Staying in sync

The Sound Devices 744T is a top-of-the-range location recorder with incredibly accurate timecode functionality.

If different elements of a system need to be synchronised, you'll need to get down and dirty with timecode. Grant Bridgeman watches the clock...

Timecode is something of a mystery to many musicians, but it's something that you may well come to depend on if you choose to eschew small-studio ambition or work with elements other than straightforward audio. Indeed, there are musicians out there who remain blissfully unaware of it at all, as their compositions stay within one system and don't need external devices to synchronise with it or be sync'ed to a moving image.

But for others, timecode is an essential part of their everyday operations, synchronously linking together different elements of the studio, as well as providing the structural detail when working with sound for film.

Get moving

The Society of Motion Picture and Television Engineers (SMPTE) defined the timecode formats that are used when synchronising discrete elements of a project. The format arrived via a filmic route, but the information it works with is used to synchronise multiple audio systems (both analogue and digital), audio-to-picture and hardware that is suitably compatible. The SMPTE timecode is an eight-digit number that is split into four sets of pairs of increasing resolution, representing hours, minutes, seconds and frames. It's the term 'frames' that has the most obvious link to the film world, as it literally represents the number of images that are recorded or played back every second.

SMPTE information is encoded using bi-phase modulation to encode an 80-bit word into every frame. The signal is a pulsing waveform that changes state between two values, and is encoded using a steady state reading as 0 and a change-of-state reading as 1. So, although in essence it is a binary signal, the information is encoded as binary coded decimal (BCD) for each pair of 4-bit words. As well as being a 'conventional' electronic signal, SMPTE can also be recorded as an audio signal or encoded into a MIDI data stream.

When timecode is transmitted via MIDI, the data is split into eight messages, so it requires two frames to transmit a complete timecode. One of the problems with transmitting timecode via MIDI is that the information can get clogged up within the MIDI data stream, so it is advisable to use a dedicated MIDI port for the transmission of timecode information to reduce problems caused by data bottlenecks.

Synchronising a system with SMPTE is – fundamentally, at least – a simple affair. The key is to have only one master clock, with all other devices slaving to that clock. Hard-wired digital systems should be synchronised using word clock, which ensures that each digital word is in-sync; most digital connections are self-clocking (S/PDIF and AES/EBU), but it is good practice to have a dedicated word clock connection.

You've been framed

Things start to get interesting when you realise that different frame rates are used for different applications. Using an inappropriate frame rate will result in the systems drifting out-of-sync – and, subsequently, things playing at the wrong speeds. These differences all relate back to the moving image and the various formats that are in place around

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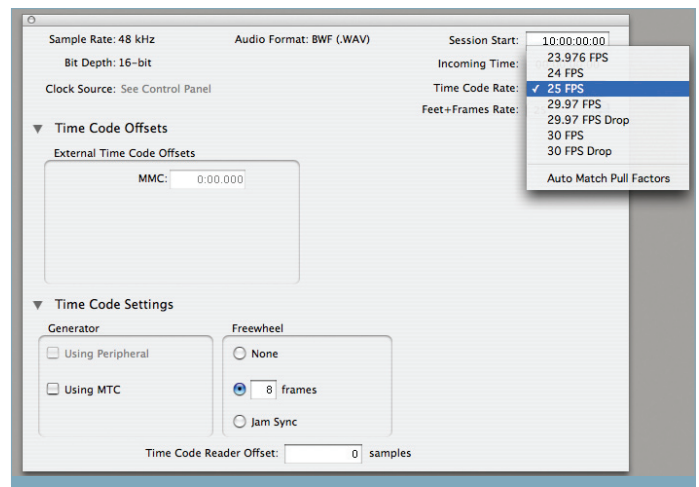
SMPTE timecode is represented in Hours : Minutes : Seconds : Frames. Timecode formats were defined by the Society of Motion Picture Television Engineers (SMPTE).



Even in basic DAWs (this screenshot is of Pro Tools M-Powered) a number of different frame rates will be catered for, enabling the DAW to be used for a variety of tasks.

the world. In the UK things remain fairly simple, with the fairly standard rate of 25FPS (frames per second) used for working with video in the PAL format. For film, 24FPS is used.

Home and away

In the USA, the issue of frame rates can become confusing: the National Television and Standards Committee (NTSC) sets different frame-rate standards for black-and-white (30FPS) and colour (29.97FPS). Perhaps obviously, it is the 29.97FPS rate that causes the most confusion.

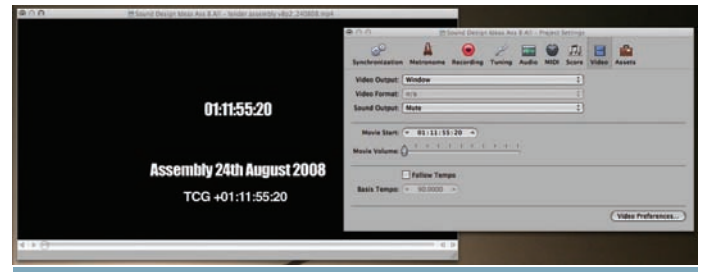
This system doesn't break down the frames into fractions of a frame, but the SMPTE code does need to reflect the fact that the frame rate is slower than 30FPS; otherwise, the SMPTE time would end up out-of-sync with 'real' time (there are 108 frames fewer per hour at 29.97FPS by comparison to 30FPS).

it is to ensure that all parts of the system are running together at the same frame rate.

Sync'ing up

Most DAWs are capable of working at a range of frame rates – which you might expect of software that furnishes studios around the world – and can also offset the timecode within the DAW itself. This can be vital if you're involved in sound design or music-to-picture work – often, the movie you are working to (and the associated OMF file) will have an embedded timecode that does not start in the equivalent place to 'bar 1'. The timecode offset function enables the timecode at 'bar 1' to be shifted so that it can be positioned to relate to the timecode of the image and its associated files.

Similarly, it is possible to offset the start of the movie file to a SMPTE position other than the



A movie's SMPTE start position sometimes requires offsetting. In this case the offset is 01:11:55:20. Most DAWs now have this feature built-in.

reels (parts) of between 15 and 20 minutes, which is very useful as this can greatly reduce the necessary additional video processing overheads on the DAW. Usually, in this case the 'hours' element of the timecode is used to designate the reel number, generating a unique timecode throughout the film. The programme material of reel one, therefore, would start at 01:00:00:00, with the sync plop and leader at equivalent relative positions – sync plop at

but with the incredible rise of the YouTube generation there is an ever-increasing market for sound-to-picture, so it is fairly certain that you'll need to activate the 'big SMPTE display' in your DAW in the not-to-distant future. MTM

The rise of the YouTube generation brings an ever-increasing market for sound-to-picture.

The solution devised to resolve this issue is called drop frame timecode, although the term is a slight misnomer as the frames themselves are not 'dropped' but the timecode labels are discarded in such a way that one clock hour equates to one SMPTE hour. This is achieved by losing the frame labels '00' and '01' in the first second of each minute, but including them when the minute value is divisible by ten. It sounds complex, but the details are controlled by the SMPTE part of the DAW – and it shows how vital

default 01:00:00:00. Working practices vary now in regard to the timecode referencing of movie files, but in the UK, two approaches are commonly used.

For broadcast material, the programme is set to start at 10:00:00:00; 50 frames before this is the sync plop and flash frame (two seconds, as the UK uses the 25FPS rate). Before that is an eight-second leader. So, the file itself would start at 09:59:50:00.

For feature films, the approach is slightly different because the film is usually split up into separate

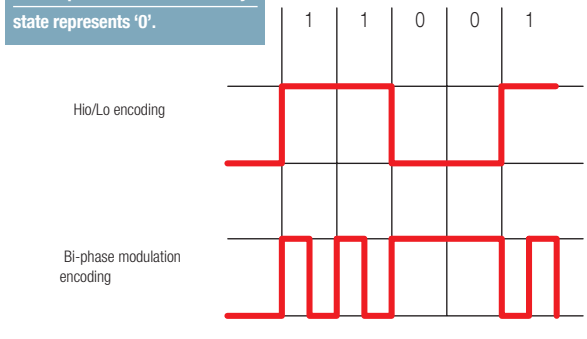
00:59:58:00 and leader starting at 00:59:50:00; the programme material in reel two would start at 02:00:00:00 and so on.

Timecode recorders

Some hardware/software audio recorders enable timecode data to be encoded within the data file (within the BWF format). This functionality is used primarily when recording sound for film or television and provides an excellent way of synchronising multitrack recordings and sound-to-camera (the relationship between the camera and sound recorder is strictly plesiochronous).

There are a variety of formats for the encoded timecode, including time-of-day (the file is stamped with the actual time of the recording) or record run (the total running time for all of the recordings, covering all takes). It is the nature of the subsequent editing and mixing work that determines which format is the most suitable.

It is quite possible that timecode and SMPTE will pass you by as you write your latest opus,



Bi-phase encoding: a change of state represents '1' and a steady state represents '0'.

Tech Terms

Flash frame
The most basic way of ensuring that video and audio files are in-sync is to place a single-frame white image in the video track that corresponds to a 'blip' tone (usually 1kHz at -18dBFS) at the same location on the audio track.

Binary coded decimal
BCD encodes the decimal information in a slightly different way from conventional binary by storing the 'tens' and 'units' of the decimal value in different words. This is not an elegant solution and harks back to the original implementation of the SMPTE code in 1972, when electronic decimal-to-binary conversion was a difficult process.

BWF
The Broadcast Wave File is the same format as the conventional WAV but has additional metadata included within it that aids workflow across the different stages of a project.

Plesiochronous
Plesiochronous systems run in very close synchronisation but are not actually locked together.

FURTHER INFO

- A Mackie document explaining the principles of pull-ups and pull-downs can be found at: www.mackie.com/support/FAQ/pullups_pulldowns.html
- Phil Rees' insight into all aspects of SMPTE goes into significant detail: www.philrees.co.uk/articles/timecode.htm
- This document relates specifically to the area of sound-to-picture, exploring the issues of drop frames and timecode modes for location recording. www.filmunderground.co.uk www.cyberfilmschool.com/50/Article/NWFILM/Audio%20Timecode.htm