



Keeping Music Alive

**DIGITAL TECHNOLOGY IS
THE MEANS TO PRESERVATION**

BY DAN CARSON

The invention of the phonograph in the late 1800s and, eventually, the availability of electric power made it possible to readily capture live music or sound, then reproduce it in quantity and replay it. Devices were built that translated sounds into minute “scratchings” on metal or wax disks. The phonograph, using a special, sharp needle, navigated the recorded “scratchings” and translated the movement of the needle into electronic audio signals that were then amplified through a speaker, faithfully reproducing the originally captured live music. Within a relatively short

period of time, audio and manufacturing technologies evolved, bringing the magic of the world’s most beautiful music and the voices of history to anyone or anyplace that could afford a phonograph and the records on which the music was recorded. The broadcasting of music and speech over the radio soon followed.

The revolution in audio recording was in full swing by the early 1900s, yet the media on which it was recorded and stored continued to evolve. The middle of the 20th century saw the

advent of magnetic tape for music storage. In the late 1980s, analog audio began to yield to digital recordings and playback devices, leading to the popular digital music formats found on today's popular CDs and the emerging DVD medium.

MUSIC CARETAKERS

So why the history lesson in a computer technology publication? By understanding the unique historical importance of audio recordings and images, one begins to envision how the use of digital technology to capture and preserve this cultural legacy will enable future generations to enjoy the fascinating evolution and exquisite beauty of recorded sound.

When Sony Corporation bought CBS Records in 1988, they acquired the archives of the oldest audio recording company in the world. Included in the CBS library were some recordings dating back to the early part of the 20th century. Combined with their own library of sound, Sony Music became the proprietor of over 500,000 recordings, nearly 35% of the world's commercially recorded music and audio. Along with the recordings, Sony is also the owner of millions of graphic images such as album covers, album inserts, and photographs of musical artists. Almost overnight, Sony inherited the mantle of preservationist and became the steward of a cultural legacy.

With recordings residing on media that vary from wax, to metal, glass, vinyl, magnetic tape, and CD, in addition to many images and photographs residing on paper or negatives, the task of cataloguing and preserving the music of the world is daunting. In the case of many early recordings and images, whose state of preservation is rapidly deteriorating, it is, in fact, a matter of pressing concern.

PRESERVING MUSICAL HISTORY WITH ZEROS AND ONES

The advent of digital audio and graph-

ics technology in the 1980s and '90s has created what Sony considers to be the most practical and flexible means of archiving its vast collection of musical recordings and artistic images. Not only do today's digital technologies provide a means to precisely capture and/or duplicate recordings and images, they also provide a means to continually monitor and maintain the Sony "music library."

"There is no such thing as media that lasts forever," says Malcolm Davidson, Sony Music's vice president of technology. "Accepting that philosophy, we asked ourselves what characteristics we would need for a system of checking the quality of media over time, of cyclically testing them to see if they're failing, and replacing the media before the quality of the sound or image deteriorates."

A UNIQUE SYSTEM KEEPS THE MUSIC ALIVE

With those key concepts in mind, Sony Music, along with several consulting partners and equipment vendors, began contemplating and designing the music archive system in the early 1990s. The initial portions of the system went live in 1996 and the system continues to evolve and expand today.

Behind the scenes of the massive project is a heterogeneous set of workstations, servers, disk arrays, tape libraries, and network connections that any technologist will find fascinating. Let's take a look at how it works.

GENERAL SYSTEM REQUIREMENTS

Sony Music elected to build its archive system based on an open systems approach. The system has two major roles: asset protection and asset management. One critical facet of the system is the fact that the file sizes involved are extremely large. The Fig provides an overall schematic of the music archive system.

Sony Music knew early in the process

that they needed to capture as much detail as possible for audio and graphic image preservation. With audio, it is particularly important to preserve every nuance and subtlety of the original recording; otherwise, it's lost forever. For graphics files, Sony wanted to capture material at the highest resolution possible. By scanning at 300dpi, for instance, the ability to enlarge material or accurately reproduce large size originals is lost. That meant Sony Music had to look at disk and tape storage, communications, and database technologies that would support substantial file sizes and would scale upward as needed.

Also a consideration was the international nature of the Music Archive Project. Whatever technologies and processes were developed had to be transferable to sites outside the U.S. Initially, Sony Music established the archiving project at its facilities in New York City. The project has since been mirrored and expanded to Sony Music's operations in London. Masters located in the UK will be archived first, then the project will expand, embracing other venues throughout the world.

INITIAL ARCHIVE FILE PREPARATION

All material for archiving, both audio and graphic, starts out being captured and manipulated on Apple Macintosh workstations at Sony's NYC Sound Studio. In the case of audio files, Sony uses Sonic Studio software from Sonic Solutions to create an AIFF (Audio Interchange File Format) audio master file. Master files are written to a 9GB MOFS (Media Optimized File System) removable hard disk.

To get a concept of file size, consider that typical AIFF files for a 60-minute album require around 638MB of disk space. That's based on the current capture technology of 44.1KHz/16 bits stereo. Sony is preparing for higher density audio, including 24 bit Linear PCM at 176.4 or 192KHz, DVD Audio, Super Audio CD (SACD), and true multi-channel (five

channels), which can take as much as 5GB for the same hour of audio.

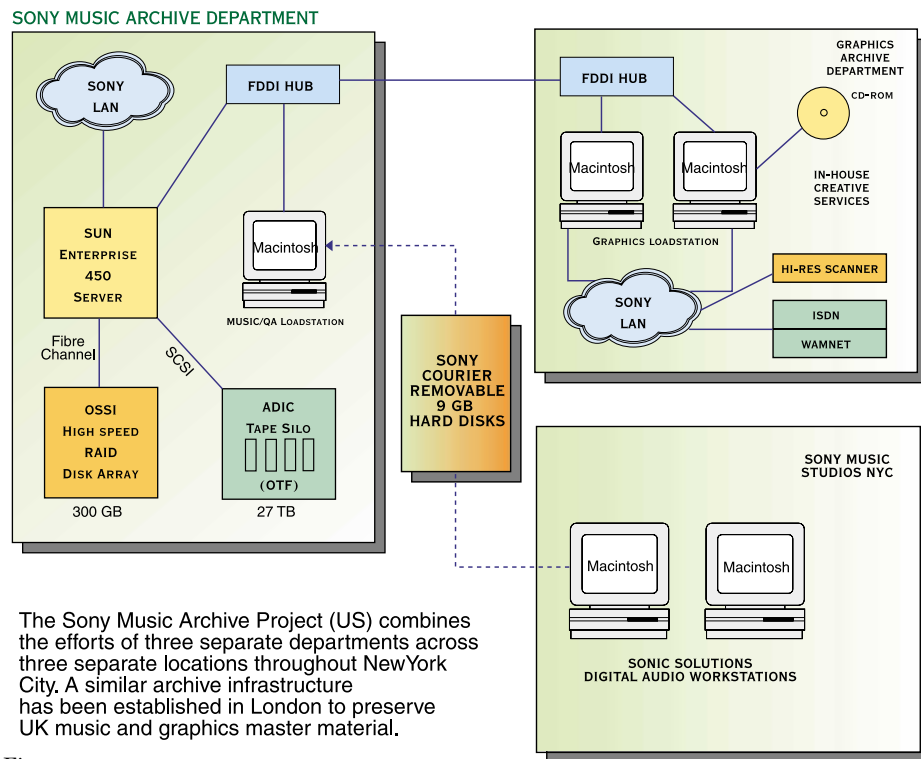
Digital Audio Workstations at the Sony Music Studio transfer audio onto removable hard drives, which are, then, sent via courier to the Sony Music Archive on the other side of Manhattan. This is a secure and cost effective method of transferring many gigabytes of data across a long distance.

Graphics files are managed by Sony's Graphical Asset Management Archive (GAMA) Department. Older graphics material, those that were not originally created digitally, are scanned into the workstation using a high resolution scanner and are, then, treated using a number of popular image manipulation programs such as Adobe Photoshop, Adobe Illustrator, and Quark Express. Files are transferred directly to the Archive System via a high-speed FDDI network connection running through a Cisco hub.

STORAGE SUBSYSTEMS ARE CRITICAL TO MANAGING MASTER ARCHIVE FILES

Once received from the Sony Music Studio, the Archive Department mounts the removable hard disks on a Macintosh "load" workstation in order to transfer the incoming files to the Sun Enterprise 450 archive server and its attached storage. Seven Sony DTF tape drives, which have an uncompressed capacity of 42GB per tape and 12MB/sec transfer rate, are integrated into an ADIC AML/E Automated Media Library. The tape library is currently the permanent residence of hundreds of tape cartridges containing archived audio and graphics master files. Copies of these files are regularly created and moved off-site for disaster protection. ADIC's software (Amass and Data Manager) manages the archive file system and controls the AML/E.

In between the server and the tape library resides high availability RAID disk



The Sony Music Archive Project (US) combines the efforts of three separate departments across three separate locations throughout New York City. A similar archive infrastructure has been established in London to preserve UK music and graphics master material.

Fig

arrays from storage solution integrator Open Systems Solutions, Inc. (OSSI). The disk arrays serve as a temporary storage medium for archive files, as well as general storage for archive department activities. Inbound master files are transferred from the Macintosh load workstation onto disk and held there until the tape library backs up the files via its normal schedule. Likewise, when archived files are requested for review or re-work by the Sony Music Studio, the tape library transfers the archive files onto the OSSI arrays. From there the file(s) are loaded onto a removable hard drive via the Macintosh load workstation, then transferred by courier to the requestor.

According to Laurence Shear, Sony Music's associate director of technology, "The RAID subsystem chosen by Sony needed to be very fast for sustained transfer rates due to the large audio file sizes. Many DB applications can get away with fast burst rates. Sony's benchmarks showed sustained transfer rates as high as 80MB/sec. The job of the RAID in Sony's archive is to move huge files on and off of tape constantly throughout the day. Also, the RAID needed to be

highly reliable and fault tolerant to ensure maximum uptime and reduce the risk of data loss. OSSI was able to provide that solution with the Metastor FibreChannel RAID. We really valued the extra effort made by OSSI to make sure that a field service engineer was on-site during the RAID install. This provided both peace of mind and training for Sony's technical staff on how to properly administer and maintain the RAID."

Both the ADIC tape system and the OSSI RAID disk subsystems are SAN capable, such that when Sony Music chooses to implement this latest evolution in storage technology, their existing investments will be fully protected. As the archive continues to grow, which is a certainty as more items are digitized and improving digital technologies promote the capture of more and more detail (translated—bigger files), both the tape and disk systems are poised to accommodate the expansion due to their scalable modularity. In fact, Sony Music recently upgraded the ADIC tape library from the 5TB capacity initially installed in 1996 up to 30TB and the system has a maximum capacity of 600TB (over 3000 DTF-2 tapes).

MONITORING THE ARCHIVE FOR QUALITY

Now that substantial numbers of recordings and images are being archived, Davidson's department wants to make sure that these master files survive without deterioration. The reality of digital storage is that, although the rate is extremely low, bit translation errors will occur over time as files are transferred from one medium to another.

To address this situation, ADIC has developed a process called Infinite File Life (IFL) for Sony Music, which will regularly review stored material and monitor the raw error rate to make sure that the digital data is being maintained in absolutely pristine, master version condition. If the review process determines that the integrity of a file or particular piece of media is beginning to deteriorate, a copy of the data files can be copied to a new piece of media before any data loss occurs.

CATALOGUING THE ARCHIVE

Another facet of the Sony Music project is the development of a comprehensive cross-reference database of the entire archive. Now that all this material is being stored, users need to be able to find any piece of it quickly and accurately. Artist names, dates, locations, titles,

labels, album graphics, lyrics, and other information relevant to every recording and image needs to be captured and indexed into a searchable database.

OTHER BENEFITS

Besides the cultural significance of preserving nearly a century of recorded sound, Sony Music's digital archive positions them well as the world inches toward the delivery of music over the Internet. Interestingly, the whole Internet aspect of the archive project is completely secondary to Sony Music's preservation role. When the project was first conceived and designed, there were no such things as MP3 and some of the other compressed music formats. In fact, when the archive first went on-line in 1996, the Internet was only beginning to take off as an important consumer and business tool. However, should the delivery of music over the Internet evolve the way Sony Music thinks it will, their digital archive library positions them well ahead of the curve and ready to take advantage of any Internet revenue opportunities that arise.

SONY MUSIC— ELIMINATING THE SOUNDS OF SILENCE

So, the next time you pop your favorite recording into your CD player, think about this; your CD sounds great be-

cause it is a perfect copy of a digital master. Sony Music has made the farsighted investment in preserving our musical heritage in digital perpetuity in a comprehensive manner that goes far beyond the preservation efforts of any other music company in the world today.

"For our current artists, it gives them a feeling of safety and comfort that their work is being preserved, but we don't know what will be deemed valuable a hundred years from now and I mean artistically valuable, not just financially valuable," says Davidson.

Thanks to the visionaries at the Sony Music Archive Project, future generations will get to decide whether the sounds that we consider "music to our ears" today are indeed music to theirs.

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