

DSP Plugins and Realtime DSP

There are many audio processes that you can do in the digital domain: EQ and Filtering; Compression, Limiting, and other Dynamics Effects; Chorus, Flange, Phasing, and other Modulation Effects; Echo, Delay, and other Time-domain Effects; Overdrive, Distortion, and more unusual Effects. This is called **Digital Signal Processing**, or **DSP**.

Audio processing in software needs no cables, and introduces no added noise (unless that's the effect you're seeking). Also, it's easy to undo, and effects settings are easy to save and recall.

The ability to process the audio file as it plays is called **realtime processing**. For example, you can insert an EQ on a vocal track, adjust the EQ settings, and hear the changes as you make them, all while listening to the other tracks. This is what we're used to with a conventional analog mixer.

You need a reasonably fast computer for realtime processing, and there's always going to be a limit to how many processes can be done at the same time. Simple things like distortion and compression are fairly easy. Complicated processes, like reverb, chorus, and pitch shifting, put more pressure on the CPU. Eventually you'll run out of CPU power, and the software will probably tell you so.

Plug-Ins

You'll find a collection of standard DSP effects built in to most software. The effects are called **plug-ins**. Plugins come in a variety of formats, and you have to be careful to use the right format when you run your audio software.

Here are some of the most familiar industry standards of audio plugins:

1. **VST - Virtual Studio Technology** – developed by Steinberg. This was the first DSP plugin format available. It is very popular, and the code is available to third-party developers, so there are plenty of VST plug-ins available, both commercial and free. Note that some software (Logic, ProTools) doesn't work with VST. Note also that these things change! *Mac and Windows*.

2. **AU – AudioUnits** – developed by Apple, and integrated with their audio system, CoreAudio. This format arrived with MacOSX, and is remarkably popular already, because of the efficient integration of the AU format with CoreAudio, under which most audio software runs on the Mac. Most developers of VST plugins have made their products available for AU. *Mac OSX only*.

3. **DirectX** - A Microsoft Windows format designed to provide software developers with direct access to low-level functions. Very popular amongst programmers, and a wide variety of third-party free plug-ins available. *Windows only*.

4. **MAS – MOTU Audio System** - A proprietary format developed by Mark of the Unicorn, primarily for use with their own products. *Mac only*.

5. **RTAS – Realtime Audiosuite** - A proprietary format developed by Digidesign, for use with ProTools. Several commercial plug-ins, but very few free ones. *Mac and Windows*.

6. **TDM – Time Division Multiplexing** – A proprietary format in use by Digidesign for their high-end ProTools systems.

Virtual Instruments, Sampling and Modeling

Plugins also come in the form of musical instruments. These 'virtual instruments' use a combination of sampling and modeling to produce sound. There are advantages and disadvantages to each.

Sampling has been around for decades. A short audio sample is loaded into RAM; then you trigger it from a keyboard or a sequencer track. The sample plays back. The samples are stored in the RAM of the host computer. A good set of samples (like a grand piano) will need a lot of RAM.

Samples exhibit what is sometimes called the mickey-mouse effect. As you transpose the sample up and down the keyboard, its tone changes dramatically.

Samples also may exhibit looping sounds. A short sample can be 'looped', repeated to make it sound longer than it really is. If you don't have a good loop point, you can hear the loop and it can be very distracting.

Sampling is effective, but it can be limited, because it is just a 'snapshot' of a sound, and it can become repetitive very quickly. Samples don't change in the way the real sound would change if performed by a player.

Modeling is a way of generating sound from scratch, without playing samples. Software programmers analyze the performance parameters of a musical instrument, and then design software to mimic the instrument's complexities.

A popular modeled instrument is the Rhodes electric piano. Rather than playing back a pre-recorded sample of a middle C on the Rhodes, modeling uses software to figure out what the note should sound like every time you hit a key. What happens to the metal tine inside the Rhodes when it's struck by the hammer? what if you strike it harder? what if the key contact is a little dirty? Are other keys being pressed at the same time? Modeling can sound very organic because it responds to its 'environment', unlike a sample, which is just a prerecorded sound.

You'll find good models of B3 organs, Clavinets, Rhodes pianos, Prophets, MiniMoogs, woodwind instruments, plucked instruments, guitars, basses, and percussion instruments. More recently, acoustic pianos and singers have shown up.

Formats. Just like DSP Plugins, Virtual instruments come in several formats. You'll usually find VST, AU, and RTAS formats of any popular virtual instrument. For example, a virtual Rhodes might come in AU and VST format. One format, VST, is written with an extra letter 'i' which stands for instrument, so **VSTi**.

Virtual Instruments need a lot of CPU, so you should know your CPU power when shopping for a virtual instrument!

Sampling	Modeling
RAM intensive. Easy on the CPU. Very common and popular. Mickey Mouse effect (sometimes). Looping artifacts (sometimes). Limited to the sound quality of the original sample. Not organic.	Minimal RAM required. CPU intensive. Becoming more and more popular. No Mickey Mouse effect. No looping artifacts. Not limited by being 'prerecorded' in the way a sample is. Very organic.

Plugin Wrappers

Most software, like ProTools, Logic, or Cubase, will only work with certain plugin formats. For example, ProTools only works with RTAS or TDM plugins, not VST or AU. Logic only works with AudioUnit. So, if I have Logic, but I want to use a cool VST plugin that I found on the internet, I'm out of luck!

But there are software tools called *wrappers* that can disguise one plug format as another. They fool the host software (like Logic) into thinking that they're one format, when they're actually another. They *wrap* the plugin in a disguise.

A well known wrapper is fxPansion. It can do several translations, such as VST to RTAS, or VST to AudioUnit