

A Closer Look At Consoles

Digital consoles don't hold up to analog consoles

By Jim Gamble

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As the world around us moves into the digital domain the battle rages on regarding the relative merits of analog and digital live sound consoles and snakes. We need to consider some of the facts surrounding the subject, including the loss – or not – of fidelity over copper wire, ground loops, headroom, and the limitations imposed by current digital audio technology.

There is the notion that twisted-pair shielded wire has fidelity losses over a 300-foot snake. But I have tested 1,000 feet of Belden snake cable with the microphone preamps set at microphone level (-30 dB) and the high-end rolls off at around 400 kHz, which is just below radio frequencies. So there are no audible losses in a 300-foot-long snake.

Jitter – variations in timing that affect phase, amplitude and so on – introduced by the sampling clocks used throughout an audio system (such as a console) or network adversely affects audio quality. In the June 2007 issue of *Live Sound International*, Carl Bader wrote about the shortfalls of digital snake systems and digital audio over networks in "Foresight," pages 34-43: "To get perfect fidelity requires a perfect clock, but perfect clocks are a theoretical ideal, where all clock transitions occur at their theoretically ideal time; in reality all digital audio clocks suffer from some amount of jitter, or variation. Too much jitter affects the audio quality and can make the audio sound harsh."

Digital snakes are also a step backwards in audio quality. Wire sounds much better than anything else you can use for that job.

Transformers are not necessary on any of the microphone inputs on most analog consoles with wire snakes. But you do have to use a Jensen ISO-MAX (DM2-2XX) stereo output transformer, between the console master outputs and the speaker processor, to remove the typical ground-loops that sometimes show up on analog consoles with wire snakes.

Phase shift must also be considered. In accordance with the Nyquist sampling theorem, digital consoles with a 48 kHz sampling rate are flat to 24 kHz. Phase shift starts one decade (divide by 10) below the highest reproducible frequency, and phase shift increases from that (one decade down) point as you go higher in frequency. This means that, in that digital audio console, phase shift starts at 2.4 kHz and increases as you go higher in frequency.

The ideal console would be flat to 200 kHz, from the microphone inputs to the master outputs. That ideal console would have no high-end phase shift below 20 kHz. But a digital console would need a 384 kHz sampling rate to equal the phase performance of that ideal analog console.

The average signal level in a live mixing console is around 25 dB below clipping, which allows for 6 dB of channel EQ gain, 10 dB of input fader gain, 3 dB of pan pot gain, plus 6 dB of gain for overall console headroom to clipping. On digital audio consoles, half of the digital steps are used up in the first 6 dB below clipping and half again

as many steps are left at the 12 dB below clipping point, and so on. Because 2nd, 3rd, and 4th harmonics are down 35 dB to 45 dB below clipping, there are not enough digital steps left over at lower signal levels to recreate those harmonics. So musical instruments don't sound real on digital consoles with 25 dB below clipping average signal levels.

Analog-to-digital converters are at their theoretical limit: 20 bits, with 4 bits of oversampling. Bit depth, together with sample rate, dictates the quality of the conversion process from analog to digital and back, so digital audio likely won't ever get any better in the foreseeable future.

Most digital mistakes show up as disturbing and very noticeable ticks or dropouts in the sound. The harsh sound caused by jitter shows up the most on vocals, as well as other high-frequency content. FOH engineers tell me that, when mixing on digital audio consoles, they need to cut the vocal EQ in the 1-3 kHz range to reduce (mask) the harshness. (There are digital plug-ins that can be used to reduce digital harshness, but they are only a Band-Aid). There will always be jitter in digital consoles, digital networks and digital snake systems, so this and many other digital sound problems will never get significantly better in the future.

Full digital console systems are a step backwards in audio quality from analog consoles. ■

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