RAID has been a mainstay of data protection for decades, but its days may be numbered as newer technologies and approaches to protecting disk-based data emerge.

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Everyone knows that to stay current, a storage manager needs to keep “tech ed up” by reading tons of technical articles, white papers, product specs and testing results. But to truly keep up with storage these days, your newspapers’ business pages need to be on your reading list, too.

While poring through all the data we collect with our twice-yearly Storage Purchasing Intentions surveys (see “Storage managers can reach for their wallets again,” p. 28), I always find it interesting that storage managers consistently rank the financial stability of a vendor as one of the least important factors—if not the least important factor—in making a purchase decision. Financial criteria isn’t just ranked low vs. things like product features, familiarity with the vendor’s other products, tech support and the perception that a vendor is a leader in their market, it’s barely a consideration, with typically only 1% or 2% of those surveyed saying it’s a key consideration. I’m not suggesting that purchases should be made only on the financial prospects of a vendor, but it seems that it should figure into the equation a little more prominently.

There’s just too much going on to overlook the business of storage and focus solely or predominantly on the technical picture. The most obvious case involves taking a chance on a startup with some hot new technology that nobody else seems to have. If the technology is a good fit that addresses a key issue, the fact that it comes from a startup shouldn’t put the brakes on the deal. But some due diligence is in order, not just to scope out the vendor’s financials but to consider things like the company’s prospects for survival, why other vendors aren’t touting the same technology and if the vendor is addressing a niche market that may be a bit too niche-y to produce enough revenue to survive.

Not too long ago, Copan Systems made waves with its massive array of idle disks (MAID) technology, which has since (in several variations) found its way into a growing number of other vendors’ products. It’s a cool idea—cram a lot of drives into a small space and just spin up the ones that are actually doing some work—that offered capacity and power conservation

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at the same time. Cool tech or not, there was something amiss in Copan’s plan, and its remains, intellectual property and presumably short customer list were recently sold to SGI for $2 million, the approximate price of a big, enterprise-class storage array. (Interestingly, SGI was itself acquired by Rackable Systems Inc., which picked up the former Silicon Valley star for only $25 million and then adopted its name.)

But chancy buys with startups aren’t the only financial hazards a storage manager needs to negotiate. Two of the hottest storage topics right now are solid-state storage and cloud storage, and while they’re definitely filled with promise, there are some caveats lurking there. STEC, one of the most successful solid-state purveyors around, tempered what normally would have been banner-waving news—record revenues that topped last year’s by 56%—with a rather glum prediction that the first half of 2010 would be far less spectacular. It’s not that user interest in solid state has already faded; it’s that EMC, its biggest customer, has a closetful of inventory and isn’t likely to be buying all that much more real soon. It’ll be interesting to see what effect (if any) this has on STEC, which has been perceived as a leader in solid-state storage.

Going back to our survey, we see that interest in cloud storage services is fairly high, but here, too, is another case where you truly need to bone up on the business side of things. For a relatively new technology (or maybe refreshed technology is a better description), the number of cloud storage service players is unprecedented (I think there are a billion of them), so the odds of any one of them going belly up are pretty high. In fact, you can count on scores of these services shuffling off this mortal coil and disappearing into the clouds.

You can, of course, take this advice too far and let financial stability and market position become overwhelming criteria. EqualLogic seemed to be cruising along just fine with good products and happy customers when Dell ponied up some big bucks for it. But most of the reports I’ve heard suggest that the new union is working out pretty well. And when storage system market leader EMC scooped up data deduplication leader Data Domain—the leader buys a leader—it doesn’t mean that you shouldn’t consider other dedupe vendors, because there are still a lot of solid dedupe alternatives out there.

If you do storage, you’re probably a tech freak to some degree, so the thought of having to wade through financial info probably isn’t very appealing. While you’re not likely to stop reading systems manuals in favor of The Wall Street Journal, a quick flip through the financial pages once in awhile can’t hurt.

Rich Castagna (rcastagna@storagemagazine.com) is editorial director of the Storage Media Group.

* Click here for a sneak peek at what’s coming up in the June 2010 issue.
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Content chaos

The world of file content and NAS storage is disjointed and threatening; we need to unravel the problem of massive files stores before the issue gets too big to handle.

ET'S FACE IT: The big problem with file content is users. People create, copy, convert, forward, edit, scan and download files all day long. It's the Wild West of storage without many controls or restrictions. I remember one customer who discovered they had 125 copies of a scanned Chinese menu on their tier 1 storage system. Wild...

Look inside any company and consider the hundreds, thousands or tens of thousands of individuals creating—and recreating—content, and it’s not hard to see how easily file sprawl becomes a pervasive and very big problem. More and more companies have hundreds of terabytes or even petabytes of file storage. In many cases, storage managers have no idea how much file content they have, the value of that content, how much it’s costing them, where it’s being stored or how it’s being protected.

We're not only creating tons of files, we're creating huge files in the form of images, video and audio content.

NAS-ty

This brings me to the next big problem with file content: How we store it. A great deal of file content gets parked on NAS storage systems and although there's great value in those systems, they create problems for storage and IT managers. For one, there are only a few vendors that provide enterprise-class NAS products, so users have a limited number of options to choose from. Clearly, having more viable products in the market would foster more competition, cost effectiveness and innovation.

I've been talking with some big NAS shops lately, and one of their biggest challenges is NAS migration. Companies with hundreds of terabytes or petabytes of NAS file content feel like they're essentially tethered to specific NAS devices because the complexity of moving that data is often perceived as an insurmountable challenge or at least...
far more trouble than it’s worth. One user told me he felt he was being perpetually held for ransom by his NAS storage.

**IS UNSTRUCTURED ANOTHER WORD FOR USELESS?**

We often refer to files as unstructured data. By its very nature there’s a lack of a defining structure to this type of content, so it can be hard for IT professionals to clearly classify the usefulness of file data. However, we don’t dare delete it because there’s always the risk that it will be needed some day; for most companies, the cost of avoiding that risk is perceived as less than the capital cost of buying the gear to store all that data.

Interestingly, industry studies have found that 60% to 80% of unstructured content is never used again 90 days after its creation. That statistic alone makes unstructured content seem synonymous with “useless” content. It costs so much to store and protect file content, so why not use it? Is it because the content has no sustainable value, or is it because we just don’t have the tools to easily and effectively make use of it?

**BACKUP GETS EVEN HARDER**

I believe the biggest challenge in a petabyte world is backup. Consider our new storage landscape with those hundreds of terabytes or petabytes of file content being stored on multiple storage systems. Now ask yourself: How do you protect all of that file content? Then think about how much that protection will cost you, not just in dollars, but in time and resources, too. Legacy methods or sticking with the status quo are insufficient ways to meet the needs of today’s requirements. This means either a new method of file protection is required or you’re just rolling the dice when it comes to recovering data. The latter choice is a hard one to make, especially when you consider that the consequences of a failed recovery could permanently damage your business. This is one of the biggest issues our data centers will confront this decade.

For the longest time we’ve been able to get by doing business as usual and solving—or forestalling—the problem by throwing more IT infrastructure and people at it. But now we’re at an inflection point where we can no longer be complacent with the status quo. Managing massive file stores is one of the “big” problems in the data center for the decade, and IT professionals need to sound the alarm and make this a real priority.

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Tony Asaro is senior analyst and founder of Voices of IT (www.VoicesofIT.com).
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COMING IN JUNE

Making the Case for Solid-State Storage
Interest in solid-state storage is high right now. The technology’s high performance, coupled with its low power consumption, makes it especially compelling for demanding enterprise applications. And with a variety of solid-state implementations now available and newer technologies emerging, it’s time to take a serious look at how solid state could enhance your storage environment.

Protecting SharePoint Data
More and more companies are deploying Microsoft SharePoint to help ease communications and enable collaboration. But SharePoint, with its multiple server architecture and other idiosyncrasies, poses new problems for effective data protection. We look at the best methods and tools for backing up SharePoint data, as well as archivers with interfaces built specifically for this collaboration environment.

Quality Awards V: Backup and Recovery Software
For the fifth time, the Storage magazine/SearchStorage.com Quality Awards take a look at backup and recovery software. As with all of the other product categories in the Quality Awards program, we poll our readers to assess their overall satisfaction with the service and reliability of the backup and recovery applications they’re currently using.

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Alternatives to RAID

The various forms of RAID have been around for a long time and have done a good job of protecting data. But high-capacity drives and new performance demands have spurred development of RAID alternatives.

By Marc Staimer

REUNDANT ARRAY of independent disks (RAID) has been the standard for disk-based data protection since 1989, and is a proven and reliable method that’s considered a basic data storage building block. Basic storage principles tend to change very slowly and, despite its popularity and track record, change is coming to RAID.

To gain more insight into why an alternative to RAID might be appealing requires some understanding about RAID and the growing problems with the technology.
RAID SHORTCOMINGS IN THE 21ST CENTURY

The purpose of RAID is to protect data in the event a hard disk drive (HDD) fails. When that failure occurs, data from that failed HDD (or multiple HDDs) is recreated from parity or copied from a mirror, depending on the type of RAID in use. Disk drives are electro-mechanical devices that have the highest probability of a failure and the lowest mean time between failures (MTBF) in any storage system.

It takes a lot of HDDs to keep up with the rapid growth rate of data storage that analyst firms like IDC, Gartner and Enterprise Strategy Group peg at somewhere between 50% and 62% per year. Statistically speaking, more hard disk drives mean more HDD failures. Disk drive manufacturers have continually increased HDD density, and today we have 2 TB SATA and are likely going to 4 TB by the end of this year. Even high-performance SAS and Fibre Channel (FC) drive capacities are pushing 600 GB. RAID problems quickly become evident when a rebuild is required with those increasingly dense drives.

Each RAID type (see “Traditional RAID levels,” p. 15) has tradeoffs in write performance, read performance, level of data protection, speed of data rebuilds and the usable storage on each hard disk drive. For example, if guaranteeing data availability is the top priority, then some variation of mirroring or multiple mirrors (RAID 1, 10, triple mirror, etc.) will be required. Having full copies of the data on other HDDs or RAID sets simplifies protection and recovery of the data but at a severe and tangible cost because each mirror reduces usable storage by the same amount of the original data. In addition, system resources are required for every copy, which can impair I/O performance. Realistically, most organizations aren’t this overprotective; most use RAID 5 and/or RAID 6.

When a HDD fails in a RAID 5 set, the system will rebuild the data on a spare drive that replaces the failed hard disk drive. The storage system then exercises every sector on every HDD in the RAID set to reconstruct the data. This heavy utilization of the other HDDs in the RAID set increases the likelihood of another HDD failure (usually a non-recoverable read error) by an order of magnitude, which significantly increases the likelihood of a data failure. Ten or 20 years ago when disk capacities were much lower, rebuilds were measured in minutes. But with disk capacities in the terabytes, rebuilds can take hours, days or even weeks. If application users can’t tolerate the system performance degradation that rebuilds cause, the rebuild is given a lower priority and rebuild times increase...
### TRADITIONAL RAID LEVELS

<table>
<thead>
<tr>
<th>RAID level</th>
<th>Description</th>
<th>Max HDD failure protection</th>
<th>Vendor or standard</th>
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</thead>
</table>
| RAID 0     | • Data striped across hard disk drives (HDDs) for maximum write performance  
           • No actual data protection | 0 | Standard |
| RAID 1     | • Synchronously mirrors all data from each HDD to an exact duplicate HDD  
           • No data lost if HDD faults or fails  
           • Typically highest performing RAID level at the expense of lower usable capacity | 1 | Standard |
| RAID 2     | • Data protected by error correcting codes (ECCs)  
           • Parity HDD requirements proportional to the log of HDD number  
           • Somewhat inflexible and less efficient than RAID 5 or RAID 6 with lower performance and reliability  
           • Not widely used | 1 | Standard |
| RAID 3     | • Data is protected against the failure of any HDD in a group of N+  
           • Similar to RAID 5 but blocks are spread across HDDs  
           • Parity is bitwise vs. RAID 5 block  
           • Parity resides on a single HDD rather than being distributed between all disks  
           • Random write performance is quite poor and random read performance fair at best | 1 | Standard |
| RAID 3     | Double Parity | 2 | NEC D-series |
| RAID 4     | • RAID 3 with a second byte-level parity disk  
           • Protects data in the event of a second HDD failure or loss of the parity HDD  
           • Performance is marginally slower than standard RAID 3, but system performance can degrade noticeably if dual HDDs are rebuilding concurrently | 1 | Standard |
| RAID 5     | • Similar to RAID 3, stripes data across many HDDs in blocks instead of RAID 3 bytes to improve random access performance  
           • Data protection is provided by a dedicated parity HDD  
           • Similar to RAID 5 except uses dedicated parity instead of distributed parity  
           • Dedicated parity HDD remains a bottleneck, especially for random write performance. | 1 | Standard |
| RAID 5     | | | |
| RAID 6     | • Most common RAID  
           • Provides RAID 0 performance with more economical redundancy  
           • Stripes block data across several HDDs while distributing parity among the HDDs  
           • Uses HDDs more efficiently, providing overlapped read and write operations  
           • Provides more usable storage than RAID 1 or 10  
           • Data protection comes from parity information that’s used to reconstruct data of a failed drive  
           • Minimum of three and usually five HDDs per RAID group  
           • Rebuilds cause lower storage system performance  
           • Potential total RAID group data loss if second drive fails during rebuild  
           • Read performance tends to be lower than other RAID types because parity data is distributed on each HDD | 1 | Standard |
| RAID 6     | | | |
| RAID 10    | • RAID 1 striped  
           • Improves write performance | 1 | Standard |
| RAID 50    | • RAID 5 striped  
           • Improves write performance closer to RAID 1 | 1 | Standard |
| RAID 60    | • RAID 6 striped  
           • Improves write performance closer to RAID 1 | 2 | Standard |
dramatically. Longer data reconstruction times typically equate to significantly higher risks of data loss. Because of this, many storage shops are stepping up their use of RAID 6.

RAID 6 provides a second parity or stripe that protects the data even if two HDDs fail or have a non-recoverable read error in the RAID set. The risk of data loss drops dramatically, but the extra stripe consumes additional usable capacity and system performance will take a bigger hit if two drives must be reconstructed simultaneously from the same RAID group. More disturbing is the increased risk of data loss if a third HDD fails or a non-recoverable read error occurs during the rebuild.

There are other RAID issues such as “bit rot” (when HDDs acquire latent defects over time from background radiation, wear, dust, etc.) that can cause a data reconstruction to fail. Most storage systems include some type of background scrubbing that reads, verifies and corrects bit rot before it becomes non-recoverable, but scrubbing takes system resources. And higher capacities mean more time is needed to scrub.

Another RAID issue is documenting the chain of ownership for replacing a failed HDD, which includes the documented trail (who, what, where, when) of the failed HDD from the time it was pulled to the time it was destroyed or reconditioned. It’s a tedious, manually intensive task that’s a bit less stringent if the HDD is encrypted. Even more frustrating is that the vast majority of failed HDDs sent back to the factory for analysis or reconditioning (somewhere between 67% and 90%) are found to be good or no failure is found. Regrettably, the discovery happens after the system failed the HDD, the HDD was pulled, the data was reconstructed and the chain of ownership documented. That’s a lot of operational pain for “no failure found.”

Solid-state storage devices actually exacerbate the aforementioned RAID problems. Because solid-state drives (SSDs) can handle high-performance applications, they allow for storage systems with fewer high-performance HDDs and more high-density, low-performance hard disk drives. Tom Georgens, NetApp’s CEO, recently noted that “fast access data will come to be stored in flash with the rest in SATA drives.” Lower CapEx and OpEx for the system can end up translating into higher OpEx because of the increase in RAID problems.

These RAID issues have inspired numerous vendors, academicians and entrepreneurs to come up with alternatives to RAID. We categorize those innovative alternatives into the three groups: RAID + innovation, RAID + transformation and paradigm shift.
RAID + INNOVATION
Several vendors have addressed traditional RAID problems by taking an incremental approach to RAID that leverages its reliability while diminishing some of the tradeoffs (see “RAID enhancements,” p. 18). IBM’s EVENODD (implemented by EMC on Symmetrix DMX) and NetApp’s RAID-DP (implemented on NetApp’s FAS and V-series) have enhanced RAID 6 by reducing algorithm overhead while increasing performance.

NEC Corp.’s RAID-TM or triple mirror (implemented in its D-Series systems) aims to solve RAID 1 data loss risk if both the primary and mirror drive fail or if there’s a non-recoverable read error. RAID-TM writes data simultaneously to three separate HDDs so if two HDDs fail or there are unrecoverable read errors in the same mirror, the app still has access to its data with no degradation in performance even as the drives are rebuilt. The advantage is performance; the disadvantage is far less usable capacity.

RAID-X is an IBM XIV Storage System innovation that uses a wide stripe to reduce RAID tradeoffs of performance and data loss risk. It’s basically a variation of RAID 10 that uses intelligent risk algorithms to randomly distribute block mirrors throughout the entire array. This approach allows XIV to reconstruct the data on very large 2 TB HDDs in less than 30 minutes. As with all mirroring technology, the tradeoff is reduced usable capacity.

Hewlett-Packard Co.’s LeftHand Networks and Pivot3 Inc. provide similar variations of Network RAID for their x86-based clustered iSCSI storage. Network RAID leverages the concept of RAID, but uses storage nodes as its lowest component level instead of disk drives. This allows it to distribute a logical volume’s data blocks across the cluster with one to four data mirrors depending on the Network RAID level. Ongoing block-level, self-healing nodal health checks allow Network RAID to copy and repair the data to another node before a failure occurs. This decreases the probability of a hard disk drive fault or non-recoverable read error causing a performance-sapping rebuild; but like all mirroring technology, it reduces the amount of usable storage.

These are just some of the RAID + innovation technologies. Others are currently incubating, including proposals for RAID 7 (triple parity and more) or TSHOVER (triple parity).

RAID + TRANSFORMATION
There are also RAID alternatives that attempt to re-invent RAID. They typically use RAID and are layered on top of it in some way. The concept is to keep what’s good about RAID and fix the rest. Examples of transformation technologies include self-healing storage and BeyondRAID.
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<th>RAID Enhancements</th>
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**RAID 6 EVENODD**
An IBM innovation that uses only two additional redundant HDDs and consists of simple exclusive-OR computations. The advantage of EVENODD is that it only requires parity hardware, which is typically present in standard RAID 5 controllers. This reduces the number of exclusive-OR operations over the more common Reed-Solomon computations at approximately 50% (based on 35 drives). EVENODD has similar performance issues of RAID 6 when dual hard disk drive (HDD) rebuilds are occurring. One advantage of EVENODD is that it’s based on XOR. A disadvantage is that it has a few hot spots in certain diagonal blocks that cause very poor short write performance.

**RAID-DM or Row-diagonal Parity**
Stores row parity across the HDDs in a RAID 4 group; the additional parity HDD stores diagonal parity across the HDD in a RDP group. The two RDP parity stripes provide data protection in the event of two HDD failures occurring within the RAID group. Performance is nearly equal to single parity RAID 4 or RAID 5. Higher performance than standard RAID 6, but with similar performance issues when concurrently rebuilding two HDDs.

**RAID-TM or RAID Triple Mirror**
RAID-TM provides the high speed of RAID 3 while providing the high reliability and double HDD fault protection of RAID 6. RAID-TM writes data simultaneously to three separate HDDs. Even with two HDD faults or unrecoverable read errors in the same mirror, the application still has access to its data with no degradation in performance even while drives are rebuilt.

**RAID-X**
RAID-X doesn’t require a spare HDD, just spare capacity on existing HDDs in the storage system. The objects can be mirrored among any two types of HDDs (no need to match drive size or speed). Rebuild performance is extremely fast because data is mirrored. This is a variation of RAID 1 or RAID 10, but with the added protection of random distribution. A second drive failure can result in data loss that can only be mitigated with additional mirrorings. Usable storage can be restricted depending on the number of mirrors (minimally half).

**Network RAID**
Lays out a logical volume’s blocks across the cluster, providing reliability configurable on a per-volume basis to best meet the needs of each application’s data. Depending on a logical volume’s Network RAID level, one to four copies of each block are striped across the cluster. A volume’s RAID level can be changed (auto-restrining) without data availability interruption. Also provides proactive block-level self-healing to decrease probability of a non-recoverable read error. However, each block copy reduces the amount of usable storage.

**Self-healing storage**
Also known as heal-in-place storage. Uses series of automated repair sequences designed to eliminate or mitigate the majority of HDD failures and unnecessary RAID data rebuilds. Isolates HDD sectors it can’t fix and only rebuilds the data lost on those sectors. More expensive upfront than traditional RAID, but with a much lower total cost of ownership. Heal-in-place storage requires a pool of unused HDDs for the fail-in-place capability.

**BeyondRAID**
BeyondRAID is essentially a virtualization engine on top of RAID that chooses the correct RAID algorithm based on the data protection required. It writes blocks that can actually alternate between data protection methodologies. If more storage capacity is required, additional HDDs can be inserted or small HDDs can be replaced with larger ones. Simple administration allows switching from single to dual disk redundancy with a single click. Protects against dual disk failures and adds transparent automatic data healing. It’s data aware, allows for mixed drive sizes, drive reordering, proportional rebuild time and self-management. Only available for small systems of up to eight drives.

**Erasure Codes**
Also known as a form of forward error correction (FEC), erasure coding adds additional information to a stored object that allows any dataset to be completely resurrected from a subset of the total information. Multiple slices (storage objects) or subsets of a dataset are distributed across multiple storage or server nodes. More additional information attached to a stored object equals greater resiliency of the dataset, protecting against larger numbers of components (disk drives, storage objects or server nodes) that can be lost and still recover the complete dataset. The additional information on each storage object also reduces the amount of usable storage. The biggest issue with erasure code based-storage is reduced write performance, especially small writes.
Self-healing storage: Xiotech Corp.’s Intelligent Storage Elements (ISE) is a good example of self-healing storage. ISE tightly integrates RAID and HDDs, and combines them into a single storage element.

Xiotech engineered ISE to resolve most RAID rebuild issues by eliminating 67% to 90% of the rebuilds. It starts by reducing HDD faults by proactively healing hard disk drives before a fault occurs using similar HDD reconditioning algorithms employed by the factory. It also uses advanced vibration controls and sealed systems called DataPacs to reduce outside influences from causing HDD faults. When a fault does occur, it reacts by providing remedial component repair within the sealed DataPac using methods similar to what the original manufacturer uses. It analyzes power cycles, recalibrates components, remanufactures the HDD, and migrates data when required to other sectors or HDDs. If the fault persists, ISE will isolate just the non-recoverable sectors and then initiate data reconstruction only for the faulted HDD sectors. So there are far fewer rebuilds and, when one is required, there's much less to reconstruct. In addition, it’s all automated so no manual intervention to pull failed drives is required. The result is equivalent to a factory-remanufactured HDD with only the components that are beyond repair taken out of service. The downside to this transformational technology is that it has higher up-front costs, although it lowers the total cost of ownership (Xiotech provides a five-year warranty).

Atrato Inc.’s Velocity1000 (V1000) uses a self-healing technology called Fault Detection, Isolation Recovery (FDIR) in combination with Atrato’s Virtualization Engine (AVE). FDIR watches component and system health, and adds self-diagnostics and autonomic self-healing, but it doesn’t attempt to remanufacture or recondition HDDs in place as Xiotech does. Atrato puts 160 2.5-inch SATA drives in a 3U system called SAID (self-maintaining array of independent disks). Atrato uses its extensive SATA drive performance database of operational reliability testing (ORT) to monitor the installed drives actual performance to detect SATA HDD deviations. Atrato also deals with HDD faults by first attempting to repair the faulting HDD sectors (although not with manufacturer-level reconditioning, remanufacturing or component recalibration). If the fault or non-recoverable read error can’t be repaired, the sector is isolated and only the affected data is reconstructed and remapped to virtual spare capacity. If a disk drive completely fails, it’s reconstructed and remapped to the virtual spare capacity. Atrato reduces the number of rebuilds and rebuild times by reconstructing only affected data on virtual drives. Atrato backs its technology with a three-year warranty.

DataDirect Networks Inc.’s DDN S2A technology heal-in-place approach to disk failure attempts several levels of HDD recovery before a hard disk
drive is removed from service. It begins keeping a journal of all writes to each HDD showing behavior aberrations and then attempts recovery operations. When recovery operations succeed, only a small portion of the HDD requires rebuilding using the journaled information so rebuild times are reduced and a service call may be avoided.

Panasas Inc.’s ActiveScan technology continuously monitors HDDs and their contents to detect problems. ActiveScan monitors data objects, RAID parity, disk media and the disk drive attributes. When a potential problem is detected, data is moved to spare blocks on the same disk. Future HDD failure is predicted through the use of HDD self-monitoring analysis and reporting technology (SMART) attribute statistical analysis, permitting action to be taken to protect data before a failure occurs. When an HDD failure is predicted, user-set policies facilitate preemptively migrating the data to other HDDs, which eliminates or mitigates the need for reconstruction.

LSI Corp. and NEC both detect HDD sector errors while allowing operations to continue with the other drives in the RAID group. If an alternative sector can be assigned, the HDD is allowed to return to operation, avoiding a complete rebuild. Performance is maintained throughout the detection and repair process. This is a limited self-healing technology that reduces the number of rebuilds and helps maintain performance.

3PAR’s InSpire Architecture is engineered to sustain high performance levels by leveraging advanced HDD error isolation to reduce the amount of data that requires reconstruction, and by taking advantage of its massive parallelism to provide rapid rebuilds (typically fewer than 30 minutes). The system uses “chunklets” in their many-to-many drive relationships. That same massive parallelism allows 3PAR to isolate RAID sets across multiple drive chassis to minimize the risk of data loss if a chassis is lost.

**BeyondRAID:** Data Robotics Inc.’s BeyondRAID sits on top of RAID and makes it completely transparent to the administrator. It transforms RAID from a deterministic offline process into an online dynamic one. Essentially self-managing, BeyondRAID chooses RAID sets based on the required data protection at any given point in time. But it’s how BeyondRAID addresses RAID issues that truly makes it stand out. It protects against one or two HDD failures and has built-in automatic data self-healing (not storage self-healing). Data blocks are spread across all of the drives so data reconstruction is very fast. Because the system is “data aware,” it allows for different drive sizes, drive re-ordering and proportional rebuild times. Because it tops out at 8 SATA drives, it’s most appealing for small- and medium-sized businesses (SMBs), but it’s a true turn it on, hook it up and forget it storage system.

If an alternative sector can be assigned, the HDD is allowed to return to operation, avoiding a complete rebuild.
**RAID PARADIGM SHIFT: ERASURE CODES**

Erasure codes are designed to separate data into unrecognizable chunks of information with additional information added to each chunk that allows any complete data set to be resurrected from some subset of the chunks. The chunks can be distributed to different storage locations within a data center, city, region or anywhere in the world.

Erasure codes have built-in data security because each individual chunk doesn’t contain enough information to reveal the original data set. A large enough subset of chunks from the different storage nodes is needed to fully retrieve the total data set, with the number of required chunks determined by the amount of additional information assigned to each chunk. More additional information means fewer chunks are required to retrieve the whole data set.

Erasure codes are resilient against natural disasters or technological failures because only a subset of the chunks is needed to reconstitute the original data. In actuality, with erasure codes there can be multiple simultaneous failures across a string of hosting devices, servers, storage elements, HDDs or networks, and the data will still be accessible in real time.

Also known as forward error correction (FEC), erasure coding storage is a completely different approach than RAID. Erasure codes eliminate all of the RAID issues described here. It’s a new approach and at this time only three vendors have erasure code-based products: Cleversafe Inc.’s dsNet, EMC Corp.’s Atmos and NEC’s HYDRAstor.

Erasure codes appear to be better suited for large data sets than smaller ones. It’s especially appropriate for cloud or distributed storage because it never has to replicate a data set and can distribute the data over multiple geographic locations.

**RAID’S EVOLUTION**

The issues with traditional RAID are well known, and are escalating with higher disk capacities. The RAID alternatives described here address many of those problems, and more new approaches are on the way. Selecting the best fit for a particular environment requires research, testing, pilot programs, patience and a willingness to take a risk with a non-traditional approach.

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Although solid state is emerging as a viable enterprise storage alternative, there’s still plenty of life left in hard disk drive technology, with higher capacity, greener and more capable drives on the way.

By Alan Radding

obody is seriously suggesting the era of hard disk drive (HDD) technology is about to end. To the contrary, HDD vendors continue advancing the technology.

Still, a few doubts arise as solid-state drives (SSDs) and other solid-state technologies take on selective enterprise storage chores. “The amount of SSD replacing hard disk drives at present is miniscule,” said Mark Geenen, chairman, International Disk Drive Equipment and Materials Association (IDEMA). Yet, IDEMA began accepting SSD vendors into its ranks in 2009.

More telling, maybe, are the enterprise storage managers willing to experiment with solid-state storage alongside HDD. “We’re testing a couple of Fusion-io cards in some servers for a couple of high-performance trading applications,” said Kevin Fiore, CIO at San Francisco-based investment firm Thomas Weisel Partners LLC. The company wants to determine if the 160 GB and 320 GB solid-state cards make enough of a difference to justify the extra thousands of dollars they cost.
Solid-state storage, however, will remain a small piece of the enterprise storage picture for some time (see “Is solid-state storage in your future?” this page). Instead, what’s driving enterprise storage is the continuation of HDD trends that have been underway for six years or more. The trends include the steadily falling cost per gigabyte of HDDs, the shift from 3.5-inch to 2.5-inch form factors, and a movement away from 15K rpm Fibre Channel (FC) to 10K and 7,200 rpm SAS and SATA drives. And don’t forget ever-increasing disk densities reflected in the emergence of 1 TB and 2 TB drives, with 3 TB and 4 TB capacities on the horizon.

Steadily evolving HDD technology will also force storage managers to revisit issues like encryption, compression and data deduplication. IT managers can now decide the best place to do encryption or deduplication: on the server, the array, an appliance or the disk drive. With the newest generation of HDDs, all options are on the table.

Similarly, new HDD technology offers more energy-saving options, primarily via disk spin-down technologies. But the massive amounts of capacity on a single drive also raise questions about the efficacy of RAID 5 as a data protection technique (see “The end of RAID,” p. 24).

**PRICE/CAPACITY CURVE**
The data storage industry has enjoyed a long ride up the price/capacity curve.

**IS SOLID-STATE STORAGE IN YOUR FUTURE?**
The cost of solid-state storage fell dramatically in 2009. Prices will dip at a slower pace in 2010 but pick up again after that, according to Jim Handy, solid-state drive (SSD) analyst at Objective Analysis in Los Gatos, Calif. Although solid-state storage comes in a variety of forms, NAND flash has emerged as the leading choice for enterprise storage.

Until recently, solid state was too expensive for anything but situations demanding the highest high performance. In 2009, SSD cost, on average, 20 times more than Fibre Channel hard disk drives (FC HDDs) on a cost/GB basis, Handy noted. But if you compared them based on cost/IOPS, SSD blows away HDD.

To Mark Teter, chief technology officer at Advanced Systems Group, SSD’s low cost/IOPS spells doom for FC HDDs. He advises companies requiring high-performing storage to replace their large numbers of FC spindles with a much smaller amount of SSD.

Already storage vendors and drive makers alike are embracing the HDD/SSD combination. EMC Corp., for example, has incorporated SSD as what amounts to tier 0 in its enterprise storage hierarchy and recommends its FAST product to automatically move data between SSD and HDD tiers. Hewlett-Packard Co., IBM, Oracle-Sun and many other storage vendors all offer SSD storage options.
Each year vendors pack more data onto disks with a corresponding drop in the cost per gigabyte. It's the storage industry's version of Moore's Law.

In recent years, 40% annual price/capacity improvements have been typical, but that pleasant pace may be slowing. “It will be increasingly difficult to get these kinds of gains,” said Mark Nossokoff, a senior member of the strategic planning team at LSI Corp.'s Engenio Storage Group. The latest gains resulted from the vertical stacking of bits on the disk to overcome the limits of the superparamagnetic effect. Future increases will need a new technology advance. Bit-patterned media (BPM), heat-assisted magnetic recording (HAMR) and microwave-assisted magnetic recording (MAMR) are the leading contenders to replace perpendicular technology (see “New technologies pack more data on disks,” p. 25).

How much capacity can be squeezed onto a 3.5-inch platter using current technologies? “I expect 8 TB within four to five years,” predicts Greg Schulz, founder and senior analyst at StorageI0 Group in Stillwater, Minn. With new materials and different technologies, Schulz won’t be surprised to see HDD capacity continue to increase dramatically. Jon Toigo, CEO and managing principal at Toigo Partners International, reports a Toshiba breakthrough that stores 4 TB per square inch (not per 3.5-inch platter). Toigo predicts a 4 TB/sq. in. disk drive within 36 months. Similar advances and new materials promise equally dramatic increases in tape capacities.

A general cost per gigabyte of HDD storage is difficult to pin down due to the wide variety of HDDs with different capacities and speeds, and the different ways HDDs are packaged and sold. Still, there are ballpark approximations. For example, a high-performance FC drive in an array would run approximately $80/GB; stick it in a SAN and the cost bumps up to $180/GB, according to Toigo. Figure approximately $60/GB for a SAS drive in

For industry analyst Mike Karp, the growing capacity of multiple terabyte disk drives inevitably increases disk errors. “For every unit of capacity we know there will be a certain number of errors,” he said.

Organizations traditionally relied on RAID 5 to overcome those errors through the use of parity data. However, because of the time it takes a system to rebuild a 1 TB drive using RAID 5 the likelihood that another drive may fail increases, compounding the problems. Karp’s solution is object-based RAID, which relies on small units of storage and allows the system to rebuild the drive in smaller increments. Others suggest RAID variations that use multiple parity disks, such as RAID 6, can do the job. (See “Alternatives to RAID,” p. 13.)
an array and $160/GB in a SAN; SATA drives are about $40/GB.

Prices are rock-bottom for consumer-quality hard disk drives with
some retailers selling 1 TB, 5400 rpm drives with a USB connection for $89
or less—about 9 cents per gigabyte! These may not be industrial-strength
drives, but at that price a manager could buy a handful and back up an en-
tire workgroup or department several times over in case one failed. Enter-
prise tape is a bargain too, Toigo added, with prices at about 44 cents/GB.

Given the low cost/GB, especially for drives with capacities of 1 TB or
more, some storage man-
agers are snapping up the
largest drives they can buy.
“We’re always buying more
hard drives. We buy SATA
for the low end, SCSI for the
midtier and we even have
a tiny amount of SSD,” said
Ben Higginbotham, director
of new technology at Where-
ToLive.com, a Web develop-
ment firm and SaaS provider
for the real estate industry.
Most recently the company
has been buying 1 TB SATA
drives in its ongoing quest
for more storage capacity.
Next up for the company
as it continues to ride the
price/capacity curve are
2 TB drives.

Thomas Weisel’s Fiore
is also constantly seeking
greater capacity with both
3.5-inch and 2.5-inch HDDs.
“We want to get the most
capacity in the smallest
footprint. It’s a real estate
issue with us” he said. Going
from 1 TB to 2 TB doubles the
amount of capacity for each
drive shelf. Similarly, with 2.5-
inches HDDs he can pack more
drives into the same space.

But not every storage
manager is enamored with

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**NEW TECHNOLOGIES PACK MORE DATA ON DISKS**

Several technologies are vying to produce the
next breakthrough in packing more bits on a
piece of storage media. Currently, perpendicu-
ar magnetic recording (PMR), which stacks
bits vertically on the surface rather than laid
out horizontally, is the technology of choice,
but it will hit the superparamagnetic limit
within a few years. But alternative technolo-
gies are emerging, including:

- **Bit-patterned media (BPM)** stores each
  bit as a nanometer-scale pattern of grains on
  the media. As described by Hitachi, it creates
  an ordered array of highly uniform islands,
  each island capable of storing an individual
  bit.

- **Heat-assisted magnetic recording**
  (HAMR) uses heat to stabilize the tiny stored
  bits, allowing smaller bits to be recorded.
  HAMR, however, creates heat, which runs
  counter to the industry’s growing green
  storage impulses.

- **Microwave-assisted magnetic record-
  ing (MAMR)** writes bits at different layers of
  the media.

HAMR will likely be ready for production by
2013, with MAMR probably ready a year later,
according to Mark Nossokoff, a senior memb-
er of the strategic planning team at LSI Corp.’s
Engenio Storage Group.
the biggest drives. “The cost per gigabyte is appealing, but the 1 TB and 2 TB drives also scare me because of the increased risk of failure,” said Darrell Stymiest, director of IT operations at UGL Unicco, a facilities services company based in Newton, Mass. Instead, Stymiest prefers to buy smaller drives, currently 300 GB or 500 GB capacities.

**FORM-FACTOR AND INTERFACE CHANGES**

The greatest capacities are still in the 3.5-inch HDD form-factor, although there’s a gradual transition in enterprise storage to the 2.5-inch HDD, which currently tops out at approximately 600 GB. “The 3.5-inch disk is still a major part of the market,” said Teresa Worth, senior marketing product manager at Seagate. “By 2012, 2.5-inch disk will pull even; from then on, 2.5 inch will take over.” IDEMA’s Geenen concurred: “Enterprise storage today is still 3.5-inch disk, but that’s changing to 2.5 inch.”

The appeal of the 2.5-inch hard drive technology is energy efficiency. “The 2.5-inch drive offers a 60% improvement in power,” Worth said. With vendors like Seagate adding intelligence to the devices that allows storage managers to selectively reduce disk spinning, hard disk drive power consumption can be reduced even more.

Lincoln, Neb.-based trade magazine publisher Sandhills Publishing Co. standardized on 2.5-inch HDDs a year ago. “We do a lot with SQL Server and for that we want a lot of fast-spinning spindles,” said Kim Mehring, IT manager. The 2.5-inch form factor enables Sandhills to pack more disks in each array, which means more spindles. By aggregating more spindles, Mehring can boost I/O performance. He considered SSD for its performance, but the cost was still too high for his budget.

Along with the form-factor transition, the industry is witnessing an interface transition from FC for tier 1 enterprise storage to SAS, and to SATA for tier 2 and archival storage. “With 2.5-inch drives we’re seeing a shift to SAS for performance and SATA for high capacity,” StorageIO Group’s Schulz noted.

But FC drives are far from dead. EMC Corp., for example, recently increased its standard 15K FC drive from 300 GB to 600 GB, according to Scott Delandy, senior product manager for infrastructure products at EMC. Where high-performance storage is required, however, EMC now recommends a combination of SSD and SAS or SATA. “You can replace 146 GB 15K drives with flash and get 30 times greater IOPS for the money,” he said. That kind of disk strategy requires automated storage tiering.

If the flash tests work out well at Thomas Weisel Partners, Fiore can...
imagine shifting away from FC over time to a combination of flash and SATA. “With FC, the largest capacity we can get is 400 GB. We’re at the mercy of the array vendor,” he said. Given his concerns about storage footprint, Fiore has been steadily buying more SATA than FC disk.

**ENCRYPTION AND GOING GREEN**

Chores previously handled by servers or appliances, such as encryption and data deduplication, can now be performed directly on hard disk drives. Specifically, vendors are introducing HDDs with built-in encryption. “Encryption really belongs at the drive level,” said Seagate’s Worth. The company already offers a self-encrypting drive and expects it to become the standard choice as part of the normal enterprise HDD upgrade process.

Storage managers, however, may not be in any hurry to buy built-in HDD encryption. “We don’t worry about encryption, and we do our de-duplication on our Compellent SAN,” WhereToLive.com’s Higginbotham said. IDEMA’s Geenen sees encryption as a way for HDD vendors to add something they might charge more for.

“We encrypt laptops that leave our premises or specific data,” Thomas Weisel’s Fiore said. “We see no need to encrypt entire drives on the SAN.”

Green storage takes several forms with HDD. First, larger capacities mean companies can get the same amount of storage while spinning fewer drives, which saves energy. Second, “vendors are building intelligent power management into the drives that allows them to drop the rpm speed or turn off writes,” StorageIO Group’s Schulz said.

Storage managers are interested in green disk drive technologies, but they’re not exactly jumping at the products. “We don’t spin down disks, but anything that saves power, like using large, slower drives, we do,” WhereToLive.com’s Higginbotham said.

Hard disk drive technology is undergoing significant shifts in form factor, capacity, interfaces and capabilities. It’s not, however, going away—certainly not in the next decade or maybe ever. Solid-state storage will get cheaper and work its way in increasingly greater volume into the enterprise storage strategy, but more likely as a complement rather than a replacement for hard drives.

"We encrypt laptops that leave our premises or specific data. We see no need to encrypt entire drives on the SAN."

—Kevin Fiore, CIO, Thomas Weisel Partners LLC

Alan Radding is a freelance writer and frequent contributor to Storage magazine and SearchStorage.com.
STORAGE MANAGERS can reach for their wallets again

The purchasing picture for storage managers is a good news/bad news story: budgets are no longer in the negative column, but they’re not rising much either.

By Rich Castagna

STORAGE MANAGERS may be able to loosen their belts a notch in 2010, but the era of storage budget belt-tightening is hardly over. Storage budgets, as reported by the 697 respondents to the Storage magazine/SearchStorage.com bi-annual Storage Purchasing Intentions survey, didn’t budge into positive territory, but avoided the negative to stay flat compared with 2009.
Given the recent context, that’s vaguely encouraging news as we saw year-over-year budgets go negative last year on both the spring (-1.9%) and fall (-0.4%) editions of the survey.

Smaller companies appear to be bearing the brunt of the still uneasy economy more than their big brethren. At companies with revenue less than $100 million, budgets are down 0.8% compared with last year. For medium-sized and large companies, the picture is considerably brighter; storage budgets should rise 1.3% at medium-sized firms and 1.9% at companies with revenue in excess of $1 billion.

With regard to sheer dollar amounts, the average storage budget clocked in at $2.8 million, just a hair shy of the $2.9 million recorded on both of our 2009 surveys. And as in previous years, that relatively high average was skewed by some pretty hefty budgets at the top end; of all reporting companies, 57% of respondents noted that their storage budgets were less than $1 million for 2010.

Whether reduced or slightly increased, storage budgets will be allocated much as they have been in previous years, with the biggest chunk—39%—earmarked for disk hardware.

**NO RECESSION FOR DISK CAPACITY**

Seeing budgets remain at the level of an extraordinarily recessionary year or rising a point or so may be small solace to storage managers who once again are faced with the need to add more disk capacity. On average, companies expect to add 40 TB of new disk capacity, up from 34 TB last fall. Over the past couple of years we’ve seen the estimates for additional disk capacity drop a bit in the fall, so the actual average additions may be lower by year’s end.

New disk capacity will be added to an already installed average of 61 TB, so if the anticipated growth follows through, that growth rate would be approaching 66%. Not surprisingly, larger companies plan to add more capacity (84 TB) than smaller outfits, but with 35 TB and 25 TB, respectively, medium-sized and small companies are gearing up for some hefty upgrades, too.

Continuing a trend that emerged over the last three years, more than a third of the money data storage managers plan to spend on disk hardware will go to buying disks to beef up the capacity of existing arrays rather than purchasing entirely new frames. This suggests that those managers anticipated the kind of capacity growth we’ve seen and “bought big” a few years back and are still topping off those larger systems.
STORAGE VIRTUALIZATION TO THE RESCUE

The need for more and more disk capacity is nothing new, but it looks like storage managers are taking (or considering) some newer approaches to cope with burgeoning data stores. In this survey, for example, we see a renewed interest in storage virtualization, an effective method of squeezing efficiency out of installed arrays. Although it’s hard to call storage virtualization “new,” companies have been fairly cautious over the years in adopting it.

Thirty-five percent of this survey’s respondents have virtualized some or all their storage, a jump of 4 points compared with last fall and a sizable spread of 8 points over last spring. The number of companies evaluating storage virtualization technology is up as well, at 24% vs. 21% in the spring of 2009. Perhaps even more telling, only 41% said they haven’t virtualized any storage compared with 53% a year ago.

And those who have taken the storage virtualization plunge are doing more of it. Last spring (2009), 53% said they had virtualized some of their block storage; this year, 69% have done so. The file storage virtualization results are nearly as dramatic: 71% have virtualized some of their file systems vs. the 58% reported one year ago. It should be pointed out, however, that the number of companies that have virtualized all of their block (20%) or file (14%) storage hasn’t truly increased much over the past year.

Plans to add storage virtualization technologies are also up. Last fall, 30% of those surveyed indicated they would purchase virtualization hardware or software; this year, 42% are in the market for storage virtualization gear. Among the many virtualization alternatives, most interest is focused on virtualization appliances (16% plan to purchase) and virtualization software that runs in an array (also 16%).

With “NAS sprawl” now a familiar phrase in our storage lexicon, interest in file virtualization seems to be gaining; 36% will give it a look and some consideration this year.

SEEKING STORAGE EFFICIENCY

Of course, storage virtualization isn’t the only route to more efficient use of installed and new storage capacity. Getting a bigger bang for the buck, especially for sub-tier-1 storage, is another tack especially when storage density is a greater requisite than performance. iSCSI systems neatly fill that bill and often still boast enough performance to host a company’s key applications.

Forty percent of respondents currently use iSCSI storage, and 41% (there is some overlap) already have or plan to deploy iSCSI storage in
their shops. Price is obviously one of the most attractive features of iSCSI storage, but for 47% of the companies represented in the survey, these systems can still burn enough rubber to serve up data for their mission-critical applications.

Cheaper storage is all well and good, but it still has to be used efficiently to minimize capacity waste. In the past year, primary storage data reduction has become, arguably, the hottest topic in storage. Users have been impressed with the results they’ve seen with data deduplication in their backup operations and its relatively easy implementation, and they’re eager to see similar results for their online or nearline storage.

Given that primary storage data reduction is still a relatively new concept and the field of players offering products is still rather small, a surprising 30% of respondents have either implemented it or plan to this year. Add to that the 33% who are currently evaluating primary storage data reduction technologies and products, and it’s clear that more storage vendors will take note and roll out new products over the coming months. An interesting parallel can be drawn to thin provisioning, which was met with some resistance by storage system vendors who feared they might cannibalize their own disk sales. Ultimately, user demand won out and thin provisioning is now a checklist item on most system vendors’ spec sheets.

Saving on operational costs is also an imperative in these days of pared-down budgets. Power conservation in storage systems has, traditionally, been met with mostly yawns from storage managers, who rated it little better than “nice to have” rather than “need it.” Saving a few bucks on electricity is still hardly a top priority, but 5% note that conservation is their most important criteria when considering an array purchase decision—a modest number but the highest we’ve seen to date.

**THE STATE OF SOLID STATE**

Solid-state storage has captured the imagination of most storage managers, and a hefty chunk of the storage budgets for those shops that have implemented this diskless storage medium. There’s an awful lot to like about solid state—it’s lightning fast, runs cool and sips juice—but it’s still significantly more expensive than traditional hard disk drives.

In the fall of 2009, when we first asked about solid state use, we found that just under 8% of respondents were using solid-state storage in some form. In our most recent survey, that slice has increased to

Given that primary storage data reduction is still a relatively new concept and the field of players offering products is still rather small, a surprising 30% of respondents have either already implemented it or plan to this year.
Change in Storage Budget Compared to Previous Year (%)

Storage budgets are flat compared to 2009, but no longer decreasing.

Planned Additional Disk Capacity (TBs)

Over the last two years, storage managers have been able to cut back on the amount of additional disk capacity they anticipated needing in the spring.

Solid-state Implementations at 10%; Many More are Evaluating

- Using SSD now
- Implementing SSD this year
- Evaluating SSD
- No SSD plans

8.6 TB - Average solid-state storage installation capacity

Spring '10 | Fall '09
ABOUT THE SURVEY

The Storage magazine/SearchStorage.com Purchasing Intentions survey is fielded twice a year; this is the eighth year the survey has been conducted. Storage magazine subscribers and SearchStorage.com members are invited to participate in the survey, which gathers information related to storage managers’ purchasing plans for a variety of storage product categories. This edition had 697 qualified respondents across a broad spectrum of industries, with the average company size measured as having revenue of $1.4 billion.
more than 10%, with another 6% planning to deploy it this year. Thirty-five percent expressed plans to evaluate solid-state storage in 2010.

Among shops currently running solid-state storage, the average installation was 6.9 TB, which is a substantial amount of solid state. Despite the high average, typical installations appear to be smaller, with 38% of those surveyed reporting less than 1 TB currently installed.

While still substantially higher than hard disks prices, the cost of solid state is dropping sharply and users seem to be increasing their purchases. For users who indicated that they would be purchasing (or have already purchased) solid-state storage in 2010, the average amount they said they’ll buy is 6.1 TB. If you factor in those respondents who said they weren’t in the market for any solid-state storage this year, that average drops to 2.8 TB, which is still a hefty chunk of solid state.

The most popular place to put solid-state storage is in traditional storage arrays, hardly surprising, as just about every array vendor out there now offers a solid-state drive (SSD) option. Sixty-nine percent of solid-state users have implemented the technology in their arrays; 33% are using it as direct-attached storage (DAS) in servers.

Though solid-state storage has obvious appeal, its price still bars entry for many companies (61% said it’s too expensive). For 43% of survey respondents, there’s no need for solid state as they’re quite satisfied with the performance of their hard disk systems.

CLOUD STORAGE ISN’T JUST AN ILLUSION
In a close race with solid state for buzzword of the year, cloud storage is taking shape as a viable alternative to building out in-house storage environments. The current survey marked the first time we asked questions specifically about using cloud storage services for things other than backup, and we were surprised at the results, especially considering all of the concerns we’ve been hearing from storage managers about putting their companies’ data out there in the cloud.

Fourteen percent of respondents report using cloud storage now, with the most activity occurring around cloud storage for disaster recovery (6%). But 4% are using it to hold primary data from their data centers, and an equal number are using it for nearline data storage.

While those statistics aren’t staggering at this point, plans for cloud storage services in 2010 tell a different story—one that’s bound to warm the hearts of service providers.

We asked respondents which types of data they will start using cloud storage services to store in 2010, and perhaps the most significant finding...
is that only 43% rule out using these services this year. Among the others, 17% will use it for disaster recovery and an eye-opening 9% will look to the cloud to store primary data. Six percent will use it for remote office data, and another 5% expect to tuck some nearline data into the cloud.

**BACKUP TECHNOLOGIES STILL TOP OF MIND**

Once again, survey respondents plan to reduce their dependence on tape as a backup medium. Thirty-one percent plan to decrease their use of tape for backup in 2010, which is the highest number we’ve seen in years (it was 29% in the spring of 2009). Over the years, however, we’ve seen higher decrease-tape-usage numbers in the spring surveys tempered by more moderate, and probably realistic, numbers in the fall editions of the surveys.

That said, it’s the bigger and smaller companies where we see the largest segments planning a reduced role for tape. Among large companies, 36% will decrease tape use in 2010, the highest we’ve seen to date. For small companies, the figure is 34%, a 6-point jump from last fall and also the highest recorded in years.

Still, some respondents (26%) report that they’ll actually increase their use of tape. But among those who plan to buy new tape libraries, the size of the libraries they’ve already purchased or are likely to purchase continues to shrink. Overall, the average number of slots in planned new library purchases dropped to 97, compared to 101 last year and 130 in the spring of 2008. (Higher tape drive densities also play a big part in reducing the number of slots required in a library.)

The move away from tape has been a long, drawn-out process and, if the technology is truly dying, it has taken a page out of Generalissimo Francisco Franco’s book in delaying its demise. We expect the slow downward spiral will level out soon, as tape still plays an important role in many companies of all sizes: 79% still spin off some or all of their backup data to tape.

But the biggest backup story continues to be data deduplication. Forty percent of respondents hope to increase their spending on dedupe technologies in 2010. That supports the 23% who are currently using dedupe in their backup operations and the 32% who plan to add it this year.

Generally, it looks like data deduplication for backup is maturing. It’s not necessarily showing the impressive jumps in implementations and spending plans as it did a couple of years ago, but rather rising steadily with fairly consistent budget allocations.
While the cloud is just getting its grip on primary data storage, it’s becoming well entrenched for backup and quickly gaining the confidence and budget dollars of our respondents. Last year, between 19% and 21% were using cloud backup services for one or more applications or storage types. In the latest survey, that number jumped to 34%, a notable increase that could signal the acceptance of cloud backup among companies of all sizes. Thirty-eight percent of small businesses are using at least one of these services and 35% of big businesses are using them—a sign that a fair number of enterprises now have faith in cloud storage.

Using cloud backup services for email and database application data ranked at the top, with both used by 18% of respondents; backing up user files or desktop/notebook files are each used by 14% of those surveyed, while 13% use these services to back up remote sites or branch offices.

LOOKING AHEAD
Each year our survey wraps up with a question that asks about intentions related to new or newer storage technologies that may not yet have market penetration. On this “What’s hot/What’s not” list, data deduplication holds the top spot, as it has for the last four surveys, with 76% of respondents already implementing it, planning to or actively evaluating the technology. Encryption was ranked second (65%) and has been near the top of storage managers’ priority lists for some time; however, this year it looks like some of those past plans for data encryption have carried through, as 60% are using encryption somewhere in the storage infrastructure vs. 43% a couple of years ago.

As noted earlier, there’s renewed interest in file virtualization; 64% have implemented it, will implement it or expect to evaluate it this year. Primary storage data reduction garnered significant interest as well, racking up 63% in its inaugural year on the list.

As storage managers set their sights on 2010 and beyond, it’s clear that using their shop’s storage more efficiently will be Job No. 1 for some time to come. ☀

Rich Castagna (rcastagna@storagemagazine.com) is editorial director of the Storage Media Group.
Taking control of storage operational costs in 2010

The deep freeze in IT spending is starting to thaw as IT organizations shift from cost-reduction mode to cost containment.

Earlier this year, Enterprise Strategy Group (ESG) published its 2010 IT Spending Intentions Survey, an in-depth study of 515 senior IT professionals regarding their midmarket and enterprise organizations’ IT spending plans and priorities for 2010. This year’s survey finds cautious optimism reigns among IT shops: Most organizations are moving out of cost-reduction mode, but are likely to characterize themselves as being in cost containment, not growth, mode. That’s good news for technology vendors as budgets begin to free up again. On the spending front, survey participants indicate virtualization, security and storage as their top areas for investment.

Among those organizations surveyed—in the United States, Canada, France, Germany and United Kingdom—52% will increase general IT spending this year vs. only 43% in 2009. More importantly, spending on data storage equipment looks promising: 54% of those surveyed will increase their spending on storage hardware this year, up from 38% in 2009.

Storage spending in 2010 corresponds to the ongoing need to manage explosive data growth, which is perennially identified in ESG’s spending surveys as a top-five IT priority. Plans for increased spending on new raw storage system purchases—whether SAN or NAS—might well indicate that equipment purchases postponed in 2009 return to the top of the priority list this year. Other top storage solutions cited by respondents as areas of investment include data replication, storage virtualization, more power-efficient hardware and data-reduction technologies.

For the second year in a row, respondents cited trimming operational costs as the top criteria for justifying their IT spend. As users shift to cost-containment mode from cost-reduction mode, it seems they’re poised to spend capital dollars to save operationally. While reducing capital expenses was second on the justification list in 2009, and tied with business process improvement, it dropped to fifth on the list of justifications for IT spend in...
2010 behind reducing operational costs, business process improvement, improving security/risk management and return on investment (see Figure 1, this page). This also aligns with the shift to cost-containment mode from cost-reduction mode.

Storage is a good place to begin looking for areas to reduce operational costs. Many IT shops make storage buys to support each new application as it rolls out. As application environments grow and more data needs to be stored, we often see users leveraging spreadsheets to map what application data lives on which storage devices. As the environment changes, new capacity comes online, or storage systems are updated or replaced, the spreadsheets need to be kept current so users know where important data is stored so they can ensure it is protected and backed up. It can get very complex, and over time the chance that critical data is left unprotected grows. Often, because of the complexity of the environment, IT is unable to appropriately leverage storage capacity where and when it’s needed and ends up with stranded capacity because it either doesn’t have the right performance or availability characteristics for the next new application coming online, or it needs file storage capacity but has space only

As application environments grow and more data needs to be stored, we often see users leveraging spreadsheets to map what application data lives on which storage devices.

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**FIGURE 1: Which of the following considerations do you believe will be most important in justifying IT investments to your organization’s business management team over the next 12-18 months?**

<table>
<thead>
<tr>
<th>Consideration</th>
<th>2010</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in operational costs</td>
<td>54%</td>
<td>62%</td>
</tr>
<tr>
<td>Business process improvement</td>
<td>42%</td>
<td>37%</td>
</tr>
<tr>
<td>Improved security/risk management</td>
<td>36%</td>
<td>32%</td>
</tr>
<tr>
<td>Return on investment/Speed of payback</td>
<td>33%</td>
<td>31%</td>
</tr>
<tr>
<td>Reduction in capital costs</td>
<td>30%</td>
<td>37%</td>
</tr>
<tr>
<td>Improved regulatory compliance</td>
<td>23%</td>
<td>20%</td>
</tr>
<tr>
<td>Reduced time to market for our products/services</td>
<td>10%</td>
<td>17%</td>
</tr>
</tbody>
</table>

(Percent of respondents, 3 responses accepted)

SOURCE: Enterprise Strategy Group
in block storage systems. It’s not unusual to see IT environments with sub-50% utilization rates across the storage environment. That’s a lot of floor space, power and cooling, and management cycles going toward managing capacity that doesn’t directly support the business. And it presents a clear opportunity for reducing operational costs.

There’s little question that 2009 was one of the toughest years in recent history for the IT industry, with far-reaching budgetary implications for technology vendors and IT end users alike. While budgetary pressures won’t let up in 2010, the shift from cost-reduction mode to cost-containment mode bodes well for the technology sector in general. As users continue to look for ways to reduce operating costs by reducing storage infrastructure complexity, those vendors that offer truly efficient and easy-to-use platforms will benefit. Users have listened to vendors push their storage efficiency message for the past year and a half. But this year it needs to be more than a marketing message. Users should demand that vendors demonstrate what they can do to help address the storage complexity, and associated inefficiencies, that the vendors themselves have had a big part in creating. ☀

Terri McClure is a storage analyst at Enterprise Strategy Group, Milford, Mass.
Storage tiering getting more automated

**THE IDEA** behind storage tiering is to put the right data in the right place and, in doing so, hopefully save some money by freeing up expensive tier 1 storage. In our latest poll, 50% of respondents said they’re currently using a tiered system in their storage shops, almost exactly the same number as a year ago. Among the half who aren’t currently tiering their storage, nearly two-thirds (63%) say tiering is, indeed, in their future, with almost half of them expecting to implement it within a year. For the most part, storage tierers like to keep things simple: 42% report they have two tiers, 34% have three tiers and only 24% run more complex operations with four or more tiers. The most popular choice for tier 1 storage is Fibre Channel (FC); 59% report their top tier as 4 Gbps FC storage, and a fairly even split have 2 Gbps FC (23%) or 8 Gbps FC (21%) at the top of their tiers. Creating the tiers is usually relatively easy, but moving the data from tier to tier can be a toughie. Thirty-two percent use automation tools to get the job done—a jump from last year’s 20%—but 54% migrate data manually or semi-automatically. And a small contingent (14%) has solved the migration problem: they don’t move data between tiers.

—Rich Castagna

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**Survey respondent**

“I hate to remember how we operated before we had tiered storage.”
Check out the following resources from our sponsors:

**3PAR, page 7**

3PAR Thin Provisioning: Eliminating Allocated but Unused Storage and Accelerating ROI

Taneja Group Report: 3PAR Thin Copy Desktop: A VDI Optimized Storage Solution

**EMC, page 4**

Optimizing Data Protection for Virtual Environments

Data Storage Priorities 2010: Data Backup, Capacity Growth and Disaster Recovery

**i365, A Seagate Company, page 10**

Five Cost-Effective Ways to Enable Fast Recovery

The Keys to Disaster Recovery Planning: i365's EVault Disaster Recovery Solutions Help Protect You From Losing Valuable Data Due to Complete Site Outage

**Precise, page 12**

The Business Impact of Tiered Storage Technology and Improving Application Performance

Business Awareness with Storage Tiering: Improve Application Performance and Control Storage Costs