

Performance Bottlenecks in Video Recording: Causes, Effects & Solutions



A paper for integrators & end users that presents the causes, effects & solutions of bottlenecks in surveillance video recording

INTRODUCTION

A high performance surveillance installation is composed of several major components, including IP cameras, management servers, recording servers, video management software (VMS), storage systems and intelligent video analytics with an experienced security professional to plan and manage the project. Integrating all of the required hardware and software to deliver optimal performance can be a real challenge as all components need to work together seamlessly. However, performance bottlenecks do occur in surveillance systems, with storage solutions playing a critical role. Without addressing the storage bottlenecks, it is useless to spend money on expensive cameras, VMS, or servers with costly processors and network interconnectivity.

This is especially true when examining recording performance, because when it comes to video recording for security and surveillance purposes, it's all about how quickly and reliably can you capture and retrieve video data? Safeguarding property, assets – and even lives – is the name of the game, and the ability to reliably retrieve and review recordings is the most important objective.

This paper presents the causes, effects, and solutions of performance bottlenecks in surveillance video recording to security professionals, integrators, and end users and examines a storage solution designed to address these challenges.

At A Glance

- The ability to reliably retrieve and review recordings is the most important objective of an video surveillance deployment
- Bottlenecks, those issues that slow or halt performance, are becoming more and more of a concern that must be addressed as they can lead to video loss
- Bottlenecks can be caused by many factors including, the power of the core processor, background activity of the RAID array, analytics, VMS, and the host I/O interface between server and storage
- To alleviate bottlenecks users can upgrade the core processor, offload processor loadings, improve storage I/O error handling and throughput and also decrease I/O latency
- The PROMISE Vess A2000 NVR appliance can be deployed to deliver steady and reliable throughput without video loss
- The Vess A2000 includes unique technologies that intelligently and dynamically reduce the overhead on the system so video can be recorded, stored and viewed more efficiently

ABOUT THE AUTHORS

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CAUSES:

Why aren't surveillance systems performing up to par?

Today, the growing adoption of HD/megapixel technology, which delivers clearer images and more vibrant colors, is having a significant impact on video recording performance. Ultra-high resolution video, continuous streaming and extended retention times are maxing out the capabilities of traditional storage approaches, such as using analog cameras and VCRs. Mobile devices are also a contributing factor here, as major manufacturers of security systems are providing accessories for phones – giving users access to their systems remotely and further increasing the need for performance optimization.

Users want it all and they want it now – they want to centrally manage and store video, effectively handle the higher resolution video from HD/megapixel cameras, record at higher frame rates, and scale to massive capacities – as well as accommodate future growth. Additionally, the wider adoption of video analytics that detect specific behavior in real-time and provide valuable information to organizations increase the demand for optimized performance. With the market moving to the high end, particularly in high security environments where detailed video is critical, performance bottlenecks – those pesky issues that slow or halt performance – are becoming more and more of a concern that must be addressed.

What is driving the need for optimized performance for video recording?

- Higher resolution cameras
- Wider adoption of video analytics
- Increasing demand for remote and mobile access
- Demand for stable and optimized performance during multi-task operation
- Market moving to high-end

EFFECTS:

How does performance impact reliability?

Performance bottlenecks can lead to frame drops (video loss), meaning the recording service is likely discontinued and won't be available to user requests – say, live view or playback - in time to make any difference. It can also lead to latency (down time). A loss of performance throughput also means not as many cameras can be supported because the more cameras you have, the more opportunities for bottlenecks you create (via the increased load each camera places on the processor, network infrastructure or storage, and in recording/display applications the bottleneck often occurs in the storage system).

A video surveillance system does many things at once, and user requests – playback, for example, make the load that much heavier. If you are running intelligent video analytics (i.e., facial recognition, license plate identification), the surveillance system now takes on an even heavier load. Other common culprits when it comes to bottlenecks include: core processor power; host Input/Output (I/O) interface between server and storage; media for video data storage; networking; storage array background activity; video management software (VMS); and different use cases. Processor capability, frame rate configuration, type of storage media, array controller settings, connecting interfaces and network traffic conditions will all affect performance as well.

Let's take a look at a typical scenario: In a large scale deployment, say, at an airport, a newly configured storage array in a surveillance system starts storing video from multiple cameras throughout the site. At this point, streaming performance is steady, as there is nothing previously stored in the disk volume. The controller just has to accept video feeds and write them simultaneously to the designated logical volume until the video data fills up the disk space. Now that the disk volume has been filled, the controller starts to manage things differently. It's still handling the video

feeds from the cameras, but now it also must erase old video archived in the disk array.

While all of this is going on, airport security receives a tip and starts to play back a designated timeframe at security checkpoint one from the footage it has archived. The system includes intelligent video analytics and is looking for specifics that can be run through a facial recognition system. If you add in dealing with and rebuilding from errors – all while staying online and continually capturing and storing live feeds – it's easy to see how bottlenecks that result in highly unstable performance can occur.

What can cause bottlenecks in surveillance video recording?

- Power of core processor
- Host I/O interface between server and storage
- Media to store video data
- Networking infrastructure
- Background activity of storage array
- Video management software
- Intelligent video analytics

SOLUTIONS:

Optimizing Performance

There are quite a few strategies that can help reduce the load on the surveillance system – and thus reduce the chances for bottlenecks to crop up. You can upgrade your core processor and offload things like networking, graphics, encoding and decoding to relieve the workload on the processor. An absolute necessity is employing a high availability RAID array optimized for video surveillance that delivers consistent performance even during disk rebuild or when the array is in a critical state.

Adopting a faster host I/O interface and storage media is another option when aiming to reduce performance bottlenecks. Additionally, you can also use port

trunking (i.e. Ethernet link aggregation); reduce the number of variables present (narrow application categories, fix configuration scenarios) and improve storage I/O error handling and throughput – while decreasing I/O latency.

When looking to improve performance, where have some systems gone wrong? They often do not offer robust reliability, with appropriate disk I/O error handling to ensure continuous recording without dropping frames. Solutions lack stability by not correctly managing disk I/O latency – particularly when it comes to write functions. They may not offer higher levels of software integration capabilities – with SDK or plug-ins, for example.



Systems may not come with the recommended configurations for video recording, plus, video won't come in at the same size and format because it's unlikely all cameras in a project provide the same image quality and recording rate. Some cameras record at a higher megapixel level, while some only need VGA level recording, and this leads to the need to simultaneously archive different video packet sizes which creates a heavy load on the processor to write to the disk array, increasing the possibility of video loss. Some surveillance systems may not be able to scale to meet future user needs - and are costly to deploy. This is particularly evident when users deploy onboard storage to archive video without considering the possibility for expanding through external storage. This means the user has to replace the entire existing infrastructure to scale to a larger base.

What can be done to alleviate bottlenecks?

- Upgrade core processor
- Offload processor load
- Use RAID array
- Adopt faster host I/O interface
- Use port trunking
- Reduce variables like narrowing down application category
- Improve storage I/O error handling and throughput
- Decrease I/O latency

THE CASE FOR THE VESS A2000 SERIES NVR Storage Appliances for IP Video Surveillance

When talking storage solutions that can be deployed to help solve bottlenecks and deliver optimized performance, stable, scalable, high-availability, easy to deploy and affordable are all attributes that should be in the surveillance solution equation.

The PROMISE Vess A2000 Series NVR storage appliance is designed to be a powerful video surveillance solution that combines the server, storage, intelligent and robust RAID firmware, as well as companion management software. Vess is a proven high performance solution for surveillance applications that has been battle tested in many established commercial projects. With 25 years of experience in manufacturing and designing storage solutions and RAID technologies, PROMISE has developed technologies and proven know-how for optimizing video surveillance recording, playback, live view and archive I/O access with incredibly steady and reliable behavior in terms of RAID cache buffer handling and Hard Disk Normal/ Error IO handling that limits dropped frames.

One of the challenges in video surveillance recording is minimizing the overhead of the hard disk drives in

order to maximize performance. This is especially important in mid-size to large-scale projects because the more cameras in an installation the more overhead the system must deal with as data is recorded in random patterns to the drives which lead to bottlenecks. The Vess A2000 Series solves this problem with a unique RAID technology called 'Wait Full Stripe' which dynamically and intelligently monitors recording patterns, collecting data in the cache buffer and waiting for a full stripe before writing the data to the hard disks and parity drives. The benefit delivered to the system is that this minimizes the mechanical overhead on the hard disk drives as it creates a sequential recording pattern which delivers smooth recording and maximum performance.



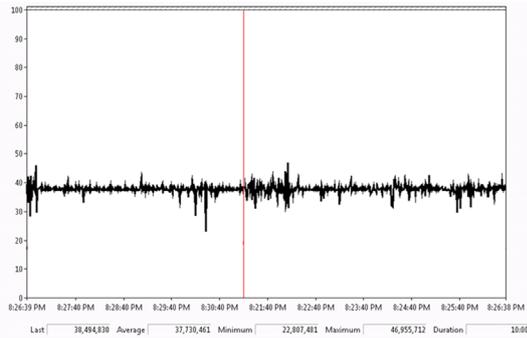
The challenge to deliver optimized performance increases when the surveillance system needs to record and playback data at the same time which places a heavy load on the hard disk drives, especially from random playback requests and different use cases that affect performance. The Vess A2000's 'Read Ahead' cache buffer feature monitors the read behavior and utilizes the idle recording time to intelligently predict the next read. By monitoring and observing regular behaviors, the Vess A2000 predicts where playback will be needed so the workload of the system is not competing with the hard disk drives. The benefit delivered to the customer is that the system can handle different requests with the high level of performance and stability that are necessary for today's surveillance environments.

Performance Comparison

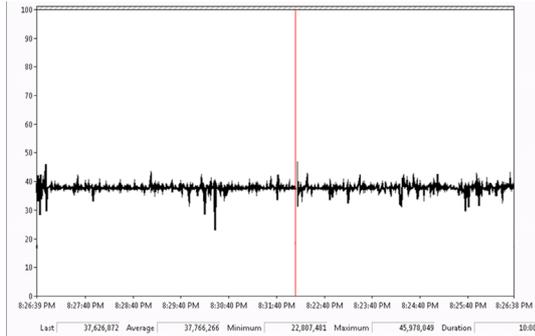
The performance advantages of the Vess A2000 Series are demonstrated in the graphs below which show its sustained transfer rates against a competing solution. The further the measured performance is from a steady horizontal line, the more likely the odds are for dropped frames. Even when in a critical state or during rebuild, the Vess A2000 delivers much more steady and reliable throughput that results in consistency without video loss.

PROMISE Vess A2000

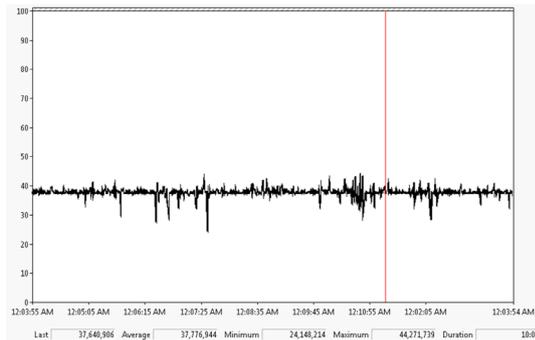
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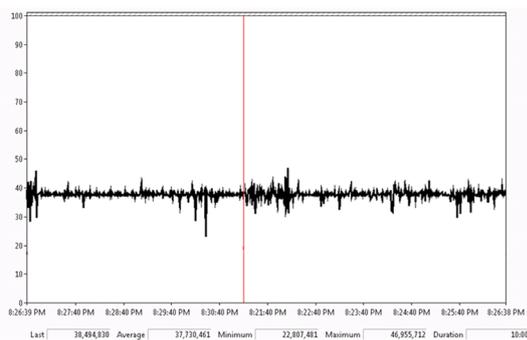
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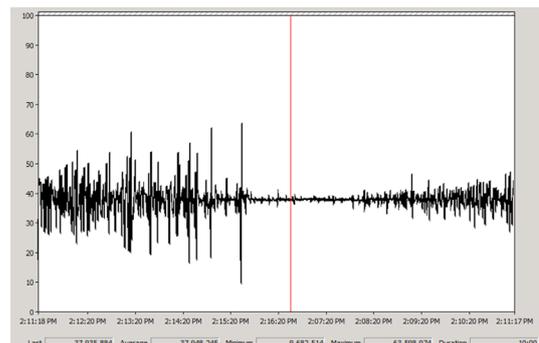
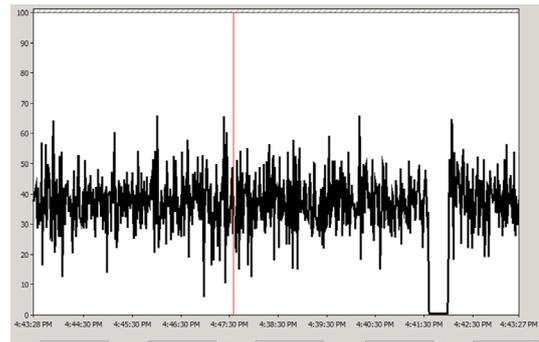
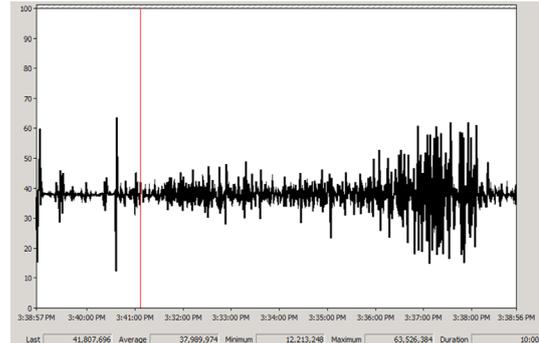
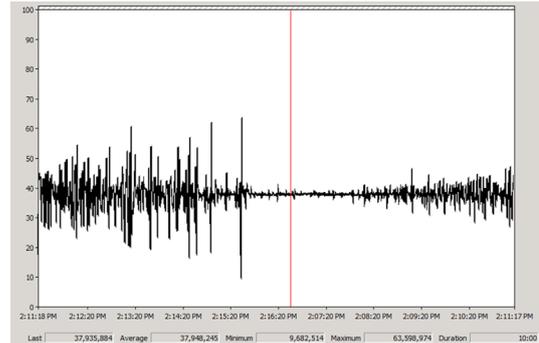
RAID5 Array Rebuild



Recording + Overwrite + Archive



Competing Solution



SUMMARY

Performance bottlenecks in surveillance recording are serious issues security professionals must address to ensure that their surveillance solution is able to perform up to an organization's expectations. The increase in the adoption of megapixel cameras, video analytics, demand for remote and mobile access to surveillance video, and the market moving to the high end has made bottlenecks, those issues that slow or halt performance, more and more of a concern that must be addressed.

Bottlenecks can be caused by a number of factors including, the core processor, host I/O interface between server and storage, background processes of the RAID array, VMS, video analytics and more. There are several ways to alleviate bottlenecks, including upgrading the core processor, offloading networking, graphics, encoding and decoding, adopting a faster host I/O interface and storage media is another option, but an absolute necessity is employing a high availability RAID array optimized for video surveillance storage that delivers consistent and dependable performance even during disk rebuild or when the storage is in a critical state.

Storage solutions are key components that serve as the foundation for a robust surveillance architecture and a high-performing solution is crucial to eliminating bottlenecks. Consistent recording performance in video surveillance is vitally important and this can be affected by many factors that can lead to dropped frames.

The Vess A2000 delivers optimized performance for many workloads which enables the recording server to maintain stability and provide consistent throughput. Plus, the Vess A2000 NVR storage appliance reduces the complexity and cost of surveillance deployments while delivering powerful, reliable, optimized storage designed to support growing security needs.

Why the PROMISE Vess A2000 Series?

- Proven capability to optimize video surveillance recording, playback, live view and archive I/O access
- Robust error handling enables non-stop recording without video loss
- Certified with industry's top VMS
- RAID engine requires no separate storage unit
- Reduces deployment costs and complexity
- Easy to scale capacity



PROMISE TECHNOLOGY

PROMISE's solutions for video surveillance provide security integrators and installers a cost-effective umbrella solution for video data management while also reducing the complexity of surveillance deployments. Backed by an unparalleled commitment to providing the highest levels of quality, reliability and support, PROMISE's surveillance solutions are highly suitable for environments like casinos, hotels, hospitals, train stations, mines, shopping malls and many more. To learn more, please contact your PROMISE sales representative, or visit:

www.promise.com/surveillance.

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