Some of the History of Hardware at CCRMA

- AI Department at Stanford:

  In the keynote speech address at the International Computer Music Conference of 1993 in Tokyo John Chowning says:

  > The computer system to which I had access was powerful indeed. It comprised an IBM 7090 that had an enormous memory of 36k 36-bit words and a hard disk whose capacity was well over 500k words and about the size of a refrigerator. The hard disk was shared by a DEC PDP-1 computer. By September 1964, with a great amount of help from a young Stanford undergraduate mathematics major, we implemented the Music IV program, provided by Max Mathews on the IBM 7090 and used the PDP-1 as buffer memory to send the samples from the hard disk to the DEC scope. The x-y converters for deflecting the electron beam of the CRT were connected to separate channels of an audio system, thus providing for stereo output.
>
> The young undergraduate who engineered this system was David Poole. He was extraordinarily helpful and patient as I at age 30, learned from him about things that I would have never have thought to be important to music. He was not only responsible for this, the first on-line computer music system, but later went on to design and build really large computers, one of which served many years as the platform for CCRMA's digital synthesizer. This synthesizer was fondly known as the ``Samson Box `` After its designer Peter Samson of System Concepts in San Francisco.
>
> With this powerful sound synthesis concept at the center, the adventure of computer music began. Music IV was so well-conceived that it was the progenitor of a number of offspring on a variety of systems used by a number of people from a variety of disciplines who intermingled and conversed as they waited for jobs to run or terminals to become free. Quite by chance,

> surprising and serendipitous alliances were made. Seemingly disparate fields found substantive connections. Composer/musicians needed to know what engineering scientists and cognitive/perceptual psychologists knew and heard. Signal processing, acoustics, psycho-acoustics and computer programming became familiar and necessary terrains of knowledge for musicians and music became a rich domain of application for engineering and perceptual sciences. Escher, Sheperd, and Risset (graphic artist, cognitive psychologist, and composer/physicist) became linked through compositions in which powerful visual illusions suggested compelling auditory counterparts. Young composers were nurtured by scientists and engineers- Godfrey Winham at Princeton, David Poole and George Gucker at Stanford, Jim Beauchamp at Illinois and, of course, Max Mathews. What a beginning - the field of music would acquire another dimension. [1, Chowning, 1993].

- Samson BOX:

  In October 1977, CCRMA took delivery of the Systems Concepts Digital Synthesizer affectionately known as the ``Samson Box,'' named after its designer Peter Samson. The Samson Box resembled a green refrigerator in the machine room at the Stanford Artificial Intelligence Laboratory, and it cost on the order of 100,000. In its hardware architecture, it provided 256 generators (waveform oscillators with several modes and controls, complete with amplitude and frequency envelope support), and 128 modifiers (each of which could be a second-order filter, random-number generator, or amplitude-modulator, among other functions).[2, Loy, 1991]. Up to 64 Kwords of delay memory with 32 access ports could be used to construct large wave-tables and delay lines. A modifier could be combined with a delay port to construct a high-order comb filter or Schroeder all-pass filter-fundamental building blocks of digital reverberators. Finally, four digital-to-analog converters came with the Box to supply four-channel sound output. These analog lines were fed to a 16-by-32 audio switch that routed sound to various listening stations around the lab.

  The Samson Box was an elegant implementation of nearly all known, desirable, unit-generators in hardware form, and sound synthesis was sped up by three orders of magnitude in many cases. Additive, subtractive, and nonlinear FM synthesis and wave-shaping were well supported. Much music was produced by many composers on the Samson Box over more than a decade. It was a clear success. [3, Smith,1991]

- The NeXT Machines:

  The NeXT computer still found at CCRMA in its black or white architecture was the first computer with a DSP or signal processing chip which could be dedicated to sound or music. In 1989 and for the sole purpose of developing a music workstation NeXT Inc. of Redwood City CA., hired Stanford Graduate Julius O. Smith and composer David A. Jaffe as well as chief software engineer Lee Boynton to develop the NeXT Music Kit. The Music Kit is an

object-oriented software system for building music, sound, signal processing and MIDI applications on the NeXT computer. It has been used in such diverse commercial applications as music sequencers, notation packages, computer games, and document processors. Professors and students in the academia have used the Music Kit in a host of areas, such as music performance, scientific experiments, computer aided instruction and physical modeling. The Music Kit was the first system to unify the MIDI and Music V paradigm, thus combining interaction with generality. It was developed by NeXT Computer, Inc. from 1986 to 1991, and by CCRMA at Stanford University from 1992 to 1996. It has also been supported by developers such as Pinnacle Research, Inc., as well as the Stanford University Office of Technology Licensing. Furthermore Julius Smith and David Jaffe designed and implemented DSP56001 software supporting the NeXT Music Kit, including the real-time DSP monitor and unit-generator modules for sound synthesis and signal processing and also wrote and supported The NeXT DSP Library. Helped support and debug the Sound/DSP Mach driver and the NeXT Sound Library.

The entire collection and algorithms of the Samson Box were translated to the NeXT by means of Common Lisp and a Music V dialect known as CLM or Common Lisp Music all done by hand by composer/scientist Bill Schottstaedt. Most of the composition work at CCRMA in the 1990's was done using home brewed software like Common Lisp Music, Common Music, the Music Kit and more. The CCRMA environment at the moment (circa 1993) consisted of an Ethernet network which connected workstations running the NeXTStep operating system and Macintosh computers plus a gateway that connected the workstations to the campus at large and also to national and international networks.

- The Lab and Open Source Community, Linux:

  At this time, the CCRMA computing environment is supported by more than 40 machines that include fast Pentium class PCs running Linux (some of them dual-booting Linux and NEXTSTEP), Silicon Graphics workstations, NeXT workstations (for old time's sake) and PowerPC Macintosh computers. All machines are connected through a switched high speed backbone and several servers provide shared services and resources to all computers in a way that is transparent to the users. A high speed connection to the Stanford University Network (SUNET) provides connectivity with the rest of the world, including direct access to the new Internet 2 network. Sound-file manipulation and MIDI input and output are supported on all platforms. Multichannel playback is supported on some Linux and SGI workstations and on the Macs through several Pro Tools systems. Digital audio processors include a Studer-Editech Dyaxis II system, two Digidesign Pro-Tools systems with CD-R drives, digital i/o cards on Linux systems, Singular Solutions analog and digital audio input systems for the NeXTs, and several Panasonic DAT recorders. Text and graphics are handled by an HP 4c color scanner on the Unix-based systems and by high resolution network connected printers

---

Previous: Motivation: Computer Music