

Ultimate guide to choosing & setting up a Digital Audio Workstation

June 2014

This guide provides comprehensive impartial advice to anyone considering music or audio production on a digital audio workstation (DAW). If you are a newcomer to DAWs you will find essential information and advice to help you make the right purchase decisions and setup you system effectively. Even experienced users will learn something useful, and those who already know it all .. well, you can just feel thoroughly pleased with yourselves!

The subject of DAWs is vast, and although this guide is comprehensive, inevitably we couldn't cover everything, especially when new technologies emerge daily. However, you will find every important subject and technology discussed, and by the time you've finished reading you will be equipped to make the best decisions for your needs.

We hope you find this guide useful, and if you do, please recommend it to others.

Thanks for reading.
The Project Studio Handbook Team

[Go to contents](#)

Contents

- 01 **What exactly is a DAW?**
- 03 **DAW applications**
 - 03 Avid ProTools
 - 04 Ableton Live
 - 04 Garageband
 - 04 Propellerhead's Reason
 - 05 Logic Pro
 - 05 MOTU Digital Performer
 - 05 PreSonus Studio One
 - 06 SaDiE
 - 06 Steinberg Cubase
 - 07 Steinberg Nuendo
 - 07 Cakewalk Sonar
 - 07 Extensibility
- 08 **Should I be using a DAW?**
- 11 **Choosing a Platform**
 - 11 Windows PC
 - 11 Windows Mac
 - 12 OSX Mac
 - 13 Android
 - 13 Apple iOS
- 14 **Choosing a DAW application**
 - 14 Minimum system requirements
 - 15 Installing OS and DAW updates
 - 15 64-bit mode
- 17 **Plug-ins**
 - 17 Native
 - 18 DSP plug-ins
 - 18 CV / gate systems
- 19 **Installing a DAW and plug-ins**
 - 19 Optimising an operating system
- 21 **License organisation & dongles**
- 22 **Screen monitors**
- 23 **i/o hardware**
 - 23 1. Motherboard built-in
 - 23 2. PCIe cards
 - 23 3. Interface / bus connected stand alone hardware
 - 24 Aggregate devices
 - 25 Digital interconnection
 - 25 Hardware / software hybrid devices
- 27 **Understanding latency**
- 29 **Loudspeaker monitors & monitor controllers**
 - 30 Using headphones
- 31 **Input controllers**
 - 31 USB & MIDI connection
 - 31 Controller keyboards
 - 32 Tablet controller apps
 - 32 Other controllers
- 33 **Setting DAW defaults**
 - 33 Sample rate
 - 33 Word-length/Bit-depth
 - 33 Digital sync and Word clock
 - 33 Audio file formats
- 34 **i/o buffer settings**
- 34 **Record levels**
- 34 **i/o routing**
- 34 **Pinging external hardware**
- 35 **Latency compensation**
- 35 **Software monitoring**
- 35 **Setting up controllers**
- 36 **Keyboard shortcuts**
- 36 **Screen-sets**
- 37 **Furniture & ergonomics**
 - 37 1. Workstation orientation
 - 37 2. Loudspeaker monitor position
 - 37 3. Screen positioning
 - 38 4. Posture
 - 38 5. Mixing controllers
 - 38 6. Monitor control
 - 38 7. Outboard
- 39 **Backing up**
 - 39 Backing up projects
 - 39 Backing up a system
 - 39 Backing up sample and sound patch libraries
- 40 **Using your DAW for other activities**
- 41 **Suggested starter system**
- 42 **Final thoughts**

What exactly is a DAW?

A Digital Audio Workstation (or DAW) is a multi-channel/track MIDI and audio recording, editing, processing, mixing and mastering system that leverages a computer based graphical interface and the non-linear recording mediums of hard discs, SSDs and flash RAM. Unlike the linear medium of tape, which must be wound back and forward to access moments in time, non-linear-editing (NLE) permits almost instantaneous access to any point in time and flexible editing and processing of multiple individual tracks of audio and MIDI data, all of which are synchronised together in time.



The Synclavier, an early digital audio workstation first introduced in 1977

Before cost effective personal computers became powerful enough to process audio natively (ie with their CPUs), DAWs were highly expensive and specialist hardware/software hybrid system such as the Synclavier and the Fairlight costing 10s, or even 100s, of thousands of dollars. But today, the modern definition of a DAW describes a system based around a personal desktop, laptop or mobile computing device augmented by a core extensible DAW application, an audio and MIDI input/output (i/o) interface, a monitoring system, and perhaps some controller devices such as a music keyboard, MIDI system real-time controller (faders and pots etc), and electronic drum pads.

Perhaps the biggest advantage a DAW has is its ability to store and recall an entire project complete with its 'live' instruments and effects, routings and automation data. Also, modern DAWs are extensible, which means third party software (plug-ins) can be added to expand feature sets and allow communication with external hardware, and their settings are saved too.

A typical basic DAW system will comprise ..

- A personal computing device (desktop, laptop or tablet)
- Additional hard drives (internally or externally connected)
- An audio/MIDI interface

- A pair of powered loudspeaker monitors (and/or headphones)
- A piano keyboard controller (MIDI and/or USB)

In order to function, DAWs rely on the successful integration of the following software components ..

- Computer platform OS
- Audio interface drivers
- MIDI interface drivers
- MIDI controller drivers
- An extensible DAW application
- Sound source, effects and dynamic processing plug-ins.

A typical current day DAW system



DAW applications

There are many DAW applications, each with their own strengths and weaknesses. Some were originally designed for specialist applications, such as ProTools with its emphasis on multi-track audio recording (tracking and mixing), and Reason which is one of the DAWs of choice for those making instrumental electronic dance music. But almost all DAWs are capable of undertaking all the primary recording studio tasks. Most have similar features, such as an arrange page timeline of tracks, which first appeared in Cubase in 1989, and sophisticated MIDI and audio editing tools.

The most popular DAWs are ..



Avid ProTools mixer window

Avid ProTools

<http://www.avid.com/us/products/family/pro-tools/>

ProTools is the DAW of choice for professional tracking studios, and was originally conceived as a replacement for multi-track tape and mixing systems. Record companies often specify that projects should be archived and delivered in ProTools format and re-mixers are expected to be able to open and deliver finished projects.

The ProTools product range is complex (and potentially confusing!) and includes various versions for different platforms, hardware systems and budgets (you can view a comparison table here .. <http://www.avid.com/us/products/family/pro-tools/>). ProTools requires bespoke Avid hardware, and although Avid has provided entry level hardware-free native versions in the past, and currently has a range of budget interface/software packages with a limited feature set, their history of

support has been patchy and it is clear that these options have been designed to encourage upgrade to the 'pro' systems. Buying into the 'pro' ecosystem is costly with major updates often making existing hardware obsolete. Avid's core system revolves around a PCIe based proprietary interface (Digi-link) which connects to external hardware including a-to-d and d-to-a converters, mic pre-amps, DSP, and synchronisation devices.

ProTools has a proprietary plug-in format. Versions of plug-ins in this format are often substantially more expensive than their VST and AU counterparts.



Ableton Live

Ableton Live

<https://www.ableton.com/en/live/>

A relative latecomer, Live is now a mature and fully featured application with innovative workflow features that have been embraced by DJs and bands for studio recording and live gigs. Live is particularly popular in the dance music scene, perhaps because of its innovative Session View interface (it has a conventional timeline arrange page too).

Garageband

<https://www.apple.com/mac/garageband/>

Garageband is free on the Mac and iOS. Conceived as an entry level music production programme for amateurs, it has inherited many of Logic Pros features and can now be used as a complete, if somewhat limited, system. If you're short of funds, it's a fine place to start learning and experimenting.

Propellerhead's Reason

<http://www.propellerheads.se/products/reason/>

Reason was revolutionary when introduced in 2000. Intended as a platform for sound design, dance and electronic music production, Reason presents a virtual skeuomorphic user interface of rack devices which can be rotated and interconnected with virtual leads. Devices can be added until the host computer's CPU capacity is reached. Propellerhead have developed Reason over the years adding impressive new synth, sequencing and effects devices and in 2009 addressed a long stand omission, the ability to record audio, with the release of a companion application Record, with which Reason integrates.



Logic Pro X

Logic Pro

<https://www.apple.com/logic-pro/>

With its roots in Emagic's Creator and Notator software for the Atari ST, Apple brought Emagic in 2002 and a slow but impressive development road map has produced the current Mac only version, Logic Pro X. Although containing a vast collection of internal instruments, effects, processors and modelled hardware devices such as amps and effect pedals, Logic has trailed behind other industry innovations such as elastic audio algorithms and track folders, but when they have been eventually incorporated their implementation is always elegant. Logic has two primary advantages over its rivals ..

1. solid integration with the Mac hardware and OS (via Core audio)
2. cost - Logic's price has tumbled from close to a 1000 bucks 10 years ago to an incredible \$233 today

MOTU Digital Performer

<http://www.motu.com/products/software/dp/>

Digital Performer has been in development by MOTU for almost 30 years and is currently at version 8. It is mature, powerful, available for Macs and PCs, and can be partnered with MOTU's superb range of hardware MIDI and audio interfaces. It's biggest user base is in the USA.

PreSonus Studio One

<http://www.presonus.com/products/studio-one/>

PreSonus started life as a small manufacturer of cost-effective audio hardware devices and have quickly evolved into a reputable developer of a wide range of studio hardware. Studio One is a relatively new

application but has already found many advocates.

SaDiE

http://www.sadie.com/sadie_home.php

SaDiE has established itself as a professional audio post production system for the broadcast industries. Systems comprise a core software application which runs on a PC and accompanying i/o and controller hardware. SaDiE is mostly used for radio and TV broadcast work. It's not cheap, but it is mature, robust and professional.



Cubase arrange page

Steinberg Cubase

<http://www.steinberg.net/en/home.html>

When Steinberg introduced its Pro-24 MIDI sequencing application for the Atari ST in 1986, the world of audio production was revolutionised. Building on their own Pro-16 application for the Commodore 64, Pro-24 presented a virtual 24-track tape machine interface. Perhaps Steinberg's greatest innovation was the track based timeline arrange page interface first introduced with Cubase in 1989, and copied by many of their competitors. Further innovations have included the VST protocol for plug-ins. For some reason, Steinberg have never quite shrugged off the perception that their products are not of professional quality, perhaps because some versions have been less than entirely stable, and perhaps because the German based company never found a strong foothold in the US market where MOTU dominated throughout the 80s and

90s. Today Cubase is a formidable and powerful application, and those that first experienced it in school and colleges (where Steinberg's education products dominate) should give serious consideration to using it in a professional context.

Steinberg Nuendo

<http://www.steinberg.net/en/products/nuendo.html>

Nuendo has been Steinberg's attempt to side step the perception of Cubase as an application for amateurs, discard legacy code, and develop a thoroughly professional application for post production. Essentially it is Cubase with a raft of specialist professional tools for video, film and broadcast work. It has found favour in professional post production environments but is not generally used in music production, perhaps because of its higher cost and broadcast centric features.

Cakewalk Sonar

<https://www.cakewalk.com/products/sonar/>

Sonar is a PC only DAW and a great one at that. With Melodyne integration (the revolutionary polyphonic pitch shifting software) and a wide range of sound source and effects plug-ins, it is fully featured and capable of professional audio and music production work.



Audio unit plug-in in Logic Pro

Extensibility

DAW applications are extensible because they permit compatible 3rd party software components (plug-ins), to be added to the system. The primary plug-in protocols are ..

- Apple's Audio Units (AU) for Mac
- Avid's TDM, Audio-suite, RTAS and AAX for ProTools (yes they keep changing it!) for Mac and PC
- Steinberg's VST for Mac and PC

Should I be using a DAW?

It often seems that the whole world has switched to using DAWs for the primary tasks of composing, arranging, recording, editing, processing, mixing and mastering audio and music. Certainly the many internet how-to guides, video channels, blogs and forums are dominated by discussions on DAW related technologies and processes.



Unquestionably DAWs offer far greater flexibility, features, and cost effectiveness than equivalent hardware based systems, but advocates of their superiority assume that we all make and record audio and music in the same way. Creativity isn't linear and those capable of leaps of imagination and lateral thinking don't always need the same tools as the masses. DAWs offer almost limitless flexibility in audio creation and manipulation, but greater choice isn't always an aid to creativity. In fact great leaps forward often result from the innovate use of limited tools.

On a more pragmatic level, if your thing is making live and authentic recordings of performances, perhaps some great mic's, a robust and portable hard disc recorder, and a mixing and monitoring system is the way to go. You can learn your system inside out, record on location, and concentrate on realising transparent recordings of great performances.

Or perhaps you favour the sound, technologies and recording processes of linear multitrack tape? You'll need to have deep pockets, and be prepared for the relative scarcity of new tape media, but if you've decided to go this route, such logistical challenges won't deter you and if you're good at what you do, you'll find enough clients who share your enthusiasm for the analogue aesthetic. Tape's popularity should ensure that there will always be specialists ready to supply the small but loyal demographic of enthusiasts, and service engineers available to keep ageing recorders running.

But for most of us (including this author), DAWs are the front runners and for good reasons. Do any of the following strike a chord? ..

- I want total control
- My creative processes are private
- I can play a bit, but I need lots of takes and comping to get it right
- I want to sing but my timing and pitch is a bit hit and miss
- I can't afford to record real performers and instruments in a professional studio
- I need lots of time to reflect, refine and tinker
- I have a day job and want to record in a location, and at times convenient for me
- I have limited finances
- It's a hobby and I have no professional ambitions
- I can't possibly afford to buy hardware equivalents of all the synth and processors plug-ins I want
- I don't have much space
- I only make dance music and electronica
- I'm involved in sound to picture
- I regularly collaborate with others who are geographically remote from me

Also, are the advantages of fast total recalls compelling for you? ..

- I'm working on multiple projects every day
- I'm a re-mixer
- I'm a mastering engineer

And let's also not forget that DAW technology has democratised music making and made it possible for those of us with disabilities, and have been socially and financially disenfranchised, to express our creativity.

However, before we move on, let's introduce a word of caution and list some disadvantages ..

- Hardware obsolescence - Computers are not designed to be used for more than 4-6 years, often

do not contain serviceable parts, and feature external and internal interconnect technologies that change and evolve (as I write, those of us with significant investments in Firewire connected audio interfaces, and PCIe DSP card systems, have some restless nights to look forward to).

- Driver issues - Many DAW components rely on current and updated i/o drivers, but manufacturers earn nothing from the considerable task of re-writing drivers for new OS's. Their focus is on selling us their latest and improved products.
- OS obsolescence - It is almost impossible to resist an OS update for ever, unless you buy and configure a DAW and never add any components to it, and as operating systems mature so do their hardware requirements.
- Compatibility - DAWs rely on the successful integration of hundreds of hardware and software components, each of which must co-exist in a complex interrelated system. A single change can upset this balance resulting in issues that are difficult to diagnose and solve. Contrast this to the world of analogue and digital hardware interconnection where standards are absolute and enduring.
- Latency - It's a tribute to the many compelling features of DAWs that we've been willing to tolerate the disastrous consequences of delayed audio signals (more on latency later).
- Mouse control - The mouse is a wonderful invention, but one thing it's no good at is facilitating the interactive on-screen process of programming a synth patch or adjusting EQ parameters.
- Inter DAW project compatibility - Unlike 24 track tape, projects created in one DAW application are largely incompatible with another unless tracks are 'reduced' to raw PCM data (.wav, .aiff) file formats and stripped of their plug-in and automation data.
- Long term backing up - Backing up core software, audio projects, and sample libraries is a formidable task, and we still have no viable medium term solution since the demise of adequate capacity recordable optical disc systems.
- Security - As more of us rely on the web for our software updates, sharing and collaboration activities, it's become almost impossible to isolate a DAW from the internet, and if you're running a PC, protecting your system from attack may be a far from trivial issue.
- Robustness - No personal computing platform based DAW system will ever be as robust as a dedicated hardware device in which software and hardware are designed to work together as an integrated system on location. A DAW is far more likely to crash at a critical time.

Choosing a Platform

Perhaps the most important step in choosing a DAW is deciding on the platform you're going to run it on. There are currently 5 primary choices ..

- Windows PC
- Windows Mac
- OSX Mac
- Android
- Apple iOS



Windows 8 is pre-installed on most new PCs

Windows PC

As we know, and despite Microsoft's clumsy development road map history, Windows on the PC is a powerful, mature and robust system supported by all the primary DAW software publishers, with one notable exception. Not only is it's software environment highly customisable but so is it's hardware, which perhaps makes it a better choice for those of us who want to configure a system dedicated to audio. The downside of this flexibility is the requirement for a degree of expertise, patience and trial and error in optimising a system, especially as Microsoft's focus is on enterprise and business and not creative applications. Never-the-less there is great satisfaction in knowing that the music and audio you record has been produced on a system of your own design. If Windows is the environment you know, you would be foolish not to consider this option.

Windows Mac

Windows on a Mac is facilitated by Apple's free Bootcamp software which allows you to switch between Windows and Mac OSX. This would appear to offer the best of both worlds but in reality you are unlikely to want, or need, to run two DAW systems on the same computer, and whilst Mac OSX is installed as standard you will still need to buy a Windows license and two DAW packages. Remember also that Logic Pro will

not run under Windows on a Mac, only under Mac OSX. Also, it is not clear how compatible audio interface drivers are with Windows running under Bootcamp and you will need to investigate carefully before committing to a system. Common sense seems to suggest that any additional software layer between the audio application and it's ASIO drivers can only exacerbate latency and compatibility issues, but when it comes to computer systems, common sense can be turned on it's head, so research forums for existing user experiences, and software manufactures for guidance.

We can't leave the subject of Windows without reminding you that the jury is still out on Windows 8's suitability for audio, and given that all new PC's will have it pre-installed, caution is advised. Again, check those user forums and compatibility spec's to ensure all the software and hardware components you intend to buy are supported.



Mac OSX, the choice form many professionals

OSX Mac

Running a DAW on Mac OSX is as close to a no-brainer as you will get in the computer world. That is, provided you are prepared to buy into the Apple ecosystem. What you lose in flexibility and freedom, you gain in security, robustness and professionalism, with an environment that requires minimal configuration and is arguably supported by more professional hardware and software options than the PC. And the icing on the cake is Logic Pro, which is ridiculously well featured even without additional plug-ins, and ridiculously cheap. The chances are that you will be able to install Logic from the app store, plug-in your audio interface, select it in Logic's audio preferences and be ready for work. Apple's Core audio layer and Audio Units plug-in format has created an API development environment in which everything just works, and Apple values it's creative industries customer base.

It's not all good news though. Once you buy into the Apple eco-system you will be at the mercy of their formidably aggressive development cycle, with new generations of Mac hardware discarding interconnection protocols sooner than many of us would like, and OS updates often breaking established and robust hardware drivers. Apple is also widening the gap between it's 'consumer' machines (iMacs and laptops) and pro models, with the new MacPro not just considerably more expensive than previous models

but also considerably, and perhaps for audio applications unnecessarily, more powerful. However, given that multi-track 24-bit audio is no longer a challenge for even consumer machines (the current range of iMacs are no slouch), and the MacPro is setting it's sights on 4k video production, this may not be an issue for many of us.



SunVox sequencer and synth for Android

Android

Google's Android system for tablets has improved immensely in the last 12 months and few would argue that it is inferior to iOS. Although perhaps not as elegant, Android is every bit as powerful and fully featured as iOS with it's only Achilles heel being the relative lack of quality apps available for music and audio recordists. This is partly to do with inherent latency issues and also the fragmentation of the OS version user base. But as we all know, you don't need a wide choice, just the right choice, and if you want the touch screen experience (and who doesn't for audio), convenience, cost effectiveness and above all portability, an Android tablet may be your best choice. Although it is unlikely that tablets will be able to offer the sheer grunt of laptop and desktop devices anytime soon, their sheer convenience will free many from conventional working methods and environments and this can only be a good thing for creativity.

Apple iOS

Everything we've said about Android applies to the iOS platform. But unless you've been living in a cave, you don't need us to tell you this. iOS is becoming a serious alternative for audio and music recordists and is perfectly capable of producing professional results if you work within its limitations. Past generations who started their careers on cassette based porta-studios could only dream of the kind of power that free or low cost iOS apps offer, and the introduction of multi-tasking and protocols that allow audio to be routed through multiple applications simultaneously give a hint of what's to come. If you are a beginner, and Logic Pro, Cubase, Live and Reason look daunting, iOS is a good place to start.

Choosing a DAW application

With hit albums being produced with FL Studio and Garageband, the distinction between pro and consumer software has become blurred. If the definition of a professional DAW is one that professionals use (ie those that make their livings from music and audio), then Logic Pro, ProTools, Performer and Nuendo are no longer the only options. If you're buying a DAW for your home studio, then personal preference and familiarity will be primary decision making factors, and your final choice may have more to do with the way you like to work and the kind of recordings you want to make than any objective technical or professional workflow evaluations.

However, if you are choosing a DAW as the centre piece of a studio that will serve paying clients, then you will need to accommodate their needs. Therefore a studio specialising in live band recordings will need to seriously consider the expense of a desktop computer with ProTools, whilst a studio catering to dance producers would be unwise to ignore Reason and Ableton Live. If you are going to use a Mac you may as well install Logic Pro, even if its only to offer it as an option to clients.

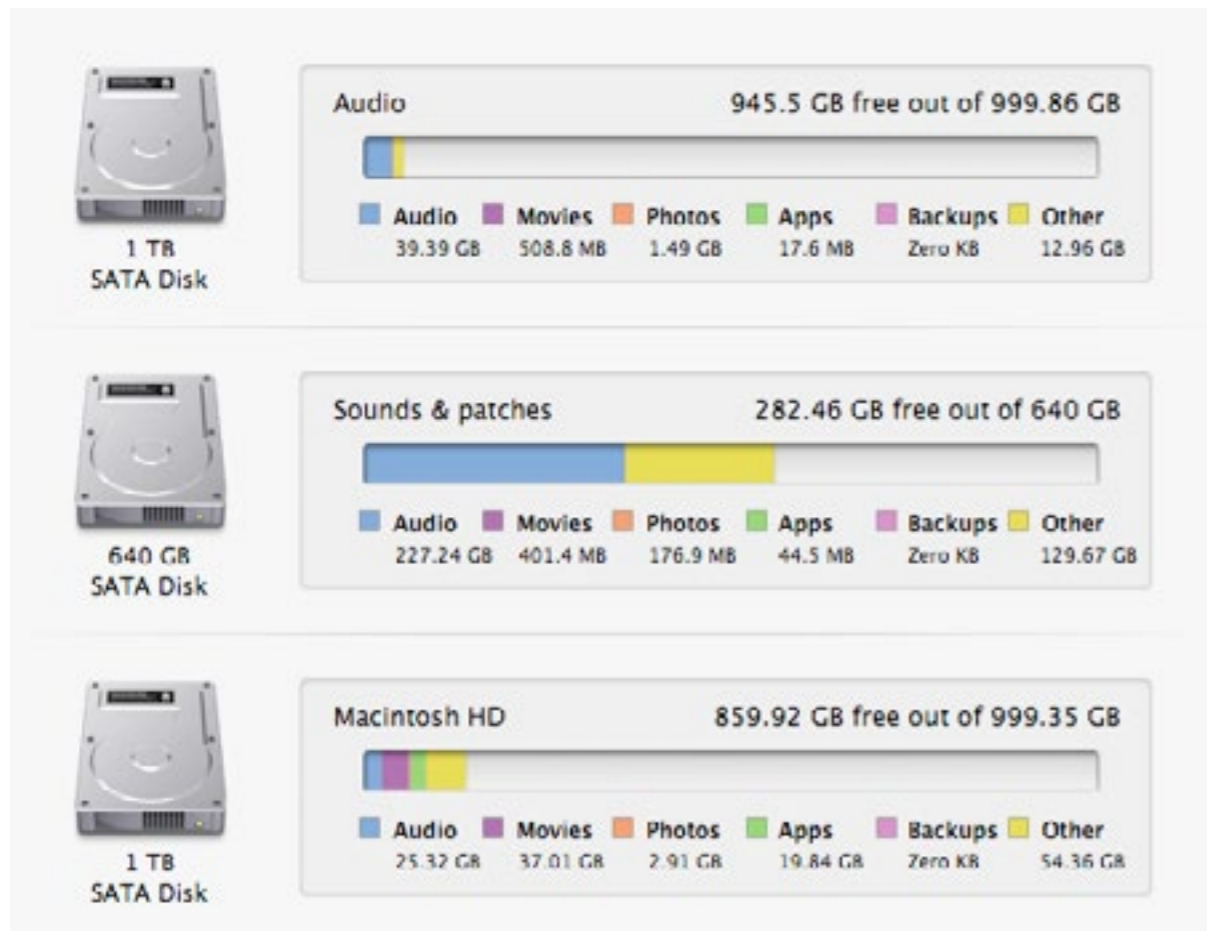
You would be unwise to choose the Android or iOS platform for anything other than personal use. Clients are unlikely to appreciate their limitations. However, only a fool would bet against mobile devices becoming practical platforms for fully fledged DAWs within the next couple of years.

Many DAW applications are available in trial versions, so after you have narrowed down your choices, you can road test them before committing to a purchase.

Minimum system requirements

Whatever you choose, you will need to check it's OS compatibility and recommended minimum system requirements. The later will suggest modest hardware will suffice (publishers want to sell as much software as possible) but it will almost certainly be the case that anything other than a relatively recent computer configuration will be frustrating to operate.

If you're going the Mac or PC route, you should plan for a processor that's at least a generation more recent than the recommended one, and twice the recommended RAM.



Hard drives for the system and applications, sounds, and audio project files

A separate hard drive for your audio that is either mounted internally (eg eSATA), or connected externally via an eSATA bus or Thunderbolt is essential for larger projects. If you plan to install extensive sample libraries, a third drive is recommended. Your drives will need to be 7200 rpm if you want to exploit the high track count potential your software offers.

You might also want to consider a 4th drive to use with Apple's Time Machine backup utility or a comparable PC application, to enable a full restore of your system and applications if the worst should happen.

Installing OS and DAW updates

Whilst we're on the subject, a word of warning about installing a major DAW or OS update. Neither of these procedures should be contemplated until you have checked the possible impact on ..

- plug-in compatibility
- software license management (including dongle and soft-dongle protected plug-ins)
- audio interface driver compatibility

This means reading the guidance at the relevant software manufactures support site for every software and hardware component of your DAW system.

64-bit mode

Finally, if you are buying your first DAW system you should choose the future proof option of a 64-bit OS and run your core DAW application in 64-bit mode. Windows 7, 8, and Apple's Mountain Lion, Mavericks and Yosemite OS's are 64-bit, as is Logic Pro and most other DAW applications. You will need any 3rd party plug-ins to be 64-bit also. Don't consider a 32-bit system, it yesterday's technology and will not be comprehensively supported in the future.

Although you may be able to run old 32-bit plug-ins within a 64-bit application using a bit-bridge software component, don't invest in any new 32-bit only software, the future is 64-bit.



Spectrasonic's bass software instrument plug-in Trillian

Plug-ins

Almost all DAWs come with an extensive bundle of 'internal' plug-ins. Logic Pro is notable in this respect. It is not necessary to add any additional third party plug-ins, even if you can afford to. However, part of the fun of DAW systems is being able to personalise it.

There is no way to cover all the available plug-ins, but if you can think of it, someone's created it! From emulations of classic vintage hardware to innovative synthesis and processing devices, it's all out there and available for purchase on the web. Most publishers offer free trial versions. There are some free and respected plug-ins available, but most will cost you. You will be able to create a system with all the sounds, instruments and processors that you know and

love. All software emulations of course.

There is much debate on the web concerning the authenticity of plug-ins that emulate real world hardware, but it is likely that their convenience and low cost (compared to hardware) will win you over, and in practice differences are unimportantly small. Also many plug-ins are unique and have no hardware equivalents.

Plug-ins tend to fall into 2 categories ..

1. native
2. DSP hardware hosted

Native

Native plug-ins run on your computer's CPU (and increasingly GPU). There will be a finite number you can use before the system is unable to cope, but for recent systems this is usually not an issue especially if you share effects on auxiliary send and return buses rather than insert them into individual channels.



Universal Audios popular PCIe card DSP powered plug-in platform

DSP plug-ins

DSP hosted plug-ins run on interconnected hardware (typically PCIe or FireWire). A notable example is Universal Audio's UAD system, which runs a popular range of plug-ins not available in native versions. However, DSP hardware becomes obsolete as interconnect protocols change (PCIe and FireWire are on the way out) and upgrade paths, if available at all, can be costly.

CV / gate systems

If you are lucky to own 'vintage' or modular analogue synths that use pre-MIDI CV gate interconnects to trigger oscillators, envelopes and other modulators, there are several plug-ins for your DAW capable of using your audio interface to transmit and receive control voltage signals. Check out Expert Sleeper's Silent Way (<http://www.expert-sleepers.co.uk/silentway.html>) and MOTU's Volta (<http://www.motu.com/products/software/volta>).



One of the plug-in in Expert Sleeper's Silent Way suite of CV / Gate plug-ins



External hard drives for sample libraries and backup

Installing a DAW and plug-ins

Plan your installation strategy carefully as the choices you make will impact the ease with which you can migrate a system and make regular backups of data. Most installation procedures allow you to choose install locations. You can use a simple storage system, providing you separate your project and audio recording data from your system and applications, but if you are building a laptop or desktop computer system, the following storage configurations are recommended for maximum security and flexibility, and future system migration ..

1. System drive (HD or SSD) - For the operating system, core DAW application, instruments, effects and processor plug-in components.
2. Audio drive (72,000 RPM minimum) - For project files and related audio files.
3. Sample libraries and patches drive - Install your instrument libraries and presets, and save your own plug-in patches and mixer channel configurations here (you may need to create custom data paths in your plug-ins). When you upgrade your computer you can simply move this drive to it.
4. Project and audio files backup drive (you could use your system drive for this) - Clone your projects to this drive at the end of each day.
5. System backup drive.

Optimising an operating system

Given that both Android and iOS have virtually no user optimisation features that affect audio, apart from turning on or off location services and a few other services such as Bluetooth, you should find you can install software and start working.

Because Core audio (and MIDI) provide an optimised software layer, there is not that much to configure

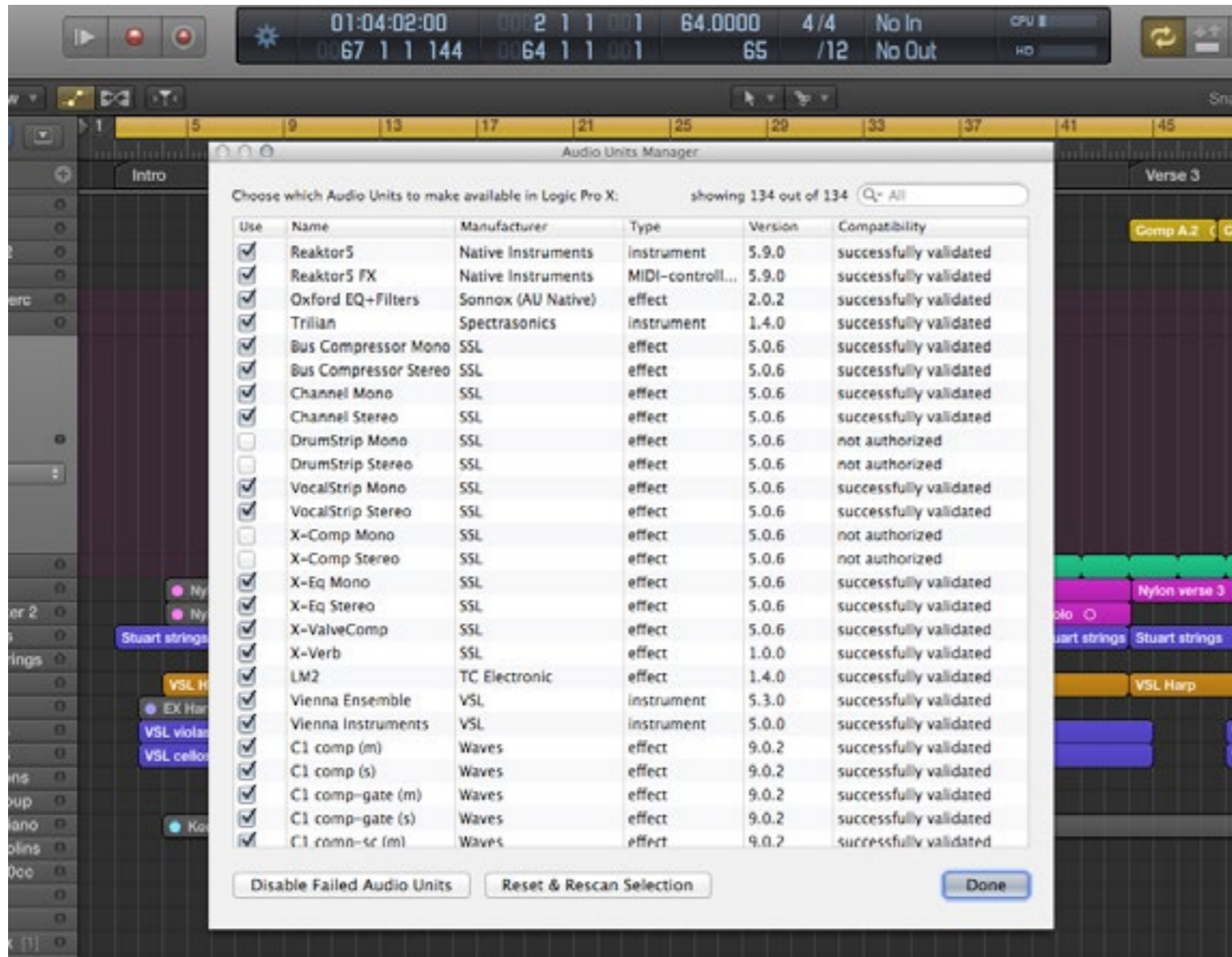
in Mac OSX either. However, you will need to open the Audio setup control panel and ensure your audio interface is selected, sample and word-length settings are correct and your word clock master and slave settings are correct. You may also need to disable DropBox, Creative Cloud, and any other automated software update services that may be running in the background. On the Mac, audio buffer settings which affect latency are usually configured within the DAW application and not the system (more on this later).

Optimising a Window's system can be a complex process, and apart from the repeating the advice given above for OSX (this time you will be using ASIO drivers rather than Core audio), it would be unwise for us to attempt to give definitive advice, but here are some of the things you will need to consider ..

- Ensure your DAW and OS software is up to date
- Use the ASIO driver for your audio interface, or try the ASIO4ALL driver if you are having trouble
- Experiment with ASIO driver buffer settings to achieve the lowest latency (256 samples or below is average), and if you are having difficulty download a latency checker to help you (http://www.thesycon.de/deu/latency_check.shtml)
- Disable Windows Firewall
- Disable anti-virus and spyware
- Disable Windows services
- Disable any unneeded utilities which came pre-installed on your system
- Set the computer power for high performance
- Disable system alert sounds
- Enable DMA (Direct memory access) on IDE channels
- Set the processor to "Background services" scheduling
- Turn off visual effects
- Install more RAM (check DAW publisher minimum recommendations and double them)
- De-fragment your audio drive or install a faster (7200rpm) dedicated one

License organisation & dongles

Many DAW applications and third party plug-ins are protected from piracy by licenses which are managed online in user accounts, and stored in USB key dongles. License management services come and go, but many manufacturers are converging on iLok (<https://www.ilok.com/>) which provides a flexible way to transfer and manage licenses. It goes without saying that an iLok USB dongle must be connected to a DAW computer in order for plug-ins to run and therefore you will need to ensure you have a free USB port. A USB 2 or 3 mains powered (not bus powered) hub is recommended.



The Audio Units plug-in license validation window in Logic Pro



An expensive entry level 21" Samsung monitor with HDMI input

Screen monitors

The days of expensive flat screens have passed and a 100 bucks will buy you a 21" monitor. However, not all 21" monitors are equal, and wide-screen aspect ratios give less screen estate than 16:9 or 4:3 models, so beware. If you're running a laptop, you can connect a large monitor when you're back at base, but with a desktop two screens are worthwhile.

We don't need colour critical screens for audio work, but ensure the screen has a compatible interconnect such as DVI, HDMI or Thunderbolt and not just the obsolete VGA connector.

When setting up 2 screens side by side consider what impact they may have on loudspeaker spacing to ensure stereo imaging is not compromised. You may wish to buy models with VESA mounts so you can attach them to arms and re-position them conveniently for different tasks such as tracking and mixing.

i/o hardware

Unless you are originating all your sounds and performances within the DAW (so called in-the-box or ITB), and only using your computer's built-in audio interface (eg headphone port) for monitoring, you will need a hardware audio interface (still also referred to by many as a sound-card).

There are three primary categories ..

1. Motherboard built-in

These will have basic facilities only for audio recording and playback and quality may well be compromised by poor quality converters and their close proximity to other noise inducing components. You should aim higher.

2. PCIe cards

There are many cards that offer both analogue and digital interconnection. Look for at least analogue stereo in/out, and either Toslink optical (SPDIF / ADAT) in/out, or coaxial SPDIF in/out. The card will need a driver compatible with your OS and should be able to operate at 44.1kHz and 48kHz sample rates both at 24-bit. You are unlikely to use 96 or 192kHz sample rates unless you are undertaking professional sound-to-picture work. Be aware that PCIe is no longer a simple inexpensive option on Macs (which require a separate Thunderbolt connected PCIe chassis enclosure), but will probably be supported for a while yet on PCs.



A popular USB 2 connected device from Focusrite's Scarlett range

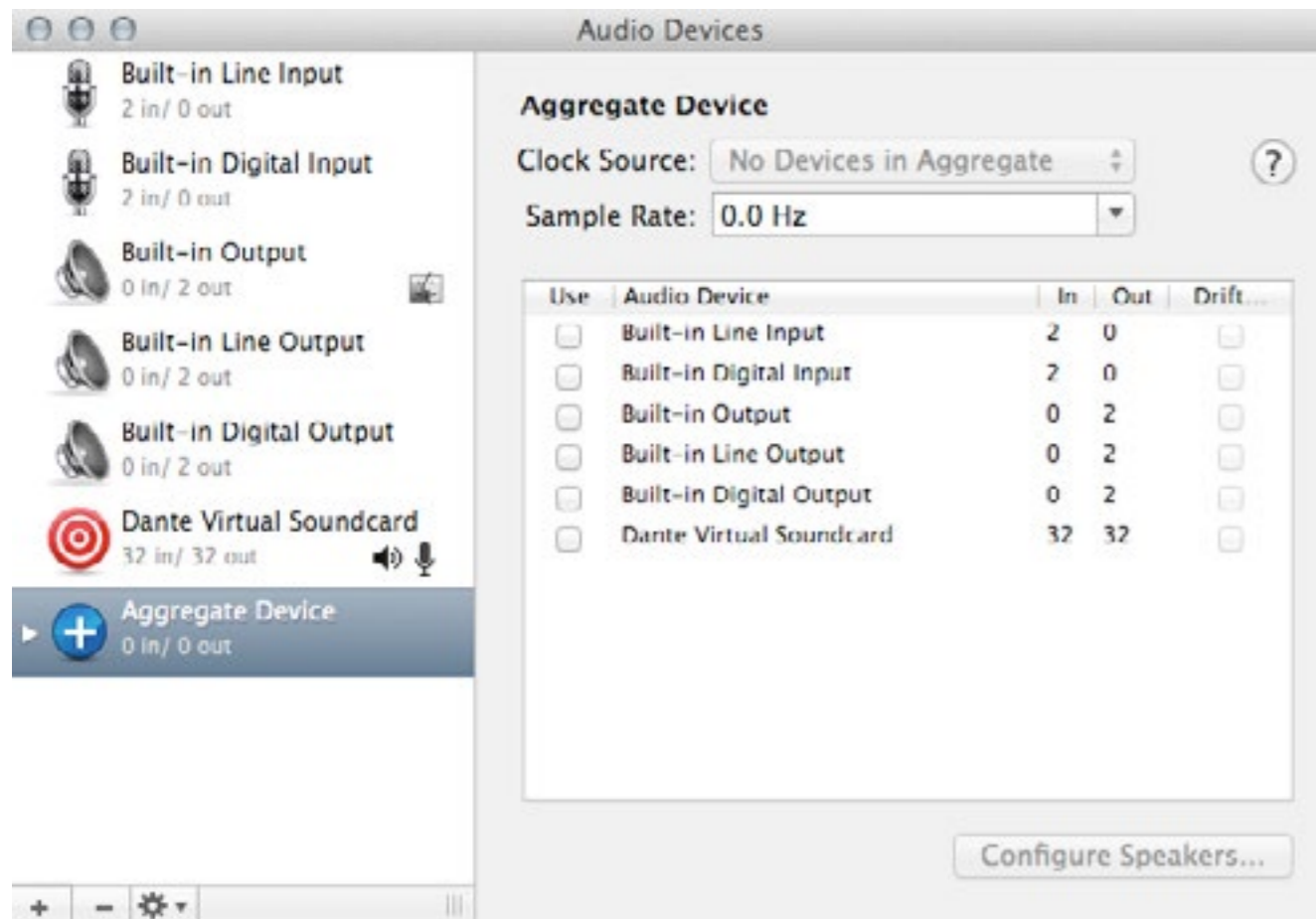
3. Interface / bus connected stand alone hardware

These types offer the greatest flexibility and quality, and if you are buying new you will want to look at options that connect via USB 3 (although USB 2 is still perfectly adequate), Thunderbolt or ethernet (audio over IP). Avoid USB 1 and FireWire, they've had their day. For the greatest flexibility you should choose

something with the following minimum specification ..

- MIDI in/out
- Stereo / 2 channel analogue line in/out
- Stereo / 2 channel analogue mic in/out
- An instrument input (for guitars and basses)
- Stereo / 2 channel digital (line) in/out on either TOSlink or coaxial SPDIF (not essential but useful)
- 48v phantom power on both mic ins
- Headphone monitor output and level control
- Direct / low latency monitoring
- Built in monitoring reverb
- A master monitoring control
- Preferably mains powered (rather than just bus)

The Aggregate device window in Mac OSX



Aggregate devices

It may be possible to use multiple devices simultaneously (eg built-in audio, a USB interface and a PCIe sound card) by creating an aggregate device in a system control panel (Apple's Core audio supports this), but remember that if they are sharing the same interconnect bus, they cannot exceed the total bus bandwidth, or power draw if they are bus powered. You will need to nominate one as the master Word clock device. Search the web on "how to create an aggregate device" for help. Unfortunately the ASIO driver protocol on Windows does not support this.

There are of course, a wide range of available devices from dozens of manufacturers which are designed to work with or without additional hardware such as stand alone mic pre-amps, mixers and analogue to digital converters. If you need to record multiple performance simultaneously, such as with live band recording, you will need a more extensive i/o and monitoring system.



A Toslink connection can carry a stereo SPDIF optical signal or an 8-channel ADAT optical signal between your DAW and an external device

Digital interconnection

The ability to transfer audio digitally to and from your DAW is not as important as it was when hardware 2-tracks (eg DAT, CD recorders etc) were the norm, but it's still a useful addition to an interface, especially if you have a hardware voice channel strip equipped with digital out.

Many choose to buy a single voice channel strip unit containing a high end mic pre-amp, EQ and compressor/limiter to record all their audio through, and some of these devices have hi-end analogue to digital converters at the end of the signal chain.

Therefore an AES3, SPDIF TOSlink or SPDIF coaxial input could be an essential audio interface feature. It's easy to make a lead to convert SPDIF coaxial to AES3 and vice versa if you need to. Don't forget

that the device will need to be digitally synchronised (<http://www.projectstudiohandbook.com/videos/playlists/digital-audio/digital-audio-synchronisation/digital-audio-synchronisation-video.html>).

If your device has ADAT TOSlink i/o, you will also be able to add an 8 channel i/o analogue to digital converter in the future that will enable you to record more simultaneous tracks or integrate external hardware such as effects, filters and dynamic processors.

Hardware / software hybrid devices

Although all bus connected stand alone hardware devices (audio interfaces and controllers etc) require some form of software driver, we would advise caution when considering hardware/software hybrids that depend on comprehensive personal computer hosted software environments to function.

Manufacturers tend to drop support for them fairly quickly after the market has been exhausted (take a bow Native Instruments, SSL, and TC Electronics) and in no more than a 2-4 years you may find yourself



Softubes impressive Console 1 plug-in and controller system

with a useless chunk of expensive hardware. Consider a device that utilises a fairly generic or mature driver (such as Focusrite's range or the Mackie Control), or one from an established and specialist manufacturer with a great reputation for long term product support such as MOTU or RME. These are by no means the only examples.

If you do decide to buy a hybrid system, you will find unprecedented integration and a hugely improved workflow that will free you from the limitations of single input devices like mice, and allow you to control multiple parameters simultaneously with assignable and dedicated controls.

Understanding latency

Latency is the time delay incurred by passing an audio signal through the hardware and software components of a DAW. If you are unsure exactly what latency is, read our comprehensive article here ..

<http://www.planetoftunes.com/sound-recording/digital-audio-latency.htm>

A great deal has been written on the subject of optimising a DAW for minimal latency (see “Optimising an operating system” in this guide), including disabling unwanted background tasks, start-up items, and

security software, and it is true that many improvements can be made to the stability and efficiency of a DAW system in this way, especially if you are using Windows, but in our experience nothing beats an upgrade in raw CPU horse-power to improve latency. A system that glitches and crashes can be completely revived with nothing more than a faster processor, and it goes without saying that multiple cores are best.

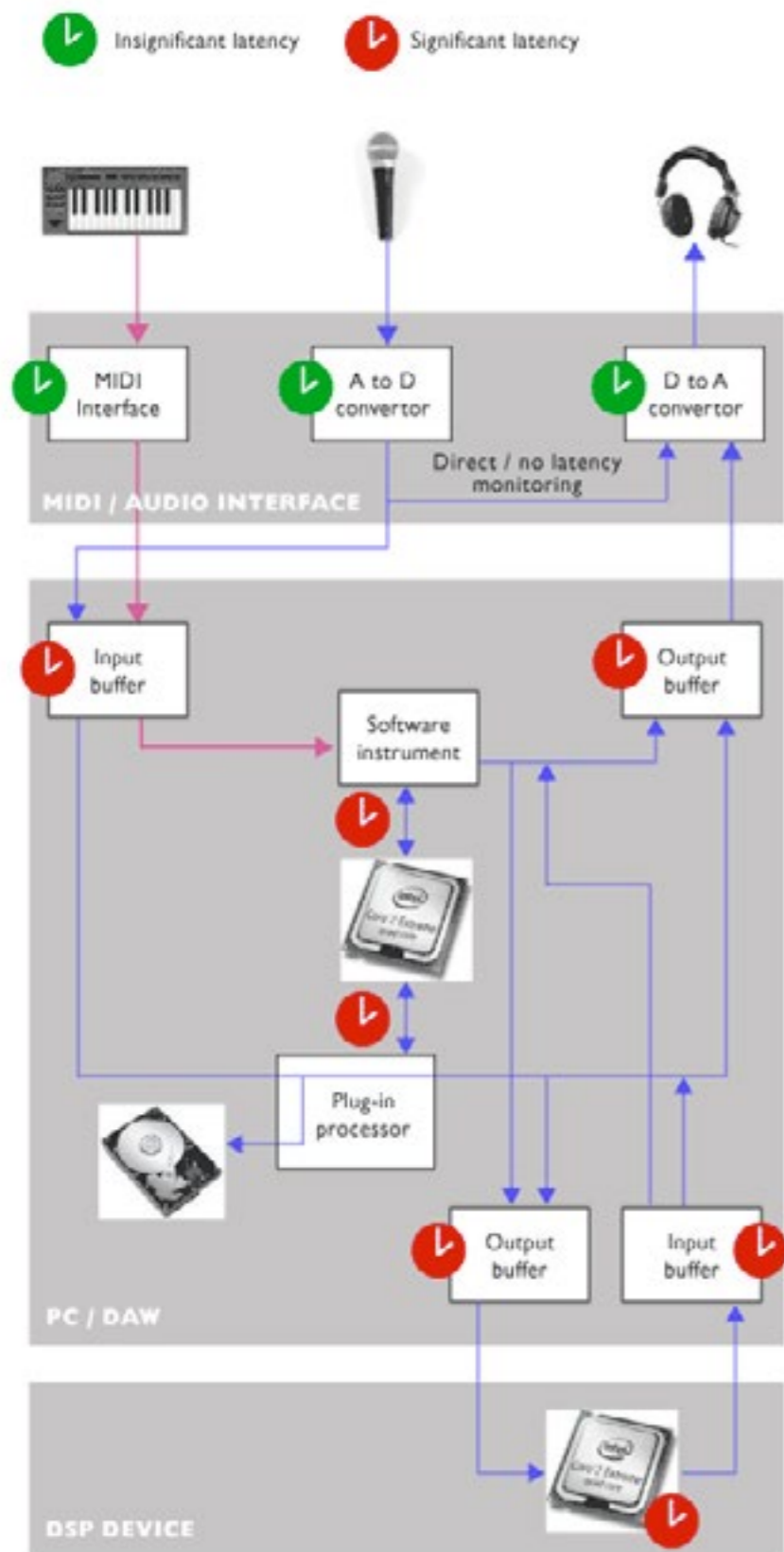
You should choose the lowest possible input/output buffer settings in your ASIO audio driver, or DAW software (Core Audio Mac users). You can do this audibly by checking for the tell-tale intermittent clicks, pops and drop-outs that occur

when buffer settings are too low. If your system works well at 128 samples (6ms round-trip delay) or lower settings, you’re doing well. 256 samples (11ms) is the average, but even 512 samples is doable if you can enable a low latency mode during recording.

No DAW or audio interface is latency free and whilst you can avoid latency during audio recording by using direct monitoring via your audio interface or a mixer, you will not be able to hear your performance with any track based plug-in effects in place. There is no work around for this (although you can reduce latency by disabling other tracks temporarily or using a low latency mode if your DAW has one), so consider an interface that not only has direct monitoring but also an in-built record monitoring reverb, or use an outboard effects unit if you are using a mixer. Adding reverb to a monitor signal during recording can help performers, especially singers, but it is by no means essential.



Logic Pro's core audio device select and latency control panel



If a little latency does not bother you, you can enable software monitoring in your DAW and monitor the record signal through the system. If there is a low latency mode, enable it to disable latency inducing plug-ins on non-essential backing tracks, and reduce the overall latency delay between record input and monitor output signals. Do not however, disable latency compensation which in most instances should be set to All (plug-ins and tracks), and will ensure that signals are in sync when you replay them after recording.

Latency in a DAW



Two very different sounding monitors, despite both having relatively flat frequency responses

Loudspeaker monitors & monitor controllers

Because of the marked differences in the character of the sound produced by loudspeakers (even those claiming flat frequency response), choice tends to be personal. Given that no single system can tell you what your mixes will sound like on every replay systems (from in-ear to theatre surround systems), or accommodate the different digital EQ profiles that users select on their in-car and portable devices, you may as well buy models you like. Whatever you buy, get to know them well by playing the music you love through them, and remember to test your mixes on the widest range of systems possible, including those owned by friends.

From an ergonomic point of view, powered (active) loudspeaker monitors that can be fed directly from the stereo out of your audio interface or sound card may be the best option. However, there is nothing wrong with using a consumer amp and hi-fi speakers. Studio monitors are built to be robust

and withstand the rigours of extended use, but do not necessarily offer superior sound quality.

However, you will want some form of monitor controller within easy reach of your work position. A simple volume control may be all your need and if your audio interface has one you need not consider extra hardware. However, if you want more facilities, here are some of the features to consider ..

- master volume control
- level meters
- mono switch
- dim switch
- multiple loudspeaker outs you can switch between

- headphone amp and volume control
- multiple selectable source inputs so you can switch between DAW and other 2-tracks
- record player phono pre-amp input
- talkback / foldback circuitry and mic



A pair of headphones (are we going to fast for you!)

standards, such as Beyer DT100's, for mixing work, as they are built to withstand session musician use, not for sound quality.

Using headphones

It is perfectly possible to work exclusively on headphones, providing you are intimately acquainted with the way commercial releases sound on them, and you make allowances for how perceptions of stereo panning and ambience can be exaggerated. You should still test your mixes on the widest range of possible loudspeaker equipped systems and in-ear headphones.

There are two basic types of headphones, closed back and opened back. As the name suggests, closed backed headphones prevent sound leakage and are suitable for performers during recording. Open backed headphones allow some sound to escape and are generally regarded as being more natural sounding. Once again, sound quality is a question of personal preference but you might want to avoid studio



Mackie Control is an established controller protocol for DAWs and hardware control surface.

Input controllers

Controllers connect to the host computing device and augment input devices such as mice, touch screens and trackpads. Most do so via USB or MIDI and transmit and receive MIDI Channel Voice Messages such as note-on, note-off and velocity as well as a sub-set known as Control Change messages. Control change messages can carry data to alter and automate properties such as volume, panning, modulation and virtually any parameter of a DAW plug-in effect or sound source. More on MIDI messages is here .. <http://www.planetoftunes.com/midi-sequencing/midi-language-specification.html>

USB & MIDI connection

Whether a controller connects via a USB or a MIDI 5-pin DIN port, most send and receive MIDI messages. There are no primary differences between USB and MIDI interconnects for MIDI, and although USB is faster, you are unlikely to notice any practical difference in performance.

Controller keyboards

Almost all DAW owners have a MIDI enabled musical keyboard controller to record performance data, and if they are adept players it may well feature a piano weighted action designed to mimic the action of a real piano. There are a wide range of musical keyboard and real-time controllers available some of which combine keyboards, faders and knobs, and others which mimic a mixer.

Although many users employ a musical keyboard to input drum patterns, some prefer a dedicated velocity sensitive drum pad controller that can be played with sticks.

Tablet controller apps

Tablet apps are an increasingly popular choice for controlling a DAW. These offer wireless touch screen control and can be effective for automatic mixes, editing plug-in parameters and initiating record from a remote location such as a live booth or room.

Other controllers

There are also a number of all-in-one systems such as Native Instruments Maschine, and Akai's MPCs which can be integrated into a DAW system, and whose physical controllers can be used to control DAW parameters.

Finally, there are a number of systems which seek to overcome the limitations of the mouse and trackpad by offering integration between a plug-in and a dedicated hardware controller. As we have already mentioned, Softube's Console 1 (<http://www.softube.com/console1.php>) is an impressive implementation of an SSL channel strip, but again we would recommend caution investing in a system that will require long-term software support as DAWs and OS evolve.

Setting DAW defaults

All DAWs allow a number of parameters to be configured prior to use and we would recommend optimising a default setup to ensure the best quality audio, working experience and compatibility with other systems.

Here are some options to consider ..

Sample rate

Use 44.1kHz for compatibility with the red book audio CD format (<http://www.planetoftunes.com/sound-recording/red-book-audio-cds.htm>), and standard MP3 preparation practices. You could use 48kHz but the difference is imperceptible, and 96kHz will reduce your track and plug-in count, again with an imperceptible improvement in quality especially when your finished track is exported to MP3. Only use 96kHz and 192kHz when you need to maintain compatibility with an external workflow, such as sound to picture work.

Word-length/Bit-depth

Select 24-bit for superior audio quality and dynamic range. All DAWs can easily handle the additional data. Find out more here .. <http://www.planetoftunes.com/digital-audio/how-do-analogue-to-digital-converters-work.html>

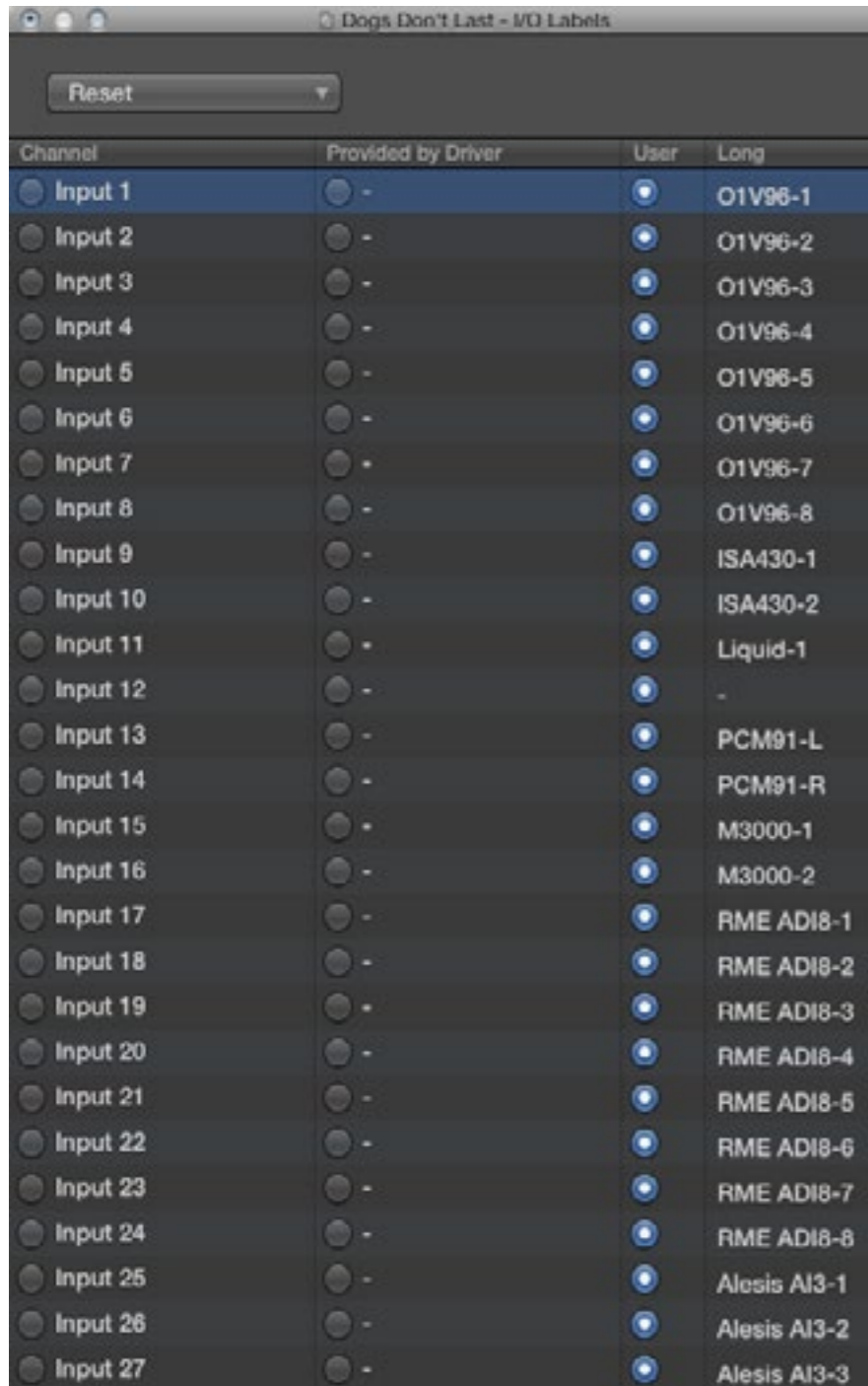
Digital sync and Word clock

Your logical choice for Word clock master is your audio interface, but if you have a digital output from a voice channel strip with one way digital interconnection, you may need to nominate it as the master and your interface and DAW as slaves. More here .. <http://www.planetoftunes.com/digital-audio/digital-audio-synchronisations.htm>

Audio file formats

The choices will be .wav or .aiff. There is no difference in quality between these formats, they are simply

different file wrappers and will contain identical PCM data. Most DAWs can convert between them. Perhaps use .aiff on a Mac and .wav on a PC(?).



Logic Pro's i/o labelling window

i/o buffer settings

First, see our advice on "Optimising an operating system" in this guide. Essentially you will want the lowest possible settings that don't cause audible pops and crackles. 32 samples will be excellent, 256 good and 512 acceptable. Experiment. If you have a PC you will need to read the advice in this guide, and search online forums and for DAW publisher advice to disable unneeded background tasks and optimise your system to prioritise audio. Mac users have very little control, Core Audio is already optimised, but you may want to disable network services such as DropBox and Adobe Cloud etc.

Record levels

If you are using a 24-bit word length it is not necessary to maximise your record levels to peaks of -3dB, -7-9dB is fine. Do not record at, or normalise signals to, 0dBFS unless you are sure your meters are taking into account inter-sample peaks. -3dBFS is the maximum your meters should be showing.

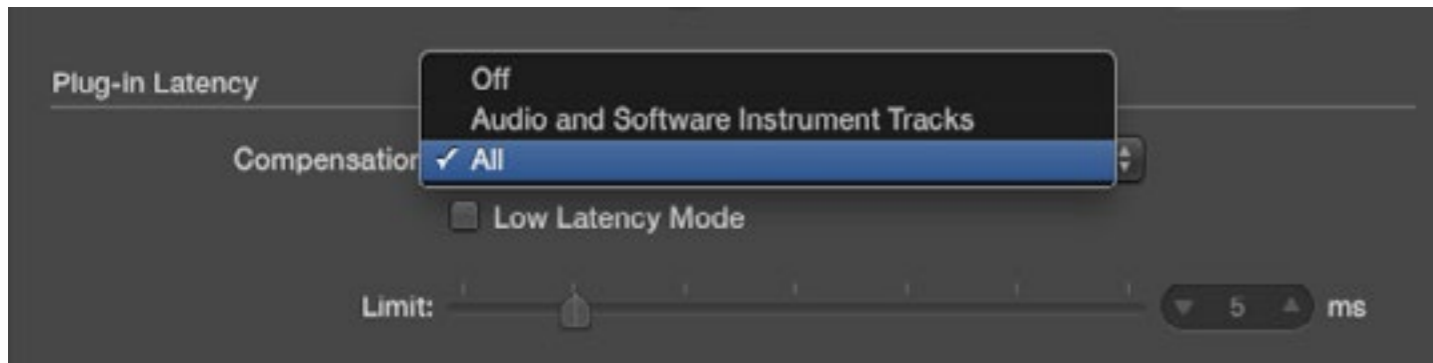
i/o routing

Once your audio interface is connected and recognised you should name it's input and output ports. If you name them in the audio interface's driver they should be published to your DAW, or you can label them within the DAW. Alternatively name them according to the devices that are connected to them.

Pinging external hardware

If you are connecting external hardware (such as a compressor or effect processor) either digitally or via analogue to digital conversion, you must ping the connection to allow your DAWs latency compensation to calculate the round-trip delay. Make the connections and routings and

hit the ping button in your DAWs i/o utility plug-in.



Logic Pro's latency compensation settings

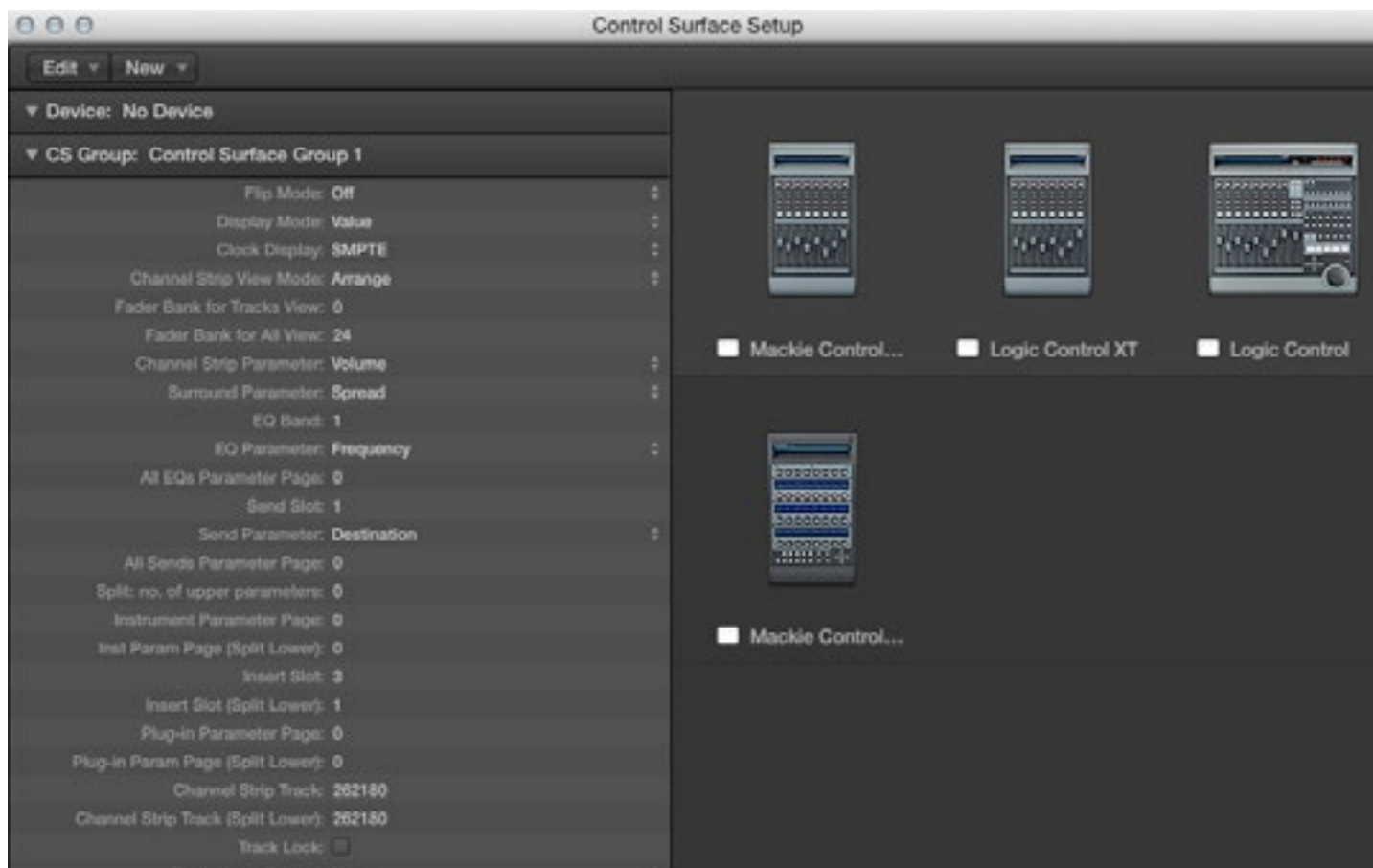
Latency compensation

Set latency compensation to 'All' to allow the system to compensate for processing delays incurred by audio tracks, mixer plug-in and software instruments. If you have connected external hardware, the delays could be significant, so if your DAW offers a low latency mode which can disable latency inducing routings during recording, assign a keyboard shortcut

to it or ensure its button is available on your toolbar.

Software monitoring

Logic Pro's controllers setup window



You will be most aware of latency issues when using software monitoring during audio tracks recording

on tracks that have plug-in processors inserted. The incoming signal is duplicated after passing through the plug-ins, but before it reaches your storage device, and the copy returned to your master stereo output so you can hear it. If you have setup a 'direct' monitoring routing with your interface or external hardware (such as a mixer), you won't need this routing, so disable software monitoring in your DAW.

Setting up controllers

If you have a hardware controller you may need to install a driver and then configure your device in your DAW. If you have a Mackie Control device and a DAW with internal support (such as Logic Pro) this is a pain free process as the drivers are built in.

Keyboard shortcuts

If you don't have a control surface take some time to learn or re-configure keyboard shortcuts for often used tools and processes. It can be a tedious process but in the long term will save your hours of time and possibly even RSI.

Screen-sets

Even if you have dual monitors, screen-sets are a must. You can configure different arrangements of windows and recall them with a single keystroke. Do it!

Furniture & ergonomics

The ergonomics of your working environment are as important as the equipment you choose. A typical audio production session lasts many hours and you will need to be physically comfortable with equipment arranged so as to allow the best possible monitoring conditions and in such a way as your creative flow is disturbed as little as possible. In planning your furniture and environment here is a possible list of priorities in order of importance ..



1. Workstation orientation

If your room is rectangular (such as a converted single garage) you should have your loudspeaker monitors against a short wall pointing down the length of the room.

2. Loudspeaker monitor position

Loudspeakers should be placed with their tweeters at ear level and ideally approximately 1.2 to 1.5 meters apart if you are monitoring in the near field (close up). They should not be too close to the wall (unless their design is dependant on it), and they should be acoustically decoupled from the surface

they stand on to prevent unwanted resonant vibrations colouring their performance. You can use foam or spikes to achieve a DIY solution.

3. Screen positioning

Your DAW screen monitor should be placed with its top edge as close to eye level as possible to prevent neck strain, and not in front of a bright window. You will probably want it between your loudspeaker monitors to ensure you are in the optimum monitoring position during mixing.

4. Posture

If you will be sitting, your chair and workstation/desk height should be arranged such that your back is straight, arms are supported at right angles from your body and your feet rest flat on the floor.

5. Mixing controllers

If you have a mixing controller device (such as a Mackie Control) you will want it to be directly between you and the loudspeakers and screen monitor.

6. Monitor control

Your monitor controller should be within easy reach, so you can alter monitoring volume, switch loudspeakers, DIM, and sum-to mono without moving from the monitoring position.

7. Outboard

If you have outboard effects and dynamic processing hardware (EQ, compressors etc), you should try to arrange them so you can use them without having to move too far from the monitoring position.

Backing up

Backing up projects

We spend huge amounts of time producing and refining our recordings and all our work can be lost in an instance if we do not have backup strategy. Audio projects are nothing like as data intensive as video, but we still recommend the following strategy ..

1. At the end of each day or session, clone your project folder to a separate hard drive.
2. When a project is finished, burn it to a DVD-R disc.
3. Every 3-4 years clone your backup drive to a new backup drive.
4. Every 5 years, clone your DVD-R discs.

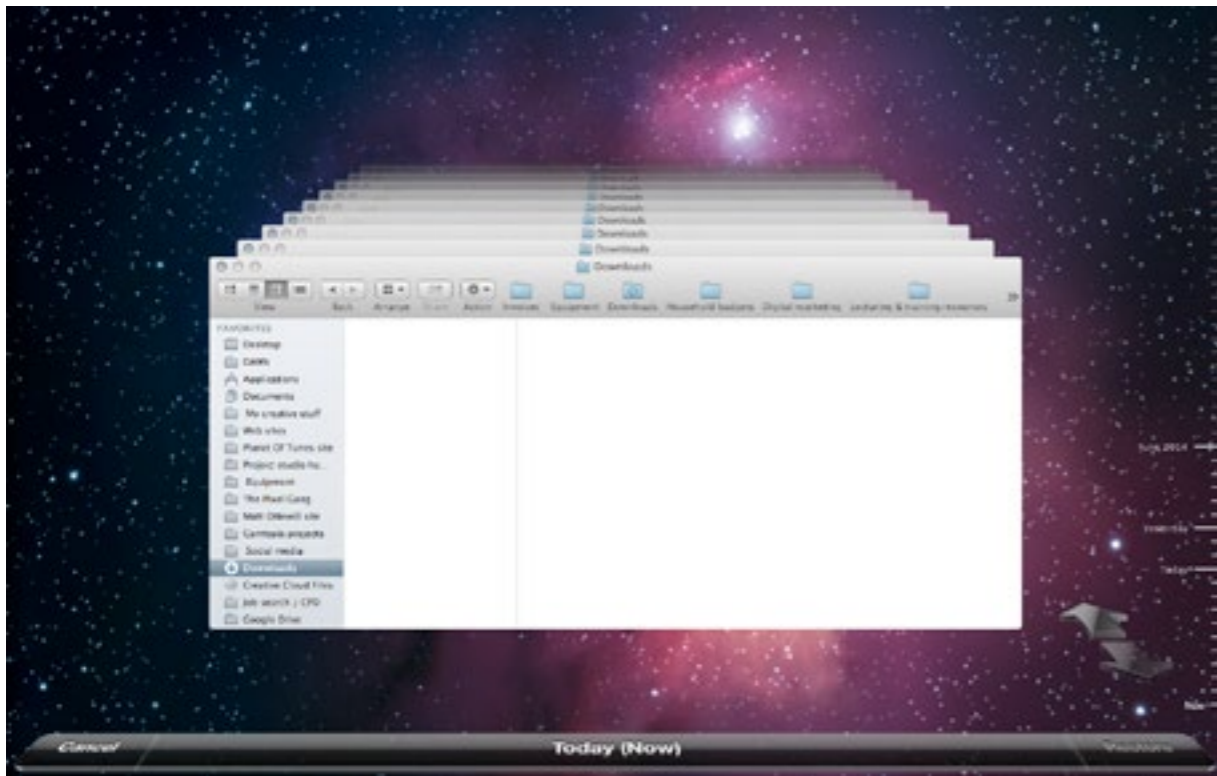
If you have a tablet you should synchronise files at the end of the day to a personal computer or a cloud service.

Backing up a system

If you have paying clients coming to your studio, it is essential that you keep regular system backups on a separate hard drive. Mac user's can take advantage of Apple's Time Machine technology or a utility like Carbon Copy Cloner to create regular backups and there are no shortage of solutions for Windows.

Backing up sample and sound patch libraries

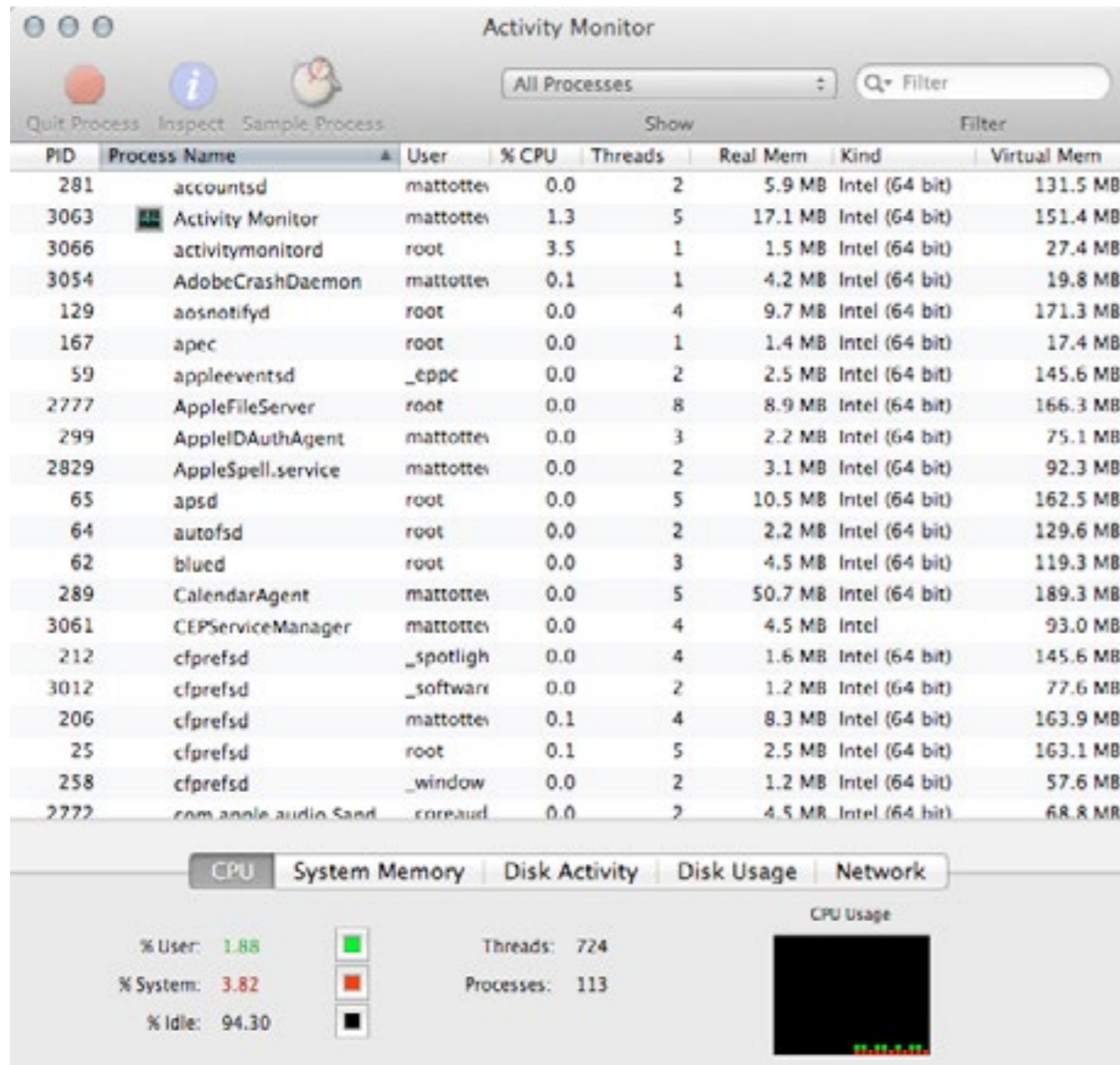
Most DAWs install substantial libraries of loops and samples and if you buy additional plug-in instruments such as Vienna Symphonic Library or Spectrasonics Omnisphere you may well find you have several hundred gigabytes of data. These libraries can be re-installed in the case of drive failure but any programs and patches you have created cannot, so ensure they at least are backed up.



Apple's Time Machine system backup utility

Using your DAW for other activities

Many of us cannot afford to have a computer dedicated to audio only activities, and separating business, personal and creative activities across different systems can be inconvenient.



A system activity monitor utility

Many purists prefer to disable all network and sharing services to ensure audio is prioritised but this is not always practical, particularly as software publishers are increasingly switching to a network only distribution model, and more and more musicians are collaborating across continents. Most users will experience no issues with networking turned on, and audio and network services can happily co-habit. However, cloud services that regularly poll systems to ensure files are synchronised can cause audible issues and should be temporarily disabled. These include, iCloud, DropBox, Adobe Creative Cloud, and Windows SkyDrive.

Also, check DAW publisher sites for advice on configuring a FireWall.

You may also want to disable any calendar, email and message notification services.

One way to achieve all this is to create a separate user account for audio with your business and personal apps disabled.

There really should be no significant compatibility issues with other creative production applications running in parallel with your DAW, especially as modern operating systems sandbox active applications and use protective memory to ensure they are not starved of RAM. Activity monitors will let you know if CPU power is being diverted to an unnecessary application or

service running in the background, but we have experienced no issues running Photoshop, Illustrator, Safari, Final Cut Pro X and Logic Pro X simultaneously on a 4-core 2011 MacPro.

Suggested starter system

Recommending a DAW system is almost impossible. We all have different needs and budgets. But if you have read this far, and feel overwhelmed by the number of factors you need to consider (even experts do!) and just want a recommendation for a starter system that will produce great professional results, and just work(!) .. here it is ..

- Apple iMac computer with 12Gb+ RAM
- External Thunderbolt 7200rpm hard drive for audio
- External Thunderbolt Time Machine backup hard drive
- Logic Pro X
- Focusrite Scarlett 2i2 audio interface
- Novation Launchkey 49 Controller Keyboard
- KRK Rokit RP5 G3 Active Monitor
- Sennheiser HD 25-SP II Closed Dynamic Headphones

Optional ..

- External Thunderbolt 7200rpm hard drive for third party software instrument libraries

This is not THE best recommended system, just one that will work with minimal setup and troubleshooting. You will be able to specify an equally powerful and more cost effective system with a PC, but it will almost certainly require a greater level of optimisation and configuration.

Final thoughts

Although manufacturers would like you to believe that you will be up and running and making great recordings immediately, the truth is that your expertise in using the many powerful features of DAW systems will evolve over many years. Even a relatively simple starter system has enormous creative potential, and is perfectly capable of realising your sonic visions. Try to resist adding third party plug-ins and upgrading your system before you have thoroughly explored and experimented with all of its built-in features.



The truth is, that for most of us, the limitation will be not the DAW technologies, but our own personal expertise and ability. Learning to evaluate and hear objectively, takes time, so take your time. After all, unlike the day when studios were the only place to experiment and learn, you won't be paying to use your system by the hour!

Thanks for reading.