White Paper

Media and Entertainment Workloads

Why NetApp ONTAP?

Justin Parisi, NetApp
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Abstract

This white paper describes how media and entertainment workloads can benefit from using NetApp® ONTAP®.

NetApp®

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1 Introduction

When you're watching the latest blockbuster movie, you're usually too wrapped up in the story and imagery to think about how much work goes into every single frame, or how much storage capacity is required in creating these films.

For instance, did you know that something as tiny as a few strands of hair can eat up 50TB to 100TB of disk space for each rendering pass? Multiplied across multiple renders, that means potentially petabytes of capacity for a single shot.

A recent customer story featured DreamWorks Animation (makers of *Shrek, Kung Fu Panda,* and *How to Train Your Dragon,* among others).

In addition to the need for raw capacity, these media workloads also require a blend of performance, simplicity, resilience, and data protection. NetApp® ONTAP® offers all of these and more.

This paper describes how NetApp ONTAP can help you achieve world-class results for media and entertainment workloads.

2 Why Media and Entertainment Companies Use NetApp ONTAP

Some of the largest, most prominent media and entertainment companies choose NetApp ONTAP to store their data, for the reasons described in this section.

Trusted and Proven Data Integrity

NetApp ONTAP has been serving data to its customers for over 20 years. With various levels of data protection technologies, such as RAID DP® and RAID-TEC™, Snapshot™, SyncMirror®, SnapMirror®, and MetroCluster™ (to name a few), ONTAP delivers serious and reliable data integrity.

"Sleep Well at Night" Data Protection and Resiliency

ONTAP also provides solutions for backup, disaster recovery, archive, and cloud enablement to help storage administrators in all industries sleep well at night, knowing that NetApp has their back if something happens at a primary data center.

Data Flexibility and Consolidation

ONTAP offers a variety of ways for end users and applications to consume storage, across both file and block protocols. Whether you want to use NFS, CIFS/SMB, iSCSI, FCP, or NVME over Fibre Channel, ONTAP can make it work without needing to stand up multiple systems across a data center. Storage administrators can serve a variety of workloads on the same cluster without missing a beat.

Storage Efficiency

In storage, there is a "race to zero" for performance and latency, as well as for how much capacity is being used in a storage system. ONTAP offers a wide array of storage efficiency features to help push the usable capacity in a cluster as far as it can go by way of inline and postprocess deduplication, compression, and data compaction.

Enterprise-Class Performance

Every ONTAP release includes performance tweaks and enhancements to squeeze every last drop of performance out of a storage system, enabling storage administrators to boost performance simply by upgrading their ONTAP version. ONTAP upgrades are simple to perform, cost nothing, and are nondisruptive.

First-Class Support

NetApp support is consistently at or near the top of all storage vendor support rankings, year after year. In the rare event that something goes wrong in your environment, you can be assured that NetApp support has you covered.

Industry-Leading Cloud Enablement

NetApp's Data Fabric initiative is providing new and innovative ways to easily move customers in and out of the cloud to offer increased business flexibility. With Cloud Volumes ONTAP, Cloud Volumes ONTAP Services, FabricPool, CloudSync, CloudManager, SnapMirror, and various other NetApp technologies, you can leverage a true multicloud architecture with minimal risk exposure.

3 Media and Entertainment Workload Types

Although media and entertainment companies have traditional workloads, as any IT shop might have, some media-specific workload types have unique needs and profiles.

Nonlinear Video Editing

Nonlinear video editing is a method of providing nondestructive video editing, in which original files that are being edited are not overwritten; instead, software modifies and applies the edits in real time.

This type of workload requires a system that can handle long sequential reads and then low-latency writes, with I/O request sizes in the 64KB to 256KB range. The key to successful storage for these workloads is low latency with no "dropped frames" – meaning that each frame that is being edited has SIMPTE time-code accuracy.

Workloads like these have traditionally resided on NetApp E-Series storage systems, using third-party file systems like GPFS, CXFS, EditShare, and others (see TR-4604 for details). However, ONTAP systems running with the AFF personality are becoming a reality for these workloads. Details on performance testing with frametest can be found in section 6, "Performance Benchmarking (frametest)."

Rendering

Rendering is the process by which video software takes a collection of images or "shots" and produces a video file from those images. One minute of video can generate 1440 frames at 24 frames per second (fps). Therefore these workloads are generally very metadata intensive (GETATTR, SETATTR, ATIME, and so on).

Typically, render workloads can range between 60% and 80% metadata operations, with the rest being an even mix of reads and writes. These environments can generate hundreds of millions of files per movie (up to a petabyte of capacity in some cases), with the average file size being between 8KB and 32KB, and thousands of CPU cores may be thrown at these workloads to reduce the amount of time it takes to render a shot.

NAS and NFSv3 are traditionally preferred for these workloads, because of the low overhead of being a stateless protocol. Given the high file count, high metadata operations, large-capacity footprint, and a workload profile that is similar to the SPEC SFS® 2014 benchmark, ONTAP running NFSv3 to a FlexGroup volume makes good sense. Customers today are running renders on FlexGroup volumes using NFSv3 with great success.

Transcoding

Transcoding files is a process in which an uncompressed video file format is recast into compressed formats that are more suitable for broadcast across a network, such as TV, pay-per-view, and internet streaming services. A single video stream can transcode into as many as 20 smaller streams for final distribution. Common formats include MPEG-2, MPEG-4, and H.264.

Transcode I/O patterns involve large reads (64KB and larger), followed by CPU processing of those reads that become writes to output frames. These workloads are usually done in parallel, with multiple video streams feeding multiple transcoders to deliver multiple output formats. These I/O patterns appear as 100% random reads and writes.

Content Streaming

In content streaming, video repositories are accessed via multiple clients for playback. Depending on scale, using Ethernet-based NAS protocols can be a viable option for content streaming repositories.

ONTAP has numerous features that can make media and entertainment workloads vastly successful. Section 4, "How Media and Entertainment Companies Use NetApp ONTAP," describes these features in detail.

Other workloads that are specific to media and entertainment, such as content repositories, are fairly generic workload types that mimic some of the same requirements as other industry workloads of the same nature.

4 How Media and Entertainment Companies Use NetApp ONTAP

Media and entertainment companies leverage NetApp ONTAP for a multitude of workloads, including but not limited to:

- Home directories
- Virtualization
- General NAS file shares
- Finance applications
- Compliance data
- Backup and archive
- Rendering
- Video editing

With new workloads landing on storage systems running ONTAP every day, it's important to understand which features are being used the most in media and entertainment and how they help.

FlexVol Volumes

NetApp FlexVol® volumes are a virtualized file system construct that allows storage administrators to organize data into their own unique containers to help maintain multitenancy in a storage virtual machine. In media and entertainment environments, this feature can be used to separate users in home directory workloads, to separate departments in shared NAS workloads, or to separate render shots into their own buckets.

FlexVol volumes can also take their own Snapshot copies and replicate via their own SnapMirror relationships.

AFF

The NetApp AFF solution offers flash-optimized ONTAP that increases overall performance for media and entertainment environments. AFF systems deliver more IOPS and throughput than spinning disk systems, at lower overall latency. For media and entertainment workloads that require high throughput and low latency, AFF can solve a lot of problems.

Snapshot and SnapRestore

NetApp Snapshot copies have been a core competency of ONTAP for decades, providing fast and low-capacity read-only point-in-time restore points for datasets. A Snapshot copy creates a list of pointers to existing data in a volume and takes up space only if the source data is deleted. However, a Snapshot copy is only as good as its ability to restore, so ONTAP also provides SnapRestore® functionality.

Snapshot copies can be restored en masse, or files can be individually retrieved, either by end users (from the Previous Versions tab in Windows or .snapshot directories in *nix), or by storage administrators via the CLI.

For media and entertainment workloads, Snapshot copies can help protect against accidental deletion of shots, ransomware attacks, and other data-loss scenarios.

Note: Only FlexVol volumes can use single-file restore.

SnapMirror and SnapVault

Snapshot copies are great in a pinch, but if you're looking for true disaster recovery or backup and archive, ONTAP provides a native replication engine that to copy both data and Snapshot copies across a WAN to a secondary (and tertiary) data center, including data centers built with ONTAP Select or in the cloud.

SnapMirror offers an exact copy of data and Snapshot copies for disaster recovery and failover scenarios. SnapVault offers asynchronous copy retention, which provides a path for backup and archive, where the destination site keeps copies for a longer period than the source.

Media and entertainment companies can keep DR site copies to reduce downtime for rendering jobs in the event of a site outage. They can also retain archives of shots for as long as they like, in case shots need to be revisited after they've been deleted from a source storage system. Additionally, the ability to replicate into the cloud can help reduce storage management and maintenance costs.

SnapLock

NetApp SnapLock® is an iteration of SnapMirror that storage administrators can use to follow compliance laws and regulations for data retention by replicating data to a destination system and setting a clock that prevents deletions or overwrites of regulated data. Enterprise SnapLock allows the storage administrator to maintain and control the timer, while Compliance SnapLock sets a permanent timer that releases the data lock only when the timer expires.

For media and entertainment workloads, this feature can be most useful when used in conjunction with SnapLock append mode, which locks video files (such as surveillance video) and allows appends to those files, but does not allow overwrites of existing locked data.

FlexClone Volumes

NetApp FlexClone® volumes in ONTAP are replicas of volumes that are based on Snapshot copies. With FlexClone volumes, storage administrators can make an instant read-writable copy of data that does not endanger the original dataset. This makes it possible to create testbeds, data analysis repositories, and or backup verification volumes (among other use cases) without taking up additional storage capacity. FlexClone volumes can also be split into their own independent volumes.

FlexClone volumes also offer methods for media and entertainment workloads to create replicas of render sets to help offload processing across CPU threads and cluster nodes.

Quality of Service

Quality of service (QoS) in ONTAP allows storage administrators to apply policies to volumes, qtrees, or files that can either cap the number of IOPS or throughput on those objects or guarantee a minimum floor for number of IOPS and throughput to ensure that a workload gets the resources it needs.

Workloads such as content streaming can benefit greatly from QoS, by ensuring that a stream gets the amount of performance it requires to present the best possible video feed across a network.

Qtrees and Quotas

Qtrees and quotas are ways in which ONTAP helps with data management.

Qtrees are folders in FlexVol volumes that ONTAP is aware of. They can be used to create a logical separation of data in a volume, as well as provide a place to apply quota rules.

Quotas in ONTAP control the number of files or amount of capacity allowed in a file system. They can be applied at the user level or at the qtree level. By using quotas and qtrees, media and entertainment companies can control how much data is placed in a volume to help prevent storage overruns and exceeding departmental budgets.

Multiprotocol Data Access

Data access to NetApp ONTAP systems can occur via multiple methods in the same platform, whether it's file-based NAS (NFS/SMB) or block-based SAN (iSCSI/FCP). NetApp has been providing this functionality for more than 15 years and is a leader in the industry for both SAN and NAS storage.

In addition, ONTAP can provide multiprotocol NAS access (SMB and NFS) to the same datasets and can honor permissions across clients. This flexibility means that storage administrators can allow their end users to access data in the ways they're accustomed to.

For media and entertainment companies, this flexibility allows organizations such as art departments to access storage across the network, whether they're leveraging Windows, *nix, or Mac clients, and other departments can have their own storage buckets with access via entirely different types of clients. For example, if the HR department mostly uses Windows, then volumes can be configured solely for Windows access.

Storage Efficiencies

NetApp ONTAP offers a wide array of storage efficiency features to drive the overall cost of raw capacity down by shrinking the amount of usable capacity needed across volumes. The following subsections describe the ONTAP storage efficiency features.

Data compaction

Writes that are smaller than 4K are compacted into a single 4K block to save space. Without data compaction, writes that are smaller than 4K occupy their own 4K block, which can add up over the course of a workload.

Compression

Compression algorithms in ONTAP attempt to compress data that is currently uncompressed to reduce the amount of space that is used. Data that is already compressed (such as JPEG files) does not see savings from compression.

Deduplication

In a large storage system environment, duplicate files and blocks within a file system or aggregate are inevitable—for example, the corporate logo across hundreds of Microsoft Word documents. ONTAP

adjusts pointers to those data blocks to reduce the amount of physical space that is used by sharing blocks across the file system. With aggregate-level deduplication, that concept is extended across FlexVol volumes that reside in the same aggregate.

Thin provisioning

Although thin provisioning doesn't technically "save" space in a storage system, it does allow storage administrators to offer flexibility in the environment with the opportunity to overprovision physical hardware without having to reserve space in ONTAP for provisioned FlexVol volumes.

FabricPool

FabricPool, introduced in ONTAP 9.2, provides an S3 client in ONTAP to tier cold data blocks on AFF or systems tagged for data protection to a choice of cloud providers or to on-premises StorageGRID®. The pointers to the data reside on the ONTAP system, while the cold data capacity is moved to lower-cost systems to free up valuable flash real estate for hot, active workloads.

Note: TR-4476 covers storage efficiencies in ONTAP. TR-4598 covers FabricPool best practices.

Media and entertainment companies store a lot of data, so squeezing every last bit of space out of your storage system real estate is vital to maintaining a high return on investment in your ONTAP systems.

NetApp Volume Encryption

NetApp Volume Encryption (NVE) offers a method for encrypting a subset of data in a storage system without having to encrypt an entire HA pair. It also offers flexibility in what hardware can be leveraged, since NSE drives often lag behind other drives in total capacity and size available.

NVE encrypts at the volume level and also offers a way to securely purge individual files by cryptographically shredding the file by deleting the encryption key for that file.

For media and entertainment companies, protecting digital assets from theft and piracy can save millions of dollars in revenue. Encrypting data can help prevent unauthorized users from accessing those datasets.

TR-4569 covers Security Hardening in ONTAP.

FlexGroup Volumes

In ONTAP 9.1, a new scale-out NAS container was added for workloads that need a blend of capacity, performance, and simplicity that can leverage all nodes in an ONTAP cluster and maximize the overall CPU efficiency for workloads. The FlexGroup volume offers a way around the 100TB, 2 billion file limits of the FlexVol volume, while offering 2 to 6 times the performance for certain workloads.

A wide array of workloads in media and entertainment can take advantage of FlexGroup volumes, including but not limited to:

- Home directories
- Video editing and rendering
- Media repositories and libraries, such as water and hair effects for CGI
- Archive

For information about preliminary performance benchmarking of media workloads on FlexGroup volumes, see section 6, "

Performance Benchmarking (frametest) – FlexGroup Volumes"

For more detailed information about FlexGroup volumes, see TR-4557 and TR-4571.

FlexCache

FlexCache®, new in ONTAP 9.5, offers a way for storage administrators to create local read/write-through caches for clients to improve performance across a WAN or prevent performance impact to a primary cluster from a mount storm.

In media and entertainment workloads, FlexCache can be used for content distribution, such as when multiple render farms across remote locations need to leverage the same content repositories and require high performance across a WAN.

See TR-4743 for full information about FlexCache.

5 DreamWorks: The Power of Data

NetApp recently presented a customer case study with one of the largest media and entertainment companies in the world – DreamWorks Animation. That case study revealed that DreamWorks has built a number of their top-grossing animated features on NetApp storage, including *Shrek, Madagascar, Trolls, Kung Fu Panda,* and *How to Train Your Dragon*. These animated feature films require a large amount of time, processing power, and storage capacity. Tight deadlines, driven by release dates, are a given.

DreamWorks' most recent film, *How to Train Your Dragon: The Hidden World,* was one of the most intricately rendered to date. Here are some technical details about that film:

- The film is comprised of about 190 million files utilizing an estimated 730TB of data
- A single sequence used about 80TB
- The film contains 134,282 frames
- The film required more than 150 million core render hours
- The studio dedicated more than half (25,000) of its 54,000 core render farm to the film
- Nearly 13% of total render units were rendered using private cloud. During peak renders, the studio hit 97,445 render units in one day
- At peak times, throughput ranges from 6 to 12Gbytes/sec and up to 400,000 NFS ops/sec

Training All the Dragons

How to Train Your Dragon: The Hidden World features a total of about 60,000 dragons, with 1,500 dragons seen in a single shot. In addition, there are about 1,100 humans and numerous other assets, including.

- 1,097 unique items in a blacksmith's shop
- 756 nails in Hiccup's house
- More than 2,000 unique character pieces (hair, clothing, other character assets)
- 3,620 dragon scales on Hiccup's dragon suit
- More than 3,000 waterfalls (15 unique), with 639 in a single shot
- More than 63 million mushrooms and 79 million pieces of coral

DreamWorks' NetApp Environment

DreamWorks uses a mix of FAS and AFF controllers in their environment, as well as NetApp Flash Pool™ aggregates for caching. By employing a blend of hybrid aggregates, DreamWorks has extended the capability of its HDD investment with increased performance. DreamWorks is heavily invested in NetApp ONTAP storage – so much so that they've put third-party disk arrays behind NetApp ONTAP storage by using NetApp FlexArray® storage virtualization software.

Key ONTAP features that DreamWorks relies on for their render workloads include:

- Nondisruptive volume move (to shift workloads around within a cluster to less-used nodes without needing to take an outage)
- Snapshot copies and SnapVault® software (for backups and archive)
- FlexGroup volumes (for high performance and high capacity)
- Flash Pool (to maximize storage and HDD investment with a hybrid aggregate approach)
- Quality of service (to detect and contain "bad actors" and misconfigured render jobs)

DreamWorks runs a variety of workloads on NetApp ONTAP, including render farms, file-based content creation, software development for content creation applications, and pipelines for container-based microservices.

Their environment is mostly NFS, with a 90%/10% split of NFS and SMB for interactive user workloads. The render farm is 95% NFS. All DreamWorks Animation productions run on NetApp storage, for both film and TV.

Storage Efficiencies

DreamWorks has chosen to use a hybrid aggregate approach to their workloads to help maximize return on investment of their disks. But they're also saving resources on the back end with ONTAP storage efficiencies.

Across three of their ONTAP clusters, they're seeing total effective efficiencies of 13.5:1, 18.5:1, and a whopping 57.1:1 – just by enabling the storage efficiency features in ONTAP, such as deduplication and data compaction at no additional cost.

Why DreamWorks Chose NetApp

DreamWorks uses NetApp because we provide the best blend of data integrity, reliability (100% uptime at DreamWorks, even during upgrades and head swaps), multiprotocol NAS, data protection, and performance for the day-to-day operations of a demanding, fast-paced media and entertainment business.

6 Performance Benchmarking (frametest) – FlexGroup Volumes

When FlexGroup volumes were introduced in ONTAP 9.1, they provided the potential for petabytes of capacity in a single namespace, while overcoming the performance limitations of being isolated on a single node in an ONTAP cluster. Naturally, media and entertainment workloads immediately came to mind as a use for this new container.

To instill confidence in these workloads being placed on FlexGroup volumes in ONTAP, we commissioned our performance testing team at NetApp to conduct some simple benchmark tests with the industry-standard frametest software.

Testing Environment

The video performance testing environment consisted of the following setup in NetApp's Customer Proof of Concept (CPOC) lab:

- 2-node AFF A700 cluster running ONTAP 9.5
- NFSv3 to a single NetApp FlexGroup volume
- Storage efficiencies disabled
- 4 data LIFs on 40GbE links
- 1MB TCP transfer size
- 9000 MTU (jumbo frames)

- 4 Linux servers running RHEL 7.4 with 128GB RAM
- Intel Xeon E5-2670 @ 2.30 GHz (2 sockets, 12 cores per socket, 2 threads per core)
- Single NFS mount per client – 1MB wsize, rsize options
- Frametest software; 16 threads, 24fps

Performance Results

In the frametest benchmark, we gathered performance numbers for throughput, as well as for number of frames dropped in a 4K video workload across clients. The benchmark simulated video ingest (writes) at ~24fps 4K uncompressed and video playback (reads) at ~24fps. The TCP transfer size and NFS wsize/rsize options were set to 1MB, because we can get better performance with streaming workloads of larger files with a larger allowed transfer size.

For writes, the best results were seen with a single client pushing 1GB/s at 24fps with just 9 dropped frames. When we pushed the writes to 4 simultaneous clients, the best frame rate with no drops was around 14fps. That same client was able to push to 30fps with around 650 dropped frames.

Table 1) Performance results (writes)—frametest.

Number of clients	Frames per second (dropped)	Throughput MB/s
1	24 (9)	1167.4
1	30 (652)	1167.2

Read tests (video playback) fared better overall, with less than 1% dropped frames at 24fps for 4 clients across the board. Each client was able to push 1GB/s to the storage, for a total throughput of 4GB/s. At 30fps, two clients (running 8 threads each) were able to push 2.9GB/s to the storage with zero dropped frames.

Table 2) Performance results (reads)—frametest.

Number of clients	Frames per second (dropped)	Throughput MB/s
4	24 (4)	4671.1
2	30 (0)	2919.7

The command options for the read tests were:

```
-r -z49856 n100000 f[n]
```

For full information about frametest options, see How to use frametest.

NetApp will be fine-tuning and running more media workload tests (such as 8K video streams) in the future to try to push the needle even further.

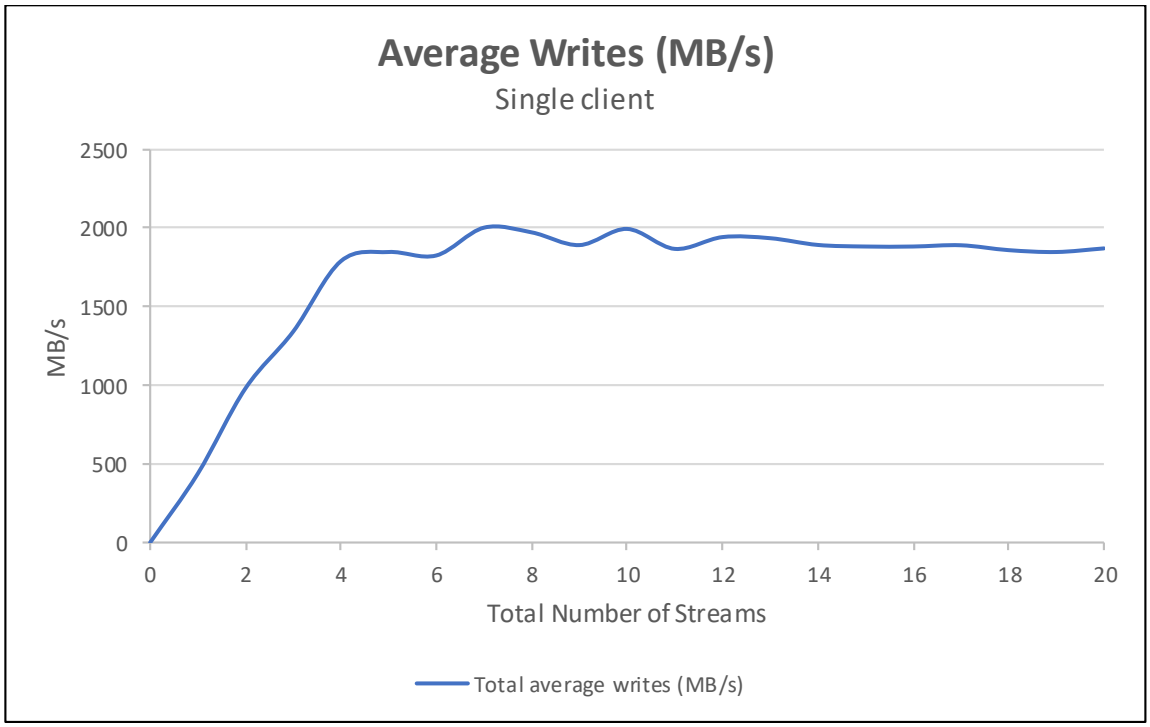
Other Testing Results

A NetApp partner also ran a similar benchmark test on an AFF A800 cluster and was able to achieve 7.9GB/s throughput for reads across 4 clients, while maxing out at 2GB/s for writes across a single client. The following graphs show those results.

Video ingest (writes) results

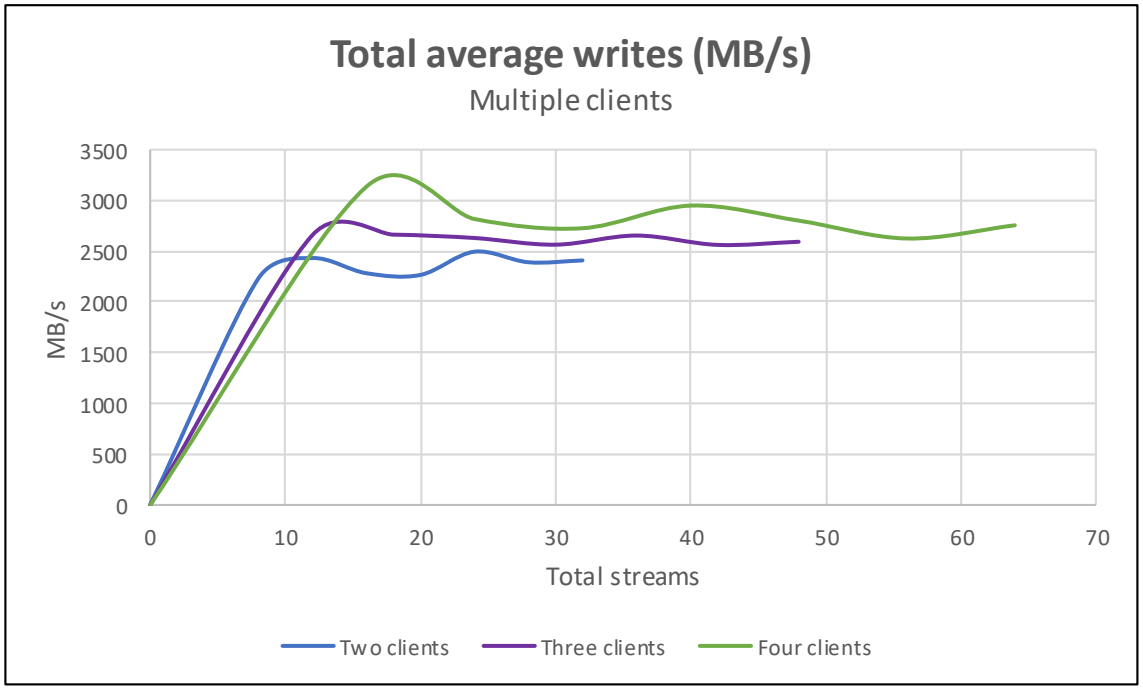
In the first graph, Figure 2, we focused on video ingest for a single client. This graph shows the total average writes in MB/s, as well as the number of streams used on the client. Once we have 4 streams, the throughput stays steady at ~1.8 to 2GB/s.

Figure 1) Average writes, single client.



When we added more systems to the workload (Figure 3), we were able to push across more GB/s. The sweet spot for this workload appears to be 4 clients with 4 streams each (16 streams total). This achieved ~3.1GB/s, and the overall workload seems to hold steady at just under ~2.8GB/s for total average writes, regardless of the number of clients. It also shows that adding more clients to a FlexGroup workload can offer more scale for performance.

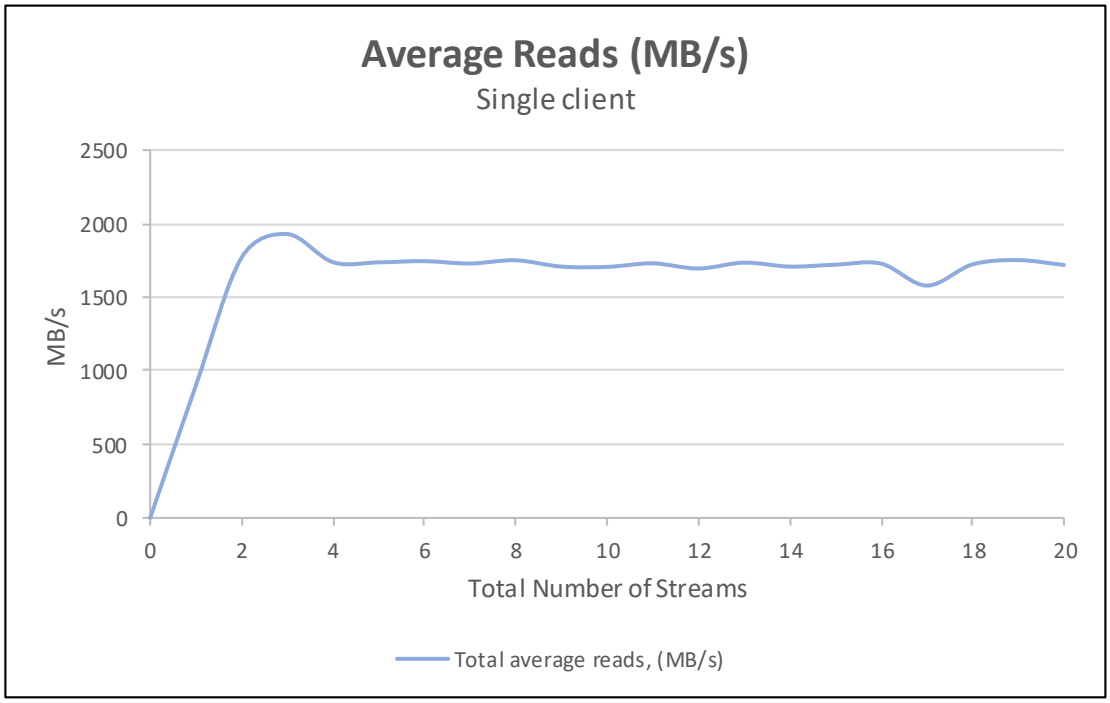
Figure 2) Average writes, multiple clients.



Video playback (reads) results

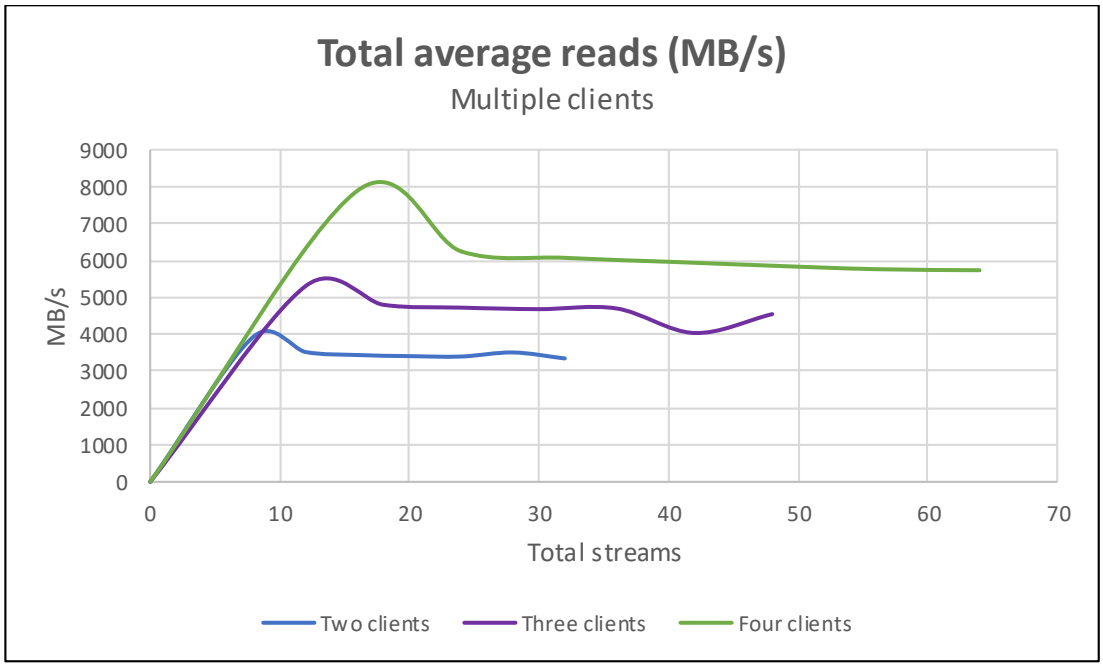
In the next graph, Figure 4, we focused on video playback for a single client. This graph shows the total average reads in MB/s, as well as the number of streams used on the client. Once we have 4 streams, the throughput peaks at ~1.9GB/s and then stays steady at ~1.7 GB/s.

Figure 3) Average reads, single client.



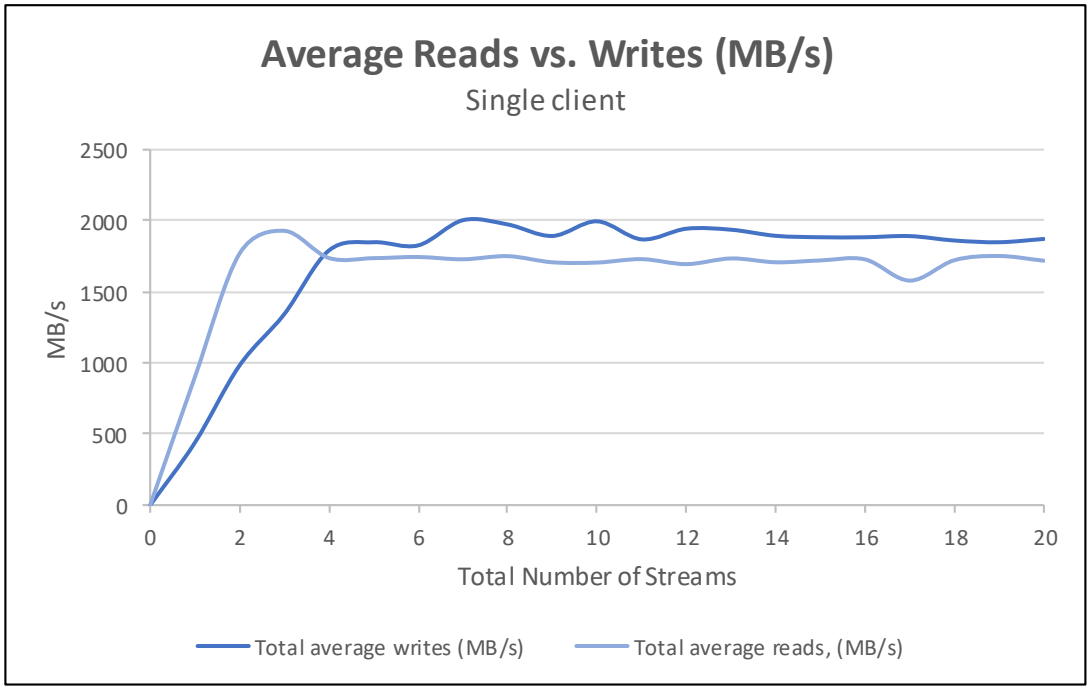
For reads/video playback with multiple clients (Figure 5), we were able to push the cluster much further. At the workload's peak, we saw ~7.9GB/s read performance across 4 clients pushing 4 threads each (16 total). The overall read workload was fairly steady at ~6GB/s with 4 clients.

Figure 4) Average reads, multiple clients.



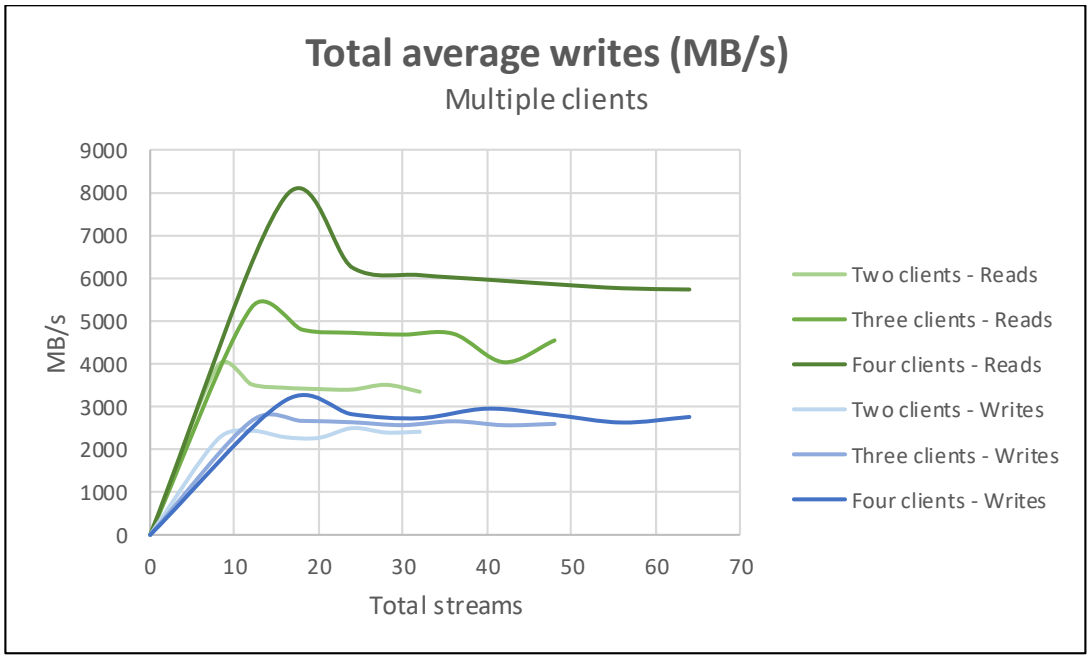
When stacking up the reads versus writes, these workloads show that reads slightly outperform writes overall on a single-client test (Figure 6).

Figure 5) Average reads versus writes, single client.



With multiple clients, reads significantly outperform writes (Figure 7).

Figure 6) Average reads versus writes, multiple clients.



7 Other Media Use Cases

Media workloads are not always movies and video – sometimes they're audio files or computer games. In fact, NetApp's very own Tech ONTAP® Podcast leverages FlexGroup volumes over NFSv3 for recording episodes in real time.

Tech ONTAP Podcast on FlexGroup

The Tech ONTAP Podcast is NetApp's weekly podcast on a variety of topics, including the latest innovations in NetApp ONTAP software. You can find the podcast at techontappodcast.com and subscribe to it via iTunes or SoundCloud.

The podcast uses Audio Hijack to record the audio on a Mac running NFSv3 to an AFF A8040 operating with the latest ONTAP release. There has never been an issue with the audio quality or any sort of outages. Here's a brief writeup I did on how we leveraged NFS on the Mac:

Tech ONTAP Podcast: Now powered by NetApp FlexGroup volumes!

Technical Details – Tech ONTAP on FlexGroup

The FlexGroup itself is 10TB total, with 8 member volumes spread across 2 nodes. The footprint is small – we've only written 56GB total across the FlexGroup, which has around 9,500 total inodes used. But the load is spread fairly evenly across the member volumes.

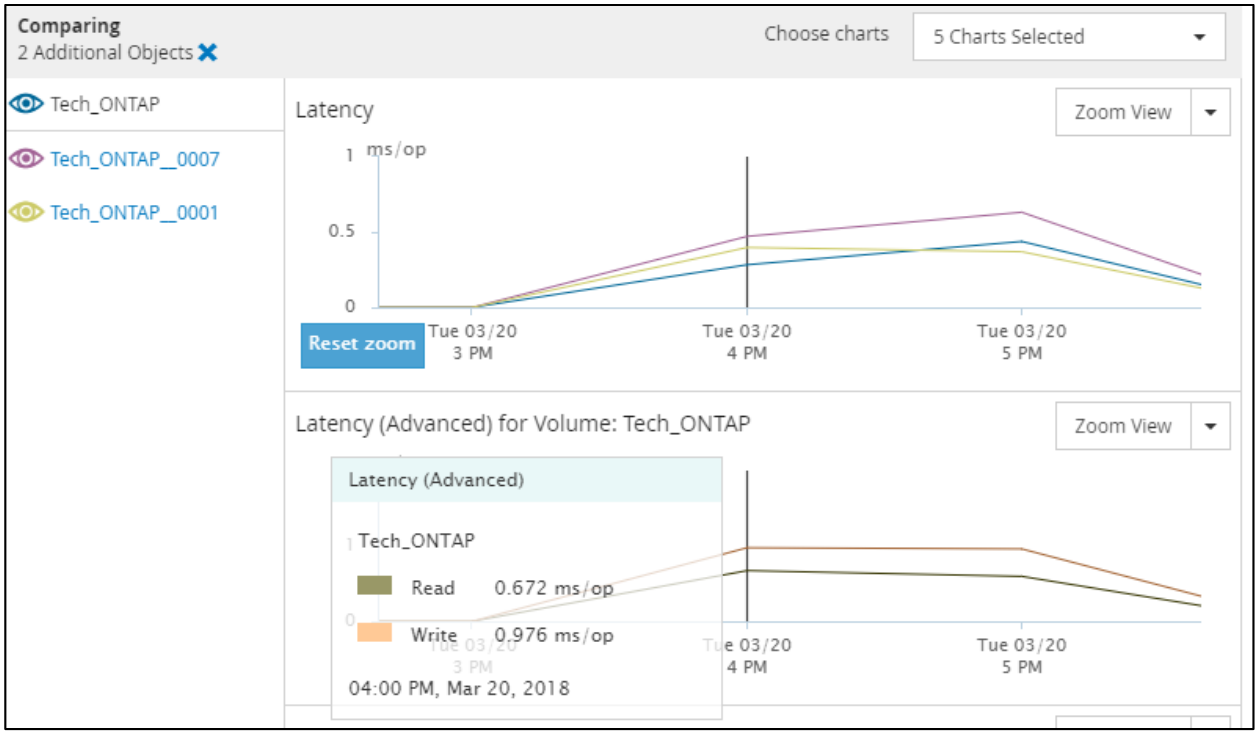
```
cluster::*> volume show -vserver DEMO -volume Tech_ONTAP* -fields used
vserver volume     used
------- ---------- -------
DEMO    Tech_ONTAP 56.61GB
DEMO    Tech_ONTAP__0001
                   7.01GB
DEMO    Tech_ONTAP__0002
                   9.96GB
DEMO    Tech_ONTAP__0003
                   6.27GB
DEMO    Tech_ONTAP__0004
                   6.51GB
DEMO    Tech_ONTAP__0005
                   6.97GB
DEMO    Tech_ONTAP__0006
                   6.56GB
DEMO    Tech_ONTAP__0007
                   6.26GB
DEMO    Tech_ONTAP__0008
                   7.06GB

cluster::*> df -i Tech_ONTAP
Filesystem               iused      ifree  %iused  Mounted on                 Vserver
/vol/Tech_ONTAP/          9455  169999553      0%  /techontap                 DEMO
```

An AFF system with FlexGroup volumes is probably overkill here, but I like to use the stuff I promote.

When an episode is recorded, it streams at less than 1MBps, with submillisecond latency (which is more important to the integrity of the audio file). This stream aggregates three separate recording threads – one for the microphones, one for an application (for remote call-ins), and one for our soundboard, which plays the theme songs and various other sound effects that we may add during the recording.

The peak latency seen was .631 ms, with peak write latency at around .972 ms.

Figure 8) FlexGroup latency during Tech ONTAP podcast recording.



Video Game Rendering

Another use case that media customers use FlexGroup volumes for is rendering for video games. The workload type is very similar to rendering for movies – lots of small files, low-latency requirements, and – most importantly – lowered completion times for jobs.

In environments like these, a storage system must be able to deliver high-end performance, with the ability to manage inode/file counts effectively and handle metadata operations efficiently. Because of these requirements, FlexGroup volumes in ONTAP are rapidly becoming the storage container of choice for these workloads.

NetApp has a number of customers across multiple media and entertainment silos that are using – and loving – FlexGroup volumes today.

Conclusion

The NetApp ONTAP rich and expansive feature set, data flexibility, superior performance, enterprise-class data protection, and cloud-ready architecture make it a perfect fit for media and entertainment workloads. Given that some of the largest media and entertainment companies in the world (such as DreamWorks Animation) use it – and love it –cements the reputation of ONTAP in this space.

Where to Find Additional Information

- TR-4211: Storage Performance Primer
  www.netapp.com/us/media/tr-4211.pdf
- TR-4476: NetApp Data Compression, Deduplication, and Data Compaction
  www.netapp.com/us/media/tr-4476.pdf
- TR-4557: NetApp FlexGroup Volume Technical Overview
  www.netapp.com/us/media/tr-4557.pdf
- TR-4569: Security Hardening Guide for NetApp ONTAP 9
  www.netapp.com/us/media/tr-4569.pdf
- TR-4571: NetApp FlexGroup Volume Best Practice Guide
  www.netapp.com/us/media/tr-4571.pdf
- TR-4598: FabricPool Best Practices in ONTAP 9
  www.netapp.com/us/media/tr-4598.pdf
- TR-4678: Data Protection and Backup – FlexGroup Volumes
  www.netapp.com/us/media/tr-4678.pdf
- TR-4743: FlexCache in ONTAP
  www.netapp.com/us/media/tr-4743.pdf
- ONTAP 9.5 Lightboard Video
  www.youtube.com/watch?v=zHJtjK6Ewvo
- FabricPool Lightboard Video
  www.youtube.com/watch?v=RF_qh9LEjzo
- FlexGroup Lightboard Video
  www.youtube.com/watch?v=Wp6jEd4VkgI
- Clustered Data ONTAP for Media and Your Business
  www.netapp.com/us/media/ds-3454.pdf
- NetApp FlexGroup Volumes: An Evolution of NAS
  blog.netapp.com/blogs/netapp-flexgroup-volumes-an-evolution-of-nas
- The Benefits of Using FlexGroup Volumes for Backup Repositories
  blog.netapp.com/the-benefits-of-using-flexgroup-volumes-for-backup-repositories/
- Keep on Scalin': How FlexGroup Volumes Scale Out Performance
  blog.netapp.com/keep-on-scalin-how-flexgroup-volumes-scale-out-performance/
- NetApp Product Documentation
  https://docs.netapp.com
- NetApp Tech ONTAP Podcast
  techontappodcast.com

Version History

Version	Date	Document Version History
Version 1.0	April 2019	Initial release

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.