DIGIDESIGN'S PRO TOOLS EXPLAINED: PART 1

Simon Price begins a three-part series designed to demystify that staple of modern music production, Pro Tools. This month, he looks at the various components that make up Digidesign's systems.

Whichever way you look at it, Pro Tools has become part of the standard kit used in professional audio production. In an admittedly sad attempt to back up this statement I counted at least 23 references (not including adverts) to Digidesign's computer-based audio workstations in a recent issue of *Sound On Sound*. Regular *SOS* readers will have noticed that many of the producers and artists interviewed use Pro Tools, some for basic multitrack recording and/or editing, and others increasingly during the creative process itself. This, coupled with the fact that the Digi 001 has brought Pro Tools into many home and project studios, has prompted *SOS* to take an in-depth look at the system that has changed the way many sound professionals work.

Part one of this three-part series aims to serve as a detailed introduction to those wishing to find out more about the applications and architecture of the Pro Tools system. Part Two will offer an overview of the software and starter operational guidelines for the many new *Pro Tools* software users. Finally, Part Three is intended as a Pro Tools 'masterclass' featuring useful techniques and working practices.

Current Pro Tools systems are, roughly speaking, the fifth generation of audio workstations produced by Digidesign. The company started life in the late '80s, producing sound chips and tapes for a handful of drum machines and sample modules. They developed a software sample editor, which evolved into the widely known *Sound Designer* software. *Sound Designer* became the front end for the Sound Tools computer-based hardware system, capable of recording and editing stereo digital audio. Since then the march of progress has seen ever-doubling track counts, progressions in software through *Pro Edit* and *Pro Deck* to Pro Tools, and the move to modular systems via TDM technology (see below).

The Pro Tools Range

Digidesign's systems now nearly all follow the same basic pattern. A computer (Apple Mac

or PC with Windows NT) runs the software front-end of the system, the *Pro Tools* application (currently at v5.01). The computer is linked to the outside world via one or more PCI cards which in turn connect to a range of audio interface hardware. Having said that, there have been versions of the *Pro Tools* application that can run without dedicated hardware, and Digidesign have recently released a cut-down version of *Pro Tools* v5 as a stand-alone program — for free! Conversely, many other music software packages can also take advantage of the Pro Tools hardware — more on that later.

The current Pro Tools range consists of Toolbox, Digi 001, Pro Tools 24, and Pro Tools 24 Mix and MixPlus. Toolbox and 001 run the *LE* version of the *Pro Tools* software, which uses the host computer's power for recording, mixing and processing audio. The rest of the range uses dedicated DSP processor chips built onto PCI cards to handle these tasks. There's plenty more to be said about this distinction, as the argument over whether dedicated DSPs are necessary — or at least whether they represent a good price/performance advantage — is likely to hot up over the next year (see the 'Playing Host to Controversy' box on page 196).

Playing Host To Controversy — DSP-based Versus Host-based Systems

There are definite signs that a showdown is brewing between the developers who back host-based audio products and those who process audio with purpose-built hardware. Steinberg's advertising for their recently released Nuendo package claims: "One of the great myths of digital audio systems is that truckloads of audio hardware and DSP chips are necessary to build a capable audio workstation." Mark of The Unicorn's excellent range of audio hardware, which works with host-based processing software, has also caused people to ask, "why should I spend extra on a DSP-based system?"

Well, for the time being at least, a deciding factor is cost. It would be difficult to argue against the fact that if you can throw enough money at a DSP-based system (ie. buy enough DSP cards) it *will* be more powerful than even the latest blistering PCs or Macs. The question is better stated as, "for what I'm doing, do the differences justify the extra cost?" So what are these claimed differences? The discussion tends to focus on two key areas: performance and latency.

• PERFORMANCE

By performance, I mean basics like how many tracks the system can play back, how complicated the mixer routing can be, and how much real-time signal processing it can manage. The DSP-based system manufacturers like Digidesign say they have the advantage here, because if you run out of processing power, you can upgrade by adding more DSPs. The host-based product developers take a different angle on this, saying that a DSP system is limited by the amount of hardware you have, while their product will improve with a newer faster computer. It's difficult objectively to compare performance between the two sides, but at this point in time a top-flight PC/Mac host system will give a basic (unexpanded) DSP-based system a good run for its money. In response to this, Digidesign focus on the — as they put it — 'power-on-demand' factor of using DSPs. By this, they are referring to the fact that with their DSP systems your track count is guaranteed. What they are alluding to is that with a host system, you may have the *potential* to do as much or sometimes more, but the performance ceiling varies depending on how much other work the PC or Mac processor has to do, and you don't always know how much you can expect to achieve.

• LATENCY

The other consideration, latency, can refer to two different limitations within a digital audio workstation — I'll call them throughput delay and controller delay. The first of these comes about because any signal processing imposed on audio in a digital system, whether it is gain changes, signal mixing or effects, is a mathematical function which takes time to process. This includes analogue-to-digital and digital-to-analogue conversion (a round trip takes about 1.5 milliseconds in most converters) so all systems suffer this problem. In a host-based workstation though, the main computer processor has to take care of all the calculations, so the software has to impose a delay on the whole system to give the processor enough time to handle everything. A DSP-based system doesn't have to worry so much

about this, because all the mixing and effects are being shared by a bank of sub-processors working in parallel, and this typically results in delays of only a few samples. When you have signals coming into a host-based system from the outside world and being routed back out with the rest of the mix, however, this delay can become significant. Given enough latency, it's difficult for musicians to play in time if they're hearing themselves with a delay. You also get this problem if, say, you send out MIDI or MIDI Clock to a drum machine and monitor it through the system. There are ways to get around these problems, such as using 'low-latency' monitoring paths that don't go through any processing, but I think it's fair to count low latency as an advantage of the external DSP-based systems.

The other issue — controller latency — is the responsiveness and resolution of the system to parameter changes (like fader movements) in the software. Again this is potentially a difficulty for host-based systems where the processor is busy and is expected to handle lots of automation as well. The worst-case scenario would be 'zipper noise' as the processor struggles to keep up with parameter changes smoothly.

In summary, on the host-based side the manufacturers' main concerns are to keep throughput latency to the bare minimum, and controller resolution as smooth as possible. For the hardware developers, the constant goal is to make sure that each generation of DSP-based hardware is sufficiently more powerful than the current PC or Mac processors to justify the extra expense. In the meantime, Digidesign have recently opted for a 'have your cake and eat it' approach; version 5.1 of the *Pro Tools* software (due for release by the time you read this) will be able to combine DSP and host-based processing within the same project.

HOST-BASED SYSTEMS

• Toolbox
The Toolbox system is basically a bundle featuring *Pro Tools LE* software, with I/O connections being provided by Digidesign's long-serving PCI card, the Audiomedia III. Uniquely in the range, this card does not break out to an external connection box; instead it has RCA/phono connections on the board itself, for both analogue and digital stereo in and out.

• Digi 001
Clambering up a rung, the Digi 001 (reviewed in *SOS* December '99 or at www.sospubs.co.uk/sos/dec99/articles/digi001.htm) uses the same *LE* software alongside a dedicated I/O box connected to a single PCI card. This makes room for increased connectivity: eight analogue ins and outs, ADAT optical, S/PDIF digital, and MIDI In and Out to round it off. Other advantages over Toolbox are 001's 24-bit converters and mic inputs.

AV — Pro Tools For Audio-Visual Applications

Unusually among music software packages, much of Pro Tools' development is intended to benefit those using the system in TV and film production. Pro Tools is now widely used in these industries for track laying and mixing music and effects, editing music and dialogue, and rerecording location dialogue. While perhaps this is not of much interest to those purely making music, the knock-on effect is that Pro Tools is really good at working sync'ed to picture; and consequently it gets plenty of use among people writing soundtrack music for video, film, games and multimedia.

There are several options when working to picture with Pro Tools. The system can receive timecode and clock information from third-party sync boxes, like MOTU's popular MTP AV, but Digidesign also have their own proprietary sync hardware option called the Universal Slave Driver. This unit not only has the coolest name of any piece of hardware on the market, it can also sync to an exotic array of timecode and clock formats.

Many video post-production facilities use Pro Tools to control Umatic, Betacam SP and Digital Beta video decks, and increasingly you can also find Pro Tools in film-dubbing theatres chasing projectors. Many home- and project-studio users favour the popular Quicktime-based capture cards, which allow

you to digitise video to hard disk. Pro Tools, like most of the other music programs, can open up these movies and display them during playback, eradicating the need to wait for a video machine to cue into position and get under way.

The two new Pro Tools video systems — Pro Tools AV and AV/XL — extend this functionality to the professional broadcast level by employing the video capture and playback hardware found in Avid video editing systems. Avid — who just happen to own Digidesign — make the systems on which a sizable proportion of what we see on TV and film is edited, so by using this hardware Pro Tools gets broadcast-quality video alongside file-format compatibility. Smart.

DSP-BASED TDM SYSTEMS

From the 001, it's a hefty leap to the modular, DSP-based TDM systems. In order to get audio in and out of these, eight or more channels of interface hardware have to be connected to the PCI cards (see the 'Interface Facts' box on page 198 for more on this). For those of you wondering, TDM (Time Division Multiplexing) is the technology that allows data to be routed between the various Pro Tools PCI cards and their onboard DSP chips. It might sound unexciting, but TDM has added expandability and flexible mix routing to the powerful recording and editing possibilities of the desktop studio, and also made possible the concept of plug-ins, of which more in a moment.

• Pro Tools 24
The cheaper of the two TDM options, this is essentially a 24-bit upgrade to Digidesign's earlier 16-bit TDM system. The basic system includes *Pro Tools* software, a PCI card that handles playback and record of 32 tracks, and a 'DSP Farm' card that takes care of mixing and processing. This system works well in situations that don't require the considerably increased processing capacity and track count of the next-generation Mix product. It's also worth mentioning that some newer powerful plug-ins, such as six-channel surround reverbs and software synths, will only work with Pro Tools Mix.

• Pro Tools 24 Mix & MixPlus
Most current TDM Pro Tools setups are Pro Tools 24 Mix systems, whose basic building block is Digidesign's Mix card, a standard PCI board containing six Motorola Onyx chips (the DSP providers also found in some Sonic Solutions DAWs and the Access Virus synth). A system containing two of these cards constitutes what Digidesign call a MixPlus (see review in *SOS* April '99 or at www.sospubs.co.uk/sos/apr99/articles/protools.htm), but in fact anything up to seven Mix cards can be stacked into one Pro Tools rig.

Pro Tools Interface Options

With TDM Pro Tools systems (Pro Tools 24, Pro Tools 24 Mix and MixPlus), you choose one or more rackmounting connection boxes, depending on how many channels of I/O you require and what connection formats you need. Each Pro Tools Mix card (or older Pro Tools 24 card) can handle up to 16 channels of I/O — this can either mean one 16-channel box (like the 1622 or ADAT Bridge) or two eight-channel boxes. The maximum total number of physical ins and outs supported is 72. Without wishing to sound too much like a brochure, here's a round-up of the available options:

888/24

This is Digidesign's top-of-the-range unit. It features eight channels of high-spec 24-bit A-D and D-A on balanced XLR connections, eight channels of AES-EBU digital, and stereo S/PDIF digital. This unit is mostly the choice of professional music studios and post-production facilities.

882/20

This interface boasts eight channels of analogue input and output on balanced quarter-inch jacks with 20-bit converters, and stereo S/PDIF. The lower cost of this interface and its eight jack outputs make this well suited to project studios based around an analogue mixer.

1622

The 1622 has 16 analogue inputs (with 20-bit A-D converters) on balanced quarter-inch jacks, plus two channels of analogue out (with 24-bit D-A converters), and stereo S/PDIF as usual. This one's ideal for music studios wishing to mix within Pro Tools rather than a separate mixer. It features digitally controlled input-level trimming.

ADAT BRIDGE

This box sports two sets of standard eight-channel ADAT optical ports for 16 channels of connection to suitably-equipped digital mixers, or of course ADATs and similar MDMs. The ADAT Bridge also has stereo AES I/O, and a stereo analogue out in addition to the obligatory stereo S/PDIF.

NON-DIGIDESIGN OPTIONS

Apogee produce two interfaces that can be fitted with a card to allow them to be used directly as Pro Tools interfaces. The top-end AD8000 is similar in functionality to Digidesign's 888/24, while the company's newer Trak2 has only two A-D converters but also includes two mic preamps and expansion options.

HARDWARE ADD-ONS

Finally, if you want to add a more 'hands-on' feel to the system, Pro Tools can be controlled by MIDI fader banks, such as the popular JL Cooper CS10 and CM Automation's MotorMix. There are also two controllers that were built with Pro Tools specifically in mind — the Mackie HUI (see *SOS* December '98 or www.sospubs.co.uk/sos/dec98/articles/mackiehui.143.htm) and Digidesign's own ProControl. While the HUI has gone on to support other applications, ProControl (see *SOS* May '99 or www.sospubs.co.uk/sos/may99/articles/digipro.htm) is so specific that it has remained a Pro Tools-only device. ProControl is a hefty investment, but those that do dig deep in their pockets get a unit that looks like a pro console, with touch-sensitive motorised faders, and the cunning advantage of communicating over Ethernet, thereby achieving better speed and resolution than you would with MIDI controllers.

Plug-ins & Third-Party Support

The TDM architecture behind Digidesign's DSP-based products turned out to be more beneficial than just making the systems modular and expandable. TDM paved the way for most current computer audio systems, by allowing you to insert software effects and signal-processing modules into the on-screen mixer — plug-ins. The key to the success of Pro Tools was that Digidesign opened up the TDM format, so that many third-party developers could create plug-ins to integrate into the same environment. Equally important was the encouragement they gave sequencer manufacturers to build in TDM support for their MIDI + audio packages. This meant that if you were a *Logic Audio* user, for example, but wanted the benefit of the Pro Tools hardware's mixing environment, you could replace the

Pro Tools front-end software with *Logic.* Eventually all the big packages — Emagic's *Logic*, Steinberg's *Cubase*, Opcode's *Studio Vision Pro*, and MOTU's *Digital Performer* — included support for Pro Tools TDM hardware. Crucially, Digidesign divided their code for Pro Tools into two separate applications: the *Pro Tools* front end, and the Digidesign Audio Engine, which runs in the background handling communication with the hardware and disk access. When a program wishes to use the TDM hardware, it works alongside DAE, reducing the amount of development needed by the third party.

Similarly, it's also possible to drive the Digi 001 and Audiomedia III hardware from different software, and still get access to the hardware's ins and outs. In this instance, the software runs its own host-based audio engine and uses the hardware more like a conventional soundcard. Again, this is useful if you prefer, say, *Digital Performer* to *Pro Tools LE*, or if you want to go over *LE's* 24-track limit, or use some *Logic* plug-ins, for example. *Cubase VST* can join the party in this way too, as Steinberg have an ASIO driver that works with Digidesign's PCI hardware.

Pro Tools In Use

Pro Tools systems with Mix hardware can play or record up to 64 audio tracks at 24 bit, and with a sampling rate of up to 48kHz. Two of the first Mix card's six chips are devoted to playback and record services, but you can tell the software to free one of these up if you don't need to go over 32 tracks. The rest of the chips are available to take care of mixing and plug-ins. The user can assign recording to any hard drives connected to the host computer on a track-by-track basis, or tell the software to share the load automatically. Two fast drives are usually enough for 64-track recording. With a Toolbox or Digi 001-based Pro Tools, the track count is down to the software and available processing power of the host computer. As mentioned above, when using the *Pro Tools LE* software with these systems, the maximum is set to 24 tracks, irrespective of the power of the host.

So a Pro Tools Mix setup is a 64-track recorder, but the system is actually also a 128-channel digital mixer. This means that as well as having 64 tracks playing back off disk, the mixer can also handle another 64 inputs coming in from outside (if you've got enough interface hardware for all those connections). As with a conventional console, these can be used for bringing in live or MIDI synth sources, or creating send/return or insert connections between Pro Tools and outboard gear. Meanwhile, any spare outputs can be used to set up cue mixes, multiple mastering recorder destinations, and so on. In addition to the audio, Pro Tools also provides up to 128 tracks of MIDI playback and record.

Given all this you'd be forgiven for thinking that Pro Tools has something of an identity crisis: is it a multitrack recorder, an editor, a digital mixer or a MIDI sequencer? The answer, of course, is that it can be all of these — but not everyone makes use of all of its capabilities. The classic scenario in larger music studios is that Pro Tools is used as an supplementary tool alongside another multitrack, such as a two-inch tape machine, digital multitrack tape or Otari RADAR, for example. In this situation, the contents of the

Current Pricing

As a guide, here is a list of the Pro Tools components mentioned this month, with their current retail prices. You can soon work out how much a system suitable for your particular requirements would cost. Prices include VAT and are correct at the time of going to press.

W www.digidesign.com

OFF-THE-SHELF SYSTEMS
• Toolbox (Audiomedia III and *Pro Tools LE* software) £480.58
• Digi 001 £880.08

INTERFACES
• 888/24 £3253.58
• 882/20 £1103.33
• 1622 £1408.83
• ADAT Bridge £1103.33

CARDS
• Audiomedia III £445.33
• Pro Tools 24 Core £5274.58
• Pro Tools 24 DSP Farm PCI

multitrack can be transferred to Pro Tools to edit drums, tune and comp vocals, make song structure changes, and also serve as a backup. Other studios record directly into Pro Tools, enabling them to save transfer times, as well as take advantage of loop recording, quick access to multiple takes, and so on. When these two schools of thought meet in the pub they will inevitably argue about sound differences between these recording methods — on this occasion I'm going to stay clear of this and go to the bar! The chances are, however, that both camps will still be using a hardware mixing console. However, more and more studios are taking seriously the possibility of using Pro Tools for mixing as well as recording and editing. This has been helped by the ProControl mix surface, which offers a reasonably familiar, mixer-like means of controlling proceedings. Taking it to the extreme, several newer studio installations have done away with a separate mixer altogether, using ProControl-equipped Pro Tools rigs, with separate preamp units for input gain control. This might sound strange, until you realise that the heart of many digital mixer systems is a PC with DSP capability and a control surface... does this sound familiar? I suspect Pro Tools' mixing capabilities will be used more and more if surround mixing becomes popular in music production — the next release of Pro Tools software will have multi-channel mixing and panning built in.

£1761.33
• Pro Tools 24 Mix £7037.08
• Pro Tools 24 MixPlus £8787.83
• Additional Mix Farm card £3512.08
• Additional Mix I/O card £703.83

CONTROL SURFACES
• ProControl £10550.33
• MotorMix• £880.08
• *manufactured by CM Automation, but marketed worldwide by Digidesign.*

POST-PRODUCTION OPTIONS
• AV option for Pro Tools £7037.08
• AV/XL option for Pro Tools £11431.58
• Universal Slave Driver £1843.58

The people most often stretching Pro Tools to fill all its potential roles are those using home studios and music-writing setups. As Pro Tools' MIDI functionality grows, other writers and artists, who aren't necessarily so concerned with budget, are also choosing to use the system during writing. Having all the recorded audio, MIDI and mix automation in one place makes it easier to move between concurrent projects.

Finally, it's worth mentioning that Pro Tools is becoming much more widely used in video and film post-production applications — see the 'AV' box on page 197 for more details.

Coming Next Month...

Hopefully, all this leaves you better informed if you've been looking to buy a Digidesign system, or at least ready to deal with the many different flavours of Pro Tools you may encounter. Next month, I'll explain how to coax *Cubase VST* and Emagic *Logic* into working with Pro Tools hardware, and look at how the *Pro Tools* software works. 🆘

Glossary

http://www.sospubs.co.uk/sos/regular_htm/glossary.htm