NetApp FAS6240 Clustered SAN Champion of Champions

Introduction

In today's enterprise, IT staff often work under an unrelenting flood of data and a much more demanding business environment. To survive these challenges, IT organizations must become more adept and efficient than ever before. As such, data center success will depend upon systems and infrastructure that can manage disparate workloads, store vast amount of data effectively and respond quickly to changing business needs. With regard to such diverse storage requirements the NetApp® FAS6240 was recently determined by Silverton Consulting to be a top performing enterprise SAN storage system.

Some enterprise class storage still lacks the agility or flexibility necessary to meet current storage infrastructure requirements. In contrast, NetApp's Clustered SAN systems specifically embrace and embody the scale-out and responsive storage capabilities required by today's more demanding enterprise IT environments.

However, agility may not be enough. Storage systems today must match agility with proven, diversified I/O performance to satisfy an enterprise's changing needs. NetApp has benchmarked superior I/O performance in their FAS6240 Clustered SAN storage array, resulting in its ranking as Silverton Consulting's Enterprise OLTP Champion of Champions™ for 1Q-2013.

NetApp systems have always been known for unified storage, integrated data protection and powerful storage efficiency features. In the fall of 2011 however, NetApp added enhanced clustered services to this potent combination of functionality to provide a more agile and responsive storage infrastructure. NetApp's Clustered SAN storage is tailor-made for the increasing challenges facing current enterprise data centers.

Enterprise challenges

According to many sources, enterprise data continues to grow at ~60% per year. What was once a large storage repository is dwarfed every year or so by current requirements. Moreover, new mobile solutions and applications coming online produce massive amounts of additional data and machine-generated data surpasses even mobile's prodigious information appetite. Lastly, as the Internet reaches over a 2.5 billion users, the data created from online activities just expands exponentially.

At the same time, the world has become a lot more competitive. If it's not current rivals driving this trend then it's developing world companies entering new markets. What this means is that if IT can't deliver functionality in a timely manner, business must seek services elsewhere. With today's SaaS offerings and other cloud-enabled capabilities, just

about any service can be obtained from outside sources. It's no wonder then that IT feels a heightened awareness to react quickly to business requests or forfeit its rights to business spending.

Just as IT has had to become more agile, data center systems and storage also must change to provide more flexibility and responsiveness. Customer and client data can no longer be stuck in rigid and immobile silo'd storage systems. Today's data storage infrastructure must be able to respond to enterprise requirements with speed and agility. That speed and agility is increasingly being delivered through clustered storage solutions that enable horizontal scale out of input/output (I/O) activity across system nodes, provide an elastic pool of capacity across the overall storage infrastructure and as such, can easily scale performance and cluster capacity as enterprise needs change.

NetApp Clustered SAN storage

NetApp's Clustered SAN solution is capable of supporting a wide variety of enterprise data storage functionality and performance requirements. Using a single virtualized pool of storage across multiple hardware nodes, NetApp offers elastic scalability that grows to PBs in capacity with performance to match and easily adapts to whatever work is asked of it. The key tenants of NetApp's Clustered SAN solutions include:

- **Non-disruptive operations –** where upgrades, expansions, and technology refresh of storage hardware can be accomplished while customer data and system storage remain fully online and accessible throughout the process.

- **Seamless scaling** – where HA-pairs of storage systems can be added online to a SAN cluster to increase capacity (up to 17 PB) and/or performance while I/O processing automatically adjusts to accommodate the new hardware.

- **Storage efficiency –** where data can be compressed, deduplicated, thinly provisioned, Snapshot® and cloned in a space efficient manner, minimizing required capacity footprint to support an enterprise's growing data needs.

- **Virtual storage tiering –** where the storage operating system automatically leverages the highest performance media and flash for the most active data via intelligent, self-learning caching hueristics.

- **Unified architecture –** where both file and block storage can be supplied from a single system, enabling the flexibility to respond to dynamic infrastructure needs.

- **Service automation and analysis –** where policy based storage management (provisioning, backup, etc..) and monitoring can be accomplished with minimal operator interaction.

- **Secure multi-tenancy –** where virtual storage servers can be created to enable secure, isolated partitions for multi-tenant customer environments.

- **Integrated data protection –** where storage can provide simple and efficient backup, compliance, and disaster recovery functionality.

- **Embedded data security –** where data-at-rest encryption with self-encrypting drives, key security from SafetyNet KeySecure key management appliances and role-based

access control (RBAC) for management and administration of SAN storage are all available to secure enterprise data storage.

Nevertheless, all that functionality would be less advantageous if system I/O performance were not plentiful. To that end, NetApp recently submitted their high-end Clustered SAN storage to an industry standard, Storage Performance Council benchmark that demonstrated NetApp's superior enterprise storage performance.

Storage Performance Council benchmarks

The Storage Performance Council[1] (SPC) has been auditing and publishing SAN storage benchmarks for almost a decade now and continues to be the number one source of independently validated block storage performance information. SPC currently supports six block storage benchmarks but the most popular continues to be their SPC-1™ benchmark.

SPC-1 was designed to ".... demonstrate the performance of a storage subsystem while performing the typical functions of business critical applications."[2] In other words, highly randomized block IO activity that mimics database-like queries and transaction updates, e.g., online transaction processing (OLTP), email server functionality and other database intensive activity. SPC-1 simulates such database activity so that I/O performance can be readily compared across a number of different storage systems and host environments.

Furthermore, all SPC benchmarks require and publish system price quotes. This allows SPC-1 results to be divided into enterprise class systems (those systems under test that cost > $1M USD), mid-range systems (systems that cost < or = $1M and > $100K) and small systems (costing < $100K). For the performance analysis below, only enterprise class storage systems will be considered. Also, all flash and all DRAM storage arrays were specifically excluded from this evaluation as their performance cannot be easily compared to hybrid (flash with mostly disk capacity) or all-disk storage arrays.

NetApp FAS6240 Clustered SAN benchmark performance

NetApp's FAS6240 Clustered SAN SPC-1 performance is fully documented in their submission report found online.[3] This report details the storage configuration under test and system performance results, which are analyzed below.

Their SPC-1 benchmark was carried out using a six-node, NetApp FAS6240 cluster, each with 48GB of cache memory and 512GB of FlashCache® with two-8Gbps Fibre Channel (FC) front-end connections running Data ONTAP® 8.1.1 software. Its backend storage capacity included 432-450GB, 15KRPM SAS disk drives. Two FAS6240 nodes were configured together in a high availability (HA) pair, with 144 of the backend disk drives cross-coupled between them. The HA pair configuration was repeated three more times to create the six-node FAS6240 SAN storage cluster.

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[1] Please see http://www.storageperformance.org/home/ as of 22 January 2013

[2] Please see http://www.storageperformance.org/results/benchmark_results_spc1 as of 11 January 2013.

[3] Please see http://www.storageperformance.org/benchmark_results_files/SPC-1/NetApp/A00115_NetApp_FAS6240-cluster/a00115_NetApp_FAS6240-cluster_SPC-1_full-disclosure.pdf as of 11 Jan 2013
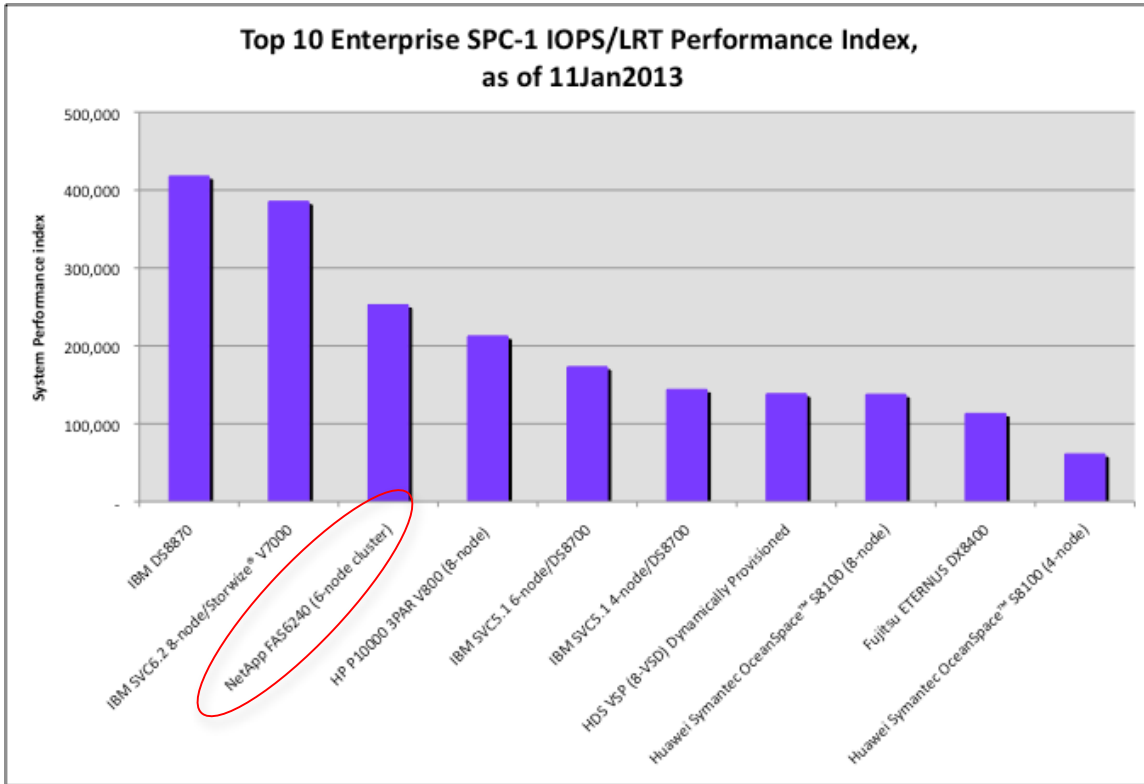
Figure 1 Top Enterprise SPC-1 IOPS/LRT Performance Index results

While SPC-1 results report on a number of primary metrics, the first chart (see Figure 1 above) of enterprise system rankings combines two measures to portray system performance across multiple dimensions of I/O workloads. The performance index shown above divides maximum system I/O operations per second (SPC-1 IOPS™) by the system's least response time (SPC-1 LRT™) which displays how well a storage system would handle disparate workloads such as sustaining high operations throughput in conjunction with high cache hit activity.

In Figure 1 the top 10 Enterprise storage systems are ranked by their IOPS/LRT performance index. The NetApp six-node, FAS6240 Clustered SAN storage came in third with both a superior LRT and a highly competitive IOPS rating behind a second place, eight-node competitive system. This shows that NetApp storage has the ability to perform well under different and varying I/O workloads.
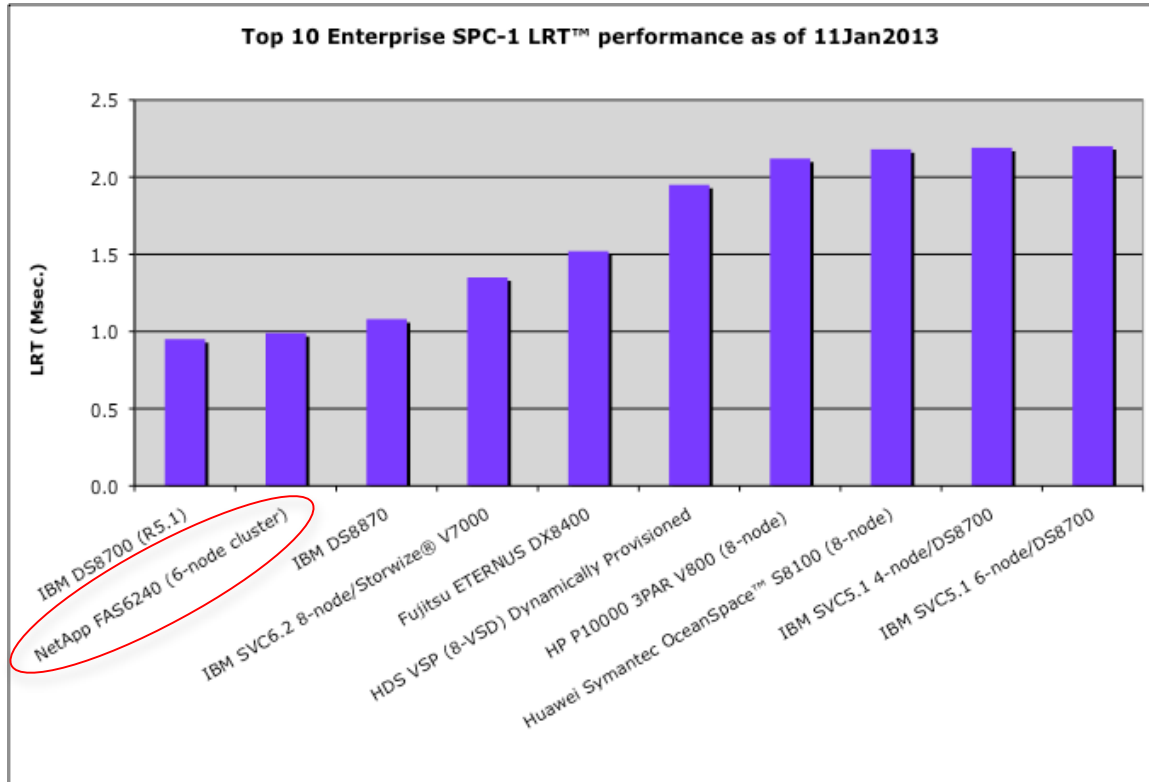
Figure 2 Top 10 Enterprise SPC-1 Least Response Time (LRT™) results

Next we turn to system response time or SPC-1's reported LRT metric. LRT provides a good measure for how quickly a storage system can respond to cache hit activity such as read requests found in cache or write activity that lands data in cache. LRT is calculated as an average for all I/O requests for storage operating under a workload that represents 10% of the system's peak SPC-1 IOPS performance.

As can be seen in Figure 2, the NetApp FAS6240 performed second best over all for enterprise class storage systems at 0.99 milliseconds. It wasn't that long ago when LRT results never came in under or even near 1 millisecond. But as shown above at least three enterprise class systems are within 20% of a 1 millisecond LRT today.
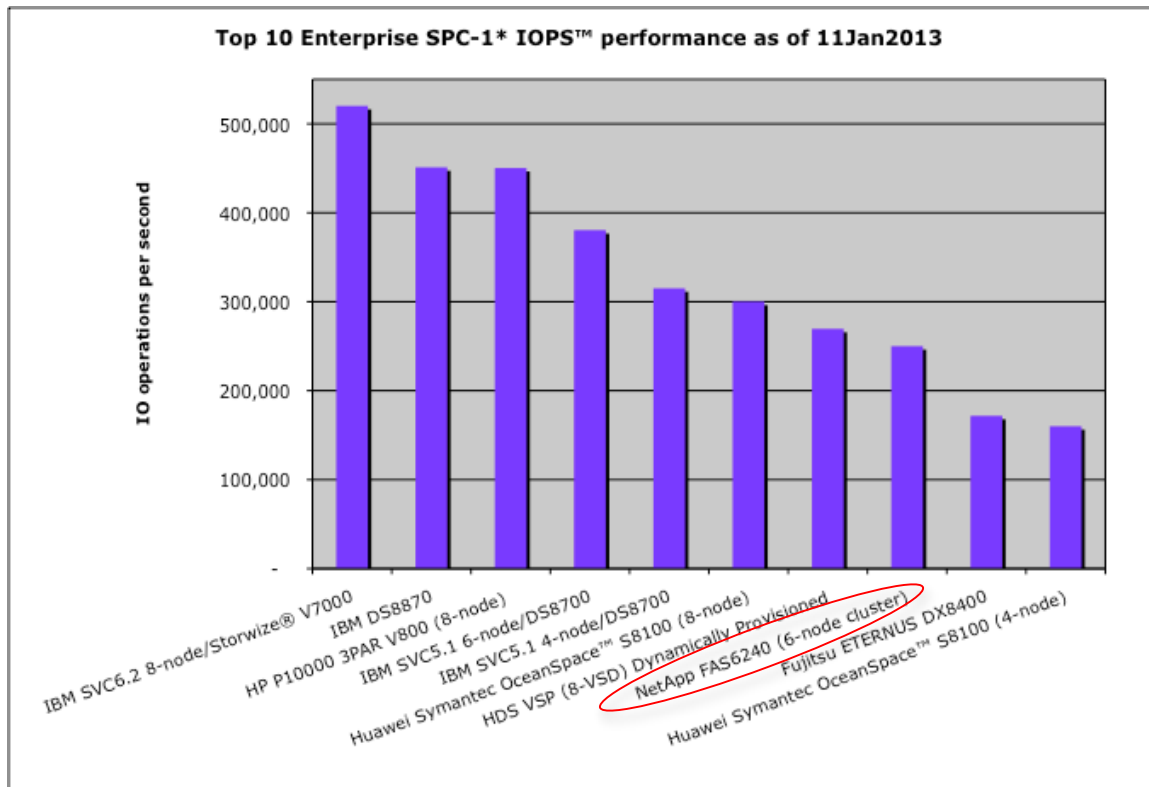
Figure 3 Top 10 Enterprise SPC-1 I/O operations per second (IOPS™)

In Figure 3 the top enterprise class storage systems are ranked by IOPS performance. As can be seen above there are quite a few multi-node SAN clusters present from many vendors which includes four eight-node systems, two six-node systems and two four-node systems. NetApp's FAS6240 with a six-node cluster came in eight place behind the four eight-node systems with its 250K IOPS performance. Although it may be slightly unfair to compare a six-node system against eight-node systems, the NetApp storage still performed well.

... NetApp FAS6240 Clustered SAN storage is SCI's Enterprise OLTP Champion of Champions for 1Q-2013...

Finally, another approach to evaluating storage system performance is to normalize system results based on storage hardware under test. It's important to note that SPC-1 benchmark submissions typically use dissimilar system configurations, such as a different number of drives, amount of DRAM cache and NAND/SSDs. However, using Silverton Consulting's (SCI's) proprietary technology, we can normalize system I/O performance and compare them as if they were running the same configuration.

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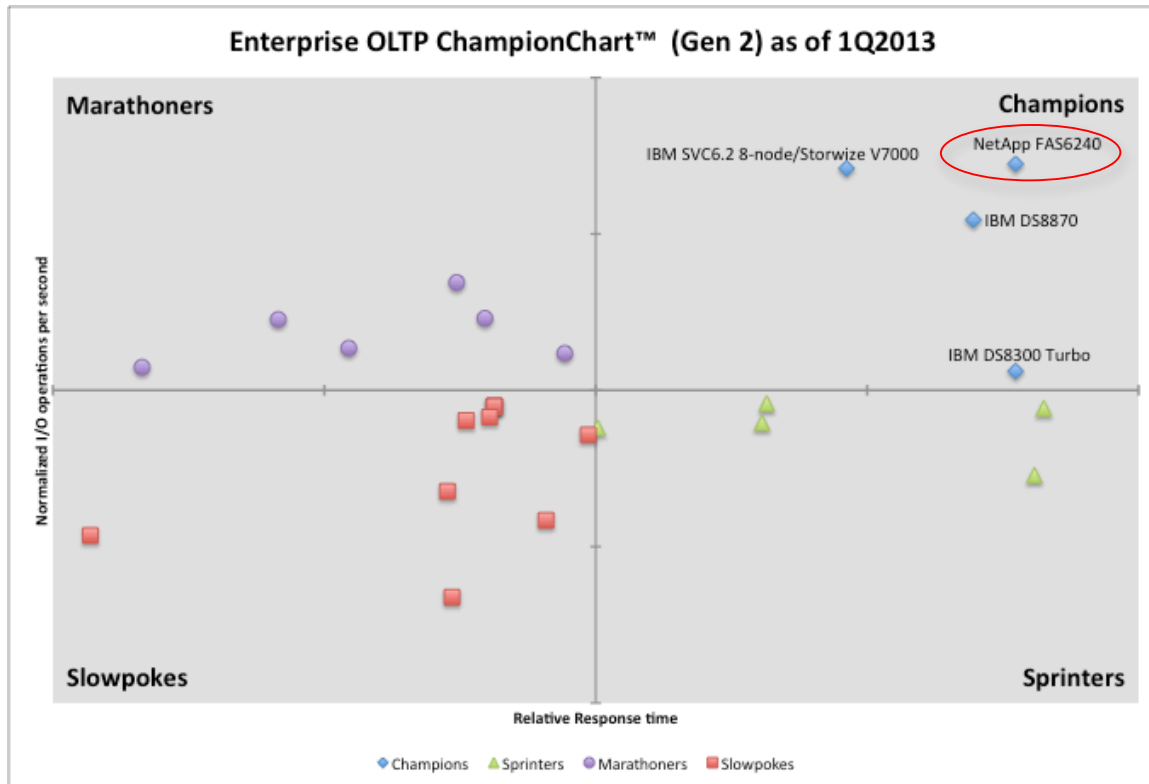Strategy, Storage & Systems

Figure 4 Silverton Consulting's Enterprise OLTP ChampionsChart™

In Figure 4 above, the 2nd generation of SCI's OLTP ChampionsChart™ for Enterprise Storage portrays this normalized I/O performance. In viewing this chart as one moves higher up the vertical axis systems exhibit better IOPS performance than expected given the system configuration under test. Similarly, as one moves further to the right in the above chart, systems exhibit relatively better response time than expected.

All of SCI's ChampionsCharts are divided up into four quadrants:

- **Champions quadrant** – systems found here exhibited the best normalized IOPS and relative response time.
- **Sprinters quadrant** – systems found here displayed good relative response time but relatively poor normalized IOPS performance.
- **Marathoners quadrant** – systems found here resulted in the good normalized IOPS but poor relative response time
- **Slowpokes quadrant** – systems found here manifested the worst normalized IOPS and relative response times.

As can be seen in Figure 4 above the NetApp FAS6240 Clustered SAN storage is SCI's Enterprise OLTP Champion of Champions for 1Q-2013 or the best performer in combined normalized IOPS and relative response time for the 25 enterprise class storage systems in current SPC-1 results. NetApp's Champion showing indicates that its storage would perform on average better than other storage systems when configured with equivalent hardware. The other systems in the Champions quadrant didn't do as well as NetApp's FAS6240 Clustered SAN but still performed admirably.

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Please note, only one other multi-node clustered storage system reached the Champions quadrant above. As such, the significant advantage in performance portrayed in IOPS ranking (see Figure 3 earlier in this report) by the other eight-node clusters vanishes when one considers how systems could perform with similar hardware configurations.

Summary

In short, some enterprise class storage still lacks the agility or flexibility necessary to meet current storage infrastructure requirements. In contrast, NetApp's Clustered SAN systems specifically embrace and embody the scale-out and responsive storage capabilities required by today's more demanding enterprise IT environments.

However, agility alone no longer suffices for today's rapidly changing enterprise environments. Nowadays, storage systems must also perform exceptionally well on multiple dimensions to support an enterprise's diverse needs. NetApp FAS6240 Clustered SAN storage system SPC-1 benchmark demonstrated superior I/O performance resulting in its ranking as SCI's Enterprise OLTP Champion of Champions for 1Q-2013.

When one combines the agility present in Data ONTAP Clustered SAN storage with the proven performance available from the NetApp FAS6200 product family one gains a storage system that easily satisfies today's enterprise data center challenges. Indeed, NetApp Clustered SAN systems supply a compelling solution to meet current mission critical storage needs as well as future enterprise storage requirements.

Silverton Consulting, Inc. is a Storage, Strategy & Systems consulting services company, based in the USA offering products and services to the data storage community.