

PROFESSOR CALLE
MUM 2600

NOTES - Chapter 6

Digital Transmission

AES/EBU – Audio Engineering Society & European Broadcasting Union.

Used to convey two channels of interleaved digital audio through a single, 3-pin XLR microphone cable.

Pin 1 = ground

Pins 2 & 3 = carry data.

Low impedance and allows a cable length of up to 100 meters or 328 feet at sample rates of less than 50kHz without loss or degradation.

In late 1990s, AES protocol was amended to include “stereo 96k dual AES signal”. New format sends information over two, synchronized AES cables carrying L & R respectively.

S/PDIF – Sony/Phillips Digital Interface

Uses unbalanced phono (RCA) connector or a lightpipe (Toslink Optical) cable.

Information is transmitted in blocks of 192 bits, consisting of 12 words 16 bits long.

SCMS (SCUMS) Serial Copy Management System

SCMS was developed in order to prevent the unauthorized copying of digital audio at the industry standard 44.1 kHz rate. Without this protection, consumers could make as many unauthorized copies of a commercial CD or DAT as they desire creating the possibility for bootlegs and other illegal products.

SCMS creates three types of “flags”:

Status 00: No copy protection. Copy as you like.

Status 10: No other digital copies allowed.

Status 11: A single copy can be produced, but that copy cannot be copied.

Jitter is a time-based error. There are two main causes:

1. Poorly designed Phase Locked Loops (PLL's).
2. Waveform distortion due to mismatched impedances and/or reflections in the signal path.

Jitter causes the signal to be “rough around the edges” like a picture out of focus. More precisely, the audible effect is a possible loss of low-level resolution caused by added noise, phantom tones, or added distortion.

MADI – Multi Channel Audio Interface. This is an AES standard developed by representatives of console manufacturers Neve, Sony and SSL. MADI is an elegant, clutter-free interface for connecting multitrack tape recorders to other tape recorders and mixing consoles.

ADAT Lightpipe is a toslink connector that transmits up to 8 channels of digital audio on one cable. Lightpipe cables only travel in one direction and do not contain timecode

information. This is why the ADAT uses 2 lightpipe cables (in/out) and a 9-pin sync cable for timecode.

TDIF – Tascam Digital Interface. This format is proprietary to Tascam and uses a 25-pin D-sub cable to receive and/or transmit up to 8 channels of audio between devices. Note that this is a bi-directional cable. TDIF-1 standard cables cannot send timecode. TDIF-2 standard cables are capable of sending time code.

Digital Audio Basics

Sampling refers to the time (length) of the sample.

Quantization refers to the level of the sample. The amplitude component of the sampling process.

The Nyquist theory states that in order to digitally encode the desired band-width, the sample rate must be at least twice as high as the highest frequency to be recorded.

Since we humans hear from 20Hz to 20kHz, it is easy to understand why a 44.1kHz sampling rate is used when producing professional quality recordings. Since $2 * 20\text{kHz} = 40\text{kHz}$, 44.1kHz is larger than 40kHz and therefore acceptable.

Signal to error ratio indicates the degree of accuracy used when encoding a signal's dynamic range.

Dither is white noise added to a digital source in order to reduce signal to error and distortion to acceptable levels.

Wordclock is defined as a single time reference controlling all digital devices connected to a single chain. In other words, it is the clock master.

You will only deal with wordclock when you are connecting two or more digital devices together.

Types of digital recorders

Fixed-head recorders are most often reel-to-reel recording devices. Most of these devices tend to be multi-track or the 24 and 48-track variety.

DASH was developed to ensure standardization between generations of ATR and tape manufacture.

CIC – Cross Interleave Code. This allows DASH recorders to interleave odd and even-numbered words correcting up to 3 words. This interleaving allows for splicing or physical editing of the tape.

Sony, Studer and Otari all manufacture DASH type recorders.

Modular digital multitrack systems:

Alesis ADAT (Super VHS tape)

Tascam DA-88 or DA-38 (Hi-8mm tape)

These systems are popular due to quality of sound, ease of use, price and the potential for unlimited multi-track recording.

Samplers allow you to capture, loop, reproduce and edit a sound. Both hardware and now software samplers are allowing larger and larger samples to be used and edited creating more life-like sounds available to studio musicians. Tascam's Giga-Sampler sample library is currently replacing musicians on movie scores and records.

ADSR – Amplitude/Decay/Sustain/Release
Refers to editing samples and loops.

Hard-Disk Recorders
Roland VS-880
Tascam (many models)
Korg 1212
Digidesigns Pro-Tools

All of these allow for non-destructive recording and editing and almost limitless recording and editing possibilities.

DSP – Digital Signal Processing
This kind of processing includes:
Amplitude modulation or change
Fades and crossfades
Equalization
Dynamic Range processors such as compressors and limiters.
Pitch and Time Change – includes plug-ins such as Serato Software's Pith 'N Time and Antares "Auto-Tune"

Definitions

Compressor – a device that reduces the gain by a ratio that is proportionate to the input signal.

Limiter – reduces gain at a fixed ration above a certain input threshold.

Plug-Ins tend to be made by third parties though Digidesign makes many of it's own plug-Ins. These DSP Plug-Ins allow the engineer to use many different processors such as reverbs, delays, EQs, compressors, limiters, pitch and time correction devices simultaneously on as many tracks as the system CPU will allow without the expense of individual hardware components. **THIS IS A BIG REASON FOR THE POPULARITY OF DISK BASED RECORDING SOFTWARE.**

The quality of the Plug-In architecture improves with every passing day and is seriously changing the way that professionals record.

Plug-Ins can be found in the following formats:
Direct X (PC and Digidesign)

Audio Suite (DSP format for the Mac)

VST (Steinberg format which can be used by others using a VST wrapper such as Pluggo)

TDM – Real time DSP for the Mac or PC running Pro Tools.

MAS – Motu Audio System plug-ins.

Digital Audio Workstations

Motu – Digital Performer

Cubase

Logic

Nuendo

Acid Pro

Reason

Recycle (Loop editor)

Others.....

Also note that now many synthesizers are coming out in software format. This allows someone with a laptop, a DAW (digital audio workstation) and some headphones to create a complete production with very little hardware. A perfect example of this is professor Calle's laptop setup:

Mac G-4 Titanium

Pro-Tools M-Box and software

Midiman USB interface

Midi Keyboard

Countless DSP plug-ins

Countless plug-in synthesizers including:

B-4 (Organ)

FM7 (DX synthesizer sounds)

Sample Tank (Sample Player including drums, bass, guitars, keys, horns, strings, etc.)

External 7200 rpm Firewire hard drive.

The future is compact and portable and the future is now.

Good luck on your projects and your test.

PC