

Transferring Old Analog Videotapes to a New Digital Medium

For over 40 years, I have been searching for an electronic storage medium that is reasonably priced, high density, and low maintenance. **Hard Disk Drives** score on all three counts.

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1. Low Maintenance:

Hard Disk Drives (HDDs) are self-contained so they do not require expensive machines to play/read them nor do they incur the problems of maintaining playback machines.

2. Density:

One hour of Standard Definition TV (SDTV) requires about 75 GB (GigaByte). Using Motion-JPEG2000 lossless compression with an average of a 3:1 compression rate, only 25 GB is required. That means that a 400 GigaBytes (GB) HDD will store about 16 hours of SDTV (NTSC).

3. Reliability:

The reliability of HDDs has increased dramatically in recent years because the four major manufacturers have solved most of the failure problems. But, as with any electronic storage medium, HDDs should be duplicated and one copy stored off-site. Also, the two copies should be made on HDDs from different manufacturers.

Heat is a major factor in the failure of HDDs and computers. A small muffin fan, properly placed, should solve most potential overheating problem of equipment that is always powered on. Clogged air filters are another common cause of failure.

Because most archival material is not required to be instantly accessible, I recommend that all HDDs in the Archive normally be powered off. This will greatly decrease the probability of failure.

4. Single HDDS vs a System of Rack Mounted HDDs:

For video material that is rarely used, external HDDs are the most economical choice. Any number of single HDDs can be stored on shelves. When an external HDD is used, it is taken off the shelf and connected to the Archive computer via a Firewire cable. Be sure to use external drives that have ventilation holes/slots to keep the internal temperature down.

For video material that is used often, a system of HDDs should be used. There are several possible types of systems available and most of them are made to mount in 19 inch wide racks.

The height depends on how many HDDs are included. All HDDs in the system can be operated automatically by a built-in server and can be either instant-access or normally off. A normally off HDD requires a couple of minutes to come up to speed.

5. Types of Automated Disk Storage Systems (Library Systems):

RAID (Redundant Array of Inexpensive Disks) RAID-5 is probably the most commonly used mass storage system. The system is always on and is constantly scanning for errors. When a block error is detected, the system immediately goes into a recovery mode and corrects the error. A possible major problem with RAID-5 could occur during the recovery. If a second block error occurs during this time, then ALL of the data on ALL of the disks is lost. This potential problem can be eliminated by using software with double parity. This is called RAID-6.

MAID (Massive Array of Idle Disks) is a system of HDDs recorded in the same manner as RAID but all of the HDDs are normally off. The advantages of the disks being off is that they consume very little power and they will last much longer. MAID HDDs should be powered on periodically and checked for errors.

6. Several HDDs in a Non-RAID Configuration:

www.archive.org has several thousand movies on-line for free. Click on "Moving Images" and also click on "About IA (Internet Archive)".

www.archive.org uses a system with four HDDs per Rack Unit. The HDDs are mounted in standard racks. There are four HDDs in each "box" or "Rack Unit". One Rack Unit (RU) is 1 3/4 inches high and 19 inches wide. This is a world standard for TV stations and the electronics industry.

7. Compression--Losey vs lossless:

Do NOT use a system with losey compression because it eliminates some of the fine details in the video AND, in the future, when your successor migrates to the latest medium, he/she may not be able to use the old compression method you decided to use.

There is a lossless compression system that is recommended for archives. It has an average compression of about 3:1. One hour of SDTV, requires about 75 GigaBytes. With loseless compression, one hour of SDTV requires only 25 GB.

That means that a single 400 GB HDD can store 16 hours of standard video.

8. How Should You Migrate/Copy Your Old Videotapes to HDDs?

If you have a lot of videotapes--like over about 2,000, you should consider using the automated SAMMA system. The SAMMA system has several advantages including the fact that the copying/migrating can be done at your facility. For information about SAMMA, go to: www.media-matters.net

For fewer than about 2,000 videotapes, you will have to ship your old videotapes via FedEx or UPS because no one (except SAMMA) will do the work at your facility. FedEx and UPS are bonded and have excellent tracking systems. I have shipped hundreds of tapes via FedEx and UPS and never lost a tape.

Contact me and I will tell you who is capable of migrating your videotapes to digital and also tell you about my favorite non-RAID storage system. Jimwheeler@aol.com

9. Fast-changing Technology:

Digital technology has been changing much faster than the previous analog technology. Two-inch quad videotape technology lasted for over 25 years. With the introduction of digital into the storage equation, we now have to cope with yearly introductions of new operating systems and application programs. The new software may NOT be able to open old files or play the material in your archive.

Converting legacy video collections to digital is a necessity. That is because none of the old analog equipment is being produced any more, with the exception of the consumer VHS VCRs. But, VHS is not a good archival format. You MUST convince your management that everything MUST be converted to digital or it will be lost. The good news is that your material will be much more usable in digital form.

10. The Archive as an Isolated Oasis:

Think of your archive as a desert oasis--isolated from the rest of the world. Your archival oasis includes the storage vault, playback equipment, and the computers/workstations being used in your archive.

Just as caravans can take products to or from a desert oasis, digital archival material can be sent and received via electronic wire, fiber optic cable, DVCAM, MiniDV, DVC-PRO, DVD, etc.

Archivists are in total control of what happens within the archive. Archivists do not need to do what the rest of the world is doing. The archive is independent--much like an oasis or an island.

Note: Please do not confuse this concept of an oasis with OAIS (Open Archival Information System) that NASA has developed.

There are three worldwide TV standards that have been in use for over fifty years and these TV systems will be around for many more years. Your archive must be able to input and output whichever system is used in your country. Eventually, a Digital TV standard will replace NTSC, PAL and SECAM so this new standard will have to be added to your system input/output.

11. Duplicate all of the Electronic Equipment in your Archive:

The military and NASA have always required redundant electronics because failure is a

certainty. So, how do we make our archival electronics redundant? The answer is to start with three identical computers. Three are recommended because, it is likely that at least one out of three computers will be usable 20 or 30 years from now. At first, only one of the three computers is used. The other two are backups and are not powered. Schedule an annual physical checkup where you verify that all of your equipment is working properly.

In a few years, it is likely that the first computer will have a failure. Switch over to one of the other computers and have the first computer repaired without doing any upgrades. A good electronics technician can fix it as long as you have the technical manuals.

12. Hire an Archival Technologist (AT):

The first step in setting up a digital oasis is to hire a consultant. This person must be creative AND open-minded as well as knowing computer hardware and software. I would call this person an "Archival Technologist" (AT). He/she must think differently than the normal IT person who is usually programmed to upgrade, upgrade, upgrade....

This person must be someone who thinks "outside the box" and is not stuck with the idea that the operating system must be upgraded each time there is a new release. Also, this person must obtain the technical manuals needed to keep this equipment operating.

13. Refrain From Upgrading Your Software:

Refrain from upgrading the software in the computers/workstations that you have dedicated to playing the videos in your archive. This means that you keep the old operating system even though new ones are being used by everyone else. Keep the old computers and old software. Because your archive is an isolated oasis, there is no need to care that the outside world is constantly changing software.

14. Upgrade the Software on One Computer/Workstation and Verify:

If your management cannot live with the idea of rarely or never upgrading the software, there is an alternative. When you do an upgrade, do it on a second computer and verify that the new software can play the HDDs in the archive. Once you are convinced that the new software is compatible with your HDDs, you can then use one of your backup computers as your main computer and retire the previous main computer to backup status.

15. Migrate/Refresh Constantly or Migrate/Refresh every Five Years:

What other choices do you have to preserve your digital video material? The only other options are to continuously migrate or refresh (using the same format/media), if you have a heavily-used collection.

Migrate or refresh the entire collection about every five years if you have a lightly-used collection.

With digital, this is not the daunting task it was with analog because it can be done

automatically at night.

In the future, a new technology may become available that is the ideal archival medium. At that time, the archivist of the future can transfer the collection to the new medium.

16. Track the Quality of the Recordings in Your Archive:

A major advantage of digital is that you can keep track of the condition of the recorded material by monitoring the raw data error rates. You can do this with a few samples in your collection about once each year or, check ALL of the HDDs in your system each year. A large increase in errors indicates deterioration and refreshing is required. There is no video quality degradation when migrating uncompressed digital video or video with loseless compression.

Each HDD has a SMART utility output that can be used by computer software to determine if the data should be rewritten.

SMART = Smart Monitoring And Reporting Technology.
<http://cmrr.ucsd.edu/hughes/subpgset.htm>

17. Summary of Possible HDD Storage Systems:

There are several different approaches to archiving video material on HDDs. Please note that you can change your approach after a few years or days if you don't like the one you started with.

A. Usage/refreshing

For an archive with lightly-used material, establish a program for refreshing the entire collection about every five years.

For an archive with a lot of heavily-used material, use a computer-controlled Library System and establish a program for continual refreshing.

B. No upgrade vs upgrade

Digital Oasis: Do not upgrade the software until the "ideal" archival medium is invented.

Verifiable upgrade: Upgrade the software on one computer/workstation and verify its compatibility with your collection. Then upgrade the other two.

C. Stored on shelves

Stored on shelves--Inactive: Placing HDDs on shelves in an archive the same way that tapes and books are stored. HDD manufacturers recommend checking them about once a year.

Stored on shelves--Active: HDDs can be placed on shelves which have power and data connectors so that each HDD can be activated from the main computer through routers/

switchers.

D. On-Line Library System

Library Systems can be configured so that each HDD is fully tested for errors on a periodic basis. If a HDD has excessive errors, it will be copied automatically and a message will be sent to your computer.

RAID-6 (Redundant Array of Independent Disks)

MAID (Massive Array of Idle Disks) is comparable to RAID-6 in cost but the HDDs will last longer because they are normally idle (no power).

18. Conclusion:

There never has been an ideal way to archive video and there may never be an ideal solution. It is advisable for you to hire an open-minded AT person and develop a program to preserve your collection as well as make your material available. Digital has opened up new possibilities for actually using the videos in your collection! What a novel concept.

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