harmonic®

WHY VIDEO STORAGE IS DIFFERENT:
AN INTRODUCTION FOR IT PROFESSIONALS

Proud Partner of Real Salt Lake

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TABLE OF CONTENTS

THE UNIQUE NATURE OF VIDEO APPLICATIONS AND WORKFLOWS

Video workflows are very different from the enterprise applications that IT organizations are accustomed to deploying and supporting. Large video files and demands for fast access and real-time performance result in requirements for highly scalable storage systems with enormous bandwidth, consistently low latency and the ability to effectively support highly specialized video applications.

IT organizations in the enterprise world may be accustomed to focusing on applications, such as CRM, ERP and email, and core elements such as databases and virtualization technologies. Though unstructured content is gaining in importance, in the enterprise world data is often block-oriented, and the relevant performance measure is frequently transactions per second.

Attempting to force-fit traditional enterprise storage into a video workflow introduces the risk that the IT organization will have dissatisfied users unable to work trouble-free with the tools of their trade. Further, IT may face support challenges resulting from attempting to deploy storage where it simply was not designed to go.

Video is unlike other types of data. In the video world the focus is on workflows, where various specialized applications are utilized almost like stations of an assembly line to process and distribute video content. In such an environment, it's critical to quickly access concurrently large video files between different systems in the workflow. Thus the key performance metrics are around latency and bandwidth, not transactions per second.

Previously, video workflows were based on analog media. Moving images were captured on film or analog videotape, and clips were physically spliced together to create new film or video materials in final form (e.g., TV shows, movies, commercials, etc.). Digital, film and video media production workflows have increasingly become file-based. As with many IT applications, the video processing infrastructure may initially use islands of direct attached storage (DAS).

However, with workflows requiring that video files be shared across different applications and by different users, the ideal approach is to have high-performance shared storage at the heart of file-based video workflows. Figure 1 shows a generic video infrastructure to support a file-based workflow, in this case for a broadcaster.

As shown in Figure 1, there may be many elements in a file-based video workflow, and the key applications may include:

- **Ingest,** which refers to taking raw video content that may have been shot with a TV camera, and converting it into video files that can be digitally processed.
- **Editing,** where video clips are cut, enhanced, sequenced, mixed with audio, and further processed into a segment of final video that someone would want to watch, like a TV show or movie. Key applications here are products like Avid® Media Composer™, Apple® Final Cut Pro™ and Adobe® Premiere® Pro, all of which typically run on very powerful workstations.
- **Transcoding,** where video files are transformed from one format to another for editing or viewing on different types of displays (e.g., TV, iPad™, iPhone™).
- **Playout,** where video files are distributed over satellite, cable or the Internet.

THE WORLD OF VIDEO WORKFLOWS

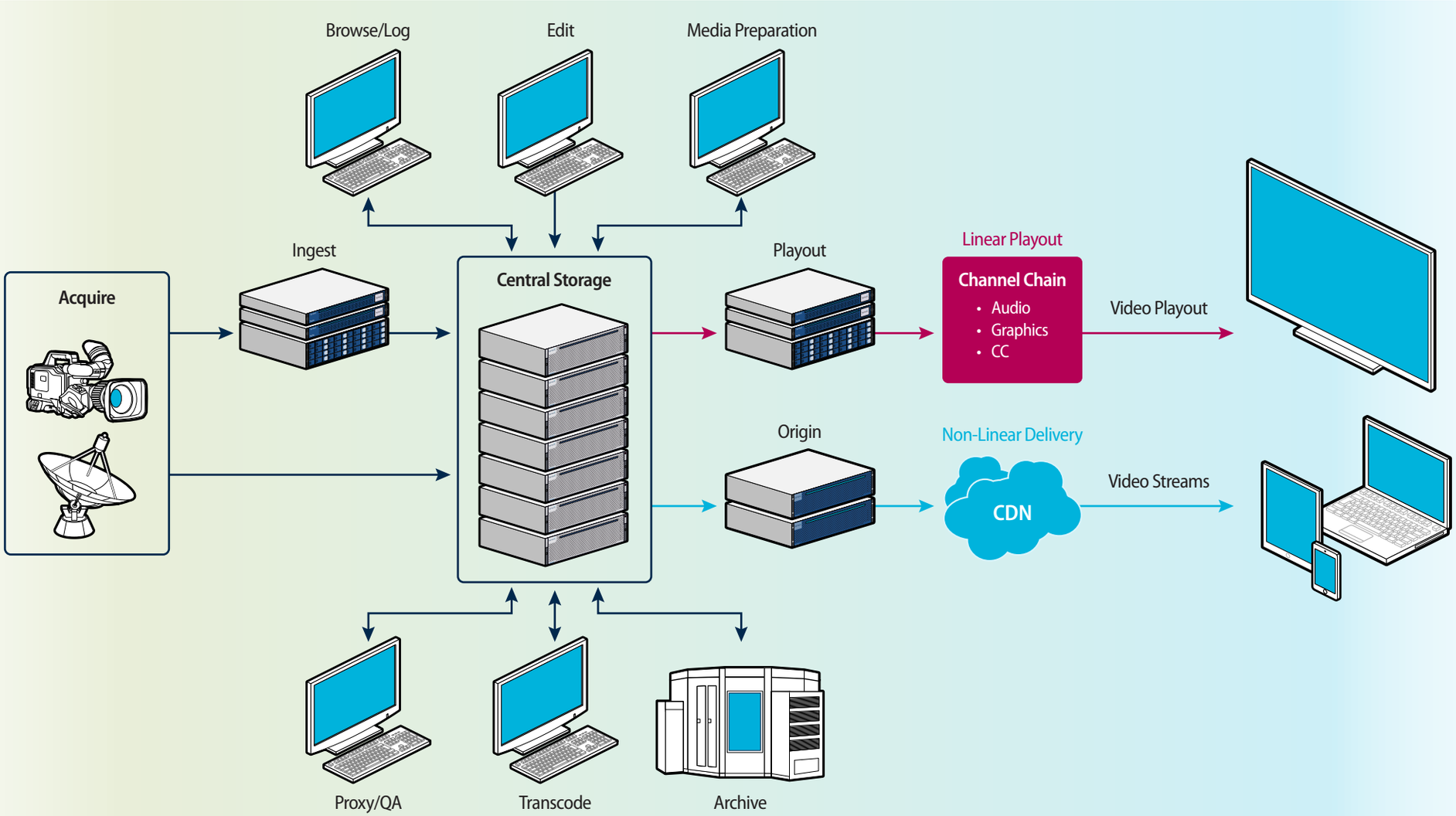


Figure 1: Traditional broadcast video workflow featuring centralized, shared storage

UNIQUE STORAGE REQUIREMENTS FOR VIDEO WORKFLOWS

There are unique, challenging requirements for shared storage to support a video workflow:

1. **Predictable, Real-Time Performance:** Many video productions must run at 24, 25, 30, 50 or 60 frames per second, and storage must be able to reliably support the consistent bandwidth required to deliver these frame rates to the requesting application without excessive latency. There's no extra credit for running faster (except for file-based processing), but running slower so that frames are "dropped" is unacceptable.

2. **High Bandwidth:** Accessing and ingesting many large video files can generate enormous requirements for bandwidth. Storage systems for video workflows are often required to support gigabytes per second of bandwidth.

3. **Media Application Support:** Media applications are different, and the storage system that works well with Microsoft® Exchange™ or SAP® ERP™ may flounder with video workflows and ingest, video editing, transcoding or playout applications.

4. **Effectively Support Hundreds of Terabytes of Large Files:** General-purpose IT storage is often optimized for transaction processing performance with small files, in environments where storage capacity is measured in terabytes or perhaps tens of terabytes. In contrast, throughput-oriented video applications use large files and storage capacities measured in hundreds of terabytes or even multiple petabytes. This different type of workload can put unique strains on shared storage.

5. **Continuous Operations:** If storage is down, the workflow grinds to a halt. In the best case this means that a lot of skilled people have to take a long break, but in the worst case it means the TV broadcast becomes white noise, the news program can't go on, or the video that thousands or millions wanted to watch online is not available. Shared storage for video workflows is mission-critical: if the data is unavailable, revenue is lost.

6. **Easy Scaling:** The ongoing rollout of HD, and now Ultra HD, content is just the latest in a continuing series of advancements in video technology. Though each advance provides a better viewing experience, each advance also results in yet another type of video that needs to be produced, with larger video files to process and store. As these continuing advancements are adopted, requirements for bandwidth are continually growing within a video workflow, such that it is important that the storage system's bandwidth, as well as capacity, can easily be increased without disrupting users or applications.

7. **Edit Growing Files:** Some workflows have very specific, and very critical, functionality requirements. For example, when broadcasting live events such as sporting events, the ability to create a highlights package while the event is still ongoing is critical, and this translates into a requirement for the storage system to be able to edit a file while it is still being written.

8. **Enterprise Integration:** In addition to the above unique requirements for video workflows, the storage system must meet some of the basic requirements of enterprise storage:

Comply with enterprise requirements for security	Integrate with enterprise management frameworks	Be easy to manage	Be simple to deploy	Be cost-effective

	Storage for Enterprise Apps	Storage for Video Workflows
Paradigm	Applications	Workflows
Key applications	Email, ERP, CRM, etc.	Ingest, video editing, playout, etc.
Data types	Block and file	File
Performance metrics	Transactions per second	Gigabytes per second; latency
Key pricing metric	Price per GB of capacity	Price per MB/s of bandwidth
File sizes	Often in KB	Often multiple MB or GB
Consistent performance	Highly desired	Critical
Scale	TBs, or tens of TB	Hundreds of TB, or petabytes

Table 1. Enterprise storage vs. video storage

VENDOR EXPERTISE

The unique nature of video applications and workflows makes it particularly important to select not only a product that meets the technical requirements, but also to select a vendor that understands this environment, knows the application partners, and has demonstrated success across a variety of demanding video workflows.

STORAGE OPTIONS FOR MEDIA WORKFLOWS:

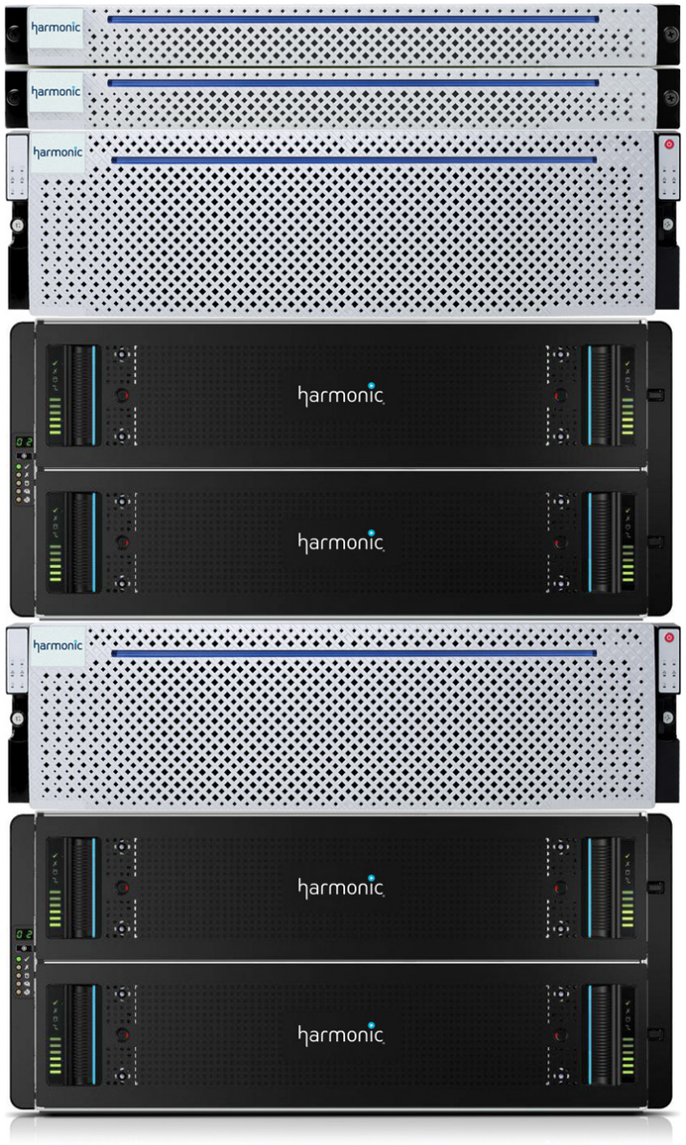
1. **Direct Attached Storage:** DAS can provide good performance for individual application silos, and offers a low "price per gig" compared to networked storage. However, as in enterprise environments, DAS does not effectively scale, can be subject to downtime, and becomes complex to manage when data must be shared. Though DAS is sometimes used to support an individual application in a video workflow, it is not a practical choice for scalable shared storage or fluid workflows.

2. **Fibre Channel Storage Area Network (FCSAN):** FCSANs with an integrated SAN file system can provide the level of performance required by video workflows, at least initially, and are a viable option as centralized storage in a video workflow. Unfortunately, the predominant file systems used with FCSANs suffer from performance degradation due to file system fragmentation; SANs can be problematic to scale; and often most importantly, FCSANs are complex and expensive to deploy and manage.

3. **Traditional Network Attached Storage (NAS) Systems:** Traditional NAS systems consist of two controllers (or "NAS heads") in a failover configuration. The controller hardware defines the performance of the system and usually becomes a bottleneck for bandwidth; once a controller is "maxed out," increasing performance requires either a "forklift upgrade" or a manual redistribution of the workload across multiple systems. This fundamental limitation in scalability often makes traditional NAS systems a poor fit for demanding video workflows.

4. **Clustered NAS Systems:** To address the scalability limits of traditional NAS systems, vendors have developed clustered file systems which can effectively join many controllers together and present them as a single image. If additional performance or capacity is required, then additional controllers can simply be added to the configuration. The scalability of clustered NAS systems makes them a viable candidate for video workflows. Like their predecessors, clustered NAS systems are accessed via standard protocols (e.g., NFS and CIFS). These NAS protocols can present a performance limitation that is insufficient for some video workflows and make it very difficult to ensure consistently low latency. In addition, many clustered NAS systems are plagued with an inability to maintain consistent performance as the file system fragments.

5. **Shared Storage System:** A shared storage system, like Harmonic MediaGrid, builds on the clustered NAS approach with a system designed specifically to meet the demanding requirements of video workflows. Like clustered NAS systems, it uses a clustered file system to scale performance while maintaining a single system image, and can be accessed with standard CIFS and NFS protocols. However, this system goes a step further by being able to deliver higher performance via a file system driver, which provides power users with true direct parallel access to multiple storage nodes through multiple Ethernet connections.



MediaGrid Shared Storage System

HARMONIC MEDIAGRID

MEDIAGRID IS A HIGHLY SCALABLE, SHARED STORAGE SYSTEM OPTIMIZED FOR DIGITAL MEDIA WORKFLOWS

Simple to deploy, manage and scale, MediaGrid storage accelerates file-based workflows and provides the ability to manage the entire asset lifecycle. It's designed for digital media applications requiring shared, real-time storage, such as ingest, playout, archive, edit-in-place, collaborative editing, transcoding and over-the-top (OTT) adaptive bitrate streaming. This system reduces the cost of storing media nearline, making it practical to economically deploy multi-petabyte digital media libraries and archives for video on demand (VOD) and other applications.

Enabled by Harmonic's proprietary distributed file system and a file system driver (FSD) installed on clients, MediaGrid is designed to deliver high bandwidth and consistent latency for video.

Unlike competing clustered NAS systems, which can only access data through one path at a time, the Harmonic FSD enables MediaGrid to deliver maximum performance through true parallel access across many storage nodes and network connections.

To meet the exacting requirements of diverse use cases, MediaGrid systems can be built in a variety of configurations. Each system can start as small as 20 TB of usable capacity, and seamlessly scale to petabytes of capacity and tens of gigabytes per second of throughput. By storing up to 504 TB of raw capacity in 5 RU, MediaGrid reduces rack space by up to 60% and lowers storage-related costs by up to 30%, minimizing Total Cost of Ownership (TCO) while providing exceptional price/performance benefits.

BENEFITS OF USING MEDIAGRID SHARED STORAGE

HIGH SCALABILITY

MediaGrid is based on a fully distributed scale-out architecture, resulting in increased performance as additional storage nodes are added. Over a gigabyte per second of bandwidth can be delivered to a single client, with aggregate bandwidth reaching tens of gigabytes per second. The high performance of MediaGrid enables reading and writing high bitrate production media format files over Ethernet. On alternative storage systems, performance may significantly degrade over time due to data fragmentation. The MediaGrid file system stripes data across all system servers, and clients then access the servers in parallel, ensuring reliable performance for any application, at any time.

SIMPLE AND COST-EFFECTIVE

Based on standard hardware components and cost-effective Ethernet technology, MediaGrid is economical to purchase and maintain. Many alternative media storage systems utilize Fibre Channel SANs to deliver the required levels of performance, but Fibre Channel is far more complex than Ethernet and requires expensive, specialized personnel to manage. Media workflows often demand the ability to quickly and continuously add new content, necessitating a need to easily scale. With MediaGrid, scaling is fast and unobtrusive: storage nodes are added, the additional capacity is absorbed by the file system, and existing data is transparently rebalanced across the new nodes as a background task.

OPTIMIZED FOR MEDIA WORKFLOWS

MediaGrid enables collaborative editing workflows with nonlinear editors such as Apple® Final Cut Pro®, Avid® Media Composer®, and Adobe® Premiere® Pro. The advanced media-specific functionality delivered by MediaGrid reflects Harmonic's deep expertise with media applications and workflows. The MediaGrid FSD intelligently uses client-side memory to read ahead and store portions of media files before they are requested by the application, providing extremely fast access to media. Clients can choose 1 Gb, 10 Gb or multiple 1 Gb or 10 Gb links to get the performance they need on a per client/application basis.

RELIABILITY AND AVAILABILITY

MediaGrid systems have no single point of failure, and leverage features such as dual active-active controllers with transparent failover, redundant data paths to protect against storage node failures, and transparent client failover to protect against controller failures. Storage nodes can be added to the system while it is running, and no down time is required for activities such as software and firmware upgrades. Data in a MediaGrid system can be transparently replicated across different physical locations on a campus while remaining under a single file system.

WORLD-CLASS SERVICE AND SUPPORT

Harmonic stands behind our MediaGrid shared storage system — and all of its products — with comprehensive service and support programs, including system design, service deployment, technical support and network maintenance. World-class service plans and a global network of flexible and responsive support professionals help ensure your ability to deliver outstanding "anytime, anywhere, any-device" customer experiences.

ABOUT HARMONIC

Harmonic is the worldwide leader in video delivery infrastructure for emerging television and video services. Harmonic enables customers to produce, deliver and monetize amazing video experiences, with unequalled business agility and operational efficiency, by providing market-leading innovation, high-quality service and compelling total-cost-of-ownership. More information is available at: **www.harmonicinc.com**.

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