WHITE PAPER

The 4K Video Revolution

With New Opportunities Come New Challenges

TABLE OF CONTENTS

1.0 Introduction

Of all the emerging technologies that greeted attendees at the Consumer Electronics Show (CES) in Las Vegas, perhaps none has garnered more media attention than the devices that can support 4K and ultra-high-definition (UHD) content.

While the term is often used generically, 4K refers to any number of high-resolution technologies that offer roughly four-times the pixel depth of standard high-definition video. In addition to the DCI (Digital Cinema Initiative) 4096 x 1716 pixel (Scope) and 3996 x 2160 pixel (Flat) standards, 4K can also refer to 4096 x 2160 pixel resolution (also known as "native resolution"), which is used primarily in digital cinema that is optimized for delivery on LCD displays.

Additionally, 4K now also refers to video delivered at 3840 x 2160 pixels (8.3 megapixels, aspect ratio 16:9), dedicated to consumer television content, which is being marketed under the moniker "Ultra HD." The technology, which promises sharper, crisper images and a wider color spectrum, is the closest you can get to movie-theater quality video.

Since all types of 4K entail roughly the same capture, production and storage challenges, for the purposes of this paper we will use the term 4K and "ultra-high-definition or UHD" interchangeably to refer to video standards having horizontal resolutions of 4,000 pixels.

The majority of films are still shot in standard HD, but the industry transition to UHD is underway as producers move to 4K. With the demand for 4K content increasing, so is the need for devices and infrastructure capable of handling and storing these large file sizes.

HD, 4K, and UHD post-production formats dramatically increase file sizes. New methods of distribution result in multiple new media formats, each requiring multiple files to be encoded and maintained. With supporting technology for 4K video now widely available, the biggest challenge for content producers, broadcasters, post production houses and distribution companies is managing these complex digital media workflows: moving huge volumes of data, having data available where and when it's needed, and storing it safely and securely.

2.0 4K Workflow Challenges

2.1 Processing

Besides an expansive gamut of colors and greatly enhanced bit depth, 4K offers a number of benefits including superior tone definition and creative flexibility in postproduction. The latter of which creates infrastructure demands throughout the entire media workflow.

On the production side, editing and processing RAW 4K video files require a level of infrastructure sophistication beyond traditional HD projects. Each 4K image has about double the amount of individual pixels when compared with HD—or more than 8 million individual pixels on average. But the impact is greater than just the pixel count. To handle the additional load, 4K workflows require four times the amount of processing power and storage capacity of standard HD.

This is an ongoing progression to ever-greater resolutions and effects. Capacities increase even more when productions add 3D to the mix. And 8K production workflows are just around the corner, which will merely compound the challenge.

The impact for media production houses as well as for content owners is that the same number of jobs will require significantly more storage to hold the data, faster storage to maintain real-time playback to workstations and more computing power to process the images in real time. And as these requirements grow, so does pressure on transport to move the data.

In addition to the processing power and storage capacity, the other link in the chain is the network to move all these bits. Traditionally fibre channel has been the dominant network backbone and continues as many people move to 8Gb or 16Gb fibre channel infrastructures. But as Ethernet protocols are moving from 10 to 40 to 100Gb, high bandwidth Ethernet is emerging as a strong alternative to Fibre Channel.

2.2 Storage and Archiving

The challenges in managing 4K workflows go beyond processing capacity. While not all Digital Intermediate (DI) processing is done in real time, dealing with larger file sizes means facilities will need high-capacity storage systems.

To formulate an optimal storage strategy, facilities first need to identify their business needs and work around any budgetary limitations. While scalability will be important as 4K will eventually become 8K, infrastructure investments should be made for the next four or five years.

While storage needs will vary based on use case cost constraints, in general there are three tiers of storage for optimal 4K production, rendering and archiving:

- **Tier 1** is designed for the kind of low-latency online storage demands of composition and editing and is often achieved using stacked and multi-terabyte Flash/Solid State Disk (SSD) arrays or high-speed Storage Area Networks (SAN) storage (10,000-15,000 rpm fast drives) for online editing. Tier 1 is the production workhorse of the storage farm, where files will be written and read multiple times, and therefore requires exceptionally robust I/O capacity.

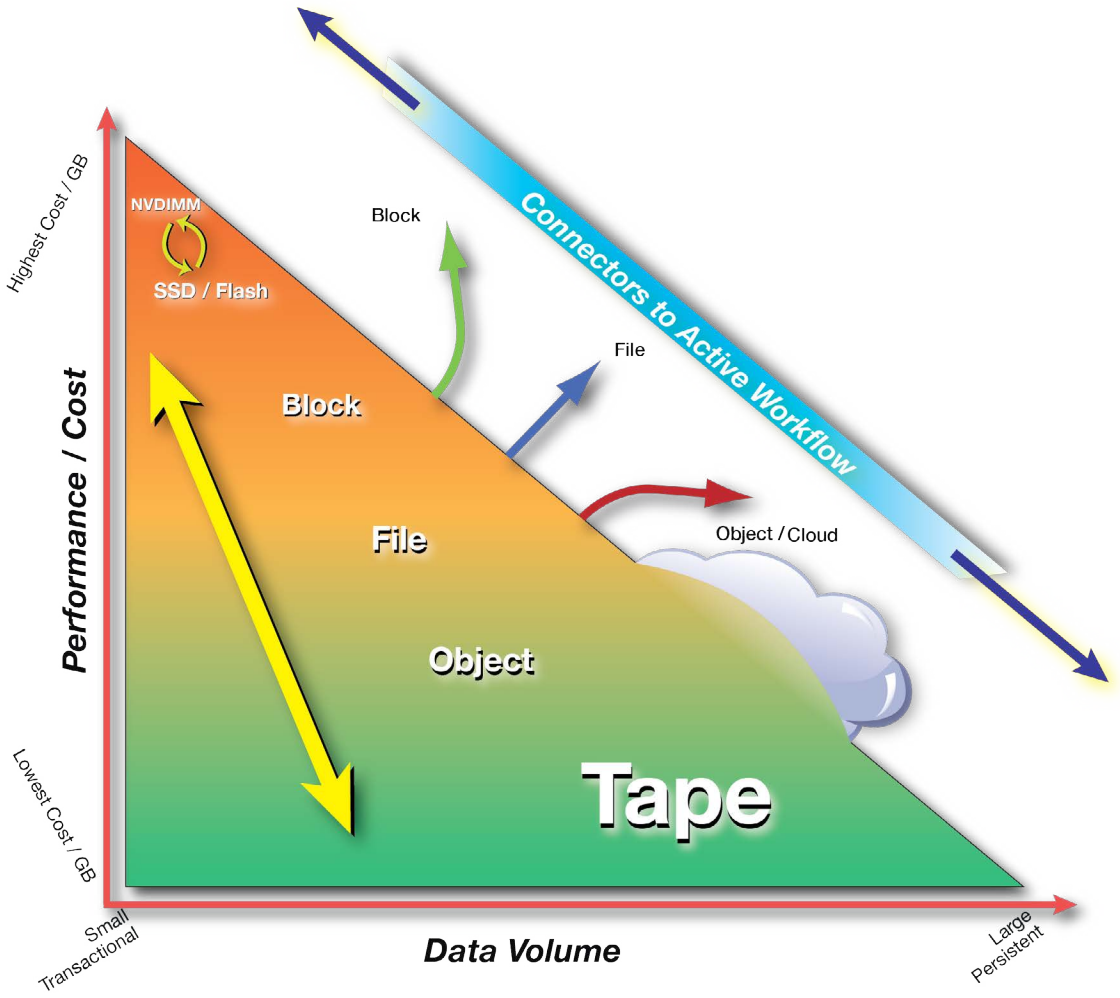
- **Tier 2** which could be called a ‘fast parking lot,’ is bigger and slower than Tier 1 and is often achieved using very robust SANs or Network-attached storage (NAS) arrays with enough overhead to be able to handle high throughput demands. Ideally, this kind of nearline storage is achieved using 3.5” drives (7200 rpm) with capacities of 4TB or more. In low-pressure editing environments where speed is not as essential, this type of storage array can sometimes be used for both online and nearline applications.

- **Tier 3** is designed primarily for warehousing, and typically encompasses storage units where data will be written to once and read from multiple times. Because some high-frame video projects require archiving storage in the multi-petabyte range, traditional SANs may be inadequate for handling the load. While traditionally tier 3 storage has been primarily handled by tape libraries, new object storage technologies now achieve the unlimited scale-out available with tape, but at throughput speeds approaching conventional Tier 1 or Tier 2 RAID arrays.

While each tier can stand alone, doing so creates silos of different data and dramatically increases the complexity and cost. An example of the problem is that IT managers will often need to overbuild their Tier 1 storage because there is no time to manually move the data to cheaper tiers before it is needed again at the fastest tier.

To reduce the complexity, and optimize infrastructure costs, production houses are increasingly moving to active archive strategies to virtualize multiple classes of storage into a single fabric.

In an analog world, an archive is where old content goes to retire. In a digital world, all data is potentially valuable and needs to be rapidly available, protected and easy to manage. But all of that data does not need to be always sitting on the most expensive high performance disk.



Creating a virtualized storage fabric: The explosion of data volumes resulting from higher resolution workflows has lead to technologies that virtualize multiple tiers of data into an extended fabric. Active archive solutions reduce the cost of the overall storage infrastructure as well as the difficulties of managing multiple silos of different storage types

An active archive breaks down the barriers between different storage tiers, and in the process reduces the IT overhead required to manage all the data. An active archive updates into the digital age the entire definition of what an archive is. In an analog world, an archive is where data is shelved and off line. In a digital active archive, data is automatically housed in the most cost efficient tier. It enables all data to be always available in an 'online' state all the time without taking up expensive primary disk capacity.

In fact, when properly applied, an active archive strategy significantly reduces the overall storage and data management costs while at the same time increasing efficiencies and the ability of users to access all data.

SGI is a leader in active archive technology solutions. From DMF and StorHouse® software layers to virtualize multiple tiers of data, to fully integrated hardware solutions including platforms built with the latest Intel® Xeon® processors. SGI offers solutions that virtualize the different storage tiers across a wide fabric of choices, from performance to economical.

3.0 Conclusion

The tremendous increase in popularity of HD-resolution video has changed the face of the media industry in the last few years. The promise of 4K and UHD video are expected to captivate audiences and catapult the industry forward even further into an all digital media workflow. As media outlets and platforms proliferate, rich media libraries will expand exponentially and production facilities will need to re-tool their infrastructure to keep pace.

But the necessary upgrades will require new investments. By one estimate, it will cost postproduction houses 10% to 15% more to process 4K than 2K. Companies such as SGI are pioneering cutting-edge server technology to keep up with the changes, while hardware and software providers are busy developing the next wave of tools for shooting, editing and displaying ultra-high-resolution video content.

While it's likely that the cost of distributing and displaying 4K video content will set the pace for widespread adoption, for the vendors, content producers, and distributors supporting this new technology 4K is more than just hype, it is simply the next logical step for an industry constantly seeking greater resolution.

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