

LIBRARY OF CONGRESS CASE STUDY

Preserving our nations's video content

The Library of Congress (LOC) is using the technology of Front Porch Digital to preserve the nation's rich treasure trove of videotape recordings so they won't be lost to future generations.

A multi-year project to migrate analog videotapes to digital files got under way in early 2008 at the library's National Audio-Visual Conservation Center in Culpeper, Virginia. The 415,000-square foot building is a state-of-the-art facility recently refurbished through a gift of \$155 million from the Packard Humanities Institute.

The Library of Congress-Front Porch Digital story had its beginnings over seven years ago. It's a story of how a daunting technology challenge was overcome through a leap of faith, go-to-the moon invention and development work, and creative solutions in hardware and software.

“The library realized that it would take many decades and be prohibitively expensive to migrate and digitize the audio-visual collection manually. Using Front Porch Digital, they would be done in a few years and drastically reduce cost.”

– Jim Lindner, Senior VP Strategic Development
Front Porch Digital



World's largest videotape collection

Imagine a pile of videotape cassettes about as tall as the dome on the U.S. Capitol in Washington. That's figuratively what the LOC archivists were contemplating as they sat down to decide how to preserve those videotapes for future generations.

"We have over 600,000 videotapes, one of the largest collections in the world," said Greg Lukow, chief of the library's Motion Picture, Broadcasting and Recorded Sound Division." The problem of preservation was urgent, because the quality of those videotapes was deteriorating, meaning that a significant portion was at risk of being lost every year," he said.

"What's more, new videotapes were streaming into the library every day – for just one example, VHS cassettes of CNN broadcasts, 24 hours a day, seven days a week. Our collection was growing by some 120,000 to 150,000 items each year."

Technology had to be invented

In 2001 Lukow engaged Jim Lindner, an internationally respected authority on the preservation and migration of electronic media and founder of the consulting firm Media Matters. Lindner, who now serves as Senior Vice President of Strategic Development for Front Porch Digital, was hired as a consultant to collaborate on finding a solution.

"When we started, we looked at the size of the collection and realized that there would be many challenges," said Lindner. "The technology to automate the migration process and achieve the throughput needed in a timely and cost effective manner simply didn't exist. We would have to invent it."

A leap of faith

Unless a creative and inventive solution could be found, the LOC faced three alternatives:

- Abandon the idea of preserving the tapes, an unacceptable option given the library's mission of making its resources available and useful to Congress and the American people;
- Preserve only selected videotapes, an option that would require extremely difficult decisions in guessing what might be important 10, 50 or 100 years from now; or
- Place a bet and have faith that creative minds would come up with a workable solution in a reasonable time frame.

"I chose the third option as a challenge," said Lindner. "I had faith that we could do this. In 2001 the technology didn't exist. I hoped we could bring it into existence in six or seven years."

The building in Culpeper was a huge advantage for the project. Originally built by the Federal Reserve, it was bought by David Woodley Packard, chairman of the Packard Humanities Institute, in 1998.

"It was more than we could have hoped for," said Lindner. "Part of it was already there – it had been built to hold enough U.S. currency to supply the eastern half of the U.S. in case of nuclear attack, so it had these amazing underground vault areas that could be adapted for storing tape, film and other archives with carefully controlled temperature and humidity conditions. Then, with the help of the Packard Foundation, the library was able to refit it and build additional space for processing, research, administration and other functions."

Four critical problems to solve

The videotape migration solution that the project team sought would have to solve four problems. It would have to:

- Eliminate the need for manual video quality monitoring
- Encode for several levels of quality simultaneously – archive, production and browsing quality
- Migrate a large number of tapes at the same time in real time
- Improve image quality while creating metadata about the content

“We started with industrial robots that were available at the time but had been designed for other purposes,” Lindner said.

“They had to be modified substantially to handle videotape cassettes. At the same time we were working on how to generate data about the tape content, developing methods for cleaning old tapes, and designing the workflow process from one end to the other. Above all we wanted to make sure we didn’t lose anything that was on the original files. We wanted to create lossless files.”

The SAMMArobot is born

It took several years and the hard work of many members of Lindner’s and Lukow’s team, but eventually they came up with the System for Automated Migration of Media Assets, or SAMMA, now known as the SAMMArobot. SAMMA Systems, formed to manufacture the Robot™ and other migration products, was acquired by Front Porch Digital in 2008.

At full production four SAMMA Robots™ will be installed at the Culpeper facility. The Robot™ is designed to migrate huge libraries containing massive numbers of videotape cassettes in either U-Matic or Betacam formats. It can produce large numbers of simultaneous digital video encodings from seven VTRs. The recordings are not copied as video but as digital files, with complete metadata to describe the condition of the content.

“The library realized that it would take many decades and be prohibitively expensive to migrate and digitize the audio-visual collection manually. Using Front Porch Digital, they would be done in a few years and drastically reduce cost,” concludes Lindner.

The SAMMArobot workflow

The digitized output from the Front Porch Digital migration machines is encoded in many formats which include JPEG2000, MPEG-2, Quicktime, Flash, MPEG-1, Windows Media, MXF, amongst others.

The Library has chosen the following formats:

- Lossless JPEG2000 for archiving
- MPEG-2 for mezzanine or working copies
- Windows Media for general purpose sharing
- Real Media for low-latency desktop browsing

Here’s how the SAMMArobot workflow goes:

Before the SAMMArobot is installed, Front Porch Digital Customer Support investigates the user’s data systems. Database support is included in the SAMMA Robot’s™ first-year maintenance agreement. If appropriate, Front Porch Digital Customer Support imports the user’s tape ID or barcode records to the SAMMA Robot’s™ SQL database.

The accessioning procedure

The SAMMArobot can hold up to 48 U-Matic or 60 Betacam cassettes at one time. A tape-prep operator pulls a suitable batch of tapes from the library and performs an accessioning procedure that includes these steps:

- Visual and olfactory inspection for foreign objects or damage
- Visual confirmation of tape markings (it’s the right tape in the box)
- Notation of inspection results in Front Porch Digital software, to be included in Front Porch Digital’s XML report later
- Printing and application of Front Porch Digital-readable barcode label

After each tape gets passed through SAMMAclean, the operator notes each tape’s cleaning status (Pass/Fail) in the accessioning procedure above. Either way, every tape’s cleaning status is reported in SAMMArobot’s XML output.

The SAMMArobot scans the tapes for barcodes. Unreadable barcodes (usually just misplaced) are reported on the SAMMArobot workstation screen so the operator can reset them.

When all tape migrations are completed, the SAMMArobot workstation screen informs the operator. Progress is always visible so the operator can predict when to return with the next batch of tapes.

A terabyte of digital files per day

Seven VTRs and four plus simultaneous encodings deliver dozens of streams all day, every day. That's a fountain of video output from one part-time operator and about ten square feet of floor space. If a user chooses lossless JPEG2000 for archiving, 15-50 Mb/s MPEG-2 for a mezzanine or working copy, Windows Media for general purpose sharing, and Real Media for low-latency desktop browsing, a SAMMARobot could easily generate a terabyte or more of digital video files every day.

To empower the Library of Congress's infrastructure to absorb that much video that fast, a SAMMARobot's™ files and metadata are organized in a standardized manner, on standard computer equipment, with standardized video connections and best practices.

Project also expected to employ SAMMA Solos™

In addition to the four SAMMARobots, the Library of Congress migration project is expected to utilize a total of 15 SAMMASolos, an appliance designed for smaller jobs, digitizing one videotape at a time. It can handle videotape in any format, including one-inch, VHS and others. Each Solo is designed to be an independent system, but has scalable control architecture. Up to 16 SAMMASolo systems can be networked and controlled by one operator using a centralized, easy-to-manage interface.

Front Porch Digital and the LOC estimate that in its first full year of operation, the migration project will produce approximately 2 petabytes (2,000 terabytes or 2 million gigabytes) of digital content. This amount of data, if stored on 700 mb CD-ROMs, would create a stack of disks more than two miles high. When additional planned systems are brought online, the annual production rate is expected to go up to three to five petabytes.

A test bed for invention

In addition to Front Porch Digital, other firms are partnering in the project. Ascent Media has been responsible for the overall design of audiovisual aspects, and Communications Engineering Inc. (CEI) is serving as systems integrator.

"Our facility is actually a test bed for research, development and invention," said Lukow. "We are fortunate to be working in collaboration and partnership with Front Porch Digital, Ascent, CEI and firms in the manufacturing and creative communities, as well as other libraries and archives to acquire and preserve these treasures for the future."

"The library holds the world's largest audiovisual collection, and we take our stewardship obligations very seriously," Lukow concluded. "With projects like this one, we are developing the ability to make our service better, faster, more useful, and more efficient, with greater capability and capacity on behalf of the American people and the American taxpayer."



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