Wisconsin Public Television

Candidate Indexing Project

Report Structure

Introduction: (pages 3-4)

Section 1: Overview (pages 5-13)

- Digital asset management; indexed video; uses within Public Television

Section 2: Project description and narrative history (pages 14-33)

- WPT work growing from this project

Section 3: Conclusions (pages 34-42)

Appendices

- Costs, technical specifications, company information
- Sample request-for-information from vendor
- Asset management bibliography

Table of Contents

Candidate Indexing Project

Introduction

The Candidate Indexing Project ("Candidate Indexing") was designed to explore the feasibility of creating a database of digitized video, and delivering searchable video by a local public television organization. Our starting assumptions were:

1) digital asset management (DAM) will underlie and enable many of the myriad new services envisioned for digital broadcasting, broadband delivery, and wireless services;
2) there will be a need for "scaled" indexing solutions, just as there are currently scaled video production solutions.

Phase I of Candidate Indexing involved creation of a database of digitized video clips of candidates running for local Wisconsin political offices, searchable by keyword, and available via the World Wide Web. During Phase II of the project we developed the framework and basic infrastructure for an ongoing collaboration among the three public broadcasting licensees in Wisconsin. Phase I consumed most of the project timeline and therefore this report focuses heavily on the Candidate Indexing activities. Phase II development was essentially prep work for a long-term project that will bring searchable video into Wisconsin classrooms. The Future Fund of the Corporation for Public Broadcasting funded the indexing work described in this report. Work began on Candidate Indexing in March 2000, and was completed in April 2001.

Video content of Candidate Indexing
All candidates on the final ballot for the Wisconsin state assembly and state senate races were invited to submit videotaped campaign statements, up to 5 minutes in length, for inclusion on the WPT Wisconsin Vote Web site. The statements were available to the general public as part of an indexed database that was searchable by district, party, race, candidate name, or by keyword.

Candidates were encouraged to use whatever videotape format they had access to. Because the statements were intended to be digitized and streamed over the Internet - never broadcast - use of high quality video formats was not essential. We also requested a transcript of the tapes for closed captioning. Once we received the tapes, the candidates statements were digitized and indexed, and placed on the *Wisconsin Vote* web site. The Web site could be accessed by the public over any standard Web browser, and the video was streamed in RealMedia at 300 kbs per second.

We also expected to examine other applications for searchable video, including:
- Public use, including both on-line and broadcast/datacast delivery
- Controlled access, targeted use (e.g., teachers)
- Internal use (e.g., production, research, curriculum development)

A more detailed discussion of the Candidate Indexing project begins on page 14.

The question driving this project was: How difficult is it for a mid-sized public television station to create an indexing system from start to finish, with minimal third-party support?

This report covers the background and history of the project, our conclusions and recommendations for indexed video as a PTV activity, and a summary of ongoing work at WPT. We focus on a fairly narrow set of issues, related to the creation and implementation of a video indexing system. However, we frequently reference the relationship between indexed video and the larger subject of digital asset management. Appendices include notes on interactions with vendors, technical data, and reference materials.

Who should read this report?
We hope this report will be useful to public television managers and educational service providers who are considering indexing video, either as a stand-alone activity or as part of a larger asset management system. We are writing specifically for those in medium-sized stations such as WPT. Medium-sized stations are most likely to:

- Consider adopting asset management in the form of indexed video
- Have sufficient resources to support asset management
- Fall short on necessary staff skills, money, and the organizational “clout” to attract major business partnerships.

Disclaimers:
Some issues—notably e-commerce, rights management and security—are of vital importance, but beyond the scope of this project. Anyone interested in pursuing searchable video should also develop a basic understanding of digital asset management on a broader level. A selection of resources is included in the Appendix.

Indexing and asset management technologies change rapidly. References to specific technologies in this report, almost certainly outdated by the time of this writing, are included to provide context for our experiences and concrete examples of the complexity involved in establishing an indexing system.

Although we have included technical information, this is not a technical report. We assume the reader has no particular expertise, just a general awareness of current technology. (We have included resource url's in the appendices). The underlying criterion for what we have included in this report is: what did we wish we had known when we started? We hope that our experience will help you ask the right questions and avoid some of the pitfalls we encountered.

Section 1—Overview of Digital Asset Management, Indexed Video and Public Television

DIGITAL ASSET MANAGEMENT

Digital Asset Management (DAM) is a simple idea with extraordinarily complex implications. The purpose of DAM is to enable information consumers to easily identify and access relevant digital content, by creating *metadata*, or descriptive information for each content element, or asset. The content may be in any form—text, graphics, video, audio—so long as it exists as a digital file. This allows unprecedented flexibility in formatting and usage of information. In our opinion, DAM will be an essential component of many organizations seeking to provide useful information to its constituencies. Information in digital format will need to be organized, managed, searchable and retrievable. This is particularly true in educational institutions, including public television organizations, whether they are engaged in K-12, higher education, lifelong learning, or job training.

Video indexing (“indexing”), a subset of DAM, is a process by which digitized video is “tagged”—with metadata—so it may be searched and viewed. The metadata can be any information about the video content or the video file. In the analog world, labels on videotape are a simple form of metadata. Tape labels facilitate organization and retrieval of particulars tapes or footage. Similarly, in the world of digital video, files and footage can be labeled and stored in a way that makes them easy to search and access. The difference is digital video allows for huge volumes of material stored in a single database, and searchable down to the frame. Information related to the video can also be stored, including rights, file size and characteristics, and so forth.

An important part of Digital Asset Management is Digital Rights Management (DRM). Without DRM a piece of content is "information" but not an "asset." An asset assumes you have some way to control usage. DRM may mean only tracking who or how often the asset has been accessed. It could mean controlling access (say, to registered users), and allows for control of any payment or deduction from an established user account. DRM may also include restrictions on ability to copy or share content, or control a time limit on use of the asset. E-commerce, as a part of DRM, is a feature that could include the ability to pay for the asset, or to buy a related asset, product or service.

For a thorough discussion of metadata and asset management, see the attached article “Why Metadata Matters,” by Steven Vedro, which first appeared in *CURRENT* magazine (September 10, 2001).

INDEXED VIDEO

Indexed video makes it possible to search through a huge volume of video and locate one specific topic or segment. Until recently video has been stored on tapes, and specific content could only be acquired by tracking down the correct tape and then wading through the whole program or perhaps through a written log. With digitized video, thousands of hours of footage can be stored on servers, but that presents the problem of finding and retrieving desired footage. The tools for doing this have only recently been developed, and are still evolving.

Indexed video includes five components:

1. *Digitized source material*, which includes both finished, edited programs, and raw footage. Video needs to be encoded at compression levels suitable for anticipated uses.
2. *Metadata "tags" and database of these tags*. How detailed or general the tags are is driven by the anticipated use of the video.
3. A *user interface* that allows access to the database.
4. A way to *deliver* the video to the user.
5. A way to *manage and control content access, use, and rights*.

In the course of determining your indexing needs, and setting up an indexing system, you will make decisions and purchases that are irreversible (or very expensive to reverse) and will affect the complexity, cost, and usability of the end product. *It is crucial to clearly define why you are indexing video and by whom and how it will ultimately be used.*

PUBLIC TELEVISION AND DIGITAL ASSET MANAGEMENT

The current state of asset management in PTV

Public television stations are already in the business of managing digital assets, in the form of video and audio tapes and files, web pages, CD's and DVD's, text files, graphics, rights information, and so on. From one perspective, we're doing quite well with this. From another view, we're in a sorry state.

On the positive side, CPB and PBS have recognized the need for and value of DAM. WGBH and WNET have taken on familiar leadership roles. Other stations and state networks have also initiated DAM activities, including South Carolina ETV, New Hampshire PTV, Nebraska PTV, San Diego, Seattle, and Wisconsin. Collectively, we are working to establish models and standards, avoid duplication, and develop communities of practice.

On the other hand, many (most?) public stations are awash in "unmanaged assets." Producers have videotapes squirreled away in drawers, with scribbled notes and logs filed ... somewhere. Associated information, such as graphics, audio files, rights information,

and research material, may be spread throughout the organization. There's a wide gap between common production practices, and a functioning digital asset management system.

Thus, in 1999, when the Candidate Indexing project was conceived, the state-of-the-art for DAM in PTV was mixed, at best. Technically, few stations had the required software, hardware, system architecture and staff skills to create even modest DAM systems. Few station managers understood the value of a DAM system, much less how to create one. There was good reason for this relative ignorance. There were few clearly defined service models, few practical business models, and little in the way of standards or even operational systems to guide the would-be asset manager.

Since implementation of the indexing project in fall 2000, there has been technical and operational progress, and growing recognition of the importance of DAM. The 2001 NAB exhibits included many asset management products, services, and solutions. Still, the overall picture isn't much clearer, and there's been relatively little practical change within public television. Looking broadly at the commercial and nonprofit landscape, one can find many examples of operational searchable video systems. On the large end of the scale Paramount uses IBM Content Manager[1] to facilitate production workflow on its TV show, *Entertainment Tonight*. CNN has a robust DAM system in place. A smaller scale use of DAM (in the form of indexed video) is found at Structural Group, an engineering and construction company, which has created a searchable archive of projects, accessible for both in-house management, and client information. Within PBS, the *Mathline* project gives teachers access to searchable video, as well as other learning materials. *The NewsHour with Jim Lehrer* provides viewers the ability to search-and-stream elements of their broadcasts.

For the most part, these are turn-key systems, created by one or more vendors and either installed at the user's facility or managed completely by the service provider. And, for the most part, these systems are beyond the reach of all but the largest public television organizations.

PTV uses for DAM

Five commonly cited applications for digital asset management (and indexed video in particular) within public television are:

1. Program enhancements – useful for the general public and PTV viewers
2. Educational applications – useful for teachers and classrooms
3. Production applications – useful for program producers – includes archiving of footage
4. Sales and internal re-purposing of video

[1] The IBM Content Manager system combines Virage indexing with a powerful, HTML-based search engine and data-tape-based storage and retrieval hardware to form a single-source solution for content management. It has open-ended storage capacity and currently stores thousands of hours of Entertainment Tonight footage going back twenty years.

5. Program information, storage and delivery (the Advanced Digital Distribution Entity, or ADDE, model. This report does not address ADDE's).

There may or may not be an e-commerce aspect to these applications; for example, tiered services for station members, or license fees for footage.

An example of program enhancements for a PBS station is a searchable archive of program segments from *The NewsHour with Jim Lehrer*. Currently, the archive contains clips that have aired on the program, and an expanded DAM system will provide access not only to program clips but auxiliary materials such as clip transcripts, jpegs related to the story, or perhaps complete interviews.

South Carolina ETV provides an online education service that approximates a DAM system for K-12 teachers and students. The site, *Knowitall.org*, is a portal that links to various educational resources sites as well as South Carolina ETV's own collection of videos and still images. The site performs searches of a video database and separate searches of lesson plans and other resources.

Storing and managing production assets in digital form will assist program production by improving speed and accuracy of accessing specific shots, interviews, logs, stills, graphics, etc. as well as making it easier for stations to share each others' assets. In addition, images could be re-purposed (why get another shot of the state capitol?) or sold. We are not aware of any PBS station using a DAM system for production at this time, although several organizations are developing such plans, including WPT and WGBH.

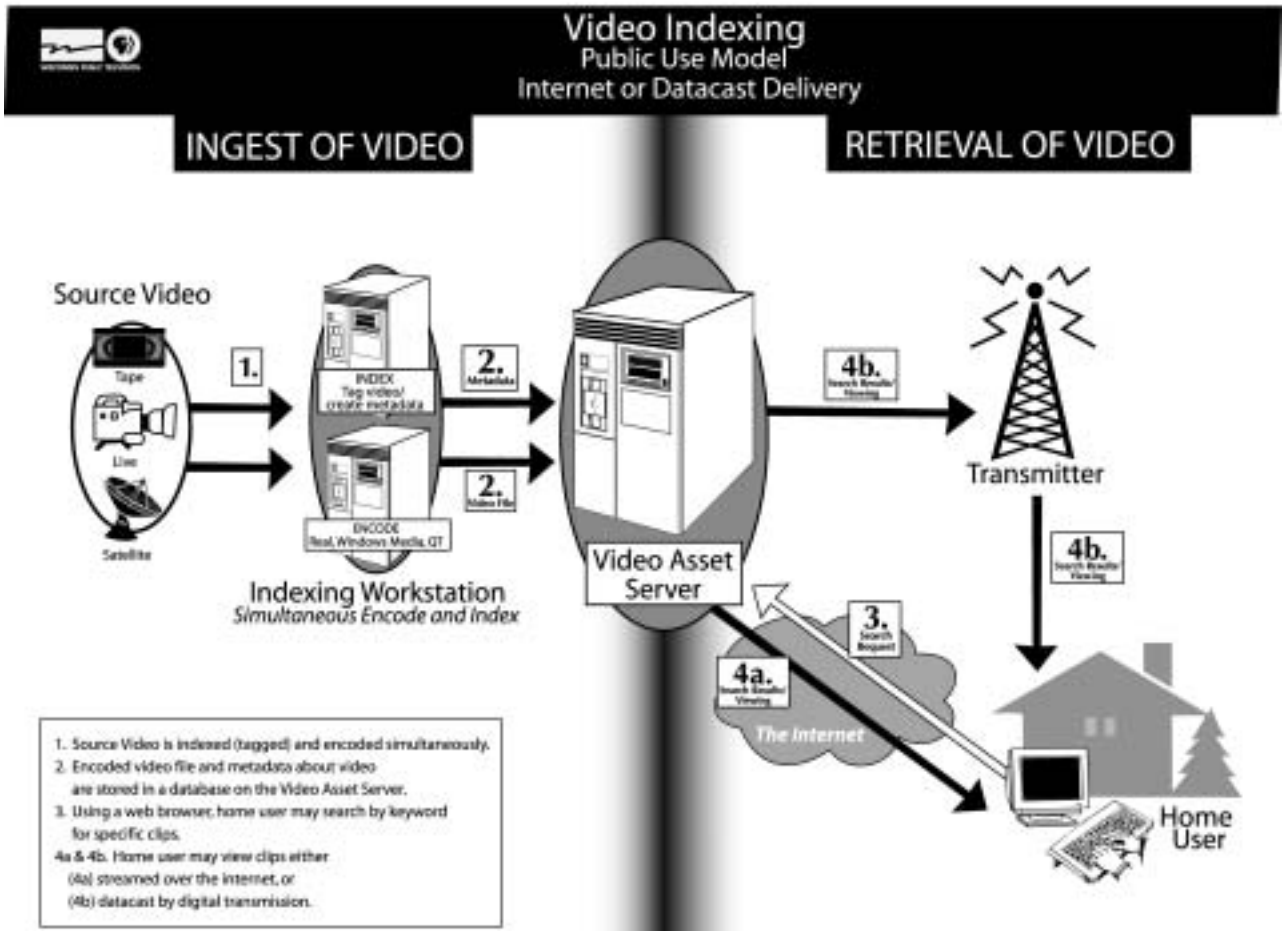
A note about archiving:
Many PTV stations anticipate using DAM to archive their existing library of assets – digital and analog. DAM is indeed effective for organizing any type of asset (assuming analog items are digitized) but that does not mean that all assets *should* be digitized and indexed. A station must think hard about which assets it truly needs to archive; specifically, which assets might you have reason to locate and use someday. Every organization has information or work that is outdated, superfluous, of poor quality, or otherwise not worth the resources it will take to digitize, index and store it.

As for using the DAM system (specifically video indexing) for logging field footage, it does not provide significantly better automation, accuracy or detail than any basic logging software. As with any logging or indexing software tools, the logging is labor-intensive in that a producer (or AP or PA) will need to create 'tags' or notes about each catalogued piece of video. Is it really worth it to catalogue every bit of raw footage from every shoot and store it in a digital database? There will need to be a balance struck between immediate value – material included in a program or program enhancement, for example – and possible value, which could include just about anything. So, while it's likely that interviews with public figures are worth saving, what do you do about all those interviews with everyday people-on-the-street? Which shots of the state capitol do you keep? Which great sunsets? It may be that a new career strand in public broadcasting will be "archivist."

We suggest you begin by thinking about DAM as a tool for finding resources and assets for *specific* users and uses. Once you understand why and for whom you are indexing and storing assets, then you can make intelligent choices about what to store and how to label or 'tag' the asset.

There can be all kind of tangible opportunities for new services for our constituents based on DAM systems. Examples of targeted uses and users:

- K-12 teachers could research, identify, preview, receive, and use media assets
- Viewers could access a range of content to help stay informed about local elections and political issues
- PTV members could receive favorite or missed clips of programs
- Producers could share assets within and between stations
- University faculty could develop and distribute curriculum materials for distance-learning applications
- New audiences could be cultivated by attaching digital assets to e-mail
- County agents or other direct service providers, could deliver new and enhanced services by creating materials tailored to their constituents



Digital Asset Management requires a new mindset

Beware the television mindset

At the start of Candidate Indexing, we envisioned a rapidly moving project, up and running within a few months. In part, our expectations were rooted in a television mindset based on these two factors:

- *Television production and broadcast technologies are well established and standardized.* This has led us to expect predictability and reliability in the function of technical systems. However, in the case of evolving technologies, such as indexing, little is established, predictable or reliable.

- *There is a community of knowledge about television production and how to talk about it.* We know how to make television. Everyone agrees, more or less, on how

> programs are created. We can control the timetable because we are collectively familiar with the process and the pieces, and speaking the same language. In the case of evolving technologies, there is no similar "community knowledge." Rather, there are discrete areas of expertise, with few established communication channels.

Despite self-admonishments to avoid the trap of our own professional certainties, we made an unconscious leap, that went something like this: we're working with a familiar medium (video); we know how to create valuable content; we have access to people experienced with encoding and serving video … therefore, we are able to manage an indexing system. This leap created a line of problems that popped up at unexpected times and places in this project. For example: we had no idea we would have to write code to make the Virage indexing and encoding machines talk to each other; we did not realize we would have to depend solely on closed captioning for effective indexing; we did not understand the extent to which we would have to outsource services from the indexing tool vendor.

Local broadcasters are accustomed to controlling every part of the content stream, from idea through production to final delivery. At every TV station, repeated hundreds of times across the country, we have assembled a complete universe of resources: producers, production staff and equipment, programming departments, and transmitters. The inherent geographical limitations of terrestrial broadcast, combined with PTV's commitment to local service, require this approach. But it makes less sense in the context of the Internet, broadband technology, and digital asset management, where a *distributed model* is more appropriate. Each station may still need local editorial, outreach, and development staff and resources, but we do not need to create duplicate server farms nor acquire the tools and skills to individually manage digital information. Developing and coordinating such a distributed approach is a daunting, but solvable, problem, as was the development of the current satellite system.

Indexing and asset management are editorial activities, not just "technology"

As public television organizations move into asset management, the temptation is to focus on technology. It's new, it's tangible, it's cool. But it's still just technology. The value of a technology comes from the professional judgment that we apply to its use, whether we are making television programs, designing a database, or indexing video.

The creation of metadata raises interesting issues. To start with, what content should be indexed? The notion of indexing and archiving all content, all the time, makes little sense. Some content is useless, fluff, with no applications. So, what's included, and what's not? What program elements are important? How will they be described? Is the digital archive open to everyone or secure? Is it designed for a specific user (like, an elementary school teacher working on the Revolutionary War) or general use (anyone who types in the keyword "Revolution")? Beyond this, do we need to consider cultural and socio-economic issues? Multiple languages? Special training to use the search functions? Will the creation

of searchable archives contribute to the democratization of information, or will it widen the digital divide? What role will public television play in all this?

For the foreseeable future, it will be necessary to make judgments about what content is available to whom, and for what purposes. That's a familiar role for public television, as necessary for asset management as it has been for broadcast programming.

Think "content," not "delivery"
Terrestrial broadcast, broadband, DVD, and direct satellite are examples of delivery mechanisms. Digital asset management enables all of these, but they will likely be used in different ways, depending primarily on bandwidth restrictions and interactivity.

Streaming video in particular is worth comment, as it's easy to equate indexed video with streaming video. Streaming video is a *method of distribution*, widely used by public television stations. A logical offshoot of our traditional core business, it also reflects an important difference: with video-on-demand, the user decides when and to some degree what is received. But streaming is an imperfect solution, at best. While the primary problem is bandwidth to the end-user, there is an additional limitation: for the most part, a user can only download material that is pre-defined by the supplier. It remains a program-based, limited choice model.

Indexing, on the other hand, is a *method of managing content*. The vehicle of distribution may vary; it may be, for example, Internet, terrestrial broadcast or internal LAN, and the video may be sent as files or streamed. Indexing allows much greater control by users, whether they are producers, teachers, or home viewers.

Think "assets," not "programs"
It's also important to differentiate between *programs* and *assets*. Television professionals prize the final creation above all else. Indeed, the program is what finally touches and moves the viewer, and is the culmination of months of hard work, expertise and creativity. But the elements that make up a program can be used in other ways, as well.

To begin with, most programs can be divided into discrete sub-sections. Television audiences of the future may want the ability to watch only the sections or topics of their interest. In the case of news broadcasts, viewers may use personal video recorders (such as Tivo and RePlay) that can selectively record program elements. Viewers may filter out some stories (for example, sports and health topics) and watch only news and weather. Teachers will want to search for program segments that relate directly to lesson plans (they do this already, by cueing videotapes). Public stations may want to offer viewers the ability to search for specific program elements related to broadcasts, as the *NewsHour* does. Stock footage libraries are another use of program elements, and the process of creating such a library would be simplified if an asset management protocol were in place. Within a station, or between stations, footage could be easily shared.

This leads to the most intriguing, and potentially most powerful, uses of digital asset management: the ability of a user to combine assets in ways specific to the intended use, and the creation of “learning object” archives.

Assets are all defined elements; for example, in the case of video, a complete program, a program segment, a specific shot (the state capitol at sunset). *Learning objects* are assets with additional descriptive metadata about how the asset can be used for teaching and learning. All learning objects are assets, but not all assets are learning objects. There's an explicit judgment made in the case of learning objects, that these assets are appropriate for an educational purpose. For example, a digital repository may include five video clips that demonstrate the Bernoulli principle. Two of these may not be usable for elementary school, for various reasons, e.g., presentation or age-appropriateness. From the point of view of a teacher seeking curriculum resources, there are five assets, and three learning objects.

The creation of learning object repositories opens the possibility of reusing assets for education. The US military, which operates the largest educational and training programs in the world, is keenly interested in this. Instead of developing repair manuals for every piece of equipment, personnel could create their own just-in-time manuals, drawing from existing learning objects. Repair of a diesel engine is essentially the same, whether it’s powering a Navy electrical generator or an Army HumVee. Much of the content can be used in either case, accessed on-demand, rather than being replicated in different repair manuals.

Even more powerful is the ability of a user to put together assets or learning objects in ways specific to the use. For example, if a teacher wants to enrich a lesson plan on the Vietnam War, she could search for video assets presenting US and North Vietnamese positions. She could find photographs, biographies, and letters from the front. These could be put together in a unique combination, appropriate for her class.

When programs and program elements are indexed and searchable, entirely new possibilities are created. We don't yet know what the business, service or distribution models will be for public television.

In our view, the critical pieces for local stations to control are content creation, and indexing/metatagging. Content creation is familiar to us. Indexing, while new, requires similar thought processes as those we apply to program creation. Together, content creation and indexing are the starting point for everything that follows. And everything that follows is best done on a larger-than-local scale, for reasons of both cost and efficiency. This doesn't necessarily imply a single entity managing servers and fulfillment, as PBS currently manages the national program service. More likely there will be a number of “communities of interest” working together.

Section 2—Project History

The historical discussion about our Indexing project refers to work done between March 2000 and April 2001. It is important to keep this in mind because the tools and our expertise have improved in the course of, and since the end of, Candidate Indexing. Our work with indexing and digital asset management continues and from the perspective of this writing we know much more than we did a year ago. However, the goal of this report is to show the processes of discovery and trial-and-error for the sake of illustrating the challenge of setting up an in-house, self-operated indexing system. Our intention is not to make recommendations about products. Our experiences were with particular versions of equipment and software during a particular time. Most of the software tools have gone through several upgrades since our testing, and some of the versions offer advancements that address or negate some of the challenges we faced in 2000. The vendors have also made improvements in customer service and training. Our suggestion to anyone embarking on a mission to set up and operate an in-house indexing system is to research each vendor for the most current tools and functionality.

PROJECT DESIGN

Focus: Candidate statements

We began this indexing project with a broad range of goals, but quickly narrowed our scope to the possible and the practical. We identified local politics as our base content. We picked this content area for a number of reasons:

- During an election cycle, there is a *built-in public interest*, as well as a clearly defined end-date (the election).
- The new service was a reasonable *extension of existing services*, and could take advantage of staff content expertise.
- There were some *existing national examples* of such a service, e.g. C-SPAN, the Freedom Channel.
- Other public television stations would identify it as potentially valuable.
- The video content, consisting primarily of “talking heads,” is easy to close-caption, relatively easy to access on 56k dial-up connections.
- Associated data such as party affiliation, congressional districts etc, was primarily factual, not requiring adherence to content standards as for example K-12 curriculum materials.
- Users would be focused on the content, not on technical quality.
- Portions of the source video would be produced for the WPT broadcast schedule, requiring less project-specific production.

We also roughed-out a design for significantly expanding the value of the candidate video database. We planned to make the video assets available, at a higher quality level, for use by university faculty. We intended to incorporate the assets into video production for broadcast or cablecast. We hoped to digitally broadcast some portion of the database, exploring terrestrial broadcast. These activities are legitimate and potentially important.

They proved to be out of reach for this particular project. In some cases, the technology simply wasn't there. In others, we found the scope of work to be beyond our resources.

Intended audience and use

We conceived of Candidate Indexing for use by the general voting public. The voter would have access to the Internet and would have an active interest in statewide or local politics, leading him or her to view our *Wisconsin Vote* web site. Most likely the user would be the same demographic as our weekly broadcast *WeekEnd* news program audience. We expected that the searchable database of candidate video statements would be most useful to the voter shortly before the election. The statements allowed an undecided voter to watch each candidate state his or her platform in summary. This would be the voter's only opportunity to watch and compare each candidate's platform on demand.

Functionality

We wanted the audience to be able to locate the searchable video through a known and existing channel for receiving political information. The WPT *Wisconsin Vote* web site was well used (over one million hits; several thousand unique visitors) and had been well publicized. By going to the *Wisconsin Vote* site, the user would be able to click on a “search video” option on any page of the web site and quickly look for a desired topic or name. To facilitate the user's search there would be dropdown boxes allowing the selection of a district, party, or campaign. This would allow the user to narrow the search parameters. Once a search topic had been entered, a series of results would appear. These would appear as thumbnail frames of video from each relevant video clip, along with a scrollable transcript of the audio for that clip. The viewer would then click on any thumbnail to view the video clip. The video, encoded in Real, would play back in a small pop-up box at 300 kb per second. The video was encoded to stream over a home computer modem, which would make for choppy and low-quality video. Therefore, a primary concern was clear and effective audio.

Web interface design

We wanted the web interface design to be as clear and uncomplicated as possible. With a limited timeline the Web interface would be spare and not richly designed. The design would be based on existing templates included in the package of indexing tools we purchased. We had intended to present a “search” option on every page of the WI Vote Web site. Timeline and resource limitations prevented this, and the search function was only available through one page of the Web site. We felt strongly about including dropdown boxes to help direct the viewer's search and so dropdown boxes for candidate name, party, district, and campaign were created.

Project timeline, partners, and team

The eight-month timeline for Candidate Indexing (March–November 2000), as originally proposed, was based on the assumption that setting up an indexing system would be simple and straightforward, a "plug-and-play" scenario. Only four months were allotted for purchase of indexing software, research and purchase of hardware, set-up of server and indexing workstations, and learning how to use the system. Web development would have a three-month timeline. Content acquisition would not begin until after the state primary, which was 8 weeks before the election. The already-short timeline became even more condensed when in late summer the decision was made to switch from the Virage indexing tools to MediaSite. (See pages 24-25 for reasons for the shift to MediaSite.) The process of negotiating a contact, researching and purchasing hardware, setting up servers and workstation had to begin all over again. We had three months (August-October) to accomplish all of this, plus caption and index all of the candidate videos. Because of the drastically shortened timeline, we also decide to outsource much of the Web interface development to MediaSite. We realize now that the timeline should have allowed for several months of planning and design, before implementation even began.

Project partners

In the original conception of Candidate Indexing, several partners were included that did not participate in the final project. The reason for the narrowing of the participants had mainly to do with the limited timeline. For instance, we hoped that Wisconsin Public Radio could contribute audio files of candidate interviews from radio talk programs to the searchable database. With the unexpected amount of time it took the indexing team to set up and figure out the video indexing system, there was not time to engage the WPR staff and work out the technical problems of trying to index audio using the same tools.

Project team

The project ended up utilizing fewer personnel in general, and requiring more computer-savvy staff hours, than anticipated. We did not fully appreciate that indexing is fundamentally a computer-driven enterprise. Most of the skills involved in traditional television and video production do not apply to the world of creating a database from, and indexing, digitized video. In the process of creating the Candidate Indexing Web site we had to not only learn about new tools but we also had to learn new skills. This led to narrowing of the scope of the project to allow for the sharp learning curve.

Some of the roles and skills needed for the indexing team were standard to television production; some were completely new to us and required swift adaptation and quick learning, and in some cases we needed to use non-television staff. Based on our experience, key team members' tasks and skills should include:

Project Director (standard television): Coordinates project as it fits within the larger mission of the station, negotiates contracts with vendors, manages vendor and partner relationships, has general knowledge of function and goals of project.

Project Manager (mostly standard television): Manages timeline and workflow of project, assigns tasks to team members, works closely and foster relationships with partners and team members outside of own agency, has knowledge of technical requirements and issues around indexing, reports on project progress and results.

Producer (standard television): Acquires and possibly produces source video/content. Determines how video will be clipped (in and out points) and determines titles, descriptions and any other metadata about clips. (In the case of our project, this person was also the Project Manager.)

Finance/Purchasing Manager (standard television): Implements contracts and purchases; maintains project budget.

Workstation Manager (non-standard television): Sets up computers and loads software for indexing workstation. Maintains and troubleshoots workstation. Requires ability to manage encoding of video from analog tape formats to various digital formats (MPEG1, MPEG2, Real, etc.). Requires knowledge of different encode/decoder engines/codecs and ability to install and configure hardware and software codecs based on manufacturers' specifications and software developer's kits (SDK's). Requires limited knowledge of HTML and XML languages for workstation set-up.

Web Developer (non-standard television): Requires in-depth knowledge of HTML, knowledge of additional middleware language (ASP, ColdFusion, PERL, etc) and graphic design experience/expertise.

Database Manager (non-standard television): Requires knowledge of Enterprise level database (such as Oracle or SQL server) and understanding of relational database design SQL and PSQL or TSQL.

System Administrator (non-standard television): Sets up and maintains servers. Skills required include the ability to load system software, configure Microsoft IIS server in a safe & secure manner, ability to interpret HTTP logs, and ability to debug VB scripts in a production environment.

Closed Captioner (standard television): Transcribes and captions source tapes using captioning software.

Tape Engineer (standard television): Encodes captioning text onto tapes. Also dubs tapes to indexing workstation format (may be Beta SP, VHS, DV, etc.)

Production Assistant (standard television): Organizes tapes, does bulk encoding and indexing, other tasks as assigned. Requires basic knowledge of video encoding and training on indexing workstation.

THE TECHNOLOGY

Encode/Indexing Workstations

Virage specified a minimum hardware configuration (dual processor, SCSI storage, NT version 4 or Windows 2000) that we followed precisely, and made our computer purchases from a local vendor. Virage strongly recommended that we purchase two machines, one dedicated to indexing, one dedicated to encoding, and linked via LAN.

MediaSite required only one dual-processing, NT machine to handle both indexing and encoding. They provided us with two models that were certified to work with their product. Between the IBM and the Dell, we purchased the Dell. Unfortunately, in the few weeks between MediaSite's recommendation and our purchase, Dell revised the model, making it incompatible with the video card MediaSite required. We ended up borrowing a MediaSite IBM for the fulfillment of the Candidate Indexing project.

Workstation Tape Deck

An SVHS deck was purchased for input to the indexer due to its compatibility with RS422 V-LAN deck controller, and its ability to carry SMPTE timecode. Since broadcast quality video was not our primary concern, a Beta deck would be decidedly too expensive for this project.

Encoding Format

Real Networks Real Video was our codec of choice, due to its ubiquity on the Internet and the availability of plug-ins from Virage and MediaSite which worked with their encoding application, RealProducer.

Servers

In setting up servers we followed the vendor basic minimum specifications.
MediaSite required an IIS server, which might be an issue for some organizations who prefer not to limit their options.

Virage can make their software work with a variety of servers. We chose to run Apache on a Windows NT environment because Apache is free and we are familiar with it.

PROJECT IMPLEMENTATION—NARRATIVE

A video indexing system includes several essential components:

- Video source (tape deck, satellite feed, digital file, etc.)
- Encode machine
- Indexing machine (encode and index may or may not be the same CPU or “box”)
- Closed captioning decoder (may be included with indexing software package)
- Media server, for streaming or file transfer

The workstation may consist of a single PC for the encoding of video and indexing of the video content. Some companies, such as Virage, recommend encoding and indexing take place on two separate machines. The workstation includes a video source (normally a deck for tape playback). The indexing machine contains a video capture card with built-in closed captioning decoder, or external caption decoder box. The workstation is connected to a streaming media server, as specified by the indexing software tools provider. The server must have the capacity to store metadata and video files.

The process of indexing

The process of indexing, as it exists today involves encoding (digitizing) videotapes and storing the encoded content in a database that is then searchable. The encoding may be done on any machine with an encode card, but on our project our encode machine was part of our indexing workstation. The indexing products we experimented with (Virage and MediaSite) allow the encoding and indexing to take place at the same time, with one pass of the source tape. The term “indexing” refers to the creation of tags to points in the video. The record of the tags is the metadata. The metadata is stored in a file separate from the digitized video file, but they are connected by name.

The metadata also includes any additional information about the video or the video file that is added manually during the indexing process. This may include title of program, name of talent, name of producer, date of production, date of indexing, information about copyright, etc. All of this becomes part of the metadata and therefore is also searchable.

Indexing tools

Currently the most effective way to index a tape is by decoding the closed captioning on the tape. In other words, the tags reference the words in the captioning. It is possible to index by the video's audio, using a voice recognition tool. For tapes that are not captioned, such as field footage, this might seem like a good solution. Most indexing vendors offer voice recognition as a plug-in. However, we experimented with voice recognition and

found it to be very unreliable[2]. For the transcribing of an interview or a meeting, voice recognition tools may be accurate enough. However, for indexing, since we want to be able to do a precise search using the transcription, we need to have strict accuracy. Therefore we do not recommend the purchase of a voice-recognition plug-in for indexing.

Indexing vendors also offer tools that index using scene changes or even face recognition. We did not purchase these plug-ins but have tried using them during training. Scene-change indexing could be useful if using the indexer to log field footage. The tool is sensitive to changes in color and geometry in the video frame and will create segments based on these factors. The drawbacks are that there will be no text attached to the segments, so descriptions or keywords need to be added manually; also, this method is not an "intelligent" way to define segments. What might appear to be a scene change to the tool might only be a camera movement or shifting of an object on camera.

The face-recognition tools are quite amazing, but only work if the tool has been "trained" with specific faces. This is useful for news broadcasts that use a known team of reporters, or maybe programs about national politics, where the same faces appear over and over. The indexer will spot the faces it's been taught to recognize, and create a tag with the person's name. This plug-in is currently less useful for general production use at a PTV station, which involves indexing a wide variety of sources of video and types of subjects.

Search and results - Creating searchable segments

The end-user search interface is a Web page, accessed through a Web browser. As with a web-based text search engine, the user enters a keyword. The search engine will find every instance where that word appears in closed captioning, or as part of the data about the video that was added during indexing (title, description, etc.) The search results page displays a representative thumbnail frame for each clip of video alongside the description of the segment and, if desired, the captioning text. The thumbnail frame is clicked, and the video segment streams for viewing. The keyword that was searched will appear someplace within each video segment, though not necessarily at the beginning of the clip.

It is crucial to understand how and why the video segments are created. When we first experimented with our indexing system a year ago, we expected that when entering a keyword to perform a search, we would find the exact spot in the video where the word appears, then we could play back the clip starting at the keyword. We quickly learned that the search and results do not function this way.

The importance of defining clips

What was not obvious to us at first was that *an indexed program must be divided into clips*, for the search and results to be effective. The clipping is done at the indexing

[2] Manufacturers of voice recognition tools claim 80–90% accuracy. We found ours to be about 40% accurate. Again, we have found that indexing and searching using captioned video is the most effective way to pinpoint an exact subject or word. Virage provides a caption decoder built in to its VideoLogger tool. MediaSite requires the purchase of a caption decoder box.

workstation, while the program is being indexed and encoded (on the fly) or by re-opening the file after indexing is complete. Remember, indexing involves adding tags to digitized video. Now we are talking about dividing the whole program into segments for searching and viewing. To clarify, the video is not actually edited. The digitized video remains intact as a complete file. Rather, in and out points are defined. These points determine what segment of video will be played back. There are several ramifications of this feature:

- Indexing tools do not make the process of indexing automatic. It is true that the program may be left alone during the time it takes a tape to run through the encoder and indexing machines. But there is considerable labor involved in deciding how to divide up a program and then entering that information into the database. There is also labor involved in labeling and describing each of the segments. In other words, the indexing tools cannot make decisions about content. This requires human judgment. It's not yet clear what professional skills will be required: will every station need a staff of trained archivists? Can the day-to-day meta-tagging be done by support staff?

- It is only possible to search for a word or topic if it has been included between the in and out points of a defined clip. A one-hour program may be digitized and run through the indexer, so that the entire program exists as a digital file. But any piece of the program—such as an introduction or a transition segment—which was not deemed valuable by the indexing operator, will not be able to be found, even if a word within the segment was entered as a keyword. This can be a useful feature. In the case of a commercial news station that wants to make its broadcasts available to the public after airing, the station may tape an "air" feed of the program, which includes commercials, but not index, the commercials. The commercials would be part of the digitized video, but the searchable database would only contain program video.

- Clips also allow for control of rights-sensitive parts of programs. A program may be encoded and indexed in its entirety, but only the parts that have rights clearance would be clipped and thus made searchable. If at some future time rights clearance is acquired for other parts of the program, then those segments may be also be clipped and made searchable. The program would not need to be re-encoded and re-indexed.

- If the program is not divided into clips, then the search results become problematic. The search will locate the keyword, but will not know what duration of clip to present. A default time can be set on the video server—say, two minutes—but then the resulting two-minute clips may be longer or shorter than the relevant content. The only way to ensure that clips contain complete segments, or complete ideas, or at least do not chop sentences in half, is to define the clips from the outset. This way it is possible to control what content is available and how it is presented.

Here is a hypothetical example using a half-hour news show to illustrate the necessity of clipping:

> The show contains an introduction, six news segments, plus commercials, sports, weather, etc. One of the news topics is gas prices, a four-minute piece. I do a search for gas prices. What I am looking for is the story I saw on TV the night before.
>
> Assume the program was digitized and indexed, but not divided into segments. Let's say the default time for clip lengths was set to two minutes. My search would turn up several results. There would be a two-minute clip containing the 30-second program open (where the upcoming news stories are listed, including a story about gas prices), 1 minute of commercials, and 30-seconds of the beginning of a story about fighting in the Middle East. The next result would be a story about forest fires in Montana and ten seconds of the beginning of the story about gas prices. The next clip would start in the middle of the gas price story and runs into the next story about... You get the idea. All I desired was to see the gas prices story in its entirety from beginning to end. But in this sort of “free-form” search, I will get results based solely on my keywords, “gas prices.”
>
> If the news program had been divided into “intelligent” segments, then my search would lead me directly to the clip about gas prices and I would see a clean segment, not longer and not shorter than I needed. Also, since the program open was not defined as a segment I don't end up with a false lead—a segment containing the words “gas prices” but not containing any relevant content.

In summary, the indexing of digitized video makes it possible to effectively organize, store and retrieve specific footage. The process involves encoding tapes not already digitized, creating markers or “tags” to points on the digitized video and then storing the video and data files on a server. Most precise search results are obtained when the indexing is done based on closed captioning text. The end user searched the database by entering one or more keywords on a Web page. The most useful results are obtained if the video program has been segmented into “intelligent” clips in advance.

PROJECT JOURNAL

Our project was designed as R & D into the feasibility of setting up a self-contained indexing system. It was expected that the reality of the tasks would be different than how Candidate Indexing was imagined. We hope that what we learned through our trials and errors will inform future indexing and digital asset management projects.

The journal that follows charts the process we went through and the progress we made in understanding and setting up an indexing system. At times our frustration with our own inexperience and the lack of a clear path or simple answers will be evident. It should be emphasized that it is not our intention to disparage any of the vendors we worked with. Our inexperience, coupled with the uncertainties of an emerging technology, contributed greatly to the difficulty of the work. At times we felt that we received less than desired

support from each of the vendors, but it is important to keep in mind that these were new companies breaking ground in a new technical field. Virage and MediaSite have both changed dramatically in terms of corporate structure. Both companies are now much more oriented towards customer service. By the time of the writing of this report, many of the issues and problems we experienced a year ago are no longer relevant, except as examples of the *kinds* of things that might be encountered.

Set-up of Virage indexing system

February - April
In February of 2000 Wisconsin Public Television purchased the Virage software package. Virage was and remains the dominant company in the emerging field of video asset management. The package includes the VideoLogger, AudioLogger and Video Search software applications. Through the spring of 2000 we researched hardware needed for the Virage workstation, and assembled a project team consisting of a videographer/editor with experience in setting up computers; a system administrator; and a Web developer.

We were not clear precisely what hardware and software to purchase for the Virage workstation and relied on Virage for guidance. However, we did not get the degree of assistance we required from them. (Virage has since created a much stronger service division and support materials).

May
By the first week of May 2000 we had assembled a list of components to purchase, and ordered the hardware for our Virage workstation. The components of the workstation arrived throughout the month of May. In June the workstation was assembled and software loaded. See Appendix for list of components and specifications.

Set-up of the workstation was not simple. The documentation we were given by Virage was neither thorough nor particularly helpful. It was especially problematic getting the encoding machine and the indexing machine to talk to each other. After some difficulty tracking down a technical support person at Virage, we learned we would have to write code to get the two machines to recognize each other. The technical support staff talked our workstation manager through the process step by step.

June
Once the workstation was set up we began the task of figuring out how to use the software tools. Learning how to use the tools was confusing and not intuitive, particularly the segmenting of video clips. By the last week of June we were able to begin indexing and encoding programs on the workstation. We also had to set up the server for the video search function and create a Web interface. The server is housed in a separate building on campus from the workstation, and the files are transferred via ftp. We set up a basic Web page using the Virage Video Search application for the end user to perform the keyword search.

One decision we made early on as we experimented with the indexing tools was to index from the closed captioning rather than using the voice-recognition tools Virage provided. Virage uses IBM Via Voice for voice recognition and we found the accuracy of the indexing to be inadequate. Indexing from the closed captioning was precise and reliable. Of course, this meant that any tape or program that had never been broadcast would have to be captioned. Fortunately, we have captioning staff and equipment in-house.

July
During the second week of July we gave a demo of the Virage indexing system that showed the bare essentials of a Virage video indexing and search system. We had not yet learned how to fully utilize all of the Virage indexing functions or how to customize the search and results pages. Unfortunately, Virage did not provide us with documentation on how to use all of the workstation functions; also, to alter input fields at the indexing station XML files would have needed to be edited. In general, Virage's technology was highly proprietary and not particularly user-friendly. For example, the search page that we envisioned for Candidate Indexing—involving multiple search fields—would be complex. The fact that Virage uses text files to contain the data about the video clips (instead of a known database such as Access or Oracle) meant that it would not be possible for us to create the Web front end on our own but would need to hire Virage to provide the service.

The switch to MediaSite

August
Because of the difficulties we were having setting up and using the Virage indexing system, we negotiated a six-month trial with MediaSite to test their indexing software and to compare the ease and effectiveness with the Virage system. Our agreement included use of the MediaSite AutoIndexer, Speech Module and Webfinder (the server tools) as well as licenses. MediaSite provided very good documentation, spelling out precisely the equipment we would need to purchase. During the first week of August our technical team had a phone conference with MediaSite's engineers to clarify equipment needs for the workstation and server.

MediaSite requires only one machine to do both encoding and indexing, while Virage requires two. For our MediaSite workstation we purchased a computer that MediaSite has certified to work with their software, a Dell Precision 420. To our surprise the Dell would not work with the video capture card we had ordered (also based on MediaSite's specifications). We encountered another surprise when we learned that the Oracle database required an NT server. Our existing Oracle server was UNIX-based. The MediaSite documentation referred only to an Oracle database, with no further specification. This required that a whole new Oracle server be set up. Luckily, we already had the software, hardware and license from a previous project and could set them up again. This potentially could have been a major hurdle for our MediaSite system.

Two MediaSite personnel came to Madison for two days to assist with set up and provide hands-on training. They tried to get the Dell 420 to accept the video capture card, but seeing that it clearly would not work, they arranged an overnight delivery of one of their

own IBM Intellistations from MediaSite to ensure that the training day would not be wasted.

The first day of the MediaSite visit was spent loading a new version of the server tools. The MediaSite visitors were eager to help us, but they were not highly technically skilled and could not help us with all of our server issues. They could not provide technical guidance or answer questions that were not addressed in the server set-up “step-by-step” guide. In particular, they could not tell us how to most effectively install Oracle with security; this is a matter of serious concern for us. The installation was completed, but once MediaSite left, our system administrator had to uninstall, and then reinstall, everything with security applied, figuring out a solution on his own.

Another issue, though not a major stumbling block, was that the University of Wisconsin-Extension normally uses Netscape Web servers, but for the MediaSite video files we had to set up an IIS server.

On the second day of the on-site visit the MediaSite loaner computer arrived and we were given hands-on training on the software along with a well-written training manual. Our Web interface developer was also pleased that MediaSite uses an Oracle database back-end that could allow her to custom-write the front-end Web page. Also, by using an Oracle database we could eliminate the need to install and run a separate web server (with Active Server Pages) to create the front-end and, instead, could could utilize our existing ColdFusion Web database software.

During training on the indexing workstation we learned that unlike Virage, MediaSite does not append the timecode from the tape being encoded to the closed captioning, but rather creates an internal timecode that appears with the thumbnail but not with the captioning. For the purposes of editing segments, this makes it difficult to determine correlation between thumbnails and caption text. Virage displays timecode along with the thumbnails as well as with the text.

MediaSite asked us to ship the Dell 420 we had purchased to the MediaSite offices in Pittsburgh so that their engineers could look at the machine and try to determine why it would not recognize the video capture card. The MediaSite engineers eventually determined that Dell had very recently made a change to the BIOS on the Precision 420, which would no longer allow the video card to work with it. MediaSite then switched the BIOS to an earlier version, which they hoped would solve the problem. The machine was sent back to us with the video capture card now in place and working, but with a new problem. Any video we encoded would play back with video and audio significantly out of synch. With no apparent solution to this problem, we continue to use MediaSite's “loaner” IBM for our MediaSite workstation.

Management of content

September

Candidate statement solicitation

In early and mid-September we sent letters to the Wisconsin state Assembly and state Senate candidates who would be on the Wisconsin ballot in November inviting them to send us campaign statements on video which we would place on our Wisconsin Vote Web site. The second letter included guidelines for the video production, including types of small-format video we could accept, maximum duration of their video (5 minutes) and some restrictions. We also requested a transcript of the candidate statement on disk or sent via e-mail as a text file. Of 195 state Assembly and state Senate candidates on the November ballot, only thirteen sent us video statements.

October

Processing of tapes

We scheduled blocks of time with our closed captioning and engineering departments to caption and encode the tapes. All of the various tapes formats received from the candidates had to be transferred to a VITC VHS tape, then captioned, then encoded onto another tape for digitization and indexing. Some candidates did not comply with our request for a transcript so those tapes also had to be transcribed by our captioner.

We began receiving candidate statements in October and though we had hoped to get them onto the Web site within days of receiving each tape, the indexing technical difficulties continued though the last week of October.

Reasons for low response

Based on informal phone discussions with some of the candidates and campaigns, the reasons for the low response included: a lack of access to a video camera; lack of time to produce the statement; and uncertainty about the value to their campaign of a presence on our Web site.

Web Interface

MediaSite contribution

Part of our agreement with MediaSite for the Candidate Indexing project was that MediaSite would create the front end Web page for us—in the style of our existing WPT Wisconsin Vote Web site. Considering the short timeline of our project, this appeared to be advantageous but ultimately led to problems. First of all, the technical contacts at MediaSite were not prompt about responding to our e-mails or phone calls regarding technical issues. Also, MediaSite was late delivering the pages to us, and the front-end we received had bugs. When we received the customized schema that MediaSite had written for us, we didn't know what to do with the pages. We had no guidance from them in this area. Ultimately it was figured out that the customized pages, or new schema, had to be set up on the IIS box as a new “instance” (new Web site). Then the Access database on the workstation had to be changed to become compatible with the new schema on the

Oracle server box. To MediaSite's credit, they provide a tool to export and import schemas in and out of databases.

Internal Web Development
Once we had received the customized schema (or front-end) pages from MediaSite, we had to figure out where to put them and how to make them work.

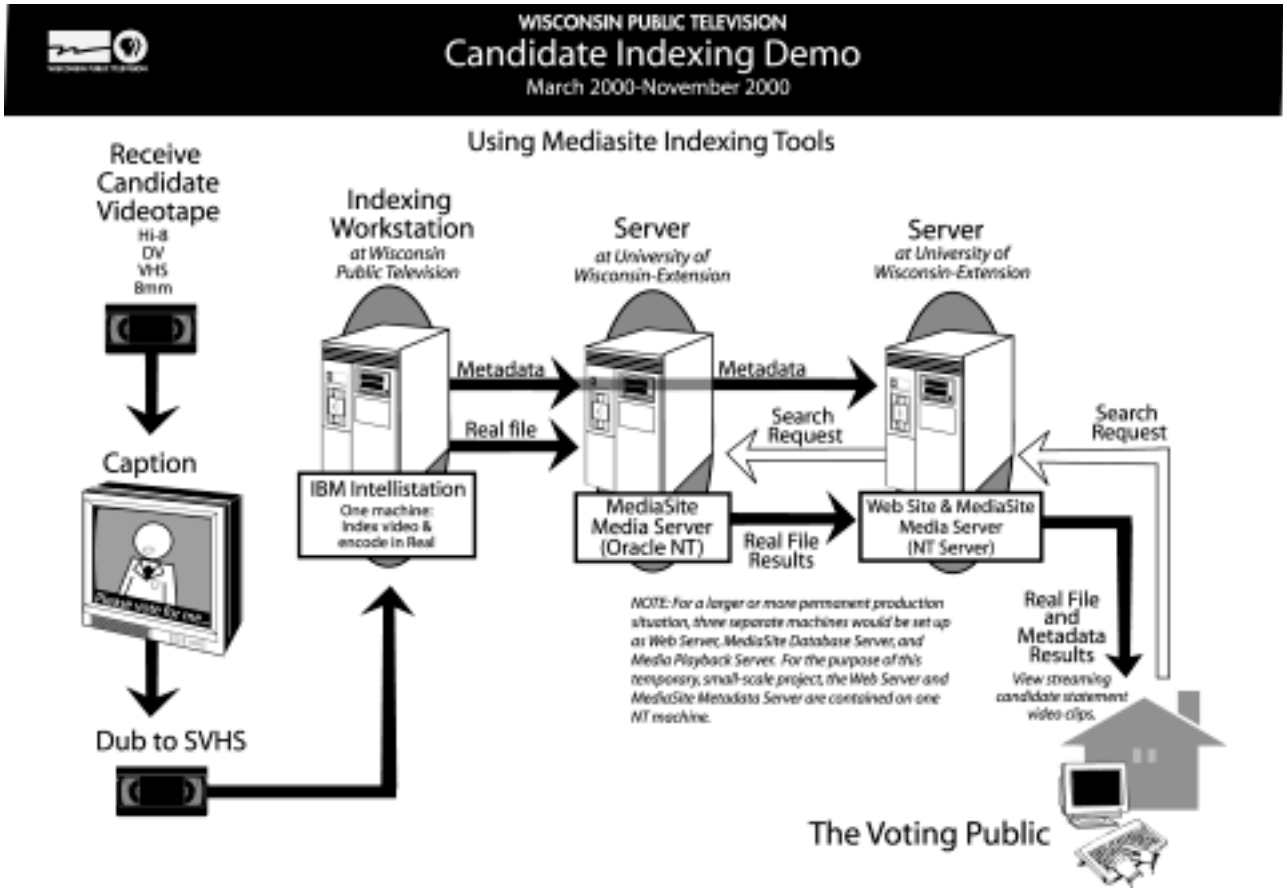
Unfortunately, we could not get the new version to work with our existing database schema, and there was more troubleshooting before we determined that we needed an additional software tool from MediaSite to transfer existing databases. This tool also had to be sent overnight and then installed.

Internal work on the Web site involved adding a javascript set of functions to our original candidate statement page. The javascript was provided by MediaSite, though some additional edits were required to point it at the appropriate ColdFusion files.

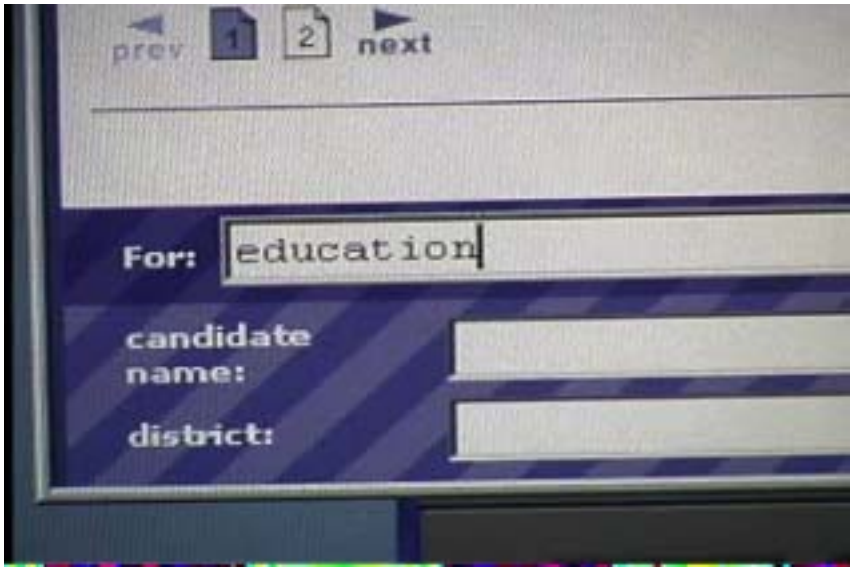
We also spent time writing queries against the MediaSite schema. The queries pulled only those candidates that had logged video clips. From the query results, a form was created to allow the viewer to select one of the candidates. Special code (provided by MediaSite) was incorporated into this form to pass the data to MediaSite's software to perform the search.

Although the ASP file that output the search results was supposed to arrive fully functional, we found several small glitches that we fixed in-house after repeated attempts to receive a corrected file from MediaSite failed.

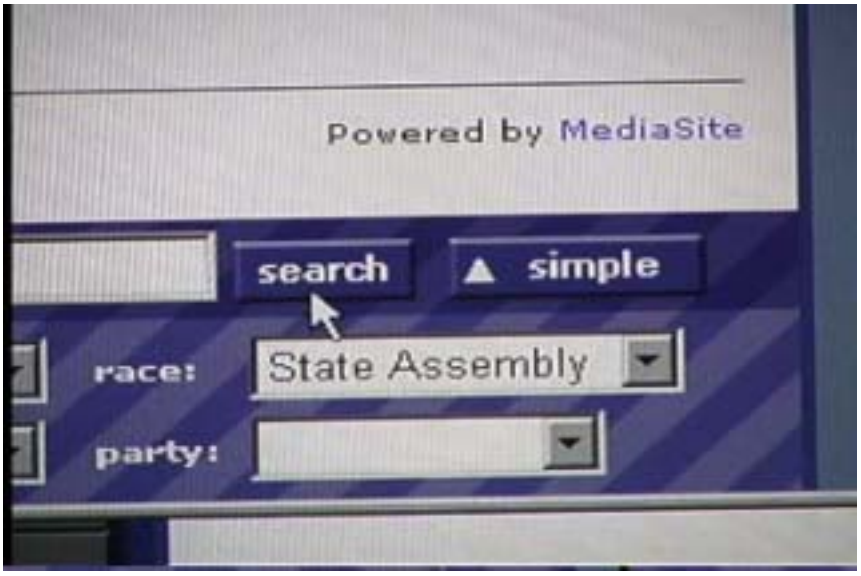
FINAL PRODUCT



It was not until one week before the election that we had a complete working MediaSite system with searchable candidate statements accessible on the Wisconsin Vote Web site. Unfortunately, the search page was not easy to find on the Web site and did not have the look or intuitive ease that we had expected. In particular, the search page contained various fields for entering keywords but did not give directions on how to do a search. As MediaSite wrote this search page, we could not make changes to it. Because there was no time to request revisions, we had to use the pages we were sent.



Keyword Search



Search Button and Dropdown Boxes

The search results page, also written by MediaSite, was awkward and contained features which were confusing. With more lead-time for design, experimentation and revisions of the search and results pages, we could come up with a Web interface that was more user friendly. Ideally, we would write the front-end pages ourselves.

Search Results

Because of the low response by candidates we had a very small database of video to search through, which did not make for a very rich search experience. If the users searched by district for candidate statements, odds were only one result would appear. The small pool of video content did not take advantage of the rich and precise search capabilities of the tools.

Playback of Clip

SECOND PHASE OF WPT INDEXING PROJECT: CREATING A SEARCHABLE VIDEO ARCHIVE FOR EDUCATION

During Phase I (Candidate Indexing), we learned how to set up and use an indexing system. The online product of this activity was a searchable video database of "platform speeches" from a number of candidates for political office. As described in this report, we have learned that a successful asset management system—even one as limited as ours—requires a high level of system integration and technical support. As a result of this steep learning curve, we postponed a number of project goals that hold great promise. These goals included:

- Controlled access, targeted use, specifically making video assets available, at a higher quality level, for use in a formal educational context.
- Internal use, including use of the searchable video as a "tape library" for production.
- Other public uses, including digital terrestrial broadcast of some portion of the database.

Of these postponed goals, we believe the most immediately viable is creating a searchable video archive for educational purposes. In many communities and states, including Wisconsin, there are fiber networks connecting K-12 schools, and there are existing protocols for inclusion of video into the curriculum.

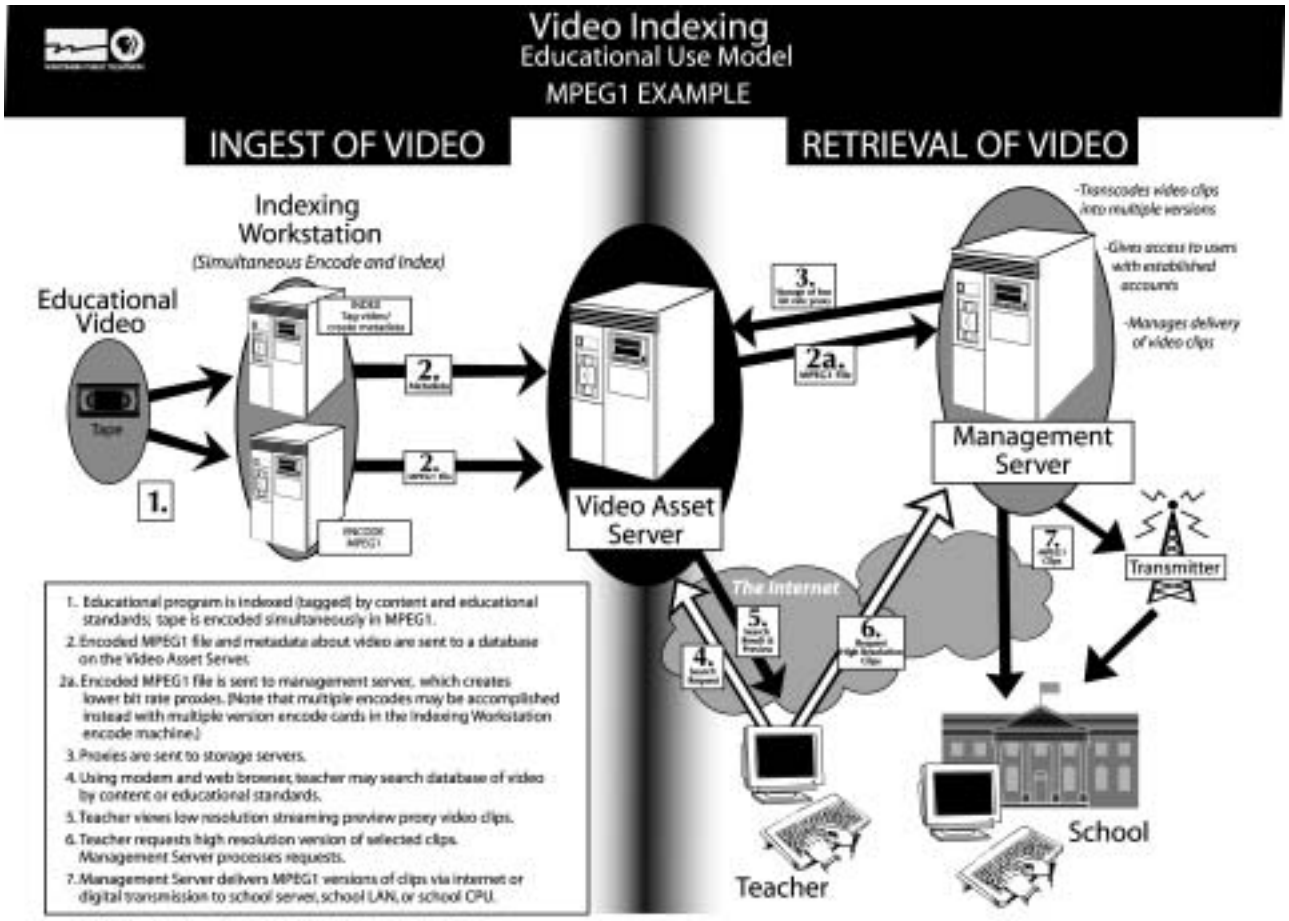
Project partners

For Phase II of the Indexing Project, the scope of work includes the participation of all three public broadcasting entities in Wisconsin: University of Wisconsin-Extension, the Educational Communications Board, and Milwaukee Area Technical College. We are in the process of creating an operational prototype of a searchable video archive composed of video assets related to Wisconsin History. This K-12 asset archive will be accessible to a test group of teachers. Video will be referenced against Wisconsin standards, and will be available to teachers in a low bit rate "preview" mode and a high bit rate "classroom viewing" mode. Video assets will be drawn from content created by the three project partners, with each partner also contributing technical and content expertise.

To accomplish this, we have established video encoding and indexing stations at each partner location, with appropriate support arrangements. We have spent the last several months ramping-up at these three sites, including on-site training, and developing the architecture for user access and fulfillment, including database, user interface, and distribution. We are simultaneously identifying the appropriate content, based on Wisconsin education curriculum standards. We expect to spend 2-3 months recruiting schools and teachers, creating the protocols for use and evaluation, and developing the necessary lesson plans. Actual classroom use will commence in 2002.

The K-12 project will allow teachers to:

- Search for video assets
- View streaming video in “preview mode” at low bit rate
- Select desired clips
- Order high bit rate versions to be delivered as files to a school computer/server



Using a standard Web browser at home or school, teachers will search for clips by curriculum standards, school subject or keyword. The clips will be previewed at a low bit rate, suitable for telephone dial-up connections. Once the teacher selects the desired clips he or she will be able to arrange them into a ‘clip reel.’ The teacher then clicks a button on the browser that automatically sends an MPEG1 version of the clip reel to the teacher’s school server (or LAN or desktop box). The teacher may at the same time request lesson plans or any other auxiliary materials to be sent to the school as well. When the teacher is ready to use the downloaded clips and materials for class, it will be available and ready on the school computer system.

This K-12 scenario is facilitated using a Telestream product called FlipFactory. The FlipFactory allows us to obtain multiple encode versions of a clip with only one pass of a source tape. Instead requiring several parallel encode machines and multiple versions (e.g., MPEG1, Real), the FlipFactory is a software solution that converts a higher quality

encoded video file to as many lesser encode versions as desired. In the case of the K-12 project, we will encode at the indexing workstation in MPEG1and allow to FlipFactory to do the Real encode for streaming preview. The FlipFactory, which requires its own server, also manages the location and retrieval of the various encoded versions. Virage and Telestream are strategic partners and have written plugs-in that allow their tools to work together.

Section 3—Conclusions

LESSONS LEARNED

In summary, we have learned that the set-up and operation of a stand-alone indexing system is complex and probably not a worthwhile activity for many PTV stations – *at the present time*. It was often not clear which hardware and software were needed to support the indexing tools, and set-up of the hardware and software required trial and error and additional research on the part of our project team. Operation of the workstations was not intuitive and generally not smooth—the indexing software still contains bugs. Crucial to our project were the advanced computer skills and experience of our project team, but these human resources may not be available at a typical public television station. Finally, the involvement of the indexing software provider is essential throughout the project, from the initial decisions made about hardware and software purchases, to the set-up and operation of the workstation and server.

ELEVEN ESSENTIALS FOR SUCCESSFUL VIDEO INDEXING

1. Understand *why* you are indexing your video
Who are the end users? Who will benefit from creating a searchable database—the public? The station? What are the benefits? Who will need which skills and technology to search and view streaming video? Understand very clearly why you are creating an indexing system, as it will shape your work and your decisions through the entire process.

2. Beware the television mindset
Television production and broadcast technologies are well established and standardized. This has led us to expect predictability and reliability, and has created shared knowledge in the function of technical systems. In the case of evolving technologies, such as indexing, little is established, predictable or reliable, and there is little common knowledge.

3. Public TV staff (probably) does not have the technical skills. Be prepared to hire or train staff.
A high level of computer knowledge is required to set up and operate any indexing system. Indexing systems are not simply “plug-and-play” and require the skills of a system administrator, Web developer who can write code, and a database manager. Every member of our project team had to learn as they went, and most of the project timeline was spent on research and experimentation. The indexing companies themselves are new ventures in a new industry and are still developing their products, services and training.

4. Consider outsourcing aspects of the work.
Carefully assess your in-house skills. Determine what pieces you will need to outsource. Outsourcing is expensive but saves the time of learning new skills and trial-and-error. You may even consider outsourcing your entire indexing project, including encoding, indexing, development of Web interface and hosting of files. All of the indexing vendors offer these services.

5. Companies are valuable—but risky—partners for public television.
Companies are eager to sell products and services, build client portfolios, and develop viable applications for their tools. Be sure you carefully review and clearly understand their actual capabilities and costs. As a PTV station, you want to take advantage of their expertise, but press them to make sure your goals and their products are aligned. Ask them to review your plans and give you feedback before you come to an agreement. Ask them for names of clients who have worked with them and contact them for recommendations. You are not buying a single product (like a video camera) where specifications are easy to compare, and the final decision often comes down to cost and a definable service contract. As much as anything, you are "buying" a company.

6. There is no out-of-box solution for indexing. Expect ongoing costs.
As of this writing, there is no out-of-the-box indexing solution for setting up an internal indexing system (although vendors will do their best to convince you they have an end-to-end solution). Research, computer staff and computer code writing are essential, as well as a healthy timeline for trial-and-error and learning new skills. Also, the equipment and software require integration, which requires advanced technical skills. Some vendors will provide integration and customization for a fee, but even after the indexing system is set up, there will be on-going costs for technical fixes and data management.

7. Technology is constantly evolving.
Making the decision to purchase an indexer and all the elements that go with it is a potentially risky venture. Technology evolves, and technology becomes obsolete. As we found with the Dell computer we bought for our MediaSite indexing workstation, a small change in a piece of hardware (such as a new set of BIOs) can render a machine completely useless for the purpose it was intended. We have seen the Virage VideoLogger package and services improve dramatically over the last year—enough to win us back to their company. Before investing in any major technology purchase it is essential to do careful research. Ideally, you will be given a trial period with the tools. Make sure that the vendor is working with other companies to ensure integration and compatibility.

8. Follow the commonly accepted standards for asset management.
This includes equipment purchases, computer language, databases and most importantly, metadata. It will be critical that whatever you set up for video indexing is compatible with the indexing and DAM systems of other organizations. (As we've noted, there are no "commonly accepted standards" yet in place. Avoid proprietary systems. Absolutely avoid companies with no track record or plans for open systems.)

9. Content – which includes metadata – is the key.
Content remains PTV's core resource. In relation to asset management, this means that controlling the metadata is critical (eg, standards, granularity, topics, syntax, and so on). Storage, networking, transport – these can and probably should be at least partially outsourced.

10. Managing the metadata will be expensive. No one knows how expensive.
We expect metadata management to be the most expensive ongoing piece of the DAM puzzle, primarily because it will always require some degree of human judgment, and may therefore not benefit from efficiencies of scale or technological progress. It isn't yet clear how "professional" metadata management will need to be. What is the equivalent of a metadata executive producer, producer, and production assistant?

11. Remember your existing project management skills!

- **Review budgets very carefully.**
  While this is necessary in any project, it is especially so with new technologies. Some of the activities and equipment related to indexing have no direct correlation to traditional television. It's easy to overlook an item or area, for example, appropriate encoding cards, appropriate servers, sufficient training.

- **You need a strong project manager. You may also need professional system integration.**
  Indexing and digital asset management are complicated processes and require very strong project management skills. It's also possible that you will need professional consultation along the way. As DAM grows in visibility, consultants will pop up everywhere. Look for a track record.

- **Assemble your project team early and meet often.**
  You will have technical meetings and content meetings, but do not neglect to bring the whole team together regularly. The technology will drive the content development and the content will drive the technology. They are to a degree inseparable. Bringing the entire team together also helps to develop a community of knowledge about this new process. Talking together minimizes the chances that a crucial piece of information is missing.

- **Make no assumptions. Research everything!**
  Do not assign resources, make purchases, set up workflow or timeline or design content or Web interfaces until every aspect of your plan has been explored. Have technical staff thoroughly study the indexing vendor documentation, interview other customers, set up a trial period with the products you are considering. Ask even the seemingly obvious questions. What isn't included in the contract that other organizations have found useful? Is follow-up support extra? Are there copies of support documentation you can review for clarity? Do they have a list of hardware recommendations your technology people can review? What, if any, training is available from vendor?

VENDOR RELATIONSHIPS

Good partners are essential to success

As we have noted, video indexing is an evolving technology, in every sense. The software is new and continually being improved. Associated technologies — e.g., handling video over IP, broadband delivery, server size, and end-user computing power — are changing rapidly. Customer demand isn't well understood. The companies involved are often new, and undergoing change as well. And for public television, the value of video indexing and DAM isn't well defined.

All of this puts special emphasis on the relationship between a PTV station and whichever vendors are selected for products and services. Working relationships with vendors is a critical factor in creating an indexing or DAM system. The working relationship with the vendor does not end with the purchase of the indexing tools. Expect frequent contact with the technical staff throughout the process of set up and implementation. You and the vendor must have a clear understanding of project goals, technical needs and staff skill requirements. Indexing tools are still new and you may encounter bugs, unclear manuals and other problems you will not be able to fix on your own. The vendor must be willing to work with you to make correct purchases for your needs and have technical staff available for emergencies. These vendors are relatively new companies in a new field and will want to learn from their customers. Take advantage of their eagerness to solve problems with their own tools, and use the feedback you give them as leverage.

Understand the difference between a company's marketing and technical groups. Sales staff will have technical expertise, but in-depth work between station and company tech staff is essential. On several occasions, we developed incorrect understandings of capabilities and requirements.

Hold face-to-face meetings. Telephone and e-mail communication are necessary, but not sufficient. Insist that every step of the process is clearly defined and understood. Don't leave questions hanging. Resist the urge to keep things moving along without first establishing firm answers for difficult questions and identifying areas which do not yet have good answers.

No vendor is perfect

As we found with Virage and MediaSite, both of these companies and their tools posed difficulties for us. Ultimately we had to choose one but were not perfectly satisfied with either. The bottom line will be to weigh your priorities and aim to get what you need through clear communication and careful negotiation.

Mixed experiences with MediaSite & Virage
The indexing team found that working with MediaSite was overall a better experience than working with Virage, though both products offered unique features and challenges; and were essentially a wash in overall capabilities.

Virage's technology is highly proprietary and not user-friendly. The workstation software was difficult to learn to use, and the company did not provide much assistance in helping us become proficient. We had the impression that Virage was not interested in selling or supporting their software but rather selling their services as an indexer. Their organization was not geared toward the autonomous user. There appears to have been a shift towards better customer service within the organization.

MediaSite gave us better customer service and support. The fact that the back-end database is in Oracle offers potentially greater flexibility. MediaSite also provides "wizards" for the creation of input fields. The MediaSite workstation software is much more intuitive than Virage; plus, we were given a well-written training manual. However, in our experience the workstation tools are somewhat less stable than the Virage tools and tend to crash.

For the second phase of indexing, we engaged in an intensive process with both Virage and MediaSite, as well as other asset management tool vendors. The issue for us was whether to continue working with MediaSite, or start afresh with Virage. (There are other companies providing indexing software and services, notably Convera, but we did not have the resources to research additional vendors.) The process consisted of on-site visits both at WPT and at vendor facilities, extended and numerous phone conversations and e-mails, and a more formal request for information" submitted to MediaSite and Virage (Virage RFI included as an appendix). E-mail in particular is a valuable tool, as there is a written record for reference.

Our criteria for choosing a vendor

Software features
- Technical reliability and quality
- Range of functions of tools
- Compatibility with other internal systems (editors, servers, databases, logging tools, etc.)

Willingness to work with us in
- Customizing tools and applications
- Negotiating costs and services
- Engaging with us not only in a buyer-seller relationship but also as partners, exploring and developing new services (for us) and new markets (for them)

Other partners

- Our own existing partners and the products they use
- Desirability of the vendors' partners
- Vendor partners in Media Asset Management

Stability of company

- Years in service
- Financial health
- Loyalty of staff
- Recommendations by other customers
- Will their business plan take them away from our area of interest?

MediaSite strengths included a company culture more closely aligned with educational applications, and several attractive software features (eg, use of Oracle, easier user interface).

However, we ultimately chose to work with Virage.

The primary reasons for choosing Virage were a stronger established client base, existing integration with other products, relatively larger size, and the company's indications that they had dramatically improved their service orientation.

Conclusion

Indexed video has a valuable, but currently limited, role to play in public television.

We believe that indexed video, as part of larger digital asset management systems, can be an important part of public television's future — but not yet. Despite rapidly evolving technology that continues to lower costs, increase power and ease implementation, indexing and DAM are currently not practical operational activities for PTV.

Indexed video, will ultimately make your content more valuable. But it also adds another task for staff to learn and accomplish, and it will require ongoing professional oversight and management.

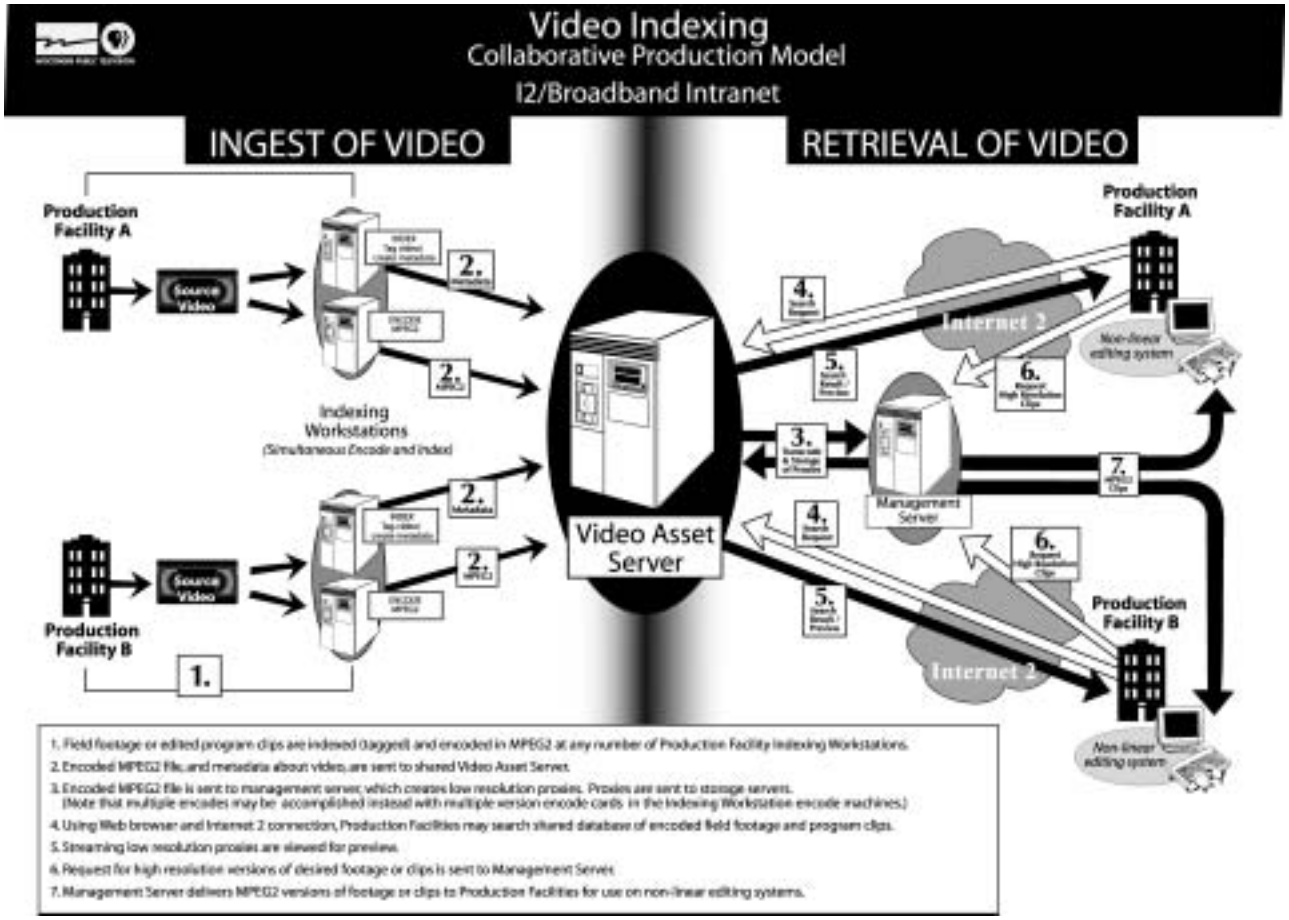
We do not believe it is currently worth the investment for a mid-sized PTV operation to develop a stand-alone searchable video system, unless the station is…

- Part of a *local inter-organizational effort* where shared assets are clearly important, such as working relationships with museums, libraries, colleges, and so on.
- Part of an *overall reconfiguration of production workflow*. If a station is being reorganized, or the technical shop updated, it makes sense to integrate both process and technology changes that support better asset management. An important starting point could be implementation of common logging methods and tools for video productions. We would encourage any producing television station that is working with digital video, to consider implementing at least some form of indexing. Once you are digitizing, the question arises, "why not index at the same time?"

Or wants to…

- Gain *expertise in the technology*, and continue staff training and organizational change related to the overall digital transition.
- Provide *basic search capability* within clearly structured content bases; for example, as NHPT is doing with its nightly news program. The number of users will be a small, growing, important constituency, but the value has yet to be proven.
- Develop *focused services*, such as K-12 delivery.

We believe that the best way for stations to proceed is to develop indexing and DAM systems on a collaborative basis.



There are important broadband capabilities afforded by Internet-2, now accessible to PTV stations. Server costs have plummeted. Software for indexing and managing assets is cheaper and easier to use. DAM creates the possibility of truly shared resources, and costs, without requiring that stations give up their traditional editorial or financial independence.

Digital asset management will underlie and enable many of the myriad new services envisioned for digital broadcasting, broadband delivery, and wireless services. The technology is changing rapidly, bringing declining costs, increased power, and easier implementation. But there are major hurdles, including: bandwidth considerations, employee skill-sets, start-up and maintenance costs, lack of accepted standards, PTV culture, intellectual property rights, and public acceptance. We believe that, for now, systems that focus on narrowly targeted consumer services (such as education), and production, such as those in use by CNN and Paramount, are appropriate strategies for PTV.

Despite the difficulties, WPT remains optimistic and enthusiastic about the value of indexed video and digital asset management. The possibility of easily locating, sharing, using, and reusing PTV content holds great promise not only for improving efficiency, but for creating new services for our local and national communities.

Report authors:

James Steinbach
Director of Programming and Production
(608) 263-1232
steinbach@wpt.org

Tina Hauser
Project Manager
(608) 262-6756
hauser@wpt.org

Wisconsin Public Television
821 University Ave.
Madison, WI 53706-1412

We invite and welcome your comments and inquiries.

APPENDICES

Costs

There's no formula (yet) for assessing the value of indexing to a public television station. However, we offer these ball-park costs to consider:

A. To purchase and set-up an operational Virage indexing system, assuming all hardware and software will be newly acquired rather than re-assigned within the station: **~$150,000**

Hardware

NT Server: **$3,000**

Workstation computers: $2850 x 2 = **$6,000**

Osprey 100 video capture card $150 x 2: **$300**

S-VHS Hi-Fi Recorder: **$4,000**

V-LAN controller: **$600**

TV Monitor: **$200**

Software

RealSystem Producer Plus: **$200**

Software package (discounted 40% for non-profit)

VAS & license, unlimited users: **$50,000**

VideoLogger: **$14,000**

Virage annual support: **$6,000**

Workstation & interface customization training: **$12,000**

Staff

Set-up staff costs (over six months):

Project Manager: 500 hours x $45/hr. = **$22,500**

Workstation Manager: 200 hours x $45/hr. = **$9,000**

Web Developer/Database Manager: 200 hours x $45/hr. = **$9,000**

System Administrator: 100 hours x $60 = **$6,000**

B. Operational costs for one year

There are too many variables to give even a ballpark estimate of the total cost of maintaining and using an indexing system for a period of time. We can, however, list the main variables and the factors that should be considered when putting together a work plan and budget.

Variables

-Number of hours of programming:

The encoding and indexing of a program occurs in real time, so one hour of programming takes one hour to index. The amount of time spent defining and tagging clips can vary a great deal. Dividing a program into a few simple segments and adding basic information tags such as title and air date can take a couple of minutes per segment. In many cases, however, additional information about a clip will be desired, such as a description of each clip or names of people onscreen, links to URLs or other documents, or additional searchable keywords that do not appear in the program transcript such as synonyms or related topics. In the case of educational use, video clips may be correlated with educational standards, grade level or auxiliary teaching materials. The time spent on research and adding rich information to each clip can add up dramatically. Potentially, many hours of work can go into indexing a one-hour program.

-Indexing Staff

The decision about who should actually do the encoding and indexing of video is not easy or obvious. Most likely a student or Production Assistant, even with few technical skills, would be able to handle the task of running video through the encoding and indexing machines. The more complicated and crucial task is deciding what segments (clips) to create from a program, what keywords or description to add to the clip, and what (if any) enhancements or auxiliary materials to add. These kinds of decisions need to be made by someone knowledgeable about the content, such as the program producer. Most likely a variety of staff will work with the content at different times – perhaps a producer will decide in and out times of program clips and write descriptions, and a PA will index and encode the program and enter the producer's information. The issue of producers spending additional time on a project beyond creating a stand alone program for broadcast is relevant to all areas of television enhancements, including Web development and interactive components. How much more time or how many additional staff need to be devoted to a single program?

-Closed captioning:

We strongly recommend using closed captioning to index video, as the other mechanisms such as voice recognition, face recognition and onscreen graphics recognition are not as reliable at this time. For video that has not already been captioned, there will be additional expense and time needed to do this. Assume at least six hours for transcribing and captioning a one-hour program.

-Workstation/Server/Web page maintenance

It might be possible to set up your indexing workstation and server, create a Web interface, and index programs without incident for an entire year. We suggest, however, expecting a few technical snags in the course of a year. Plan to call in your workstation manager and system administrator for the occasional crisis. Also plan to install software upgrades once or twice per year. If the indexing system is being used for multiple purposes (say, internal production use and public program viewing) then you must plan to create multiple Web pages and multiple databases.

Technical Specifications

These specifications represent hardware and software we purchased and/or used for our MediaSite and Virage indexing trials between March 2000 and April 2001.

MediaSite

Indexing/Encoding Workstation

Encoder and Indexer:
Dell Precision Workstation 420 MiniTower (purchased)
Dual Pentium III 800MHz Processor
512MB RAM
Windows NT

IBM Intellistation (borrowed/used)

Indexing Workstation software

RealProducer 7

Videomedia V-LAN Controller

ViewCast Osprey 100 Video Capture Card (x2)

Servers

Web Server
Compaq Proliant
Dual Pentium III Processor
512 MB RAM
NT 4.0

Oracle Database Server
Compaq Proliant
Dual 400 MHz Pentium II Processor
I GB RAM
RAID 5 Disc Array

MediaSite Package

-AutoIndexer Module
-Highlights Module
-Sphinx Speech Module
-Module Manager

Web Interface Software

Macromedia Fireworks, Dreamweaver & ColdFusion Studio
SQL Navigator (to view database)

Virage

Indexing/Encoding Workstation

Encoder:
OTC 3100SW01 Percheron HE Workstation Computer
Dual Pentium III 1GHz Processor
512 MB RAM
Windows 2000

Indexer:
OTC 3100SW01 Percheron HE Workstation Computer
Dual Pentium III 1GHz Processor
512 MB RAM
Windows 2000

Indexing Workstation Software

RealProducer Plus 8

Videomedia V-LAN Controller

ViewCast Osprey 2000 Video Capture Card
Viewcast Osprey 100 Video Capture Card

Server

Compaq Proliant
Dual Pentium III Processor
512 MB RAM
NT 4.0

Virage Package

-Video Application Server
-VideoLogger

Tape Decks

Sony SVHS SVO-5800

Panasonic DVCPRO 50

Bibliography

Burke, Ken. Getting Your Assets in Gear. *Catalog Age*, July 1, 2001.

Doering, David. Defining the DAM Thing. *EMedia*, August 2001, Vol. 14 Issue 8, p 28.

Mancebo, C. Jason. Asset management in news and broadcast production environments. *Broadcast Engineering*, October 1, 2001.

Robinson, Sara. Putting It Together. *Inter@ctive Week, 7/9/2001, Vol.8 Issue 27, p 3.*

Van Tassel, Joan (2001). *Digital Content Management: Creating and Distributing Media Assets by Broadcasters*. Washington, D.C.: NAB Research and Planning Department.

DAM Vendors/Integrators, Asset Management Products, and Contact Information

Ancept, Inc.
Product*: MediaPoint*
612-677-1385
www.ancept.com

Artesia Technologies (has a good general discussion of DAM, specific discussion about WGBH activities)
Product: *TEAMS*
Eastern Region 301-548-7850
Western Region 408-532-1223
www.artesia.com

Ascential Software (a spinoff of Informix)
Product: *Media360*
1-800-966-9875
http://www.ascentialsoftware.com/

Bulldog Group
Product: *Two.Zero*
310-244-2855
www.bulldog.com

Convera (formerly Excalibur, joined with Intel)
Product: *Screening Room & RetrievalWare*
1-800-788-7758
www.convera.com

IBM
Product: *Content Manager*
1-800-426-2255
ibmcm@us.ibm.com.

eMotion
Product: *MediaPartner*
1-866-236-6846
www.emotion.com

MediaSite (bought by **Sonic Foundry,** now **Sonic Foundry Media Systems**)
Product: *Rich Media Publisher Suite*
1-877-783-7987
www.mediasite.com

Virage Technologies
Product: *VideoLogger*
650-573-3210
www.virage.com

PBS Web Sites using Virage

Mathline:
http://www.pbs.org/teachersource/math.htm

Online NewsHour:
http://www.pbs.org/newshour/

American Field Guide:
http://www.pbs.org/americanfieldguide/

Other resources

CPB is developing a comprehensive DAM **glossary**. There are several glossaries available as part of published reports, none (that we know of) free.

Following are additional references (as of 12/01)

ADL Colab
The Advanced Distributed Colab site has comprehensive specific and technical information about the Sharable Content Object Reference Model (SCORM) specifications and other aspects of both asset management and distributed learning.
http://www.adlnet.org/index.cfm

ETV Cookbook
DTV, not DAM, but valuable
http://etvcookbook.org/home/index.html

United Entertainment Media, Inc
The Guide to Digital Television
General information about DTV, glossary
http://www.digitaltelevision.com/dtvbook/toc.shtml

eContent
It's a Digital World, After All: Options in Digital Asset Management
by Bill Trippe
October 2001
http://www.econtentmag.com/Magazine/Features/trippe10_01.html

Interwoven
General glossary, not specific to TV
http://www.interwoven.com/developer/expertise/general/glossary.html#other

Picdar, Inc.
Limited but clear DAM glossary
http://www.picdar.com/htdocs/faq.html#contmanage

Electronic Cinematography
General video production glossary
http://www.gregssandbox.com/gtech/elecinema/elcineglossary.htm

PCOV
Glossary of acronyms (general computer related, not video or broadcast)
http://www.sunline.net/rjalbert/pcov/Intranet/Glossary.htm