

Why We Need Digital Technology: A Mini-Essay

The basic need for digital technology in audio systems derives from the shortcomings and inflexibilities of analog recording processes. If analog were perfect, no need would exist for digital technology; unfortunately, analog means of sound recording and reproduction are imperfect. Even though analog recording methods are over half a century old and have undergone tremendous improvements and refinements in sound quality and application since their inception, certain fundamental restrictions are inherent to analog signal paths and storage devices. It is to address the limitations of analog that digital audio was conceived, and it is to overcome these analog limitations that digital is necessary.

The first built-in flaw to analog concerns its dependence on the medium of recording and storage. Problems such as wow, flutter, azimuth error, print-throughs, dropouts, etc., while having been extremely minimized in professional formats, still affect the resultant sound quality. The tape path itself, for example, can easily distort and add noise to the analog signal. With analog process, noise and distortion introduced by the handling methods is, from a technical standpoint, inseparable from the original analog signal itself. Digital recording, on the other hand, easily rejects noise resultant from the storage medium through means such as error correction and error concealment. Advanced coding systems can detect changes in bit statuses and therefore prevent misinterpretation of the digitally stored information. Generational loss is thus eliminated. Once a high quality master has been produced, all copies can theoretically be identical.

Another limitation with analog recording is simply its linear nature. The most complicated editing on analog tape machines involves literally cutting and splicing the tape itself (not much room for error there). With a non-linear recording system such as digital, any part of the recording can be instantly accessed, retrieved, or combined with other parts of the recording. This flexibility of editing necessarily speeds up the amount it takes to edit audio and also makes the process much easier. As well, a non-linear digital editing system facilitates a creative potential previously unavailable to musicians and producers. Certainly, at least, engineers using hard disk based digital storage devices no longer have to wait for the tape to rewind!

The final major drawback to analog processes that I would like to mention is its extreme cost. A recent ProTools add in Mix magazine outlined this exact point, comparing the cost of a high-quality, full analog 24-track recording set-up (about half a million dollars) to that of the equivalent ProTools set-up (a mere \$75,000). The computer industry is an industry of scale which means that it can produce large amounts of product at a low cost to consumers. Digital audio benefits from the size and technological advances of the computer industry. Basically, digital circuitry costs less to manufacture, uses standardized component outlines, and can easily be assembled on automated equipment.

Despite the many advantages of digital audio over traditional analog methods, certain drawbacks exist to digital audio as well which allows analog means to still achieve a foothold in the marketplace. Digital's reliance on conversion from a continuous analog signal to discrete system necessarily degrades the signal itself. Although this conversion process technically degrades the signal less than most analog paths, many engineers feel that digital "noise" is a worse evil than analog noise. Also, the relative youth of the digital audio industry has created lack of standardization concerning sampling rates, bits levels, etc. which causes many engineers to fear the need to upgrade their systems in the future (similar to the continuous upgrading process involved in the computer industry). Finally, the learning curve associated with learning the new hardware of digital systems hinders it still from becoming completely accepted in the audio industry.