Subtitle Timing and Time code

Introduction

Video material is made up of individual pictures (or frames) that are sequentially displayed at a particular frame rate (25 or 30 frames per second) with each frame being assigned a unique frame number. This sequential frame numbering is known as **time code**

Scope

Time code is required both for preparing subtitles and for transmitting or otherwise using subtitle files. This White Paper explains how time code is used in the subtitling process.

Subtitle Preparation.

During the subtitle preparation process each subtitle is timed to appear at a specific point in the video to match the dialog. The time code of the first frame during which the subtitle is displayed is the **in-cue** time.

Generally, subtitles should be presented on-screen only when required, and should stay visible for long enough to ensure the viewing audience can read and understand them. It is good practice to attempt to match the subtitle presentation timing with the spoken dialogue, but in certain cases that can be difficult to achieve. Furthermore, an existing subtitle should not remain on-screen once there have been considerable changes to the content of the program material, such as a shot change or cut.

The subtitled language can also have an impact on presentation timing as reading speeds differ between languages.

Another consideration is the age of the target audience, as younger audiences generally require simpler subtitles that remain on-screen slightly longer than an adult may require.

Time code

Time code has the format HH:MM:SS:FF (Hours, Minutes, Seconds, Frames), and subtitle durations are generally measured in seconds and frames.

The time code signal can be represented in several ways:

1. **VITC** (Vertical Interval Time Code SMPTE 12M-1999) - a video level signal that is inserted into the VBI (Vertical Blanking Interval) area within the video material.
2. **DVITC** (Digital Vertical Interval Time Code SMPTE 266M-1994) – the same as **VITC** but in a digital (SDI) video signal.
3. **LTC** (Longitudinal or Linear Time Code SMPTE 12M-1999) - an audio signal recorded with the video material.
4. **BITC** (Burnt-In Time Code) - an always visible timecode display burnt-in to the video material. **BITC** is not machine-readable so a manual synchronization process is required to tell the subtitle preparation software what the time code of a specific frame is. From this the time code of all other frames can be calculated. This is referred to as re-striping the time code.
5. **HD Timecode** (SMPTE 291M-1998) – A range of timecodes can be carried in the non picture area of and uncompressed HD-SDI signal (HANC and VANC) including ATC (Ancillary Time Code RP 188-1999) and HANC Timecode (RP196-1997)
6. **Compressed file time code. –** Some compressed video file formats contain time code either within the video file or as an associated time code file.

Missing Frames

When video is encoded from tape to a compressed file format there is a risk that not every frame of video will be captured correctly. Missing or dropped frames can be caused by bad sections on the source tape or limitations in the encoder.

The result is that not every frame is present in the compressed video file. If there is a valid machine readable timecode (VITC, DVITC, LTC or timecode within a compressed video file) for each frame then the subtitle preparation system will show the correct time code at all times.

However if the only source of timecode is burnt-in (BITC) then dropped frames will cause an accumulating timecode error through the file. For example if the start time code is 10:00:00:00 and if there are 50 frames dropped over a duration of 90 minutes then the timecode will be incorrect by two seconds by the end of the material (at 25fps)

Where missing frames are unavoidable then it is possible to compensate for the resulting timing errors in some cases.

Dropped Frame Compensation

In the case where dropped frames are suspected then internal subtitle preparation time code can be updated on an ‘even spread’ basis. This is achieved by manually entering the timecode for the first and last frames. From this the subtitle preparation software can calculate if there are any missing frames.

Example:

Start timecode = 10:00:00:00

End time code = 10:03:59:24

Duration = 00:04:00:00

Frame rate = 25

Frames expected = 6000

Frames counted = 5996

Dropped frames = 4

In order to compensate for the dropped frames a one frame discontinuity is added at the following time codes:

10:00:30:00
10:01:30:00
10:02:30:00
10:03:30:00

In other words these time codes will be missing within the internal video. So when stepping through the video the time code displayed will step:

10:00:29:23
10:00:29:24
10:00:30:01

This method will compensate for the occasional dropped frames so that any subtitles are never more than a few frames out when compared to the master media with no dropped frames.

Limitations

There is no way of automatically detecting which specific frame is missing.

The ‘even spread’ method is only suitable where there are never more than a few missing frames and they are evenly spaced out through the material.

The following situations will not give good results with this method:

- Clusters of dropped frames. Where many frames are dropped during a short section of the media but the rest of the media has no dropped frames.
- Many dropped frames. If the number of frames dropped is high, even if they are evenly distributed, then the video will become unusable for preparation and timing errors will be more than one or two frames. The exact level of what is or is not acceptable is subjective. However drop rates up to 0.2% (one frame every 20 seconds) are probably acceptable.

The frames marked as missing (see example above) will not correspond to the actual missing frames so the BITC and the internal subtitle preparation time code will not match.

Time code discontinuities.

In most cases any video material used for subtitle preparation will have contiguous time code. However if the video material has been edited it is possible there will be discontinuities or jumps in the time code where video frames have been removed.

Subtitle Transmission.

A subtitle file contains a list of subtitles with in and out cues plus other formatting information. When a subtitle file is used to generate an output it is vital that the time code reference is the same as that used during the preparation process. If there is any mismatch the subtitles produced will be miss-timed.
For example:

- A film is subtitled based on a VHS tape copy of the broadcast master:
- The timecode on the tape is in VITC format and this matches the master tape.
- The subtitle file for the film is delivered to the broadcaster and loaded on to the transmission system.
- However the master is edited before transmission and the time code changed.
- The starting time code is the same but after the first edit point the time code used when creating the subtitles no longer matches the master.
- When the subtitle file is played out the subtitles will no longer match the audio.

Subtitle timing terminology

Term	Description
in-cue	The point at which a subtitle becomes visible on-screen
out-cue	The point at which a subtitle is removed from the screen
duration	The time the subtitle is actually visible on-screen
interval	The time between consecutive subtitles

Therefore, to ensure the subtitles appear or disappear from the screen in the correct sequence and at the correct time all in and out-cues should have a unique time code value.