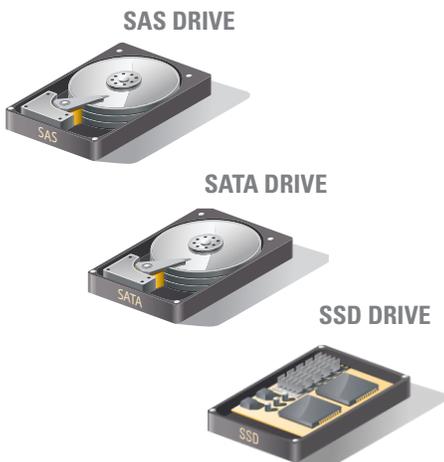


## **6 TIPS FOR SELECTING HDD AND SSD DRIVES**

With today's wide variety of storage devices, many people are confused as to what type of drives they should be using for what data types. Adding to the confusion is that SATA and SAS refer to disk drive interfaces, whereas SSD refers to a particular kind of internal technology. Selecting a drive technology and interface type can seem complex with considerations of random access performance, sequential performance, cost, density and reliability all coming into play. In short, there are a number of factors to be considered when selecting drives for your storage deployment. This paper examines six of them.

## FACTORS FOR MATCHING DISK TYPE TO DATA TYPE

1. Random Access Performance
2. Sequential Performance
3. Density
4. Reliability
5. Cost



## SIX TIPS FOR DRIVE SELECTION

### 1. DON'T CONFUSE INTERFACE TYPE WITH DISK PERFORMANCE OR RELIABILITY

For awhile “SAS” and “SATA” were used as convenient shorthand for fast or dense disk drives, respectively. Now, however, we have SSD drives with SATA interfaces as well as inexpensive and dense but relatively low-IOPS 7200 RPM drives with SAS or even Fibre Channel interfaces. Users can no longer make blanket statements like “SAS is better for databases” because it might be off by a factor of 1000x if the comparison is between a blazing fast SLC SSD with a SATA interface, and a relatively sluggish 7200 RPM NL-SAS drive.

Crafty salespeople are often exploiting this confusion by pitching a “SAS array” filled with 7200 RPM NL-SAS drives that are in fact identical in performance to ordinary SATA drives of the same family (which makes sense because they are exactly the same physical drive, just with a different I/O chip). This is fine if the customer understands this is what they are getting, but it's questionable if the customer actually was trying to buy a high IOPS configuration for a transactional workload like SQL, Oracle, Exchange, VMware, etc. An array of 7200 RPM NL-SAS drives, for instance, will have identical real-world sequential and random performance when compared to an array of 7200 RPM SATA drives selected from the same family.

Users can't even use SAS or SATA as shorthand for desired drive reliability. There are several SATA drives that have a claimed 2 million hour MTBF (and in the case of some drives like the 3TB Hitachi 7K3000, demonstrated by Nexsan's field experience). This is in contrast to the typical 1.6M hour MTBF number for many 3.5" 15,000 RPM SAS drives, or the even lower 1.4M hour MTBF number for some 2.5" (SFF) 7200 RPM NL-SAS drives.

Think about that last number for a minute - for a 30TB system, users would need 30 of the 1TB SFF NL-SAS drives, while only needing 10 of the Hitachi 7K3000's - one third as many. Furthermore, and this is crucial, because the 7K3000 is so much more reliable, there would be 4.2 times as many SFF drives failing per year. Making matters worse is that the 7K3000's would only consume 113 Watts, whereas the SFF drives would consume 189 Watts for the same capacity. When power is a concern, 3.5" drive systems often deliver twice the gigabytes per Watt as compared to 2.5" drive systems.



Interface performance has almost no influence on IOPS except in the negative sense that complex or new interfaces sometimes have bloated or immature drivers stacks which can hurt IOPS.”

**7200 RPM NL-SAS**



**VERSUS**

**7200 RPM SATA**



**=**

**IDENTICAL REAL-WORLD SEQUENTIAL AND RANDOM PERFORMANCE**

## 2. FOR BEST \$/GB, 3.5” 7200 RPM SATA IS STILL KING

We storage vendors have a seemingly endless variety of pricing models, but one constant seems to be that 2.5” systems cost twice as much per gigabyte as 3.5” systems, assuming both are using “enterprise-grade” drives. But as previously noted, the 3.5” solution will be far more reliable.

10K and 15K SAS solutions in either 2.5” or 3.5” form factor will be approximately 3x to 6x more expensive per gigabyte. SSD solutions can be from 10x to 50x more per gigabyte than comparable SATA drives.

## 3. HDD PERFORMANCE IS MOSTLY DICTATED BY DENSITY AND MECHANICAL SPEED

The random or transactional (IOPS) performance of spinning drives is dominated by the access time, which in turn is determined by rotational latency and seek time. Interface performance has almost no influence on IOPS, except in the negative sense that complex or new interfaces sometimes have bloated or immature driver stacks which can hurt IOPS. Highly random applications which benefit from high IOPS drives include email servers (such as Exchange), databases (such as Microsoft SQL Server and Oracle) and hypervisor environments (such as VMware and Hyper-V).

Sequential performance, which is important for applications like video and D2D backups, are dominated by the RPM of the drive times the bits per cylinder. This number will decrease 50% or more as the drive moves from the outermost to the innermost cylinders. Again, as long as the interface is fast enough to keep up (and it is in all modern hard drives), the interface speed (or even the quantity of interface ports) has no measurable effect on sustained performance. The fastest drives today can sustain less than 200 MB/s, which is less than the performance of a single 3 Gb SATA port.

## 4. CONSIDER SSD INSTEAD OF 10K OR 15K DRIVES FOR TRANSACTIONAL WORKLOADS

Due to their ever-increasing performance and reliability, 7200 RPM SATA drives are taking on more types of workloads including moderate transactional applications. However, 15,000 RPM drives can deliver roughly two to three times as many small block random transactions as 7200 RPM drives due to their lower rotational latency and much more powerful actuator arm. As a result, they are often used for demanding database or Exchange workloads.

## OLD MODEL

Random data on SAS or combination of SAS/SSD



Sequential data on SATA



## NEW MODEL

Random data on SSD only



Sequential data on SATA



Recently, Solid State Drives (SSD's) have become mainstream options from most storage vendors. Though not very fast at sequential workloads, they are incredibly fast at random small block workloads and may be a superior choice for demanding SQL, Oracle, VMware, Hyper-V and Exchange requirements. Many customers report that they can support more guest Virtual Machines per physical server due to the lower latency of SSD solutions, which may offer tremendous cost savings depending on specifics of licensing and hardware.

SSD's continue to advance at a very fast pace, and are now the leading technology in terms of dollars per IOPS as well as IOPS per watt. Today it is very likely that an all-SSD solution will have lower overall capital and operational cost than one made from 15,000 RPM drives due to the reduction in total slots required to achieve a given transaction performance, and the greatly reduced power footprint as compared to spinning drives for a given number of transactions. Some enterprise SSD's meet or even exceed the reliability and durability of 15,000 RPM drives, especially when one considers that far fewer SSD's are required to achieve any given IOPS level.

The resulting question is, "Are 15K SAS drives really necessary anymore?" Can SSD be used for the fraction of your data that's truly random while modern, high-performance SATA is used for everything else? Great benefits derive from pushing high IOPS data to SSD, especially to Single Level Cell (SLC) and Enterprise Multi Level Cell (eMLC) models of SSD. SLC SSD devices have the highest write-cycle durability of flash-based devices and also have the highest random write performance, but are the most expensive. Less write-intensive applications can make effective use of eMLC SSD. In general, Nexsan discourages the use of MLC SSD devices until perhaps someday in the future when their reliability and durability challenges can be addressed.

## 5. SSD AND 10K/15K DRIVES ARE NOT BETTER FOR VIDEO

Somewhat surprisingly, 10,000 RPM and 15,000 RPM drives are not better for video and other media streaming applications, unless there are numerous independent streams being written or read from the same RAID set. In fact, 3TB 7200 RPM drives have higher sequential speed than 2TB drives and often have higher sustained sequential performance than 15,000 RPM drives.

In small RAID sets, the performance limitation might be the drive transfer rate. Therefore, selecting a drive that excels in this area makes sense. In large RAID sets, or with large numbers of drives behind a single controller, the limiting factor is likely

## NEXSAN QUALIFICATION PROCESS:

### 1. START WITH FACTORY FRESH ENTERPRISE-CLASS DRIVES



### 2. QUALIFY DRIVES WITH STRICT QUALITY TESTING



### 3. QUALIFY THE ENTIRE ENCLOSURE FILLED WITH DRIVES BEFORE SHIPPING



END USER

to be the RAID engine or the SAN interface technology rather than raw disk speed. So, drives may be chosen based on other factors such as cost, density or reliability. Power requirements for 7200 RPM drives are much less than 10,000 RPM or 15,000 RPM drives on a per-GB basis, especially when Nexsan's proprietary AutoMAID technology is used to further reduce power consumption of intermittently or lightly loaded arrays. Video applications often have extended periods of inactivity for some or all of the arrays, so it is an ideal candidate for maximal AutoMAID power savings.

### 6. SWEAT THE SMALL STUFF

Most importantly, pay close attention to how your vendor treats the subject of hard drives. In the spirit of chasing profits, many are moving to a logistics model where the drives are not tested in the storage array until it arrives at the customer site. Still other vendors are phasing out the rigorous qualification and ongoing screening process that once was commonplace. Some no longer perform specific qualification checks between drive hardware and firmware revisions, and the hardware and firmware revisions of all the components of the storage array. This is a recipe for disaster, especially with large numbers of drives at a site.

At the low end, many vendors are allowing resellers, or even end users, to purchase disk drives from distribution, the "gray market" or even places like Ebay. Every time a disk is handled or shipped, its reliability is likely to go down. Many of these secondary suppliers are not supplying "factory fresh" drives and are either selling seconds, refurbs or drives that have been rejected by more reputable suppliers like Nexsan who perform strict qualification and incoming inspection of drives.

Nexsan starts by using only "enterprise-class" disk drives, not consumer grade. Enterprise-class disk drives are those that pass the manufacturers highest quality and reliability tests. Frequently new drive technology appears in consumer products before they are released in storage systems designed for data centers, and rightly so. Nexsan only considers those drives that can meet minimal quality standards even before subjecting them to strict quality testing.

Nexsan pioneered the use of advanced statistical performance measurement technology embedded in every RAID controller we make, allowing rejection of types of drives that cannot handle the rigors of high density, high duty cycle environments. Only drive models that have performed well in exhaustive engineering trials are sold, and our ongoing drive screening process ensures that



every drive has been thoroughly tested in the enclosure that is ultimately installed at the end user site. This constant, relentless surveillance ensures that problems are reported back to the drive manufacturer quickly and before they have a chance to put customer data at risk.

Nexsan is proud of setting the gold standard for drive reliability, which of course is critical when your best-selling storage system holds 60 drives!

## CONCLUSION

There are many considerations when selecting the right drive type for your environment. Don't let market hype sell you on something just because it's today's fad. Be clear on your requirements and on the drives, interfaces, price/GB, and finally, reliability available in what you select. Nexsan is proud of our track record in enterprise-quality, value and reliability. Watch Nexsan customers talk about Nexsan reliability at [www.nexsan.com/videos](http://www.nexsan.com/videos).

## ABOUT NEXSAN

Nexsan® is a leading provider of innovative data storage systems with over 10,000 customers worldwide. Nexsan's pioneering hybrid storage systems combine solid-state technologies, spinning disk storage and advanced software to deliver radical new levels of performance and capacity at lower cost. The company's advanced technologies enable organizations to optimize traditional, virtual and cloud computing environments for increased productivity and business agility. With more than 28,000 systems deployed since 1999, the company delivers its data storage systems through a worldwide network of solution providers, VARs and system integrators. Nexsan is based in Thousand Oaks, Calif. For more information, visit [www.nexsan.com](http://www.nexsan.com).