If We Could Turn Back Timecode:
Finding a Way to Better Ancillary Data

Presented by Kelly Haydon and Benjamin Turkus
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No Time to Wait 3rd Annual Conference
What do Cher and Timecode have in Common?

1. They’ve been around forever
2. Their relevance is constantly questioned
"...If [capturing timecode] were possible (and not super hard) to do in every instance, I probably would. I think the reason it isn’t always captured is more the fact that it’s a huge pain in the ass with our available tools." - Michael Angeletti, Stanford Media Preservation Lab
The Timecode Problem

- Most preservation container formats have not been developed to contain the totality of ancillary data from an analog signal (the AS-07 working group is progressing on this specification for the MXF container format).

- Proprietary capture software often does not interpret timecode as a stream which does not preserve the signals native discontinuity. Rather, software will only capture the first timecode stamp and either lay down a bogus continuous track or just capture the timecode of the first frame.

- Preservationists lack community-supported resources for capturing and understanding timecode.
“Adopted in the 1960s by the Society of Motion Picture and Television Engineers, SMPTE timecode is an industry standard frame numbering system that assigns a specific number to each frame of video in hours, minutes, seconds, and frames format.” (The Professional Video Sourcebook, BH Photo/Video).
Brief Timecode Timeline

- 1956 - videotape is here, yay! But editors can't see the frame lines; the cut and splice method is adapted upon but imprecise and tedious.

- 1960s - electronic splicing systems are introduced but required the editor to search for a desired splice point and mark it with an electronic tone, also a tedious and imprecise process.

- 1967, EECO introduced the timecode synchronization system to the industry and in 1969, SMPTE/EBU standardized the timecode that we know today. Each frame of video has its own unique timecode and linear tape-to-tape editing is efficient AF.

Source: “Time Code Basics,” Anonymous, American Cinematographer; Mar 1983; 64, 3; ProQuest pg. 23
Brief Timecode Timeline

Timecode becomes an integral part of productions workflows recorded on both film and tape.

Edit Decision Lists (logs timecode of correspond to the final cut).
Video production workflows often logged the reel number of the tape shot in a day’s work.

Tape 1 - Start Timecode: 01:00:00;00
Tape 2 - Start Timecode: 02:00:00;00
Tape 3 - Start Timecode: 03:00:00;00
Characteristics of Timecode

Three characteristics to look out for when assessing your timecode*

- Is it VITC or LTC timecode?
- Is it Drop Frame or Non Drop Frame?
- Is it Continuous or Discontinuous?

*DV Time (DV timecode captured via firewire) and DAT are not included in this timecode discussion.
Characteristics of Timecode: VITC & LTC

Longitudinal TimeCode (LTC)

- The earlier of the two timecode types
- Usually (but not always) recorded on audio track 2.
- Prone to drift, read errors, and cannot be read at fast speeds.
- Listen to what ltc “sounds” like: https://www.youtube.com/watch?v=zjH0RFV206M

Vertical Interval TimeCode (VITC)

- VITC is integrated into the video track of the tape which resolves a number of problems found with LTC
- Provides indexing resolution down to the video field; this means VITC timecode can be read at all speeds the video is played back at
- Frees up the 2nd audio channel for recording

Audio Track 2 (Timecode)
Audio Track 1

Video Track

Control Track

Audio Track 2
Audio Track 1

Video Track

Control Track

NOTE: Track configurations can vary by format. Images are non-format specific examples

Source: “Time Code Basics,” Anonymous, American Cinematographer; Mar 1983; 64, 3; ProQuest pg. 23
Characteristics of Timecode: NDF & DF (it’s an NTSC thing)

- Drop Frame [DF] and Non-Drop Frame [NDF] are distinguished by the colon or semi-colon present before the frame count:

  Drop Frame: HH:MM:SS;FR (01:01:01;01)
  Non Drop Frame: HH:MM:SS:FR (01:01:01:02)

- Simply two different ways of labeling a frame. Drop Frame timecode accommodates the 29.97fps framerate of color, introduced after the 30fps was already established for monochrome.
- “When an American TV frame-rate video production must be edited to actual clock time, Non Drop Frame timecode must be used. If staying in time with an actual clock is not important, especially on short video productions like commercials, the bastard 29.97 fps Drop Frame timecode is often used.” - Shawn Amaro, “How to Use Drop Frame or Non-Drop Frame.”

Source: “SMPTE EBU”, Phill Rees: https://drive.google.com/drive/folders/1fTTe27RhP1G_v-C8Ac_d9L_itBrg1xls
Characteristics of Timecode: Continuous & Discontinuous

- Continuous timecode is an unbroken clocking moving forward from the first frame to the last.

- Discontinuous timecode occurs when a recording abruptly stops and starts again. Discontinuous timecode is common in recordings not made within strict broadcast workflows: video art, independent media, home movies
So why should archivists care about Timecode?

Legacy timecode (or “time code”) is a tool for:

- Restoring, finishing, or rebuilding film and video works based on existing edit decision lists (either paper based or software generated)

- Identify the placement of a camera roll in an array of tapes (tape 1, tape 2, tape 3, etc.)

- Contextualizing the support documentation found in a collection (and raising the research value of that documentation)

- Finding important/interesting material amid large quantities of media based on available documentation

1979 edit decision list for a production recorded on Umatic tape (VTOldboys.com)
Timecode: The Original Trash Fire
Capturing Timecode: A New Bare Minimum?

$10 < $1,000

$450

$145
What are the issues regarding timecode? Source recordings may have multiple timecodes: vertical interval timecode (VITC), linear timecode (LTC), and more. Some are present on purpose, others by accident; some may have good integrity and continuity, others may be discontinuous. Any or all of these timecodes may provide forensic help for future researchers. A legacy timecode may be keyed to old documents like tape logs, may provide clues about the older source tapes that were assembled to create the video program you are now preserving, and may (as with footage of NASA space vehicle launches) represent elapsed time that can be correlated to other data streams. In many cases, this is data you do not want to lose.

Carl Fleischauer, AMIA-L, 2014

https://lsv.uky.edu/scripts/wa.exe?A2=ind1402&L=AMIA-L&D=0&P=218059
When Timecode Makes U Wanna Scream

- LTC does not match VITC
- LTC is DF and VITC is NDF.
- LTC is inconsistent or garbled.
- User bit code if present is inconsistent.
- VITC changes line assignment or drops out completely in a single tape.
- Time code in the picture [BITC] does not match LTC or VITC.

David Crosthwait, AMIA-L, 2014

https://lsv.uky.edu/scripts/wa.exe?A2=ind1402&L=AMIA-L&D=0&P=224872
The Problem of Timecode Revisited

The challenges of transmitting, through a digitization set up, the different types of timecode, messy or not, that could be recorded onto a tape

The work-in-progress discussion of how best to store these different types of timecode within a digital video file

- The complexities of timecode as recorded onto different video formats (what’s possible; what’s common; what’s rare)
- The complexities of choosing the right decks and connections to capture
- Capture card differences/issues
- File format compatibility with all of this nonsense
Matroska, timecode, and side data

VBI (Vertical Blanking Interval) and ANC (Ancillary Data)

- Timecodes (LTC, VITC, ATC)
- Captions (North American CEA-608, CEA-708, European and Australian WSS/Teletext, Japanese ARIB B37)
- Recording Information
- Bar and pan/scan data
- Camera acquisition dynamic metadata
- Audio Metadata
- Film Transfer and Video Production Information

<table>
<thead>
<tr>
<th>DID</th>
<th>SDID</th>
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<td>EIA 708B Data mapping into VANC space</td>
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<td>EIA 608 Data mapping into VANC space</td>
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When angry, count to four.
When very angry, think of Cher.

Decklink Duo 2 Drama
In FFmpeg/vrecord, we can now:

1. store a correct first frame timecode stamp within our files; and
2. store vrecord-produced sidecar txts that will log all of the analog timecode values, continuous or not, as we wait for the larger Matroska side data advancement.

avdevice/decklink_dec: capture timecode to metadata when requested

If the user provides a valid timecode_format look for timecode of that format in the capture and if found store it on the video avstream's metadata.

Slightly modified by Marton Balint to capture per-frame timecode as well.

Signed-off-by: Marton Balint <cus@passwd.hu>

master (#1)

Jon Morley authored and cus committed on May 31

1 parent fb480a1 commit 0946c0ec177dc48ef0677f804aa42d95e667c417
Chris Isaak "Let Me Down Easy"
Reprise Records

Cher "Song For the Lonely"
Cher "Living Proof"  Press Kit 2002
Warner Bros. Records
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<th>Format</th>
<th>SMPTE LTC</th>
<th>SMPTE VITC</th>
<th>Capture Recommendation</th>
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<td>x</td>
<td>n/a</td>
<td>No SMPTE timecode, but Sony RCTC (rewritable consumer timecode)</td>
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Trust your machines (but read your manuals)

Built-in Time Code Generator/Reader
The generation and reading of SMPTE format VITC and LTC and user bits comes as standard in the BWV-D75. LTC can be automatically recorded on the dedicated time code track and VITC recorded in the vertical blanking interval of the video signal. Time code or user bit settings can be easily executed using the push buttons located on the control panel. User bit settings can be pre-set and stored in non-volatile memory. External/internal time code, REGEN/PRESET, or REC-RUN/FREE/RUN selections are available.

2. Plug-in Time Code Generator/Reader (BKU-905)
The BKU-905 enables the recording and reading of SMPTE LTC and user bits on the address track of the tape. The BKU-905 consists of a plug-in TC Board (TC-42) and Time Code Control Panel.

Full Range of Functions

Built-in time code generator (SVO-5800/5800P only) and reader
The built-in time code generator and reader allow the unit to record (SVO-5800/5800P only) and read time codes (LTC 1, VITC 2) or user bits simultaneously with the video and audio signals.

Sony Service Manuals for BVU-950, SVO-5800, and BVW-D75
Puzzling Over the Permutations
The New Discontinuity (w/ vrecord)
Time After Timecode? If Only!

- MKV side data (for timecode/s and lots of other stuff)
- FFmpeg & decklink ability to read multiple timecodes
- Format-by-format decision tree, with recommendations for diff scenarios (a.k.a. how to set yourself up for success)
- Rethinking workflows and digitization racks
- Automated audio LTC conversion (some tools out there)
- User Bits (super fun, not discussed at all in this prez)
- More vrecord testing and tweaking