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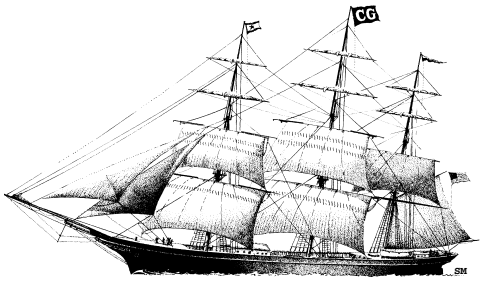

Navigating Information Technology Horizons℠

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Maximizing the Business Value of Information and Lowering Energy Consumption with IBM's DS8700

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Management Summary

With *Earth Day* rapidly approaching, it is the appropriate time for each of us to ask what we have done to improve the quality of the environment in which we live. For example, what have we, as individuals, done to reduce the amount of energy we consume in our daily lives? What can we do to reduce our energy consumption? Do we turn off lights and TVs when we leave a room? Admittedly, the amount of energy this saves may be small, but multiplied by a million lights and TVs, it can add up. More significant, perhaps, is the amount of energy that we can save in our daily commute to work or school. Our cars are consuming gasoline at an alarming rate. We are often more concerned with the quality of the sound system than we are with the energy efficiency. Today, however, there are a number of options: a standard internal combustion power plant, an all-electric solution, or a *hybrid* solution. A standard engine may be the least expensive from an acquisition standpoint, but it does not provide the energy efficiency of other options, and the cost of gasoline is rising while you read this. Unfortunately, the acquisition cost of an all-electric car may still be too high for many, the distance that it can travel between charges is limited, and the number of refueling stations to be found are few and far-between. A good alternative is available, however, in the form of the hybrid car, a combination of a gas engine along with a battery-driven power plant charged by the gas engine. This solution provides the best of both worlds: lower acquisition price than an all-electric, but better mileage economy than a gas-only engine. Alternatively, we could take public transportation and share space with others, reducing energy consumption per person-mile even further.

The enterprise data center faces similar challenges. Applications are generating more data every day, with storage requirements doubling every 12 to 18 months for many enterprises. In many cases, the urgency to access that data demands faster I/O throughput and a significantly higher number of I/Os per second (IOPS). In other cases, especially long-term backup and archive, the urgency to access the data is low, but the requirement for more capacity is high. For those applications that require very high IOPS, solid state disks (SSDs) provide an ideal, but expensive, solution. SATA disks are an inexpensive alternative for long-term storage requirements, with a low acquisition cost and high capacity, up to 2 TBs, but relatively slow performance. Many data centers are now consolidating their IT infrastructure, sharing one storage platform to handle all environments, automatically and dynamically, without manual intervention. Fortunately for them, an easy-to-use hybrid storage solution is now available, IBM's *System Storage DS8700*.

With Release 5.1 of the *IBM Storage System DS8700*, IBM has delivered an easy-to-use tool to migrate data dynamically and transparently from high-performance SSDs to high-capacity disk drives, and back again, taking advantage of the best characteristics of each as data moves through its life cycle. To learn how IBM makes storage systems smarter in order to provide the maximum value to your enterprise, please read on.

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Data Center Storage Requirements

Over the past few years the proliferation of under-utilized servers in the data center has led to an almost uncontrolled server sprawl and an increase in the total cost of ownership (TCO) of the IT infrastructure. This, in turn, has led to the deployment of a series of under-utilized storage silos to support them, stranding TBs of inaccessible storage on a series of islands throughout the enterprise. The data center may not only have reached maximum capacity in terms of floor space, it also may have reached a crisis point in terms of available power. There is simply no more very expensive energy available to many data centers and, with an increasing need for more processing power, storage capacity, and I/O bandwidth, restricted by a declining IT budget, the IT staff must find a way to change the existing IT paradigm.

In an attempt to gain control of the TCO, the enterprise has engaged in a program to consolidate and virtualize multiple applications on new multi-socket, multi-core servers. This enables the IT staff to improve server utilization, reducing the waste of IT resources, reducing the number of costly software licenses and the cost to manage complex systems, and the energy required to run the servers and cool the data center. Simplifying the storage is another matter.

Storage requirements in these enterprise data centers have been exploding, are exploding, and will continue to explode into the foreseeable future – and there is nothing that the IT staff can do to stop it. In 2009 alone, more than 2.5 billion RFID tags were sold, generating mission-critical information that needs to be mined and acted upon by the enterprise seeking to become smarter in their IT operations. In addition, 4 billion new camera phones were put into operation, creating petabytes of images that need to find a home in one of the myriad of social networking photo sites that populate the Internet. These are but two examples of the manner in which web use is rapidly expanding the requirements for storage.

The many demands being placed upon system storage are, in fact, limiting the advantages that might be gained from server upgrades. A consolidated and virtualized storage solution is required. It needs to have the ability to support Tier-1 applications that have a requirement for hundreds and thousands of random access IOPS on enterprise-class Fibre Channel (FC) disk drives and solid-state disks (SSDs) with non-volatile NAND flash memory.[1] At the same time, the data center needs to support multi-tier applications with less urgency but significantly higher capacity requirements on SATA drives. Rather than deploying hundreds of drives, with a minimum of data on each in order to achieve the required IOPS and improve performance, the data center can install just a few SSDs to support the hottest data, reducing the cost of under-utilization and over-provisioning, and minimizing the cost of application downtime. Adding these few SSDs to a storage system can significantly reduce I/O wait time, enabling higher server utilization.

Enterprise-grade applications need the scalability and flexibility to migrate data from SSDs to HDDs[2], and back again, as the value of the data changes, not to mention the increased reliability due to no mechanical parts and no rotating parts. All of these factors have increased the attractiveness of SSDs to the enterprise data center.

New processor capabilities are allowing applications to be consolidated which often overwhelms storage systems. There is now a huge disparity between how fast the CPU can process data and the ability of the storage subsystem to deliver it. **The rotational speed of HDDs, with their inherently-limited IOPS, creates a bottleneck that degrades *overall* system performance. Virtualized applications are driving storage I/O demands to new highs as more information is requested. Reducing I/O wait time has become a critical issue for the IT staff looking to improve *server* utilization.** If the data center can minimize I/O wait time, then the enterprise can increase revenue.

SSDs have created a new, faster tier for I/O processing, Tier-0, to deliver the performance required by today's high priority, time-sensitive applications which are being deployed by today's smarter enterprises. SSDs can deliver significant benefits for a data center struggling with lagging I/O performance (See Exhibit 1, on the next page). Even though SSDs are perceived to be more expensive than HDDs on a *cost per GB* basis, they are actually less expensive on an *IOPS per GB* basis. **Unfortunately, SSDs also create a potential administrative nightmare for administrators trying**

[1] See the issue of Clipper Notes dated February 10, 2009, entitled *A New Tier of Storage Appears – Faster, Solid-State Drives State Their Case,* and available at http://www.clipper.com/research/TCG2009006.pdf.

[2] Hard Disk Drives.

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to cope with the dilemma of which storage volumes to assign to which tier. Optimization tools are mandatory, especially where applications and requirements are changing dynamically.

Today, the smarter data center needs help to manage their data. It needs an easy-to-use, multi-tiered storage platform that has support for Tier-0 SSDs, Tier-1 FC HDDs, and Tier-2 SATA drives to provide the performance necessary to keep pace with a rapidly growing enterprise. It needs the scalability to grow dynamically and the flexibility to migrate data from one tier to the next, and it needs the resiliency to enable 24x7 workloads with better than five 9s of availability, ensuring the fastest critical application replication performance. Security is another requirement that is on the front burner of every enterprise data center. Advanced access control and disk encryption are mandatory in order to protect enterprise data assets. Moreover, the enterprise storage platform has to be easy to use – to reduce manual interventions and, therefore, lower the TCO of the storage infrastructure.

In order to provide the enterprise data center with the capability to understand the performance of existing workloads, and which form of storage is best suited for those workloads, a dynamic solution is required to migrate data from one tier to another as the value and urgency of that data changes. In order to assist the data center staff, IBM has upgraded their flagship storage platform, the *IBM Storage System DS8700*, with additional functionality, including an easy to use management tool, *IBM System Storage Easy Tier*, in order to optimize and simplify the performance of enterprise storage assets.

IBM System Storage DS8700

Based upon over fifty years of enterprise-class storage innovation, IBM's System Storage DS8700 provides the enterprise with a proven solution for data storage and delivery. With an installed base measured in the tens of thousands, the DS8700 continues to deliver the kind of performance and scalability that the data center demands in order to supply mission- and business-critical applications with the information they need, when and where they need it.

IBM introduced the DS8700 in October 2009 as the most advanced model in IBM's *DS8000*[3] lineup, introducing new dual IBM *POWER6*-based controllers[4] that innovate to a new level of performance for IBM's flagship enterprise disk platform. With an overall performance improvement of up to over two-and-a-half times, the DS8700 was designed to support the most demanding business applications with superior data throughput, unparalleled resiliency features and five-nines availability. Moreover, with its tremendous scalability, flexible tiered storage options, broad server support, and support for advanced IBM deduplication technology[5], the DS8700 can help simplify the enterprise storage environment by consolidating multiple storage systems onto a single system while providing the availability and performance that you've come to trust for your most important mission- and business-critical applications.

Exhibit 1 –
Potential Benefits of Tier-0 SSDs

- **Increased revenue opportunities** – as a result of more transactions in less time;
- **Reduced infrastructure costs** – because of lower storage acquisition and operational costs;
- **Improved application performance** – as applications dependent on random I/O are unlikely to find their data in cache;
- **Reduced server costs** – as a result of smaller servers, reduced DRAM capacity, and less energy;
- **Improved availability** – due to lower component failure rates and faster error recovery; and
- **Enable new applications** – with higher I/O requirements.

The DS8700 now supports up to 2048TB of storage using 1024 high-capacity, 2TB SATA drives, but it can also support a variety of FC HDDs and solid state disks to provide the data center with the kind of performance required by the most demanding high-performance applications. The DS8700 controllers include a 4-port,

[3] See **The Clipper Group Navigator** entitled *The IBM DS8000* Series of Enterprise Storage is Fast, Scalable, and Now Tiered dated August 30, 2006, and available at http://www.clipper.com/research/TCG2006078.pdf.

[4] See **The Clipper Group Navigator** entitled *UNIX Consolidation and Virtualization – IBM Supercharges System p with POWER6* dated June 12, 2007, and available at http://www.clipper.com/research/TCG2007069.pdf.

[5] See **The Clipper Group Navigator** entitled *The Mainframe and its Storage - The Search for Optimized Infrastructure* dated March 4, 2010, and available at http://www.clipper.com/research/TCG2010007.pdf.

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4Gbps interface for FC and FICON, with RAID-5, -6, and -10 support for data integrity.

In order to maximize the business value of information, the enterprise needs to increase the performance of business applications. How can you increase that performance and by how much? How much floor space can you save by replacing hundreds of under-utilized HDDs with only a few SSDs while improving the I/O performance? With the deployment of SSDs into the DS8700 environment, the data center can increase performance by up to 300% to 400% and remove racks of HDDs.

IBM has now continued down the innovation path, adding to the functionality of the DS8700 with the introduction of IBM System Storage Easy Tier and the *IBM Storage Tier Advisor* tool, in order to initiate a controlled migration of data to SSDs. These tools enable the DS8700 to provide continuous workload monitoring, workload hotspot analysis, and smart data placement to a beleaguered data center staff.

IBM's Easy Tier Solution

IBM's *System Storage Easy Tier* is clearly the headline functionality of Release 5.1 of IBM's System Storage DS8700, providing the IT staff with the capability to automatically optimize SSD deployments by migrating only the hottest data to the SSD environment. **Quite simply – Easy Tier enables the data center with a smarter way to manage storage.** Easy Tier takes the guesswork out of the process, providing the IT staff with a simplified management of tiered storage by automating smart data placement via two relocation functions.

1. **The dynamic ability to automate the relocation of sub-volume data** (in 1GB segments) to the *right* tier based upon historical performance.
2. **The ability to facilitate a non-disruptive manual migration of a full volume of data**, to ease the burden on an already overworked IT staff. This flexibility allows the staff to migrate full volumes to SSDs, and back again, based upon the *usage temperature* of the data, to meet their needs – the hottest data moves to SSD and the coldest data reverts back to HDD.

Easy Tier can migrate full or partial volumes to a new disk type, to a new RAID type, to a drive with a different speed, or to a new striping method. It can provide a *balanced performance level*, delivering the full promise of SSD performance while lowering the TCO associated with over-provisioning an expensive resource. There is no need to try to establish a fixed set of tiering policies that must be set and reset, manually, to accommodate changing workload dynamics.

In fact, IBM has submitted an *SPC-1*[6] benchmark for the DS8700 with Easy Tier consisting of a blend of 2.3TB of SSD and 96TB of SATA HDD, realizing an increase in IOPS of 330% from an all HDD environment. This is the first time that any vendor has submitted a Tier-1 SPC-1 result using SATA and SSD. In a separate benchmark that IBM has run, relocating just 10% of enterprise data from HDDs to SSDs can result in an increase in throughput of 300% based upon an IBM internal DB2 brokerage workload.

In yet another internal IBM benchmark based upon *POWER7*, DS8700, and *DB2*, IBM reported a four-times improvement in throughput for a similar brokerage application. For this benchmark, IBM added 4.6TB of SSD storage to 38.4TB of 15K FC HDDs.

By being smart, Easy Tier can reassure the data center staff that they utilizing all of their storage assets properly, while also reassuring the CIO that they are not overspending for that storage. Using Easy Tier enables the data center with the capability not only to right-size their storage, but it enables them to optimize the infrastructure, as well, consolidating more VMs per server. It also reduces the TCO of the storage by lowering storage administration costs by automating the process of smart data placement. Easy Tier itself is easy to install and is virtually maintenance-free.

IBM has also provided a Storage Tier Advisor tool, a windows-based client to provide guidance on how current workloads can benefit from existing or additional SSDs. The Storage Advisor calculates the present amount of hot data and estimates the migration time to move that hot data to SSDs. This tool provides guidance on how a current workload can benefit from existing and additional SSDs. Administrators can determine the ROI by the rate of performance change. The Storage Advisor shows the amount of hot

[6] SPC-1 consists of a single workload designed to demonstrate the performance of a storage subsystem while performing the typical functions of business critical applications. Those applications are characterized by predominately-random I/O operations and require both queries as well as update operations. Examples of those types of applications include OLTP, database operations, and mail server implementations. For more information, see http://www.spec.org.

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data in each volume and the capacity in each volume that already has SSD capacity. It should be noted here that both of these tools, Easy Tier and the Storage Advisor, are available with the DS8700 at no extra charge.

Additional DS8700 Enhancements

IBM has improved DS8700 scalability with the introduction of support for two new HDD options in Release 5.1 – a 600GB 15K FC drive for enterprise performance with greater capacity and a 2TB 7.2K RPM SATA drive that doubles raw capacity. IBM also has introduced a *mini-pack* option for SSDs to minimize cost. This enables the budget-conscious data center to deploy SSD technology with one-half of the investment. IBM also has updated the DS8700 with the thin provisioning feature previously available on other models in the DS8000 family, along with a faster, concurrent, non-disruptive code load time for faster microcode updates.

In terms of business continuity, IBM has provided enhancements for the DS8700 to support multiple *Global Mirror* sessions, which improves disaster recovery granularity in long-distance disaster recovery deployments. In addition, it has provided an update for *Remote Pair FlashCopy* to enable higher data availability and resiliency. Furthermore, IBM has also delivered a variety of additional enhancements:

- Full disk encryption enhancements to satisfy Payment Card Industry (PCI) data security requirements and
- High-performance FICON Multi-track Extended Distance Support to enable higher throughput for longer *zHPF* distances.

Conclusion

Managing storage growth is rapidly evolving into one of the leading issues for storage managers in all enterprise data centers. They need to have proper capacity forecasting and reporting tools in order to manage the TCO of storage systems. This includes the cost of energy, the cost of floor space, and administrative costs, as well as acquisition cost. The advent of SSDs, while carrying a higher acquisition cost, in fact can lower the TCO for data centers with very high IOPS requirement. For those data centers, the management of data between SSDs and HDDs becomes a critical component in the cost equation. The manual assignment of data between SSDs and HDDs cannot do anything but increase the TCO of any hybrid system. The automatic, dynamic assignment of the data center's hottest data is a bottom line necessity.

With System Storage Easy Tier and the Storage Tier Advisor, Release 5.1 of the DS8700 continues IBM's reputation for outstanding quality and world-class engineering tools. With today's challenging economic climate, the data center needs an enterprise disk platform that combines the highest levels of system and application availability with superior performance and lower TCO, exactly what you get from the IBM System Storage DS8700.

If your enterprise data center needs to provide a higher level of performance from the storage system while staying within the limits of an already tight infrastructure budget, take a closer look at the IBM System Storage DS8700.

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