Chapter 38 of the Society of Broadcast Engineers
SBE
EL PASO - LAS CRUCES - JUAREZ

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NEWS

M A D I

BY RYAN SALAZAR

Learn how to use MADI to route and manage multiple audio signals to and from consoles.

MADI technology allows the transmission of 56 or 64 channels of digital audio data at up to 48kHz, or 28 to 32 channels of digital audio data at up to 96kHz.
When the acronym MADI (Multichannel Audio Digital Interface) appears, it may invoke thoughts of the 1980's MIDI (Musical Instrument Digital Interface). The two, however, are unrelated. The MIDI standard, as everyone knows, allows two devices (a trigger device and a sound source) to both communicate and understand each other in the realm of music, with MIDI technology standardized and maintained by the MIDI Manufacturers Association (MMA). MADI technology, however, was developed shortly thereafter, in 1991 (revised in 1993), and initiated by four professional audio equipment manufacturers: Solid State Logic (SSL), AMS-Neve, Sony and Mitsubishi. The MADI standard was finalized as AES10 and is controlled by the AES. MADI is a digital audio routing technology that sends literally dozens of audio feeds through one cable.

Used by professionals in the studio industry, MADI technology allows the transmission of 56 or 64 channels of digital audio data at up to 48kHz, or 28 to 32 channels of digital audio data at up to 96kHz. The 24-bit maximum resolution makes the MADI standard ideal for work with a large number of audio channels, such as when a digital audio workstation is used with a large format mixing console. There is so much practicality for MADI technology because you can send audio through literally hundreds of feet of cable and it is lossless.
Although optical connections are one method of sending a signal, the preference of many, including myself, is doing so via coaxial cable. A single, 75Ω coaxial cable or optical cable is sufficient to handle 64 channels, which can dramatically reduce the amount of cabling necessary in any studio. BNC connectors are used for the MADI coaxial format, for runs of 30ft to 50ft or so, while SC-type fiber optic connectors are used for the MADI optical format. These allow runs up to 2000ft, give or take. As with any cabling, the quality and strength of the signal is reliant on the quality and manufacture of the cable or wire, with higher-grade preferred because it provides the best transmission.

NEWS CONTINUES IN PAGE 2

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For some time, audio was routed in facilities via analog patch bays. Setup was laborious with soldering and labels before, eventually, "crunchy" audio resulted when patch channels went bad. MADI eliminated the need for short runs with multitudes of connections and junctions. The MADI interface was conceived for serial transfer of digital multichannel audio in recording and broadcast studio applications, specifically to allow the simplification of multichannel digital audio equipment interconnection. So, how does it MADI do it? The secret is, of course, the encoding.

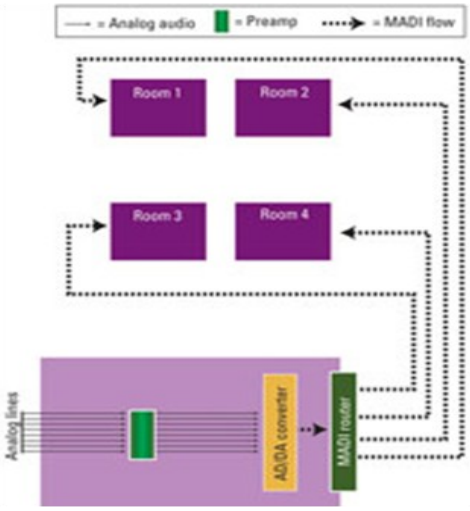

Figure 1. In some settings, a DAW is connected with MADI to an ISDN. Because MADI accepts analog signals, it can route duties like talkback to assigned channels.

MADI encodes and transmits multichannel audio in a clever way. It starts with Linear Pulse Code Modulated Audio (LPCM), a subtype of Pulse Code Modulated Audio (PCM).PCM is a digital representation of an analog signal where the magnitude of the signal is sampled regularly at uniform intervals and then quantized to a series of symbols in a digital (usually binary) code.

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EL PASO,TX CHAPTER 38 MEETING MINUTE
DATE 3/13/2012 LOCATION: GRAND CHINA BF

MEETING CALLED TO ORDER: 12:33 PM, BY ANTONIO CASTRO, THERE WERE 13 MEMBERS AND 3 GUESTS.

REPORT OF THE SECRETARY: MINUTES ACCEPTED BY WARREN REEVES, 2nd BY OWEN SMITH

REPORT OF THE TREASURER: CURRENT BALANCE OF $ 6,061.10, CHECK FOR US POST OFFICE NOT CASHED YET
ACCEPTED BY OWEN SMITH, 2nd BY LAWRENCE MONTENEGRO.

REPORT OF THE CERTIFICATION COMMITTEE: SENT INFO TO KDBC ABOUT CERTIFICATION CTO.

REPORT OF THE MEMBERSHIP COMMITTEE:NO REPORT

REPORT OF THE FREQUENCY COORDINATOR COMMITTEE:
NO REPORT

REPORT OF THE SCHOLARSHIP COMMITTEE: NO REPORT

REPORT OF THE WEB SITE COMMITTEE 940 HITS. (33 MORE FROM LAST MONTH)

REPORT OF THE EAS CHAIRMAN : NO REPORT

REPORT OF THE PROGRAM COMMITTEE: PRESENTATION FROM HARRIS WENT VERY WELL. CHAIRMAN MENTIONED A PRESENTATION FROM NORBERT MILES , KINT 98 RADIO WEB STREAMING FOR APRIL

UNFINISHED BUSINESS: WARREN REEVES POINTED TO BE "READY" WHEN FCC VISIT: PUBLIC FILES IN ORDER
NEW BUSINESS OR ANY ITEMS FOR THE CHAPTER INTERES:
ELECTED NEW OFFICIALS

NEXT MEETING DATE AND LOCATION: APRIL 10, 2012 AT KTEP INSTALLATIONS. TIME : FROM 7 TO 9 PM. AT LIBERAL ARTS BUILDING, SUITE 209

MEETING ADJOURNED: ***AT 13:03 PM***

A NOTE FROM THE FQCY COORD'R :

Warren reeves recommends that Radio Engineers should take a look at the FCC SELF INSPECTION CHECKLIST: **http://transition.fcc.gov/eb/bc-chklsts/**

APRIL PROGRAM

WHAT A GREAT PRESENTATION FROM HARRIS MADE BY DAVE BUCK, SYSTEMS ENGINEER. THANKS TO BURT YOUNG

Our presentation for April will be titled "FUNDAMENTALS OF BROADCAST STREAMING, by KINT98.com"

Presenter: NORBERT MILES.
When: Next Tuesday, April 10.
Where: UTEP, Liberal Arts building, suite 209.
Time: From 7 to 9 PM.

Meals: Pizza "The Engineer" and drinks.
Tour to KTEP installations will follow at Cotton Memorial building

Sending a simple, two-channel stereo signal is described in AES3, the main thrust of which concerns cabling and the physical interface between devices. Essentially, for a left and right stereo signal, data is sent in audio blocks, each of which is made up of 192 frames numbered 0 to 191. Each frame is divided into two sub-frames (or channels): A (left) and B (right). Each subframe contains the information for a single sample of the PCM audio. This is the AES interface format for serial digital transmission of stereo or two-channel LPCM sound. MADI adds an entirely new dimension.

The AES specification outlines transmission of 56, mono, 24-bit resolution channels of audio data with a common sampling frequency in the range of 32kHz to 48kHz. In layman's terms, 28 stereo "AES" audio channels (AES3-1985 data, to be precise) stream on a common bearer, but are not "networked" per se; in other words, MADI is only a point-to-point interconnection.

As outlined in the AES10 Standard, a signal from a studio component device is sent into the MADI encoder (which contains a clock generator). Then, it is converted it into 4B/5B code (or a 4-bit value sent as a 5-bit codeword — the extra bit for synchronization). Next, it is transmitted via non-return-to-zero-inverted (NRZI) stream to the MADI decoder (containing clock synchronization and a clock regenerator tied back to the transmitter). The decoder intercepts the 4B/5B code and converts it back into a recognizable data signal. Then, the signal is transmitted to a studio component device. You may have noticed the clock provision; this is because MADI is asynchronous, meaning that the data is transmitted at its own rate, without regard to the sampling rate. (A common synchronization source linking all devices is a good idea in order to prevent errors in data recovery, as an example. It is a good idea, regardless.)

As mentioned earlier in this article, the MADI serial data stream is organized into frames. Each comprises 56 channels (numbered 0-55). These channels are consecutive within the frame, with audio data remaining in linearly coded, 2's-complement form. This means data remains just as it is within the original digital audio interface. Each channel consists of 32 bits (called a "packet"), with 24 assigned as audio data (or nonaudio data if the non-valid flag is invoked). Additionally, four bits are assigned for the validity (V), user (U), channel status (C) and parity (P) bits as they are used in the AES3-1985 standard audio interface. Thus, structure and data within contributing dual-channel AES bit streams can be preserved intact when traveling in the MADI multichannel bit stream. The other four bits per channel (referred to as "mode bits") are used for frame synchronization on the MADI interface, for preserving information concerning A/B preambles and for start of channel-status block within each of the contributing audio channels. MADI's transmission rate is fixed at 125Mb/s without regard to the sampling rate or number of channels, with the actual data transfer rate being 100Mb/s because of the 4B/5B-bit encoding scheme.

For post-production applications, the MADI interface is miraculous. Despite manufacturers creating proprietary interfaces (which are mostly based on the AES standards anyway), MADI remains a tried-and-true communication method. Even a CD player can be inserted into the line. For example, in the engineer's room, there is typically a DAW connected with MADI to an ISDN box. The great thing is that MADI accepts an analog signal, so you can create a MADI network and assign different channels for different things, like talkback. If your voice talent is in Mexico, you can route through MADI (via ISDN on one of the channels) his or her part in the production with two-way communication. Of course, this is more of a long-distance application, whereas I'm concentrating on local coaxial connections. But, the point is to show the ability exists. Despite having more channels available on fiber, I prefer HD-SDI coax, which can be expensive.

Here's one last thing: I mentioned clocks. A separate or external clock is usually what is called for in larger systems. Some devices feature their own digitally-controlled clocks, allowing for operation without an additional word or AES clock line. That said, clocks are another discussion in themselves, for another time.

Ryan Salazar is director of engineering and post production technology for StudioZ Productions