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Tech Note

Choosing a Laptop Computer

Some things to consider when buying a computer for audio measurement and analysis applications.

By Calvert Dayton

A perennial question we get here at Rational HQ is, "What kind of laptop should I buy to run Smaart?" We have always studiously avoided recommending a specific make or model of computer to anyone (with the possible exception of our moms) because there's simply no such thing as a one-size-fits-all "right" answer to that question. Like any other technology decision, the definition of "right" depends a lot on exactly how you're planning to use it, how much you can spend, how patient you are, how much weight you're willing to lug around, really any number of factors.

But with that said, when buying a new laptop there's actually a mercifully short list of basic options to consider. In terms of hardware, it really comes down to a choice of:

1. **Operating system(s)**
2. **Form factor** – the size, shape and weight of the computer
3. **CPU type**
4. **Graphics processor and graphics memory**
5. **Other Stuff.** (Hard disk size, RAM, networking, a built-in stereo line-in would be nice...)
6. **Manufacturer**. This one is of interest not just in terms of expectations for quality, reliability and service but also may determine whether accessories such as a docking station or swappable drives are available.

Let's have a look at each of these areas and ponder some of the factors that might shape one's decision-making when shopping for a new laptop. Many of the same issues would bear on choices for a desktop or rack mount machine however you tend to have a few more options for customizing those types of systems, so we'll focus on laptops for the purposes of this discussion.

Operating Systems

Skip this section if you already know which OS you want/need to use. I really don't want to wade into the Mac versus PC debate too much. Having spent significant portions of my computing career using both platforms I would have to guess I've spent roughly equal amounts of time cussing each of them. These days I use a Mac at the office and a home-built Windows XP at home. I move quite a bit of work back and forth between them with relatively little trouble and I am reasonably happy with both systems.

I chose a Mac for the office primarily because I need to run both Mac and PC applications. Mac's cost a little more as a rule but Apple's licensing terms only allow running their OS on their own hardware. I also needed to buy new software at the same time since we were starting pretty much from scratch, so there was no significant prior investment there to consider. If I didn't need to support both Mac and Windows users and/or we already owned a lot of Windows software, I might well have decided differently.

It's kind of an awkward time for Windows, as you might have heard, so it was nice to have another option. But Vista actually has some potentially interesting technology under the hood for pro audio applications and I imagine the folks in Redmond will get it mostly working sooner or later. They always do. Seems like it typically takes a full year, sometimes two, to shake enough bugs out of a new OS or a major revision to achieve really usable reliability – as anyone who ran right out and bought Windows XP or Mac OS X (et al) on the first day could attest.

If the pattern bears out, Vista should just about be approaching that point now and I have actually found it to be pretty usable if you run as an admin and turn off User Account Control (Apple and Ubuntu definitely did *that* better). So if a Windows machine is what you need, don't let anyone scare you... *too* much. Also note that Vista Business still comes with XP downgrade rights. Some manufacturers will even ship you a machine with XP pre-loaded under a Vista Business license but to DIY, all you need is an OEM installation CD for XP (which you can often find laying around your office).

Form Factor

There are a number of trade-offs associated with the form factor of a laptop computer, i.e., its size, shape and weight. In addition to purely physical considerations such as how heavy a machine is and will it fit in your backpack, form factor will also be a determining factor in screen size and battery life. In fact, that may be the best the best place to start narrowing down the options since it doesn't really matter how thin or how light a machine is if it won't do what you need it to do. Some things to consider here include:

- How many programs will this machine typically be running at the same time?
- Do you need to be able to read the screen from a few feet away or have someone working over your shoulder?
- If you need a big display some times and not others, would it be a viable option to simply plug into an external monitor when you do?
- Do you tend to work near sources for external power?
- How much size and weight you are willing to lug around?
- How much money can you spend?

A big juicy display is obviously a highly desirable quality in a computer, particularly if you need to run several programs at the same time. So are long battery life, compact size and light weight, a screaming fast CPU and video section and for most of us, the lowest possible price.

Unfortunately, some of these factors are going to be somewhat at odds with each other in practice. Extended battery life typically comes at the price of bigger batteries and/or a lower-performance CPU. Bigger batteries mean more weight and some of the larger screen sizes big screen may put you in the market for bigger backpack, which may not fit conveniently under an airline seat on a crowded flight – not to mention drawing more power, meaning more weight for bigger batteries and/or shorter battery life... and of course all this stuff costs money.

There trade-offs in both directions. Nobody likes working on a screen that's too small for what they're doing or a keyboard that's too cramped to type on comfortably, any more than they like lugging around a big, heavy brick of machine and/or paying through the nose for a computer. There's such a thing as penny-wise and pound-foolish and in this case, one might also say ounce-wise and pound-foolish (with apologies to the metric system). It's up to you to spend some time thinking about how you work and where you're most willing to compromise.

Processor Type

I'll cut to the chase and state up front that for our purposes the best processors commonly found in laptop computers these days (pending widespread availability of low-power tri- or quad-core variants in portables) are the Intel Core Duo (Core 2 Duo, etc.), along with the newer dual-core Pentium E series and Dual-core variants of AMD's Athlon architecture — basically anything with "X2 64" in the name. We can touch on some of the other options but those two are going to be the hands-down winners for a highly portable real-time audio analysis platform.

The original Pentium 4 architecture has pretty much disappeared from the earth at this point (and good riddance, I say). The newer Pentium E's and "Core" series processors are different animals. It's my understanding that more recent Intel processor architectures actually have more in common with the Pentium 3 than the Pentium 4 in some ways, having descended from a chip originally designed as a low-power Pentium "4" mobile by an entirely different development team (who lacked the resources to throw out the baby with the bath water as Intel did for the flagship Pentium 4). But please don't quote me on that.

In any case, a Core Duo or dual-core Pentium E (particularly the E5xxx) clocked at 2 - 3 GHz actually runs rings around a dual-core Pentium D running at 3 - 4 Ghz, while also converting significantly less electricity into heat. The same is true of the AMD X2 series CPUs, although even the higher-end AMD chips seem to be lagging behind the newer offerings from Intel at this point.

Intel Centrino (not to be confused with Celeron) isn't actually a processor, it's a marketing program. To qualify for the Centrino logo a machine has to use a specific combination of Intel processor, chipset and wireless networking adapter. Newer Centrino machines will likely have a Core Duo or Solo processor. Older machines carrying this brand and possibly some current down-market models as well might have a

Pentium M (forerunner of the Core series) or a full Pentium 4 (gack!) CPU, so make sure you know what you're getting.

Celerons? Just say no. The Intel Celeron manages to combine most of the flaws of the original Pentium 4 architecture with few of its benefits. Oh, maybe that's not entirely fair. I guess they're fine for some things, just not Smaart. The biggest problem with the Celeron from our perspective is that it was designed primarily for business computing and lacks the Streaming SIMD extensions (SSE) found in the full Pentium and Core series processors. SSE is one of the things that can make Smaart go significantly faster, both for processing FFTs and in the case of older versions of Smaart (et al) graphics. So that's a obviously a major drawback in our little corner of the computing world.

Intel Atom CPUs? I have no personal experience with the Atom series processors from Intel but from judging from spec's and benchmark results, it looks they arguably ought to run Smaart about as well as a similarly clocked Pentium III, which is to say, better than a similarly clocked Celeron but that's setting the bar pretty low. Atom does have SSE at least. One significant drawback (for our purposes) that the Atom CPU is going to share with the Celeron however is that they are both found pretty exclusively in lower end systems featuring chipset graphics with shared graphics memory. (More on that in a moment.)

AMD's Sempron looks to be pretty comparable to the Atom, reprising the comment about low end systems, chipset video, and sharing system memory for graphics processing. Here again I'm relying on spec's and benchmarks in making this assessment. I've never actually laid hands upon a Semperon-based machine.

Graphics Processor and Memory

The graphics processor (GPU) of a computer can dramatically affect the performance of a program such as Smaart. Depending on the program design, it can be almost as big a factor in program performance as the CPU. Smaart 6, for example, is particularly sensitive to graphics processing power because it does all its real-time charting in OpenGL. Given a decent graphics section, version 6 can actually run significantly faster than SmaartLive 5 runs on the same machine, even though version 6 is doing twice as much work under the hood. This is because OpenGL shifts much of the work of drawing graphs from the main CPU to the video card, greatly relieving one of the primary bottlenecks in previous versions of Smaart – assuming the computer's graphics section is up to the task.

Another important spec' that's easily overlooked is where the video memory lives. Smaart 6 can actually be pretty happy with as little as 16 Megs – 32 or more is better but video RAM these days tends to be measured in hundreds of MBs anyway. So on newer machines, the *amount* of video memory is unlikely to be an issue for us. But a problem with chipset graphics processors and even some of the name brand (we'd be talking ATI and nVidia) GPUs used in some mid-range systems is that they lack any dedicated video memory. Instead they just use a block of system RAM.

The issue with this approach, GPU performance aside, is that graphics data now has to squeeze through the same pipe as everything else the CPU is doing with memory, rather than having its own pipe directly into the GPU. This might be fine for typical computer programs that spend 99% of their time waiting for someone to tell them to do something, but for a program like Smaart that is constantly chunking large buffers of data around, in addition to spewing real-time graphics out onto the screen dozens of times per second, it's less fine.

Some of this might be somewhat less of an issue with older versions of Smaart and perhaps other systems as well. SmaartLive and its predecessors (and likely some or all of the other Windows-based systems out there) used Windows' native 2-D drawing API to do their real-time charting. More of the work of graphing is done by the main CPU in that case and there's a real limit to how many things a single CPU can do at one time. Graphics hardware could still be an important contributor to performance, but CPU power would probably be king when it came to increasing throughput. It also meant that real performance benefits of better graphics hardware might tend to be a function of how effectively the OS utilized the hardware, more than anything the program did.

Other Stuff (RAM, Hard Disk, Networking... etc.)

RAM and hard disk space are obviously important factors in how well a machine does its job. But it's hard to find a new machine these days with less than a gigabyte of RAM installed or hundred gig's of disk space, which I would think should get most people started. More is always better of course (at least up to the point where you have all you can use) but these are also the two components of a typical laptop that are most readily field upgradable. So if you were looking for places to cut a few corners, this might be one.

Other nice-to-haves to look for are a firewire (a.k.a, IEEE 1394) port, preferably full-size, and a stereo line level audio input (we hear they're coming back). You may plan on using a outboard USB or firewire device for audio acquisition but it's always nice to have options. Most of the other things that used to be extra-cost options in a laptop computer now come as standard equipment. Any machine you buy is going to come with an ethernet port, probably wireless networking and maybe bluetooth as well. Anyway those things can also be added later as USB peripherals or PC cards if necessary.

Manufacturer

What's in a name? That depends a lot on what stands behind it, I guess. I usually build my own desktop computers (and fix them myself when they break) but laptop computers are made out of a lot more purpose built parts, with a lot fewer pieces that you can walk into Radio Shack and buy. With laptops you need to worry a little more about warranty service and the manufacturer's ability to support you in the field. Dell, HP or IBM (to name a few) may charge more for a given hardware configuration than JoeCo (apologies to Joe if there really is a JoeCo) but if something goes pop inside, is that going to mean the

difference between sending the machine in for a new mobo or tossing it in the nearest dumpster and buying a new one? Enquiring minds want to know (ideally before buying).

Another consideration is that a company building a bajillion laptops a year is going to be better able to offer such niceties as docking stations, car/airplane power adapters and other goodies than someone making a few hundred machines here and there, or even a few thousand. There's also more incentive for third parties to build compatible accessories and components such as memory modules. I'm not necessarily trying to sell the idea of a name brand computer, just saying do your homework and consider all your options before dropping that kind of coin on a lesser known quantity.

If you're spending your own money and trying to squeeze every possible cent out of your computer budget, you might want to consider looking for a blow-out on last year's model from a name brand manufacturer, as opposed to a faster machine from a second tier company. Brute CPU clock speed is actually among the least important factors in overall machine performance (within limits) but often can come at the highest premium in price. Refurbished machines are another possibility when pinching pennies, but consider that someone sent them back for a reason and there aren't all that many things you can really repair on a laptop after the fact, so that can be kind hit or miss. A used machine might actually be a better option if you happen to know the computer works fine and the owner is just trading up.

Personally, I would want to look at any of those options before buying a spanky new low end machine. Smaart, by design, is a pig of a program with a pretty voracious appetite for CPU, RAM and graphics processing. It has to be, to do what it does and as computers become more powerful, people always seem to want to do more with them. So it pays to do your homework and do a little shopping around when buying one. Not only will you improve your Smaart-using experience in the near term, this will also help to maximize the useful lifespan of your new machine in the longer run.

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