Technology Paper

Seagate Briefing: Optimizing Video Surveillance System Reliability and Performance

As the world's leading supplier of hard drives, Seagate Technology knows well that all customers and storage applications are not alike. Sometimes the unique requirements of hard drive applications are intuitively obvious. For example, the storage needs of an enterprise database application are clearly different from those of a portable MP3 player stowed in a pocket while jogging.

Yet both systems use drives for storage and, though vastly different in size, they share a significant amount of technology in common. Other storage applications are much more subtle in their differences, while still having important unique characteristics that must be acknowledged to ensure storage products deliver optimal value, performance and reliability.

Such subtle differences can be found in the growing hard drive market in the video surveillance industry. Here drive use is expanding at a tremendous rate, reflecting the flexibility and advanced performance of hard drive storage over legacy tape-based systems. According to IMS Research, the estimated worldwide market for video surveillance equipment was US$6.6 billion at the factory level in 2006,and is expected to grow to an estimated US$11.6 billion by 2011. Nearly one-third of the estimated revenue would be from hard drive-based surveillance DVRs and NVRs.[1]

While the adoption of hard drives over tape in video surveillance systems is reaching 100 percent, there is significant room for improvement in system interoperability, with reliability continuing to be an industry-wide challenge. Many customers, having moved to digital surveillance systems and drive-based storage, revel in the improved capacity, performance and flexibility but are disappointed by unexpectedly high failure rates. In addition, they hunger for increased performance to take advantage of the trends towards megapixel recording and intelligent video analytics.

Seagate has been working with customers who seek higher levels of performance and reliability, and has identified three key approaches to achieving that goal: ongoing education, improved practices in system design for performance and reliability, and deployment of purpose-built surveillance drives and related controls.

1 Source: J.P. Freeman Co. 2006 Worldwide Video Surveillance Market Report, March 1, 2006

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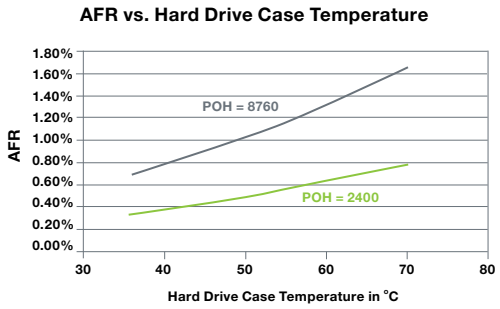
How much effect do environmental conditions have on a digital video surveillance system's reliability?

For a specific example, the following graph displays the predicted annual failure rate (AFR) of Seagate® SV35 Series™ hard drives as a function of case temperature and power-on hours (POH):



As can be seen, failure rates dramatically increase as drive case temperatures escalate. Dealers and system integrators, installers and even customers must be educated about proper operational conditions for video surveillance equipment if they are to mitigate damage to electronics and other equipment brought on by exposure to harsh conditions.

Where can I learn more about proper operational conditions for my digital surveillance equipment?

Seagate provides partners and customers with a range of educational tools that can be used to help inform people on drive opportunities, risk areas and best practices. Seagate maintains a library of **technology papers** that can aid in this educational effort.

Are there other factors beyond the operational environment that impact digital surveillance system reliability?

Proper enclosure or chassis design is a key factor in achieving optimal reliability. Electronic systems must be housed in well-designed enclosures specifically engineered for proper temperature management and vibration control or compensation. Because hard drives are critical components in digital surveillance systems, Seagate has developed its Design Services Center, which provides dedicated engineering expertise to help customers evaluate system enclosures for best practices in temperature and vibration/shock management.

What is Seagate doing to help optimize hard drive reliability in digital surveillance systems?

Seagate philosophy on improving products for a given storage segment is one of engagement. Intimate knowledge about the specific needs of a given storage segment is only achieved by actively engaging with customers and partners on a focused, low-level basis.

This philosophy is reflected in the introduction of the SV35 Series drive, the first drive specifically designed and optimized for the video surveillance market.

The SV35 Series drive represents a significant investment by Seagate in the engineering and support resources for a growing market. Such commitments result in valuable learning and advances in technology, functionality, performance and reliability that simply don't occur as quickly without a focused approached.

How does the SV35 Series drive differ from other Seagate products?

It is a well-known fact that IT component manufacturers design and market products by usage model or segment. Desktop, notebook, server and emerging consumer electronics have been the platforms manufacturers design around from processors to hard drives. But Seagate recognized that the surveillance DVR does not fit any of these platforms, forcing surveillance customers to choose the "best-fit" hard drive product for their solutions. Seagate SV35 Series "purpose-built" drives were developed to specifically address the needs of the surveillance DVR market. Below is a comparison of several Seagate drive products specialized to service different segment niches.

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Platform-Specific Drive Comparison Table				
	Barracuda®	**Pipeline HD™**	**SV35 Series™**	**Barracuda ES**
Platform	Desktop PC	Consumer Electronics	Surveillance DVR	Server and RAID Storage
Optimal Application	Personal computing	Personal video recording (set-top box)	Surveillance digital video recording	RAID-based surveillance digital video recording
Maximum Power Use	Spin-up power –3.0 amps; seek power 10.0 to 12.0 watts	Spin-up power 2.0 amps; seek power < 8.0 watts	Spin-up power 2.0 amps; seek power < 8.0 watts	Spin-up power –3.0 amps; seek power 10.0 to 12.0 watts
Duty Cycle/ Usage Profile	8x5	8x5	24x7	24x7
Performance Profile	Priorities are data integrity; ECC, error logging, retries, and performance	Priorities are reliability, stream integrity, and low acoustics	Priorities are 24x7 reliability, video streaming performance and low power consumption	Priorities are data integrity, RAID-friendly integration features and performance

This table illustrates how subtle differences in storage platforms drive the need for specific products with task-optimized features and functionality.

What surveillance-specific features should I look for?

In the SV35 Series drive, Seagate has focused on increased reliability and video streaming performance through power management and thermal control, and optimized data payload reading/writing.

While many surveillance digital video recorders (SDVRs) are implemented on a PC platform, most have moved to embedded systems that use optimized components. For example, it is common to use smaller, more efficient power supplies to save on system cost and control heat more effectively. The SV35 Series drive supports this design practice by offering best-in-class power consumption in both spin-up current and seek current. This approach doesn't degrade performance, and enables the use of low-cost, cooler-running power supplies and more efficient cooling fans, thereby lowering the overall cost of the SDVR while increasing the reliability and lifespan of the drive.

Are there other ways to cut my surveillance system's heat output?

SDVR designs commonly include enough storage to hold a desired amount of online archival video storage. System archival needs can vary widely, from only a few days of archival video up to many months. Archival storage needs typically dictate using more than one drive in the SDVR system.

Of course, the most frequent function of a SDVR system is actively recording video. Once images are recorded on the system, they are rarely reviewed and sometimes never viewed again before being overwritten. To satisfy this use model, most SDVR systems incorporate enough storage to meet the customer's archival needs, and then simply record on the drives one after another, overwriting old data once the archival period has elapsed.

As a result, at any given time it's likely that one or more drives in the system are spinning and running at full performance levels, even though not actively being used by the system. The SV35 Series drive supports features that enable putting the drive into standby mode when not in active use. This greatly reduces the drive's power consumption and heat generation, as well as extending its useful service life.

In addition, in order to satisfy the archival capacity requirements detailed above, some security professionals have chosen to utilize multiple moderate-capacity desktop drives in their video security systems. Their goal is to minimize storage costs; unfortunately, such efforts have met with little success.

Deploying limited-capacity desktop drives imposes significant limitations and liabilities on video security systems, negating any theoretical cost savings.

With no application-specific features to address power management, desktop drives can suffer heat-related failures caused by the rigorous duty-cycle and power-on requirements of video surveillance.

In addition, more moderate-capacity desktop drives are needed to meet a given capacity requirement, and that means more potential points of failure. The additional drives take up more space than necessary, consume more power and produce more heat—the latter a key factor in reduced drive longevity and thus surveillance system reliability.

Why is optimizing read/write performance important?

Surveillance systems spend the majority of their time streaming video and a small percentage of time writing traditional data. Optimizing

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performance for reading or writing video streams depends on reliable, predictable and timely command execution.

Perhaps surprisingly, complete data integrity for video is not vitally important. That's because a small error introduced into a common video surveillance steam doesn't compromise the overall integrity of the visual image. While a small, perhaps imperceptible, flaw may occur, the overall video is still intact.

However, today's surveillance systems more commonly feature advances in intelligent video analytics and megapixel image recording. In order to manage the vast amounts of video and related metadata in an intelligent or megapixel surveillance solution, a keyed relational database or similar traditional data organizational system is often used. It is absolutely critical that reads and writes for such systems employ the utmost levels of performance and error correction and detection to ensure data integrity isn't compromised.

An important feature of the SV35 Series drive is its support of the ATA-7 streaming command set. ATA-7 is an extension of the industry-standard ATA command set for controlling hard drives. The streaming component of this standard enables the SV35 Series drive's reads and writes to be customized for either video or data payloads. Using the ATA-7 streaming commands, both of these requirements are elegantly met.[2]

Why is drive interface important? And why is the surveillance industry moving to SATA over traditional PATA?

Ballooning file sizes in video surveillance are behind the insatiable hunger for greater storage capacity; such data can quickly fill even the most copious storage system. But sheer drive capacity isn't enough. Efficiently transferring these voluminous files demands drives with outstanding throughput, as well as robust error correction features to ensure data integrity is maintained during transmission. Parallel ATA (PATA) drives have done an admirable job of meeting these requirements, and now SATA drives are raising the surveillance storage bar even higher. The SATA interface takes advantage of recent breakthroughs in very large scale integration (VLSI) technology and high-speed serial transceivers, enabling SATA drives to deliver an unprecedented blend of performance, flexibility, data integrity and reliability.

SATA storage devices have been embraced throughout the computing world, from OEMs to system builders/integrators and end users. Enormous sales volumes have helped drive down prices to very affordable levels. Couple this with the many compelling benefits of SATA and it's easy to see why SATA hard disk drives are attracting renewed interest from many surveillance manufacturers, system builders/integrators and installers.

For more information, see the Seagate technology paper: *SATA Drives Raise the Surveillance Storage Bar.*

SV35 Series Summary

The unique suite of features offered in the SV35 Series drive enables customers to immediately begin making incremental progress toward improved performance and reliability in video surveillance applications. The time-honored Seagate strategy of focusing product categories on specific storage platforms to drive continuous improvement should pay still higher dividends in the future.

2 For specific guidance and descriptions of how to implement the features of the SV35 Series hard drive, including the ATA-7 commands, see the SV35 Series Product Manual.

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