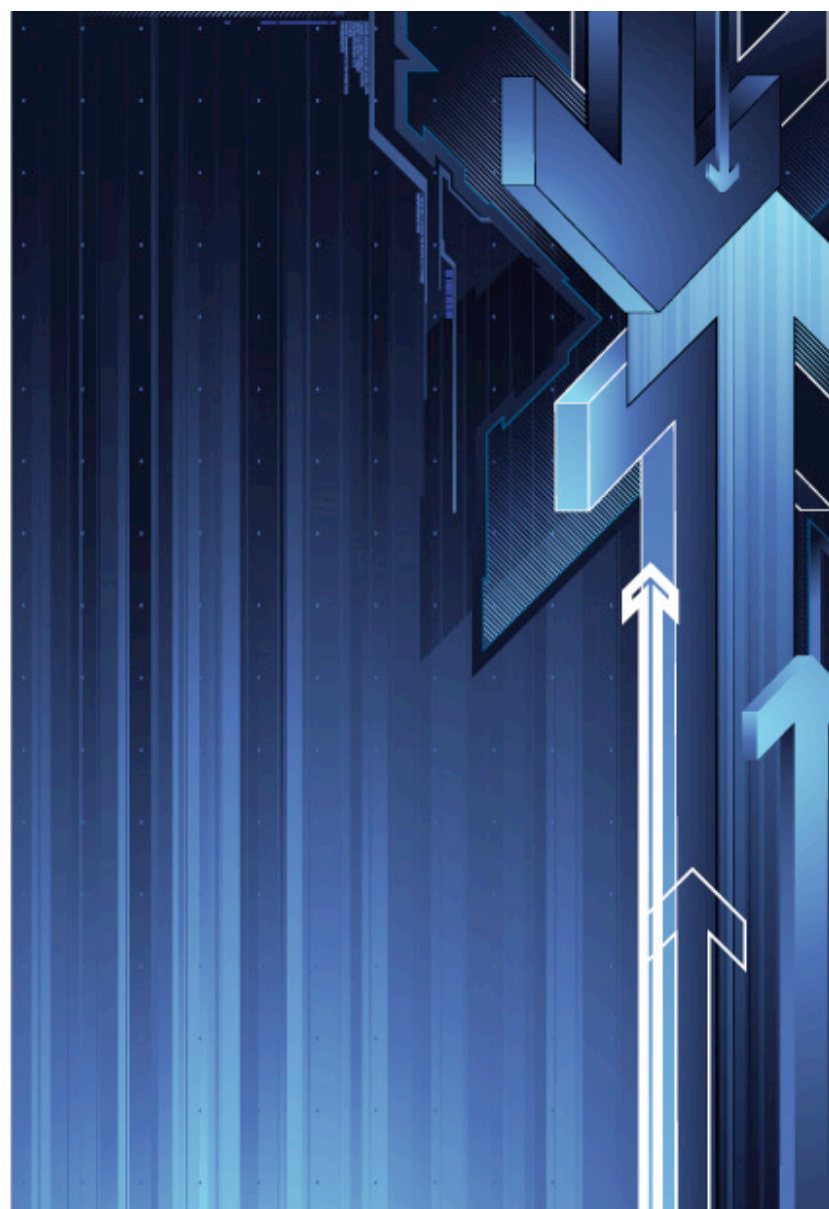


PROMISE[®]
TECHNOLOGY, INC.



AV Postproduction with the VTrak E-Class RAID Subsystem

Performance tuned storage for multi-user creative environments

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Overview

Reliable, high-performance RAID storage is at the center of digital film and video postproduction (see Figure 1). As digital video data-rates grow, the critical storage characteristics are capacity and performance/bandwidth. Innovations delivered by the PROMISE VTrak E-Class RAID subsystem solve many of the storage challenges of postproduction (post). The capacity and performance metrics are exceptional and the modular design enables projects of all sizes.

The transition to 100% digital workflow has changed the way productions are shot, edited and delivered. Storage technology is one of the enabling factors.

From the production perspective, digital cameras let directors get nearly instant feedback on set. Solid-state camera media enables non-linear access to any point in time, eliminating the need to queue up for the next shot, like you would with tape formats. This allows crews to shoot quickly with higher shooting ratios and removes time-consuming tasks like on-set film handling or rush processing. Ingesting footage into post has many fewer steps, so rough cutting can start sooner.

From the post perspective 100% digital means all of the material will be stored and transformed on disk. Post techniques of the past used expensive single-purpose edit stations with small islands of direct-attached storage. These are now replaced with centralized/shared storage and consumer-off-the-shelf computers running powerful software. Centralized storage drastically improves agility; it also allows proven enterprise data management techniques to be used to assure data availability.

High quality digital video files are large (see Table 1). Video files take up a lot of space on disk and need fast networks to support multi-stream playback without dropping frames. The table below shows some popular formats that are used in film and video production. The popularity of HD and shift to digital has blurred the lines between capture resolution and release resolution, pushing more productions toward HD capture even if the project will be used for lower resolution web delivery.

Video format	Disk space for 2-hours of video	Data rate MB/second
SD – ProRes-422 HQ 486i @ 30 fps	60 GB	7.88
HD – ProRes-422 HQ 1080p @ 25 fps	170 GB	23
HD – Uncompressed 10-bit 1080i @ 30 fps	1.2 TB	166
2K – 10bit RGB/full frame DPX	2.2 TB	305
4K – Uncompressed 10-bit DPX	8.7 TB	1210

Table 1: Popular video codecs

Once the files are stored on disk, multiple copies are inevitably made as the files are processed. Tracking and managing the files is critical to project efficiency and crucial for larger post facilities where multiple projects use the same capacity and bandwidth resources.

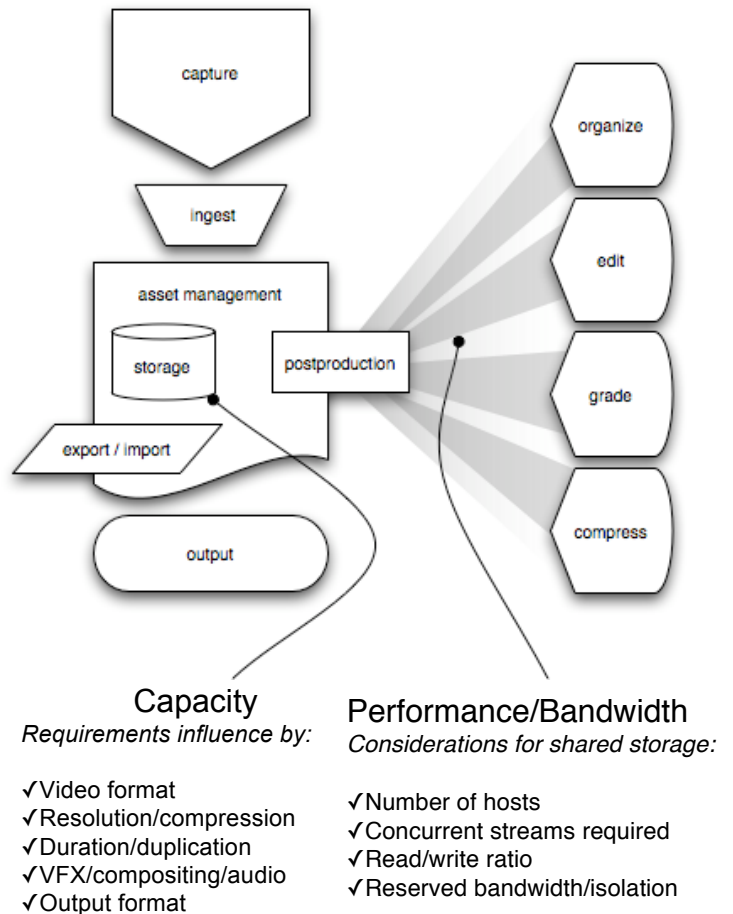


Figure 1: Capacity and performance/bandwidth

VTrak E-Class Storage

Workflow environments are only as solid as the foundation they're built upon. The VTrak E-Class RAID subsystem sets the highest standard for reliability, price, and performance. VTrak is performance tuned for the film and video industry's best large-file sequential throughput. With VTrak E-Class you don't have to sacrifice performance for rock solid fault tolerance and reliability.

Data Integrity Features:

- ✓ Redundant battery backup unit for cache (up to 72 hours)
- ✓ APC UPS support – Changes to cache to write-through during power outage
- ✓ Self-healing with Predictive Data Migration (PDM) on the drives
- ✓ Dynamic priority control for background tasks like rebuild or PDM



Figure 2: VTrak E-Class front view. LED indicators display current system health and activity

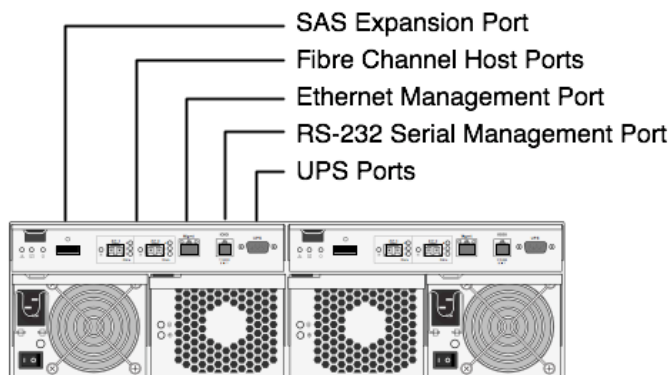


Figure 3: VTrak E-Class rear view. All components hot-swap. LED indicators display component status

Redundant and Active-Active

VTrak E-Class has a *No Single Point of Failure* (NSPOF) design with redundant, active-active RAID controllers (see Figure 3). This assures access through any component failure, even an optical cable break.

Active-active means both controllers work simultaneously. Under normal operation performance is optimal with this configuration. If a controller were to fail, access from the failed controller moves to the surviving controller. All files remain accessible without interruption. High availability is critical to support multi-user environments where downtime impacts the whole team.

In some video applications, maximum write performance is more important than zero-downtime. VTrak controllers can be set to operate independently by disabling cache mirroring. With this configuration the user data is securely protected by RAID as well as a battery backed cache. If a controller were to fail, targets can easily be assigned to the surviving controller since all drives are accessible to both controllers.

Advanced features, like Logical Unit Number (LUN) masking, are provided at no additional charge. LUN masking allows shared storage targets and private storage targets to coexist securely across a Storage Area Network (SAN). LUN masking can also be used for smaller installations to provision dedicated storage for multiple hosts with a single VTrak E-Class subsystem.

Advanced Video Codecs

New digital video formats allow images to be captured at virtually film resolutions and moved from the camera/media to protected RAID storage faster than real-time. Postproduction software can manipulate many of the files in the native camera format. This allows initial work to begin the moment the files are on disk.

By streamlining constraints at ingest, hours or even days can be cut from the postproduction schedules of the past.

FCP Native Codec Support

- ✓ DVCPRO HD (P2) – Panasonic
- ✓ XDCAM EX – Sony
- ✓ AVC-Intra
- ✓ AVCHD
- ✓ RED (RED plug-in required)

Fibre Channel Topology

For AV applications, Fibre Channel host connectivity offers the flexibility to go from a small direct-attached solution to a Storage Area Network (SAN) using the same VTrak E-Class hardware. Fibre Channel is a mature, high-performance industry standard, used in enterprise computing. Like Ethernet networking, the greatest benefit of FC is that it can provide diverse connectivity relationships that can improve availability and can effectively scale to meet your growing needs.

The use of SAN file systems like Xsan can further expand Fibre Channel's scaling capability, by enabling the storage to be pooled across physical hardware, providing both aggregated performance and transparent expansion to multiple SAN attached hosts simultaneously.

RAID Expansion

VTrak E-Class SAS expansion ports enable the user to dynamically expand the RAID subsystem with VTrak J-Class JBOD expansion chassis (see Figure 4). Expansion can be done incrementally as capacity requirements grow or upon initial deployment to support larger configurations.

For the large-file sequential performance needed for video, the 32-drive E+J configuration provides optimal performance. When additional capacity is needed deploying another E or E+J will allow for linear scaling of performance and capacity.

The VTrak E-Class architecture supports attaching up to four JBOD subsystems for capacity applications like archive and backup. But the documented multi-user AV performance 32-drive configurations should be used in AV environments.

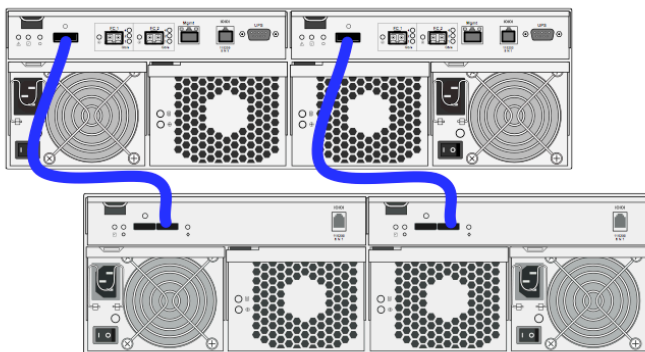


Figure 4: VTrak E-Class expansion

Capacity Planning

Before production begins, project planners should be able to estimate capacity requirements for all stages of the production. The use of a media asset manager like Final Cut Server™ from Apple can improve work efficiency and capacity utilization by providing revision control. Target capacity utilization should not exceed 70-80% in AV environments.

Estimate:

- ✓ Program duration
- ✓ Capture format
- ✓ Shooting ratio
- ✓ Ingest ratio
- ✓ Visual FX
- ✓ Audio production
- ✓ Music production
- ✓ 2D & 3D Graphics
- ✓ Edit reviews & revisions
- ✓ Final delivery formats

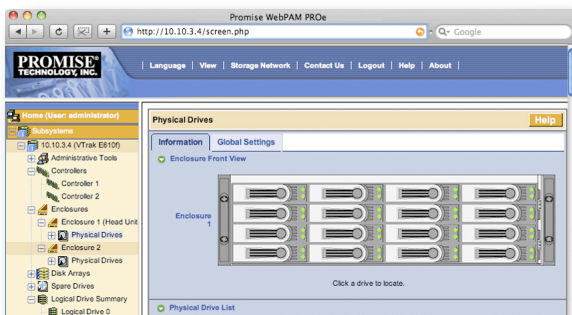


Figure 5: WebPAM PROe in a Safari browser

Easy to Setup

VTrak E-Class is easy to configure through its browser-based management interface, WebPAM PROe (see Figure 5). Administrators can manage all the VTrak units on their network from any computer. No software needs to be installed.

- ✓ Bonjour discovery
- ✓ HTML interface
- ✓ Secure management using SSL/SSH
- ✓ Multiple user rights levels (view, maintenance, power, super)
- ✓ SNMP built in
- ✓ Email notification

A simple guided setup walks you through configuration. VTrak also has the ability to upload proven configurations for Final Cut Studio and Xsan. Novice and advance users alike can optimize VTrak for their own environments.

Flexibility to Scale

With its modular design VTrak E-Class supports configurations for both small and large multi-user environments. Users can start with as few as four drives (currently 4TB raw capacity) and re-share the directly attached storage to other users across an Ethernet network (see Figure 6). While not optimal, this arrangement works well for individuals or small post houses that use third parties to collaborate on hardware or talent specific tasks like Telecine, digital intermediate processing, 3-D compositing, audio and music production.

1. **Fibre Channel attached workstation:** Files can be exported and imported rapidly and high-resolution work like grading and can easily be done on the fibre attached workstation without performance concerns
2. **Network attached workstations:** Rendering tasks are commonly performed on Ethernet attached workstations, as these types of tasks don't have the latency requirements of editing or grading in real-time. Audio/music postproduction can be done over Ethernet using local compressed image proxies for video synchronization. Once the work has been completed project files and final mixes can quickly be transferred back to the RAID protected storage.
3. **Laptop users:** Compressed video proxies and lightweight EDLs now allow users to edit anywhere. Original high quality imagery stays under tight control while remote or contracted talent can work with watermarked reference material, reducing the likelihood of them sharing confidential material.

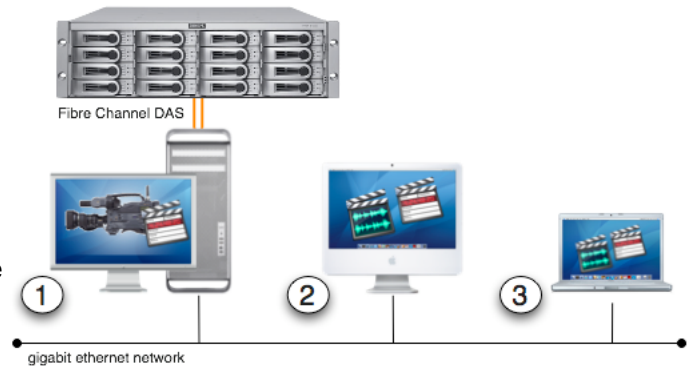


Figure 6: VTrak E-Class DAS, multiple hosts use a network share over Ethernet

Shared Storage Volumes

Xsan provides the best of all worlds for postproduction. Files can be manipulated and progress through all stages of post while remaining in a central location (see Figure 7). All Xsan hosts can access the files with direct high-speed, block level access. Access control down to the file level means that users can work as they would with local storage.

Each Xsan host has software installed that communicates with a Metadata Controller (MDC) over a dedicated Ethernet network. The MDC acts as a lock manager, controlling all access to the storage and simplifies how the storage is presented to the host. With Xsan, files can then be shared effortlessly.

All control-data moves on the Ethernet network—out-of-band from storage I/O—preserving performance/bandwidth for the video streams.

1. **Multiple Fibre Channel attached workstations:** High performance access is available to all Xsan hosts. Files can be exported and imported rapidly and high-resolution work like finishing/grading can be done from any Xsan host.
2. **Final Cut Server:** Adding an asset manager to the SAN controls and tracks how the assets are used. This also can automate tasks like create and manage low-res proxies for use in scoring or other third party tasks.
3. **Network attached computers:** network attached nodes still have enough performance for audio and frame based tasks. Laptop users can checkout proxies from Final Cut Server for remote editing tasks.

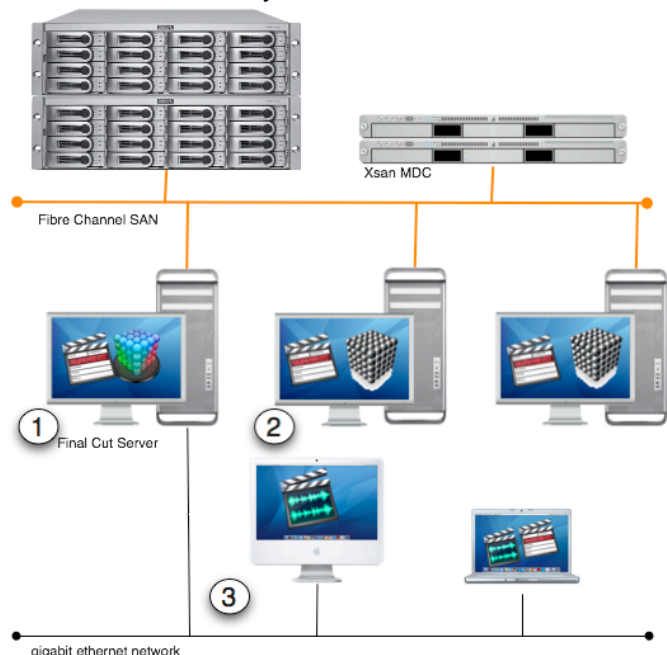


Figure 7: VTrak E-Class Xsan, Multiple hosts connected by FC, and multiple host using a network share over Ethernet

Reliable, Predictable Performance

The job of a RAID storage subsystem is to provide a safe place to store digital files and to deliver those files rapidly when requested. AV files add an extra challenge. Users expect flawless real-time playback of video every time! Add to this requirement the demands of multiple simultaneous users, and you can see why AV environments must use specially qualified high-performance storage.

To avoid congestion through peak periods, usage estimates for each workstation are critical. PROMISE provides performance estimates of specific video formats with both 16-drive and 32-drive configurations (see Figure 8). These estimates allow users to deploy storage with consistent performance and scale both capacity and performance linearly by adding additional storage in 32 drive increments (see Figure 9).

PROMISE performance tunes VTrak E-Class for AV file management. Extensive testing produces predictable, repeatable, and documented configurations. Users simply upload a configuration script to the VTrak E-Class, mount the storage, and then they can focus on their work.

Details about VTrak E-Class configurations and scripts are available for download from the Apple website:

<http://support.apple.com/kb/HT1200>

Simultaneous FCP Streams

16-drive vs. 32-drive VTrak E-Class with Apple Xsan 2

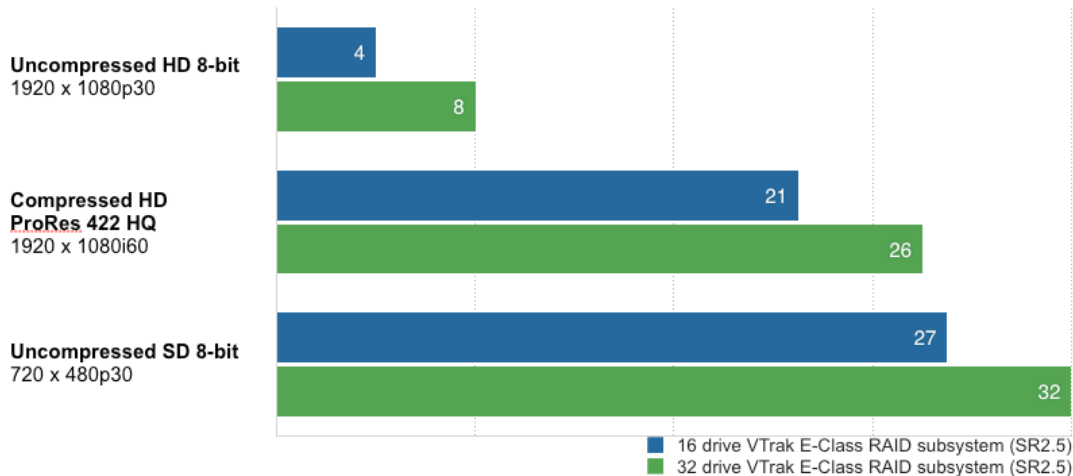


Figure 8: Video performance comparison of 16-drive and 32-drive configurations under Xsan

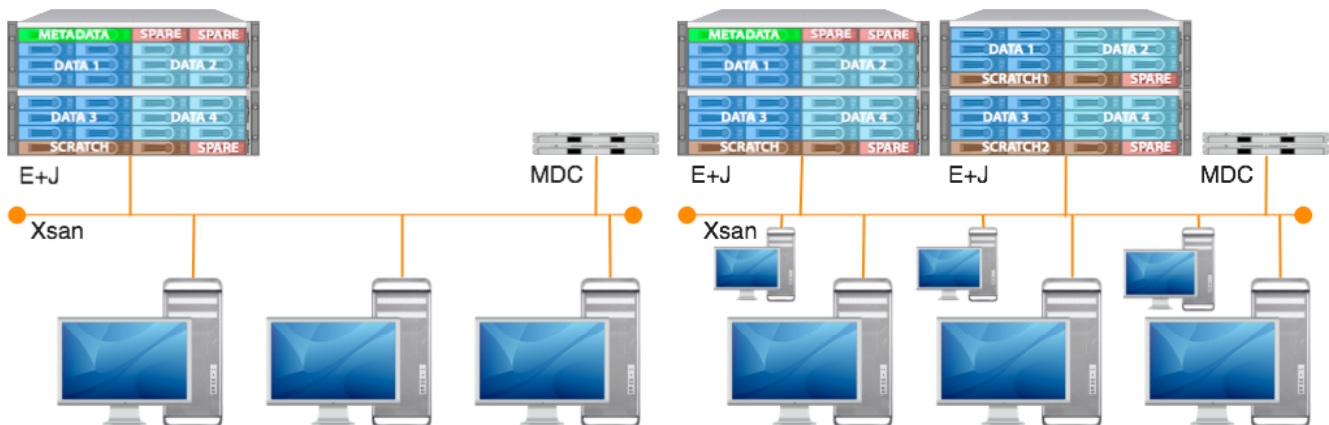


Figure 9: VTrak E-Class scaling under Xsan

Postproduction pushes computer hardware to the limit. Administrators need easy to use tools to keep systems running their best. With VTrak users can download a subsystem report, revealing every detail in a browser-readable HTML file. PROMISE also makes troubleshooting the VTrak easy. Real-time embedded tools enable users to diagnose and optimize conditions as the post environment scales.

Performance Monitoring

VTrak E-Class web based management interface WebPAM PROe features graphical performance monitoring (Figure 10). This gives administrators a real-time view of access patterns making it easier to diagnose and optimize their environment. This feature is especially useful in large environments where there are many factors that may contribute to increased SAN performance.

Statistical views include:

- ✓ Fibre Channel Host Ports
- ✓ Logical Drives
- ✓ Physical Drives

Bandwidth, IOPs, latency, and cache usage all can be viewed without impact on subsystem performance.

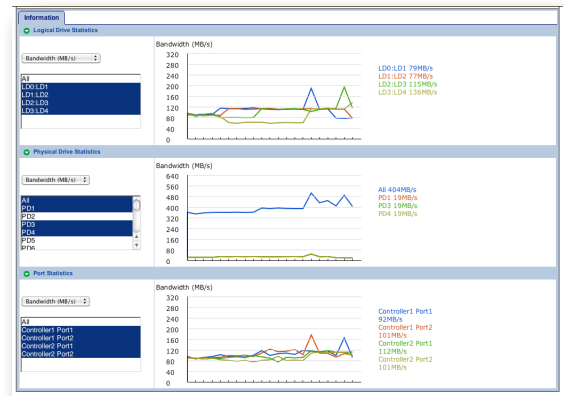


Figure 10: Performance statistics in WebPAM PROe

Qualified Storage for Mac OS X

VTrak E-Class for Mac has been qualified to support the advanced postproduction tools created by Apple. Installing a VTrak E-Class RAID subsystem affords the user end-to-end support of their Mac based environment. PROMISE understands that post customers need to use every means possible to bring their magic to the screen. We also understand PCs running Windows are commonly used for 3D applications and Linux powers many of the powerful rendering applications. PROMISE offers our storage expertise to support all of these platforms with the VTrak E-Class for Mac.

Exhaustive testing and development by PROMISE assure VTrak E-Class RAID subsystems deliver incredible user experiences under Mac OS X with Final Cut Studio, Xsan 2 and Final Cut Server. Hard drives selected for use in the VTrak for Mac endure an exacting screening process so delivered subsystems meet the high expectations of Mac users, right out-of-the-box, every time.

Conclusion

VTrak E-Class has been designed for exceptional performance in mission critical AV environments like film and video post. Proven VTrak E-Class deployments worldwide benefit from the consistent industry leading performance that enables users to scale their storage effectively to meet growing capacity and performance/bandwidth requirements. By using field proven PROMISE RAID configurations, complex Xsan setups can be can be deployed quickly, easily and with confidence. The full hardware redundancy of the VTrak E-Class means postproduction work will continue even with component failures.

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