TCO REPORT

Tape vs. Object Storage

Economic Advantages of Object Storage
vs. LTO for Media Active Archives

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Executive Summary

We are living in an age of explosive data growth. IDC projects that the digital universe is growing 50% a year, doubling in size every 2 years. In media and entertainment, the growth is even faster as capacity-intensive formats such as 4K, 8K, and 360/VR gain traction. Fortunately, new trends in data storage are making it easier to stay ahead of the curve.

Historically, many studios and broadcasters have relied on LTO tape as the most economical option for long-term media archiving and backup — but that is beginning to change. The increasing costs of maintaining and expanding aging tape libraries are prompting many businesses to explore other options. At the same, the costs of more modern and flexible solutions like object storage now make them a cost-effective alternative to LTO tape.

In this paper, we will examine how object storage stacks up against LTO tape for media archives and backup. In addition to a detailed total cost of ownership (TCO) analysis covering both capital and operational expenses, this paper will look at the opportunity costs of not leveraging the real-time data access of object storage to monetize existing data.

Finally, we will demonstrate the validity of the analysis with a real-world case study of a longstanding network TV show that made the switch from tape to object storage.

The limitations of tape storage go way beyond its lack of scalability. Data that isn't searchable is becoming a tangible liability for businesses, and one that will only become larger with advances in AI and machine learning.

KEY TAKEAWAYS

- 10-year TCO for object storage is 47% less than tape
- Tape management costs play a significant role in overall TCO
- Scalability of object storage is essential to meet growing capacity demand
- Integrated data protection capabilities of object storage reduce downtime
- Rich metadata, embedded in objects, improves search capabilities and enables future AI-powered search enhancements

Trends in Media Storage

It's not uncommon for businesses to see the amount of media they are generating to grow in excess of 50% a year. And it's not going to let up. IDC predicts that by 2020, the digital universe of data will increase a thousandfold to 44 zettabytes of data.

Fortunately, this data deluge has created positive ripple effects in the development of new technologies and solutions to help organizations better manage their media — and make it available at a moment's notice — at a cost that is comparable to or less than tape.

Evolving cost comparison: tape vs. disk

This paradigm shift in how organizations store media is being driven by several factors. First, maintaining older archival technologies like LTO tape becomes increasingly expensive — and time consuming — as archives expand.

Second, the cost of alternatives, such as petabyte-scalable disk-based storage, are decreasing. New storage architectures are driving down costs by leveraging the economics of industry-standard servers and inexpensive commodity hard drives.

Third, new software solutions now make it simple to combine multiple high-capacity servers into a single, easily-managed storage system with limitlessly scalable capacity. This reverses the traditional economics of disk storage where increased scalability historically drove higher cost per capacity.

Real time search and retrieval brings significant value

Beyond cost, object storage also offers the advantages of rapid search and real-time access for media monetization. The ability to instantly search on specific attributes — such as date, media type, contents, or description — and then instantly retrieve assets has the potential to significantly increase the archive's value.

In the near future, this value will rapidly increase as emerging technologies such as artificial intelligence create new options to analyze media, scanning images and audio for specific attributes. New tools will enable analysis such as facial recognition, speech recognition, and action analysis, creating new avenues re-purposing and monetizing stored media.

With these capabilities, archives become an asset that continuously contributes to the bottom line, rather than simply consuming overhead.

Comparing attributes: tape vs object storage

Despite the advantages of object storage for backup and archive, 49% of companies still rely on tape storage. This attachment to tape is usually driven by the following two factors:

1. The misconception that LTO tape is cheaper than other solutions
2. A reluctance to update legacy processes and IT environments

Before we examine the TCO of using object storage in an on-premises private cloud versus traditional LTO tape, let's first look at these two solutions more closely.

[1] IDC, "The Digital Universe of Opportunities," April 2014

Comparing Storage Technologies

	OBJECT STORAGE	LTO TAPE
Data Access	<0.01 second	1 minute to multiple hours, depending on tape location and library workload
Scalability	Dynamically add capacity by adding nodes. Single system can span multiple locations.	Add capacity with additional tapes. Rapid access limited to those in library.
Searchability	Yes. Embedded metadata can be searched with Google-like tools	Search via media asset manager database
Geo-Distribution	Easily shared across regions	Limited to physical copies
Management Workload	Low. Cloud-like management. No manual intervention. Metric: Single FTE for multi-petabytes	High. Significant manual intervention. Metric: 4 FTEs for multi-petabytes
Data Recovery	Self-healing media, integrated data protection. Included software enables replication to public cloud, if desired.	Manual processes, logistics and tape handling
Data Durability	Erasure coding, 14-nines data durability, distributed across multiple sites	Two copies
Equipment / Media Refresh	Nodes typically refreshed every five years; transparent, background process with minimal management	Media refreshed every two to five years. Drives replaced every four to six years. Significant manual intervention.
Future-proofing	S3 objects are an industry standard. Accessed via standard HTTP interface. Easily migrated to other S3 systems.	Limited backward compatibility. Requires regular data migrations to updated tape formats.
Artificial Intelligence Readiness	Numerous AI vendors developing tools that support the S3 interface. Embedded metadata easily enriched.	None

Increasing Limitations of Tape Storage

Magnetic tape data storage has been around since the 1960s, and today's LTO tape storage technology is an evolution of the original introduced by IBM, HP, and Seagate nearly 20 years ago. At the time, LTO tape was a state-of-the-art solution for long-term storage and backup, but a lot has changed since that first 100GB tape cartridge was produced in 2000. Today, many companies are switching from LTO tape due to the costs of maintaining and expanding their libraries, including challenges around media life, data integrity, and access.

Limited Media Life

Roughly every two to three years, the LTO Tape consortium has released a new generation of the technology, offering expanded capacity. Introduced in 2015, LTO-7 is the current generation, which means the release of LTO-8 is expected by 2018 at the latest. While this all sounds like progress, the existence of so many generations of the technology introduces significant challenges in terms of maintenance and upgrades.

One major limitation of LTO Tape is that these systems can only read back two generations. That means a company running LTO-7 cannot read LTO-4 or older tapes. Older tapes must be read and re-written in the newer format, a process that can take several months in large environments.

But the length of the upgrade process is not only a nuisance; it actually affects an organization's ability to leverage data in other more critical operations. That's because the reading and rewriting of old tapes during the upgrade process occupies high-performance disk space. So during a multi-month upgrade process, a company has to actively deal with resource contention and increased operational overhead.

Delayed Access

LTO tape was designed for long-term storage of static data without much consideration for easy access, searchability, or retrieval. In the best case, accessing an asset may take a minute or two. If the library has other jobs queued up, that time may stretch to many minutes or hours. And that assumes that the tape is actually in the library, is readable, and does not jam.

But these delays are irrelevant if you can't even find the data you need. Because LTO tape files lack rich metadata, it's impossible to search for the files you need based on a wide range of information. If you're trying to locate a file based on data that's not captured in your MAM system, there is no way to conduct an ad hoc search. As more and more companies look to monetize media using artificial intelligence and machine learning, there will be added pressure to replace LTO tape storage with more agile and flexible backup technologies that make it possible to access and update metadata of stored media on the fly.

Labor-Intensive Maintenance

Maintaining an LTO tape library is a labor-intensive proposition. Significant mechanical complexity makes it expensive to maintain and scale. Adding capacity can be painful if all library slots are full. Conversely, removing expired files is also a lot of work. When an asset expires, IT must import the tape to delete the file, which makes reclaiming storage space operationally time consuming.

Once the data is on LTO tape, most organizations rely on regular health checks to ensure data integrity. This ongoing process requires IT to restore the data, run checksums, and re-archive. And if the health check uncovers a problem with the data, the often clunky and slow software interfaces of tape libraries make it very difficult to identify failures and errors. As a result, specialized IT staff is required to track down the problem, who must act fast to avoid sync issues with the archive platform.

All of these maintenance challenges are further exacerbated by the lack of any type of central management. As a result, any type of failure requires IT to debug three major subsystems— the tape library, the archive management platform, and the media asset management (MAM) platform.

When looking at LTO tape for backup and archive, any one of these issues — limited media life, delayed access, and labor-intensive maintenance — would be enough to prompt organizations to look for a better solution. However, taken together, the use of LTO tape is pushing many IT departments within data-intensive organizations to the breaking point.

The Rise of Object Storage

Fortunately, the inherent limitations of LTO tape have helped spawn new storage technologies that address the need for economical, scalable, and highly durable active archival systems.

Among the new technologies, object storage has quickly set itself apart as an extremely scalable, flexible, and cost-effective technology. By storing files as objects in a flat structure with embedded metadata, object storage offers infinite scalability, real-time searchability, rapid data retrieval, and lower management costs.

Cloud storage technology, now available in the datacenter

These features made object storage technology the obvious choice for cloud storage, and it was quickly adopted by Amazon, Google, and Microsoft to power their public clouds. All online video platforms, including Netflix, YouTube, and Amazon Prime, are built on object storage. This same technology, and its availability and management simplicity is now available on-premises.

"S3": A storage service and a storage protocol

Amazon's storage service, named "S3", has risen to dominance in the cloud storage market. Confusingly, the term "S3" has a second meaning: it also refers to the protocol used to communicate with the "S3" storage service.

The S3 protocol has become the de facto standard for communication with object storage, just as NFS and CIFS/SMB are the standards for file storage. With the vast number of solutions leveraging this protocol, Cloudian entered the market to offer companies the benefits of S3-compatible object storage in an on-premises private cloud environment. This allows companies to capitalize on the scalability and cost benefits of object storage in their own data center.

Object Storage addresses the limitations of tape

Whether in the public or private cloud, object storage addresses the limitations of LTO tape. As companies look to increase the capacity of their storage, as well as the frequency with which they access it, object storage checks off all the right boxes in terms of data durability, availability, performance, and accessibility.

Key Attributes of Object Storage

LIMITLESS CAPACITY

With traditional network storage, the structure is usually arranged in hierarchies that have practical limits, typically in the range of 1 petabyte of capacity per system. In the age of 4K and 8K formats, that limit can be exceeded with just a few hundred hours of media. Object storage has no hierarchy and therefore eliminates these limits. The system can grow to whatever size is needed, and can accomplish this growth in cost-effective increments and with little or no downtime.

HIGH DATA DURABILITY

Object storage systems enhance data durability with a technology called "erasure coding" which distributes information across multiple servers, or "nodes". Depending on the configuration, data is protected from the failure of a single node, or even multiple nodes. If those nodes are distributed across multiple sites, the data can even be protected from an entire site failure. Using these techniques, the likelihood of data loss can be reduced to an infinitesimally small probability.

SELF-DESCRIBING MEDIA

Object storage integrates rich metadata to label (or "tag") assets. Tagging assets with complete descriptions (such as title, scene, subject, performers, or whatever else will be helpful in future searches) makes it easier to access that data in the future. Media can then be searched using a Google-like search tool, wherever the asset is located.

70% LESS COST

Because object storage is built on non-proprietary industry-standard servers, it costs much less than traditional enterprise storage systems, often as much as 70% less. Most enterprise network storage systems employ complex architectures and costly add-on software to achieve high reliability and enterprise functionality, . Object storage uses conventional server technology and software that includes sophisticated data management tools.

Why Object Storage?

- Infinite scalability
- Real-time access
- Better recovery
- Searchability
- Interoperability
- Lower admin costs
- Future proof

CASE STUDY

LTO Tape Storage vs. Cloudian Object Storage — 47% Savings

When evaluating the impact of switching from LTO tape storage to object storage, it's important to examine the total cost of ownership (TCO) over a set period of time.

In this section, we will present a hypothetical deployment scenario for an organization with 10 petabytes of media. The comparison will be between storing the media on LTO 6 tapes and Cloudian object storage.

In this scenario, the organization has a 2-copy policy for tape storage, which makes its storage requirement 20 petabytes for tape. The default scenario assumptions are summarized in Table 1.

Scenario Parameters	Value
Analysis Time Horizon	10 years
Media Requiring Storage	10 PB
Total Initial Tape Storage Requirement	20 PB (2 tape copies)
Total Initial Object Storage Requirement	10 PB (usable capacity with erasure coding, 14-nines data durability, distributed across multiple sites for DR)
Data Transfer Rate	11 TB of media transferred to/from archive per day

Table 1. Scenario media assumptions for LTO storage vs. Cloudian object storage

Now that the amount of media has been established, we need to look at the hardware and datacenter requirements for each technology.

LTO tape requires a much larger datacenter footprint, as well as robots to add and remove LTO tapes from the slots. Cloudian object storage runs on disk, which has a smaller footprint but does incurs higher datacenter power and cooling costs. Table 2 lays outlines the physical footprint of using these two technologies.

LTO Tape	Cloudian Object Storage
10,000 Slot Library (20 LTO 6 Drives)	25 HSA4010 appliances in distributed EC configuration
350 sq ft Datacenter with 4 Robots	100 sq ft of datacenter
8 Servers on Fiber Channel Hosting the Archive Platform	NA
300 TB of High Speed Disk Storage to Service Tape Flows	NA

Table 2. Scenario datacenter assumptions for LTO tape and Cloudian object storage

Capital Expense Analysis

Using the assumptions outlined in Tables 1 and 2, we can now estimate the TCO of ownership for using the two technologies over a period of 10 years. First we will look at the capital expenditures required for running these technologies over the 10-year time horizon. In Table 3, we detail the hardware, software, and real-estate costs associated with each approach.

Capital Expenditure	Cloudian Object Storage	LTO Tape
Hardware (with Support contract)	$4,500,000	$4,964,000
Staging Storage (Nearline disk)	NA	$425,000
Software	Included in hardware	$2,100,000 (archive mgmt. SW)
Media	Included in hardware	$2,500,000
Technology / Media Refresh	$2,000,000	$1,000,000
Support (balance of 10 years)	$660,953	$913,165
Real Estate	$168,000	$588,000
Power and Cooling	$1,075,200	$460,800
Offsite Storage (Base SLA)	NA	$42,000
Capex Total	$8,404,153	$12,992,965
35% Savings for Cloudian	**$4,588,812**	

Table 3. Scenario TCO for capital expenditures

After accounting for all the capital expenditure costs, Cloudian object storage offers a 35% savings over LTO tape, amounting to more than $4.5 million over 10 years. When calculating the hardware costs, this analysis factors in the need to buy the full storage capacity upfront, as well as the staging storage that LTO requires to conduct read-and-write activities without impacting MAM workflows. There are no staging costs for object storage, as this disk-based solution is able to meet performance SLAs without additional storage.

It turns out that the cost of software and media contribute significantly to the cost savings equation. LTO tape requires the purchase of additional software to manage the archive platform. LTO also requires the procurement of tape media, both for the original capacity and replacement tapes for the format refresh every 5 to 7 years. For object storage, a full hardware refresh is assumed after 5 years. Because this refresh can be performed as a background task, the task is non-disruptive. In terms of support, Cloudian again comes out ahead at two-thirds the cost of the support required to manage LTO tape.

The datacenter expenses provided a slight advantage to LTO tape, as the power and cooling costs are nearly double for Cloudian object storage. However, this edge is nearly eliminated with Cloudian's lower real estate costs and elimination of offsite storage expenses.

The table clearly debunks the myth that capital costs of running LTO tape are cheaper than object storage running on disk. The organization in this scenario would save 35% in capital expenditures, as well as reduced operational costs.

Operating Expense Analysis

As a technology, LTO tape incurs operating costs that are significantly higher than object storage. In the table below, you will see how the LTO tape compares to object storage in terms of the cost of daily operation, maintenance, data recovery, and data access.

Operating Expense	Object	Tape
Daily Ops & Maintenance (Includes Planned Downtime)	$1,000,000 (1 FTE over 10 years)	$4,000,000 (4 FTEs over 10 years)
Data Recovery Cost (Downtime)	NA	$500,000
Data Access Cost (SLAs)	NA	$250,000
Opex Total	**$1,000,000**	**$4,750,000**
79% Savings for Cloudian	**$3,750,000**	

Table 4. Cloudian achieves a 79% savings in operating expenses vs tape

When calculating the costs of daily operations and maintenance, this analysis looks at the number of full-time employees (FTE) required, at a cost of $100K/year each. The very nature of LTO tape makes it prone to higher operational costs. A study performed at the San Diego Supercomputing Center found that maintaining a 5 PB tape environment required three FTEs.

Running health checks, deleting files, replacing tapes, expanding tapes, performing ongoing maintenance, and other management tasks all cause LTO to require significant staff. Loss of media access due to tape errors that require recovery also increase the operational costs. Not only does this scenario require a half FTE to debug, fix, refresh media, and perform other maintenance, all of these actions introduce downtime, which adds to the fiscal impact to the business.

LTO tape also requires a one-quarter FTE to maintain data access through the retrieval and loading of tapes. For this analysis we assumed a 10 PB environment would require a total of four FTEs.

Object storage, by comparsion, requires little maintenance.

- The entire cluster is maintained within a single management environment
- Media is self-healing
- Component failures are gracefully accommodated via built in redundancy, eliminating the need for emergency response
- Phone home support provides the option for remote monitoring
- On-site support services minimize staff workload

These factors combine to allow even multi-PB environments to be administered by a single FTE, compared with four FTEs for the tape environment. The end result is a 79% savings in operational expenses for using Cloudian object storage instead of LTO tape.

TCO Summary

When the capex and opex costs are combined, Cloudian object storage offers an impressive 47% savings over LTO tape, adding up to more than $8 million over 10 years.

Table 5 provides a summary of the associated costs and savings for both solutions in this scenario.

	Cloudian	LTO Tape	Cost Differential	% of Savings for Cloudian
Capex	$8,404,153	$12,992,965	$4,588,812	35%
Opex	$1,000,000	$4,750,000	$3,750,000	79%
TOTAL COSTS	**$9,404,153**	**$17,742,965**	**$8,338,812**	**47%**

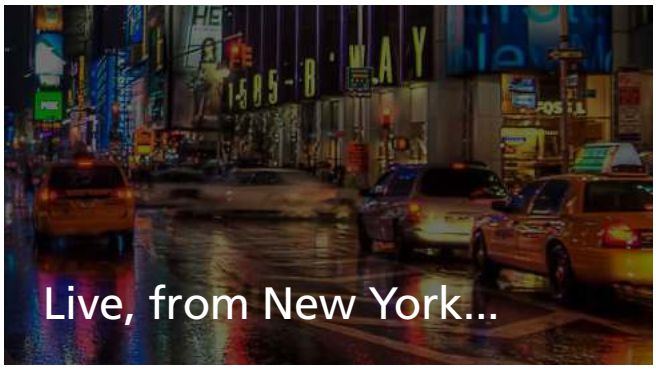
Table 5. Summary of cost savings of object storage vs LTO tape

While the capital expense savings are large, the analysis of operational expenses also reveals significant savings. Because object storage is a flat file structure running on commodity hardware, the daily operations and maintenance are 79% cheaper then LTO tape. Furthermore, object storage virtually eliminates costs associated with data recovery downtime and latency in data access. In summary, because Cloudian Object Storage requires less than one-fourth the amount of FTEs for ongoing management and has no associated data recovery or access costs, it offers significant savings over tape.

This example highlights the importance of capturing all costs when making a decision on the most economical choice for archival storage. Of course, these are just the financial benefits. The performance and real-time media access also open up new efficiencies and monetization opportunities

CASE STUDY

Weekend Comedy Show



Media companies know the challenges of managing enormous amounts of data, which was certainly the case with a long-running weekend comedy TV show. Over its tenure, this extremely popular network program had amassed data from hundreds of episodes and millions of digital assets, amounting to 3+ petabytes of data.

The massive effort required to manage all of this data in an aging LTO tape library was becoming untenable. Multiple generations of tapes, libraries, MAM software and systems platforms conspired to create significant management complexity. On a more mundane note, the volume of media had consumed all available physical space onsite.

After evaluating a variety of solutions, the show found that Cloudian object storage offered the most effective option for a future-proof solution that could easily scale to meet the demands of 4K and 8K video, and emerging technologies. Cloudian's built-in collaboration and disaster recovery tools, and its support for the show's existing media asset management (MAM) solution, made it the obvious choice.

By switching to Cloudian object storage, the show gained much more flexibility for managing video assets, which are a key driver of recurring revenue for the show. Additionally, the show improved its data integrity and achieved multiple operational benefits.

Flexibility Benefits

- Freedom from proprietary hardware or drivers
- Data portability and shareability
- Hardware independence
- MAM independence

Data Integrity Benefits

- Effortless disaster recovery with no downtime
- No need for regular health checks
- Any data errors are quickly found and fixed
- Easy to create nodes in multiple locations

Operational Benefits

- No chain of dependencies for accessing data
- Data is instantly available to other business units for monetization
- Searchability opens up opportunities to leverage video assets in new ways
- Elimination of data migration headaches

With immediate and reliable access to its growing library of episodes, digital shorts, and more, the show hasn't looked back. The show now has a stable and flexible storage platform that has lowered their storage costs and operational overhead while providing long-term, future-proof data protection.

If a major network show managing petabytes of data can benefit from object storage, imagine what it can do for you.

Conclusion

After examining the TCO of object storage vs. LTO tape, and seeing the benefits achieved in a real-world case study, it's easy to understand why object storage is quickly becoming the standard for data storage, backup, archive, and recovery.

It's clear that when all costs associated with data storage are tracked, object storage beats tape storage hands down. And even with costs aside, on-premises object storage with Cloudian provides businesses with the flexibility they need to respond to changing technology environments, storage requirements, data monetization opportunities, and more.

If you're running tape today, it makes a lot of sense to evaluate the benefits of switching to object storage before the limitations of your current solution impact your business more severely — and the sooner the better. As tape infrastructure ages, the transition only becomes more difficult.

Historically, there's been a lot of debate about tape versus disk-based storage, which eventually came down to disk being better but more expensive. Object storage changes the analysis completely. With Cloudian, it's now possible to enjoy the benefits of disk-based storage at a lower total cost than tape.

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