



# Storing Video:

The Ultimate Guide for TV, Film and Corporate Video Production Companies.

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# 1

## Storage.

One of the biggest headaches for anyone dealing with video

## 5 key considerations of video storage

Time

Cost

Durability

Security

Usability

# Businesses need to think harder about storing their valuable video assets.

Whether it's for transferring data during a project or as a long-term archive, ensuring your footage is securely and efficiently stored can be a constant cause of concern for video professionals.

Finding the right solution is difficult due to the plethora of different devices, formats and options available. It's a decision that's further complicated by the gargantuan storage capacities required by busy production houses, who need to store everything they shoot – even though most of the rushes will never make it past the edit.

Modern cameras are constantly evolving to increase the available resolution, which in turn increases the total file size and the storage required. It quickly means you're handling terabytes and terabytes worth of data.

The chief considerations are time and cost, but these are very closely followed by reliability, security as well as usability. Finding a solution with the right blend of these factors is a challenge often faced in the media community.

There are a few issues to consider:

- Time – how long do you need to keep this data for? Are you looking at temporary storage or archive?
- Cost – how much can you afford to spend and how much data do you need to store?
- Durability – how is the device going to be used and handled?
- Security – the security of your media can be very important. How much do you need to ensure that it won't fall into the wrong hands?
- Usability – are you comfortable dealing with a more technical solution or do you want something you can just plug in and use?

These factors can all influence each other – better security can cost more, usability may come at the cost of durability, etc – so you need to take a close look at what your requirements are.

Here we take a look at the main storage options used by video production teams; both solutions for transferring footage data and those solutions more suitable for storing it on a long-term basis in archive.

# 2

How does data get stored?

# The Basics of Data Storage

Before we begin, it's worth taking a quick look at the way data is stored and used by computers.

Computers use binary code to store data, with video files stored as strings of ones and zeros. These ones and zeros represent numbers that in turn represent a particular command available to the 'brain' of the computer, its processor. Processors have an 'instruction set' - a list of several hundred different commands - millions of these instructions can be carried out per second.

Processors can't interpret data on their own - software is the key to this. Software tells the processor where to look for data and what instructions to use in order to carry out the software's functions. That can be something as simple as listing the contents of a directory, or the more complicated actions Final Cut Pro performs on video data.

Inside the computer, the ones and zeros are represented by actual physical changes in individual

transistors, such as an electrical current that is or isn't flowing or voltages that are high or low. Each one or zero is called a bit. The more powerful the processor, the longer the binary strings it can handle. Modern processors have hundreds of millions of transistors and can handle strings that are 64 bits long.

So, storage devices are just a way of storing sequences of bits and sending or receiving those sequences to or from the processor. For video, the important bit is the differences in how they do this, how much they can hold and how the computer can access that data.

# How much storage do I need?



## Did you know

A bit is a single numeric value, either '1' or '0', that encodes a single unit of digital information.

A byte is a sequence of bits; usually eight bits equal one byte.

Bits are grouped into bytes to, generally speaking, increase the efficiency of computer hardware.

8 bits	=	1 byte ( B )
1024 bytes	=	1 kilobyte ( KB )
1024 kilobytes	=	1 megabyte ( MB )
1024 megabytes	=	1 gigabyte ( GB )
1024 gigabytes	=	1 terabyte ( TB )
1024 terabytes	=	1 petabyte ( PB )
1024 petabytes	=	1 exabyte ( EB )
1024 exabytes	=	1 zettabyte ( ZB )
1024 zettabytes	=	1 yottabyte ( YB )

Based on uncompressed HDTV 1080i/1080p Resolution 1920x1080 and 25 fps, you'd need the following approximate storage requirements:

1 frame of video	=	2025 KB
1 second of video	=	118 MB
1 minute of video	=	7119 MB
1 hour of video	=	417.13 GB

# 3

## Storing Video: The Cloud

# Using the Cloud for storage

## What is it?

In the simplest terms, cloud storage is a system where data is stored on servers. However, unlike a traditional file server where data is accessed across a network, cloud servers are accessed across the Internet and usually hosted by third parties.

Cloud service providers operate large datacentres – either their own (as in the case of Aframe) or leased from hosting companies such as Rackspace or Amazon Web Services. They then allocate these resources according to the needs of the customer, providing them with data storage they can access themselves.

## Best for

Work in progress, finished work, and archival footage that has a high commercial value.

## Cost

Variable. Costs vary from service to service and will depend on a number of factors including the functionality the service has and whether they have the extra costs of renting server space through a third party. However, the cost of a service will be scalable, going up or down depending on what the customer needs at the time.

# Using the Cloud for storage

## How does it work?

Cloud storage uses a distributed architecture model which means that physically your allocated storage may be spread across multiple servers that are shared among multiple customers. However, this will be invisible to the customer who will simply upload their data to the service.

This arrangement is known as a public cloud – the service can be accessed by anyone and your data sits on servers alongside data from other customers. When a service is using a third party hosting company, it's often the case that different services will be running side-by-side on the same servers. The knock-on effect is the server may not be set up in the optimal way to deliver a particular application.

Any software service that runs its own cloud avoids this and can ensure that they are optimized for their customers' needs.

A variation of this is a private cloud. In this case, an organization implements its own service. The model of distributed storage is duplicated but it is a closed system, hosted inside the organization's firewall.

A further variation is a hybrid or virtual private cloud. This works like a public cloud in that it is accessible across the internet but customers' data is hosted on dedicated servers, not shared with any other customers.

Cloud storage services may be accessed through a desktop client, phone or tablet app or through a standard web browser.

“First to mind when asked what ‘the cloud’ is, a majority respond it’s either an actual cloud, the sky, or something related to weather.”

Citrix Cloud Survey.

# Using the Cloud for storage

## Advantages

### Scalability

Storage can be scaled according to requirements, increasing or decreasing, starting or suspending services as needed without having to invest in (or write off) hardware.

### Accessibility

Whether cloud services use browser based interfaces or their own applications, because the data is stored in the cloud it can be accessed by anyone with the right access permissions from any location.

### Functionality

Cloud services will provide more than just the storage. Powerful search tools to make exploring and using your archive easier, the facility to preview files before downloading them, ways to share files easily, syncing tools to ensure that data is automatically backed up from local systems to the cloud.

### Maintenance-free

Subscribing to a cloud service means also buying the support and maintenance required to keep it running and robust, with updates performed with minimal distraction to the user.

### Security and backup

Fail safe back-up systems ensure data is always safe and available. It puts the responsibility to do this on the vendor, removing the need to take on in-house or third party resources.

### Upgrades and development

In order to keep ahead of the competition, cloud services will usually work to offer services that exceed the expectations of their customers.

### Tax advantages

Unlike purchasing servers and equipment which counts in the books as capital expenditure, the cost of cloud service subscriptions can be accounted for as operating expenditure with the tax advantages that brings.

### Cheaper and easier than in-house solutions

The result of all the advantages above is that a cloud service will be cheaper and easier to set up and maintain than doing it in-house. There's no need for dedicated space, equipment or the IT expertise needed to keep it running.

“In order to keep ahead of the competition, cloud services will usually work to offer services that exceed the expectations of their customers.”

# Using the Cloud for storage

## Disadvantages

### Reliant on internet connection

Using the system always requires internet access. If you're at home or in the office, this is probably fine. But if you're on location or on the move and relying on a 3G or 4G mobile connection, that may not be so easy.

### Upload and download speeds

Moving large quantities of data to a cloud solution needs a fast internet connection and, even then, if you're moving terabytes worth it can still take a long time. Uploading 1 terabyte of video through a 1 Gigabit Per Second connection would take over 2 hours <sup>[1]</sup>.

Check out your internet speed at [speedtest.net](https://www.speedtest.net).

### Location of data

Cloud solution providers use datacenters throughout the world, often leased from shared service providers, companies such as Rackspace or Amazon. As a service user, you often have no indication of where your data is being held. This could raise some legal concerns.

### Trust

Despite the rigorous back up processes cloud services will have in place, the fact they can't see and hold their media can put some people off adopting the cloud. Some are also nervous about having to rely on external systems and service levels.

### Functional inflexibility

Customizing a solution or adding bespoke features to meet your individual needs can be very difficult as the service is being used by multiple customers.

“Uploading 1 terabyte of video through a 1 Gigabit Per Second connection would take over 2 hours.”

# 4

## Storing Video: DVDs

# Using DVDs for storage

## What is it?

DVD (Digital Versatile Disc) is an optical disc storage format, invented and developed by Philips, Sony, Toshiba and Panasonic in 1995.

DVDs are the same size as CDs but have higher storage capacity. There are three types of DVD:

- DVD-ROM – This is the type used for distributing media such as films or video games to consumers. The DVDs are pre-recorded, the data being stamped onto them by the manufacturer. The data can only be read from the disc, not written or erased.
- DVD-R, DVD+R – Data can be stored on the disc once using a DVD recorder after which it functions like a DVD-ROM.
- DVD-RW, DVD+RW, DVD-RAM – Rewritable DVDs. Data can be stored and erased many times.

## Best for

Data distribution.

## Cost

Cheap. Blank rewritable DVDs cost a few pence each. Many computers come with DVD burners as standard and external DVD writers can be bought for as little as \$30.

# Using DVDs for storage

## How does it work?

A DVD is made up of several layers of plastic, which together are only a millimetre thick, encasing a metallic reflective surface. When a disc is being read by a DVD drive, a laser is shone onto the disc and changes in how it reflects back are interpreted into the binary information that represents the data on the disc.

In the case of DVD-ROMs, data is stamped in microscopic tracks in the plastic that are made up of pits (indentations) and flats backed by a reflective material. As the drive spins the disc at high speed, the laser beam is guided across the disc and shines on the pits and flats. Flats reflect back, pits don't. This generates the ones and zeros.

Writeable DVD formats (DVD-R, DVD+R) work in much the same way. The reflective layer is covered by a transparent dye. When writing data to a DVD, a second higher-powered laser in the DVD drive 'burns' the dye, turning it translucent. This creates the on-off pattern to the reflected light that represents the binary.

Rewritable DVDs contain a dye that can be returned to its non-reflective state after it has been made reflective enabling you to write data to them again and again.

Although they look like CDs and work on the same principle, DVDs differ in that the data tracks are much smaller and can have more than one layer. Discs can also be double-sided giving a total of 4 data tracks. This what gives them the significantly larger capacity – up to 15GB for a double-sided DVD compared to 700MB for a CD.

On a DVD, the data tracks are just 320 nanometres wide, with each pit or land being a minimum of 400 nanometres long and 120 nanometres high. These microscopic dimensions mean the spiral track on a DVD is extremely long. Were the data tracks from a double-sided, double-layer DVD a single layer of a DVD to be stretched into a straight line it would be 30 miles long <sup>[2]</sup>.

## ? Did you know

You can use toothpaste to polish out scratches on a DVD. As a slight abrasive, it works well on light scratches. Just be gentle as DVDs aren't as durable as your teeth.

# Using DVDs for storage

## Advantages

### Durability

If high quality discs were used and then handled and stored appropriately, DVDs should not degrade over time. Although it's quite common to find an unreadable or corrupt disc, this is usually as a result of mistreatment rather than a fault with the physical storage medium.

### Size

DVDs are small and light so it costs little to send a DVD by post or courier. Having said that, if you have a lot of media to send, the cost of shipping/ couriers can soon add up.

### Ease of use

Data can be easily copied onto a DVD-R or DVD-RW. Windows and Mac OS both have inbuilt capabilities to burn data onto DVDs so no extra software is required.

## Disadvantages

### Hardware

In a corporate environment where older, cheaper or lower spec desktop machines are still rife, some don't actually have DVD drives. What's more, the latest trend in wafer thin laptops and tablets means DVD drives have started to become obsolete. This could be an issue when sending data to clients.

### Accessibility

Data can only be accessed when the user has physical access to the disc.

### Searchability

A collection of DVDs sitting can't be searched so if they are being used for archiving, they need to be cataloged and filed carefully so the right disc can be found at the right time.

### Easy to steal or lose

DVDs are small and light and can easily go missing. Without a proper storage system, DVDs often get put in drawers or disappear under a pile of papers on a desk.

## ? Did you know

DVDs have an expected lifespan of 100 years (although this is yet to be proven).

# 5

## Storing Video: Hard Drives

# Using hard drives for storage

## What is it?

Hard drives are found inside most computers and laptops and are where software and the operating system are stored, as well as data. Introduced by IBM in 1956, a hard drive stores data on one or more rapidly rotating discs coated with a magnetic material.

Portable hard drives work in the same way but are usually used to just store data. They can be connected to computers by USB, or wirelessly across wi-fi networks. Files are stored in a standard directory structure and can be searched using the built-in file search capabilities of the host machine's operating system.

## Best for

Data transfer.

## Cost

Cheap. The cost of hard drives has plummeted in recent years, by approximately 50% every 14 months. In 1980 the average cost per gigabyte of storage was \$437,500 (a little over £247,000)<sup>[3]</sup>. By 2015 that is now \$0.02 (£0.01).

# Using hard drives for storage

## How does it work?

Data is written onto or read from the discs by magnetic heads arranged on a moving actuator arm. When writing data, the heads change the magnetization at microscopically small individual points on the discs into one of two states representing a 1 or a 0, the binary code that is interpreted by the computer into video files. When reading data, the heads detect the differences in the magnetization which generates an electrical pulse to represent the binary sequence.

Data is written onto the discs in a “random-access” manner, meaning the individual blocks of data are stored or retrieved in any order from any position on the disc, rather than sequentially. When this spacing of data becomes too untidy, the drive can become slow and has to be ‘defragmented’ – essentially, tidying up the data so that connected parts are located closer to each other.

The primary characteristics of a hard drive are its capacity and performance. Performance is specified by the time to move the heads to a file (Average Access Time) plus the time it takes for the file to move under its head (average latency, a function of the physical rotational speed in revolutions per minute) and the speed at which the file is transmitted (data rate).

## ? Did you know

The first ever hard drive, the IBM 350, was approximately the size of two refrigerators, weighed over a ton and cost \$3,200 per month to lease from IBM. All that for around 4MB storage space.

# Using hard drives for storage

“Portable hard drives are now available with up to 8 terabytes of storage.”

## Advantages

### **Simplicity**

Portable hard drives are usually easy to move between computers running the same operating system and can usually be simply plugged in via USB. They need no extra software in order to access them.

### **Size**

Portable hard drives tend to be relatively small so are easy to send by courier or mail.

### **Capacity**

As technology constantly improves the capacity of hard drives continues to grow. Portable hard drives are now available with up to 8 terabytes of storage. However be prepared to pay upwards of \$1,000.

### **Reusability**

Data can be written to and deleted from the drive as often as required.

# Using hard drives for storage

## Disadvantages

### Delicateness

Hard drives can break easily if dropped or jolted. The shock can cause the head to touch the disc wiping out the data that is stored on it irretrievably.

### Fallibility

Hard drives are a mechanical device with moving parts so, like all mechanical devices, if they are used a lot they will all eventually wear out. Then there are wear and tear issues that come from day to day use – faulty cables caused by constant plugging and unplugging – and their vulnerability to power surges.

### Bad sectors

Some magnetic sectors may fail while not destroying the whole drive. This can lead to reading and writing errors when a bad sector is required.

### OS dependent

A hard drive formatted for Windows cannot be used on a device using another operating system such as Apple's MacOS.

### Accessibility

Data on a portable hard drive can only be accessed by the computer it's plugged into or shared across a closed network.

### Needs back up

As hard drives are prone to failure, users still have to ensure data is backed up somewhere else so it isn't lost in the event of the hard drive failing.

### Unreliable security

Securing the content on a hard drive tends to be reliant on using a separate solution, such as software to encrypt them. There isn't any security built in to the drive itself. If the files on a drive haven't been secured, they can be accessed by anyone who has access to it.

## ? Did you know

Hard drives are prone to failure without warning. As such it is important to keep backups of any data stored on a hard drive; doubling the cost of storage.

# 6

## Storing Video: LTO

# Using LTO for storage

## What is it?

LTO (Linear Tape-Open) is a magnetic tape based data storage technology, originally developed in the late 1990s as an 'open standards' alternative to the proprietary magnetic tape formats that were the norm at the time.

Tape is best suited as an archive and back-up solution but the initial investment in hardware and the network infrastructure required means it is not really option for smaller production houses.

## Best for

Archive.

## Cost

Expensive. LTO tapes themselves are very cheap – a tape with 3TB capacity can be bought for around \$20. However, in order to use a tape, you have to buy a tape drive. These can cost from several hundred to a couple of thousand pounds, and need to be installed in a network environment. However, for large-scale archiving – where the overall economies of scale cover the initial investment in the hardware needed – tapes have always been seen as very cost-effective.



# Using LTO for storage

## How does it work?

The tape is enclosed in a plastic cartridge that is inserted into a separate drive to read or write data to the tape. The tape is wound around a single reel, the end of the tape is attached to a perpendicular leader pin that is used by an LTO drive to grasp the end of the tape and mount it in a take-up reel inside the drive. This pulls the tape from the cartridge over heads that read and write the data.

The tape itself is magnetic. When writing data, the heads magnetise the tape at specific points. When reading the data back, these magnetic points and the gaps between them are detected by the heads to generate an electrical signal – on or off – to represent the binary 1 or 0 states.

The standard form of LTO technology goes by the name Ultrium, the original version of which was released in 2000 and could hold 100 GB of data in a cartridge. HP's LTO version 6, released in 2013, can hold 6.25 TB in a cartridge of the same size.

HP, IBM and Quantum Corp. recently extended the LTO tape product roadmap to include generations 9 + 10. LTO 9 will offer up to 25TB of native capacity and LTO 10 is projected to offer 48TB.

“The original version of LTO was released in 2000 and could hold 100 GB of data in a cartridge. HP's LTO version 6, released in 2013, can hold 6.25 TB in a cartridge of the same size.”

# Using LTO for storage

## ? Did you know

LTO tape media has a life expectancy of up to 30 years when maintained in controlled storage environments.

## Advantages

### Capacity and durability

For many years, tapes have been the first choice medium for long term archiving and off-site backups. Tapes have a life expectancy of over 30 years.

### Writing speed

Transfer speeds when writing data to a tape is fast making it a good medium to backup large amounts of data in a single go.

### Security

Modern LTO drives can encrypt data as they write it to tapes meaning the data can only be read by the same machine unless the encryption key has been shared. Even if data hasn't been encrypted, someone still needs a tape drive to access it which they are unlikely to have.

### Cost

LTO tends to be one of the most cost effective archive solutions. A 1.5TB tape costs around \$25 compared to \$70-100 for a disk drive with the same capacity.

# Using LTO for storage

## Disadvantages

### Initial setup costs

As mentioned, a dedicated tape drive is required which can cost at least several hundred pounds and other peripheral hardware – such as switches, routers and power supplies – may need to be bought and setup in order to install it into a network.

### Specialist software

Computers will only be able to access the drive and read and write data to it if they have dedicated software installed.

### Slow reading speeds

Unlike a hard drive, where data is stored at random points across the disc, data is stored on tapes in a linear fashion. This means access to specific bits of data on the tape can be slow as the tape has to be physically wound through the heads to the correct point. Once the correct location has been reached, data transfer can be very quick.

### Reusability

The linear nature of data storage means tapes can only be reused when all the data has been wiped from them. Files cannot just be overwritten.

### Space requirements

Tape drives are quite large and need to be situated in a proper rack.

### Support requirements

As part of a broader network environment, tape drives need ongoing technical support and maintenance.

“Access to specific bits of data on the tape can be slow as the tape has to be physically wound through the heads to the correct point.”

# 7

## Storing Video: Network Server

# Using network servers for storage

## What is it?

A file server is a computer attached to a network with the main purpose of providing a shared, central storage of data (such as documents, sound files, photographs, video, images, databases, etc.) that can be accessed by computers, called 'clients', attached to the same network.

## Best for

Archive.

## Cost

Expensive. Servers can cost several hundred pounds, usually more, and more than one is needed, if only to ensure that there is a backup in the event of failure. Then there is the added costs of setting up the network environment and, of course, ongoing maintenance.

# Using network servers for storage

## How does it work?

The term 'server' demonstrates the role of the machine – it is there simply to serve files to the other machines, it is not intended to perform tasks or run software on behalf of its clients.

Servers tend to be arranged in rack units, connected to an organisation's network through load balancing routers. Data is stored on one or more hard drives in the server. Servers are usually used in combinations, with files mirrored on multiple servers to enable them to balance the load when multiple users are trying to access them at the same time and ensuring files are backed up.

## ? Did you know

Almost the entire structure of the Internet is based on millions of servers running continuously throughout the world.

# Using network servers for storage

## ? Did you know

In 2010, data centres (servers, cooling, and other electrical infrastructure) were responsible for 1.1-1.5% of electrical energy consumption worldwide. To put this in context, that's less than the 6 billion cell phones in the world use to recharge their batteries.

## Advantages

### Capacity

With a rack server environment, additional servers can be added easily to expand capacity if required.

### Searchability

Data can be indexed and searched, either with the native search tools in the client's operating system or through specialized search and knowledge management software such as Salesforce or Knowledge Owl.

### Reliability

A properly setup server environment will include back up and fall-over processes to ensure that, even in the event of a server failing, data can always be accessed.

### Security

Network servers are used in combination with system security to limit access to files to specific users or groups. In enterprises, this task is usually performed by what is known as a directory service, such as Microsoft's Azure Active Directory.

# Using network servers for storage

## Disadvantages

### Depreciation and obsolescence

As with all technology, servers you've invested in will eventually become obsolete and will need to be replaced or upgraded, and they don't retain any sell on value.

### CapEx costs

Buying servers will be counted as capital expenditure in the business accounts, not ideal for a collection of assets that will depreciate so quickly.

### Complexity

Setting up file servers on a network and the associated back up, load balancing and security processes is complicated and requires specialist knowledge. A lot can go wrong.

### Maintenance

Because of their complexity, in-house IT specialists or external service providers are required to look after the equipment and software.

### Access

Data can only be accessed if the user has access to the network the servers are a part of. With the right environment, it is possible to allow remote access to the network via Virtual Private Network (VPN) connections, but these are complicated to setup and managing access rights can be time-consuming.

### Infrastructure

Servers should be set up in the right environment. They need to be housed in racks, ideally in a dedicated, air-conditioned room and uninterruptible power supplies. Setting up the network environment means buying and setting up other peripheral hardware like routers and switches.

“Data can only be accessed if the user has access to the network the servers are a part of.”

# 8

## Storing Video: Flash Memory

# Using flash memory for storage

## What is it?

Flash memory is known as a solid state storage device, meaning there are no moving parts. It's use as a storage medium varies from USB drives, SD cards and Compact Flash cards, to SSDs (Solid State Drives) intended to replace computer hard drives and even Panasonic's P2 cards.

Flash memory has numerous advantages over hard disks and most other storage types, namely; silent operation thanks to no moving parts; incredibly fast read-write access and a very small size and weight. However, we don't just use solid state storage for everything as it tends to be more expensive and often has smaller storage capacity compared to, say, a hard drive.

## Best for

Short term storage & data transfer.

## Cost

Cheap. A 64GB capacity USB drive can be bought for as little as \$15. A similarly sized SD card costs only a couple of dollars more. However, for larger capacities, solid state storage devices tend to be dramatically more expensive than other storage types<sup>[4]</sup>.

# Using flash memory for storage

## How does it work?

Flash memory has no moving parts. Instead, data is stored in individual memory cells using electronic transistors, known as floating-gate transistors. Each transistor has two sides known as gates. When the gates are connected by electrons they represent a one, when disconnected a zero. That series of ones and zeros is interpreted as the binary code that represents the data.

Traditionally, each cell had two possible states (one or zero) so stored only one bit of data per cell (known as single-level cells, or SLC flash memory). Newer types of flash memory, known as multi-level cell (MLC) devices, can store more than one bit per cell by choosing between multiple levels of electrical charge to apply to the floating-gates of its cells. The primary benefit of MLC flash memory is a lower cost per unit of storage, due to the higher data density. However, SLC flash memory tends to benefit from faster transfer speeds and a longer lifespan.

Depending on the technology used, a SLC 32GB SD card can contain some 274 billion transistors<sup>[5]</sup>. When you consider the size of an SD card, that's pretty incredible.

“A modern 32GB SD card can contain some 274 billion transistors.”

# Using flash memory for storage



## Did you know

Some SD cards now have built in WiFi to enable you to automatically transfer images to your computer, mobile phone or tablet, without having to connect a cable.

## Advantages

### Durable

Solid state drives have no moving parts so are much more resistant to shock, water and impact than hard drives.

### Fast

Modern professional video cameras produce a lot of data very quickly, so the storage device has to be able to cope. Because of their incredibly quick read-write speeds, flash based memory cards are one of the few devices up to the job.

### Portable

SD cards and USB Flash drives are very small and lightweight so make it very easy to move media around.

### Easy to use

The more common 'consumer' facing cards can often be plugged directly into a computer, either via the USB port or integrated card reader. Other devices such as P2 cards usually require specialist card readers, however their plug-and-play functionality makes it simple to move media around.

## Disadvantages

### Easily lost

Their small size makes them very easy to lose.

### Capacity

Solid state storage devices capable of holding 2TB are starting to become available but they certainly aren't common. The more widely available capacities fill up quickly when filming so you'll need a few of them.

### Price

Whilst it's relatively cheap to buy small capacity cards (64GB SD cards cost around \$25), comparatively, it's very expensive. The 2TB SSD mentioned above costs in the region of \$5,000, whereas you can easily find a 4TB hard drive for less than \$150.

### Poor searchability

As with DVDs, a collection of cards or drives can't be searched en masse, so careful cataloging and filing is required.

# 9

## Storing Video: XDCAM Discs

# Using XDCAM discs for storage

## What is it?

Strictly speaking, XDCAM isn't actually a type of storage device, but instead is a recording format introduced by Sony in 2003. What people are actually referring to is called a Professional Disc (pictured). However as the sole pro-camera manufacturer to use Professional Discs, and only on their XDCAM camera range, they quickly became synonymous with the recording format, with many people combining the names and calling them XDCAM Discs.

Professional Discs (PFDs) are a type of optical disc, similar to that of a CD or DVD, however, by storing data more densely, they can achieve far greater storage capacities. Sony Professional Discs come in four sizes; 23GB, 50GB, 100GB and 128GB.

## Best for

Data transfer.

## Cost

Expensive. Cartridges themselves are reasonable - a 50GB cartridge costs around \$60 although this will only hold around 145min of HD footage so, for productions with large shoot ratios, this could begin to add up. But as well as needing to invest in the right camera in the first place, you will need a disc reader to access the recorded media. These cost in excess of \$3-4,000.



# Using XDCAM discs for storage

## How does it work?

Professional Discs (PFDs) make use of an optical disc to store data, much like CDs and DVDs. However, where they use infrared and red laser technology respectively to write to the disc, PFDs utilize blue laser<sup>(6)</sup> technology. The electromagnetic radiation emitted from the blue laser wavelength allows for a much higher density of data to be stored, compared with CDs or DVDs. 23GB can be stored on one single 12cm disc (the size adopted by Sony), that's the equivalent of nearly 5 single layer DVDs. In order to offer larger storage capacities, Sony offer dual, triple and quad layer discs for use in their XDCAM cameras.

Critically, whilst you would assume it would be best to always opt for the larger storage amount, their quad layer (128GB) discs can only be written once. All of the others are rewritable, much like rewritable DVDs.

Professional Discs store data on the optical disc using a phase change process that momentarily heats a tiny area of the discs surface to a temperature of 400-800°C. The resulting recording is very stable, able to resist extreme high and low temperatures when recording in harsh environments.

## Phase Change Recording

An optical recording technique that uses a laser to alter the crystalline structure of a metallic surface to create bits that reflect or absorb light when they are illuminated during the read operation.

# Using XDCAM discs for storage

## Advantages

### 'Format Free' Recording

Sony Professional Discs enables the recording of multiple formats within the same disc. This offers flexibility when shooting as camera operators can flick between recording formats on the fly depending on the shooting requirements.

### Durable

Housed inside a cartridge, the optical disc is protected from dust, scratches and other physical damage. Due to the way data is written to the optical disc, the resulting recording is also very stable, able to resist extreme hot and cold filming environments.

### Portable

Cartridges are reasonably small and lightweight so easy to send by mail or courier.

## Disadvantages

### Proprietary format

In order to use Sony Professional Discs, you'll need to use one of their cameras.

### Lack of future proofing

As the only manufacturer to support Professional Discs and on just a few of their cameras, there is a risk that the storage devices be discontinued in favour of a more widely accepted storage type.

### Poor searchability

As with any removable media, a collection of cartridges in a drawer can't be searched, so careful cataloging and filing is required.

“23GB can be stored on one single layer of a disc, that's the equivalent of nearly 5 single layer DVDs”

# 10

## Storage Area Network

# Using SAN for storage

## What is it?

SAN (storage area network) is a high-speed network of storage devices that also connects those storage devices with servers. It provides block-level storage that can be accessed by the applications running on any networked servers. SAN storage devices can include tape libraries and disc-based devices, like RAID hardware.

## Best for

Centralized storage management.

## Cost

Organizations often choose to deploy a storage area network because it offers better flexibility, availability and performance than direct-attached storage (DAS). Because a SAN removes storage from the servers and consolidates it in a place where it can be accessed by any application, it tends to improve storage utilization. Storage utilization improvements often allow organizations to defer purchases of additional storage hardware, which saves money and requires less space in the data center.

However, you need to weigh the costs against the benefits to see whether a SAN investment makes sense for you. The equipment that you need to buy to create an effective SAN can be pricey - the payback period averages between 12-18 months for a large SAN.

# Using SAN for storage

## How does it work?

Understanding the storage area network (SAN) configuration is critical in SAN environments. Various SAN implementations have limitations or requirements on how the devices are configured and set up <sup>[7]</sup>.

The three SAN configurations are point to point, arbitrated loop, and switched fabric:

### **Point to point**

The devices are connected directly to the host bus adapter (HBA).

### **Arbitrated loop**

Arbitrated loop topologies are ring topologies and are limited in terms of the number of devices that are supported on the loop and the number of devices that can be in use at a given time. In an arbitrated loop, only two devices can communicate at the same time. Data being read from a device or written to a device is passed from one device on the loop to another until it reaches the target device. The main limiting factor in an arbitrated loop is that only two devices can be in use at a given time.

### **Switched fabric**

In a switched fabric SAN, all devices in the fabric will be fibre native devices. This topology has the greatest bandwidth and flexibility because all devices are available to all HBAs through some fibre path.



Did you know

## SAN Infrastructure

SANs often use a Fibre Channel fabric topology - an infrastructure specially designed to handle storage communications. It provides faster and more reliable access than higher-level protocols used in NAS.

# Using SAN for storage

## Advantages

### Disk utilization

The number one benefit from installing a SAN is better disk utilization. When all your storage is tied together through a centralized storage network, you gain the ability to manage everything as a single entity.

### Backup in disparate locations

Most SANs utilize Fibre Channel technology or other networking protocols that allow the networks to span long distances geographically. That makes it more feasible for companies to keep their backup data in remote locations.

### Operational expenses

Many of the cost benefits of a SAN come from the reduction of operational expenses over time. Things such as less floor space, power consumption, reduced manpower requirements, and application uptime are often some of the benefits.

### Scalability

SAN Architecture facilitates scalability - Any number of storage devices can be added to store hundreds of terabytes.

## Disadvantages

### Zoning

Zoning is the way Storage Area Networks (SANs) keep devices isolated from each other; this has implications for security, fabric stability, and resource management.

### Time/labor intensive

Deploying a SAN is a complicated process that often requires specialized knowledge and a great deal of planning, particularly if your SAN is very large.

### Return on investment

SANs are very expensive as Fibre channel technology tends to be pricier and maintenance requires a higher degree of skill.

“The cost and complexity of SANs dropped in the early 2000s to levels allowing wider adoption across both enterprise and small to medium-sized business environments.”

# 11

## About Aframe

# The Cloud Video Collaboration Platform

Aframe is the cloud video collaboration platform and one central location where teams can instantly view, access and work with high resolution media. Aframe drives business efficiencies and dramatically increases the usage and value of media assets. Headquartered in London with operations in Boston, New York and Los Angeles, Aframe is trusted by broadcast, media and corporate organizations worldwide.

## Central Video Platform

Aframe is a cloud collaboration platform that provides one central location for global teams and international partners to access and manage high resolution video. Trusted by the world's largest organizations, Aframe is the only solution to combine fast UDP upload, transcoding, metadata support, video player, dynamic search, online review and approval, and analytics.

## Media Management & Collaboration

Aframe's central platform helps marketing, promos and reversioning groups take control of their assets and manage them more effectively. With less time spent wrestling with technical issues, teams can be more productive and make more use of assets.

## Asset Monetization

Commercial teams can create online catalogs, sales kits and screeners to improve professionalism and customer service. The central cloud platform overcomes the commercial and technical challenges of securely managing and distributing assets to improve partner communications, streamline the sales process, broaden sales reach and ultimately increase revenue.

## Production

Aframe reduces the complexity of managing media across all types of production. Cloud-powered workflows means everyone, wherever they are based, has instant access to the content they need from one central place. By reducing the barriers of production, teams can focus on creating the highest quality content and complete productions in record time.

*Aframe has presented productivity gains across multiple business units.*

*We only expect our reliance on Aframe to grow.*

Matthew Yelavich, CTO,  
Nine Networks

# References

[1] [http://www.calctool.org/CALC/prof/computing/transfer\\_time](http://www.calctool.org/CALC/prof/computing/transfer_time)

[2] <http://electronics.howstuffworks.com/dvd2.htm>

[3] <http://www.statisticbrain.com/average-cost-of-hard-drive-storage>

[4] <http://www.zdnet.com/crucial-m500-drive-significantly-reduces-ssd-price-per-gigabyte-7000013874>

[5] <http://answers.yahoo.com/question/index?qid=20090417020305AAHzy6s>

[6] [http://en.wikipedia.org/wiki/Professional\\_Disc](http://en.wikipedia.org/wiki/Professional_Disc)

[7] [http://www-01.ibm.com/support/knowledgecenter/SSGSG7\\_6.2.0/com.ibm.itsm.tshoot.doc/r\\_pdg\\_hats\\_sanconfig.html](http://www-01.ibm.com/support/knowledgecenter/SSGSG7_6.2.0/com.ibm.itsm.tshoot.doc/r_pdg_hats_sanconfig.html)