zEnterprise – The Ideal Platform For Smarter Computing

The Benefits Of Storage Consolidation
From Server Sprawl To Storage Sprawl, The New Era Of CIO Pain

But what about the storage?

You can virtualize and consolidate it all on DS8000.

CIO

IBM
Storage Administrators Face Problems Similar To Server Administrators

- Insatiable demand for growth
  - Continuous hunger for more storage
  - Both structured
    - Larger databases
    - Bigger data warehouses
  - And unstructured
    - Rich media (web, images, video, email, documents, etc.)
    - Driven by Big Data Analytics
  - Regulatory requirements to maintain more data for longer periods

- Flat IT budgets
  - Little to no growth in budgets
  - Expectation to manage more with the same staff
  - Traditional approaches
Industry Analysts Confirm What IT Managers Already Know

These pain points result from storage sprawl. Smarter Storage Strategies
Low Disk Utilization Drives Up Cost

The typical UNIX or x86 disk storage is running at 20-40% utilized

System z disk storage runs as high as 60-80% utilized

- System spins disks that are mostly empty
- Configuration planned for I/O peaks
- Configuration planned for Data growth

Resulting in 60-80% of the hardware, storage software licenses, maintenance, floor space and energy that YOU pay for being wasted
Smart Computing Strategies Drive Storage To Higher Levels Of Efficiency

Smarter Computing strategy for Storage Systems is:
Virtualize -- Consolidate -- Tier

- **Embedded Storage**
  - Low utilization
  - Low productivity
  - Manual recovery

- **Shared Storage**
  - Better utilization
  - Better productivity

- **SAN**
  - Better productivity
  - High levels of productivity

- **Storage Virtualization**
  - High utilization
  - High efficiency
  - SSD performance
  - Automation
  - Labor productivity

Most data centers are here today

Advanced storage capabilities

Service Management,
Storage Virtualization,
Dynamic Tiers
(Hierarchical Storage Management,
Information Lifecycle Management)
Introducing DS8800 – Smart Enhancements To A Superior Design

- In addition to its advanced hardware design, the DS8000 is smarter storage
  - Evolution from manual configuration and tuning to automation and efficiency
  - Automation and efficiency are imperatives for multi-tenancy environments, such as cloud computing
  - It all starts with our volume management foundation

- Advanced storage efficiency and quality of service (QoS) capabilities
  - Support for larger volume sizes and new GUI can help increase administrator productivity and lower operating costs
  - Easy Tier enhancements can help clients more effectively optimize performance and capacity management
  - I/O Priority Manager feature can help improve application service levels, enable consolidation, and lower infrastructure costs
DS8800 Under The Covers

**Higher performance and efficiency**

- Compact and high efficiency drive enclosures
  - New 2.5”, small-form-factor drives
  - 6 Gb/s SAS (SAS-2)
  - New enclosures support 50% more drives

- Upgraded processor complexes
  - IBM POWER6+ for faster performance

- Upgraded I/O adapters
  - 8 Gb/s host adapters
  - 8 Gb/s device adapters

- More efficient airflow
  - Front-to-back cooling
  - Aligns with data center best practices
The Storage Cost Capacity Dilemma …

Our distributed storage is a mess. How can I contain and clean this up?

You need Smarter Storage. Let’s show you a case study on how we can integrate a group of distributed server storage environments save you both capacity and storage costs.

CIO

IBM
Messy Distributed Storage Vs. Clean Centralized Storage With DS8800

- Storage added on a per server basis
- Fragmented Storage Capacity and Storage Cache
- Storage is shared rather than virtualized
- Flash/SSD is over-provisioned and not available to all hosts
- Allocating Flash/SSD is a manual process

- Enterprise class virtualization
- Storage utilized at 60%
- Use the same storage admin as your zEnterprise storage
- Storage Cache available to all connected hosts
- SSD can be provided to all/any hosts that would benefit
Dramatic Storage Cost Savings Through Consolidation In Smart Storage

Deployed on Sun

- Sun Storage 6180 Array
- Sun F5100 Storage Flash Array

Best fit on zEnterprise

- Incremental add on DS8800

**235.3TB** embedded storage
- 36.31% utilization
- 74 points of admin

**$7.8M** (3yr TCA)

**143.0TB** embedded storage
- 59.73% utilization
- 1 point of admin

**$4.6M** (3yr TCA)

46% less

75GB/240GB active storage required per workload

Storage configuration is based on IBM internal studies.
Prices are in US currency, prices will vary by country.
Consolidating Storage With DS8800 Saves 46% Over Distributed

- **Hardware**
  - DS8800 saves 23% over distributed
    - Distributed
      - 235.32TB
      - 36.31% Utilized
    - DS8800 = $3.7M
      - 143.04TB
      - 59.73% Utilized

- **3 Yr Labor**
  - DS8800 saves 76% over distributed

- **Annual Cost/Active GB**
  - Distributed = $71.07
  - DS8800 = $46.84
The Storage Performance Dilemma…

To address performance problems, we are purchasing more drawers and spindles, and this is contributing to my storage sprawl.

Our Easy Tier capability allows you to make use of Solid State Drives to increase performance and reduce your storage footprint. Let’s show you how it’s done.
Performance Constrained By Current Drive Limitations

- Processor capabilities are out-stripping disk drive and RAID controller performance (rotational speed and IOPS)

- As a result, servers and storage systems become more unbalanced between CPU/controller capability and storage performance

- Clients add more drive spindles to improve performance

*Performance gains through HDDs has become ineffective and wasteful*
Solid-state Drives (SSDs) Positioned To Address Performance Gap

New Tier-0 drives for high priority, time-sensitive applications

Potential client benefits

- Increase revenue opportunities
  - More transactions in less time
- Reduce storage infrastructure costs
  - Reduce acquisition and operating costs
- Reduce server infrastructure costs
  - Smaller servers, DRAM memory capacity, cost and power
- Improve availability
  - Lower component failure rates and faster error discovery
- Enable new capabilities
  - New functions and applications become feasible

Solid-state drives

- Random access storage
- Non-volatile, semiconductor (NAND flash)
- No mechanical parts
- No rotating parts
- Same form factor as traditional HDDs
Easy Tier In DS8800 Optimizes Use Of SSD Across Shared Workloads

- Migrates data extents between SSD and HDD in the same pool
  - Automatic hotspot detection
- Virtualized SSD is shared across all workloads using the pool
- More cost effective use of SSD vs. ad hoc dedicated assignment
  - Use less SSD to achieve the same overall performance benefits
- Transparent to applications, no code changes required

![Diagram of SSD and HDD arrays with data migration]

Example: Complex database transactional workload

Overall Transactions per seconds

Baseline

Easy Tier

3x Increase
Small Amounts Of Optimally Managed SSD Can Improve Storage Price/Performance

*Easy Tier achieves 78% of the maximum SSD performance potential with just 13% blend of SSD*

Transactional Database Performance as Blend of SSD is increased

Source: IBM Internal Study of Benchmark Factory transactional database workload performance as Easy Tier migrates data to SSD. The performance data contained herein was obtained in a controlled, isolated environment. Actual results that may be obtained in other operating environments may vary.
Another Technique For Improving I/O Performance

**I/O Priority Manager Automatically Applies Resources to High Value Workloads**

- Administrators select from 4 Performance Groups (service levels) to assign to each volume
  - ‘1’ for highest; ‘2’ for standard; ‘3’ for low priority; ‘0’ for no priority (default)
  - All volumes are associated with a Performance Group and all I/Os are monitored

- System resources are dynamically allocated to higher priority volumes (applications) when there is resource contention

*Automated quality of service management delivers performance when and where it’s needed*
Free Up Your Valuable Resources With I/O Priority Manager

How I/O Priority Manager works

- I/O Priority Manager delays the right amount of I/O from lower priority volumes, so higher priority volumes get more throughput.
- Automatic and only when there is contention for a resource between multiple volumes.

---

**DB like workload**

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Throughput (IO/s)</th>
<th>Priority Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10000</td>
<td>On</td>
</tr>
<tr>
<td>6</td>
<td>20000</td>
<td>On</td>
</tr>
<tr>
<td>11</td>
<td>30000</td>
<td>On</td>
</tr>
<tr>
<td>16</td>
<td>40000</td>
<td>On</td>
</tr>
<tr>
<td>21</td>
<td>50000</td>
<td>On</td>
</tr>
<tr>
<td>26</td>
<td>10000</td>
<td>Off</td>
</tr>
</tbody>
</table>

**DB like workload**

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Response Time (mins)</th>
<th>Priority Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>On</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>On</td>
</tr>
<tr>
<td>11</td>
<td>80</td>
<td>On</td>
</tr>
<tr>
<td>16</td>
<td>120</td>
<td>On</td>
</tr>
<tr>
<td>21</td>
<td>160</td>
<td>On</td>
</tr>
<tr>
<td>26</td>
<td>200</td>
<td>Off</td>
</tr>
</tbody>
</table>

---

04 - Benefits Of Storage Consolidation V1.2

19
Easy Tier Enhancements \textit{(2^nd Generation)}

- Easy Tier automatic mode now supports migration between any two tiers
  - Supports migration from HDD to HDD in the same pool

- Automatic \textit{extent} rebalancing within a tier
  - Easy Tier automatic mode redistributes extents within a tier whenever:
    - It shows I/O skew
    - When new capacity is added or when capacity is removed
  - Keeps performance optimized when capacity changes

\textit{Superior volume management leads to higher efficiency and flexibility}
Where Is The Competition? Lost In The Sprawl!

- EMC FAST does not support System z or System i data
- EMC does performance rebalancing with its Symmetrix Optimizer feature:
  - Charged feature
  - Difficult to use and may not help much
- Optimizer moves data around to attempt to reduce disk hot spots, but this is reactive based on long-term trends (e.g., multiple days)
  - DS8000 Storage Pool Striping does this proactively and now supplements that with extent rebalancing
- EMC FAST VP is disabled by default.
  - Users must create multiple objects and parameter values and maintain these as workloads change
- EMC provides a GUI wizard
  - Their documentation recommends the wizard be used on only relatively simple FAST VP environments
- FAST is priced
  - There are initial charges
  - Incremental charges as drive capacity is added to the system
  - Post-warranty maintenance charges

Easy Tier is Free
System z And IBM System Storage Synergy

- System z and IBM System Storage have a unique relationship
  - Collaborate
  - Comprehensive testing in zSeries lab
  - Share cross support by skilled resources

- This helps IBM System Storage and System z development to:
  - Better design products that work well together
  - Implement streamlined, efficient, integrated product offerings

- This provides value to System z and IBM System Storage customers by helping to:
  - Verify product reliability
  - Speed implementation
  - Reduce risk
zEnterprise And IBM DS8800 Synergy

Maximize utilization through storage virtualization and consolidation

Centralized storage platform and structured practices minimize labor costs

Efficiently use solid state disk increases performance up to 300% on critical apps

Incremental addition of storage minimizes cost of acquisition

Tivoli management tools improve productivity