



ENERGY AND PERFORMANCE COME TOGETHER WITH STORAGE BENCHMARKING

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RESEARCH AREA

» Enterprise Storage

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Introduction

Green IT concerns, such as power consumption and carbon emissions, continue to grow in importance with end users. While cost-cutting is a tangible incentive for Green IT programs, such initiatives are no longer just about saving money. Higher level issues, such as understanding and minimizing an organization's environmental impact, are driving organizations to quantify their carbon footprint and take action to reduce it. As such, demand is growing for suitable tools that help IT decision makers weigh their energy reduction goals against the performance requirements of their organization.

The Storage Performance Council (SPC) is one organization working to meet that demand. Recently, the SPC announced the SPC-1/E Benchmark, its second storage performance benchmark to include energy extensions. Historically, industry-standard benchmarks have focused primarily on the performance and price/performance of the tested configurations. The SPC-1/E Benchmark adds real-world energy consumption to the mix, offering more detailed insight into the various tradeoffs (performance, energy usage, and cost) of deploying one product – or one technology – over another.

Two SPC-1/E results have been released to coincide with the introduction of the new benchmark. Xiotech, a storage solution provider, has posted two separate results for the same Emprise 5000 product. Xiotech's two test configurations were identical except for the disk technology used: The first test used 146 GB 15K RPM FC disk drives while the second used higher capacity, but slower, 600 GB 10K RPM FC Seagate drives.

Xiotech's approach to this new benchmark provides interesting insight into the performance and energy-efficiency tradeoffs of deploying the higher-capacity/lower-performance 10K rpm drives versus the higher-performance/lower-capacity 15K rpm drives. In this report, Ideas International (IDEAS) analyzes the outcomes of the two test results over a series of metrics to help users understand which disk technology may be better suited to their needs.

The New SPC-1/E Benchmark Extensions

With the growing focus on Green IT, the SPC continues to expand its benchmark family to include quantifiable data on energy consumption as well as performance. Recently, the SPC announced its second benchmark to include energy extensions, the SPC-1/E Benchmark.

Earlier this year, the SPC released the SPC-1C/E Benchmark, which expanded the SPC-1C "Component" Benchmark to support energy extensions. While the SPC-1C/E applies only to Small Storage Subsystem configurations, the SPC-1/E (and SPC-1) extends into larger, more complex storage subsystems. The benchmark provides the opportunity to examine not only the performance and price/performance characteristics of the tested configurations, but also the energy consumption characteristics. Moreover, the benchmark offers acute insight into the relationships between these three metrics.

What is the real impact on performance and energy consumption between using the much touted high-performance 15K RPM drives versus the high-capacity 10K RPM drives?

Until recently, performance benchmarks were primarily about speed. But now, with the addition of energy extensions to the SPC benchmarks, other factors can be taken into account when assessing a product's applicability to a particular environment. These added dimensions can show that in some circumstances, raw performance or price/performance isn't everything.

The SPC-1 Benchmark consists of a single workload designed to demonstrate the performance of a storage subsystem as it carries out the typical functions of business critical applications. Such applications are characterized by predominately random I/O operations and require both queries (read) as well as update (write) operations. Examples of these types of applications include OLTP, database operations, and mail server implementations. The SPC-1/E Benchmark introduces the measurement of energy during the test. Performance and energy measurements are taken continuously throughout the testing period to build a picture of energy consumption, not only at the peak and idle states, but also at the points in between.

With the introduction of this new benchmark two results have also been released for the Xitech Emprise 5000. These results provide an opportunity to see how the benchmark can bring a new level of detail and insight into the public domain – one generally reserved for storage specialists in vendor organizations.

Let's look at the available results to see what the outcomes reveal.

Xitech Emprise 5000 on SPC-1/E

Storage solution provider Xitech has released two separate SPC-1/E results for the same Emprise 5000 product. Xitech's Emprise 5000 is a complete, self-enclosed, virtualized storage solution built on its Intelligent Storage Element (ISE) technology. The ISE is a tightly integrated storage environment, purpose-built, according to Xitech, to maximize performance and reliability. Each ISE includes one or two sealed DataPacs (capacity modules) and dual Managed Reliability Controllers, which locally manage cache and data protection processes.

What is very interesting is that two tests for the same product have been released at the same time, with only the drive type changing between the tested configurations. What Xitech has done is to modify only one variable in the configuration, in this case the disk technology used, between the two tests. The first test used 146 GB 15K RPM FC disk drives while the second used 600 GB 10K RPM FC Seagate drives. Everything else about the configurations remained the same.

Top marks go to Xitech for this approach. Even if one is not in the market for a Xitech product, the outcomes of these tests are interesting because they provide some visibility on more general technology concerns, such as: What is the real impact on performance and energy consumption between using the much touted high-performance 15K RPM drives versus the high-capacity 10K RPM drives?

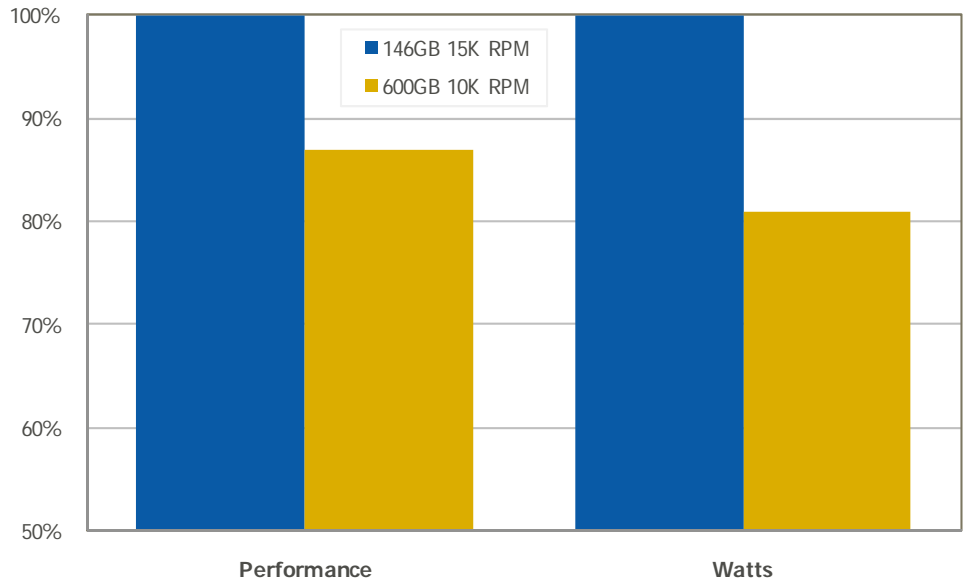
So which is best?

Analysis of Results

As stated above, the first test of the Xitech Emprise 5000 used 146 GB 15K RPM disk drives and the second used higher capacity, but slower, 600 GB 10K RPM Seagate drives. Ten drives were configured into each subsystem. Chart 1 (next page) provides a summary of the high-level outcomes.

These results suggest that a modest tradeoff in performance can result in potentially significant energy savings.

Chart 1 – Performance Compromise vs. Power Savings



Source: Storage Performance Council (www.storageperformancecouncil.org)

As expected, the faster 146 GB 15K RPM drive configuration provides higher levels of performance. It also consumes more power. But if performance is not a primary factor then the lower energy profile of the slower disks may be of interest.

The chart reveals that the relationship between performance and power consumption is not linear. Compared to the 146 GB 15K RPM configuration, the 600 GB 10K RPM configuration consumes 19.4% less energy yet delivers only 12.9% less performance. These results suggest that a modest tradeoff in performance can result in potentially significant energy savings. These potential savings may be further enhanced once the extra storage capacity of the 600 GB drive is factored in.

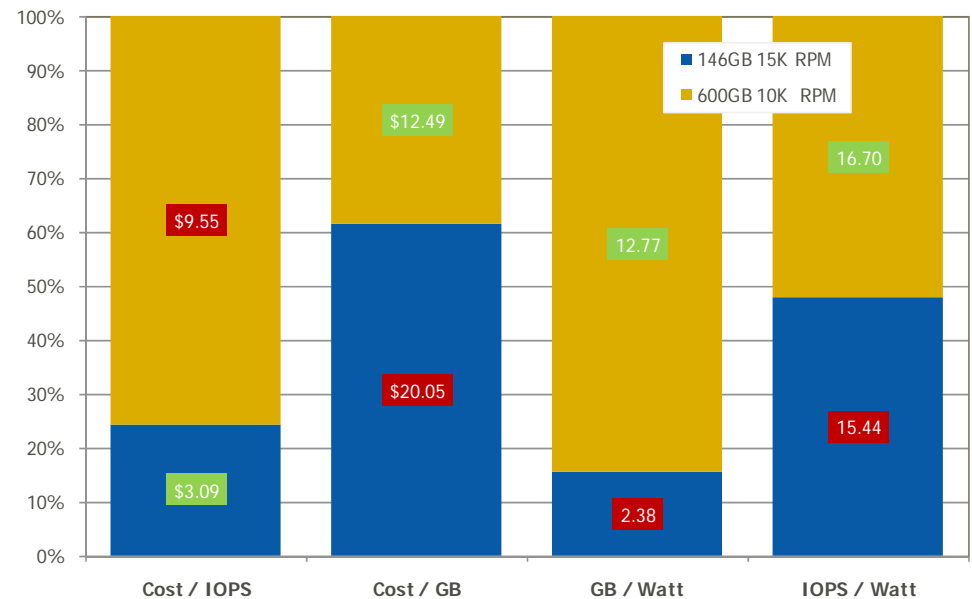
Chart 2 (next page) looks at four metrics from the two tests to quantify these extra dimensions. IDEAS has taken the key outputs from the two SPC-1/E tests – such as performance, energy consumption, cost of solution, and capacity – and created four composite metrics:

- » Price /Performance (Cost/IOPS)
- » Price/Capacity (Cost/GB)
- » Capacity per Watt (GB/Watt)
- » Performance per Watt (IOPS/Watt)

Chart 2 plots the outcomes for each of the four metrics in a head-to-head fashion. The 146 GB 15K RPM drive outcomes are in blue and the 600 GB 10K RPM outcomes are in yellow. Note that the biggest area in a given bar is not always better. When it comes to price/performance for example, smaller is better. The labels for each segment of each bar have been color coded. Green indicates the more favorable outcome, while red indicates the less favorable one.

Among the four metrics that IDEAS analyzed, Capacity per Watt produced the largest delta between the two configurations.

Chart 2 – Storage: Capacity/Power/Price Profiles



Source: Storage Performance Council (www.storageperformancecouncil.org)

Capacity per Watt (GB/Watt)

The high-level outcomes discussed above show that using the slower 10K RPM drives over the faster 15K RPM drives can reduce raw energy consumption by 21%. However, this outcome does not factor in the capacity differential of the two subsystems. Taking the overall capacity supported between the two subsystems into account reveals that the 10K RPM 600 GB drive subsystem can provide over 12.7 GB per Watt while the 15K RPM 146 GB drive subsystem provides just under 2.4 GB per Watt. Among the four metrics that IDEAS analyzed, Capacity per Watt produced the largest delta between the two configurations. This outcome shows that if capacity and energy consumption are paramount, then there are big savings to be realized from deploying a slightly lower performing product.

Price/Capacity (Cost/GB)

Taking energy out of the equation and looking at price per capacity, the 600 GB 10K RPM offering has the edge over the 146GB 15K drive. However, compared to Capacity per Watt, the differences are less pronounced, with the 15K drive configuration costing \$20.05 per GB versus \$12.49 per GB for the 10K drive configuration.

Price /Performance (Cost/IOPS)

From a Cost/IOPS perspective, the 15K drive type wins. In this case, capacity carries a higher premium than performance. Due to the higher capacity drives, the cost of the 600 GB 10K configuration is relatively much higher than the performance differential between the two configurations. The 146 GB subsystem provides slightly (15%) more performance than the 600 GB 10K configuration at a much lower (about one third) price.

The SPC-1/E Benchmark gives Xiotech an independent means on which to demonstrate its PowerNAP feature and quantify any potential savings.

Performance per Watt (IOPS/Watt)

Perhaps the surprise of the four metrics is that the 600 GB 10K solution wins in the performance per unit of energy metric, IOPS/Watt. Although the 15K drives offer more performance, the 10K drives consume significantly less energy. While the two effects essentially work against each other, the energy advantage of the 10K drives ultimately wins out. The 10K drive subsystem delivers 16.7 IOPS per Watt while the 15K drive subsystem delivers 15.44 IOPS per Watt.

The Overall Outcome

What does all of this mean? Well, the 600 GB 10K RPM drive configuration is better in three of the four categories, where capacity and energy use are dominant factors. But not surprisingly, where flat out performance is the overriding criteria, the 146 GB 15K RPM subsystem has the ascendancy over the 600 GB 10K RPM variant.

Idle Power Consumption – How Low Can It Go?

Another newsworthy aspect of these two test results is Xiotech's demonstration of its PowerNAP feature. PowerNAP was announced in April of 2009 and is a feature of the Emprise 5000 product line that allows the subsystem to be placed into a low-power standby mode during idle periods. It is ideal for storage systems that undergo extended idle periods, such as those used for back up to disk, disaster recovery, archival storage, and workloads that run only during standard business hours. Using Wake-on-LAN protocols, PowerNAP can be initiated from the system management interface either directly or remotely, or it can be automated for regular, hands-off use. According to Xiotech, this feature allows the subsystem to go from 500 Watts of energy consumption at "application idle," to around 24 Watts in this PowerNAP "deep-idle" state.

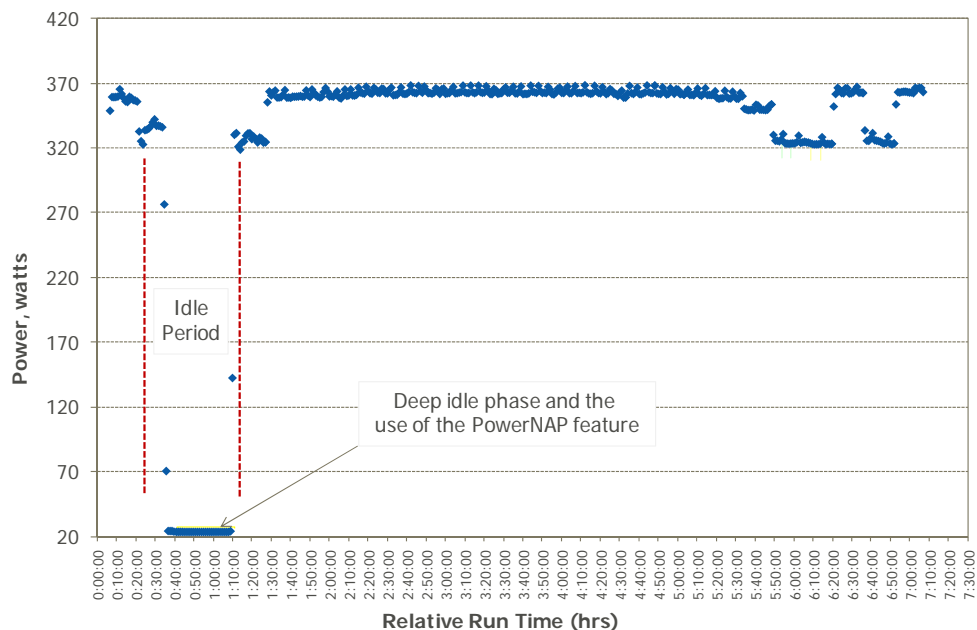
If an organization has long periods where the subsystem is idle, being able to reduce energy consumption in such a big way can be very beneficial. How much an organization can save is very dependent on the workload profile and how much idle time exists. For example, a highly utilized installation with no idle time during a 24-hour period will not realize savings from PowerNAP. However, in a low-utilized installation, where the workload is essentially run only during business hours, there may be as much as 16 hours per day of idle time. In this scenario, deploying PowerNAP could result in significant energy savings.

Based on the SPC-1/E results for the 146 GB configuration, IDEAS calculated the electricity costs to run the subsystem at around \$173 per year using the PowerNAP feature, and as much as \$476 a year without – representing a savings of over 60%. Until now, IDEAS only had Xiotech's claims, which were not easy to independently verify. The SPC-1/E Benchmark gives Xiotech an independent means on which to demonstrate its PowerNAP feature and quantify any potential savings.

Chart 3 (next page) shows the power usage profile of the 600 GB 10K RPM configuration for the duration of the test. The workload moves through various states throughout the test, including an idle period toward the beginning. This is where Xiotech used the PowerNAP feature.

... the SPC Benchmarks with energy extensions help because they quantify outcomes, providing more than just rule of thumb estimates. Sometimes they produce counterintuitive outcomes that could not be arrived at without the data.

Chart 3 – SPC-1/E Benchmark Power Usage Profile 600 GB 10K RPM Configuration



The depth of information provided by the SPC Benchmarks is very informative and will allow companies to assess with a lot more clarity the intersection of performance and energy consumption. IDEAS certainly looks forward to future competitive tests, where other companies will demonstrate their power-saving features.

In Review

At this time, Xiotech's Emprise 5000 is the only product featured in the SPC-1/E test; hence, it is difficult to draw competitive comparisons. However, the PowerNAP feature in particular is certainly eye-catching, given its ability to reduce power consumption to such a high-degree. This technology, which is not yet common in the industry, is a sign of things to come.

With the addition of energy extensions, IDEAS believes that the SPC Benchmarks are taking on a new level of relevance. In light of the increasing focus on Green IT, the IT community is crying out for independent, quantifiable, and verifiable insights into the tradeoffs involved in choosing one technology over another. As this report has shown, the addition of the energy extensions to the performance perspectives of the SPC Benchmarks enables more in-depth analysis of the technologies being tested. The benchmarks enable users to probe multiple dimensions – not only in isolation, but in conjunction with each other – in order to choose the technology that best suits their needs.

Moreover, the SPC Benchmarks with energy extensions help because they quantify outcomes, providing more than just rule of thumb estimates. Sometimes they produce counterintuitive outcomes that could not be arrived at without the data. For example, in an industry where the need for speed is built into the collective psyche, the analysis of these two results – where the 600 GB 10K RPM drive solution won in three of the four categories – shows that the fastest is not always the best for a given situation.

Of course, many variables go into the makeup of a storage solution, and what proves true in one scenario may prove false in another. However, with the increasing importance users are starting to put on Green IT and understanding an organization's environmental impact, IDEAS believes access to this sort of quantifiable data is very important to allow users to make more informed decisions.

ABOUT THE STORAGE PERFORMANCE COUNCIL (SPC)

The SPC is a non-profit corporation founded to define, standardize and promote storage benchmarks and to disseminate objective, verifiable storage performance data to the computer industry and its customers. The organization's strategic objectives are to empower storage vendors to build better products as well as to stimulate the IT community to more rapidly trust and deploy multi-vendor storage technology.

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