ATTO TECHNOLOGY
TECHNOLOGY BRIEF

SAS vs. SATA Hard Disk Drives for Media & Entertainment Workflows

Workflows for Media & Entertainment applications present a uniquely diverse storage environment, one that requires capacity, reliability and performance. Consequently, they are some of the most challenging to support.

A single second of uncompressed video in the latest 4K video format requires upwards of 1GB disk storage capacity. For a typical feature film, that means storing 20TB or more of unique data.

What's even more challenging is that the finished product needs to be transcoded into multiple versions to support various methods of distribution. There is clearly a strong need for capacity to accommodate the large volume of data being created, and that's why so many system architects will turn to low-cost, high-capacity SATA drives instead of more reliable, higher-performance SAS drives to store all of their data. But before making a decision to implement a SATA-only solution, it pays to consider the respective advantages of SAS and SATA storage technologies so that each one can be strategically deployed.

When to Use SAS, When to Use SATA, and When to Use Both

SATA drives undoubtedly make the best choice when price/capacity ($/GB) is the most important solution criteria. But for scenarios where an IT team is required to support 24x7 operations, remote editing, and simultaneous multi-stream play out, reliability and performance become very important as well. In these cases, SAS drives, which have a commanding market share for all but archive and cold storage applications in general IT markets, will provide the better value proposition.

Three important factors other than capacity need to influence the decision process when considering SATA versus SAS drives as primary storage for M&E applications: reliability, performance and cost.

Reliability

Desktop SATA drives are designed to operate at a 10-20% workload. That's typical for a single workstation used a few hours a day/5 days per week. But more rigorous use will significantly increase the possibility of drive failure. Bit error rate (BER), the probable number of bit errors occurring on the media, is 10 times higher (1x1015 versus 1x1016) for SATA drives than for SAS drives.[1] Also, MTBF (mean time between failure), an indication of how long a drive can be expected to operate, is often 25% less for SATA drives. These rates are based on typical use profiles — a SATA drive subjected to a 50% workload (instead of the more typical 10-20%) would likely experience a much lower MTBF.

Compared with SATA, SAS drives are designed with more robust mechanical components. This lets them operate at 100% workload — basically, 24x7— for a longer time without failure.

Enterprise SAS drives also contain sophisticated vibration compensation features that make them less susceptible to rotational vibration, as well as vibration from drives and other components that cause read and write heads to become misaligned with tracks — a factor in a chassis containing more than eight drives. The performance impact of this can be seen when disks are forced to complete additional rotations to complete a read or write command. Desktop SATA drives, in comparison, have very basic compensation mechanisms that are much more sensitive to vibration-related issues.

End-to-end data integrity validation is a critical need for many Media & Entertainment applications. Only SAS supports validation from the host to the physical storage media. Additionally, only SAS supports the full SCSI command set, full duplex I/O and dual path connectivity. All of these features ensure that data is transferred quickly and accurately. For example, using dual path connectivity, users can see performance improvements of up to 40% and eliminate single points of failure. Since almost 2/3 of storage failures are caused by interconnect issues, SAS dual path can make a huge difference in keeping operations running smoothly.

One of the greatest restrictions on SATA technology is cable length. Due to signal quality limitations, SATA drives are limited to 1-meter cable runs: Longer runs risk poor performance, data errors and unstable RAID groups. Users should keep in mind that this 1 meter limitation is for total cable length — a chassis with eight SATA drives connected by 5-inch cable stubs (a fairly typical scenario) would exceed the limits of the specification. If there is no expander present to retime and regenerate the signal, cable length needs to be calculated from the host adapter all the way to the end of the last drive. The cable length limits for SAS drives, in comparison, are 10 meters for standard copper and up to 100 meters when using active optical.

Performance

Completing reads and writes quickly is the key task for hard drives. Here, SAS provides better performance than SATA by a wide margin. With faster rotational speeds (up to 15K) and more precise read/write head mechanisms, SAS drives display over 50% lower latency than typical SATA drives and up to four times greater I/O capabilities. Even with sequential large block transfers, SAS can offer double the performance of SATA.

In addition to rotational speed differences, SATA drives are less predictable, resulting in higher latency and unexpected delays in returning data. SATA drives can have latencies exceeding 2.5x that of SAS drives.[2] For applications that demand fast response, or where high IOPS are required, these performance delays may be unacceptable.

Cost

When evaluating any potential cost benefits to SATA vs. SAS storage, it is useful to consider the situation from several different perspectives. Acquisition cost — the price to purchase the drive from a distributor or website — is often 2 or 3 times less for desktop SATA drives than for SAS ones. But it's also important to consider total cost of ownership and overall value. SAS drives typically come with a much better warranty. And if managing replacement costs is important for your organization, that warranty alone can make the higher up-front investment worth it.

[1] *How SAS, Near Line (NL) SAS, and SATA Disks Compare. Scott Lowe, Data Center, February 7, 2012*

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SAS vs. SATA: A Case Study

ATTO recently worked with a production company that was storing raw video footage on-set using 8-drive JBODs with SATA disks attached to an ATTO ExpressSAS RAID card. They would take footage from the camera's HDD and download it to the RAID-protected JBOD. Drives would then be pulled from the JBOD and transported to the main studio for post-production editing.

Although the drives were shipped in a protected case, they were still subjected to use and abuse. Along with typical handling during the shipping process, the regular pulling and inserting of drives created heavy wear on the drive and chassis contact pins. In addition, the drives were being used almost constantly for ingest, editing and data copy operations. Ultimately, these factors contributed to higher than normal drive failure rates.

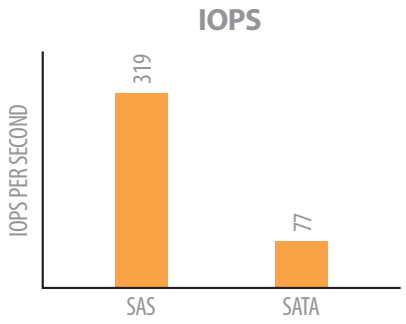
Drive failures invariably occur at the least convenient time — typically right before a big deadline. The company's drives were protected in a RAID 5 configuration, but losing one drive required a long rebuild to the RAID group to restore it to full operation. They were seeking a solution that would allow them to support large storage requirements, a high degree of up-time, protection of unique data and efficient backup. ATTO helped to solve all of these issues.

The large amount of uncompressed data the company was generating in the field, and a need for easy portability, necessitated the use of high-capacity SATA drives. However, ATTO recommended two significant changes to the workflow. The first was to use a RAID 6 configuration instead of RAID 5 to provide an extra level of protection from drive failures. We also suggested that the production company implement a more rigorous tracking system so that drives could be rotated out of use prior to a failure. Both these changes increased the company's on-set uptime.

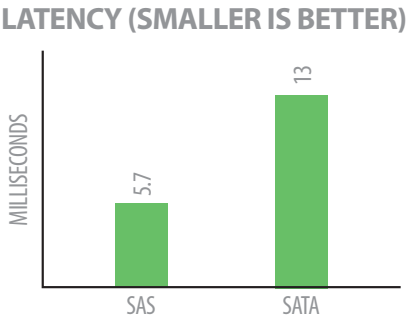
Another recommendation was to use ATTO's ExpressSAS RAID adapter with disk pass-through mode for high-speed duplication of data to digital tape. With this mode enabled, they could attach high-speed tape to one channel of the RAID adapter, and storage to the other. Then, using LTFS they could quickly and efficiently make backup copies of their data. This process eliminated a bottleneck, and it also ensured that their data was completely backed up in case of catastrophic failure. The company found that the ExpressSAS RAID adapter made copying data to tape so easy that they incorporated it as part of their regular process.

ATTO also recommended several changes to improve the workflow in the company's main studio. First, several systems were set up to use the same disk pass-through feature. Second, ATTO suggested implementing a tiered approach, with high-performance/low latency RAID 5-protected SAS storage for current projects and hot files, and additional RAID 6-protected SATA-based disks for general-purpose storage that required larger capacity volumes. Finished projects were to be transferred to digital tape for long-term archiving.

This new, tiered storage architecture simplified movement of files from the field and increased data availability and the company's overall storage return on investment.



SAS drive I/O capability is 4x greater than SATA drives



SAS drives display over 50% lower latency than typical SATA drives

Conclusion

Both SAS and SATA drives should be part of any storage ecosystem. SATA's cost-to-capacity value proposition makes it a good fit for streaming applications such as archiving, backup and cold storage. SAS, on the other hand, makes the best choice for primary storage where performance is critical and files are shared among several users. Ultimately, the question should come down to whether or not you can afford to lose data on a drive. If the data is a backup copy of files, or if they are being used as part of a comprehensive disaster plan, then SATA may be the more cost-effective solution. But for primary copies of data, or if that data needs to be available 24 x 7, then SAS is the clear choice.

[2] *Choosing Between SAS vs. SATA Hard Disk for Your Server RAID System. Intel Corporation, April 12, 2013*