recovery sites.

Data protection and business continuity

Typical cloud SLAs dictate that cloud services and infrastructure are always available, with no service disruption. Traditional storage systems, which aggregate disks into RAID groups, can experience hours to days of data recovery delays and days to return to contractual performance levels following a hardware or disk failure.

The XIV cloud solution minimizes downtime and promotes rapid return to operations—perhaps the fastest in its class—which dramatically reduces impact on ongoing operations and promotes contract compliance, helping avert major risk in the event of hardware failure or disaster. Even during a disk rebuild, performance impact is negligible because all XIV disks participate in the rebuild simultaneously, effectively distributing the processing throughout the system.

Continuous availability and nondisruptive upgrades and maintenance
Unplanned outages can typically impact a larger population of tenants in cloud environments than in traditional infrastructures. Planned cloud downtime also presents major problems since it is nearly impossible to coordinate with many unrelated tenants that have different system needs. Therefore, highly available storage systems must support self-healing, hot upgrades and on-line maintenance.

To help ensure system availability during routine maintenance and hardware failures, the XIV Storage System provides:

- Nondisruptive upgrades and maintenance—with all hardware and software maintenance performed while applications are running
- Self-healing through hardware redundancy and distributed data redundancy—without human intervention—for rapid recovery with minimal performance impact
- Benchmark-speed disk rebuilds in the case of a hardware failure

Data protection and recovery to ensure business continuity
Since protecting data from loss and corruption is a fundamental cloud requirement for storage, cloud infrastructures must include snapshots, mirroring and backups, as well as rapid recovery.

The XIV system is designed for business continuity, eliminating unplanned downtime and accelerating return to operations from disasters large and small. Incorporating hardware, software and data considerations, the XIV architecture delivers:

- Best-in-class, space-saving, minimal-impact differential snapshots with service level agreement granularity
- Synchronous data replication for total data currency
- Asynchronous data replication for long-distance replication that strikes the right balance between remote data preservation and minimal impact on ongoing system latency
- Highly responsive, automatic recovery, ensuring predictable results and minimizing risk in a range of disaster scenarios

Getronics launches new pay-per-use cloud service model

Getronics' new Utility Hosting service is built on a dynamic infrastructure that employs IBM Integrated Service Management solutions for provisioning and storage management to help staff rapidly switch on and off cloud environments and proactively increase capacity as needed. See case study.

Benefits:
- Enabled the company to launch a new pay-per-use service model that differentiates it from other hosting providers
- Reduced management costs per server per year by nearly 80 percent
- Reduced time to market for new services from as long as four weeks to just a few hours

Flexible reporting, billing and chargeback features

More than a technology shift, cloud computing is about a new technology-enabled business model. Instead of purchasing and maintaining IT resources, organizations pay a fee for the necessary computing services. The most significant economic benefit of this model is the "pay-for-what-you-use" approach, in which large investments in hardware and software, and the major infrastructure maintenance effort, are replaced with dynamic payment for resources actually used. Storage resource usage is usually measured by the amount of data stored on the cloud and transferred to and from the cloud. In some cases, other usage parameters, such as bandwidth consumed may be billable as well. Typically, cloud providers use a monthly utilities-like billing model. Storage must be able to track the cloud-based usage of each customer, providing all the necessary information to the billing system.

The extensive XIV reporting and statistics tools make the data easily available for chargeback and billing purposes. Since the XIV system provides this functionality out-of-the-box, there is no need to install management services to collect the data, as typical systems require. The XIV Storage System can also export the information in a variety of formats to integrate easily with resource utilization software, such as IBM Tivoli Usage and Accounting Manager. The XIV solution curtails billing complexity, overhead and expense.
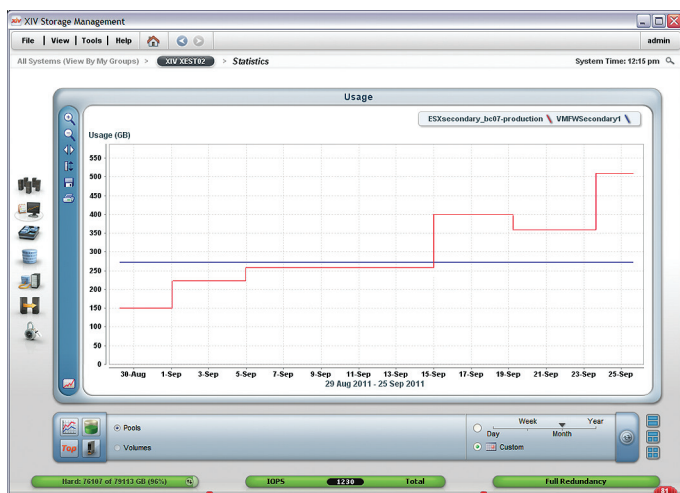
Figure 5: IBM XIV storage provides GUI-based capacity reporting for pay-for-what-you-use billing.

Conclusion: Delivering on the promise of cloud computing

Cloud computing is a strategic solution for driving cost savings and realizing results, while promoting deployment flexibility and accelerating implementations. IBM is a clear leader in cloud services, ranking as a "cloud champion" by a BTC Logic Survey.[6] IBM XIV storage, a robust component of the IBM private cloud portfolio, offers unique value to cloud environments, integrating IBM server and storage products, and value-added software such as Tivoli storage management products. It is no wonder that so many Fortune 500 companies rely on IBM cloud solutions.

The cloud-proven success of general purpose XIV storage across a variety of industries makes IBM XIV storage an essential element of an IT cloud infrastructure. Its transformational virtualized design, powerful architecture and integration with virtualized environments are ideal for any delivery model and any stage of cloud implementation. As evidenced by XIV success stories, even though the XIV series is positioned for the private cloud space, many customers are leveraging XIV storage for their public clouds as well.

An end-to-end cloud solution featuring IBM XIV storage minimizes storage management overhead, creates an agile, future-driven environment and can ensure continuous business operations, helping the organization achieve its cloud objectives and drive organizational vision and efficiencies.

About the IBM XIV Storage System series

The IBM XIV Storage System is a proven, high-end disk storage series designed by listening to customers and addressing their storage challenges across the broadest spectrum of business applications. The XIV series offers highly affordable storage suitable for even the most demanding workloads, providing tier 1 consistent high performance and high reliability, at tier 2 costs. Never compromising performance for reliability, the XIV grid architecture applies massive parallelism to allocate system resources evenly at all times and scale seamlessly, without the need for complex, time-consuming tuning and configuration. A recognized industry leader in enterprise storage manageability, the XIV system sets a new standard for ease of use by automating most tasks and providing an amazingly intuitive user interface. Its grid architecture enables performance to grow with capacity and integrates seamlessly with cloud technologies for even greater agility in accommodating growth.

The XIV Storage System has met with rapid market acceptance and success, with thousands of installations in diverse industries worldwide, including financial services, healthcare, energy, education and manufacturing. The XIV series supports a wide range of workload needs, from capacity-hungry to ultra-high performance. It integrates easily with virtualization, email, database, analytics and data protection solutions from Microsoft, IBM, SAP, Oracle, SAS, VMware, Hyper-V, Symantec and other leading applications. The XIV series plays a key role in IBM's end-to-end dynamic infrastructure solutions, integrating seamlessly with IBM ProtecTIER, SONAS, SAN Volume Controller, IBM Storwize® V7000 and Tivoli products. Customers also benefit from industry-leading IBM 24×7x365 global support and service.

The IBM XIV Storage System series offers several models, all based on the same proven XIV architecture and the same simple, cost-effective pricing approach of all functionality provided with the system software at no extra charge.

For more information

To learn more about the IBM XIV Storage System, please contact your IBM sales representative or IBM Business Partner, or visit **ibm.com**/storage/disk/xiv

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[6] "BTC Logic Ranks: Top Ten Cloud Companies," BTC Logic, Q3 2011.

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