Guide to Investing in a Digital Archive

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As television and broadcast facilities change over to digital broadcasting the need for a digital video archive becomes apparent. Data rates for video are increasing dramatically as more stations move towards broadcasting in Digital Video 25 standard definition (DV25 SD) and High Definition (HD). Many studio cameras no longer have tape cartridges in them, instead they use 1394 fire wire for a direct connection or store recorded video on a hard disk, flash memory or optical media. Many stations also now process video directly from camera to their Non Linear Editing (NLE) systems. Recording to videotape is no longer an option, but archives must still be created. The answer lies in a digital video archive system that can be tailored to match the needs of the facility.

But what should you look for in a system? This white paper will help you decide what system will serve you well now, and in the future.

Key items for consideration are:

- Size of the archive
- What to do with legacy footage
- Selecting a format to store video
- Future growth
- Adding media asset management
- Workflow, workflow and workflow
- Who will access the archive
- Webcasting
- Access from NLEs

First, you need to figure out the size of archive you will need now and how much it will grow over time. The first part is easy as you know how many hours of video you are creating right now, but what do you want to do with your existing footage? This is a trade off: do you convert the video content on your old tapes to a new digital format to store them, or do you leave the existing video library alone and only archive your new content? The problem becomes more complex if you add asset management to your new archive, as you now have to decide if you wish to catalogue the legacy footage, as well.

Sometimes decisions are made for you. Your legacy footage may be deteriorating or you may really need the floor space occupied by the existing video library. Other factors include the availability of older equipment to play the video as well as the maintenance and support costs for that equipment.

Adding a low cost Media Asset Management (MAM) package will also pay dividends. It gives you the ability to search and browse content over the web and to play it out on your computer without making any request for a video tape. Another benefit of using a MAM is that you can easily add metadata about the clip according to your workflow, and it can be as simple or complex as you want to use. But do you want to add legacy content to your archive using the same rules?

Converting legacy content for a digital archive requires careful planning. Unlike a digital archive system that runs at computer network speeds, video transfers from tape are one to one.

Considering the time to prepare the video, view the content, copy it into a digital format, add metadata and you can clearly see that a 3000 hour library can take 4500 hours to convert. Once converted, however, the ongoing cost for maintaining the archive drops precipitously. Calculating the size and type of the archive equipment needed revolves around several key factors:

- Total number of hours of video
- Additional video added each year
- Storage format or formats in the case of legacy content and workflow
- Size of near-line versus off-line (if any) storage

Calculating size of the existing archive is easy if everything is in a single format, which is never the case. You may wish to select a single format going forward and convert all legacy content into this format, or you may use multiple formats to reduce the archive size. A common format currently being used is DV25, which occupies approx 12 GB of storage for each hour of content. This format lends itself to usage with NLEs as well as producing a good quality image. But what if most or your content is Beta SP tape? A straight MPEG2 conversion of Beta SP would only need 3.6 GB of storage for each hour of content. That's a 3:1 difference in cost per hour of storage. With digital storage it is simple and easy to mix formats as they are stored as digital files just like a WORD document. Table 1 shows common video formats and the amount of storage space required.

Format	Equivalent Bit Rate	Storage required for 1 hour	Hours per LTO 4 tape
SMPTE 601	168 Mb/sec	75.6 GB	10
Beta SP	8 Mb/sec	3.6 GB	222
DigiBeta	80 Mb/sec	36 GB	22
DV	25 Mb/sec	11.25 GB	71
AVI	25 Mb/sec	11.25 GB	71
DVCPRO	25 Mb/sec	11.25 GB	71
DVCPRO 50	50 Mb/sec	22.5 GB	36
DVCPRO HD	100 Mb/sec	45 GB	18
MPEG2 @ 10 Mb/sec	10 Mb/sec	4.5 GB	178
MPEG2 @ 12 Mb/sec	12 Mb/sec	5.4 GB	148
MPEG2 @ 15 Mb/sec	15 Mb/sec	6.75 GB	118
DV HD	50 Mb/sec	22.5 GB	36

Table 1

Next, estimate your future needs. It is highly likely that you will be recording and playing High Definition programming in the near future, and that the quality of the video will continue to increase as technology moves forward. For the next 10 years it is unlikely that we will see an increase beyond current compression rates and that 50 Mb/sec and 100Mb/sec will be the standard video compression rates we will use. Fortunately, computer technology develops at a faster rate than video and the next generation storage systems will easily double in capacity every 2-3 years.

So, for example, if we have a library of 4000 hours of legacy content that consists of 3000 hours of Beta SP and 1000 hours of 601, and decide to use DV25 format for the 601 format when converting the video, we would need an archive of:

(3000 x 3.6 GB) + (1000 x 11.25 GB) or approximately 22 TB

If we add 500 hours of content each year and we use DV25 as the standard, we need 28 TB to archive the additional content over the next 5 years.
Combining the old and new content requirements yields a digital video archive of approximately 50TB to keep everything near-line.

Figure 1 shows a typical system for an archive of this size, a Qualstar BQ66 video archive system, consisting of a server with 3 TB hard disk cache and a 66 tape cartridge robotics cabinet with 2 tape drives and 52 TB of near-line storage capacity.

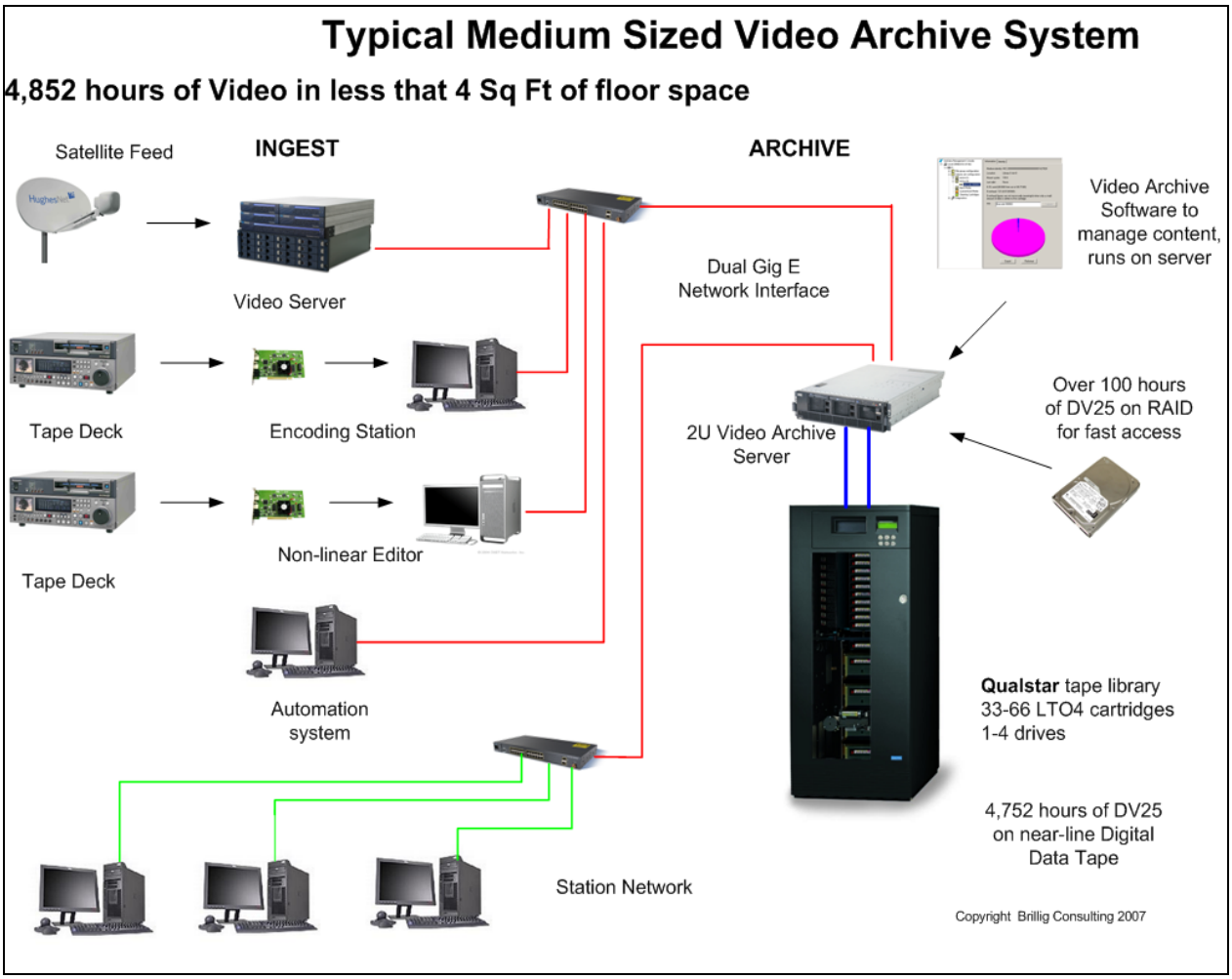

Fig. 1

We have established our format and current and future archive need, but is it necessary to have everything near-line? It is often possible to put considerable content on the shelf instead of keeping it near-line. Using contemporary video archive management software from developers like XenData or SGL allows the easy export of content on digital data tape that is still tracked even when residing on the shelf. If a request is made for a clip that is no longer near-line, a message is generated identifying the clip and associated tape cartridge via its barcode. Then it

is a simple process to reintroduce the tape cartridge to your system and the archive software restores the clip.

Adding an inexpensive media asset management software package such as Pictron can also make life easier as it allows the content to be moved off-line. The archive can now be viewed and searched using low-resolution proxies without having to access the high resolution content until it is needed.

The comparative cost of storing content in a robotic tape library is very low, much lower than your existing analog video library. Since modern digital archive systems use the same data tapes used in the computer industry they are readily available, competitively priced and store vast quantities of data. Table 1 shows the number of hours of video that can be stored on an LTO 4 tape. This compaction of data results in being able to store a 3000 hour archive in DV25 format on just 44 tapes in a small 7U rack mounted video archive system such as the Qualstar BQ44 model. It is now perfectly feasible and cost effective to keep all of the content near-line in a robotics cabinet as part of the video archive system

Sometimes we need to access video clips rapidly as is the case in a news environment, or do we? It is usually acceptable to be able to browse and view low-resolution content instantly to determine what is needed for that next project. This reduces time to access and move content over a network and reduces bandwidth requirements dramatically. Using low-resolution proxies is even more important if the content library is being shared with several geographically disperse sister stations. Keeping frequently accessed content on hard disk allow us to optimize the workflow. Putting all of the content on hard disk results in a visit from the chief accountant.

The best solution for most archive systems combines hard disk and automated tape with the ability to seamlessly move content between the two mediums as dictated by workflow and cost efficiencies. The hard disk storage allows instant access for low-resolution proxies, short length clips and those clips that have recently been part of your workflow. The tape storage is for the higher resolution video, longer program content, and any content that is not in frequent or recent use. If you can wait three minutes for a clip to be restored from a tape then you can save a lot of money when purchasing your system by reducing the amount of disk storage needed.

Sizing the archive system disk and tape storage elements centers around your workflow. If you have hours of content that requires frequent or rapid access then more hard disk storage is necessary. If most of your content can be accessed within minutes using a larger near-line robotic tape library is much more cost effective than buying lots of disk. For example, a typical Qualstar video archive system uses 2-3TB of disk cache and from 16 TB to 428 TB of tape storage behind it as a near-line archive which is sufficient for 1,400 to 38,500 hours of DV25, all accessible in under three minutes.

We have established how to size the archive, but we haven't established the usage model for it. Analyzing your workflow is critical to selecting your digital video archive; get it wrong and you will be suffering for the next ten years; get it right and life will become much easier. This is where a System Integrator or a consultant can help you. Experience has shown that most broadcast facilities don't have a full understanding of what can be done with the storage hardware and software systems available today. A TV station will often purchase a digital archive system and use it just as they did their old analog video tape library, failing to take advantage of the system's capabilities because they applied their old workflow.

Designing the workflow requirements should be the first step in defining a digital video archive system. Then the archive can be designed, sized and configured to work for you. Items to be considered include how you ingest content and where it comes from. Is the content processed first by NLE stations? Does it go directly to air? What are your usage rights? What content do you need to archive and what content do you need to keep readily available and for how long? How does the video move through your facility? How do you want to track the content and who needs access to it?

Let's take a local television station, for example. Much of their standard programming is downloaded from satellite but the weather and sports programs are all produced locally. They also do some special programming that they want to retain. They are still using Beta SP cameras for their news crews, and have two NLE stations that are primarily used for preparing the news. They have automation software to manage the station and use two parallel video playout servers. They have approximately 3000 hours of mixed format content in their video library.

Currently, they load the camera tapes into a deck connected to the video server and transfer raw footage into the server and convert it to mpeg format. Then they transfer it from the video server to the NLE for editing. The finished content is then moved back to the video server manually so that it can be given an ID and be managed by the automation software, which schedules it for playout. A copy of the finished content is made on a video tape and stored in the video library together with the original raw content video tape from the camera. A listing of the content on the video tapes in the library is entered into an Excel spreadsheet. Once the content has been played out the clip is manually deleted from the video server.

How can this workflow be changed to improve operations when adding the digital video archive system?

First, the video from the cameras can be routed directly to the NLE stations, easing the burden on the control room staff to keep the video server free to play out scheduled programming. A simple encoding station can be added to do this that can do double duty. It can convert the Beta SP format into an MPEG format and generate a low-resolution proxy for the MAM software. At his point you can add some basic metadata to the low res images of the raw footage so that you can search on it later, even to the point of splitting the low res proxies into multiple sub clips with metadata attached to each clip. A small amount of work up front will pay dividends later when searching for content.

The edited footage is then sent to the video server for playout, or picked up by the station automation software and placed into the digital archive until needed. It is important that finished content is moved by the automation software, otherwise there is no record of its location. The raw content can be placed directly into the digital video archive as it can now be searched and retrieved via the MAM software without passing through either the video server or the station automation software because it will be restored to the NLE before it is re-purposed.

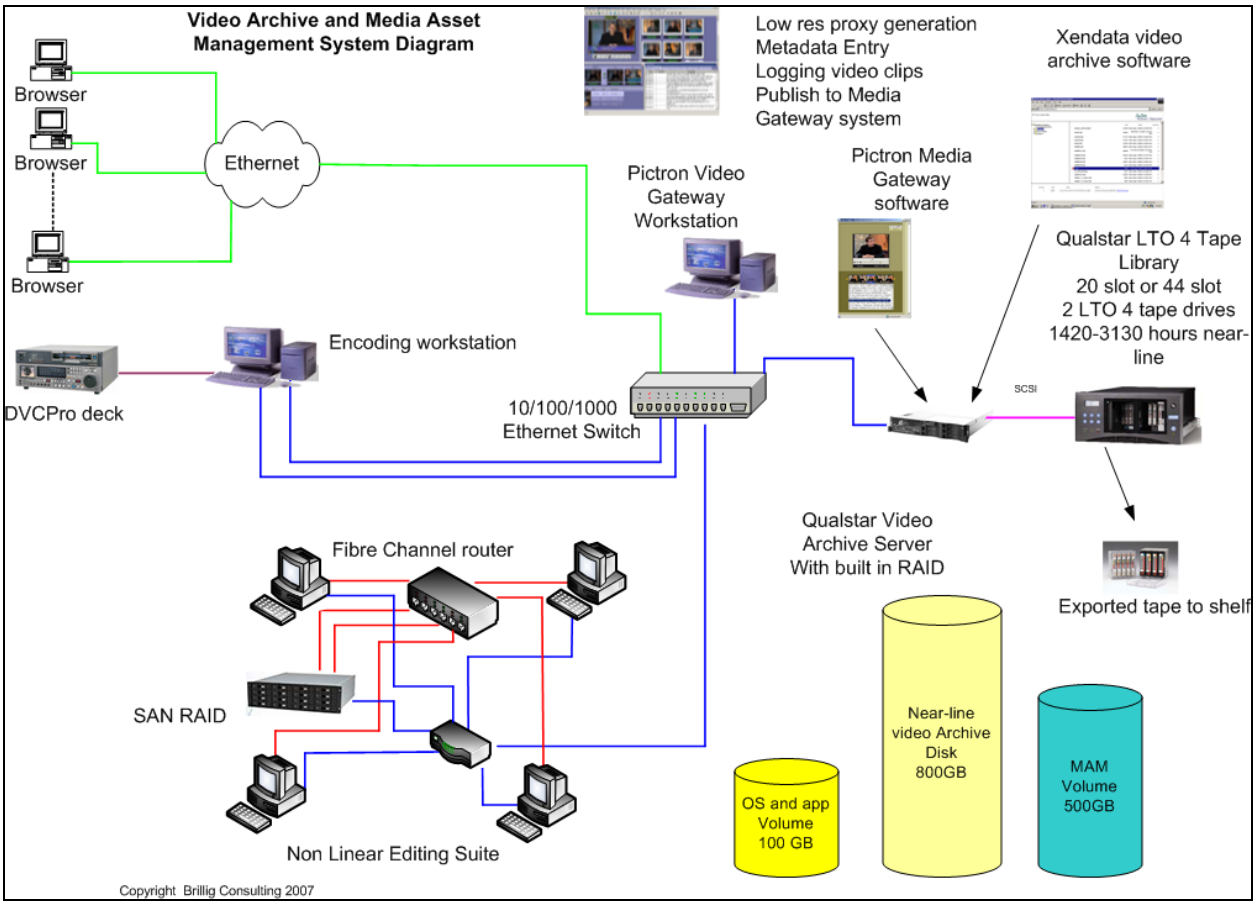

Fig. 2

When planning your video archive it is important to determine who needs access to the content versus who wants access. Existing analog archives typically have a librarian who is in effect the gatekeeper. Preventing video tapes from leaving the library to sit on someone's desk, making copies for editors and producers and issuing tapes for upcoming broadcast programs are some of the tasks that they must manage. When you transition to a digital archive access to the video library can be drastically changed for the better. However, now the responsibility for obtaining the correct clip for tomorrow's news shifts to others in the operation. Typically you will want to limit access to the high-resolution format to those who directly use the high-res content, and expand access for others to the low resolution proxy content. Most MAM software packages allow controlled access to specific video content and general public content. None of this activity compromises the station automation software accessing the archive. In fact a digital archive system will, when properly designed allow parallel access to video stored in the archive and minimize the amount of video being transferred over your network. This is a great advance over a standard analog tape based video archive.

Finally you must determine what your plans are for the next 5-10 years. Do you wish to do (or are you already) webcasting? Are you going to switch to HD broadcasting? Is it likely that you will be incorporated into a group organization? What are the long range plans for the group or organization that you already belong to? Do they wish to have a central archive? Do they wish to make sister station video archives available to the entire group? These are

all questions that can affect what you design and install for your video archive system. Adding Media Asset Management makes webcasting much easier, and it also allows other television stations to access and browse your video archive safely and securely. Sizing the archive for a switch to HD is also easier to do up front, without significant additional costs if planned correctly.

If you are ready to start planning and designing an archive, then contact your local System Integrator, talk to industry experts, research the vendors, and walk the floors at trade shows to ask questions and get information. Get an expert to visit the facility, talk to your staff and sit down with you to develop you workflow and archive needs. Plan on using some of you budget to do a study and design up front before committing to any equipment or software.

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