



# WHITE PAPER

## Hitachi Leads with SAS

**By Mark Peters**  
With Steve Duplessie

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# Introduction – HDS, SATA, and SAS

## Semantics vs. Value

All too often in the world of IT, goodness can be obscured by semantics; positive advances are often buried in obfuscation. Just look at the title to this introduction—three acronyms before even one sentence is written! Acronyms don't always help. Indeed, they can often complicate an already confusing issue. While a certain level of detail is always going to be needed, most buyers—IT or otherwise—buy attributes rather than acronyms. They buy things that are going to be useful—abbreviations don't communicate utility. Lest this all seem too obvious, the reason for such clarification is that HDS now offers a SAS architecture for mid-range customers. Such a statement is the start down a path of interminable and escalating part-number detail and spec-sheet ennui. It is simply nuts and bolts. Features are important, but as any Sales 101 attendee knows, customers buy advantages and benefits.

So, to put it differently, Hitachi now offers a mid-range storage product that uses the latest technology to permit users to benefit from high-end features and capabilities in a flexible, risk-free package that they can both afford and actually use without a PhD. It has been designed to address the very reasonable premise that being a 'medium-size' business does not have to automatically mean compromised business and operational needs when it comes to storage. Yes, the scale might be less (although these days 'medium-size' is getting pretty big), but the features and functions are basically the same because all the challenges of business, data-management, and regulatory-compliance are precisely the same... unaffected by whether the 'enterprise' is measured in TB or PB. Indeed, one could argue that the challenge of creating a successful mid-range system is tougher for vendors because, in addition to the normal overall needs of functionality and affordability, they must also make something that is very flexible and very easy to use. This is because mid-sized businesses are more likely to have more applications and users on just one or a few device types—and less likely to have an army of storage specialists available to manually tweak their systems.

## Market Needs

The Hitachi Data Systems AMS 2X00 is aimed at the mid- to high-end of the modular storage market. By its very nature, the inherent details will get a lot of publicity and discussion. After all, the product includes things that are new to this market segment: SAS architecture and drives, active-active controllers, and a number of other new features. Of course, this paper will have to detail some of the basic features, but throughout the discussion, the intent will be to cover more than the list of ingredients—instead focusing on what those ingredients can mean to users and why they are important in the networked storage market.

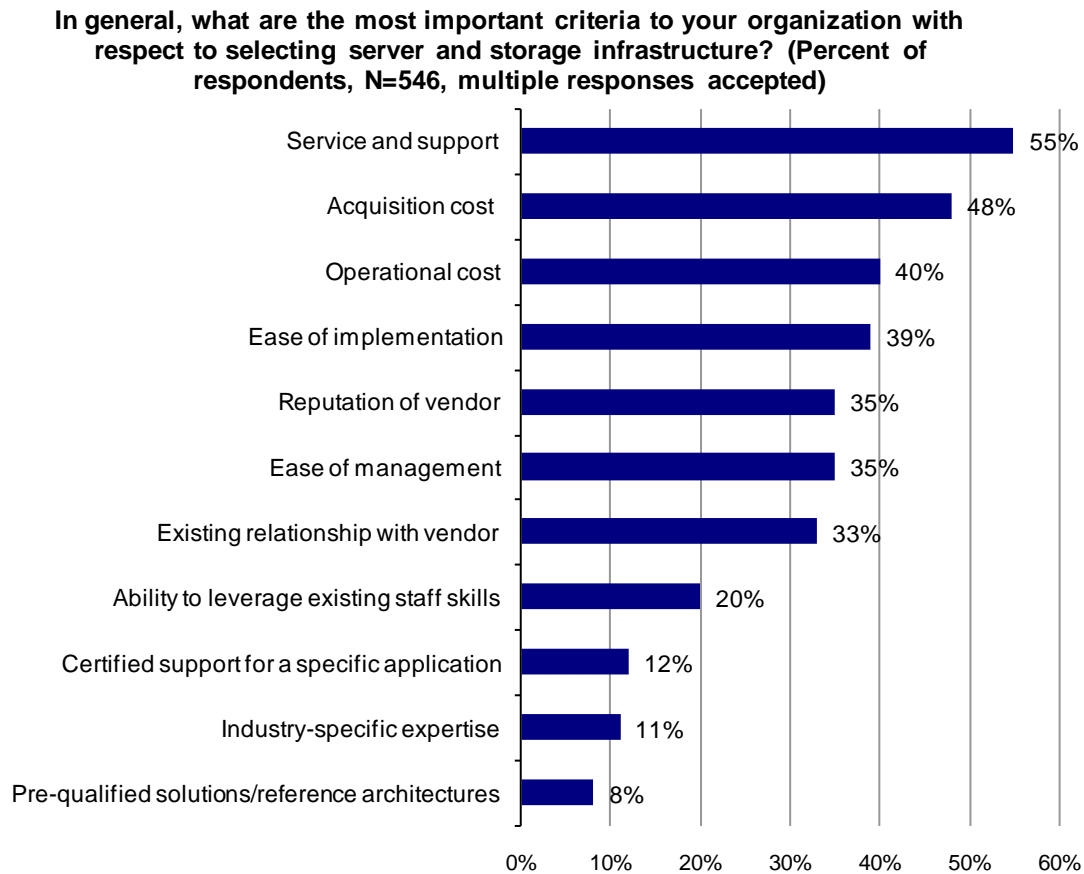
Before looking at the new product family, a quick reminder of what we commonly think of as the basic challenges facing businesses—the mid-range as much as any—is worthwhile:

- Operational Needs
  - Flexibility to cope with growth of both applications and servers (whether physical or virtual)
  - Keep personnel costs low through task automation and by making management and administration easy
- Business Prerequisites
  - Investment value and protection (flex with a growing and changing environment)
  - Keep operational costs to an optimal minimum
- Data Protection Requirements
  - Ensure uptime, availability, and recovery (but with minimized backup windows)
  - Security, ability to protect the business (via compliance) as well as the data itself

Although looked at with slightly different terminology, and in a different priority order, Figure 1 shows that many of these attributes are indeed important to end-users. Recent ESG research looked specifically at the mid-range marketplace and the criteria that are most important to users when choosing server and storage infrastructures. It

is a very revealing list; one that will be referred to many times when evaluating the likely impact and true market applicability of the new AMS product packages.

**FIGURE 1. MID-RANGE USER BUYING CRITERIA FOR SERVER AND STORAGE INFRASTRUCTURES**



Source: ESG Research Report: Medium Size Business Server and Storage Priorities, June, 2008

## The New AMS Announcement

This month, Hitachi introduced its latest members of the Adaptable Modular Storage family. There are three versions, all offering the new highlight features:

- Symmetric Active-Active controller with Dynamic Load Balancing
- SAS storage architecture for performance and reliability

The SAS backend has the advantage of supporting SAS, SATA, or a combination of both disk types with host connectivity being either FC or iSCSI. This build-out of Hitachi's offerings is all part of its overall SOSS (Services Oriented Storage Solutions) architecture, which laudably aims to integrate all block-, file-, and object-based storage; with specific application needs addressed via a 'business-centric,' GUI-based management approach that encompasses everything from virtualization and migration to search. What is more than just 'laudable' is that Hitachi is actually delivering on the vision.

At a high level, the new AMS products promise to address the basic challenges mentioned earlier:

- Addressing Operational Needs
  - Advanced, Dynamic Load Balancing controller and an intuitive GUI
  - Performance and capacity scaling via the fast backplane, RAID groups, and 'MegaLUN'
  - Combining the load balancing and performance capabilities produces devices especially well suited to function in rapidly growing virtual server environments
- Addressing Business Prerequisites
  - Backwards and forwards drive compatibility, and data-in-place upgrades
  - Optional SATA drives to permit economically appropriate tiering and spin-down
- Addressing Data Protection Requirements
  - Five 9's reliability, and wide ranging DR capabilities
  - Security, ability to protect the business (via compliance) as well as the data itself

The two smaller models (2100 and 2300) are already shipping and the high-end 2500 is expected around year-end.<sup>1</sup> There is a great deal of features and functionality within the new products—from the operational ease of the controller to VMware suitability—but before everything else, the number one point of interest for most prospective users is likely to be the implementation of a SAS back-end architecture and drives.

## SAS Architecture

### SAS Technology

SAS, Serial Attached SCSI, is a composite of very mature technologies (ATA, SCSI, and FC) often described as the 'best of all worlds.' First and foremost, SAS leverages the thoroughly well known and proven SCSI protocol, but with increased speed, error recovery, and expandability when compared to bus technologies (such as FC). Just because it is portrayed as a 'mid' type architecture does not mean its main operational attributes are anything less than the standard FC alternative. With dual porting and full duplex, it provides a very viable networked storage option for users that do not need the largest systems and do not want the high complexity and cost that accompanies them. Like many good things, it's relatively easy to explain:

- **High Performance** – the architecture is currently at 3 GB/sec. This compares to either 2 or 4 GB/sec for FC; however, SAS offers a full duplex interface to the disks, which translates to greater internal bandwidth and allows more work to get done.
- **Improved Connectivity** – SAS is a point-to-point architecture, which is better for enterprise operations when compared to shared drives on a shared bus (or arbitrated loop). In the latter method, each drive 'waits its turn' for connectivity to the controller, whereas the point-to-point method provides considerable concurrency, which translates to improved performance. Remember that this direct connection is not just some arcane engineering nicety—it is the ability to consistently give access to data for applications and users. It is about getting work done. FC's restriction to a 1:1 connection over the arbitrated loop can be mitigated—at a price—via switching but even then, the communication is simplex rather than duplex.
- **Enterprise Class Drives** – the drive building block for SAS is a tried and tested technology; essentially the same physical HDDs that are used elsewhere, spinning at 15k RPM (up to 300 GB at that speed) just like the FC connected devices that users are accustomed to. Indeed, there are some who run SCSI 3 over FC and use the same drives! For SAS, all that's changed is the interface—and that has itself been well proven in server environments. Reliability (or Mean Time Between Failures, MTBF) is consequently as good as FC drives. A quick check of specifications on any of the main HDD supplier or industry group websites reveals that the MTBF for both SAS and FC drives is typically between 1.2 and 1.4 million hours; although this is somewhat higher than SATA. What's even more important is that, given the target

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<sup>1</sup> Note that these models do not replace the existing FC-only 200, 500 and 1000, which are planned to continue at least into 2009.

market and applications for SAS products, the duty-cycle for which SAS is intended (80-100%) is very much higher than it is for SATA (can be down around 20%). SAS drives are designed to be enterprise class 'work-horses.'

- **Operational** – the move from parallel to serial results in far fewer—and less cumbersome—cables. Some parallel systems were getting to the point where the cabling was actually a reliability and practicality issue; not only in terms of 'connection-confusion,' but simply because the cabling was becoming bigger than the drives themselves! Better yet, one cable type supports both SAS and SATA drives.

## SAS Value

First and foremost, SAS represents a genuine alternative to FC for high performing and high reliability business operations. Although the basic 'bricks' (HDDs) are the same as FC, the potential value to users of SAS comes from everything that goes into creating an overall SAS architecture: the interface itself, the cabling, and the easy ability to support SAS and SATA on the same shared system and shelves. And, of course, with Hitachi's new AMS devices, there's the operational efficiency of the controller (discussed in depth in the next section).

SAS offers a new, convenient 'medium-size' choice for users that, though really not the highest 'enterprise scale,' have previously been forced to choose between SATA (lower performance and potential reliability concerns) and FC (architecturally more complex with potential for arbitrated loop 'traffic jams'), this is a perfect balance. It is proven, reliable, fast, and economical. Probably the only thing standing in the way of even faster SAS success is the natural skepticism of anyone when faced with such a deluge of fine qualities after becoming so accustomed to compromises.

Now, of course, SAS remains more expensive than a pure SATA play, so only users who really need the performance and functionality of SAS are likely to move up. That said, the ability to mix and match SAS and SATA (and the various speed and capacity types within both categories as well) makes for a very flexible proposition that allows for increased consolidation by supporting a wider range of drives in one device—both a key driver of consolidation and also an opportunity for economic optimization for mid-range IT organizations.

## SAS Potential

As mentioned in the introduction, details and specifications are important—just not as important as what they mean to users: what useful work can be done and what necessary IT needs fulfilled? SAS represents a viable and powerful option for users.

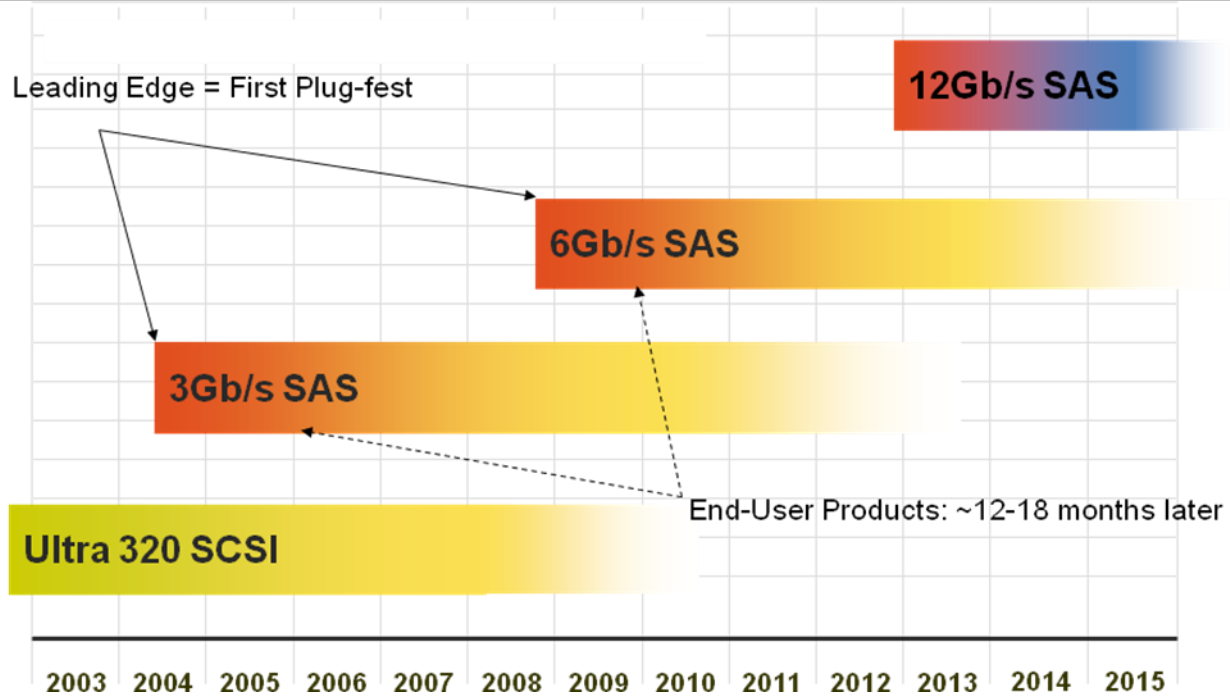
If it were not for the existing broad installation of FC drives, it seems apparent that in many places, SAS—had it been available!—would have been the drive of choice. It is a perfect market and usage fit. In reality, a significant market change is almost certainly just a matter of time. SAS will replace FC as the drive interface of choice for more and more mid-range performance- and reliability-sensitive installations. Admittedly, sweeping market changes don't generally happen overnight in IT, but the eventual dominance by SAS will be hastened as its rise will naturally lead to fewer choices of FC hard drives being available. Furthermore, as SAS rapidly gains share and popularity, natural market dynamics will come into play; with it becoming the focus for user-expertise and best-practices, product innovation, and cost improvements. Thus, while the move to SAS by Hitachi might be seen as bold by some, the reality is that Hitachi is simply being 'fast out of the blocks.'

One of the attractions of SAS is its clear roadmap: 6 GB/sec is the next step,<sup>2</sup> with 12 GB/sec already mapped out (see Figure 2). This is good from a growth perspective as well as in terms of investment protection (since backward compatibility, both to prior SAS drives as well as SATA drives, is part of the standard). With more and more mid-market applications requiring shared storage—and more and more users moving to iSCSI SANs for their ease and economy—the timing for a high performance option (that has the key benefits of FC without the cost and complexity of FC) could not be better.

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<sup>2</sup> As this paper is published, the roll-out of 6 GB is in full swing—with the SCSI Trade Association announcing its readiness on 09/29/08 for an on-schedule 'Plugfest' in November 2008. Of course, 6 GB SAS brings a slew of new acronyms—SSC, DFE, and SEZ for instance—which, while of engineering criticality, they are expected functionality 'table-stakes' to users.

FIGURE 2. SAS ROADMAP



Source: SCSI Trade Association – used with permission

## Hitachi's AMS Implementation

### More than SAS

While the SAS implementation will be—understandably—very newsworthy, it is really the overall AMS package that counts; certainly it is that overall package that users will be considering. The new products have considerably more than just SAS. The new controller (see section below) is significant, as it brings its own value and is also the crucial component to 'getting useful work done,' which is what prospective users will really focus on. As a system designed for the mid-range user looking for high-end functionality without the associated complexity and potential price-tag (which is operational and people costs as much as hardware), here is a selection of examples of what makes the overall system useful:

- **Operational Efficiency:** first and foremost, this efficiency is delivered by the load balancing in the controller. It drives a better use of available resources and can therefore reduce the amount of resources needed. These new products also support easy and economical tiering, which is a crucial tool in the battle to increase efficiency (and ROI) without losing effectiveness. Additionally, the ecologically (or plain economically) aware will also be pleased by the storage spin-down capabilities and variable speed fans.
- **Scalability:** many 'medium-size' businesses want to become bigger. Having a system that can consolidate many of their operations and still grow with them over time is vital. The larger AMS 2500 goes up to 480 drives, which could be a shade under a half PB! ESG research<sup>3</sup> shows not only a large increase in worldwide digital archiving (from some 9000 PB in 2007 to over 90,000 PB in 2012) but more significantly, indicates that the only media type within that that gains share

<sup>3</sup> Source: ESG Research Report, *Digital Archive Market Forecast*, August 2007

of total is external disk (which doubles over the same period from 19% of the total to 38% of the total). Clearly, when it comes to external disk systems, size matters.

- **The GUI:** it is not only intuitive, it is also thorough. Unlike some competitive products, it is not a cut-down tool... indeed, the Command Line Interface and GUI abilities are 1:1 in terms of functionality, meaning that users do not need to be storage 'gurus' to achieve even sophisticated results.
- **'MegaLUN':** this descriptively named feature is the ability to support a very large volume (up to 60 TB) spanning every drive behind the controller; such a 'set and forget' LUN capacity is very useful for large consolidation projects, such as Exchange farms and significant archives. This feature also offers performance advantages since the heads will have to travel shorter average distances for seek operations.
- **Performance and capacity scalability:** not only can everything be done non-disruptively, but RAID groups 'morph' automatically to absorb new drives (LUN striping adjusts over the wider group), which can drive better performance as well as address capacity needs. Performance needs can also be addressed via tiering and varying drive types or also via the flexible cache abilities (which mean different applications can have appropriate block sizes, or indeed the cache-residency option can be used to ensure the highest performance for some limited data).

## Key AMS System Attributes

### Controller

Aside from SAS itself, the main news for these new products is the controller. The only option is an active-active controller, which also provides dynamic load balancing. In simple terms, this is a very flexible resource that automatically manages the disk pool behind it and stands in stark contrast to the standard dual controller model that has existed in the mid-sized market. 'Active-active' means that any volume can be connected through any controller to any disk. This is in contrast to a traditional system where LUNs are effectively 'owned' by certain controllers (for example, storage processor 'A' for Exchange data), which makes the initial administration and layout tricky. The flexible management provided by the new AMS controller equates to ease of use and better use of resources since there's no concept of any controller 'owning' anything—the most available resources are applied to any IO activity. This means far less administration as the controller automatically uses the least busy resource—and automatically moves traffic to another controller in case of any issues. Administration demands are also reduced because hot spots do not need to be manually managed and any drive issues are identified by precise address. This all matters because ESG research (Figure 3) clearly shows a strong correlation between the

### Some Other Basic AMS Facts and Figures (because details do matter!)

#### Raw numbers

- 4 – 32 MB cache
- 120 to 480 drives – mixed SAS and SATA
- 2048 to 4096 LUNs
- 512 to 2048 hosts

#### Drive types

- SAS drives: 15k 146 GB, 15K 300 GB, 10K 400 GB
- SATA drives: 7200 – 500 GB or 1 TB

#### Data protection

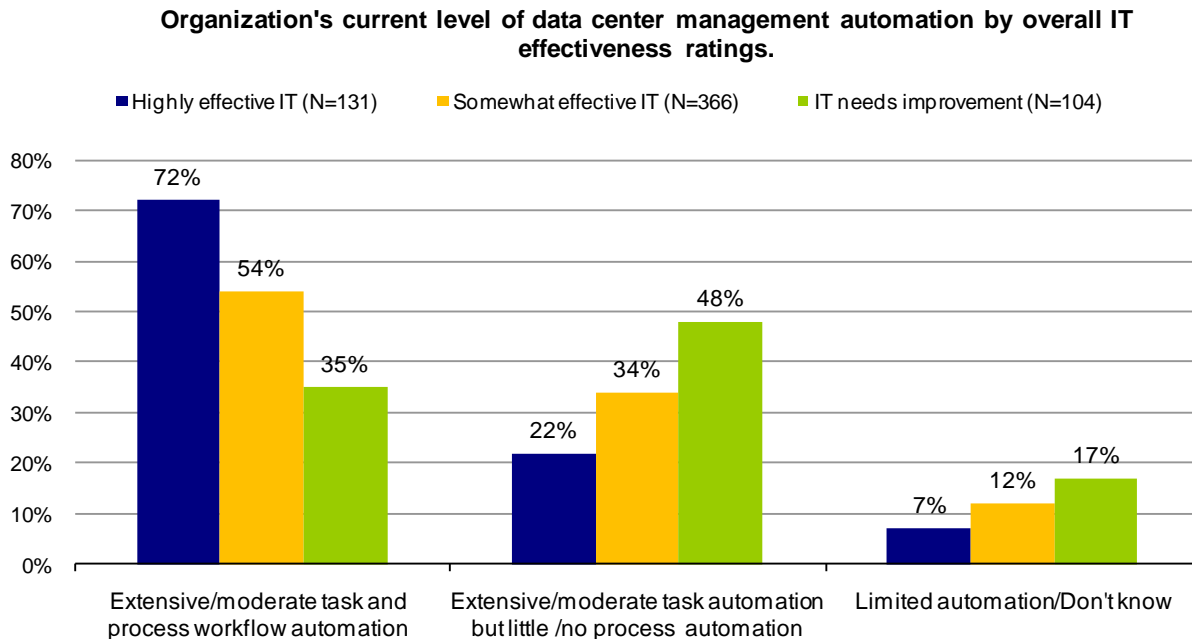
- Multiple RAID levels, and replication options
- WORM (write-once-read-many) capability for data retention
- Redundant power supplies, controllers, batteries and fans
- HDD patrol functions (extra checks for SATA)

#### Noteworthy

- Data in-place upgrades
- Non-disruptive microcode upgrades
- Global sparing
- Hot pluggable drives and components
- Extensive help and search tools in GUI
- Thin Provisioning (planned availability mid-2009)

degree of automation in IT operations and overall IT effectiveness ratings. Manual management—of the type regular modular storage controllers and storage require—is not often a route to effective IT.

**FIGURE 3. AUTOMATION AFFECTS IT EFFECTIVENESS**



Source: ESG research report: 2008 IT Service and Infrastructure Management Survey: Uncovering the Business Value of IT Management Automation and Best Practices, March 2008

This can all be characterized as bringing high-end management attributes to the mid-range. And it saves money, too, since there is no concept of a 'primary' or 'preferred' path; clearly, there's no need to buy an expensive, separate pathing manager. The extensive backend pathing (eight connections to each drive tray) also adds two useful elements that work in favor of extended uptime and data availability. A user would have to lose all eight connections before access to a drive is lost and—since there's no arbitration—if anything does fail, the specific address is known, which precludes the troubleshooting that can be irksome in traditional systems.

### HDS Credibility and Support

Although 'support' is not all-too-often relegated to an afterthought in product analyses, the reality (refer back to Figure 1) is that it is the number one criteria for users and prospective buyers. Vendor reputation also ranks high in terms of user buying criteria. So, put simply, while the technological superiority and business value of the SAS architecture and active-active controller may be great for the 'chatterati' to debate, in the real world, users are most concerned that what they choose will be serviced and supported well by a vendor they trust. Hitachi has excellent, 'rock-solid' vendor credibility and comprehensive support offerings. This excellent product heritage is backed up by extensive web support and training, as well as Hi-track (call home ability) and best practice documentation and advice around common, major applications (such as Exchange, SQL, and VMware). Of course, the new AMS products also fit with the overall Hitachi SOSS approach, and can integrate—for example—into a NAS solution with files that would be archived (and searchable) on an HCAP platform. It's a very comprehensive approach.

From the active-active load-balancing controller to its renowned service and support, Hitachi has a full offering. SAS makes it interesting, but it is the complete solution that makes it compelling for users to consider. Of course, many existing Hitachi customers will simply be happy that the range of products they can get from Hitachi has extended; however, this is also a product that is well-designed to provide broad application-suitability (whether for primary and dynamic data or secondary and persistent) and advanced functions—a product with which

Hitachi is aiming to extend its general market penetration beyond the very highest end where it has traditionally had the majority of its success.

## Usage and Considerations

So, which particular applications do these new AMS products serve best? The quick—and not glib—answer is that it depends.<sup>4</sup> In other words, the range of configurations is sufficiently wide that the products can be made to suit most likely mid-range uses. This is crucial because in the mid-range market, success is borne of flexibility and general suitability. It is not necessary to be the absolute best at any particular thing as long as the system is at least good enough (hopefully more than that!) for anything and everything. These new devices offer a good range of attributes from raw performance and throughput for OLTP and database usage (taking advantage of the switching and pathing, plus high speed SAS), through to MegaLUNs and high capacity ('Nearline SAS') drives or even archival (1TB SATA) drives, which are perfect for addressing the upswing in file and archival requirements. In addition, the flexible cache controls allow the box to be tuned for anything from e-mail to video streaming.

The name of the game is flexibility... and consolidation. Consolidation is important not only because of the attraction of having everything run on one simple, capable platform, but also because of the current rush to virtualize servers. This is just as prevalent and pertinent in the medium-size business market as anywhere else. And this is an area where the SAS architecture Hitachi is using in these new AMS products will serve well. Why? Figure 4 clearly shows that the number one challenge for users implementing networked storage with server virtualization is performance concerns; a mid-market that has not had the budget (or likely the skills) to adopt a FC implantation represents a great opportunity for HDS and its SAS offerings as a way to address performance concerns without giving anything up or incurring the pain of high costs and complexity.

The importance of server virtualization cannot be over-stated and falls into three categories:

- 1) **Increase in server virtualization** – recent ESG research<sup>5</sup> shows that server virtualization is still in its early stages; over the next two years or so, our results indicate that the number of physical servers that are virtualized will more than triple (still to only about 25% of all machines) and the number of virtual machines that represents will quadruple. This move is in favor of a networked storage system that permits extensive host connectivity and that is certified with VMware (including VMotion) and MSCS—the new AMS products fit the bill.
- 2) **Server virtualization drives storage growth** – the same ESG research found that, since virtualizing their servers, 54% of respondents had experienced an increase in their overall storage capacity (18% found an increase of more than 20%). Although this is counter-intuitive to the promises of consolidation, it is essentially explained by latent demand. AMS products offer easy, non-disruptive scalability.
- 3) **Storage virtualization compliments server virtualization** – these technologies go hand-in-hand to order to provide the optimum flexibility and maximum resource utilization.

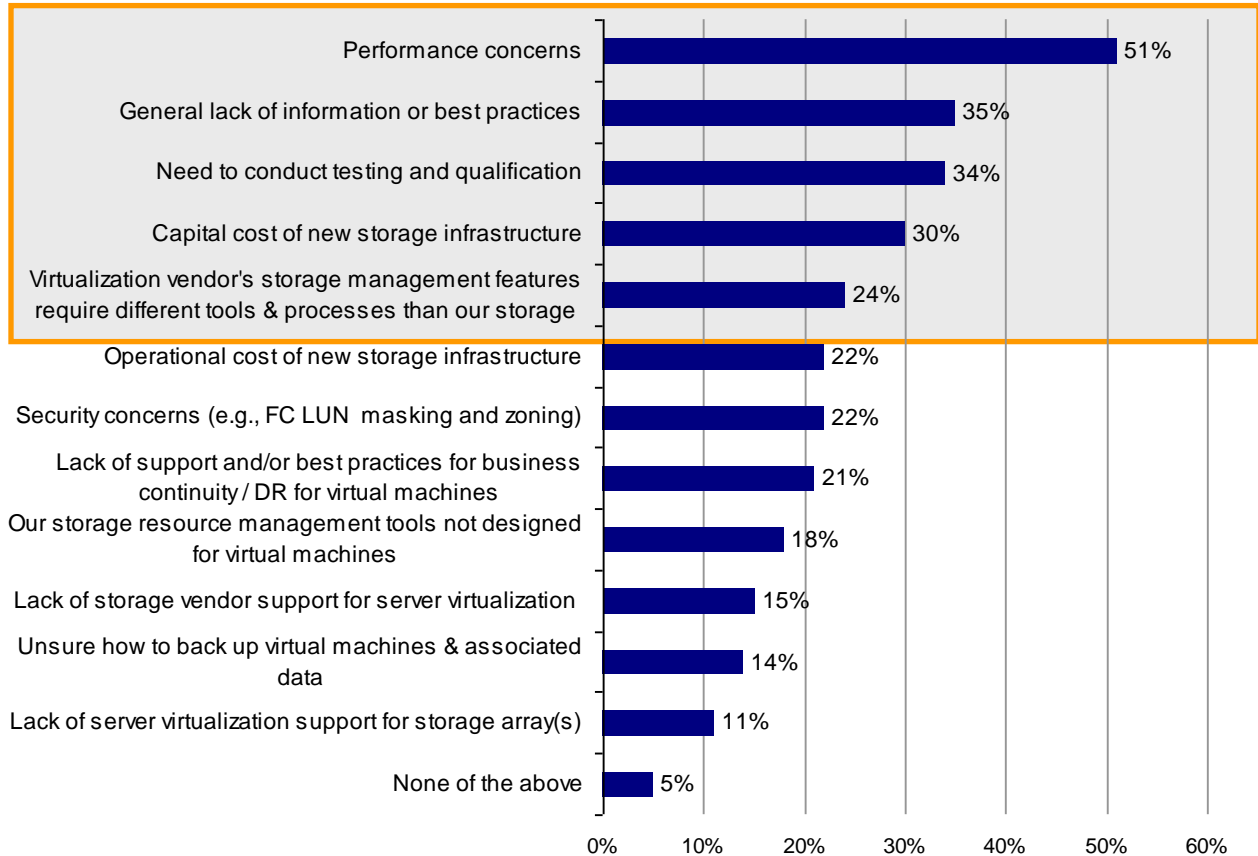
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<sup>4</sup> For a full analysis of the new platforms from an operational and performance viewpoint, an ESG Lab is planned to be produced in late 2008.

<sup>5</sup> Source: ESG Research Report, *The Impact of Server Virtualization on Storage*, December 2007.

**FIGURE 4. CHALLENGES RELATED TO IMPLEMENTING SERVER VIRTUALIZATION WITH NETWORKED STORAGE**

**In general, what are your organization's biggest challenges when it comes to implementing server virtualization with networked storage? (Percent of respondents, N = 311, multiple responses accepted)**



Source: ESG Research *The Impact of Server Virtualization on Storage*, December 2007

## ESG's View

Sometimes, it's best just to state things simply. That being said, the AMS 2X00 series looks to be an excellent new mid-range offering from Hitachi. Simple is good because that's what the target user in this space wants. And simple is good because Hitachi hasn't always had a perfect track record when it comes to keeping its messages crisp and succinct! So, to be clear: SAS is a fine technology, one that is only going to grow in popularity and take market share as its value proposition is so strong: it takes the best of what's gone before and packages it so that it's easy to use, relatively inexpensive, and does not make everything else you've brought obsolete. There's added practical value by supporting SATA with the same architecture, GUI... and cables! The reaction of Hitachi's competitors will be interesting to watch; they cannot afford to attack the SAS choice much because they're either considering or introducing SAS—or will be soon.

However, neither SAS nor the new active-active controller (technically excellent as they both are) is really the point—if it were, it would be like choosing a car based just on the spark plugs or style of pistons. As we know, the users at which this technology is aimed:

- a) Trust HDS to make a good technology choice (as you'd trust BMW or Toyota to choose good spark plugs and pistons);
- b) Are more interested in other aspects of the package—mainly service, value, and ease of use, which are all aspects where the new AMS products should score relatively well.

So, although the technology is crucial to be 'in the game,' the game is not won on technology alone. Of more importance is service and support (at which Hitachi excels, and where—as its executives read this—it should continue to invest) combined with Hitachi's reputation as a vendor. In stating these two elements, price (the other key criteria from Figure 1) has been ignored. Not because it is unimportant, but because service and reputation perceptions are built over time, whereas price can be adjusted dynamically to meet changing market and competitive conditions (and, indeed, the inherent attributes of SAS will over time help HDS to be decently competitive in this respect anyhow). HDS has an enviable reputation as a quality vendor of quality products.

Arguably, these new AMS products may make it the leader—in a product sense—in the medium-size market. However, many in the market would also rank the company as the leader in terms of high-end product... and yet, although it is a very successful leading player in that area, it has not managed to convert that 'quality perception' into market dominance. The modular mid-range storage market is not yet a market with a declared winner, so Hitachi's opportunity is distinct and large. That said, and as with any product, there are things that could further improve the overall package, although some can be addressed fairly easily. For example, it would be good if native thin provisioning were available sooner, but it can be achieved today when the AMS is run behind a USP VM.

Overall, Hitachi has a great story. As it uses these new products to expand from its core high-end focus, it must—more than ever—learn to express itself simply and appropriately (as the target market needs) and avoid falling into presenting excessive or overly complex details. Using car analogies again, Hitachi needs to talk about service, general suitability, and flexibility; to talk perhaps about cup-holders and drive-ability, not compression ratios and differentials. Yes, that's where the engineering skill is and that's what produces the end-user value, but it's not what end-users actually rate and base their decisions upon.

Users considering Hitachi Data Systems' new AMS products will find an excellent, flexible, easy-to-use mid-range storage platform. Acronyms aside, the company has mixed valuable ingredients that add up to a very sound package capable of delivering operational efficiencies to the medium-sized IT operation. SAS is certainly good, the new active-active controller is definitely good, and overall—taken with Hitachi service, support, and reputation—the package is very good indeed; more than that, it is very much in line with what the target market users specifically say they want.



20 Asylum Street  
Milford, MA 01757  
Tel: 508-482-0188  
Fax: 508-482-0218

[www.enterprisestrategygroup.com](http://www.enterprisestrategygroup.com)