by Jim DeRoest

RS/6000, Still Rockin'

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It has been a number of years since I've written a column about electronic music and AIX. This is largely because the road to squeezing an audible chirp, squawk or bang out of an RS/6000 hasn't always been easy. My old system disk has made all kinds of noises for years, but I've never been able to orchestrate them into anything pleasing to the ear. Considering what goes for "music" these days, maybe I should record it. I could start a whole new genre, "Techno Compu Grunge, the new Seattle sound." I could even set up an audition with Bill Gates and get him to play it on the Microsoft Network. Maybe I've got something here!

Back to planet Earth. Early on, if you wanted to synthesize audio on a UNIX system, you got yourself a NeXT Computer Inc. or Linux box. The only synthesis options for the POWER Micro Channel musician was wrestling with IBM's Multimedia Audio Capture Playback Adapter (M-ACPA) or with a third-party Digital/Analog Converter (DAC). The problem with these devices was they didn't support many standard sound formats and there wasn't much in the way of available software to drive them.

Times and technology have changed over the last two to three years, and things have gotten much better. Enter Ultimedia Services for AIX and the Ultimedia Audio Adapter for Micro Channel. These provide the basic tools needed to record, play and sequence most audio formats on a POWER architecture computer. Yet, as nice as the Ultimedia system is, it is still limited compared with the audio resources available in the Intel Corp. x86 and Apple Computer Inc. Macintosh worlds. This void has partially been filled by a crafty fellow, Dev Mazumdar.

Mazumdar started by coding an AIX Micro Channel driver for Creative Labs Inc.'s Sound Blaster MCV adapter (`http://www.soundblaster.com`). With the advent of PCI and ISA support in the PowerPC line around 1993 or 1994, Mazumdar's company, 4Front Technologies, Los Angeles, CA (`http://www.4front-tech.com/index.html`), has since developed drivers for most of the popular sound cards on the market. More about this later. First, let's take a look at the basics of computer audio and music synthesis.

Computer-Generated Music

Computer-assisted audio synthesis and compositional techniques have been explored since the mid-1950s. Initially, composers such as Iannis Xenakis used computers to

generate statistical distributions of patterns for musical compositions. The composer would plan the general flow and shape of a piece and then use random distribution techniques to construct sound patterns and sequences that may not have otherwise been envisioned. Audio synthesis algorithms were later added, which allowed a composer to incorporate unimagined sound textures into a composition. The duality of computer audio synthesis and composition fit well with the standard notion of orchestration and composition and, thus, influenced the development of new synthesis and composition languages such as Max Mathew's "Music" and Barry Vercoe's "Csound."

The advent of personal computers brought similar computer synthesis techniques into the home studio. Although the market is essentially directed at the audio requirements for computer gaming, the resulting components can often be used to manipulate and orchestrate musical compositions on a PC. The development of the Musical Instrument Device Interface (MIDI) specification, which was introduced in 1983, provided a means for using a computer to sequence wave forms and manipulate more advanced audio devices such as synthesizers, samplers and other computers. The neat thing about audio processing on a computer is you are not restricted by the interfaces hardwired into more advanced devices like synthesizers and samplers. Because you have programmatic control over wave timbres and orchestration, you can bend the rules a bit: explore new sound synthesis algorithms, develop new tools and protocols. After all, this is what creative expression is all about.

Computer music is created by first generating or sampling digital audio wave forms. Sampling is the process of recording discrete snapshots of an analog signal. The frequency of snapshots to wave frequency is carefully controlled to render an accurate digital representation of the input signal. This is all handled by the analog-to-digital encoder on the computer's sound card. Digital wave forms may also be constructed using algorithmic methods to create yet unheard sound palettes. The resulting wave forms can then be acoustically rendered from a digital signal processor on the sound card or synthesizer. Keep in mind that there are a large number of wave form formats; the format generated by one tool may not be compatible with other tools or signal processors. IRCAM, the European Institute for Acoustic and Music Research based in France, has made some headway in defining standard formats. An audio format guide is available via anonymous FTP to `ftp.cwi.nl/pub/audio`. Once a sound set has been created it can be sequenced into a nice melody using a compositional language or a MIDI sequence.

Example 1. Typical MIDI Sequence

Performance Action	MIDI Message
1. Select Harpsichord Voice	(PROGRAM CHANGE)
2. Forte Attach	(VELOCITY)
3. Play Middle C	(NOTE ON)
4. Release Slowly	(AFTER TOUCH)
5. Release C	(NOTE OFF)

A Word about MIDI

MIDI is a somewhat standardized protocol that allows computers, electronic musical instruments and effects processors to share control information. MIDI messages passed between these devices indicate the what, when and how of the nuances and gestures that make up a musical performance. In a sense, it is similar to an elaborate master-slave remote control network. A MIDI message does not contain the audio signal itself, but rather the control information that specifies how and when to create a particular event on the sound generator.

MIDI messages are transmitted at up to 31.25 Kb/s over five-wire DIN (stands for Deutsche Industrie Norm) cables between devices. A message may be sent or received on one or more of 16 data channels. Each message is made up of 8-bit bytes and will usually consist of

a combination of one to three status and/or data bytes. Status bytes direct actions such as note on, note off, velocity (attack), controller position, program change, after touch (key or pad pressure) and pitch bend. Data bytes specify things such as the note number (0-127) or the position number of a controller wheel or switch. An example MIDI message might select the actions on a keyboard synthesizer as shown in Example 1.

MIDI is an excellent protocol for collaboration and sharing between composers over a network. Even with a slow modem connection, it's possible to generate MIDI sequences for a remote sound device. Web pages do it every day. Imagine jamming with a group of musicians scattered around the world. When participating in a remote jam session, care must be taken to ensure that everyone sharing MIDI data files is not using system-exclusive commands. System-exclusive commands are parameters that have been added by the vendor to take advantage of some proprietary feature. Also, some agreement must be made as to what voices and channels will be used. In 1991, the General MIDI (GM) specification was defined for just such a purpose. GM is a refinement of the Standard MIDI specification, which didn't guarantee interoperability.

Another specification, dubbed Extended MIDI (XM), was introduced in 1995 by Eric Lukac-Kuruc, an engineer at Digital Design and Development, and is gaining wider attention in the MIDI community, primarily in Europe. The XM specification defines more channels, more parameter types and higher speed than the existing specification. The idea is to realize denser transmission of messages. I play MIDI-controlled electronic drums and can vouch for the fact that MIDI messages can be dropped when you've got a lot happening over a thin 31.25-Kb/s bandwidth. Other MIDI extensions have been implemented by Yamaha Corp. (`http://www.yamaha-xg.com`) and Roland Corp. (`http://www.rolandus.com`), the XG and General MIDI Standard (GS), respectively, that are directed at enriching and broadening the MIDI sound set. The MIDI Manufacturers Association (MMA) was founded in 1984 to assist in defining this evolving standard. In that the MMA is made up of vendors all competing to have their own extensions included in the specification, this is often an uphill battle.

Sound for the RS/6000

So you want to make your PowerPC sing like a bird? On the software side, the easiest way to get started is by installing Ultimedia Services for AIX (see Table 2). What you'll get is a set of multimedia tools integrated into the AIX Common Desktop Environment (CDE). Using the Ultimedia tool set, you can record, play, edit, compress and convert most standard audio formats–this includes 8-bit and 16-bit PCM, `wav`, `snd`, `au`, Mu-law and A-law formats. There's a nice object programming API that can be used with the IBM System Object Management (SOM) architecture and it is callable by

Table 1. Music and Audio Software

Chord	Lyrics and chord formatting program
Csound	Audio synthesis composition language
Jam	XView MIDI keyboard program
Karalin	MIDI-based karaoke application
MiXViews	UNIX-based digital audio processing program
Sigen	*/dev/dsp* signal generator
StudioSound	Multitrack recorder, mixer for X11 Motif
Tclmidi	Tcl/MIDI editor, sequencer
TiMidity	MIDI-to-Wave converter
Wave	Sound-generation program
Xcmf	Creative music format player
Xdrum	Drum sequencing program
Xfmedit	Editor for controlling FM synthesizer registers
Xmidi	MIDI player
Xmuseq	Piano-roll-style MIDI editor
Xsynth	Keyboard synthesizer interface
Xwave	Audio editor, player and recorder for X11

Note: A larger list is available at 4Front Technologies' Web site (http://www.4front-tech.com/index.html).

Table 2. Useful Electronic Music Resources

AIX Ultimedia Services
http://www.austin.ibm.com/ hardware/adapters/ultimedia.html

Audio Engineering Society
http://www.aes.org

Bibliography of computer and electronic music
http://alpha.science.unitn.it/~oss/bibliographye.html

ChipChat Technology Group
http://www.chipchat.com

Computer Music Journal
http://mitpress.mit.edu/e-journals/Computer-Music-Journal/

Digital Music Newsletter
http://pages.prodigy.com/digitalmusic/

Electronic Musician
http://www.cardinal.com/publications/index.htm

EQ Magazine
http://www.eqmag.com

id Software Inc.
http://www.idsoftware.com

IRCAM
http://mediatheque.ircam.fr

Keyboard Magazine
http://www.keyboardmag.com

Keyboards Online
http://www.keyboards.de

Mix Magazine Online
http://www.mixmag.com

MIDI Manufacturers Association
http://www.midi.org/

Music & Computers Magazine
http://www.music-and-computers.com

Society of Motion Picture and Television Engineers
http://www.smpte.org

Sound Advice newsletter
http://www.soundav.com/index.html

Timara computer music links
http://timara.con.oberlin.edu/resources/links/links.html

Worldwide Internet music resources
http://www.music.indiana.edu/music_resources/

XM
http://ourwold.compuserve.com/homepages/eric_lukac_kuruc/xmenu1.htm

C and C++ programs. Ultimedia also provides similar capabilities for video, but that's a topic for another column. Ultimedia-compatible sound cards include IBM's Ultimedia Audio Adapter and ChipChat Technology Group's Micro Channel Sound Board.

If you're not opposed to porting, there are a growing number of public and shareware packages available that have been written for the Open Sound System (OSS) device driver and Direct Music (DM) API specifications (see Table 1). Much of this code is courtesy of the continuing efforts of the legions of Linux programmers. In fact, OSS was derived from Linux (the OSS specification is described in Jeff Tranter's *Linux Multimedia Guide*, O'Reilly & Associates Inc., 1996, ISBN 1-56592-219-0). All you need to do is get the OSS driver from 4Front Technologies. 4Front has OSS drivers for AIX and other popular UNIX implementations to drive everything from Gravis Ultrasound (`http://www.gravis.com/`) and Turtle Beach Systems' sound cards (`http://www.tbeach.com/`) to Creative's new AWE64. OSS software from 4Front contains the first commercial implementation of the DM API.

Computer music possibilities have really opened up in the last two years for the RS/6000. Although still lagging behind the Microsoft Corp. Windows world when it comes to full-feature music sequencing and notation software, POWER architecture brings some heavy processing capabilities to the table that are ideal for wave form manipulation. If computer music isn't really your bag, you still might want to try out the voice-processing features available with Ultimedia services. How about a game of *Doom* complete with sound? Yes, id Software Inc.'s *Doom* has been ported to AIX using OSS drivers. For more information on audio-processing software and hardware, take a look at the Web sites in Table 2. Now that it has finally started to get its sound gear together, the RS/6000 is definitely rockin'!