IBM XIV Storage Systems
Enterprise Storage Reinvented

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IBM XIV Storage - Technology Profile

- Disruptive grid technology providing one virtual storage space
- More than 450 systems in production to date
  - Best TCO for Enterprise Storage: >50% savings
  - Tierless architecture implemented as tier-1 storage
- In production more than 4 years
  - More than 50 patents filed
  - Delighted and loyal customers
- For customers, this means:

Benefits:

- Next-generation storage product
- IBM integration, support and services

Why Did IBM Acquire XIV?

- IBM +50% market share of Mainframe Disk and Enterprise Tape (M/F + Open)
- IBM seeks to grow share of Open System Enterprise disk
- Part of a billion dollar strategy to displace EMC/HP/HDS in market share terms
  - In 2007 IBM shortlisted 5 Storage Technology Companies
  - XIV (founded 2002) was acquired by IBM on December 31, 2007
  - Appointed Moshe Yanai XIV CEO (father of EMC's Symmetrix) an IBM Fellow

"The XIV's innovative architecture and IBM ownership mean that it will be included on many user shortlists…"

Gartner

Information Explosion Creates Storage Challenges

How much data does mankind store?

- IDC* says about 281 exabytes in 2007
- By 2011, we'll reach 1,773 exabytes
- That's 600% growth in 4 years

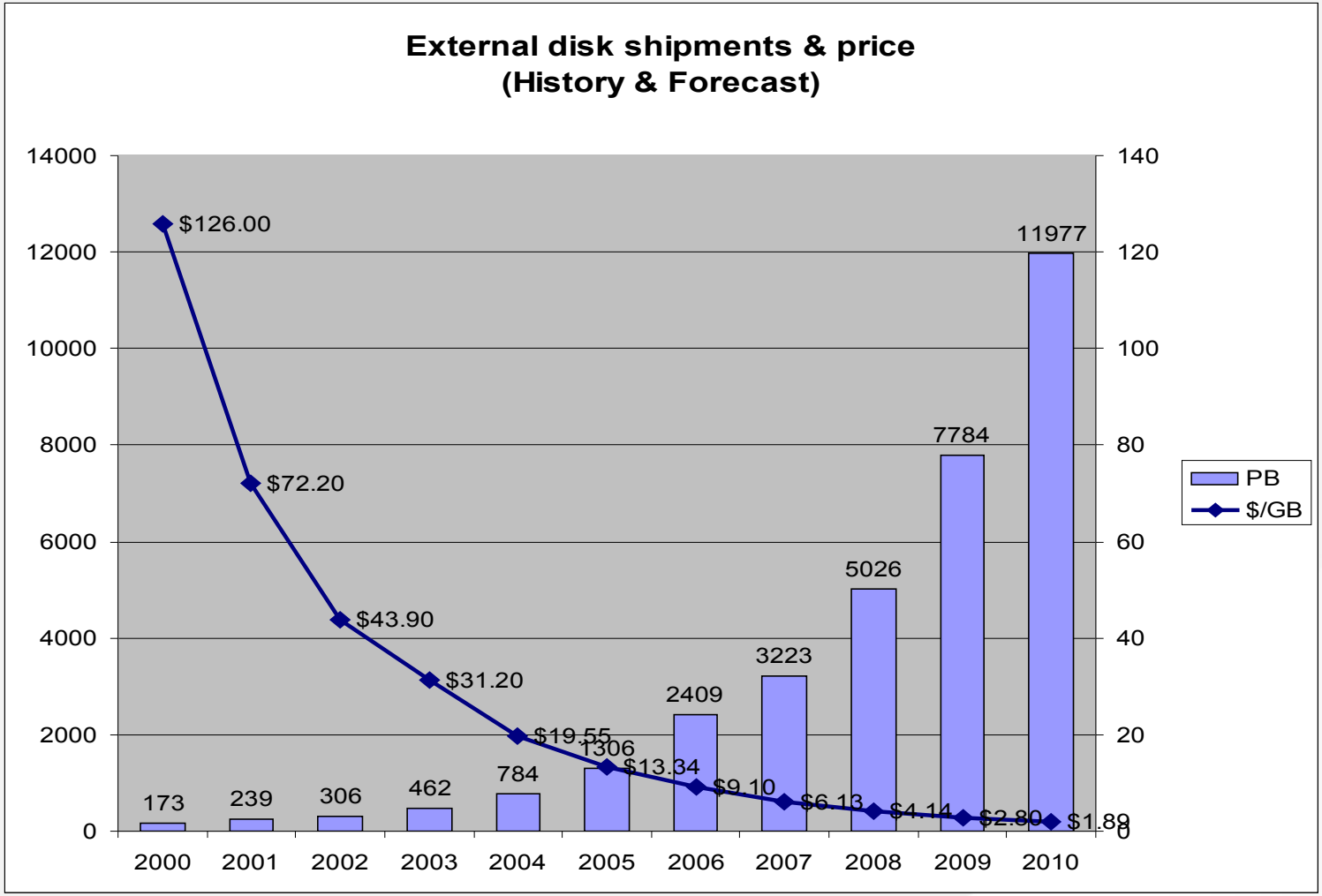
281,000 PB

XIV aims to provide a simple solution for the modern enterprise's storage needs

1,773,000 PB

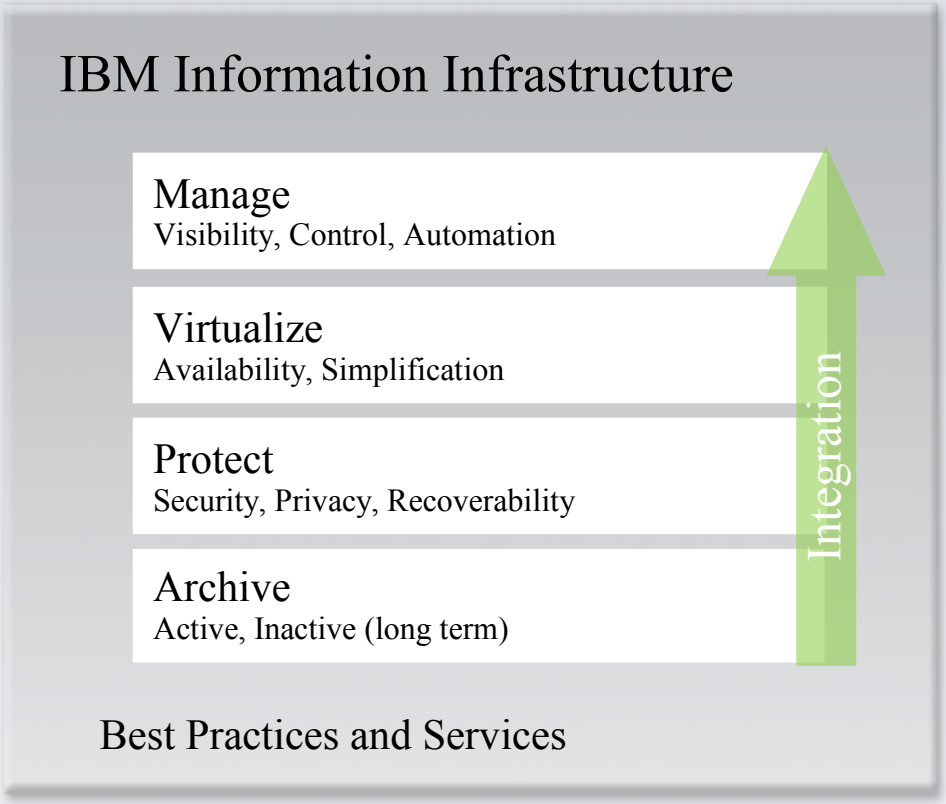
*IDC White Paper Sponsored by EMC, "The Diverse and Exploding Digital Universe", March 2008

External Storage Capacity Growth Trend



Source: IDC, 2007

A Solution From A Single, Proven Vendor – IBM



- Integrated Business Transformational Solutions
- Unified Management Software
- Comprehensive Tape, Disk and Network Hardware
- Deep and Proven Industry Expertise
- Flexible Financing Options

IBM Information Infrastructure is Complete

Intelligent Management. Protected Information. Smarter Insights.

Disk Systems
- IBM XIV Next Generation Storage
- SAN Volume Controller
- DS family of disk drives
- Solid State Subsystems

Tape Systems
- TS family of tape drives, libraries and virtualization
- Diligent VTS

Services
- Consulting
- Assessments
- Design
- Migration
- Deployment
- Hosting
- Business Partners

Storage Networking
- Switches
- Directors
- Routers

Availability Management
- IBM XIV Storage management
- TotalStorage Productivity Center
- Global Mirror, Metro Mirror
- Tivoli Provisioning Manager
- Tivoli Storage Process Manager
- IBM Systems Director family

Business Continuity
- IBM XIV unlimited snapshots
- Productivity Center for Replication
- Tivoli Storage Manager (TSM) family
- Tivoli Continuous Data Protection (CDP)
- Tape cluster grids and Peer-to-Peer
- GDOC, GDPS

Compliance and Retention
- DR550, DR550 Express, FS gateway
- Grid Archive Manager, GMAS
- TSM Space Management for Unix/Windows
- GPFS, DFSMS
- N series SnapLock™
- WORM tape support

Security
- Encrypted Media
- Tivoli Security Management family

IBM Information Infrastructure: Enterprise Disk Storage

For clients requiring:
- One solution for mainframe and distributed platforms
- Disaster Recovery
  - Across 3 sites
  - Across 2 sites > 60 miles apart
- Secure encryption

DS8000
- Supports mainframe and distributed platforms
- Global Mirroring
- RAID 6*
- Encryption*
- Optimized for Capacity > 50TB

For clients requiring:
- Distributed environment support
- Save power, cooling and space
- Future-proof capacity expansion
- Optimized capacity utilization
- OLTP and Databases (Oracle, etc.)
- Proven in Financial markets
- Exchange and Web 2.0 workloads

XIV
- Supports distributed platforms
- Simple management
- Virtually unlimited no overhead snapshots
- Thin provisioning
- Rapid capacity roll-out
- Optimized for capacity > 50TB

For clients requiring:
- IBM i support
- Distributed environment support with a focus on tier 2 cost-efficiency
- Optimized for Oracle and DB2 environments

DS5000
- Supports IBM i and distributed platforms
- Oracle, DB2 environments
- Cost efficient storage for capacity < 50TBs

For clients requiring:
- Virtualization of multi-vendor storage infrastructure silos

SVC
- Virtualizes multiple vendor environments, including IBM, EMC, HP and others

For clients requiring:
- Support for mid-range mainframe platforms

DS6000

For clients requiring:
- Support for intensive computational applications
- High performance computing

DCS9900

For clients requiring:
- NAS or File Storage support

N series

Scale Out File Storage (SONAS)

IBM XIV Storage Provides Exceptional Value

Disruptive [Grid] Technology providing one platform for all enterprise storage requirements, with self-healing and self-tuning

XIV Support Value

- Up to 80% decrease in power, space and cooling costs/TB (SATA)
- Up to 70% savings on Tier 1 storage costs (commodity components, thin provisioning, snaps, DR - all included)
- 70-80% reduction in operating cost (Virtual volume management, elimination of storage tiering, data classification and performance tuning)
- Rapid roll out of new applications (Snap Shots and Seamless migration)
- Capacity Savings – Thick to Thin Migration

Problems XIV Solves

- **Data centre power, space and cooling constraints**
- **High cost, complexity, management and risk associated with tiered storage**
- **New application time to market**
- **Virtual Server roll outs (VMWare)**
- **Database and OLTP consistent performance issues**
- **Compliance and regulatory issues by backup and archiving to Disk via high performance VTL (Diligent)**

Key Attributes for Enterprise Information Infrastructure

- **Reliability** – Business data more critical than ever, with no tolerance for downtime; requirement is now greater than 5 nines
- **Functionality** – Tier 1 functions (e.g. snap, replication, thin provisioning) that scale with no performance penalty and are inherently built-in to the architecture
- **Power and Space** – "Green", Minimize power usage, cooling and floor-space
- **Manageability** – Total system virtualization, with emphasis on ease of use
- **Performance** – Consistent performance under all conditions, eliminating hot spots and staying consistent under hardware failures
- **Total Cost** – Reasonable capital cost and minimal ongoing cost - so business can concentrate its efforts on its core and not on IT
- **Future Proofed** – Ease of volume growth and scalability of architecture supports requirements for today and tomorrow.

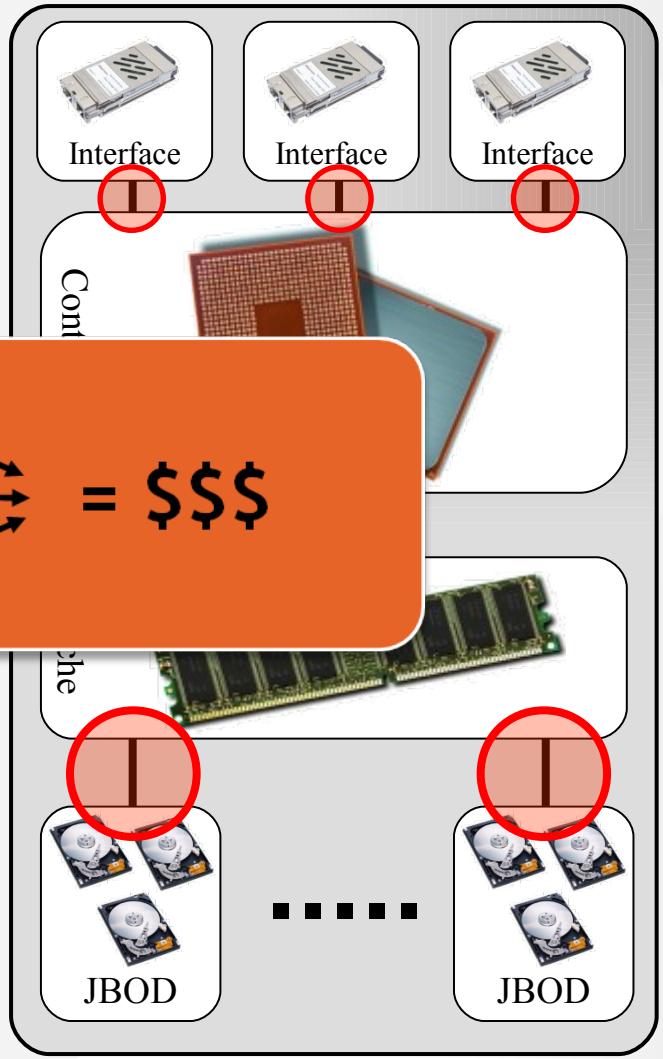
Traditional Enterprise Storage Solutions: Scale Up

Building blocks:

- Disks
- Cache
- Controllers
- Interf
- Interc

PERFORMANCE
RELIABILITY
SCALABILITY
= $$$

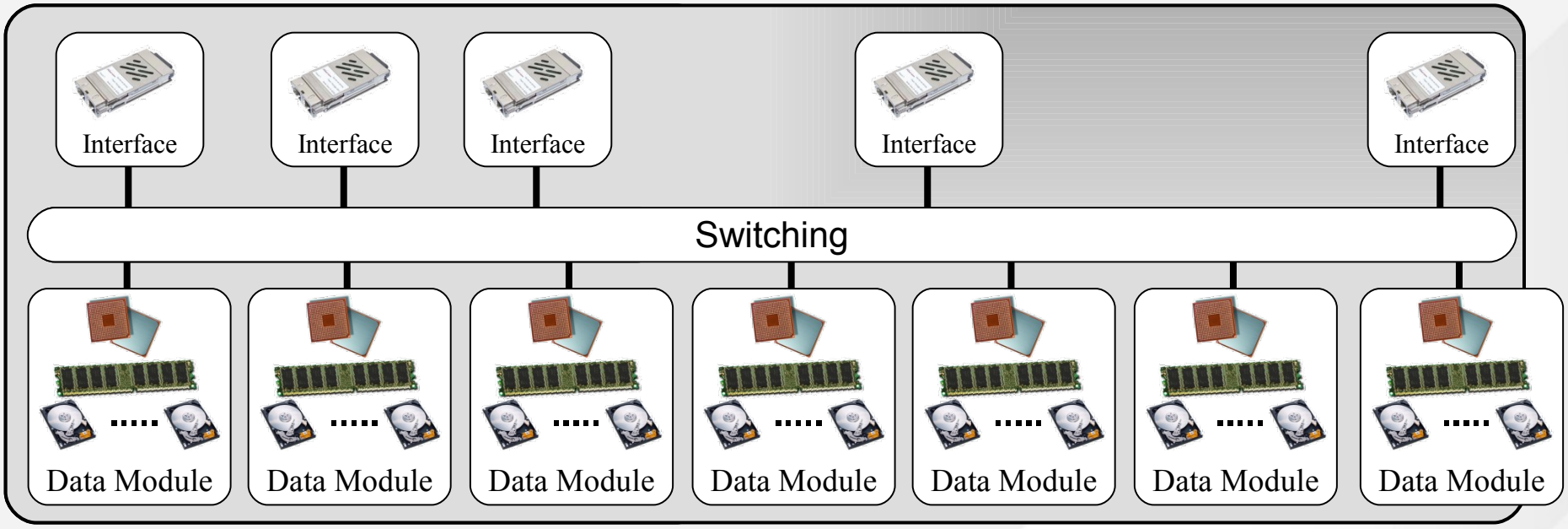
With this legacy architecture, scalability is achieved by using more powerful (and more expensive) components



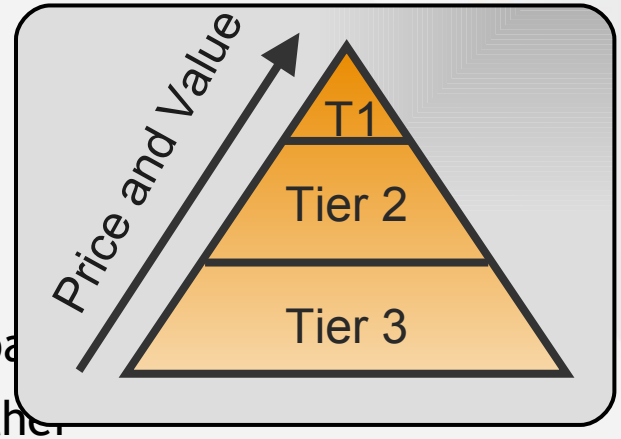
IBM XIV Storage Architecture: Scale Out

Design principles:

- Massive parallelism
- Granular distribution
- Off-the-shelf components
- Coupled disk, RAM and CPU
- User simplicity



Single-Tier System

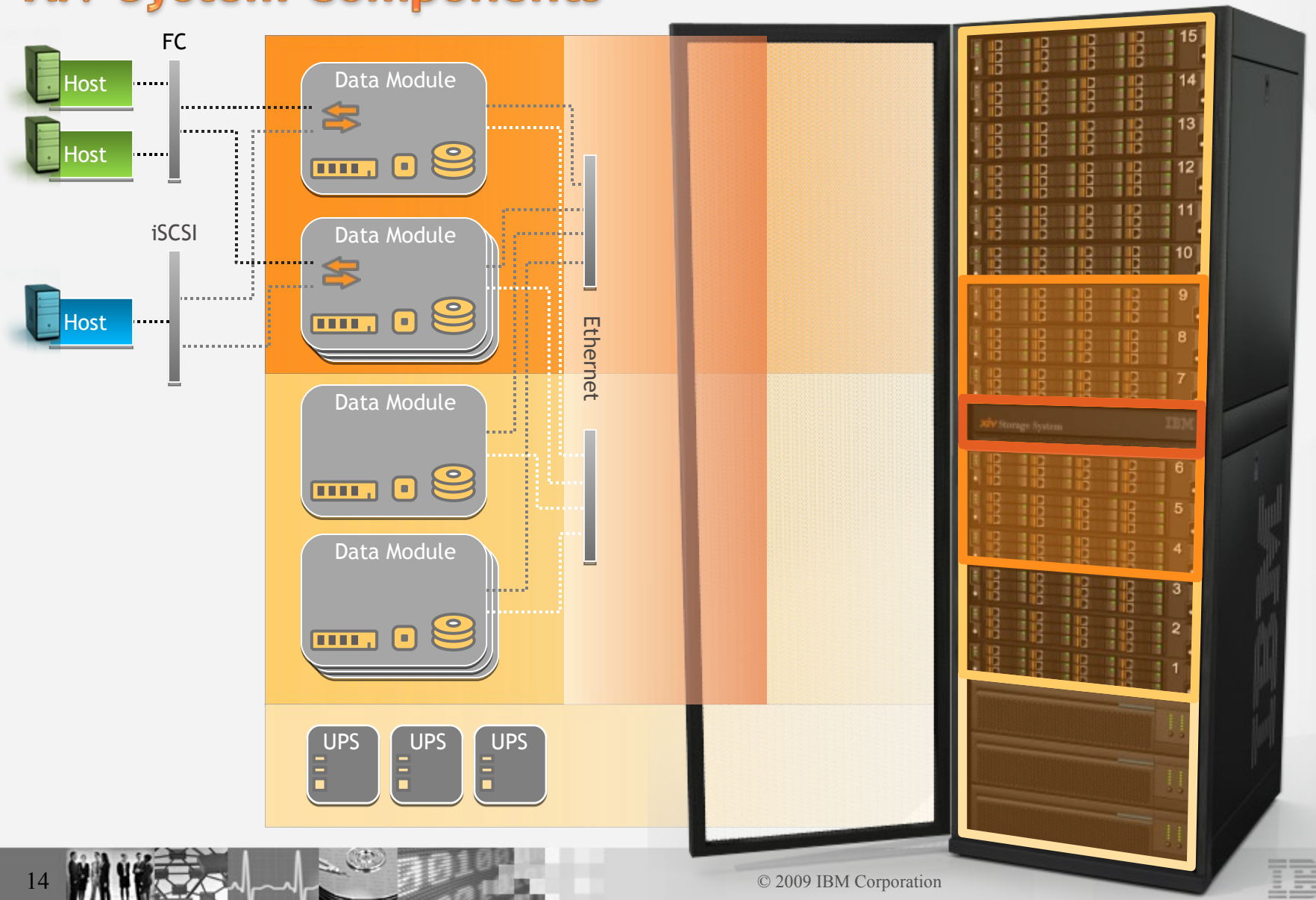


- High-end system at mid-range cost
- Avoids ILM and HSM overhead
  - Single storage solution for a mixture of workloa
  - No need to migrate data from one tier to another
  - System resources fairly allocated to benefit all applications
  - Higher Utilization than tiered system
- No need to classify applications into tiers
  - Same high-end reliability for all
  - Top performance available to all applications
- Interoperable with a rich set of platforms and applications

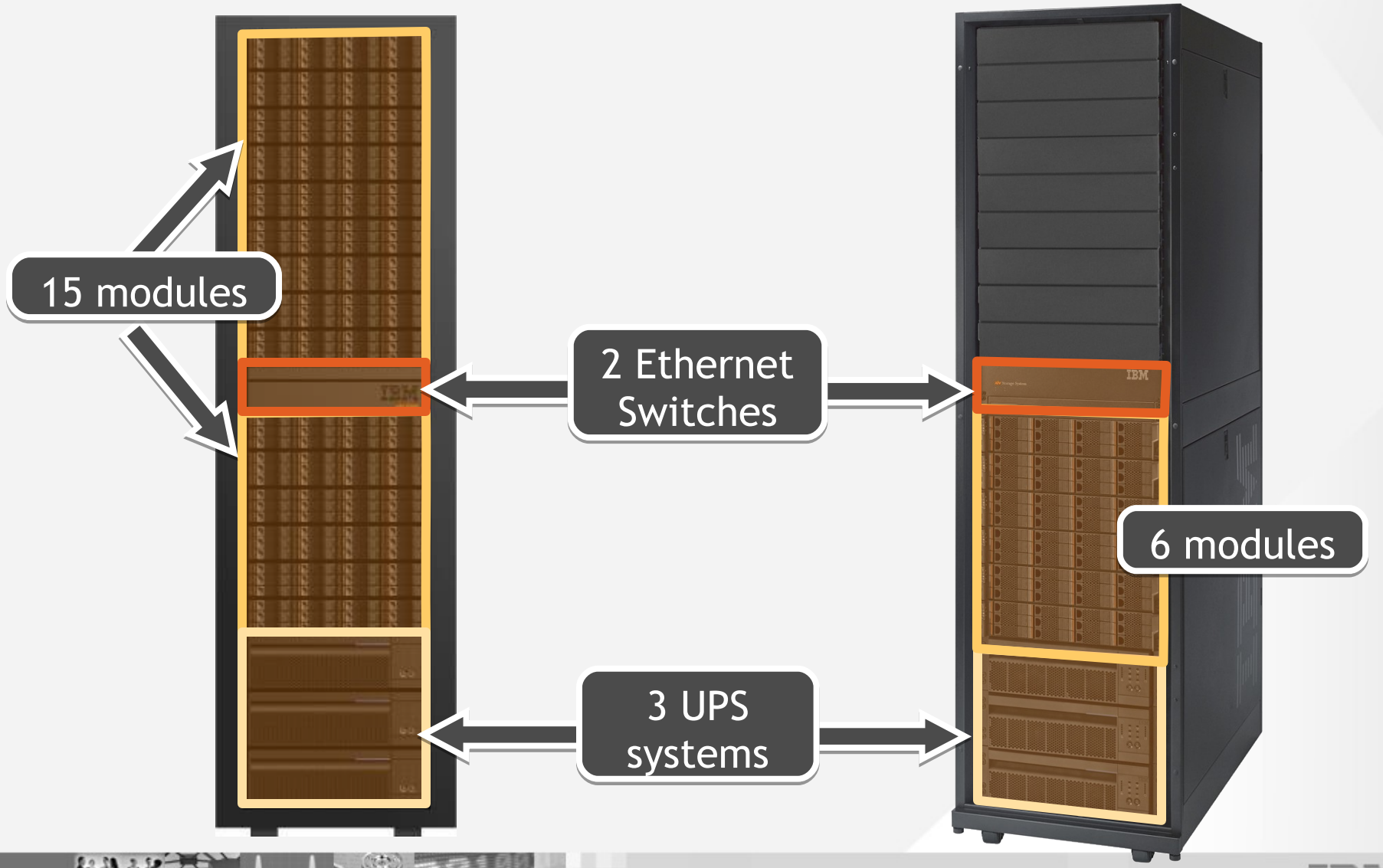
Benefits:

☑ **Simple and efficient deployment**

XIV System Components



System Modules Range: 6, 9, 10, 11, 12, 13, 14, 15



IBM XIV Storage System: Full Rack

- 15 modules:
  - 12 disk drives in each module
  - 120GB of memory (15 * 8)
  - 6 of the modules with interface and data functionality
    - FC ports (4 per module)
    - 1 gig iSCSI networks (2 per module)
- 24 FC ports (4GB) and 6 external iSCSI ports
- 180TB raw in a single rack (1 TB Disks)
- 79TB usable space

IBM XIV Storage System: Minimal Partial Rack

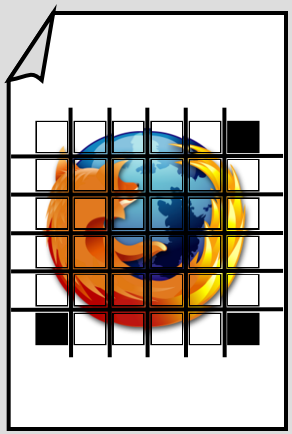
- 6 modules:
  - 12 disk drives in each module
  - 48GB of memory (6 * 8)
  - 2 of the modules with interface and data functionality
    - FC ports (4 per module)
    - 1 gig iSCSI networks (2 per module)
- 8 FC ports (4GB)
- 72TB raw in a single rack (1 TB Disks)
- 27TB useable space
- Expansion ready

IBM XIV Storage Distribution Algorithm

- Each volume is spread across all drives
- Data is "cut" into 1MB "partitions" and stored on the disks
- XIV algorithm distributes the partitions across **all** disks in the system

XIV disks behave like connected vessels, as the distribution algorithm aims for constant disk equilibrium.

Thus, IBM XIV's Storage overall disk usage could approach 100% utilization when loaded



Interface

Interface

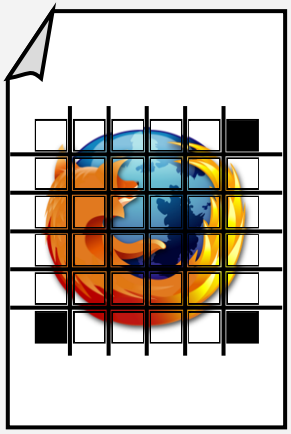
Data Module

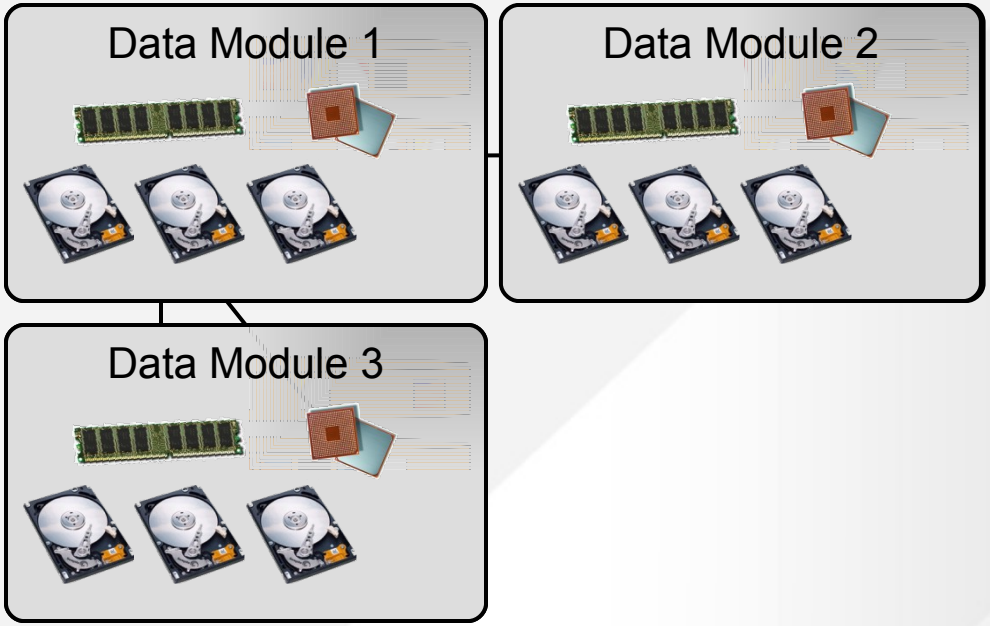
Data Module

Data Module

XIV Distribution Algorithm on System Changes

- Data distribution only changes when the system changes
  - Equilibrium is kept when new hardware is added
  - Equilibrium is kept when old hardware is removed
  - Equilibrium is kept after a hardware failure





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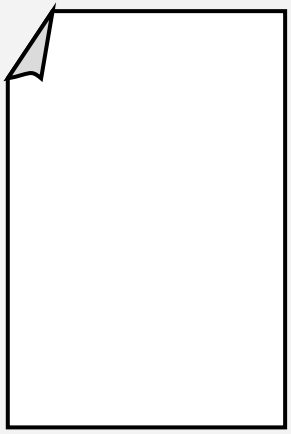

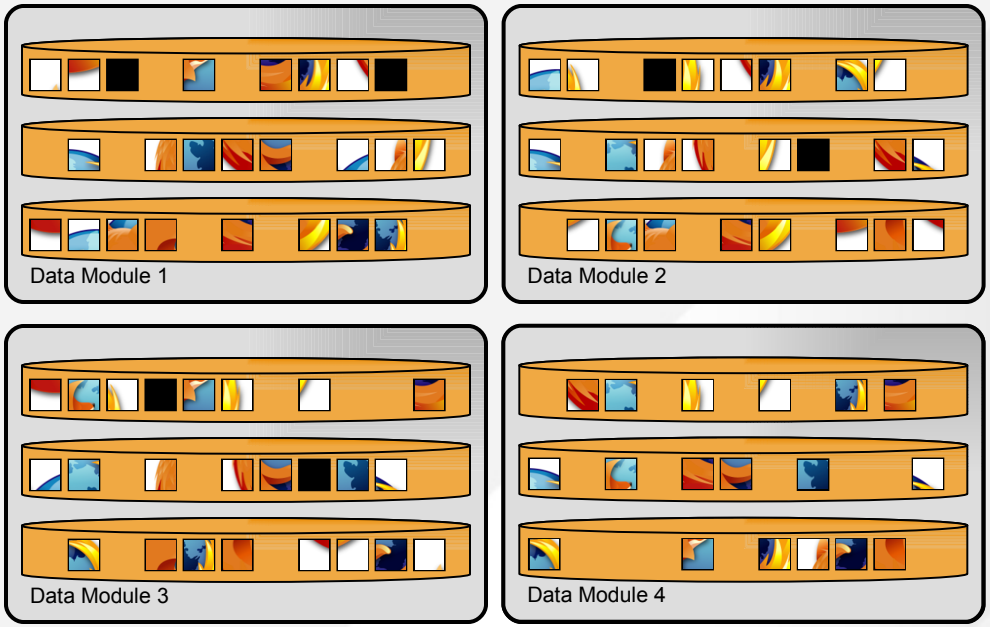

[hardware upgrade]

XIV Distribution Algorithm on System Changes

- Data distribution only changes when the system changes
  - Equilibriu
  - Equilibriu
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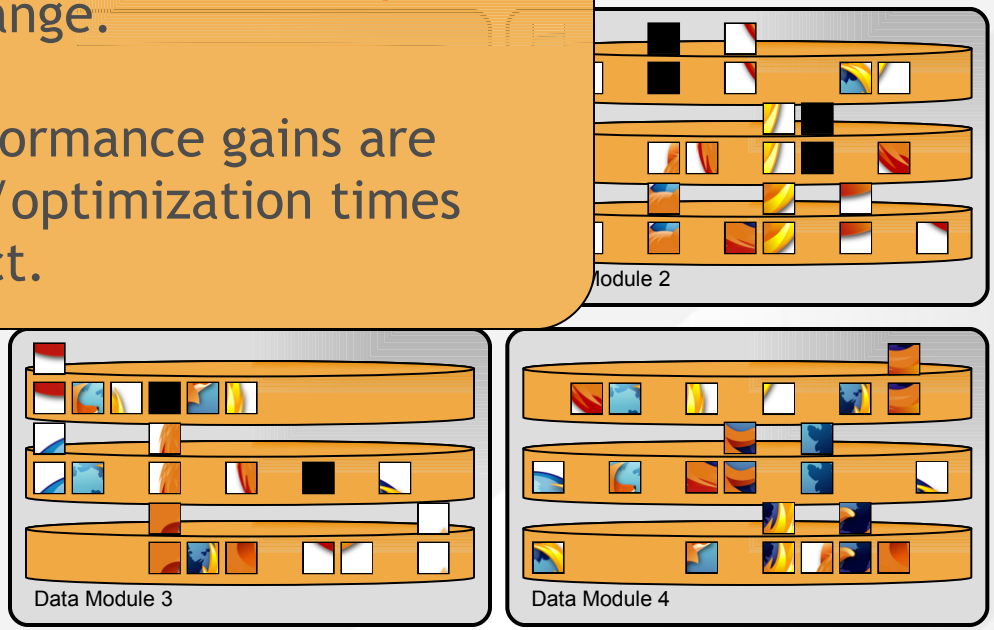
The fact that distribution is full and automatic ensures that all spindles join the effort of data re-distribution after configuration change.

Tremendous performance gains are seen in recovery/optimization times thanks to this fact.



IBM XIV Storage: Concept of "Spare"

- Traditional approach
  - Dedicated disks used for spares
  - In many systems spares are dedicated for a RAID group
- IBM XIV Storage approach
  - Recovery time: 40 minutes for 1 TB disk (full)
  - No dedicated spare disk, only global capacity
  - All disk are equally used
  - Minimize the risk of technician mistakes
  - Higher availability with no performance impact
- 180TB raw is 79 TB net
  - Spare space for 3 disks and a full module
  - 79 = (180 – 12 – 3)/2 – 3.5 (internal use)

Thin Provisioning

- Buy and deploy storage according to consumed capacity
  - Not according to generous projections
- Manage thin provisioning per Storage Pool
  - Allow varying provisioning guidelines for different applications
- Innovative space reclamation
  - Ability to **reclaim space** freed by the application
  - Reclaim space upon data migration (Thick-to-Thin)
- Thin provisioning is intrinsic to the XIV architecture
  - Not an afterthought with architectural limitations
  - Simple, straightforward capacity management and tracking
  - No space consumed when data is only 0

Benefits:

- ☑ Reduce and defer capital outlay
- ☑ Minimal management overhead

XIV Data Migration and Replacing Outdated Hardware

- Automatic data migration
  - XIV is placed between the Servers and the legacy storage array
  - Migrating *Thick to Thin* provisioned volumes
  - Online data migration from any other storage array
- New hardware can be added to the system
  - Better performance, less power, more density
- Outdated hardware can be phased out and removed
- All system components can be replaced with:
  - No down time
  - No host re-configuration
  - No administration effort

IBM XIV Storage SNAPs without Limitations

No Added Charge

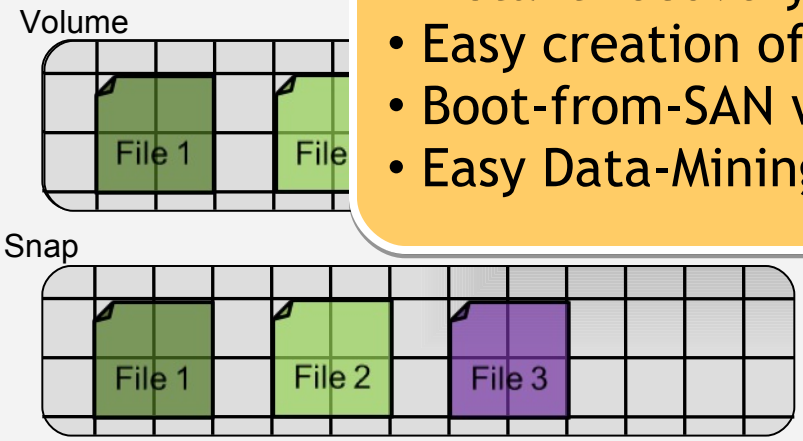
- SNAP creation/deletion is instantaneous
- High Pe
- Practic
- Differe
- SNAP c

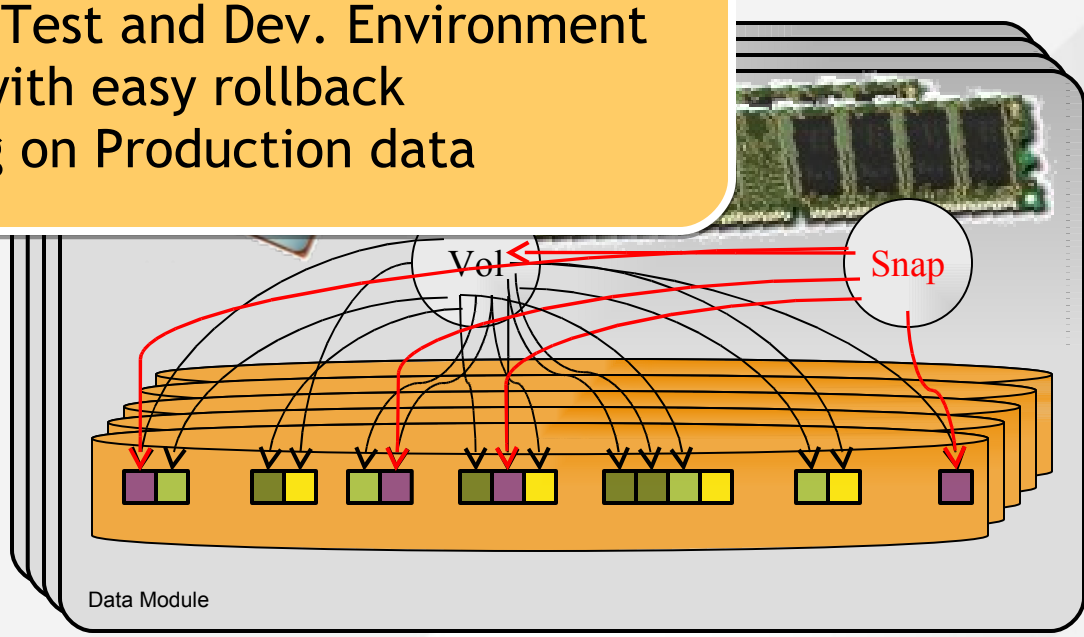
Distributed SNAP on each Server.
nory operations

as fast as
n volumes

High Performance SNAPs provide:

- Easier Physical Backup to Tape
- Instant recovery from Logical Backup
- Easy creation of Test and Dev. Environment
- Boot-from-SAN with easy rollback
- Easy Data-Mining on Production data





Restore Volume from SNAP copy

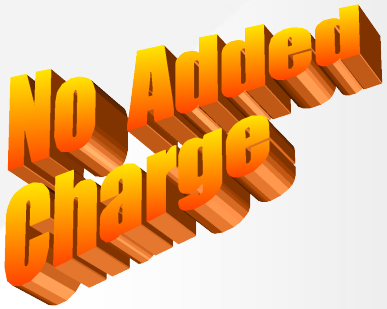
As Host Writes data, it is placed randomly across system in 1MB chunks

Each Server has pointers in memory to the disks that hold the data locally

On a SNAP, each Server simply points to original volume. Memory only Operation

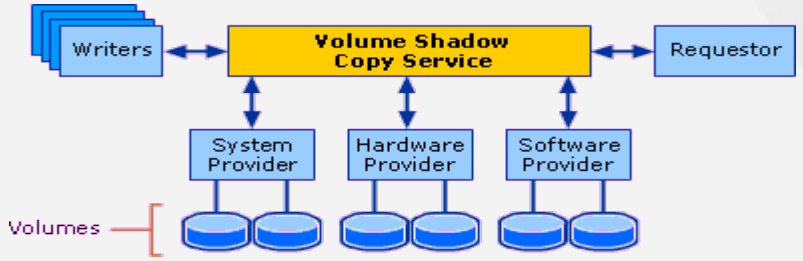
Remote Mirroring for Disaster Recovery

- Low granularity – any to any volume replication
- Every IO is committed to local and remote copies before completion
- Various policies upon link failure
  - Re-sync when link is resumed
  - Full completion or Fail
- Automatic Snap is used to keep copies self-consistent even during re-sync after link failure
- Flexible restore options:
  - Local servers and remote data
  - Remote servers and remote data
  - Remote server and local data
- Over dedicated FC or IP ports



Point-in-Time Services: CGs, Microsoft VSS and TSM for Copy Services

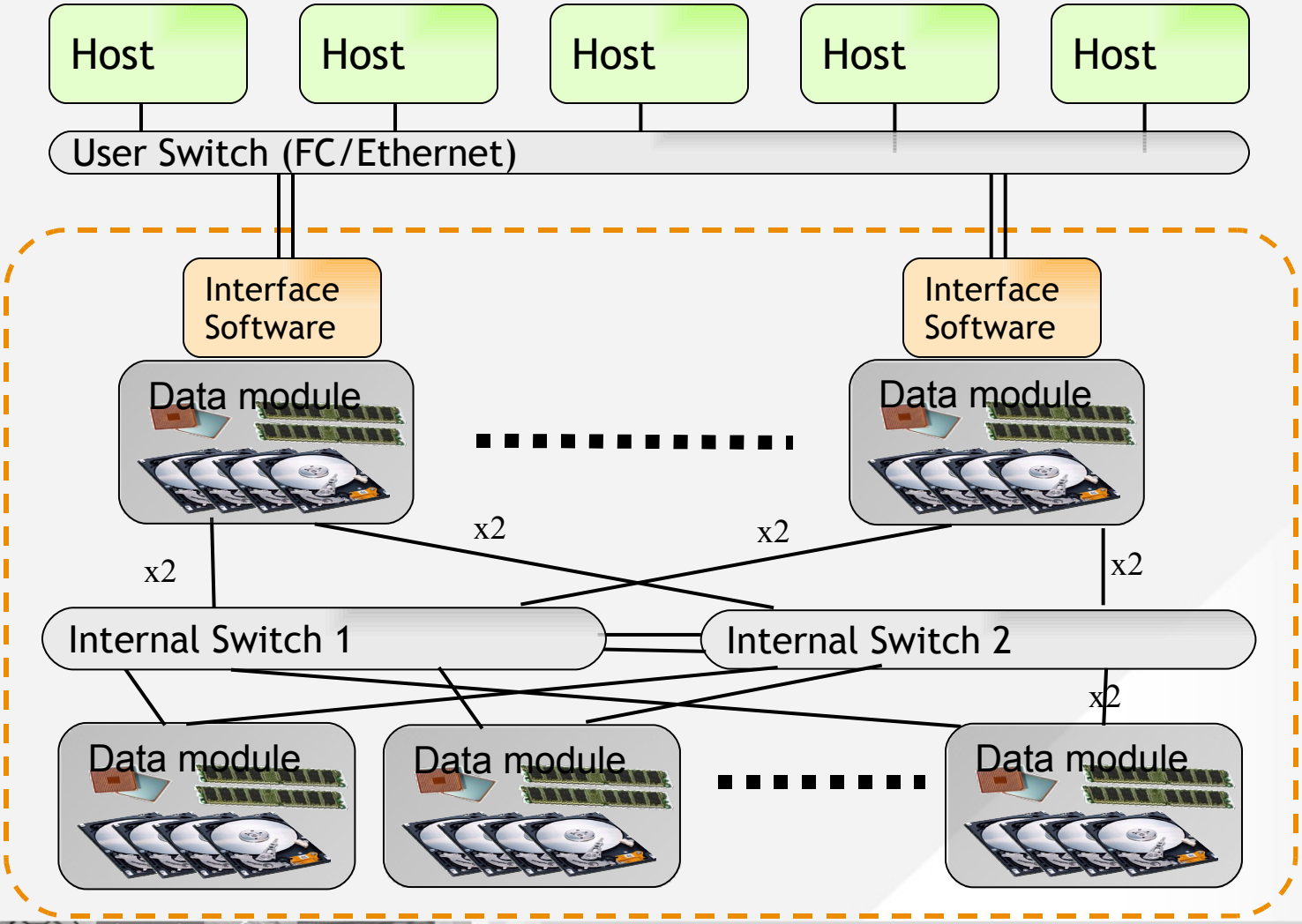
- XIV supports consistency groups
- XIV VSS Provider
  - FC and iSCSI Support
  - Storage Snapshot creation
  - Snapshot restore (instant restore with TSM 6.1)
  - (Un)Mapping Snapshots to Host
- Transportable Shadow Copies support
- Internal XCLI client
- Operates with 3rd party VSS Requestors
- TSM 6.1 for Copy Services: Exchange, SQL and files
- TSM 6.1 Advanced Copy Services: Oracle, DB2, SAP



Why do we recommend standard OS MPIO and not proprietary multi-path software?

- Standard OS multi-path SW is available and mature
- XIV is an Active/Active array – round robin works well
- 2'nd generation multipathing integrated well with OS
- Allows multi-vendor storage support
- Allows customization (e.g. XIV Windows DSM)
- It does not cost extra
- Symantec DMP - some customers would like common multi-path SW for all hosts and storage vendors

IBM XIV Storage is a Grid Architecture



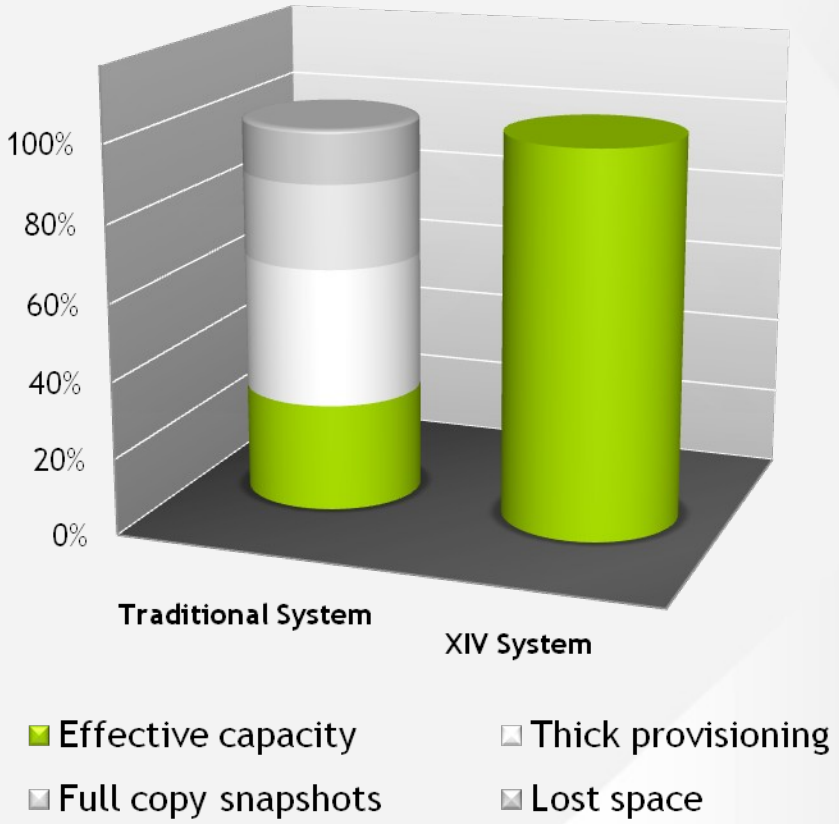
System Power Usage

- Power consumption of a system comparable to XIV is 180–380W per raw TB
  - Typically using 146GB 15K rpm disks (380W per Raw TB)
- Power consumption of an XIV rack is 7.7KW
  - 180TB raw capacity, 79TB net capacity
  - 42W per raw TB today, 97W per useable TB
- Rack power consumption will not change much with 2TB disks
  - But capacity will double
  - Consumption per raw TB expected to drop to 21W

3 to 6 times less power for the same (or better) performance and reliability levels

Superior Effective Capacity

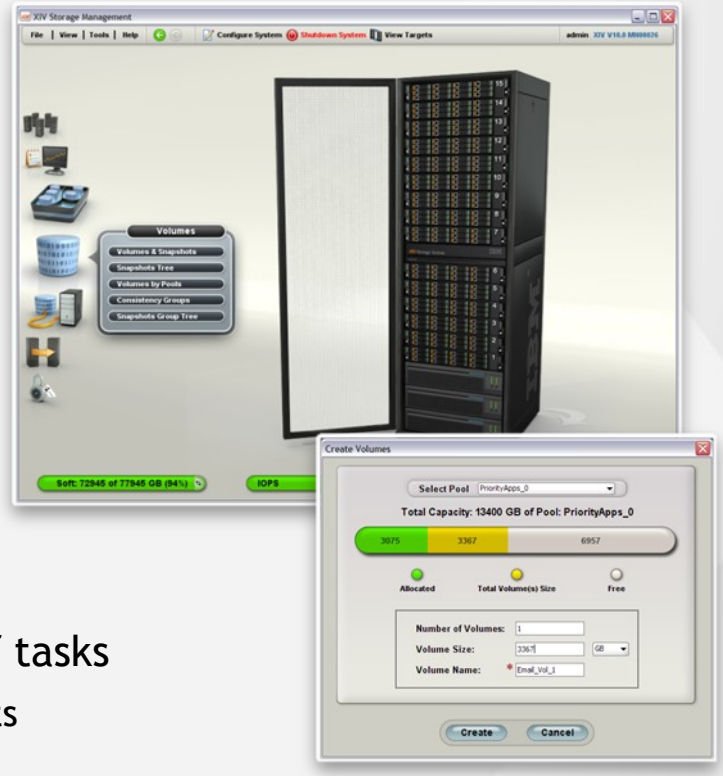
- Effective capacity
  - Net space used by application data
- Thick provisioning
  - Space pre-allocated based on anticipated use
- Full copy snapshots
  - Non-differential volume copies
- Lost space
  - Space wasted due to inflexible volume layout



Fewer TBs address the same applicative needs

Administration Made Easy

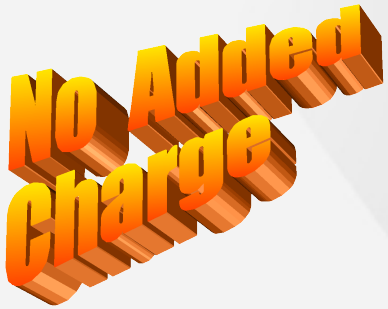
- Use your time to provision storage:
  - Define volumes in seconds
  - Resize volumes painlessly
  - Create instant snapshots
  - Create test environments with writable snapshots
- Don’t spend time optimizing:
  - No need for performance tuning
  - No need for complex layout patterns
- Role-based management allows safe delegation of tasks
  - Application administrators manage their own snapshots
  - Integrate with the organization’s LDAP
- TPC 4.1 Support through SMI-S



Simplicity saves time and money

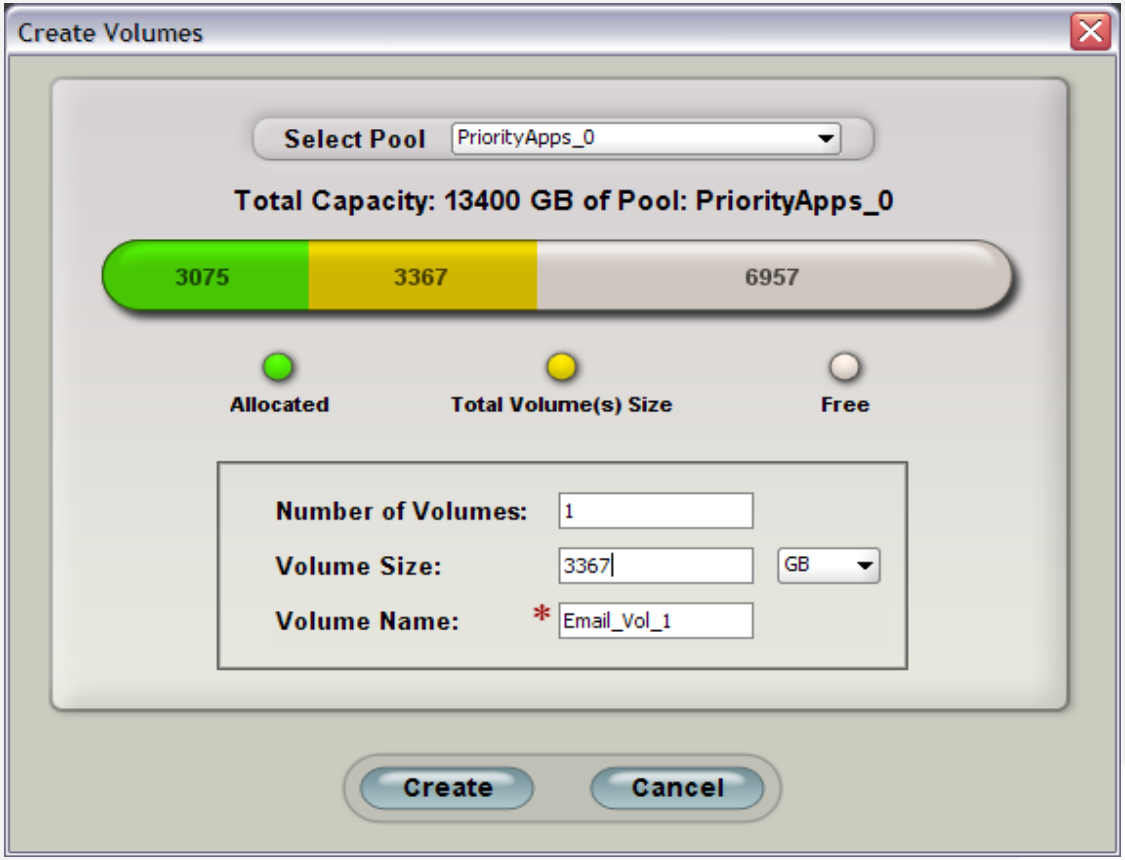
Better service to the organization

IBM XIV Storage Simple and Intuitive Management



- Intuitive GUI (Java based) with Script Generator
- Command Line Interface (CLI)
- XML over SSL to all features
- Event management (SNMP)
- Complete event logging
- Events notification via email, SNMP and SMS
- Management service provided from 3 modules
- No dedicated management station
- Role-based management:
  - Storage Admin
  - Application Admin
  - Operator

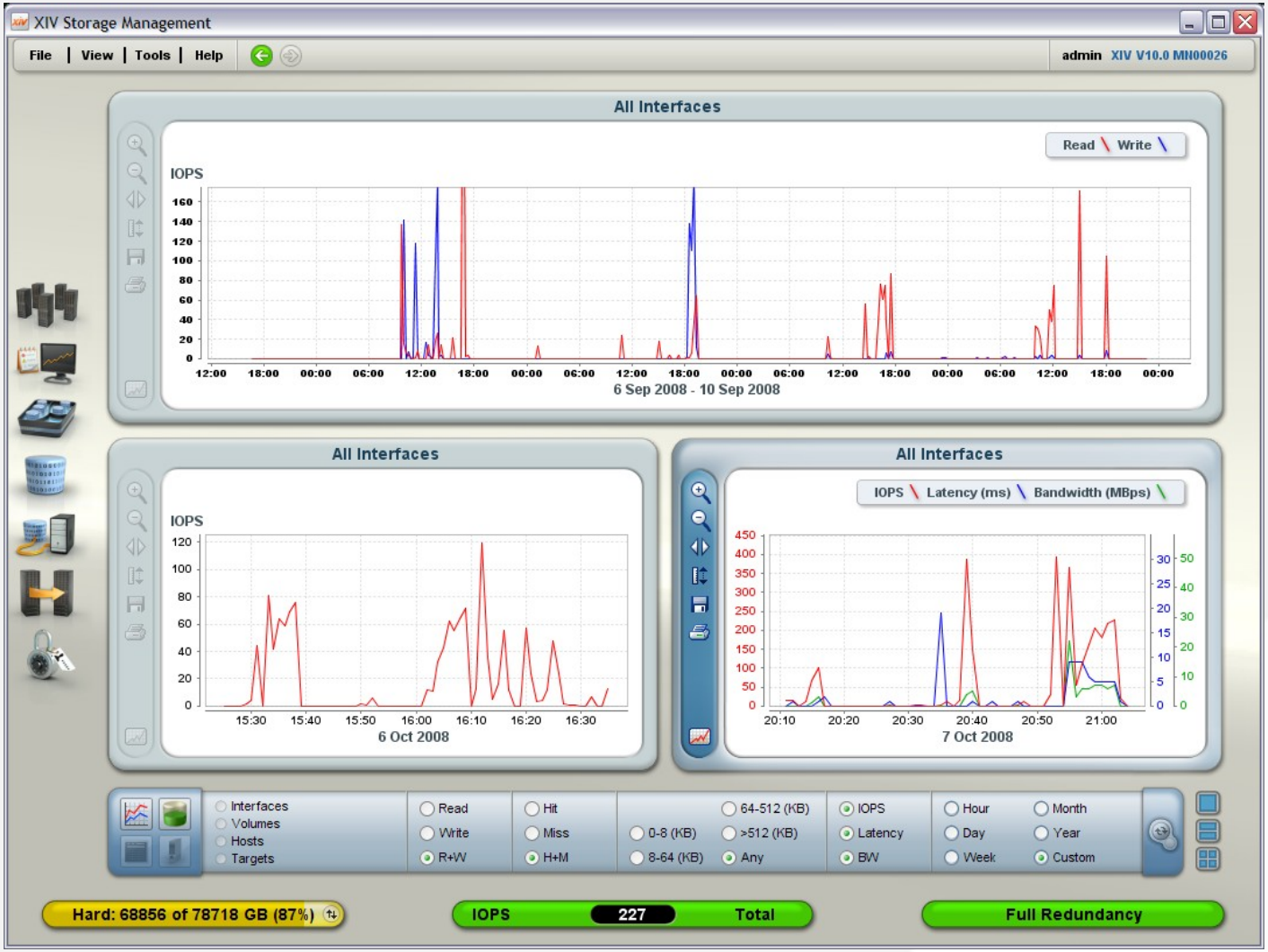
Intuitive Management: Creating a Volume



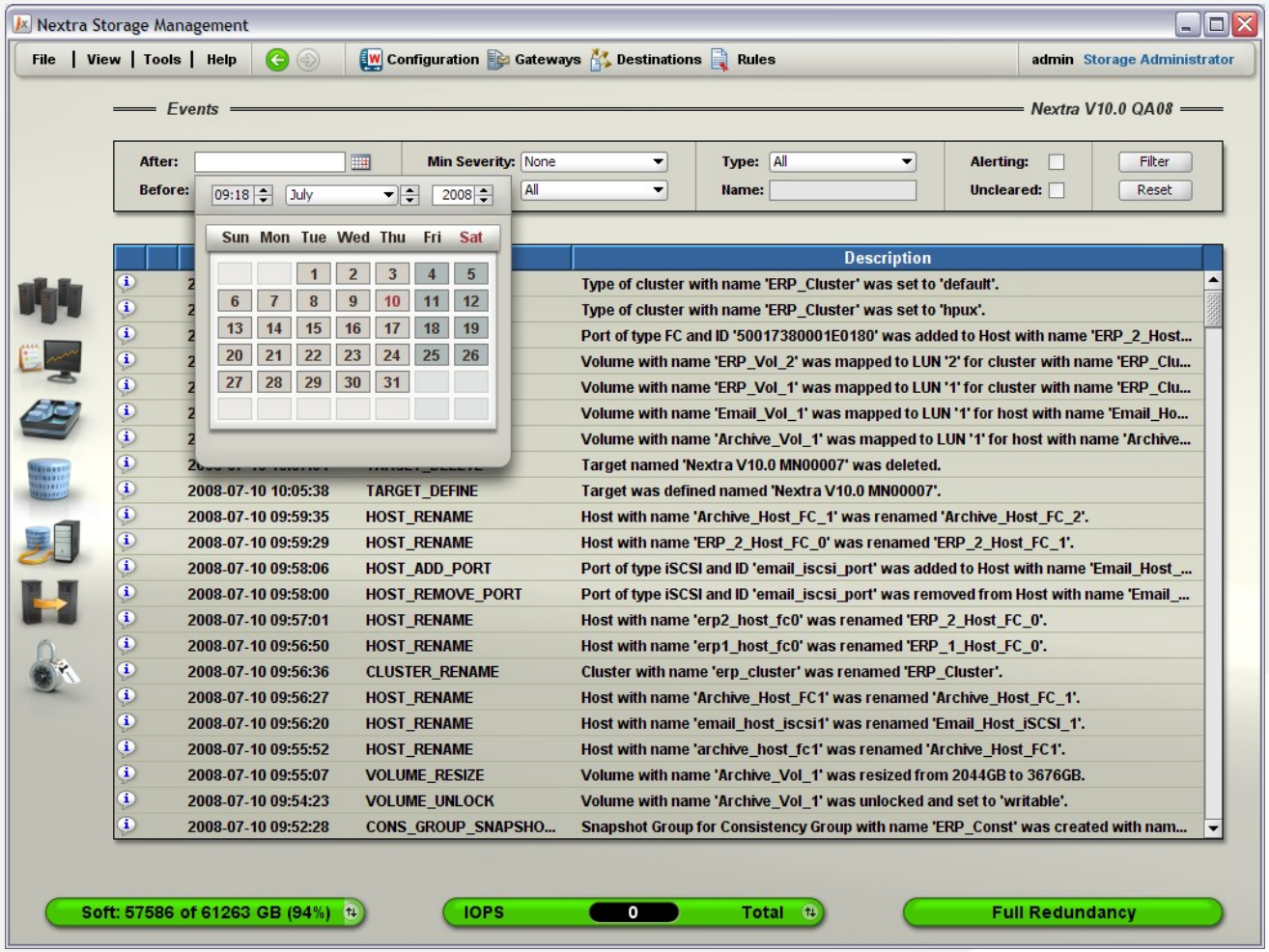
Used capacity is always known

Intuitive Management: Managing Storage Pools

IBM XIV Storage: Monitoring



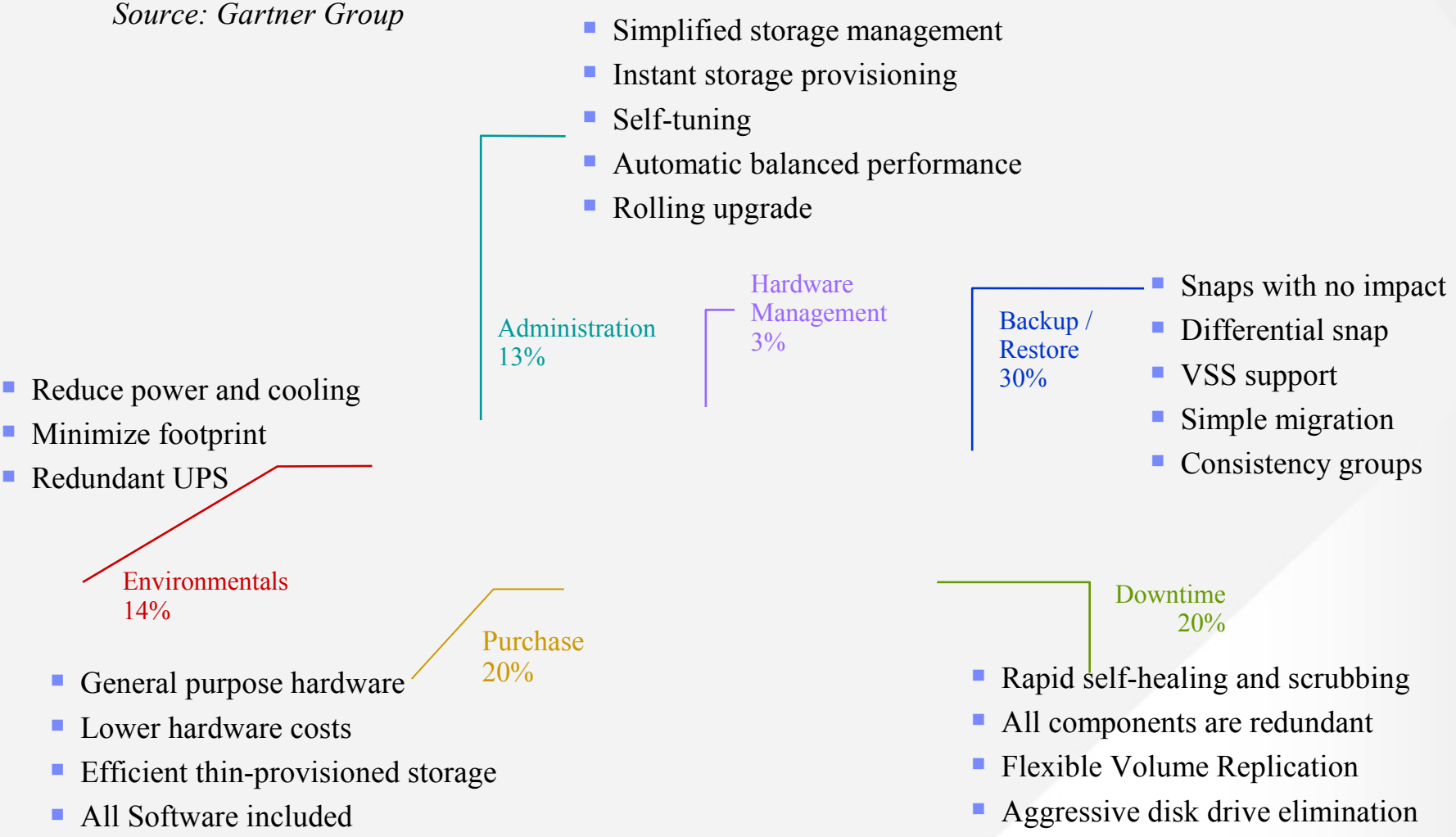
IBM XIV Storage: Events Log



Total Cost of Ownership - The impact of IBM XIV Storage

Average Storage TCO for Storage Systems

Source: Gartner Group



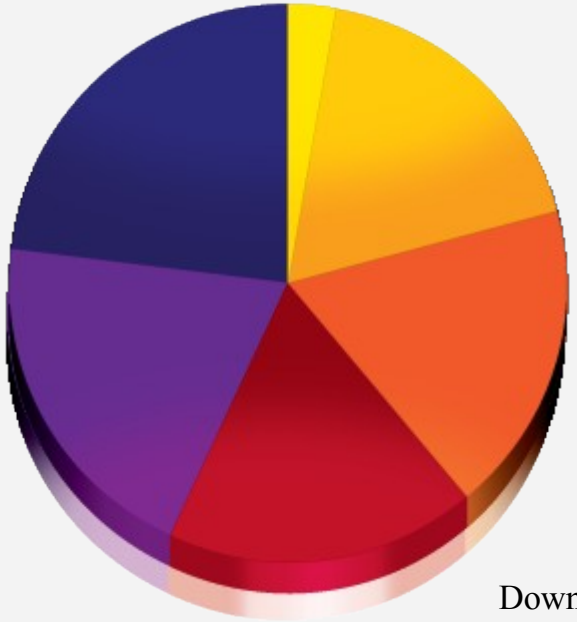
How XIV storage tackles every TCO cost factor

Backup/Restore

- Snaps with no performance impact
- Differential snaps
- VSS support
- Simple migration
- Consistency groups

Environmentals

- Reduced power and cooling
- Minimized space footprint



Administration

- Fast deployment
- Simplified storage management
- Space reclamation
- Self-tuning
- Rolling upgrade
- Transparent scaling with no hidden costs

Acquisition

- Single-tier architecture
- Commodity hardware
- Lower hardware costs
- Just-in-time purchasing
- Efficient thin provisioning
- Optimal capacity use
- All key aspects scalable
- All software included; no licensing

Downtime

- Less hardware to fail
- Integral UPS
- Less human intervention
- Easy to monitor
- Rapid self-healing and scrubbing
- All components redundant
- Free and flexible volume replication

IBM XIV Storage TCO

- Reduced capital costs; no software fees or licenses
- Less storage needed, thanks to:
  - Thin provisioning
  - Management efficiency (no orphaned space)
  - Differential copies
- VHCSR drives: Up to 85% saving in power, cooling, and space
- Simple and intuitive management - manage very large capacity with less staff
- Dynamic storage allocation
- Automatic data migration
- Easily replace outdated modules with new ones
  - Get more capacity, performance, and power efficiency
  - No administrative effort

IBM XIV Customers

NaviSite

Hosting services

Business challenge:

Develop a reliable, high-performance storage infrastructure that can reduce the cost of management while scaling to accommodate a rapid increase in demand.

Solution:

Grid-based, enterprise-class storage based on the IBM® XIV® Storage System featuring snapshots and writable snapshots

Benefits:

- Grid-based technology distributes data across disks, providing high availability without compromising performance
- Intuitive interface allows more IT staff to work directly with storage, improving ability for 24/7 customer support
- Works with virtualized servers to speed deployment from days to hours
- New volumes can be created and assigned in minutes

"The IBM XIV Storage System allows us to provide a highly reliable, highly performing platform to our customers that should help NaviSite gain an advantage over its competitors."

– Mark Clayman
Senior Vice President of Hosting Services
NaviSite

NaviSite® Run With Us.

Increases storage reliability, performance and efficiency

Virginia Commonwealth University Health System (VCUHS)

Regional and academic medical center

Business challenge:

VCUHS, an academic medical center, needed to overhaul and consolidate its outdated, complex, multi-vendor storage and backup environment. They sought a highly reliable, easy-to-manage platform that would deliver uninterrupted information flow at minimal cost.

Solution:

VCUHS switched from multi-vendor complexity to an all IBM solution comprised of: the IBM XIV (two racks, 80 TB usable each, at primary and backup sites), IBM System p® (IBM AIX®), IBM Tivoli Storage Manager and a virtual tape library in place of their legacy tape backup, IBM System Storage SAN Volume Controller (SVC) for online migration. Environment includes: Microsoft® SQL Server®, Oracle databases, IBM Lotus Notes® (15,000 users), and VMware.

Benefits:

- Major reduction in TCO overall
- Uninterrupted access to patient and business data
- On-demand scaling for easy growth

"XIV has lived up to all the promises to be a revolutionary technology. It's a major cost-saver, yet it changes the paradigm of storage management. With the XIV system, we are well-positioned for the future."

— Greg Johnson, CTO
VCUHS

VCU Medical Center
Every Day, A New Discovery.

Leveraging reliable storage to help lower patient risk

Bank Leumi

Banking and financial services

Business challenge:

Bank Leumi needed a new storage management solution that would meet its ever-growing need for storage capacity. However, a tight IT budget meant that the company needed to limit its capital expenditures as well as manage all of its storage hardware with a small team. The company began to look for a storage system with high performance and reliability, as well as rich features for optimized administration.

Solution:

Bank Leumi installed one IBM XIV® Storage System and subjected it to the rigors of its most challenging high-end application. On the XIV system, the application ran smoothly from the start, keeping pace with write requests and completing each analysis process within one third of the time. The XIV system proved to be robust even with snapshots. The bank subsequently deployed seven XIV Storage System racks.

"We are using the system for applications that previously ran on our Tier 1 and Tier 2 systems—in short, we're getting Tier 1 capabilities without Tier 1 costs."

— Ester Lior
Storage Director
Bank Leumi

Benefits:

- Leverages the single-tier architecture of the IBM XIV Storage System to consolidate storage tiers
- Can improve back performance, even when using snapshots
- Helps dramatically reduce management overhead

Improves backup performance and reduces administrative overhead

Bezeq International

Telecommunications services

Business challenge:

A leader and innovator in its field, Bezeq International maintained a sizable storage environment that routinely grew in large quantities. To support its operations, the business had assembled a complex, tiered storage environment composed of multiple operating platforms. Unfortunately, the management burden for this environment was beginning to take its toll on the company's IT operations.

Solution:

Bezeq International initially deployed a single IBM XIV® Storage System to support its file server operations; however, pleased with the overall functionality of the system, the company implemented three additional systems to support various functions including its e-mail server, collection system, video recording system and backup operations. The storage hardware is also used to implement new virtual operating environments.

Benefits:

- Simplifies the storage infrastructure, easing the management burden and netting a lower total cost of ownership
- Helps optimize overall performance with intuitive interfaces that enable the easy creation of virtual environments
- Streamlines backup processes, helping to support higher daily compliance and improved data security

"We started using the IBM XIV Storage System with our peripheral applications, gained confidence and quickly extended its use to our most business-critical applications."

– Eyal Zafrir, CIO
Bezeq International Ltd.

Creates a more efficient and capable storage environment

JoongAng Ilbo

Newspaper and media publishing

Business challenge:

JoongAng Ilbo, publisher of Korea's leading daily newspaper, needed to resolve the systems management workload and overall performance issues they were experiencing with the company's existing storage platform. They wanted to find a reliable solution that would be easy to manage and that would deliver consistent high performance.

Solution:

With the help of IBM Business Partner Haywardtech Corporation of Korea, JoongAng Ilbo replaced their existing storage system with an IBM XIV® storage system with 25 TB of storage space. The system is configured in 60 storage volumes to support the company's Oracle database and numerous enterprise applications, and serves as many as 3,500 concurrent users.

Benefits:

- Delivers consistent performance, even during peak production times
- Offers simpler administration, which enables reduced IT labor costs
- Enables new levels of business efficiency and improved customer satisfaction

"Efficiency is the priority factor when we invest in IT. The solution we chose had to be highly reliable, cost-effective, able to integrate with our legacy IT components, and able to flexibly address ad-hoc business requirements. The IBM XIV Storage System has given us all this."

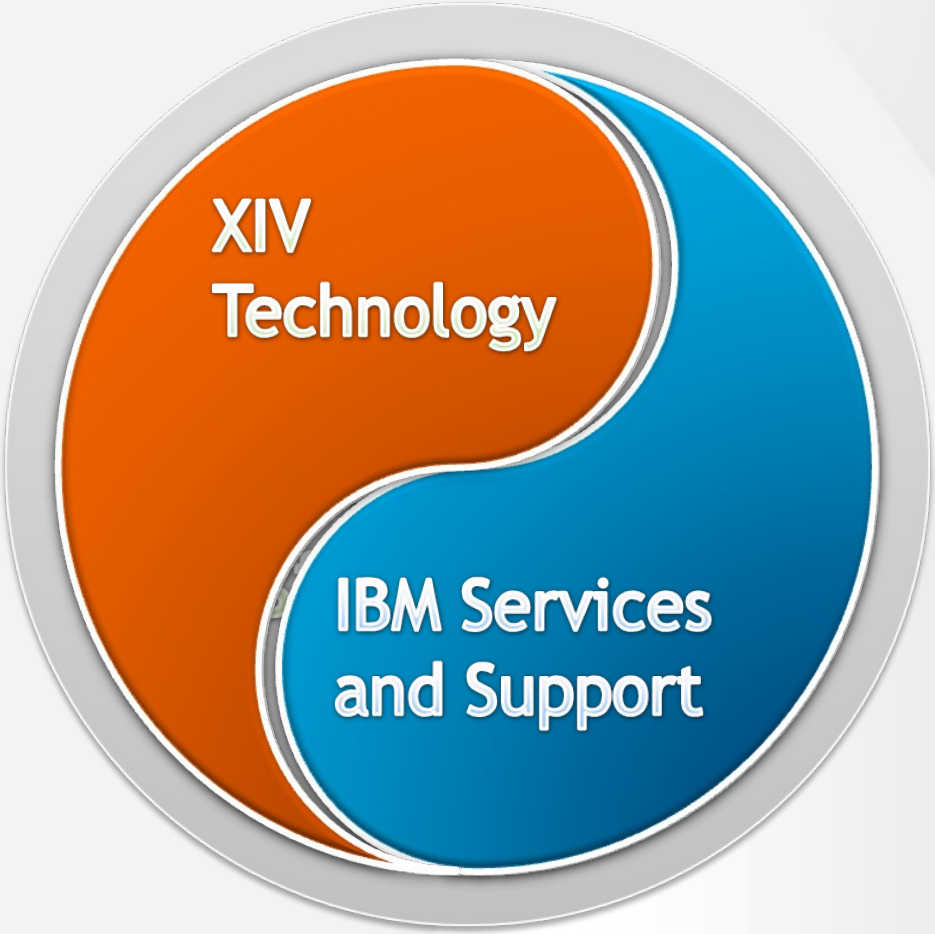
— *JinSoo Lee, CIO*
JoongAng Ilbo

JoongAng Ilbo

Improved business efficiency and customer satisfaction

XIV and IBM Synergy

- Groundbreaking XIV technology
  - In production since 2005
- Renowned IBM global services and support
  - 24 X 7 worldwide
  - 4 hour response time
  - “Call home” and remote support
- State-of-the-art solution from an IT powerhouse



Bottom Line: Real-World Benefits

- **Reliability**
  - Revolutionary self-healing takes minutes, not hours
- **Functionality**
  - Thin provisioning and replication built into the architecture
- **Power and Space**
  - Minimize power, cooling and floor-space with SATA drives
- **Performance**
  - No “hot spot” on disks, Massive parallelism, spindle utilization, self-tuning and cache effectiveness boost performance dramatically
- **Manageability**
  - Simple, easy management; a logical volume has only two parameters: name and size
- **Total Cost**
  - Off-the-shelf components
  - No charge for software features (Snap, DR, Management)

Thank You

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For more information visit http://www.xivstorage.com

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