

Performance... On Demand

Concurrent efficiently reduces cost per video stream and improves system reliability by using STEC Zeus^{IOPS} Solid State Drive in its digital on-demand systems.

The Challenge

Digital On-Demand systems provider Concurrent Computer Corporation needed improved video streaming efficiency and enhanced system reliability.

The Solution

STEC Zeus^{IOPS} Solid State Drive: DRAM-like access times with no moving parts.

The Benefit

By using ZeusIOPS SSDs in Concurrent's MediaCache instead of hard disk drives, Concurrent was able to improve overall system reliability and improve video streaming efficiency from content library to streaming server by 500%.

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Streaming “On-Demand”

The world is moving towards an “On-Demand” model. The providers of content, information and communications are eager to deliver a myriad of media services to end-users. Google wants to provide better searches, MapQuest wants to put a map on every device, OnStar wants to be “the push button” resource for drivers, and Verizon wants to stream music, video and television to every phone, home and office. As consumers, we have come to expect our media and communication needs to be met, instantly, consistently and reliably. Going forward, the request of our “On-Demand” culture will only accelerate and drive the need for increased reliability, lower costs and improved performance in the delivery of vital data, content and associated services.

Why the push for more? High Definition (HD) formats for video and radio, larger capacity files, more precise maps and GPS services will each require greater bandwidth, reliability and consistency. This case study looks at how one “On-Demand” leader in infrastructure solutions is preparing to improve the current generation of services and seamlessly prepare content providers for the future.

The Five S's of "On-Demand"

The five S's of "On-Demand" are Simultaneous, Singular, Sustainable, Superior and Speed. Each of these helps describe the requirements for advancing the best practices of "On-Demand" solutions for Video-On-Demand (VoD) and other media services.

Simultaneous

Each "On-Demand" session must be able to deliver content or information from a shared resource, as if the "On-Demand" user were the only person accessing the data. This means that each user must have simultaneous access with independent control. In the VoD market, this is measured in "concurrent video streams," the ability to deliver simultaneous video streams for the same content without affecting the performance, flexibility or control of any of the other streams. This is vital to content providers, because this is the revenue event.

Singular

Each customer expects their "On-Demand" delivery to be unique to their needs and schedules. They expect to start at any time, stop at any time, resume at anytime and save at any time. Not only must the VoD solution be able to deliver simultaneous video streams, they have to be able to act independently or singularly. If the infrastructure does not meet these needs the content providers lose money and fail to retain customers.

Speed

We have all heard "Top Gun's" catch phrase, "the need for speed" ; however, despite being a bit cliché, it is vital to the VoD and all "On-Demand" content providers. Speed determines the type and quality of services that can be delivered. In this case, speed is not about performance, it is about competitive advantage, customer retention and revenue growth.

Sustainable Delivery

High-performance is not enough. "On-Demand" solutions have to be predictably high-performance and sustain a constant delivery of content streams. There can be no gaps, hiccups or pauses in the video stream. Without sustainable delivery performance, content providers experience massive customer support burdens thus reducing the value of the VoD service for the customer.

Superior Reliability

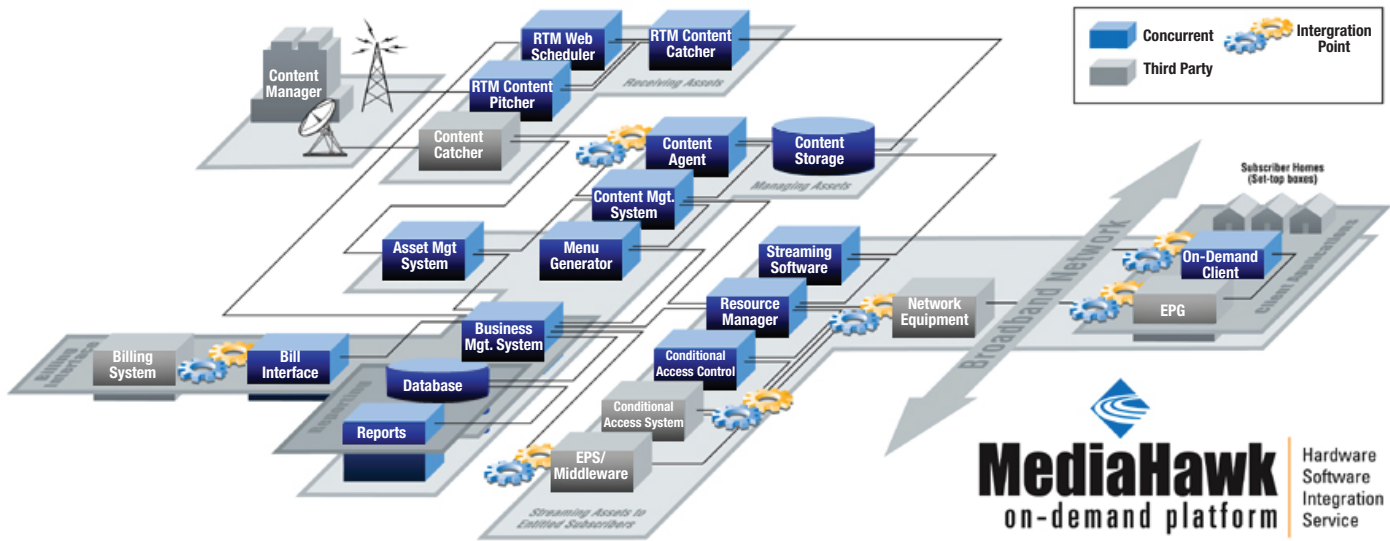
The crux of the five S's is superior reliability. To state the obvious, "On-Demand" must be just that, on demand. This means 24 by 7 operations, with flawless execution and the removal of every possible risk to meet the extensive requirements of these solutions.

Let's look at how one of the leaders in "On-Demand" infrastructure solutions is addressing the requirements of the five S's.

Delivering “Concurrent” Video Streams

Concurrent Computer is the second largest VoD solution provider with over 1.1 million video streams deployed in the field today. They compete with the likes of Cisco, Motorola and SeaChange, all of which are driving solutions to meet the five S's. Concurrent is delivering solutions to some of the world's largest content providers including: Time Warner, Comcast, Cox Communications, Brighthouse, Jupiter Communications and Telecom Italia. Concurrent's VoD product is the MediaHawk On-Demand platform. The MediaHawk's advanced software manages the delivery of content, management of simultaneous unique stream controls, management of the media library and supports the billing needs of the content provider. They run this solution on high performance COTS (Computer Off-The-Shelf), industry standard servers.

Figure 1: MediaHawk Content Delivery Infrastructure



The MediaHawk On-Demand platform can be configured to support a wide variety of system architectures, including distributed, centralized and hybrid deployments. The storage library uses traditional RAID (Redundant Array of Independent Disks) protection to provide necessary reliability and scalability with an acceptable economic performance. While the MediaHawk platform is designed to provide high reliability to the end user, hard disk drive (HDD) failures can result in maintenance events that consume valuable company resources. Concurrent needed a solid state solution to complement their RAID HDD solution that would increase overall system reliability and reduce the “care and feeding” required by the HDD storage solutions.

Key requirements included:

- Improve the performance on a cost/video basis
- Lower operating cost of the MediaHawk infrastructure
- Prevent lost revenue and operational burden due to HDD replacement and maintenance
- Improve the reliability of edge servers through the replacement of HDDs
- Reduce the service requirements for distribution servers outside and inside the data center

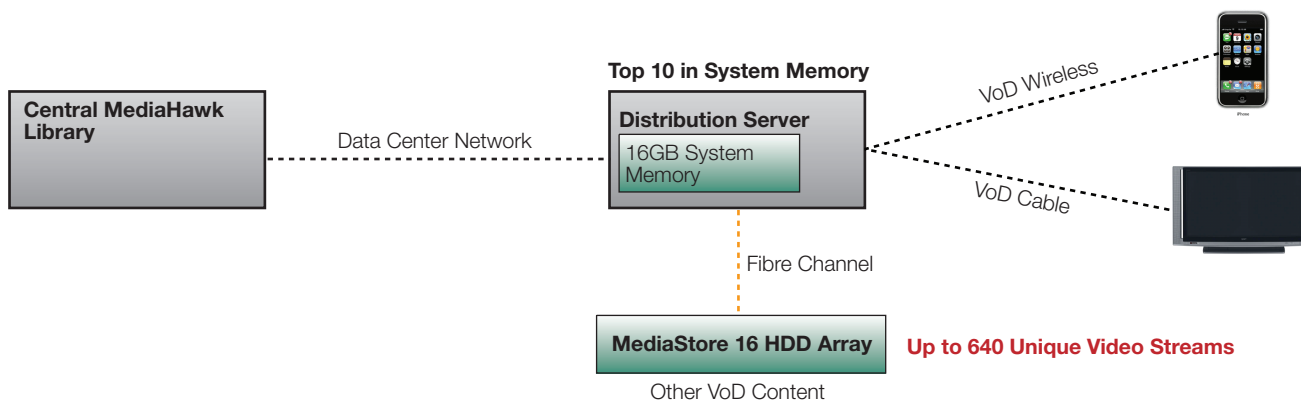
Improving Concurrent's MediaHawk

When Concurrent began their quest to improve the performance and reliability of their edge distribution servers, one of the key concerns was the reliability of disk drive(s) and another was to improve the number of video streams that could be delivered on those servers. Their search for a replacement technology led Concurrent to STEC's Zeus^{OPS} Solid State Drive (SSD).

Heirarchy of Video Stream Delivery

When Robert Drouin, director of engineering at Concurrent, was discussing the hierarchy of storage for VoD Streams, he said the MediaHawk solution started with two levels of storage for VoD delivery: system memory and HDD. However, the HDD solution was not always as reliable as customers demanded and the HDD system was limited in its ability to scale unique video streams efficiently.

Figure 2: Legacy VoD Content Storage Hierarchy (HDD-Based)



As you can see in the diagram above, the distribution server is used as a storage device for the top 10 VoD content items. The system memory is used to provide high performance delivery of unique video streams for the high demand items, while the MediaStore disk array is used to store lower demand content.

The Search for a Solution

The engineering team at Concurrent was chartered with finding a solution to not only improve the performance but also the reliability of their MediaHawk solution. Maximizing server memory and concatenating this resource among multiple servers helped with larger content and helped grow the number of video streams. But ultimately, Concurrent needed to find a way to efficiently improve the performance and reliability of the persistent media in the MediaStore.

The technology of choice was to use Solid State Drives.

What is a Solid State Drive

A Solid State Drive (SSD) is a storage device that uses memory (NAND Flash or DRAM) to store data versus traditional disk drives which use spinning platters and magnetic heads.

The primary advantage of using SSD is improved performance in three dimensions:

- I/O Operations Per Second (IOPS) – this is the primary measure of how many unique transactions a drive can handle
- Access Time – this is how long it takes to access data on a drive. For HDD's this is a function of the speed of the drive head and the rotational speed of the spinning disk platters
- Data Transfer Rates – this is how fast the data can be moved to or from the storage device

In the world of SSD there are multiple types, providing varying degrees of performance and reliability. DRAM SSDs are very costly, albeit remarkably fast. Flash SSDs are much more cost effective, but not all Flash SSDs are alike.

Within the realm of Flash SSD, there is a broad range of possibilities that resemble the range of HDDs sold today (enterprise class to client-grade):

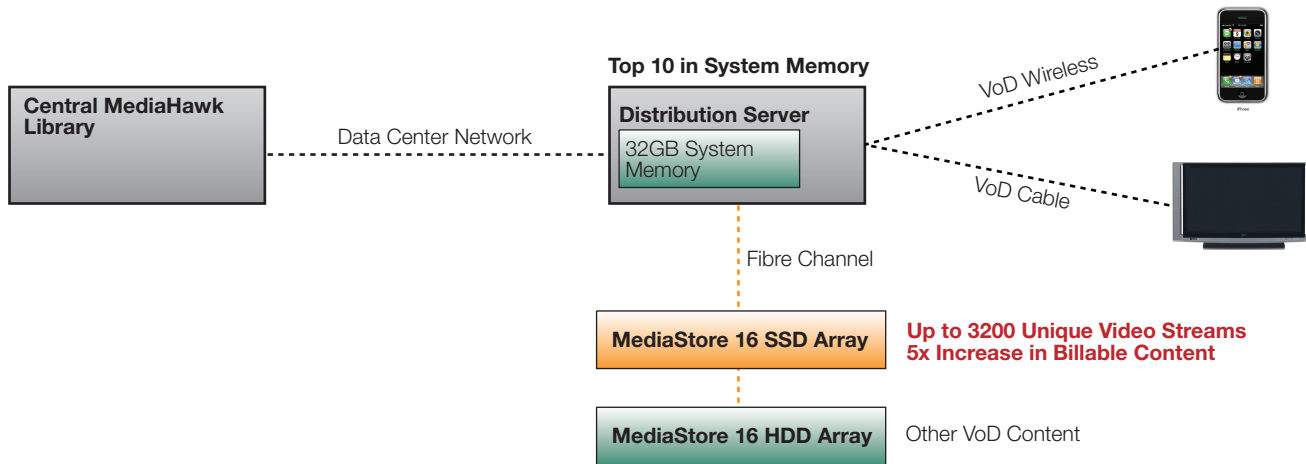
SSD Technology	Pros	Cons
Enterprise Class SSD (Optimized for Storage arrays and Servers)	Extremely fast access times Fast writes Fast reads Low power consumption Low cost Full Data Protection Superior reliability and endurance SMART Commands	
Client Class SSD (Optimized for Notebooks)	Low cost Fast reads Low power consumption	Slow access times Very slow random write speeds Number of write limitations

Concurrent looked at all types of SSD, much like the tale of the three bears, finding that DRAM-based SSD was too expensive, Client-grade SSD was too slow and unreliable, while the Enterprise-class SSD was just right.

The MediaCache Solution

The engineering team at Concurrent developed a new solution to improve storage performance and reliability called MediaCache. MediaCache provided a way to eliminate or mitigate the need of the HDD-based MediaStore. Based on STEC's Zeus^{IOPS} SSDs, Concurrent was able to replace HDDs with SSDs creating a new tier of storage capacity within their system. This meant that Concurrent could now efficiently increase the number of video streams with the improved performance and reliability of enterprise-class SSD and reduce the risk associated with HDD based storage.

Figure 3: Enhanced VoD Content Storage Hierarchy



As you can see the use of SSD-based storage has a significant impact on the performance of the distribution system. For content providers this is a significant revenue opportunity per server/day.

5x the Performance and Reliability

STEC enterprise-class SSDs provide significant improvements in all three performance measurements and are able to help improve the number of video streams each edge server can deliver. This increases the competitiveness of Concurrent's MediaHawk solutions and lowers the cost per video stream for the content providers.

The following table outlines the significant advantages of STEC SSD versus HDD and highlights the overriding dimension to the storage decision:

A total cost of storage based on the "Price for Performance" metric:

	STEC Zeus^{IOPS} SSD	Hard Disk Drives
Form Factor	Standard 3.5in. HDD	Standard 3.5in. HDD
Random Read Operations	52,000 IOPS	319 IOPS
Random Write Operations	17,000 IOPS	319 IOPS
Sequential Read/Write Throughput (Sustained)	250/200 MB/s	73-125MB/s
Access Times	20-50µs	7,000µs (7ms)
Capacities	18-300GB	18-300GB
Media	SLC Nand Flash Memory	Hard Disk

As you can see the STEC SSD delivers significant performance advantages in I/Ops, data rates and access time.

To achieve the same performance as a single STEC Zeus^{IOPS} SSD, it would take:

	STEC Zeus^{IOPS} SSD	# of Required HDDs to Equal STEC Zeus^{IOPS} SSD
Access Times	20-50µs	156
Random Read Operations	52,000 IOPS	163
Random Write Operations	17,000 IOPS	53
Sequential Read Throughput (Sustained)	250 MB/s	3
Sequential Write Throughput (Sustained)	200 MB/s	3

Benefits of SSD

The primary cause of failures in HDDs is not the electronics; it is the mechanical portion of the device. HDDs have spinning disk platters, motors, actuator arms and disk heads moving at speeds up to 15,000 RPM. It is not surprising that HDDs have limited reliability and must be grouped in RAID solutions with redundant configurations to insure reliability. SSD, on the other hand, provides high reliability and low power consumption by using non-volatile memory storage technology.

The use of memory devices removes the reliability risk of HDDs. Since SSDs have no moving parts, they are quiet and do not present the rotational vibration issues that cause drive enclosures to be built more like military tanks. And because SSDs do not need the excessive power to drive mechanical components, their use reduces power consumption, reduces cooling requirements and improves system reliability. The use of SSD lowers the operating, management and service costs of the MediaHawk system for Concurrent and their content provider customers.

The following table summarizes the key advantages of SSD vs. HDDs:

	STEC Zeus^{IO}SSD	Seagate¹ 7200 SATA	Seagate² FC 15K Drive
Power (watts)	8.4	13	16.5
Acoustics (bels)	0	2.7	3.6
Vibrations Levels	None	12.5 (rad/sec)	1.0 (Gs)
Host Connect SATA	Yes	Yes	No
Host Connect SAS	Yes	No	Yes
Host Connect FC	Yes	No	Yes
Service Levels	Low	High	Medium

As you can see SSDs uses 35-50% less power than HDDs to reduce cooling and improve reliability. Since there are no moving parts, there are no acoustic or vibration issues. All of these combine to make SSD significantly more reliable and operationally cost effective than HDDs. Finally, SSDs are plug-and-play with current HDD systems. STEC SSD solutions use the same host connection and physical dimensions (1.8", 2.5 and 3.5") of traditional HDDs for fast and easy integration.

¹http://www.seagate.com/docs/pdf/datasheet/disc/ds_barracuda_es.pdf

²http://www.seagate.com/docs/pdf/datasheet/disc/ds_cheetah_15k_5.pdf

Why Concurrent Chose STEC SSD?

We asked Tim Dodge, director of marketing for Concurrent, to outline why he felt the use of SSD, the Zeus^{OPS} drive in particular, helped solve the stringent requirements of the content providers.

He listed five key reasons:

- The STEC-based MediaCache improved transport efficiency from content library to streaming server by 500%.
- SSD does not have any moving or spinning parts and are more reliable than stand alone HDDs. The lack of moving parts means the SSD offers a significant power and cooling savings versus typical FC HDDs.
- “The STEC SSD drive was well packaged,” said Tim Dodge, “It was an elegant plug-and-play replacement for the HDDs that Concurrent was using...”
- The use of SSD provides a new level reliability for our content provider customers, which will translate to more revenue per server, more video streams/\$, and an improved end-customer experience.
- Engineering and design support by STEC was outstanding and a key reason for working with them.

When Robert Drouin, director of engineering at Concurrent, was asked why he chose STEC, he replied “The product did what is said it would, out the box and the engineering support we received was great versus other vendors.” He continued, “STEC reacts like a hungry start-up, but is a big public company that makes them safe to partner with.”

Five Solutions for the Five S's

STEC's Zeus^{IOPS} SSD provides the right balance of cost, performance and interoperability that Concurrent needed to meet their customer requirements. Here is how the STEC Zeus^{IOPS} SSD drive helps Concurrent improve their support of the five S's:

Simultaneous

The Zeus^{IOPS} SSD drive supports up to 52K IOPS vs. 319 IOPS per HDD and up to 250MB/sec read performance for hosting multiple video streams per drive.

Singular

Zeus^{IOPS} can support multiple independent video streams. The use of command queuing up to 512 commands and background processing of queues enables it to support the large number of individual commands associated with each video stream.

Speed

The drive provides over 50X the random transactional performance to improve downloads from the Core Library to the distribution server and provides the 250MB/sec read performance for supporting HD content.

Sustainable Performance

Through advanced Flash management techniques and a patent-pending innovative architecture, STEC provides high performance SSDs with long vitality and consistent performance.

Superior Reliability

STEC's SSDs provide the fundamental advantage over spinning HDDs. The lack of moving parts and lower power are not the only ways in which STEC SSDs create superior reliability. Zeus^{IOPS} is based on STEC's patented Wear-Leveling Algorithm and has a proven 10-year data retention capability, 12-bit CRC for added data security and error prevention, EDC/ECC algorithms, rugged aluminum alloy case and a 5-year warranty.

“To address the future needs of VoD customers, we needed to find new and innovative ways to deliver more streams of high-bandwidth content,” states Concurrent CTO Bob Chism. “STEC's Zeus^{IOPS} solid state drives allowed us to deliver the right mix of high-performance and reliability further cementing Concurrent's technological leadership in the VoD space.”

By using STEC's SSD solutions, Concurrent was able to improve the reliability, performance and total cost of ownership (TCO) of their MediaHawk solutions.