Does your DAW know the correct time?

Clocking the DAW

By Tal Herzberg

When watching a movie, the experience of motion is artificial – projecting a series of 25 still photos (snapshots) per seconds creates the effect of continuous motion. Our eyes' persistence of vision, somewhat like a compressor's release time, tricks our brain into experiencing a non-stop linear visual sensation. The same concept applies to digital audio: each audio sample is essentially an "audible snapshot" that stores a waveform's instantaneous value at a particular moment. This snapshot is so short it can't be heard as a discrete sound, but becomes audible only as part of a series of continuous samples. Playing these back consecutively tricks our brain into experiencing a non-stop, linear sensation of audio.

BIT DEPTH VERSUS SAMPLE RATE

It is crucial to understand the difference between sampling frequency (also called sample rate or clock speed) and bit depth. *Sample rate* is the number of samples recorded or played back every second (at 44.1 kHz sample rate, we're recording or playing back 44,100 samples per second). *Bit depth* determines a sample's resolution by defining how accurately its level can be measured, but whether the sample is 44.1 kHz with 16-bit resolution or 44.1 kHz with 24-bit resolution, there are still the same number of samples per second. The most common clock speeds in pro audio range from 32,000 to 192,000 samples per second (CDs are recorded at 44,100 samples per second).

REGULATING THE FLOW

The key to systematically analyzing and manipulating data streams of any kind (audio, video, etc.), is to create a predictable environment where predefined units (samples, pixels) can be individually acquired, stored, addressed, routed, and manipulated. These environments are created by designing electronic circuits where data can flow among various elements (microprocessor, memory, input/output devices, etc.). An extremely accurate electronic clock, based on the oscillation created by applying a voltage to a crystalline structure, determines the rate of this flow.

The clock is essentially the equivalent of an orchestra's conductor – a sort of a metronome. It's the device that dictates the pace at which audio samples move throughout the DAW.

JITTER

Imagine if the snapshots making the movie were randomly spaced: The visual experience would be non-linear, because at times too many snapshots will be squeezed into too short of a time, while large gaps at other times would create dark moments without visual information. The same applies in digital audio: all audio samples should play at a predictable, regular rate to create a linear audible experience, without "holes." Failure to do so will result in poor sound, caused by a phenomenon called *jitter*.

CLOCK SOURCE

The sound difference between well- and poorly-clocked DAWs can be quite dramatic, so it's important to use the most stable clock source available. The most common source is the one onboard every DAW's audio interface. Alternatives to those are external clocking devices, which are dedicated stand-alone hardware boxes offered by various companies, many of which are more precise than the clocks in typical audio interfaces. These boxes may also provide synchronization facilities, allowing the DAW to generate or lock to time code. Another option is to use the clock in a quality external AD/DA converter.

CLOCK TYPES, PROTOCOLS, CONNECTORS

The two most common types of clocks are *word* and *video*. Although they use different protocols, both attempt to achieve the same goal: tightly regulate data flow in the DAW. Other common clock protocols are AES, S/PDIF, and x256 (Super Clock).

When using an external clock source with the DAW, every audio interface needs to reference this clock as its master timing source (clock signals may be distributed individually, or daisy-chained). The most common connection is a coaxial cable with BNC connectors on both ends. The AES protocol commonly uses 110-ohm cable with XLR connectors on both ends, while S/PDIF clock usually uses the same cable with RCA connectors.

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Note that AES and S/PDIF connections can also transmit two channels of digital audio while carrying the clock, making it a very convenient