Part 2
in our beginner's series

Nuts & Bolts

BY ALEX CASE

Outboard Signal Processing

If you read last month's article on the fundamentals of signal flow through a console, you should have (or be developing) a comfortable understanding of channel paths and monitor paths. But the fun part of our job isn't just getting a microphone signal to tape—it's being able to capture accurately, enhance subtly, or radically reshape the sounds being recorded and mixed.

The more entertaining part of our job is signal processing. After microphone selection and placement tweaks, we generally turn to signal processing for fun/help, using some combination of filters, equalizers, compressors, gates, delays, reverbs, and multieffects processors.

The important question is, How do we hook up all this outboard gear to an already convoluted signal path through the console?

Parallel and serial processing

Philosophically, there are two approaches to adding effects to a mix. Consider first the use of reverb on a vocal track. The right reverb supports a vocal track that was probably recorded in a dead room with a mic positioned close up.

It's not merely a matter of support, however. A touch of just the right kind of reverb can enable the vocal to soar into pop music heaven,creating a convincing emotional presence for a voice fighting its way out of a pair of loudspeakers.

The distinguishing characteristic of this type of parallel signal processing is that it is addedto the signal—it doesn't replacethe signal. The structure is illustrated in Figure 1A. The dry (i.e. without reverb; more generally, without any kind of effect) signal continues on its merry way through the console as if the reverb were never added. The reverb itself is a parallel signal path, beginning with some amount of the dry vocal, going through the reverb, and returning elsewhere on the console to be combined with the vocal and the rest of the mix. (Note that in these examples, signals are being routed to a L/R bus for monitoring on the speakers shown, as discussed last issue.)

Conversely, consider equalization. A typical application of equalization is to make a mediocre sounding track beautiful. A dull acoustic guitar is made to shimmer and sparkle,courtesy of some boost around 10 or 12 kHz. A shrill vocal gets a carefully placed dip somewhere between 3 and 7 kHz to become more listenable.

The idea is that this 'fixes' the sound; you don't want to hear the unprocessed version anymore, just the good one. Adding shimmer to a guitar isn't so useful if the murky guitar sound is still in the mix too. And the point of eq-ing the vocal track was to make the painful edginess of the sound go away.

Here the signal processing is placed in serieswith the signal flow, as shown in Figure 1B. Equalizing, compression (and other dynamics processing),de-essing, wah-wah,distortion, and such are all typically done serially so that you only hear the effected signal and none of the unaffected signal.

We'll explain what all those processes are, of course—stick with this series.

The effects send

Not surprisingly, parallel and serial flow structures require different approaches on the console. For parallel processing, some amount of a given track is sent off to an effects unit for processing.

That's what the effects sends for. Also known as an echo send or aux send—short for auxiliary—it is a simple way to tap into a signal within the console and send some amount of

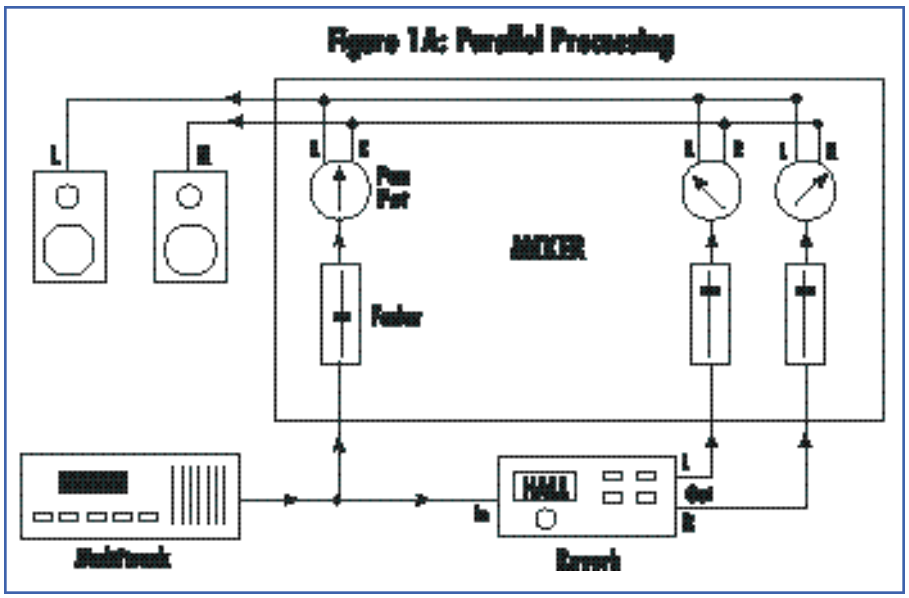


Figure 1A: Parallel Processing

that signal to some destination. If that destination is, say, a reverb or delay, the "effected" signals come back to the console's effect returns or aux returns—another set of your console's inputs that usually feed straight into the master L/R bus.

Probably available on every channel module of the console, the effects send is really just another fader or knob. Not a channel fader or monitor fader, the effects send fader or knob determines the level of the signal being sent to the signal processor. Reverb, delay, and such are typically done as parallel effects and therefore rely on effects sends. Check out Figure 2A to see how it works.

There's more to the effects send than meets the eye, however. It's not just an 'effects fader.' An important benefit of having an effects send level knob on every channel on the console is that a single effects processor can be shared by all those channels. Unless you have lots of very high quality (i.e. very expensive) reverbs, for instance, it isn't practical to use one on just the snare, or just the piano, or just the vocal.

Turn up the effects send level on the piano track a little to add a small amount of reverb to the piano. Turn up the effects send level on the vocal a lot to add a generous amount of reverb to the vocal. In fact, the effects send levels across the entire console can be used to create a separate mix of all the music being sent to an outboard device. It's a mix the engineer doesn't usually listen to; it's the mix the reverb 'listens' to when generating its sound.

Fading fast

So in case you thought there wasn't enough for the engineer to do during a session, let's review the faders that are in action: the channel faders are controlling the levels of the signals going to the multitrack, the monitor faders are controlling the levels of all the different tracks being listened to in the control room, and the effect sends are controlling the levels of all the different components of music going to the reverb. Three different sets of faders have to be carefully adjusted to make musical sense for their own specific purposes.

There are two more subtleties to be explored. First, as we are rarely satisfied with just one kind of effect in a multitrack project, we would probably like to employ a number of different signal processors all at once on a single project.

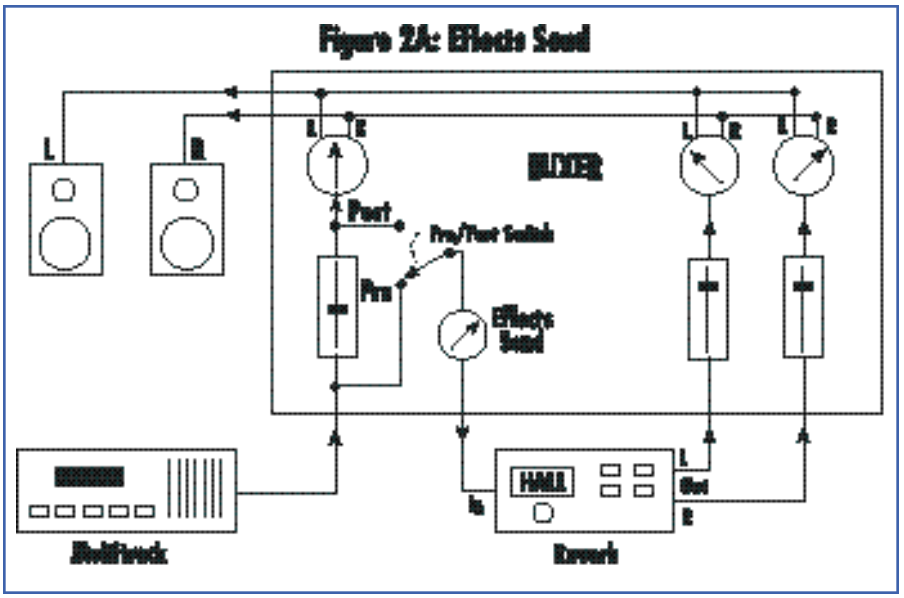
Each one of them might expect to use its own effects send. That is, we might have one box with a sweet and long reverb dialed in, another adding a rich, thick chorus, and perhaps a third box generating an eighth note delay with two or three fading repetitions.

The lead vocal might be sent in varying amounts to the reverb, chorus, and delay; the piano gets just a touch of reverb; and the background vocals get a heavy dose of chorus, echo, and a hint of reverb. We need more than an effects send to do this—we need three effects sends.

The solution, functionally, is that simple: more effects sends. It's an important feature to look for on consoles, as the number of sends determines the number of different parallel effects devices you can use at once during a typical session.

Beyond this ability to build up several different effects sub-mixes, effects sends offer us a second, very important advancement in our session work: cue mixes (On some consoles, there are two sets of sends—one set labelled 'effects' and one labelled 'aux'. In that case, it's usually the aux sends that fulfill the functions we're about to discuss.)

Generally sent to headphones in the studio or, in the case of live sound, fold-back monitors on the



stage, an aux send is used to create the cue mix, a mix the musicians use to hear themselves and each other. As the parameters are the same as an effects send (the ability to create a mix from all the channels and monitors on the console), the cue mix can rely on the same feature. With one exception: the cue mix, unlike the returns from the effects devices, is not returned to the console, but sent to monitors or headphones.

Now let's do a fader check: channel faders control any tracks being recorded, monitor faders build up the control room mix, aux or effects send number one might control the mix feeding the headphones, aux or effects send number two might control the levels going to a long hall reverb program, aux or effects send number three might be the signals going to a thick chorus patch, and aux or effects send number four feeds a delay unit—six different mixes carefully created and maintained throughout the overdub.

That's a lot to do at once. Oh, and by the way it's not enough for the right signals to get to the right places; they also have to make musical sense. The levels to tape need to be just right for the medium on which you are recording. The monitor mix needs to sound thrilling. The headphone mix needs to sound inspiring. And the effects need to be appropriately balanced—too much or not enough of any signal going to any effects unit and the mix loses impact.

This is some high-resolution multitasking. And it is much more manageable if the console is a comfortable place to work. Experience through session work in combination with studying magazines like this one make this not just doable, but fun.

Pre or post

With all these faders performing different functions on the console, it is important to revisit the regular monitor fader to see how it fits into the signal flow.

Compare the monitor mix in the control room to the cue mix in the headphones. The singer might want a vocal-heavy mix (also known as "more of me") to sing to, with extra vocal reverb for inspiration and no distracting guitar fills.

No problem. Use the send dedicated to the headphones to create the mix she wants.

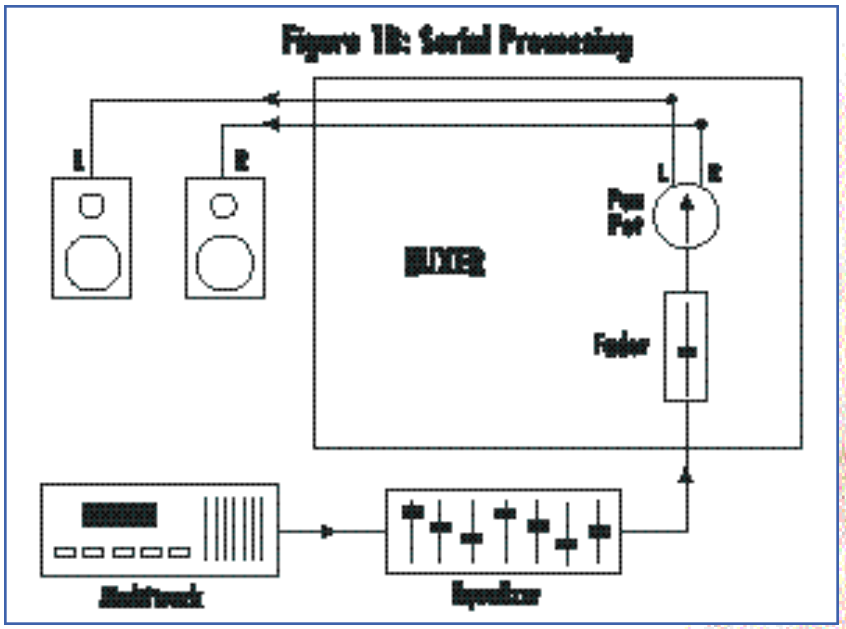
But you have different priorities—you want to hear the vocal in an appropriate musical context with the other tracks. Moreover, extra reverb on the vocal would make it difficult to evaluate the vocal performance going to tape as it would perhaps mask any pitch,timing, or diction problems.

So clearly the cue mix and the control room mix need to be two independent mixes. They're created using aux sends and monitor faders.

But other things go on in the control room during a simple vocal take. For example, you might want to turn up the piano and pull down the guitar to experiment with some alternative approaches to the arrangement. Or perhaps the vocal pitch sounds iffy. The problem may be the 12-string guitar, not the singer. So the 12-string is temporarily attenuated(its level is lowered) in the control room so you can evaluate the singer's pitch relative to the piano, which is in tune.

All these fader moves in the control room need to happen in a way that doesn't affect the mix in the headphones—an obvious distraction for the performer. That's what the pre/post switch shown in Figure 2A is for.

A useful feature of many aux or effects sends is that they can grab the signal before (i.e.pre) or after (i.e. post) the channel or monitor fader. Clearly, it's desirable for the headphone mix to be sourced pre-fader so that it will play along independently, unchanged by any of these control room activities.



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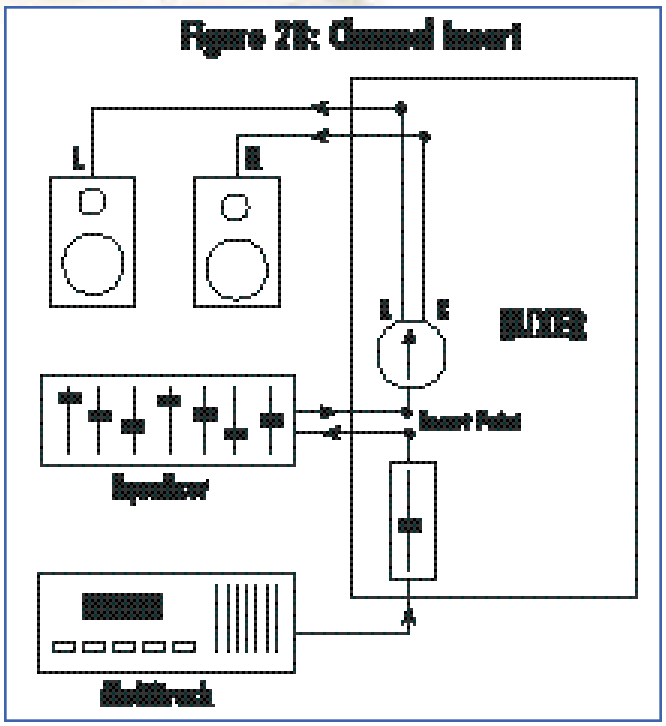

Figure 2B: Channel Insert

What is the usefulness of a post-fader send, you might then ask? The answer lives in the aux send's other primary function: effects sends.

Let's observe a very simple two-track folk music mixdown: fader one is the vocal track and fader two is the guitar track (required by the folk standards bureau to be an acoustic guitar). The well-recorded tracks are made to sound even better by the oh-so-careful addition of some room ambience to support and enhance the vocal while a touch of plate reverb adds fullness and width to the guitar.

A touch of reverb can enable the vocal to soar into pop music heaven, creating a convincing emotional presence for a voice fighting its way out of a pair of loudspeakers.

After a few hours, er, I mean five minutes of tweaking the mix, the record label representatives arrive and remind you that "It's the vocal stupid." Oops, the engineer is so in love with the rich and sparkly acoustic guitar sound that the vocal track was a little neglected.

It must be fixed. Not too tricky—just turn up the vocal.

Here's the rub. While pushing up the vocal fader will change the relative loudness of the vocal over the guitar and therefore make it easier to follow the lyric, it also changes the relative balance of the vocal versus its own reverb. If the vocal's reverb send is pre-fader, turning up the vocal leaves its reverb behind; the vocal becomes too dry, the singer is left too exposed, and the larger than life magic combination of dry vocal plus super-sweet reverb is lost.

The solution is the post-fader effects send. If the source of the signal going to the reverb is after the fader, then fader rides will also change send levels to the reverb. The all-important relative balance between dry and processed sound will be maintained.

Effects are generally sent post-fader for this reason. The engineer is really making two different decisions, determining the amount of reverb desired for this vocal, and the level of the vocal appropriate for this mix. Flexibility in solving these two separate issues is maintained through the use of the post-fader send.

The insert

As seen in Figure 1B, serial processing is much simpler than the buss concept of sends and returns we've just talked about for parallel processing. Rather than sharing one effect over many channels and mixing it with a dry signal, you're routing an entire signal through an effect and not sharing that effect with any other signals.

You could just run your signals through your effects before sending them to the mixer. But there's another way to do serial processing that offers some advantages in flexibility—the channel insert, shown in Figure 2B.

An insert point has a send that goes from a mixer channel to an effect, and a return that comes back from the effect to the mixer channel. Using this pair of connections "inserts" your outboard effect into the signal flow.

Why use an insert? Remember that every mixer channel can do a number of things to a signal—input gain control, eq, level, aux sends, buss assignment and panning. Sometimes certain signals may sound better if you can work on them a bit with the mixer before they go to the outboard effect. For instance, you might want to set the input gain or eq on a sound before compressing it.

For those situations, a channel insert lets you take a signal from a mixer channel, send it through an effect, and bring it back to the point from which it left. Some mixers allow you to select where the insert attaches to the signal flow; the most common inserts come after the eq and before the level fader and bus/pan controls.

On most mixers, an insert is a single tip-ring-sleeve (TRS) jack, which accepts a TRS plug like the ones you see on headphones. A TRS jack can carry two signals, one on the tip and one on the ring, with the sleeve acting as ground reference for both. For headphones, one signal is the left channel and the other is the right, but for an insert, one signal is the send and one is the return. Signals travel to and from the mixer on one cable, which often splits into two separate cables to plug into the effect in/out (a "Y" cable). Usually the tip is the send and the ring is the return, but check your mixer's manual to be sure.

Wrench turnings

An organized approach to the console and also the outboard processing equipment will help make it easy and fun to work in a room full of gear. An intuitive understanding of when to use an aux or effects send and when to use an insert will free your mind to be creative with the effects.

And knowing that cue mixes generally use pre-fader sends while most parallel effects need post-fader sends will keep you out of trouble.

Alex Case welcomes suggestions for 'Nuts & Bolts.' Write to him at case@recordingmag.com.