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# STORAGE

Vol. 10 No. 7 September 2011

## FC, iSCSI, NAS: How to choose storage for virtual servers

Virtual servers need networked storage to yield the biggest benefits; but you don't have to gamble to get the right storage for your VMs.

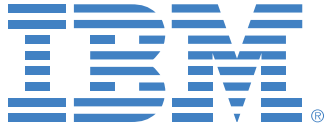
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A photograph of a server room aisle. The aisle is lined with server racks on both sides. The floor is light-colored tile. A person in a light-colored shirt and dark pants is standing in the distance, looking at a device. The ceiling has yellow insulation and various cables. A large black server rack door is visible on the right side of the frame.

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# Let's get real about the cloud

*Cloud storage is really a pretty simple concept, so how the heck did it get so complicated?*

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**HIS WEEK**, a few of my fellow editors and I spent more time than reasonable people would expect trying to work out a definition for the term “cloud washing.” Trying to steer clear of using obvious (and probably accurate) words like “bunk” and “nonsense,” we eventually cobbled together a definition that seemed to do the trick without insulting anybody all that much. But I learned a valuable lesson along the way: This cloud thing is a squirmy, squishy-squashy thing, and getting our arms around it ain’t gonna be easy.

If it’s so hard to define a term about how vendors are twisting the meaning of “cloud” to obfuscate and ultimately (they hope) convince you their old products are new now that they have “cloud” in their names, it’s bound to be just as hard to define what cloud truly is. Right now, it’s pretty confusing. Another thing I’ve learned is that the vendors doing most of the cloud washing are really cloud *wishing*, as in wishing they had a real cloud product to promote.

Also not helping very much is the hyperbole on both sides of the issue: the “Hallelujah, cloud storage is the answer to all our prayers” gang vs. the “Harrumph, if cloud storage doesn’t solve all my data center problems, then what good is it anyway?” folks.

I recently read a blog post on another publication’s website that declared backup was dead because it could be replaced by the cloud. Really? Interestingly, the blogger didn’t get into any details about recovering data from the cloud, but I guess that’s something that could be worked out, ya know, later. His final advice was to virtualize everything—servers and storage—if you want to use cloud storage. I don’t know why people insist on taking away the cloud’s silver lining with scary stuff like storage virtualization. I haven’t found the page in the cloud storage rule book that says virtualizing in-house storage is required to use the cloud.

At the other end of the spectrum, I’ve gotten some press releases from an outfit called MeriTalk that describes itself as a “community network” of government workers. The group sent me the results of a few surveys it’s

done, including one titled “Consolidation Conundrum Report.” The paper seems to spell doom for the Obama administration’s efforts to cut spending by consolidating federal data centers, with cheery data points such as only 10% of federal IT professionals surveyed believe consolidation goals can be met and 25% predict we’ll have more data centers in a few years than we do now. And they’re not exactly optimistic when it comes to the cloud, with 62% saying they don’t believe their agencies can use managed services. But my favorite part is this line: “Adding capacity is infinitely more difficult than just flipping a switch.”

Of course, the cloud-is-good side would just replace the phrase “infinitely more difficult than” with “as easy as.”

The truth is somewhere in between, but both ends of the cloud storage discussion aren’t doing much more these days than muddling the issues. There’s a lot to think about and a few choices to make when considering a cloud storage option, but it’s not that complex. And if vendors would quit their cloud washing nonsense, it’d be even easier.

In its simplest terms, a cloud storage service offers an off-site alternative to building on-site storage. And evaluating a service or product requires pretty much the same routine of weighing cost, performance, features, maintenance and so on. If you do all the homework and decide that buying more infrastructure and supporting it is the best choice, fine. If the cloud service comes out on top and shifts the Capex to Opex, that’s fine, too. It can be that straightforward.

**In its simplest terms, a cloud storage service offers an off-site alternative to building on-site storage.**

The cloud just sounds riskier, right? Maybe you think that you could end up updating your resume if you send your firm’s data into the cloud and the unthinkable happens. But buying the stuff instead won’t give you much job insurance either if the new gear goes belly up.

If you need more to think about, consider this tidbit from a survey called the Sogeti World Quality Report: “Emerging economies, such as China, are the fastest adopters of cloud infrastructure.” So, China and its fellow up-and-comers are manufacturing a lot of the storage that ends up in your data center, but rather than buying that stuff themselves, they’re going to the cloud. Maybe there’s something to be learned from that as well. ☉

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\* [Click here for a sneak peek at what’s coming up in the October 2011 issue.](#)

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# The impact of virtual storage appliances

*Software-only storage controllers running in virtual machines are an easy, economical way to get shared storage. But the current crop of products aren't up to enterprise standards . . . yet.*

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**VIRTUAL STORAGE APPLIANCE (VSA)** is storage controller software that runs within a virtual machine (VM) turning servers into data storage systems. There are a number of them available, including Hewlett-Packard's StorageWorks P4000 Virtual SAN Appliance Software (formerly LeftHand), which is the most widely adopted, and VMware's recently announced vSphere Storage Appliance. The implications of VMware offering a VSA are compelling, although the immediate impact is minimal.

VSA solutions are typically positioned as small- and medium-sized business (SMB) storage because of performance limitations that draw a distinct line in the sand between VSA and hardware-based storage systems. However, the line will begin to disappear as processors and memory become even faster and cheaper. And you can count on innovations that will overcome technical limitations and improve not only performance but reliability and scalability.

Storage networks made it possible to share what was once a very expensive resource: storage. But the cost of storage has gone down significantly and data storage vendors have created a wide range of software features that have become requisite in the data center, such as snapshots and replication. We also wanted high availability to ensure that our data was always accessible.

But now all that can be achieved in the virtual data center without storage networks. If you have 10 VMs running on a single physical server then you're sharing the storage in that server across those 10 applications. A VSA provides the snapshot and replication features without requiring an external hardware-based storage system, and it also provides high availability to another server. All this can be done today—there are literally thousands of VSA users who have implemented that type of environment. So what changed?

Adding a product like Fusion-io's PCIe-based solid-state storage to this environment makes things a bit more interesting. Performance tests with Fusion-io-equipped VSAs don't reach the vendor's touted 100,000 IOPS but can achieve approximately 30,000 IOPS, which is very respectable performance, especially for a VSA system that typically tops out at approximately 5,000 IOPS. But the main reason you go with a VSA is cost, and adding Fusion-io or any other solid-state storage will increase the price significantly. Price/performance is what matters, so combining solid-state and VSA isn't necessarily front of mind when considering alternatives to traditional storage networks.

But the writing's on the wall. The elements needed for a new class of VSA—an enterprise-class VSA—are taking shape. Enterprise-class VSA requires new software, a purpose-built architecture and physical servers with new storage-specific designs to overcome the limitations of today's VSA products. This last point is an important one: optimizing servers to support storage systems doesn't mean building a storage system but rather having the proper reliability and availability that external storage arrays provide.

There are some applications that still aren't being virtualized because of performance limitations. Many of these are high-performance database applications that can't afford the inherent latency of virtualization. But an enterprise VSA would be architected to enable even the most performance-starved applications to be virtualized.

Ultimately, VSAs could spell doom for networked storage. Not only could it happen, but it should happen. Enterprise VSA would exponentially drive down costs, improve manageability and result in landscape-changing business enablement. But it will take time because of technology incumbency, lack of awareness, internal politics and the fact that enterprise VSA is just a good idea. And existing VSA solutions will need major architectural changes to evolve into enterprise VSA.

This doesn't mean storage goes away. On the contrary, it's storage technology, expertise and experience that will make the difference. If storage system vendors cling to the legacy of the physical data center, they run the great risk of overlooking the value of this new storage concept.

**Enterprise VSA would exponentially drive down costs, improve manageability and result in landscape-changing business enablement.**

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EMC has taken a small step toward this approach with its new PCIe card, but it's modest at best.

The server vendors are well positioned because they now own advanced storage technologies as well as server platforms. But they still seem less inclined to innovate. VMware has taken an important step with its VSA, but it's not clear if they have a grand vision of merging virtual server and storage into a common stack. And even with their tight connection to EMC, VMware has very little storage DNA. Enterprise VSA is up for grabs and the vendor that gets it right will be the next big player. ☉

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Tony Asaro is senior analyst and founder of Voices of IT ([www.VoicesofIT.com](http://www.VoicesofIT.com)).

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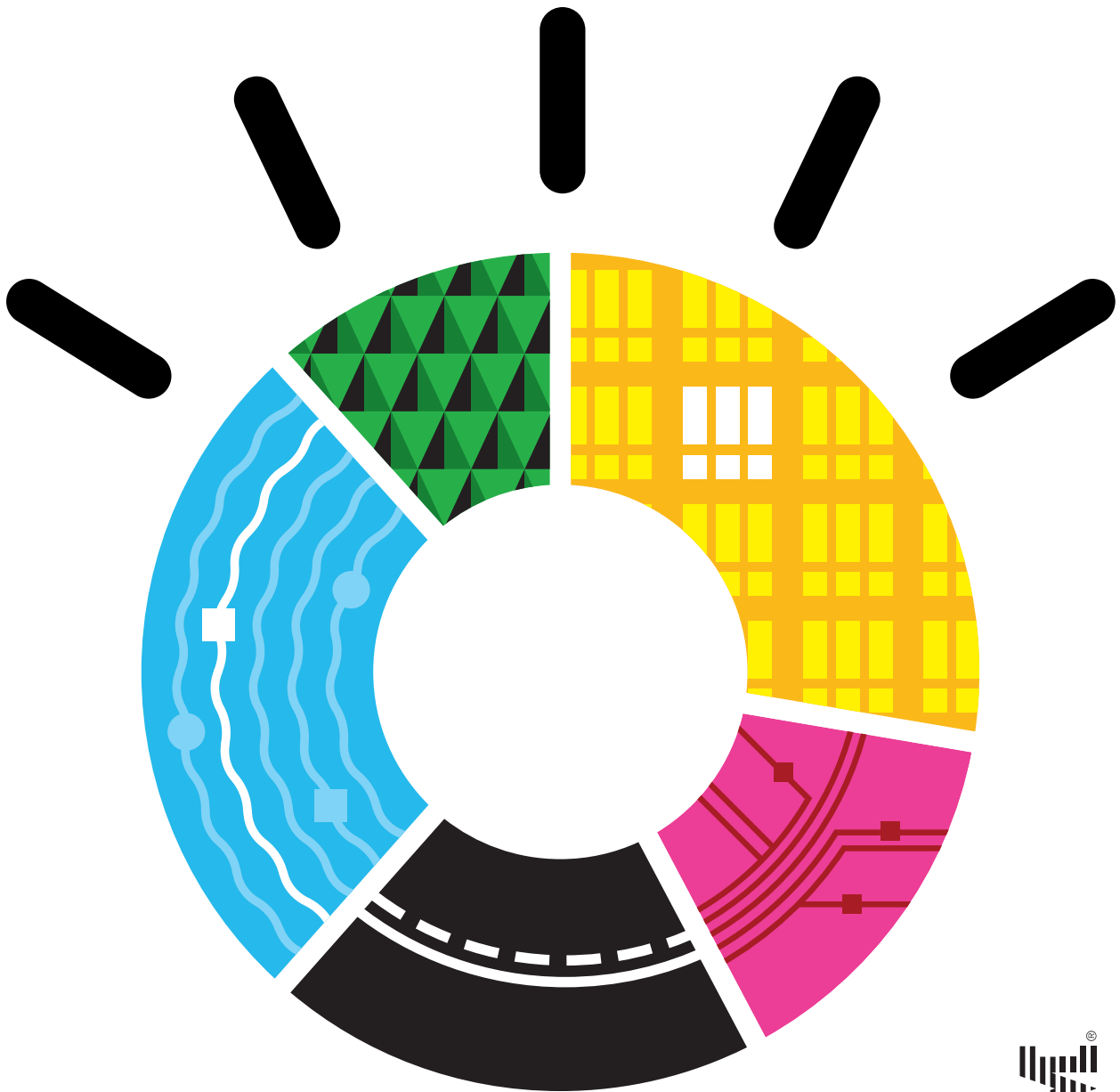
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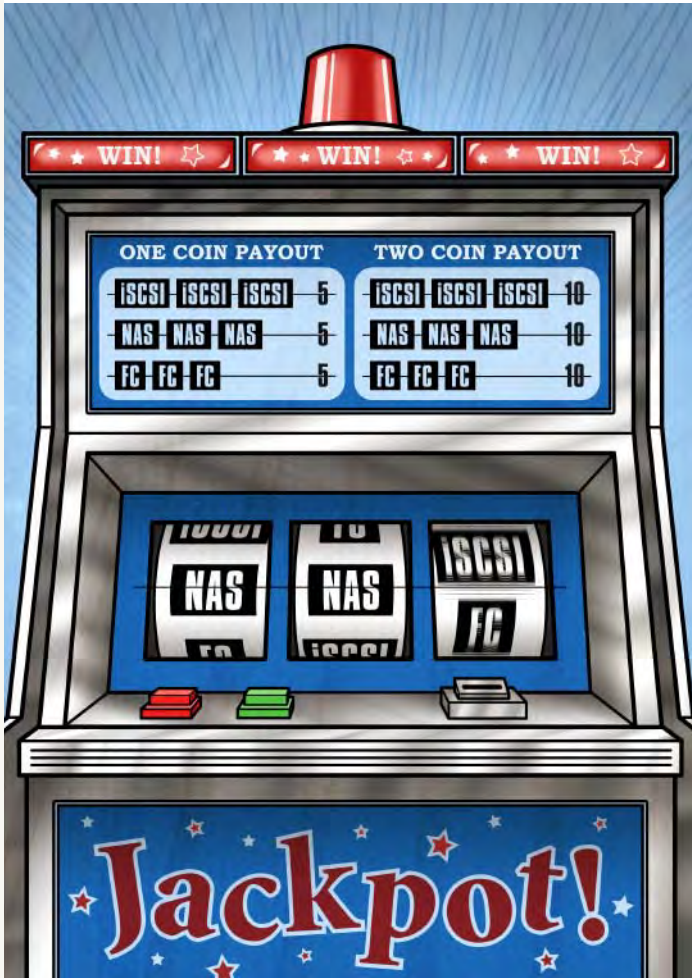
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# Pros and cons of FC, iSCSI and NAS

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***It's a given that virtual servers need a good shared data storage system. All the major networked storage protocols will work with virtual machines, but some are better than others in certain environments.*** BY ERIC SIEBERT

**CHOO**SING A DATA STORAGE SYSTEM to use with virtualized servers is one of the most critical architecture choices you'll have to make, and one of the most challenging. There are many options available, but there's no single type of networked storage that's hands down the best for virtual servers. Each environment is different and what works well for one may not work well for another.

Fibre Channel (FC) has been the traditional choice for virtualization, but iSCSI and network-attached storage (NAS) have become increasingly popular alternatives that can provide good performance for more limited budgets. Let's look at the characteristics of each networked storage type and review its pros and cons.

## FIBRE CHANNEL STORAGE

For performance and reliability it's hard to beat FC storage, but the performance comes at a price in terms of both dollars and complexity. Because of its deep roots in the data center, FC is generally the most popular storage choice for larger virtual environments, based mainly on its speed (currently 8 Gbps with 16 Gbps becoming available) and reliability. FC storage networks tend to be isolated and thus more secure than Ethernet-based storage devices. But Fibre Channel requires special host bus adapters (HBAs) and switches that are more expensive than comparable Ethernet components.

So, implementing a Fibre Channel network from scratch can be costly. Also, FC environments are more complex to implement and manage as their configuration is very different from a traditional network infrastructure. While most companies have staff with network administration skills, many don't have the same resources for FC storage-area network (SAN) administration. Designing and managing a SAN architecture usually requires specialized training that can further add to the expense of implementation.

**Designing and managing a SAN architecture usually requires specialized training that can further add to the expense of implementation.**

### Advantages of using FC storage

- Commonly deployed enterprise storage architecture; many environments may have existing SANs
- Typically the best performing storage due to higher available bandwidth
- Isolated FC fabrics are more secure; logical unit number (LUN) zoning and masking can be used to control access

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- Able to boot from FC storage (boot from SAN) so local host storage isn't needed
- Block-level storage that can be used with VMware vSphere VMFS volumes

### Disadvantages of using FC storage

- Typically the most expensive storage option to implement from scratch
- Requires specialized and expensive components such as switches, cables and HBAs
- May be complex to implement and manage; typically requires dedicated storage administrators
- Fewer security controls available; authentication and encryption are complicated to implement

If you plan on having many high disk I/O virtual machines (VMs) running on your hosts then you should seriously consider using FC storage for maximum performance. Fibre Channel over Ethernet (FCoE) is also an option that allows you to run FC storage over traditional Ethernet components, but it can be just as expensive to implement as it requires 10 Gbps Ethernet (10 GbE) networking and special switching gear.

If you already have an FC SAN in your environment, then using it with virtualization just makes sense. And expanding an existing SAN is much easier and cheaper than implementing a new one. You really can't go wrong with FC storage if your budget can afford it and you can handle the management complexity.

## iSCSI STORAGE

iSCSI storage is a popular and solid alternative to Fibre Channel. iSCSI is a block-based storage like FC but it uses traditional Ethernet network components for connectivity between hosts and storage devices. Because you can use existing Ethernet components, iSCSI is often much cheaper to implement. iSCSI works by using a client called an initiator to send SCSI commands over a local-area network (LAN) to SCSI devices (called targets) located on a storage device.

iSCSI initiators can be software or hardware based. Software initiators use device drivers that are built into the hypervisor to use Ethernet network adapters and protocols to write to a remote iSCSI target. Hardware initiators use a dedicated iSCSI HBA that combines a network adapter, a TCP/IP offload

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engine (TOE) and a SCSI adapter into one device to help improve the performance of the host server. While software initiators work just fine in most cases, hardware initiators offer slightly better I/O performance and use less host resources. You can also boot from hardware initiators; in addition, a new technology called iSCSI Boot Firmware Table (iBFT) will let you boot using a software initiator if the installed network interface card (NIC) and hypervisor support it.

iSCSI performs very well on 1 Gbps Ethernet networks, but switching to 10 Gbps can give it a huge boost and put it on par with (or better than) FC. Most hypervisors support 10 Gbps iSCSI, but the cost may be so high that it will be just as expensive as FC to implement. The biggest risks to using iSCSI are the additional CPU overhead when using software initiators (which can be mitigated with hardware initiators), and the more fragile and volatile network infrastructure it relies on. The latter issue can be addressed by completely isolating iSCSI traffic from other network traffic.

### Advantages of iSCSI storage

- Lower cost alternative to FC storage that uses standard Ethernet components; iSCSI storage arrays also tend to cost less than FC arrays
- Software initiators can be used for ease of use and lower cost; hardware initiators offer maximum performance
- Block-level storage (like FC) that can be used with vSphere VMFS volumes
- Speed and performance is greatly increased with 10 Gbps Ethernet
- No special training/skills needed to implement and manage the technology
- Supports authentication (CHAP) and encryption for security, as well as multipathing for increased throughput and reliability
- Can be deployed more quickly than FC

### Disadvantages of iSCSI storage

- Because iSCSI is most commonly deployed as a software protocol, it adds to CPU overhead vs. using hardware-based initiators
- Performance is typically less than that of FC SANs
- Typically doesn't scale as high as FC storage systems
- Network latency and non-iSCSI network traffic can diminish performance

iSCSI also offers more variety and greater flexibility when it comes to

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choosing data storage devices. You can purchase a range of iSCSI storage products, from small dedicated iSCSI storage devices for less than \$2,000 to large enterprise-class devices.

Keep in mind that when it comes to performance you generally get what you pay for. If you have a large number of VMs and heavy workloads, you need to spend more for a storage system. iSCSI is a great choice for many companies that want affordability and simplicity. While iSCSI is often criticized for its performance,

a dedicated, properly configured iSCSI system can perform nearly as well as a Fibre Channel setup and will be adequate for many environments.

**If you have a large number of VMs and heavy workloads, you need to spend more for a storage system.**

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## Emerging techs: FCoE, 10 GbE and CNAs

**NEWER TECHNOLOGIES** are now available, such as Fibre Channel over Ethernet (FCoE) and 10 Gbps Ethernet (10 GbE), that offer alternative architecture choices while providing big boosts in performance and throughput. FCoE provides encapsulation of a native Fibre Channel (FC) frame into an Ethernet frame to bring together the benefits of FC architecture over an Ethernet infrastructure. FCoE can eliminate the need for costly Fibre Channel hardware. 10 GbE provides a huge speed boost over conventional 1 Gbps Ethernet, but requires network interface cards (NICs) and switches that are specifically designed for 10 Gbps.

FCoE and 10 GbE are directly related to each other as you can only run FCoE on 10 Gbps networks. Converged network adapters (CNAs) combine the two technologies onto a single network adapter, eliminating the need for separate FC and Ethernet adapters. CNAs reduce the number of server adapters, cables and switch ports required, which can help reduce expenses. FCoE, 10 GbE and CNAs are great technologies, but like any new tech they can be expensive to implement for early adopters.



## NAS

The big difference between iSCSI and NAS (specifically, NFS) is the type of protocol used to write data to the storage device. iSCSI uses a block protocol and data is written in blocks by the virtual host to the storage device. The host server is responsible for maintaining the disk file system on the storage device just as it would with local disk. NAS, on the other hand, uses a file-sharing protocol and the host server simply communicates with the storage device that maintains the disk file system.

With NAS, you're essentially offloading the storage device functions responsible for writing data to the drives from the host server to the storage device. NAS uses a special software NFS client built into the hypervisor that uses a network adapter in the host to communicate with the NFS server.

All the major virtualization platforms support using NAS devices for their virtual machines. Because NFS is a widely supported protocol, there are many different options for using NAS storage with your virtual hosts. These can range from taking a standard physical server and converting it into an NAS server, using virtual NAS software or using a dedicated storage appli-

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## I/O virtualization

**I/O VIRTUALIZATION** is increasingly being used with server virtualization. It enables a single physical I/O adapter to appear as multiple virtual network adapters (NICs) or host bus adapters (HBAs). One of the challenges with server virtualization is that hosts require a large number of I/O adapters to connect to both data and storage networks. A typical host may have six to eight NICs used for general network connectivity, and at least two NICs or HBAs to connect to storage networks. I/O virtualization lets you consolidate many I/O adapters on a host into a single adapter or two that can handle all I/O requirements. I/O virtualization is implemented in several different ways. Companies like Xsigo Systems Inc. emulate HBAs and NICs over either standard Ethernet or InfiniBand fabrics. Virtensys takes a different approach and uses a PCIe extension adapter to connect to an appliance that contains shared I/O adapters. Both approaches can greatly simplify host I/O connectivity, and reduce hardware costs and host power consumption.

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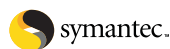
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ance. The costs and performance characteristics with each option can vary greatly; dedicated appliances offer the best performance at the greatest cost.

Almost every storage vendor offers a NAS storage device that supports NFS. With block storage devices, allocating storage will consume the full space right away, but with NAS, capacity grows as data is written to it. Regardless of your budget, you can easily find a good NAS device that will meet your requirements.

In most cases, NAS won't equal the performance of a Fibre Channel SAN, but a properly architected NAS system can meet the performance needs of most workloads. Similar to iSCSI, NAS uses NICs to communicate with storage devices, which may mean a 1 Gbps speed limit, but newer 10 Gbps NICs offer a huge speed increase if you can bear the cost. The performance of NAS is nearly the same as iSCSI. As long as the CPU doesn't become a bottleneck, the maximum throughput of both iSCSI and NAS is limited by the available network bandwidth.

**In most cases, NAS won't equal the performance of a Fibre Channel SAN, but a properly architected NAS system can meet the performance needs of most workloads.**

### Advantages of NAS

- Many NAS storage devices use thin provisioning by default, which can help conserve disk space
- File locking and queuing are handled by the NAS device, which can result in better performance vs. iSCSI/FC where locking and queuing are handled by the host server
- NAS doesn't have a single disk I/O queue like block storage devices, which can result in greater performance; NAS performance is based on the bandwidth of the network connection and the capabilities of the disk array
- Can be less costly to implement than FC storage as it uses standard Ethernet components; NAS arrays tend to cost less than FC arrays
- No special training/skills are needed to implement and manage the technology
- Expanding virtual datastores is done easily by increasing the disk on the NFS server; datastores will automatically increase accordingly

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- Snapshots, cloning and so on are done at the file system level instead of the LUN level, which can offer greater flexibility and more granular support

### Disadvantages of NAS

- Booting directly from a shared storage device isn't supported with NAS devices
- There is CPU overhead as the hypervisor must use a software client to communicate with the NAS server
- Some vendors don't recommend NAS storage for certain sensitive transactional applications due to latency that can occur
- Support for new virtualization features sometimes lags vs. block storage devices
- NAS doesn't support multipathing from a host to the NAS server; only a single TCP session will be opened to a NAS datastore, which may limit performance

You shouldn't be discouraged by some of the disadvantages of using NAS, as they may only apply to specific circumstances or result from poorly architected NAS solutions. With a properly sized solution that can handle the VM workloads on your hosts, NAS is usually as good a choice as a block-storage device. In the past, NAS had limited support from virtualization, but it's now fully supported.

## AND THE WINNER IS . . .

There are a lot of factors to consider when choosing a storage device for your virtual environment, but decisions ultimately come down to simple factors such as budget, performance and capacity. Many storage devices now come with direct integration support for virtualization so this can also be a big factor. VMware vStorage APIs offer many benefits that allow for tighter integration between the storage device and the hypervisor, as well as offload many storage-related tasks from the hypervisor to the storage array.

Another area of concern is support. While Microsoft Hyper-V has pretty broad support for just about any storage array supported by Windows, VMware has a strict hardware compatibility guide that lists all supported storage devices. One reason for this is that VMware has very deep API integration and the guide ensures that storage devices have been tested

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with vSphere. It also lists the various integration features supported for each array.

While Fibre Channel is a well-established storage platform, don't be afraid to try iSCSI or NAS devices as more affordable alternatives. With a wide variety of iSCSI and NAS products to choose from, you'll have to research their capabilities and scalability to ensure that they'll meet your requirements. Storage is the most critical design decision you'll make for your virtual environment, so spend the time researching the alternatives to understand the different technologies and features that are available. ☉

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**Eric Siebert is an IT industry veteran with more than 25 years of experience who now focuses on server administration and virtualization. He's the author of *VMware VI3 Implementation and Administration* (Prentice Hall, 2009) and *Maximum vSphere* (Prentice Hall, 2010).**

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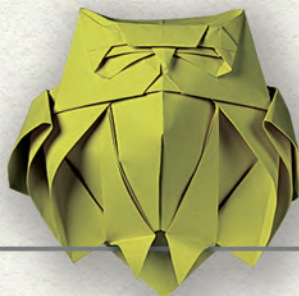
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# Cloud backup is **READY** for the **Enterprise**



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**Cloud backup services have seen increased adoption by SMBs, but with a choice of methods and tighter controls, cloud backup is now also a viable enterprise alternative.** BY JACOB GSOEDL

**BACKUP WAS** one of the first services offered by cloud storage vendors, and it's still the most popular way of using cloud storage. Once considered an option for only smaller companies, some enterprises are now using cloud backup for remote office and desktop/laptop data protection, archival and off-siting of backups to supplement existing in-house backup services.

The benefits of backing up to the cloud are compelling: no need for backup infrastructure, minimal IT resource requirements and usage-based pricing that becomes part of your monthly operational expenses. But the benefits are offset by security concerns and restore challenges, especially if a lot of data must be restored from the cloud. With accelerated adoption of cloud services, cloud-based backup options have substantially increased, giving companies several alternatives:

- Backup managed service providers (MSPs)
- Cloud-enabled backup applications
- Cloud gateways

## CLOUD CONSIDERATIONS

Regardless of the alternative your company opts for, this list of key features and considerations will help determine the right product for your environment.

**Security.** Security is still the main reason companies steer clear of cloud services. To address security concerns, cloud backup products must adhere to the minimum following best practices:

- Data must be encrypted during transit, usually via a secure socket layer (SSL) connection if the Internet is the transport
- Data must be stored encrypted in the cloud via a state-of-the-art encryption protocol, such as 256-bit AES encryption
- The cloud service provider must support strong, enforceable authentication with features like password expiration and complexity

Encryption key management must be clearly understood; most cloud service providers defer key management to users with the benefit that encryption keys are unavailable within the cloud. But with encryption key management the responsibility of users, the cloud service provider won't be able to help if the keys are mismanaged or lost, preventing access to the data. Because encryption keys are critical, some companies put them in an escrow account as protection against loss or corruption.

**Compliance.** There may also be compliance issues related to using cloud backup. For public companies or industries that are subject to additional regulatory requirements, only cloud service providers that adhere to SSAE 16/SOC 1 (formerly known as SAS 70) should be considered. SAS 70/SSAE 16 is an audit standard for service providers where an external auditor evaluates controls and processes, and prepares a report that's

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shared with the service provider's customers. Because there's a Type I and Type II SAS 70/SSAE 16 examination, it's crucial to confirm that the service provider performs the more stringent Type II audit. Only a Type II audit report expresses the auditor's opinion on whether the controls tested operated effectively enough to provide reasonable assurance that the control objectives were achieved during the period specified. For instance, Sarbanes-Oxley (SOX) audits usually only rely on Type II audit reports.

You should also understand the scope of the audit report and what it covers. Many smaller MSPs are quick to declare SAS 70/SSAE 16 compliance

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## Cloud backup options: The pros and cons

Cloud Backup Option	Pros	Cons
<b>Managed service provider (MSP)</b>	<ul style="list-style-type: none"> <li>• Simplicity</li> <li>• Cost-effective</li> <li>• Few on-premises IT resource requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Complete dependency on the MSP for all aspects of the backup</li> <li>• Control is handed off to the MSP</li> </ul>
<b>Cloud-enabled backup applications</b>	<ul style="list-style-type: none"> <li>• Extends and supplements existing backup infrastructure and processes</li> <li>• Except for backup data location, control remains with the customer</li> <li>• Cost-effective</li> </ul>	<ul style="list-style-type: none"> <li>• Requires a cloud-enabled backup application</li> <li>• Little impact on IT resource requirements</li> </ul>
<b>Cloud gateways</b>	<ul style="list-style-type: none"> <li>• Works with any backup application that supports backup to disks</li> <li>• Extends and supplements existing backup infrastructure and processes</li> <li>• Except for backup data location, control remains with the customer</li> </ul>	<ul style="list-style-type: none"> <li>• Introduction of an additional IT infrastructure component that needs to be managed</li> <li>• Higher cost</li> </ul>



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by providing data center or Amazon (if the MSP uses Amazon on the back-end) SAS 70/SSAE 16 reports, which usually aren't sufficient. While a data center SAS 70/SSAE 16 report addresses physical controls, it has no bearing on operational controls of the MSP in relation to change management, program development and access grants. Therefore, it's highly recommended to request the latest SAS 70/SSAE 16 report from the cloud service provider prior to signing with the service, and to have the report reviewed by the internal and external auditors.

**Hybrid vs. pure cloud backups.** In a pure cloud backup scenario, agents on protected servers and desktops perform backups directly to the cloud. Quick setup and minimal maintenance are benefits of this service. A pure cloud backup product is best-suited for personal backups and backups for smaller firms with limited amounts of data to protect (typically a few terabytes). The drawbacks of backing up directly into the cloud are performance and bandwidth challenges because of latency and bandwidth limits of available Internet connections; these shortcomings are most important when restoring data.

Latency and limited bandwidth are mitigated by hybrid cloud backup products that use an on-premises disk or gateway as the initial backup target from which the data is replicated to the cloud. The on-premises intermediary usually caches the most recent backups for on-premises restores, minimizing tedious recoveries from the cloud; it also moves data into the cloud asynchronously. For a pure cloud backup solution without the on-premises intermediary for quick restores, it's essential to understand all restore options, including the ability to have backups shipped to you on a disk or NAS device; restore options become more relevant as the amount of data stored in the cloud grows. Similarly, some MSPs accept the initial full backup on an external storage device (known as "seeding") to avoid a time-consuming first backup over the Internet.

**Efficiency.** Backup processes that are OK for on-premises backups may be unacceptable for cloud backups. For instance, the ability to perform sub-file backups of changes to files is an indispensable feature in a cloud

**A pure cloud backup product is best-suited for personal backups and backups for smaller firms with limited amounts of data to protect (typically a few terabytes).**

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backup product. With email personal folder files (.PST files) that can grow beyond gigabytes, and large Excel spreadsheets and PowerPoint presentations spanning tens of megabytes, being able to only back up file changes to the cloud rather than complete files is a non-negotiable feature for a cloud backup product. Similarly, the ability to perform continuous incremental backups minimizes the amount of traffic for each backup. The traditional weekly full and daily incremental backup discipline frequently used for on-premises backups doesn't work for backing up data into the cloud. Limited network bandwidth makes efficiency one of the primary virtues in a cloud backup product. So anything that can help reduce the amount of data to be moved into the cloud is critical.

Compression and source-side deduplication are two technologies that help minimize the amount of traffic sent into the cloud. Data deduplication reduces bandwidth usage and also helps cut the cost of backing up to the cloud. Because cloud storage pricing is usually based on gigabytes stored, compression and dedupe are instrumental in lowering monthly fees. To maximize data reduction, some MSPs deduplicate on the source side and one more time in the cloud. While the scope of source-side dedupe may be limited to a single or few hosts, dedupe in the cloud can be performed against all data, resulting in significant additional data reduction.

"We deduplicate and compress before we send data across, and we deduplicate one more time once data is in the cloud," said Karen Jaworski, senior director of product marketing at i365, a Seagate company and backup MSP.

**Transport.** Besides source-side dedupe, cloud backup products differ in the way they manage available bandwidth. The ability to limit and throttle bandwidth while backups are in progress helps minimize the impact on users and other apps sharing the Internet connection. Moreover, being able to configure multiple bandwidth limits for different times of the day helps optimize the balance between backup performance and the impact on other users. Some cloud service providers, such as AT&T, give customers the option to use a multiprotocol label switching (MPLS) circuit instead of the

**Because cloud storage pricing is usually based on gigabytes stored, compression and deduplication are instrumental in lowering monthly fees.**

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Internet; this option is relatively cost-effective for customers who already use MPLS. The quality of service (QoS) feature of MPLS lets users label backup data as low-priority traffic, eliminating the impact on other users and applications altogether. This is especially attractive for midsized and large companies with many users and a lot of protected data.

## BACKUP MANAGED SERVICE PROVIDERS

Handing off backups to a managed service provider is the quickest way of getting backups into the cloud and the method with the fewest internal IT

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# Cloud backup checklist: Key features

Feature	Reason for relevance
Encryption of data in transit and at rest in the cloud	Prevents access to the data by cloud service provider staff and other unauthorized users
SAS 70/SS AE16 Type II compliance of the cloud service provider	Ensures the service provider has strong IT controls in place; a must-have for public companies and for industries with additional regulatory requirements
Data deduplication	Reduces storage cost; source-side deduplication also reduces bandwidth requirements
Hybrid cloud backup option	Cached on-premises backups eliminate long restore times of a pure cloud backup solution
Getting data in and out of the cloud via physical device	Options of initial "seeding" of backups and delivery of restore data via physical disk to minimize initial backup and restore times
Incremental forever	Ensures efficient ongoing backups
Sub-file-level backup of changed files	Minimizes the amount of data to be backed up, especially with large files
Bandwidth features	Throttling and scheduling to minimize the impact of backups on other users

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requirements. MSP offerings are available as pure cloud backup products where the user installs agents on desktops and servers that directly back up data into the cloud; they're also available as hybrid cloud backup products where the cloud service vendor provides a managed on-premises gateway to store backup data locally before replication into the cloud.

MSP offerings range from consumer, small office/home office (SOHO) and small- and medium-sized business (SMB) products to cloud backup services targeted at the enterprise. "While the sweet spot for cloud-based backup is still the small to midsized company, larger enterprises have started leveraging the cloud to supplement internal backups, especially for DR [disaster recovery], remote office and end-user data protection," said David Chapa, senior analyst at Milford, Mass.-based Enterprise Strategy Group (ESG).

Consumer backup services were popularized by Mozy (now part of EMC Corp.) and Carbonite. They're pure cloud backup products, licensed to protect a single desktop or laptop, and may not have all the features expected in a business backup product. For instance, the Carbonite service doesn't offer deduplication. "Deduplication is less required in our target market where the average amount of protected data is less than 50 GB," said Pete Lamson, general manager of Carbonite's Small Business Group. Both Carbonite (with Carbonite Business) and Mozy (with MozyPro) have expanded their offerings into businesses. While Carbonite targets small businesses with a simple and highly affordable backup service, MozyPro is aimed at small and large businesses alike.

Joining Carbonite with a focus on small companies with up to 50 users is Symantec Corp. with Backup Exec.cloud, which is now in beta in North America with general availability slated for this fall. "Backup Exec.cloud has centralized management and provides global visibility to protected hosts, and we try to make backup as simple as possible," said David Mitchell, product manager for Symantec's hosted endpoint protection.

For enterprises, IBM has rebranded and renamed its managed backup

**Handing off backups to a managed service provider is the quickest way of getting backups into the cloud and the method with the fewest internal IT requirements.**

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service offerings with a focus on resilience: SmartCloud Resilience. The IBM product spans the data protection spectrum from backup and recovery to archival and DR.

Hewlett-Packard (HP) Co.'s enterprise Electronic Vaulting Service is a managed server backup product powered by Asigra Software; HP's Mobile Information Protection uses Autonomy Connected Backup, which HP has just made available as PC Backup Services for the SOHO and SMB markets, and is available through channel partners.

i365 has been offering managed backups since 1997, and the company has one of the most complete and feature-rich cloud backup offerings addressing the needs of small and large companies. Available as pure service, software, and physical and virtual appliances, it can be deployed on-premises, in a hybrid arrangement or as a pure cloud backup product.

Iron Mountain Inc. has one of the strongest brands in the backup world but its cloud message changed with the sale of its Connected Backup and LiveVault backup software to Autonomy. Iron Mountain is currently focusing on backup services rather than software development.

"We continue to offer cloud backup services for businesses," said Ken Rubin, senior vice president and general manager of the Iron Mountain healthcare service. "For the healthcare and financial services sectors, we provide advanced solutions; for instance, for hospitals we offer a managed backup product with tight integration with all major PACS [picture and archival communication system] systems."

—KEN RUBIN, senior vice president and general manager, Iron Mountain healthcare service

**"For the healthcare and financial services sectors, we provide advanced solutions; for instance, for hospitals we offer a managed backup product with tight integration with all major PACS [picture and archival communication system] systems."**

## **CLOUD-ENABLED BACKUP APPS AND GATEWAYS**

While small companies are more likely to opt for the MSP approach, larger companies are more apt to extend their existing backup infrastructure

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into the cloud using either their existing backup software or a cloud gateway. The incentives to expand the backup infrastructure into the cloud range from replacing off-site tapes with backups in the cloud to leveraging the cloud for backup jobs that can be performed more cost-effectively.

Cloud support in commercial backup applications varies considerably. CommVault Systems Inc. has added extensive cloud support and supports a wide range of cloud service providers (AT&T, Amazon, Microsoft, Nirvanix and Rackspace). Supported cloud providers appear as additional backup media and all backup features, such as deduplication, are available when backing up to the cloud. Archival into the cloud with stub support for on-demand retrieval of archived data and block-based replication of changes into the cloud for recovery into a compute cloud service such as Amazon Elastic Compute Cloud (EC2) are just a couple of features that distinguish CommVault Simpana. Similar to CommVault, both Symantec Backup Exec and NetBackup support backing up into the cloud, but they currently only support Nirvanix. Arkeia Network Backup supports replication of backup sets into Amazon and Nirvanix.

EMC Avamar and NetWorker currently don't have out-of-the-box integration with cloud service providers. Instead, EMC is selling Avamar to MSPs. "We decided on Avamar to power our enterprise backup service because of its efficient source-side deduplication and scalable Avamar Data Store grid," said Dick Mulvihill, co-founder and managing partner at Hexistor Data Protection Service LLC, a Chicago-based backup MSP.

IBM Tivoli Storage Manager (TSM) doesn't currently support direct backups into the cloud. "We're working with cloud gateway manufacturers such as Riverbed for cloud backup support; cloud backup gateways are simple and quick to set up and have the advantage of locally cached backups for quick restores," said Steve Wojtowecz, vice president of storage software development at Tivoli.

Cloud gateways that move data into cloud storage are available from

**"We decided on Avamar to power our enterprise backup service because of its efficient source-side deduplication and scalable Avamar Data Store grid."**

**—DICK MULVIHILL, co-founder and managing partner, Hexistor Data Protection Service LLC**

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Nasuni Corp., Panzura Inc., Riverbed Technology Inc., StorSimple Inc., Twin-Strata Inc. and others. While some gateways are touted as hybrid cloud storage products to extend on-premises storage into the cloud, Riverbed Whitewater's focus is exclusively on cloud backup. Available in different configurations for small businesses to large enterprises, traditional backup applications back up to the Whitewater gateway appliance, which then deduplicates, compresses, encrypts and asynchronously moves data into supported cloud providers (which currently include AT&T, Amazon and Nirvanix). The StorSimple gateway stands out because of its extensive support of Microsoft SharePoint.

## CLLOUD BACKUP GOES MAINSTREAM

Backup to the cloud is moving from a niche application into the mainstream, especially in the SOHO and SMB sectors, and it's being used increasingly by larger companies to supplement their existing backup infrastructure. The increased adoption of cloud services by public companies and even government agencies suggests that security concerns with cloud services are slowly abating. However, proper due diligence must be taken when evaluating cloud backup, such as implementing solid backup processes and strong controls, to avoid unpleasant surprises. ☹

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**Jacob Gsoedl is a freelance writer and a corporate director for business systems. He can be reached at [jgsoedl@yahoo.com](mailto:jgsoedl@yahoo.com).**

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# NetApp nudges Dell for top midrange array spot

Dell plus Compellent proved to be a strong combination, but not quite strong enough to overtake NetApp on our sixth Quality Awards survey for midrange arrays. BY RICH CASTAGNA

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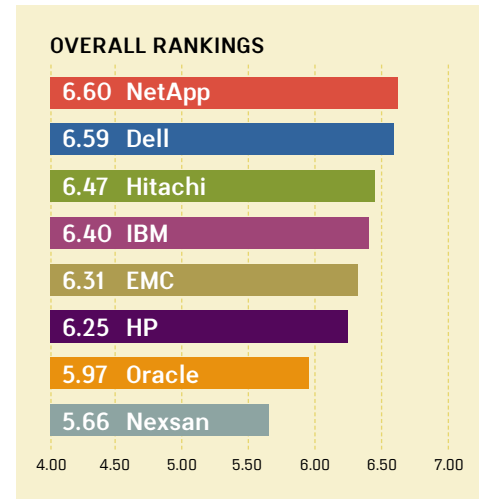
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**TO SAY NETAPP INC.** outscored Dell Inc. on the latest Quality Awards survey for midrange arrays is something of an overstatement. With the slimmest possible margin separating them—0.01—the two data storage behemoths duked it out in every rating category, sharing honors along the way and finishing in a near dead heat. With all scores tallied, NetApp topped Dell with a score of 6.60 vs. 6.59. Obviously, both vendors' products are highly regarded by their customers, even as that trust and loyalty has been earned via two distinct routes. NetApp is a networked storage pioneer, while Dell has successfully leveraged partnerships and acquisitions to build an impressive portfolio.

# Overall rankings

NetApp and Dell led a generally strong group of eight midrange vendors and their product lines. Hitachi Data Systems (HDS), with an overall 6.47, wasn't far behind the leaders, and IBM's 6.40 was also just a bit off the pace. Rounding out the field were EMC Corp. (6.31), Hewlett-Packard (HP) Co. (6.25), Oracle Corp. (5.97) and first-timer Nexsan Corp. (5.66). (For more information about our process and surveyed products, see "[About the Quality Awards](#)" and "[Products in the survey](#)," below.)



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## PRODUCTS IN THE SURVEY

The following vendors and midrange array model lines were included in the Quality Awards survey. The number of responses for each finalist is included in parentheses after the product names.

Acer AS2040 or AMS 2100/2300*	Infotrend ESVA E60 or F60 Series*
BlueArc Corp. Titan 2000/3000 Series, Mercury*	NEC Corp. D3/D4/D8 Series*
DataDirect Networks Inc. S2A Series*	NetApp Inc. FAS200/FAS900/FAS2000 (124)
Dell Inc. CX Series, Dell EqualLogic PS Series or Dell Compellent Storage Center (93)	Nexsan Corp. E-Series, SATABeast, SASBeast (15)
Dot Hill Systems Corp. AssuredSAN 3000 Series*	Oracle Sun Storage 6000 or 7000 Series (43)
EMC Corp. Clariion CX Series/VNX Series (184)	Overland Storage SnapSAN S2000*
Fujitsu Eternus DX400 Series*	Pillar Data Systems Axiom 300/500/600* (survey conducted before the Oracle acquisition)
Hewlett-Packard (HP) Co. EVA Series, P4000 Series, 3PAR E200 or F200/F400 (129)	Reldata Inc. 9240i*
Hitachi Data Systems (HDS) USP VM or AMS Series (65)	SGI Corp. InfiniteStorage 4000/5000/6000 Series*
IBM Storwize V7000, DS3950, DS4000, DS5000 or DS6000 (84)	Xiotech Corp. Emprise (ISE) 7000/9000 Series*

\* Received too few responses to be included among the finalists

# Sales-force competence

Setting the table for its close competition, NetApp bested Dell in the sales-force competence category by a scant two-hundredths of a point: 6.40 to 6.38. The two vendors evenly divvied up the six statements in the category. NetApp showed its strength with a sales team that's knowledgeable and reps who understand customers'

businesses and interests. Dell's reps scored high for taking time to learn their customers' industries, and for their flexibility and willingness to negotiate. HDS' 6.31 placed it third, just trailing the leaders on most of the category statements.

## BREAKING DOWN THE NUMBERS:

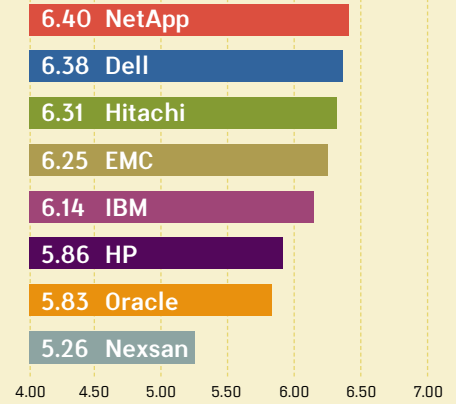
**Smart sales:** The highest overall average for a single statement in this category was a 6.36 for "The vendor's sales support team is knowledgeable."

### Four vendors

scored 6.00 or better on all six statements: NetApp, Dell, HDS and EMC.

**The worst scores** across the board were for "My sales rep keeps my interests foremost" (5.86).

SALES-FORCE COMPETENCE



## WHAT THEY'RE SAYING:

*"Everyone compares themselves to NetApp. What does that say?"*

—SURVEY RESPONDENT

**ABOUT THE QUALITY AWARDS** The *Storage* magazine/SearchStorage.com Quality Awards are designed to identify and recognize products that have proven their quality and reliability in actual use. Results are derived from a survey of qualified readers who assess products in five main categories: sales-force competence, initial product quality, product features, product reliability and technical support. Our methodology incorporates statistically valid polling that eliminates market share as a factor. Indeed, our objective is to identify the most reliable products on the market regardless of vendor name, reputation or size. Products are rated on a scale of 1.00 to 8.00, where 8.00 is the best score. A total of 457 respondents provided 797 midrange storage array evaluations.

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# Initial product quality

Pre-sales activities and inking contracts are the pregame show with the real kickoff happening when the gear gets uncrated. Midrange vendors—led by NetApp’s solid 6.74 for initial product quality—are apparently doing a good job of creating a winning first impression, as the overall average for this category was second highest (just trailing the numbers for product reliability). Dell once again finished second with an equally impressive 6.68; HP tallied a 6.60 for a strong third-placing showing. NetApp scored highest for four of the six statements, with fifth-place HDS snagging the remaining two statements.

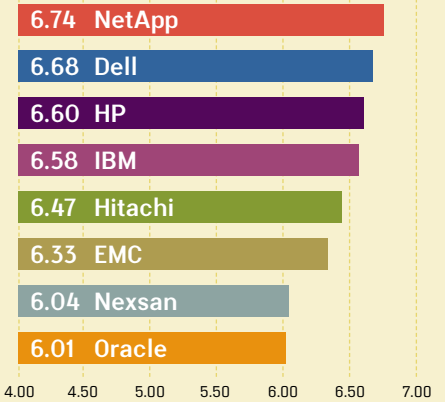
## BREAKING DOWN THE NUMBERS:

**HDS’s 6.95** for “This product was installed without any defects” was the highest single statement score for all categories in the survey.

**NetApp’s first-place** finish was achieved with top scores for getting up and running quickly, requiring little vendor intervention, needing only a reasonable amount of professional services and ease of use.

**All eight products** totaled scores higher than 6.00, only the second time that has happened in six surveys.

INITIAL PRODUCT QUALITY



## WHAT THEY'RE SAYING:

*“Our HDSAMS 2300 is rock solid.”*

—SURVEY RESPONDENT

# HEAVY HITTERS

Respondents’ average installed capacity (in TB) with midrange arrays vendors.

HDS	..... 94	EMC	..... 79	Oracle	..... 71	HP	..... 58
Nexsan	..... 90	NetApp	..... 72	IBM	..... 64	Dell	..... 46

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# Product features

Some claim the parity among midrange arrays is so great that there's little difference in their features. That may be true for core capabilities, but there's still considerable differentiation among vendor's wares. NetApp won the product features category with a 6.63 score that was enough to squeak by strong showings by HDS (6.55) and Dell (6.52). NetApp scored highest on four of the seven features statements, including those for snapshot (6.82), mirroring (6.79) and replication (6.61) capabilities, which are acknowledged strengths of NetApp products.

## BREAKING DOWN THE NUMBERS:

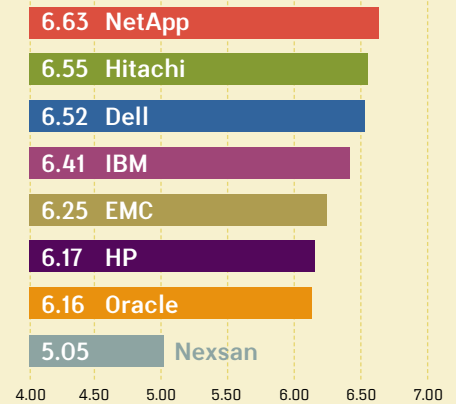
### Second-place

HDS had the highest statement score in the category for all products, a 6.88 for "This product's capacity scales to meet my needs."

Dell came in third, with top scores for overall satisfaction with features (6.71) and management features (6.63).

Along with the top three finishers, IBM had 6.00-plus scores for all category statements.

PRODUCT FEATURES



## WHAT THEY'RE SAYING:

*"The technology behind Dell/Compellent is very good; the three tier technology... can move heavily used data to tier 1 (fast disks)."*

—SURVEY RESPONDENT

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# Product reliability

The true test of any midrange storage product is how well it fares over an extended period of time. In all but one of the past midrange surveys, the overall average for reliability was the highest among all categories—which is also the case this time (6.45). Dell’s 6.75 put it on top, ahead of NetApp (6.69) and HDS (6.66); within striking distance were IBM, EMC and HP. Dell scored highest on four of the five statements, ceding to HDS only for the statement related to applying patches nondisruptively. With the exception of HDS, all products had their lowest scores for the nondisruptive patching statement. NetApp’s second-place finish resulted from trailing Dell by just a few hundredths of a point on several statements.

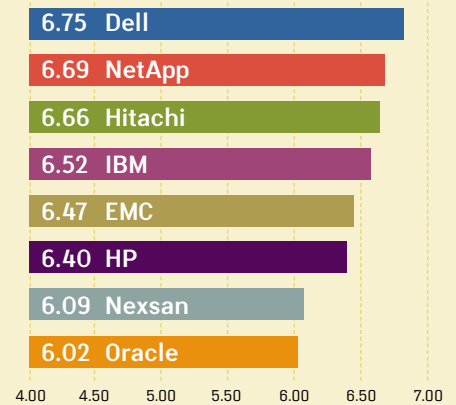
## BREAKING DOWN THE NUMBERS:

**All products** had average scores of 6.00-plus in the reliability category.

**Dell was tops** for meeting service-level requirements, having very little downtime, needing few unplanned patches and providing comprehensive upgrade advice.

**IBM, EMC and HP** joined the three leaders by scoring 6.00-plus on all five category statements.

PRODUCT RELIABILITY



## WHAT THEY'RE SAYING:

*“NetApp: Reliable and flexible.”*

—SURVEY RESPONDENT

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# Technical support

Things will break, but the vendor that responds fast and with a good fix will please any data storage pro. Dell snared its second category win with an average score of 6.62, splitting the eight tech support statements with second-place NetApp (6.57). HDS and IBM tied for third, each tallying averages of 6.35. Dell's strengths were delivering support as promised, rarely requiring problem escalation, solving issues in a timely manner and having well-versed support personnel. NetApp led for doing a good job training its partners, providing good training and documentation, and taking ownership of problems when they arise.

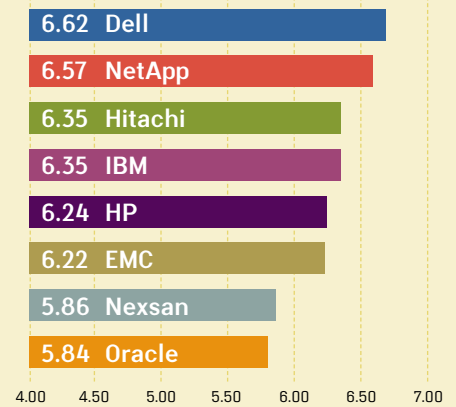
## BREAKING DOWN THE NUMBERS:

**Dell's 6.93** for "Vendor supplies support as contractually specified" was the highest rating for any statement in this category; its 6.91 for "Support personnel are knowledgeable" was the second highest.

**The two leaders'** statement scores were remarkably consistent; for Dell, its eight scores had a range of 0.60; for NetApp, the range was 0.49.

**Besides Dell** and NetApp, HP was the only vendor to receive scores of 6.00-plus for all statements.

### TECHNICAL SUPPORT



## WHAT THEY'RE SAYING:

*"Dell support is excellent every time."*

—SURVEY RESPONDENT

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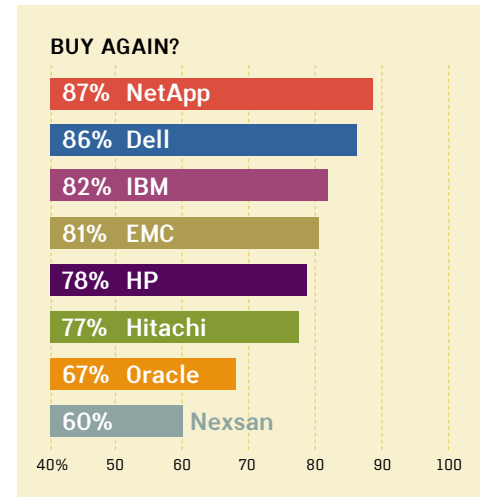
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# Would you buy this product again?

A true test of customers' satisfaction is whether they would come back for more. Often these results don't jibe with the category scores, but NetApp and Dell again lead the pack with solid scores that should generate some repeat business. Among NetApp users, 87% said that knowing what they know now, they would make the same purchase again. Dell users were nearly as loyal, with 86% ready to repeat their purchases. IBM (82%) and EMC (81%) users were similarly inclined, with HP (78%), HDS (77%), Oracle (67%) and Nexsan (60%) rounding out the field.



On past Quality Awards surveys, midrange users have reported generally positive reviews for their systems of choice, and the scores from this survey reinforce those impressions. The midrange segment is the fastest growing slice of the storage array pie, so another survey of mostly positive results is good news for both users and vendors. ☺

**Rich Castagna** ([rcastagna@storagemagazine.com](mailto:rcastagna@storagemagazine.com)) is editorial director of the Storage Media Group.

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# Curious about cloud? Consider these simple, safe ways to get started

*Cloud-enabled storage arrays are among the ways that cautious end users are testing the cloud without the worry.*

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**HERE SEEMS TO** be a new category of data storage system on the horizon: a cloud-enabled storage array. The broad market isn't using this terminology yet; but while some call it tiering, others a gateway or a hybrid cloud, they all have one thing in common: a low-risk opportunity for end users to stick their toe in the water and experiment with cloud storage infrastructures.

Traditional storage vendors are using cloud as a storage tier within the storage array; perhaps the best known is EMC Corp. tiering to the cloud using Fully Automated Storage Tiering (FAST) with its Celerra product line. In that system, cloud is treated as a storage tier for long-term archiving of infrequently accessed data. We're also seeing F5 Networks Inc. take a similar approach with its ARX product line in which it tiers file data to the cloud.

Similarly, on the gateway front, we have Panzura Inc., StorSimple Inc. and TwinStrata Inc. offering systems that can be used as on-premises storage systems or as a gateway to cloud service providers. And with these systems, the way cloud services are leveraged can be configured in multiple ways. Cloud can be the primary storage target, with the gateway only holding cached data to eliminate the latency associated with storing data off site. (These systems also typically encrypt, dedupe, compress and provide snapshot functionality.) Alternately, data can be pinned with the local system holding the primary copy of the data and the cloud being used as a disaster recovery (DR) target. This approach gives cloud skeptics a low-risk option to test cloud services because the primary data stays on site and the remote copy is encrypted. This is much more affordable than using array-based remote copy tools and maintaining a remote site yourself.

There's also an emerging category of software to consider designed for virtual use. It can leverage storage capacity and characteristics regardless of whether it's on site or in the cloud, creating a stretch or geo-distributed

cluster. There are different capabilities of cloud services depending on which type of storage media is assigned to it, and these software programs recognize that for users. Some of the gateways probably fall into this category, so there's bound to be a bit of overlap, but as storage increasingly becomes more virtualized and more of a software-layered-on-commodity-hardware play, this is an area to watch. Gluster, with its software-only offering, has made a notable early start here.

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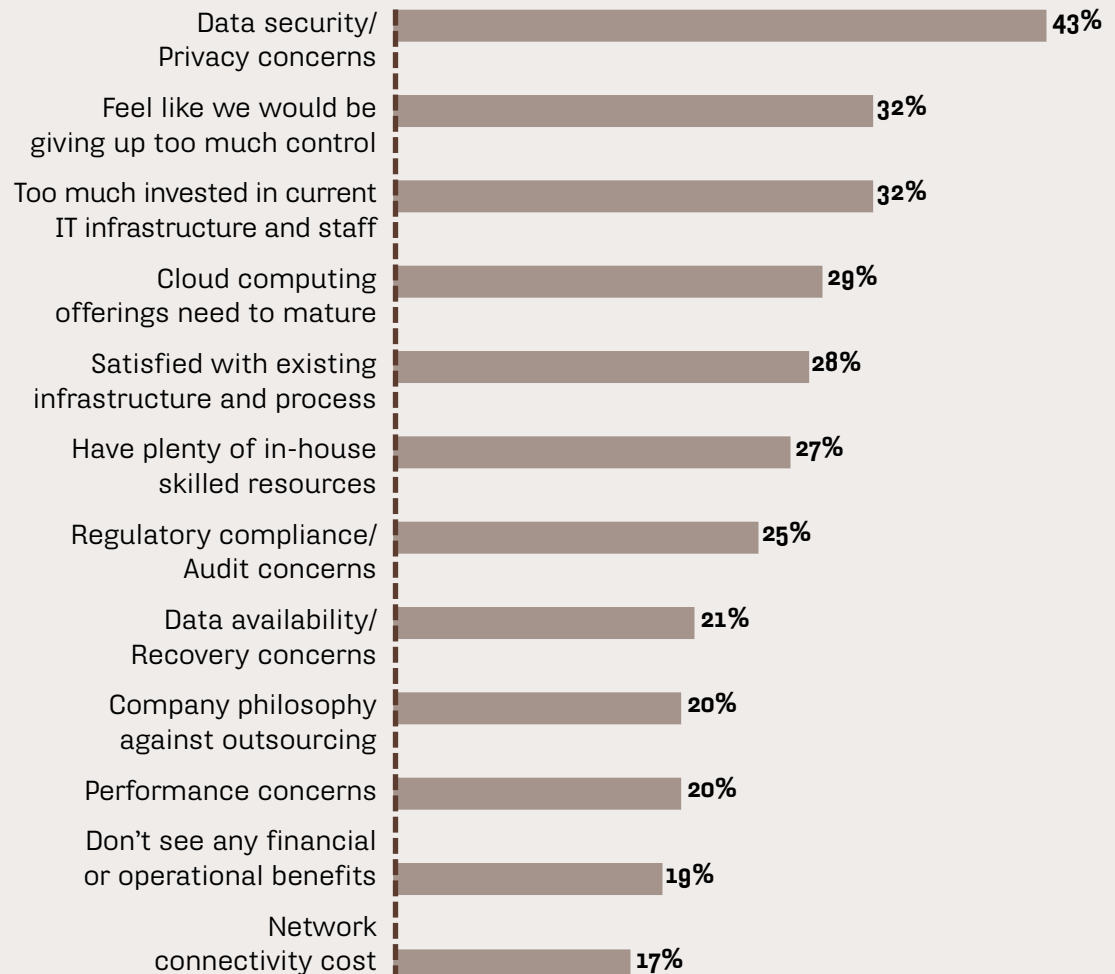
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### Why do you believe that public cloud computing services will have little or no impact on your organization's IT strategy over the next five years? (Multiple responses accepted)



SOURCE: Enterprise Strategy Group

## HYBRID, SHMYBRID

To buy into the hybrid cloud message you first need to buy into private clouds. And the jury is still out on what exactly constitutes a private cloud. Is it simply that your IT department has deployed virtualization and transformed to a service-oriented architecture (SOA)? Others will tell you that you must meet very strict criteria having to do with RESTful APIs, global namespaces and scalable object stores owned and operated by IT. We (recalling my storage vendor days) used to represent the storage-area network (SAN) in PowerPoint charts with a cloud and describe it with a lot of the attributes we use to describe cloud today. Indeed, many definitions of the SAN could also match the description of a private storage cloud. And a cloud-enabled array may not even be a part of an overarching cloud strategy; it may just be a safe, easy way to enable remote replication data recovery services.

Why do I think this cloud-enabled array approach may be a big part of IT strategy over the next few years? That's one part of this equation that's simple to answer. IT is a combination of people, processes and technology. For existing storage users who want to stay with legacy arrays or keep existing processes in place, using cloud as a storage tier behind what appears to be a conventional array gives them the extensibility and price points of cloud without radically altering processes or having to retrain staff. Or, for those users who need a more comprehensive DR strategy but can't afford a remote site, system and the staff to manage it, using tools within a storage array and turning some dials to mirror encrypted data to the cloud is low risk and affordable. Cloud-enabled storage arrays are bridging technology, tying the present to the future, and a familiar, safe way to test a cloud strategy. ☉

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**Terri McClure is a senior storage analyst at Enterprise Strategy Group, Milford, Mass.**

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# I/O: The next frontier

*Processors get faster, networking tech takes it up a notch and bus designs keep up the pace, but they may all be dragged down if we can't find a fix for slow I/O performance.*

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**HERE'S NO QUESTION** I/O is the next frontier the computer industry must conquer. We've met the compute challenge reaffirming Moore's Law over and over again as the industry doubles processing power every 12 months to 18 months. Memory speeds have also kept pace with the CPU, so processors and RAM can feed each other at similar speeds. In the realm of networking, the technologies seem to enjoy a big kick every three years to five years. With 10 Gigabit Ethernet (10 GbE) in the volume implementation stage and 40 Gig parts already available, we're swimming in bandwidth.

But all those advances may be held up by one laggard: I/O. It's been causing havoc with application performance and putting a dent in productivity for years.

To see why, we need to get down to basics. I/O is the transfer of data to or from a device that's handled by the file system or operating system making an I/O call. For data storage, it's a SCSI call that goes through the HBA/NIC/CNA and over the network to the SCSI device. The command is processed by the array's storage controller, and data is extracted from the disks and placed on the network or data is written to the disks. An I/O problem generally means it takes too long to read from or write to the disks. This I/O gap has existed for at least three decades, and it gets wider every year with little being done about it.

Until now.

NAND flash memory chips may be the solution that finally closes the I/O gap. Flash memory promises to be the best solution to the I/O problem we've seen in three decades. With solid-state storage, we're able to feed the compute/memory complex, traversing the network and the buses, with data moving at speeds that can keep the entire system working at peak efficiency.

The implications are profound. In many ways, VMware and other hypervi-

sors are in a near stall state: the easy applications are already running as virtual machines (VMs), but the I/O problem must first be resolved to get mission-critical applications into the server virtualization fold. No IT shop will move a latency-sensitive, I/O-bound application that's been fine-tuned to run on a dedicated server to the VM environment until the I/O characteristics are equal or better on the VM side.

Demanding apps—like high-performance computing (HPC), seismic, bio, pharmaceutical, media and entertainment, and weather forecasting—are hobbled or stopped dead in their tracks because of the I/O issue. The implications for solving the I/O dilemma are enormous.

While solid-state is seen as the solution, where and how it's used to solve the I/O problem is still uncertain. The easiest way to get into the game is solid-state storage in hard disk form factor that can plug into a traditional array. That's the easiest way to get a quick boost, but it's only a partial solution. The array's controller, which was never designed for such powerful devices, quickly becomes a bottleneck. Dell, EMC, Hewlett-Packard, Hitachi, IBM and practically all data storage vendors offer this alternative.

To deal with this "constriction" in the storage array controller, a number of vendors have developed controllers that are designed from the ground up to deal with solid-state drives (SSDs). These arrays can accelerate latency-sensitive apps by 4x to 10x. Vendors in this category include GridIron Systems, SolidFire, Violin Memory and others.

Flash can also be used to grab the I/O before it reaches a storage array and cut out all the travel up/down the buses to the HBA/NIC/CNA and across the network fabric. For this alternative, the flash memory is implemented on a PCIe card that's slotted into the server. Latency-sensitive data is kept in the flash memory on the card and the relevant I/O is trapped by the card and handled locally. The driver in this case is crucial and is gener-

**Demanding apps—like high-performance computing (HPC), seismic, bio, pharmaceutical, media and entertainment, and weather forecasting—are hobbled or stopped dead in their tracks because of the I/O issue.**

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ally supplied by the card vendor. Performance is outstanding because no extraneous latency-adding devices get in the way. Think of this approach as memory being made to look like a disk. The biggest downside is that the I/O performance is only available to the server that holds the solid-state card. Vendors in this category include IO Turbine (which is in the process of being acquired by Fusion-io), Fusion-io, VeloBit and others.

Still another approach is to use flash memory as a cache that front ends a storage array, such as NetApp's Flash Cache. Here the cache is designed to be smart enough to hold that portion of the data that's frequently requested by the applications. Instead of a small number of SSD drives that the array itself could hold, the benefit of flash is now applicable to data in the entire array.

Variations on these approaches are coming fast and furious. For example, we've seen products from vendors like Alacritech and Avere Systems that use a combination of DRAM, flash and hard disk drives (HDDs) in a package that front ends a number of NAS boxes to essentially breathe new life into old NAS systems. The variations are as many as there are creative entrepreneurs, and it remains to be seen which approaches will ultimately prevail.

It's high time we solved the I/O problem. HDDs have been the mainstay in data storage shops for as long as one can remember. But fundamental changes are occurring now that will forever change how I/O is done. The performance and productivity gains you'll see won't just be incremental, they'll blow your mind. ☺

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**Arun Taneja is founder and president at Taneja Group, an analyst and consulting group focused on storage and storage-centric server technologies. He can be reached at [arunt@tanejagroup.com](mailto:arunt@tanejagroup.com).**

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## High satisfaction among cloud backup users

Nearly 25% of our 244 respondents use cloud backup—a fairly high number given the uneasiness about sending data offsite and the relative newness of this incarnation of cloud storage. Sixty-five percent of cloud backup users are very satisfied or satisfied with the services they're using, and 49% expect to expand their use. Respondents send an average of 42% of their backups to the cloud and maintain an average of 12.6 TB of backup data in the ether. While touted as ideal for mobile user and remote-office backup, the heavy use case is for data center backup (58%). Users still rely on the service's software for access (58%), but 47% use an in-house appliance or array to stage backups before they're shipped to the service. The top reason for not using cloud backup: Nervous about sending data into a public cloud. The most recognized cloud backup services are Amazon (10%), Symantec (7%) and EMC (6%); Google, IBM, Iron Mountain and Microsoft were all at 5%. —Rich Castagna

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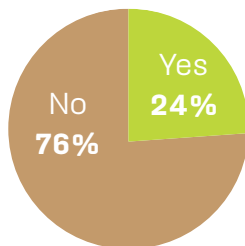
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### Does your company currently use any cloud storage services for backup?

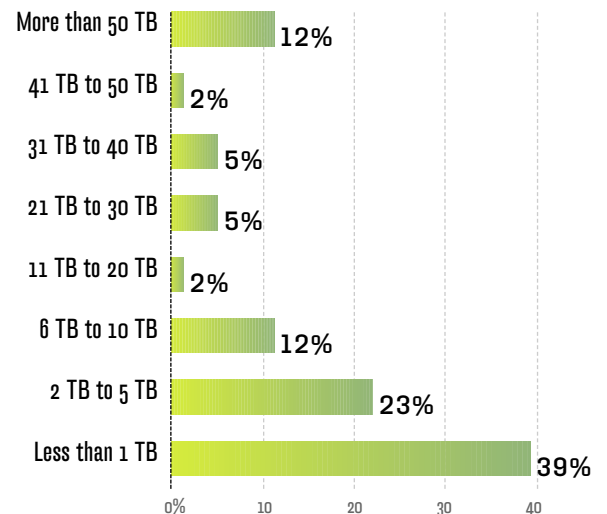


### Why doesn't your company use a cloud backup service?\*

- 51%** Not comfortable sending our data into a public cloud
- 46%** Our current backup setup is adequate
- 30%** Communications bandwidth isn't adequate at this time
- 27%** Concerned about restoring large amounts of data
- 21%** We're currently evaluating cloud backup services
- 18%** Cloud backup services are too expensive
- 16%** Worried that a cloud backup service may go out of business

\* Multiple responses permitted

### How much data does your company have stored with cloud storage backup services?



**29%**  
Say better data security would convince them to try a cloud backup service.

**“Works well for remote sales laptop users, but too expensive for data center backup due to the bandwidth required and the time to restore in a catastrophe.”**

—Survey respondent

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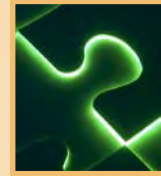
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# STORAGE



## COMING IN October

### What storage managers are buying

This is the ninth year of our exclusive Storage Purchasing Intentions Survey that asks data storage managers how they plan to spend their budgets, the technologies they're implementing or evaluating, and other initiatives and issues under consideration. We analyze the current results and compare them to past data to determine emerging storage buying trends.

### Storage networking decisions

We'll take a look at some of the storage networking technologies that are likely to have the most impact in current and future data centers. We'll consider how FCoE will fit in, if Fibre Channel is really dead, how Ethernet is poised to dominate and whether new techs like virtual I/O are really ready.

### The state of solid-state

Solid-state storage has carved out a fairly specialized and still rather small niche in the storage ecosystem, but it has certainly established itself as a viable alternative. We'll look at what technologies are working now, the most popular, and effective, implementations of solid-state technology, and what to expect both near-term and further down the road.

**And don't miss our monthly columns and commentary, or the results of our Snapshot reader survey.**



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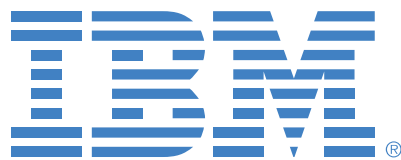
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