IASA-TC 06
Video Preservation Guidelines

https://www.iasa-web.org/tc06/guidelines-preservation-video-recordings

Overview of the First Edition

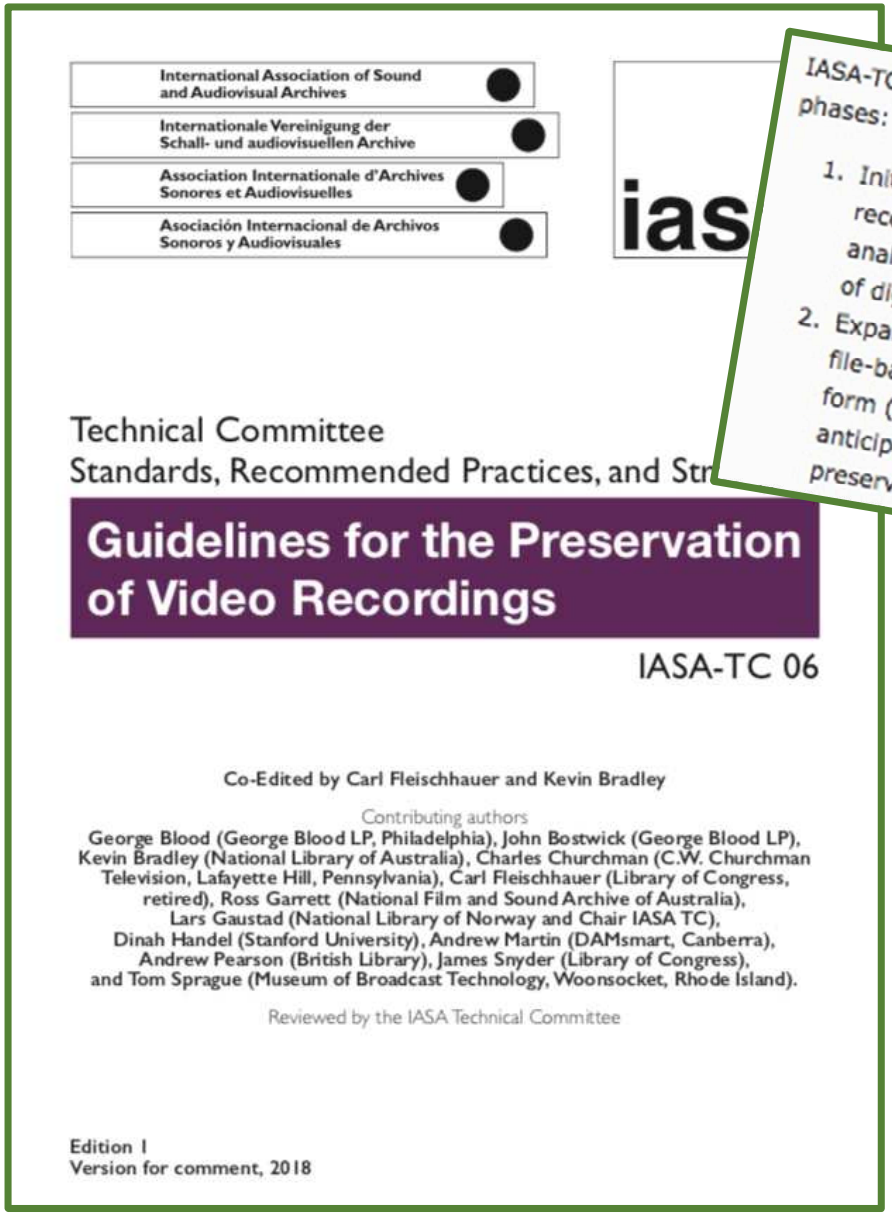
Carl Fleischhauer and Lars Gaustad

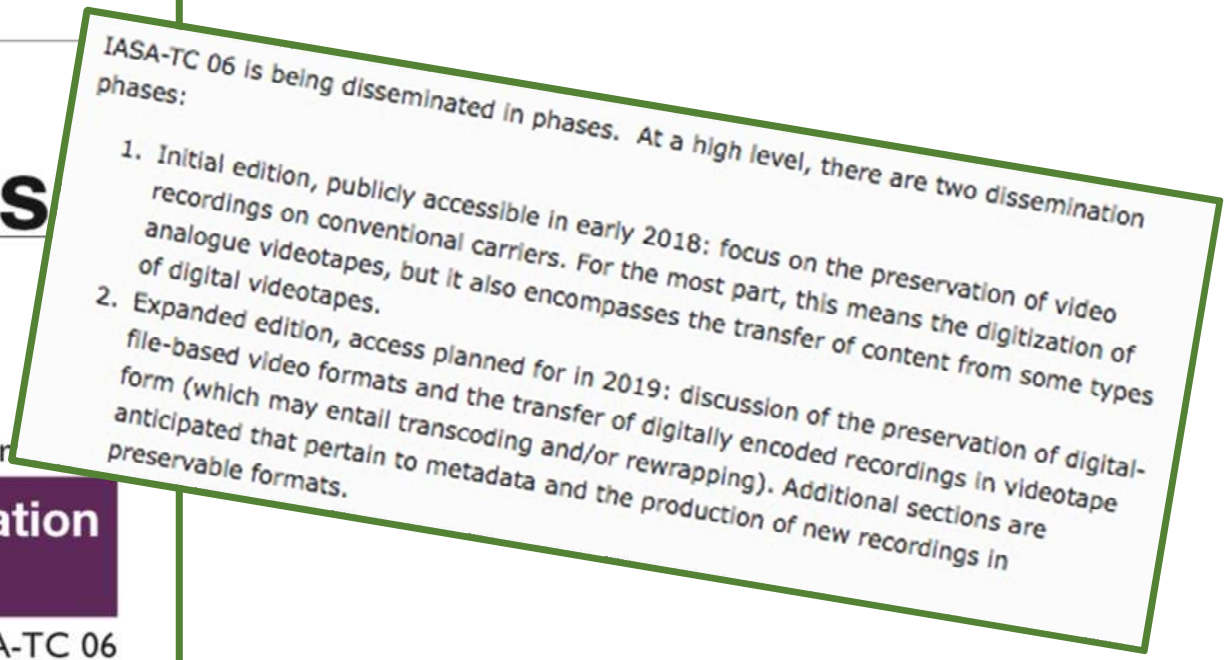
IASA Technical Committee

NoTimeToWait3

BFI Southbank, London, October 25th 2018

https://www.iasa-web.org/tc06/guidelines-preservation-video-recordings





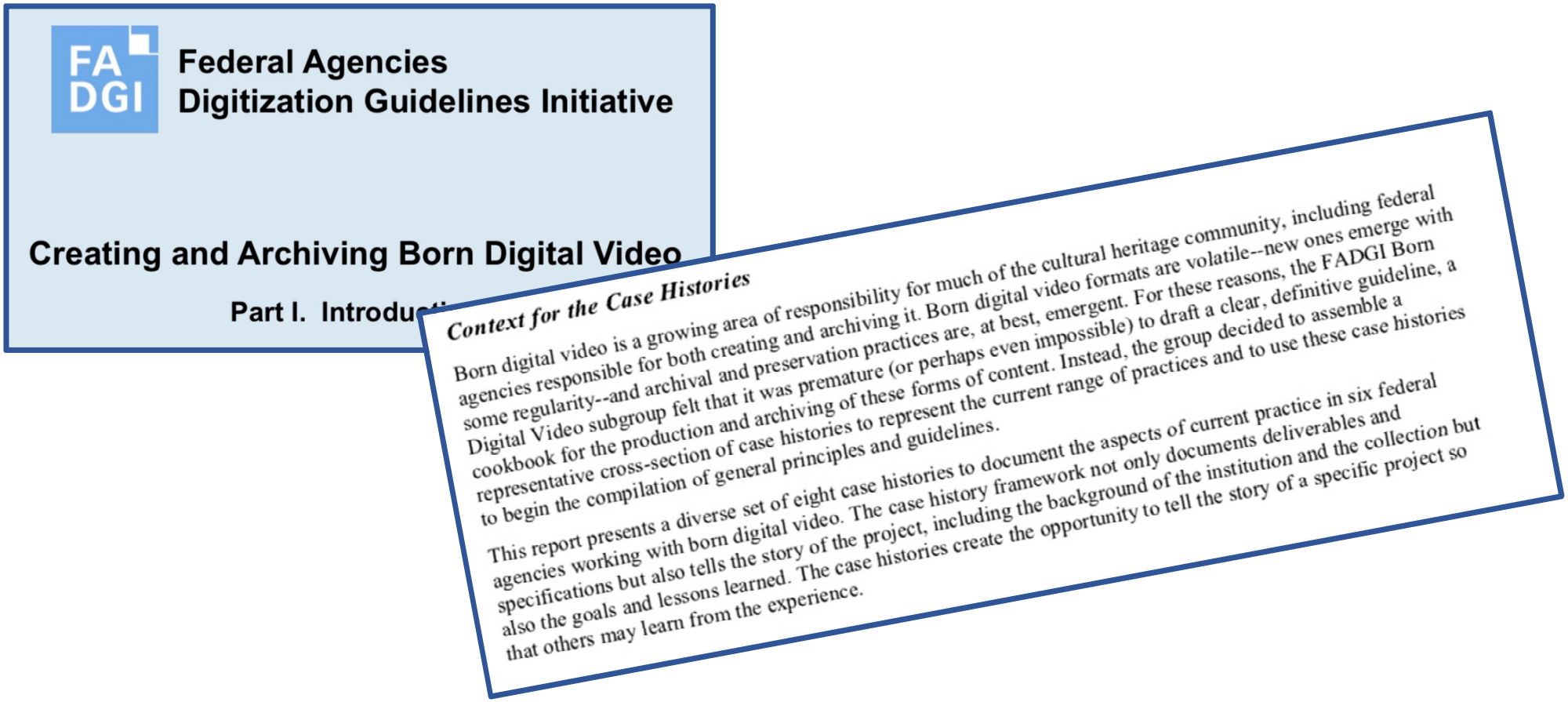
IASA-TC 06 to be published in phases

*First **edition***

- *Focus on carrier-based recordings, i.e., videotapes (mostly analogue)*

*First **version***

- *Online only as set of PDF files, second version will also be in print*



What about file-based born-digital video? The second edition of IASA-TC 06, coming in the future, will treat born digital video. For the moment, here is one useful source of information about file-based digital video:

- http://www.digitisationguidelines.gov/guidelines/video_bornDigital.html

There are others as well.

A.1.4.1 Target audiences and varying levels of detail

The IASA-TC 06 authors hope that the guideline will have high interest for a wide range of readers. We envision our archetypal reader as an archive administrator, technically sophisticated but not an engineer, who does some combination of managing a preservation-production operation (in-house activities) and selecting and managing preservation-service contractors (outsourced work).

IASA-TC 06, first edition

Part A. Introduction

Part B. Video Signal, Preservation Concepts, & Target Formats

Part C. Video Carriers and Signal Extraction

Part D. Planning, Setup, & Workflows for Video Digitisation

Part E. Bibliography

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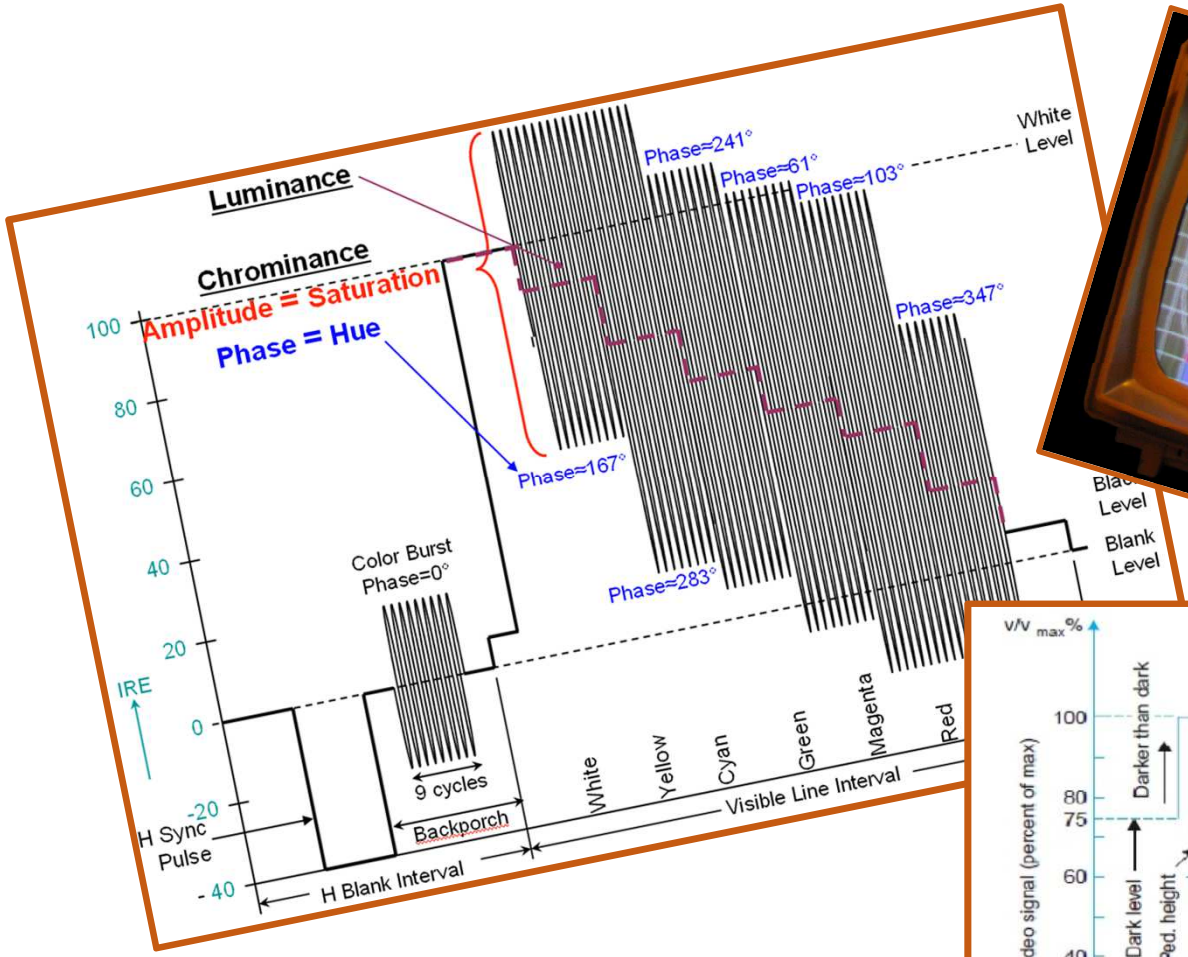
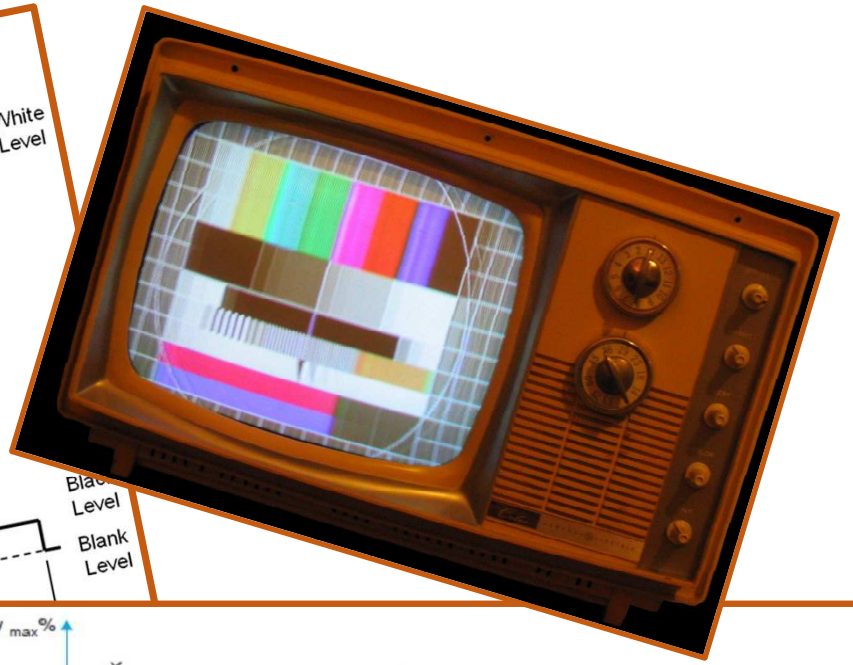
B.3 Target Formats for Video Recordings to be Digitised "as Video" in Real Time





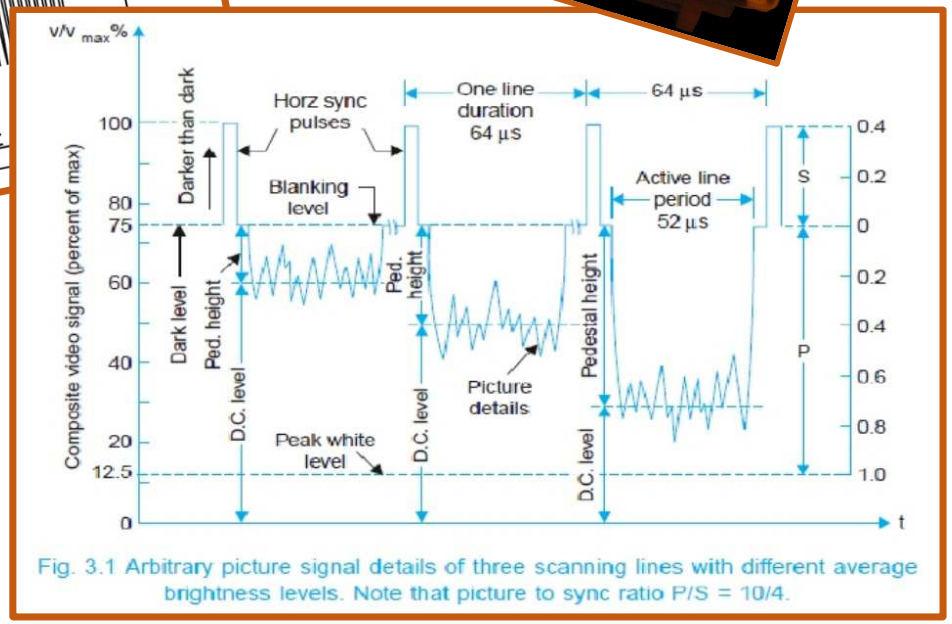
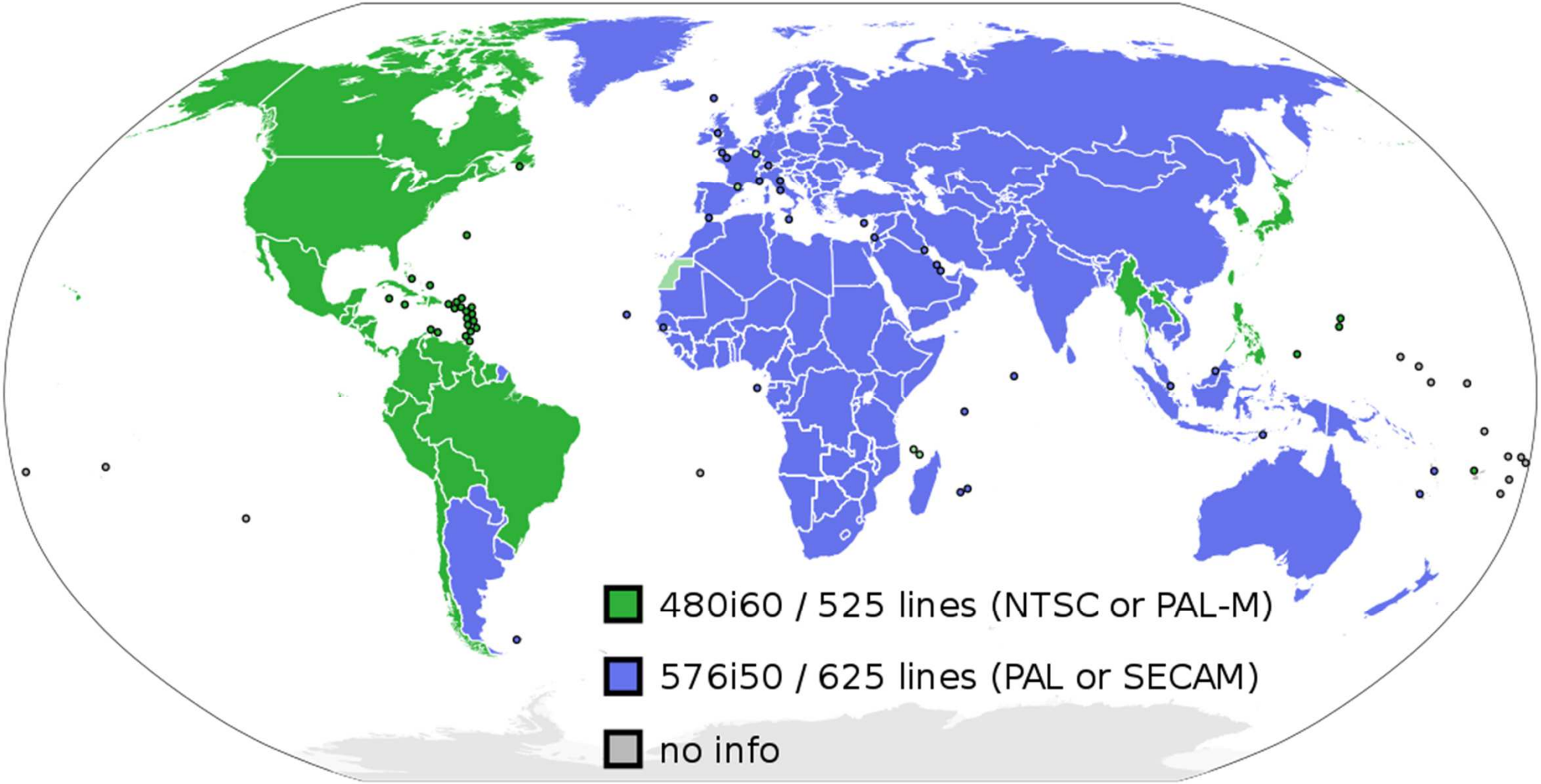
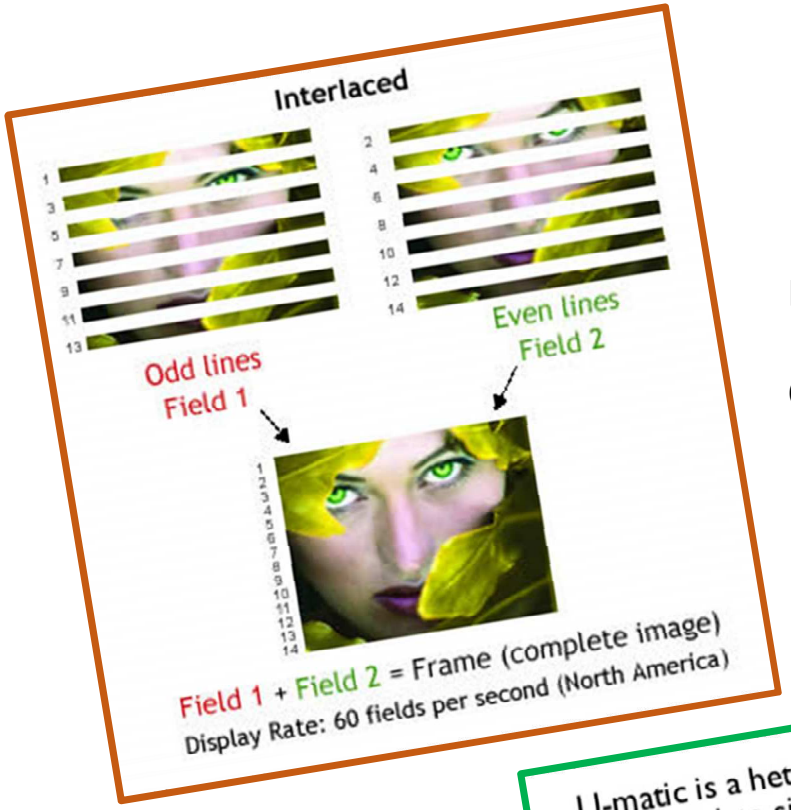


Fig. 3.1 Arbitrary picture signal details of three scanning lines with different average brightness levels. Note that picture to sync ratio P/S = 10/4.


480i60 / 525 lines (NTSC or PAL-M)
576i50 / 625 lines (PAL or SECAM)
no info



Interlacing

Colour-under

text paragraph from TC 06 section on U-matic tapes

U-matic is a heterodyne or colour-under system that converts composite video into a reduced-data signal that requires less bandwidth and can be recorded at slower tape speeds. The heterodyne process separates the luma and chroma signals, and then reduces the chroma for recording. Luma is recorded as an FM signal, while chroma is recorded as an AM signal. The down-conversion is reversed for playback, where the chroma signal is remixed with the luma signal to recreate the composite output. This type of colour-under system is also used for VHS, Beta, S-VHS, 8mm, and Hi8mm format. Although efficient in terms of data flow and storage, the process of up and down converting, along with the mixing of luma and chroma in composite delivery, greatly increases noise and artefacts associated with U-matic (and other colour-under) recordings (Sony: 2016).

B.1.1.3 Broadcast standards and the formatting of video recordings

The descriptions of common features in section B.1.2 and B.1.3 highlight the close relationship between *broadcast* rulemaking, especially in the United States and Europe, and its influence on the production and formatting of *video recordings*.

Rules promulgated by the U.S. Federal Communications Commission (FCC) are supported by a variety of standards from the Society of Motion Picture and Television Engineers (SMPTE) and made manifest in the design and development of video recording devices and signal/payload formatting. In the U.S., many important technical details were given shape by the National Television System Committee (NTSC), established by the FCC in 1940 to resolve the conflicts that emerged when analogue television systems became a national phenomenon. Subsequent NTSC specifications were central to the development of colour television in the 1950s.

In the United Kingdom, broadcast rulemaking is one role for the Office of Communications ("OfCom"). In Europe and in many other regions that do not employ NTSC specifications, regulations have been promulgated by the *Comité Consultatif International pour la Radio* (or *Consultative Committee on International Radio*, abbreviated as CCIR) or, as it has been officially named since 1992, the International Telecommunication Union Radiocommunication Sector (ITU-R). CCIR System B was the broadcast television system first implemented in the 1960s and, during the four decades that followed but prior to the switchover to digital broadcasting, this system was used in many countries.[2] Meanwhile, just as SMPTE provides supporting engineering standards in the U.S., the European Broadcasting Union (EBU) provides engineering standards that support ITU-R regulations.

The broadcast-transmission-related technical rules from the FCC and CCIR did not specify how video is to be recorded but they influenced the development of videotape recorders and signal/payload formatting. The members of standards committees in SMPTE and EBU include specialists from hardware and systems manufacturers; these members and their parent companies thereby help shape the standards, and the overall process increases buy-in and adoption within the industry. Although never as universal as one might hope, these relationships also increase the level of standardization in video recordings.

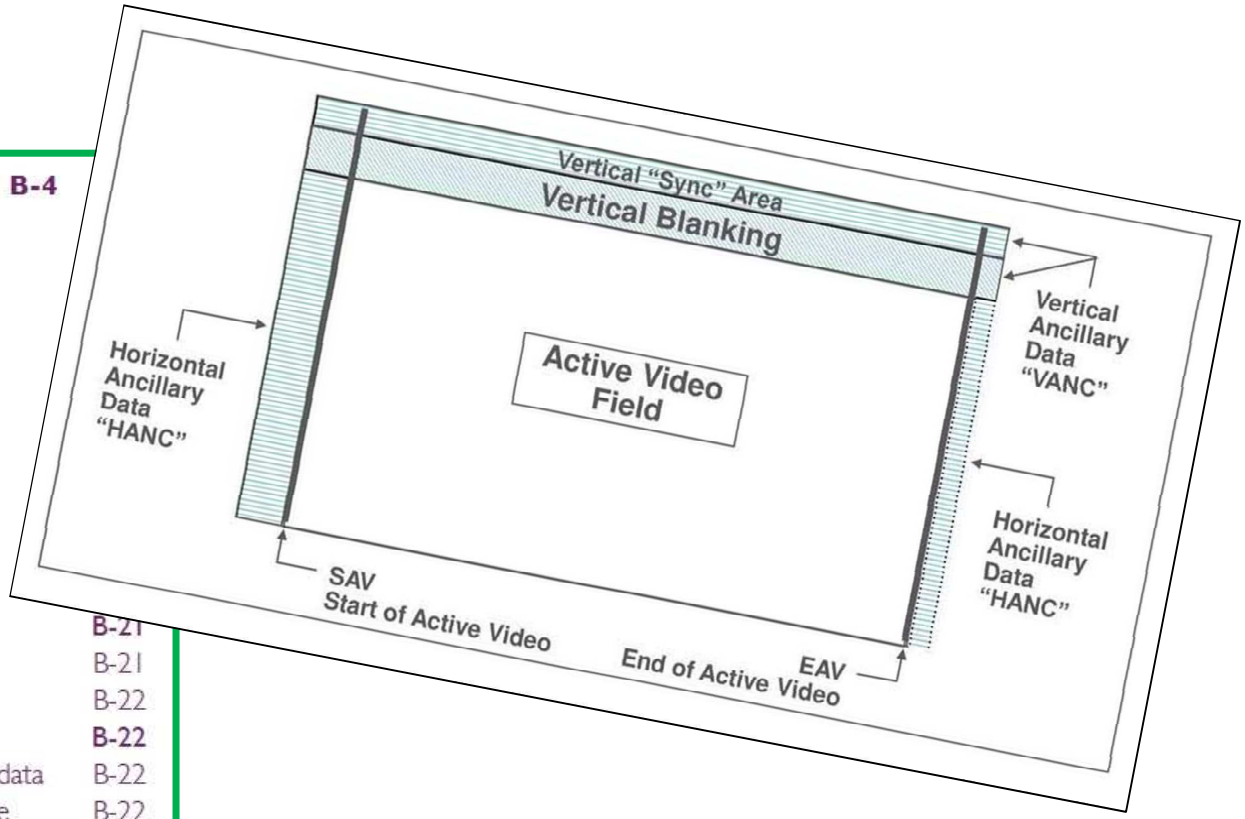
Standards and specification from other branches of the industry have also influenced video formatting in our period of interest. One of the most important is *RS-170*, which spells out many of the intricacies of the synchronizing and timing of NTSC analogue composite picture data (see section B.1.2.6). This standard began its life under the auspices of the Electronic Industries Association (later renamed the Electronic Industries Alliance; EIA), a U.S. trade group for the manufacturers of electronic equipment, including television sets. As the standard took shape in the mid-1950s, it was also central to the NTSC specifications for television broadcasting in the United States, and it influenced parallel developments in other nations to fit the needs of the PAL and SECAM systems (see section B.1.2.1 below). In later years, the RS-170 standard was updated and republished by SMPTE.[3]

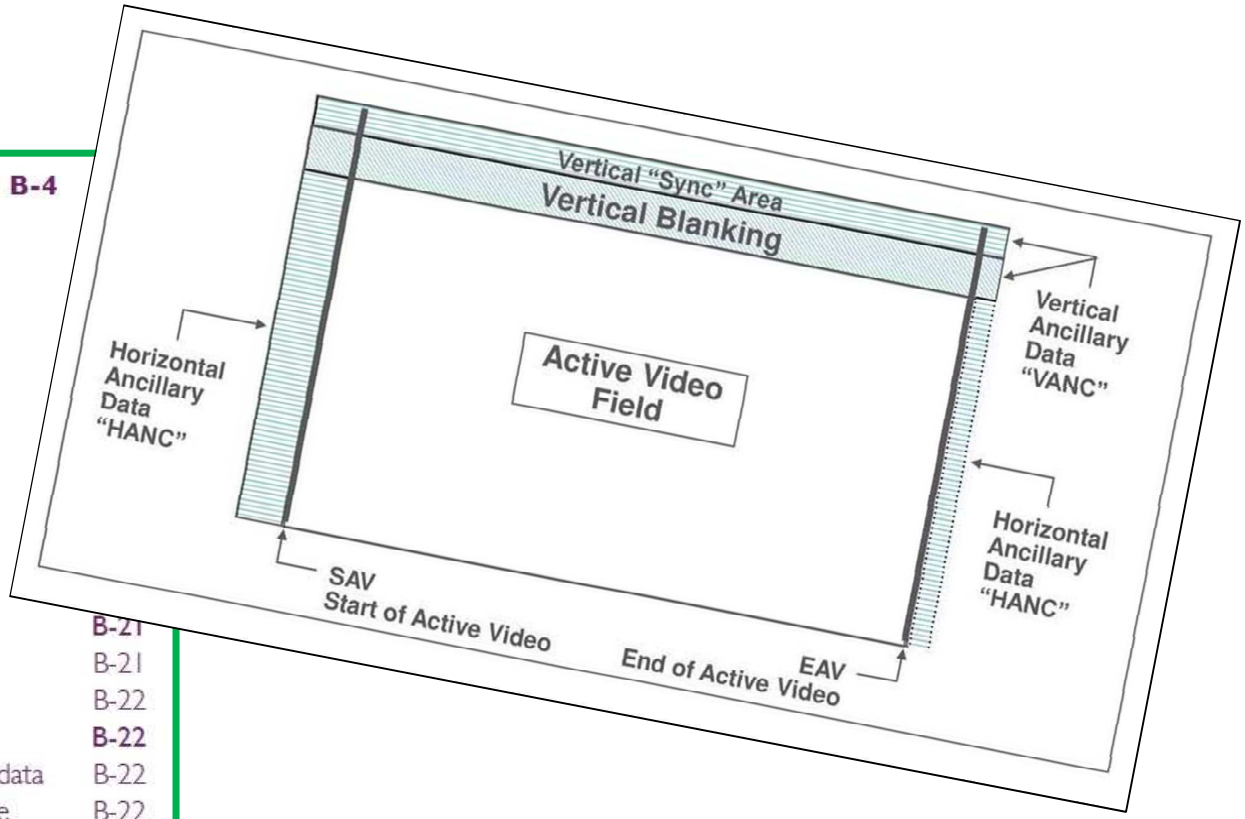
Broadcast specifications, rules, and related standards are (or have been) set by the following bodies (and there are more!)

UNITED STATES (and elsewhere)
- FCC
- SMPTE
- NTSC
- EIA
- ATSC (digital TV)

UNITED KINGDOM
- OfCom

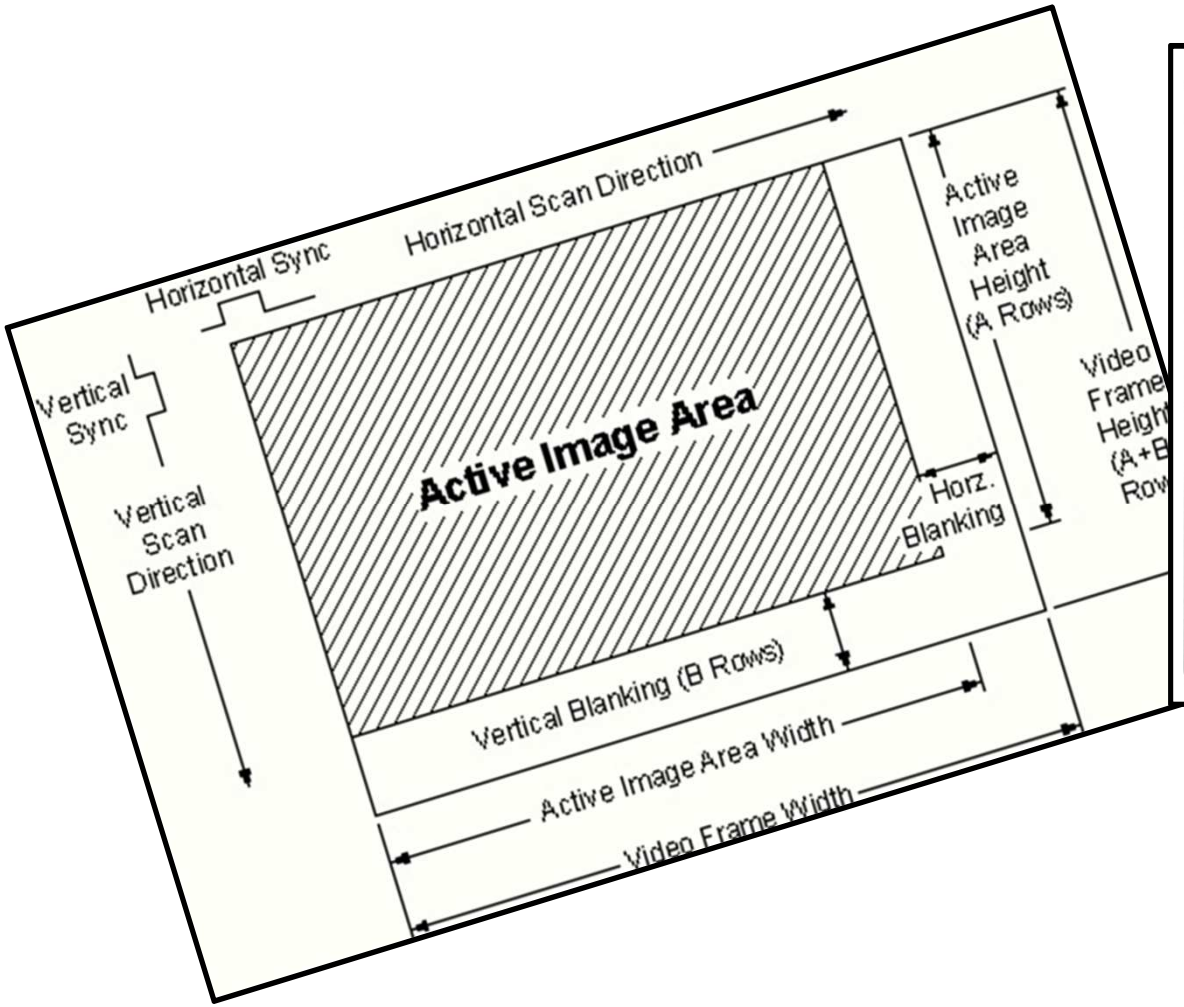
EUROPE (and elsewhere)
- ITU-R (former CCIR)
- EBU

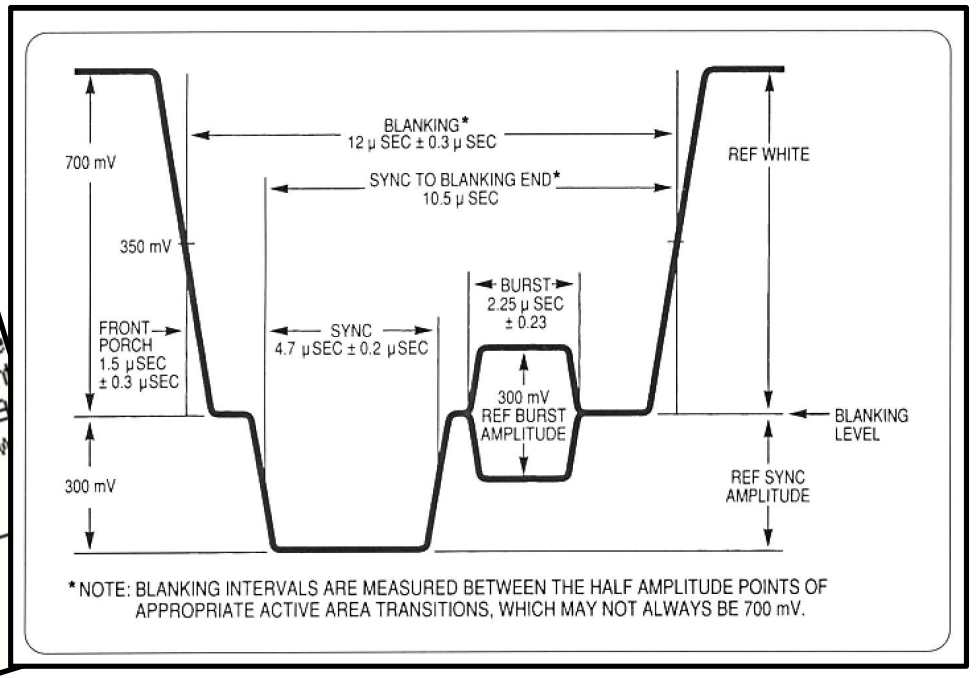


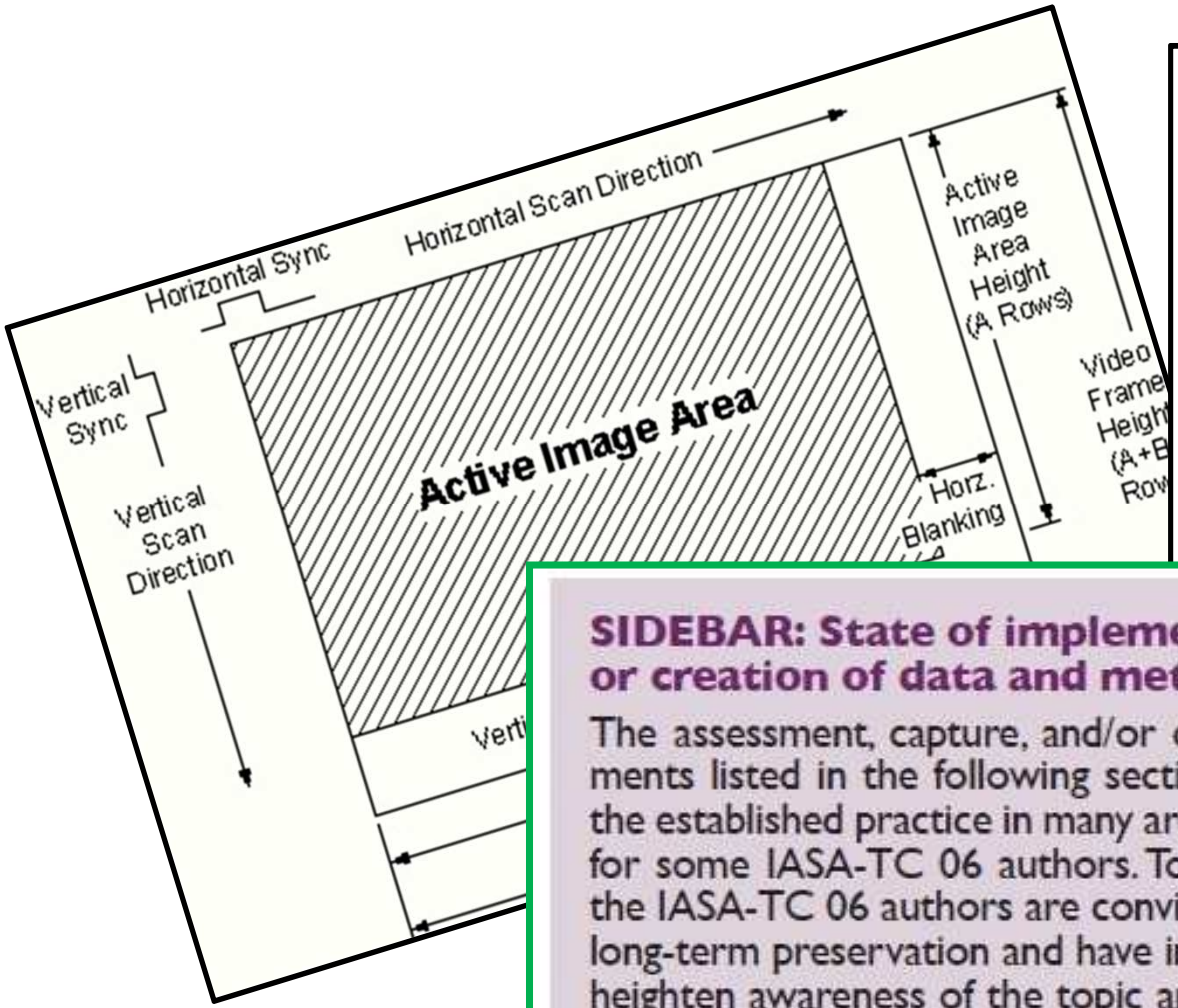


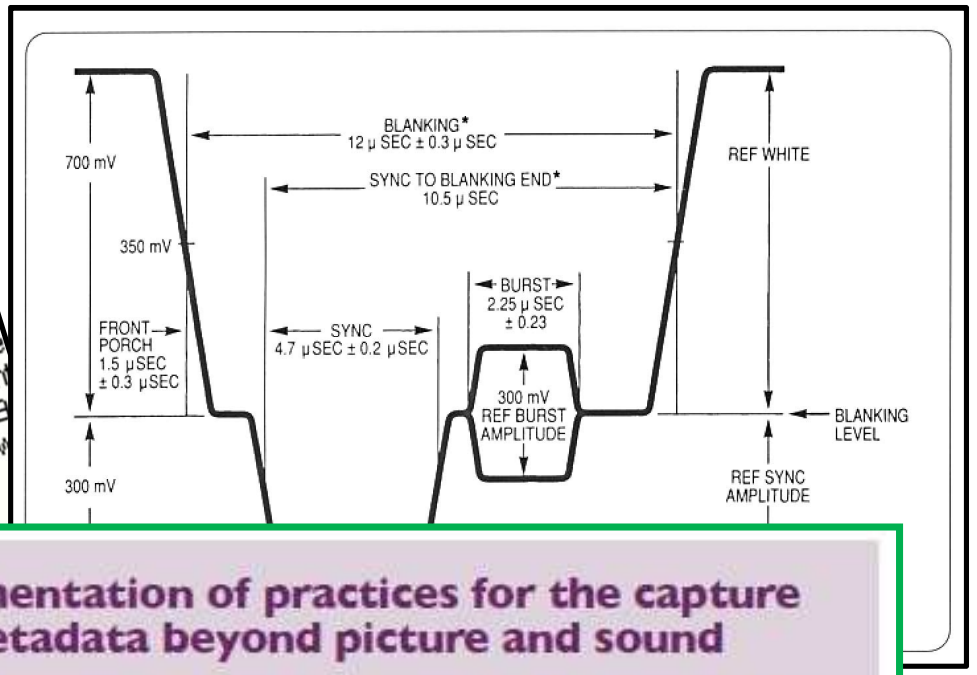
. . . and such components as

- Multichannel Television Sound (MTS)
- Descriptive Video Service (DVS).


Horizontal Sync
Horizontal Scan Direction
Active Image Area Height (A Rows)
Video Frame Height (A+B Rows)
Vertical Sync
Vertical Scan Direction
Active Image Area
Horz. Blanking
Vertical Blanking (B Rows)
Active Image Area Width
Video Frame Width


700 mV
350 mV
300 mV
BLANKING*
12 µ SEC ± 0.3 µ SEC
SYNC TO BLANKING END*
10.5 µ SEC
FRONT PORCH
1.5 µSEC
± 0.3 µSEC
SYNC
4.7 µSEC ± 0.2 µSEC
BURST
2.25 µ SEC
± 0.23
300 mV
REF BURST
AMPLITUDE
REF WHITE
BLANKING
LEVEL
REF SYNC
AMPLITUDE
*NOTE: BLANKING INTERVALS ARE MEASURED BETWEEN THE HALF AMPLITUDE POINTS OF APPROPRIATE ACTIVE AREA TRANSITIONS, WHICH MAY NOT ALWAYS BE 700 mV.





SIDEBAR: State of implementation of practices for the capture or creation of data and metadata beyond picture and sound

The assessment, capture, and/or creation (when warranted) of the payload elements listed in the following sections (D.1.4.2.1 through D.1.4.2.5) is *not* part of the established practice in many archives, including the archives that are home base for some IASA-TC 06 authors. To a degree, what is written here is aspirational: the IASA-TC 06 authors are convinced of the value of these payload elements for long-term preservation and have included the descriptions that follow in order to heighten awareness of the topic and to encourage the continued development of practices and tools.

Part B. Video Signal, Preservation Concepts, and Target Formats

B.1 The Video Signal and Bitstreams: Format and Features

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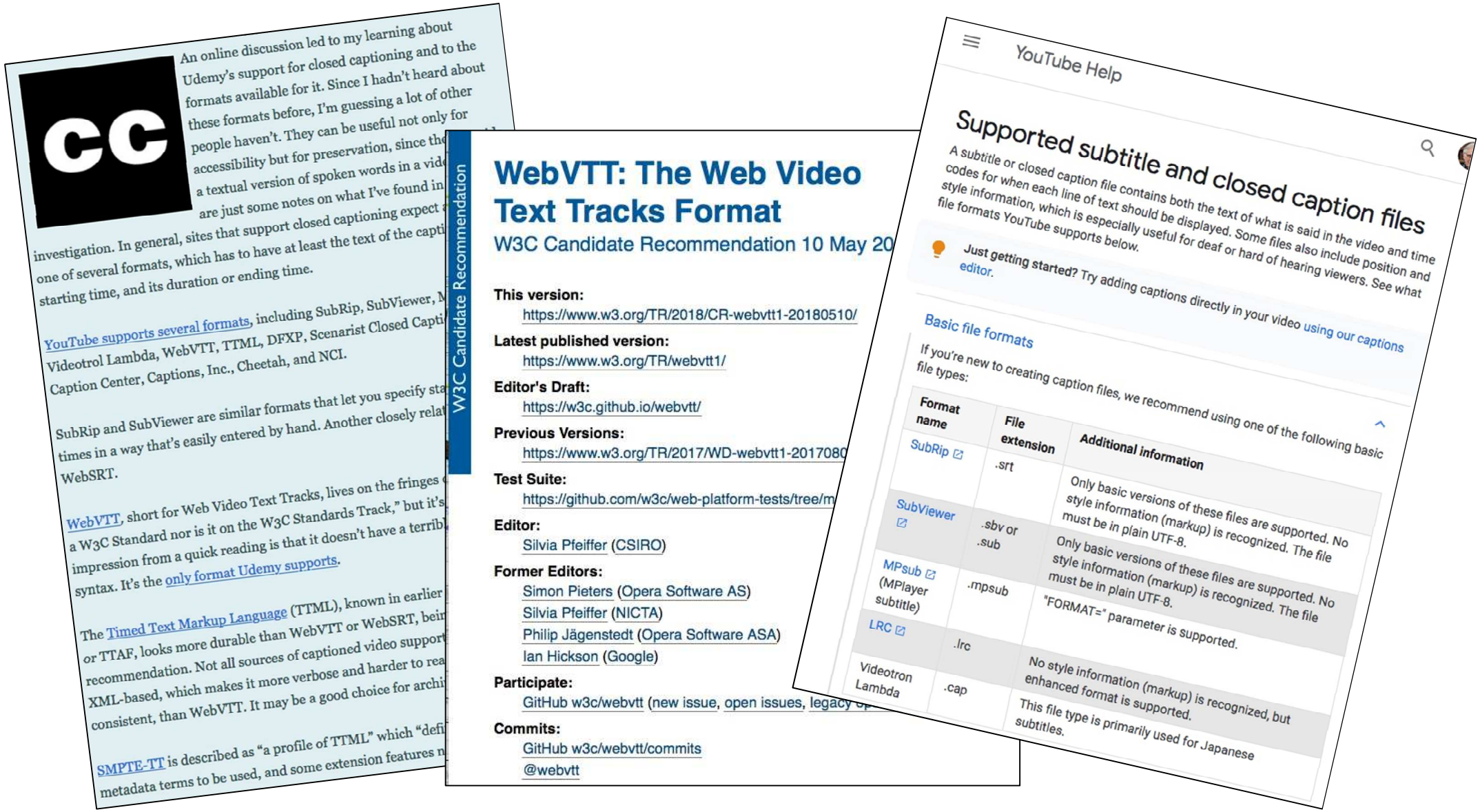

https://madfileformatscience.garymcgath.com/2016/03/16/ | https://www.w3.org/TR/webvtt1/ | https://support.google.com/youtube/answer/2734698

Formatting Elements

- File wrapper
- Encodings
- Metadata

Formatting Elements

- Wrappers
  - Often indicated by file extensions
  - Generally identified by Internet MediaType (aka MIME type)
  - Examples
    - Audio Video Interleaved, .avi, video/avi
    - Matroska, .mkv, video/x-matroska
    - MXF, .mxf, application/mxf
    - QuickTime, .mov, video/quicktime

Formatting Elements

- Encodings
  - Encoded data represents the *essences*, e.g., picture and sound
  - Picture encodings highlighted in IASA-TC 06
    - Uncompressed picture
      - Color-difference component (YCbCr), 10-bits, 4:2:2 chroma subsampling, stored as V210
    - Lossless compressed picture
      - FFV1
      - JPEG 2000 (lossless)

Formatting Elements

- Metadata
  - Tech info needed by the player app
  - Plus –
    - Administrative, e.g., identifier (and more)
    - Descriptive, e.g., program title (and more)
    - Other supplementary, e.g., digitisation-process information (and more)
  - Store in file wrapper and/or database

B.3.1.2.1 "Marketplace wrappers" with picture as lossless compressed FFV1 or as 10-bit-deep uncompressed, 4:2:2 chroma subsampling

- Subtype: OpenDML AVI wrapper,[43] FFV1 encoded video.[44] May require "side-car" files to carry captions or subtitles, if present, and supplementary metadata to document some payload elements as described below.
- Subtype: OpenDML AVI wrapper, v210 encoded video.[45] May require "side-car" files to carry captions or subtitles, if present, and supplementary metadata to document some payload elements as described below.
  - Comment: The OpenDML extension is required in order to support files greater than 2GB, and recommended because it offers additional support for valuable embedded metadata.
- Subtype: QuickTime wrapper,[46] v210 encoded video.

B.3.1.2.2 MXF wrapper with picture as 10-bit-deep uncompressed, 4:2:2 chroma subsampling

- Subtype: format conformant to SMPTE standards and realized in various digitisation systems[47]
- Subtype: format as described in FADGI specification AS-07[48]
- Subtype: format as described in the BBC White Paper 241 (Glanville and Heritage: 2013)

B.3.1.2.3 MXF wrapper with picture as losslessly compressed JPEG 2000

- Subtype: format as described in FADGI specification AS-07
- Subtype: format as produced by the SAMMA devices, now discontinued but formerly available from Media Matters and subsequently Front Porch Digital[49]

B.3.1.2.4 Matroska wrapper with picture as losslessly compressed FFV1

- Subtype: format version that employs Matroska and FFV1 as standardized by IETF (forthcoming), with the specification as developed by the MediaConch/CELLAR project (forthcoming)[50]

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B.2.3.3 Why do format recommendations vary?

Specialists in the field of video preservation have not reached consensus about preferred digital-file formats for preservation. Their mix of opinion reflects the following factors:

- Video preservation practices are not yet mature, format specifications are still being refined, and there is relatively little actual experience. See the sidebar in section B.3.1.2.
- An archive (or the contractor who regularly services an archive) may have an installed equipment base (and related experience) and this base supports one format but not another.
- For some classes of content with relatively simple *payloads*, different specialists recommend different options, all of which are perfectly respectable.
  - Examples: Collections of ethnographic footage or oral history recordings; in general, such materials are unlikely to include elements like multiple time codes, captions or subtitles, or complex audio track configurations.
- For other classes of content with relatively complex payloads, specialists have paid scant attention thus far, and there are few thorough analyses and recommendations.
  - Example: Recorded television broadcasts; such materials often include embedded binary-coded captions or subtitles and may also carry multiple strands of time code inherited from the footage that was assembled to produce the program. These legacy time codes often have great research or forensic value. There may also be multiple soundtrack channels that may carry coded language identification. Other forms of *ancillary data* may also be present.

Implementation notes: Matroska/FFV1 and MXF/JPEG2000

Excerpts from TC 06 section B.3

- Matroska/FFV1: ever-growing use in implementations that predate the final completion of standardization processes, but are thought to conform to what will be the final standardized form.
  - There is current use in memory institution archives; in the United States, notable examples include the University of Indiana and New York Public Library. This format has been greeted with great enthusiasm, and supporting tools are coming into play prior to the completion of the IETF standardization process, which should reach the point of publication [as an RFC] during 2018.

Meanwhile, regarding Matroska and FFV1, a user perspective is presented in a very helpful paper published by Indiana University (Casey: 2017). The report includes notes about the value of the open-format approach and the risk-avoidance that the university's Media Digitization and Preservation Initiative (MDPI) saw in the adoption of this format combination. The Indiana University project postdated the MXF adoptions cited in the preceding paragraph, beginning with an early phase in 2011–12, using a version of the MPEG-2 lossy encoding format. The MDPI team revisited format selection in 2015 as the refinement and IETF standardizing of Matroska and FFV1 was moving into high gear. The MDPI project has now embraced that format combination.

- MXF/JPEG 2000: in extensive use in several archives in the early SAMMA-profile form, with the new AS-07 profile in initial implementations and use.
  - The SAMMA-profile version of this format is in use in some memory institution archives, e.g., the Library of Congress, the national libraries of Norway and Australia, and Libraries and Archives Canada. The SAMMA profile lacks some of the features defined in the AS-07 specification, e.g., handling of legacy time codes, captions, and SMPTE-conformant wrapping of interlaced-picture data. Some vendors have implemented AS-07, and this process will continue during 2018.

Regarding adoption—of MXF in general, and with JPEG 2000 encoding in particular—it is worth noting the widespread use of the MXF wrapper by broadcasters and the entertainment industry. In some cases, this use of MXF incorporates JPEG 2000 picture encoding, generally with lossy compression. For example, MXF/JPEG 2000 is central to widely adopted standards like those for digital cinema.[1] Thus many (but not all) memory institutions closely allied with broadcasters and the entertainment industry are drawn to MXF-based formatting for their work.

B.3.7 Format recommendations in terms of source material characteristics

B.3.7.1 Ethnographic footage and oral history recordings

B.3.7.2 Edited documentaries and modest independent productions

B.3.7.3 Broadcast and other professional productions

Illustrative examples

B.3.7 Format recommendations in terms of source material characteristics

B.3.7.1 Ethnographic footage and oral history recordings

B.3.7.2 Edited documentaries and modest independent productions

B.3.7.3 Broadcast and other professional productions

Illustrative examples

B.3.7.1 Ethnographic footage and oral history recordings

- Practical option:
  - FFV1 in Open DML AVI
  - With supporting metadata carried in sidecar file or in the archive's database
- Acceptable options:
  - Uncompressed v210 in QuickTime
  - Uncompressed v210 in Open DML AVI
  - For both: supporting metadata and fixity data carried in sidecar file or in the archive's database
- Preferred options:
  - FFV1 in Matroska
  - Lossless JPEG 2000 in MXF
  - Uncompressed v210 in MXF

B.3 Appendix, part 2. Full Detail Target Format Comparison Table

For contextual information and explanation, see section B.3.4

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Cate-gory**	**Factor**	**Explanatory comment**	**What kind of information is sought in the cells?**	**Marketplace wrappers with FFV1 or uncompressed v210**			**Uncompressed v210 in MXF**		**Lossless JPEG 2000 in MXF**		**FFV1 in Matroska**
2					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	AS-07 Baseband Shim	Standards compliant v210 in MXF	AS-07 baseband shim	SAMMA profile (versions not distinguished here)	FFV1 in Matroska (Active IETF Internet Drafts)
32		Support for different line counts and frame rates	*Capability:* able to carry image data with varying numbers of lines and frame rates, including NTSC, PAL, and SECAM picture	With comment or citation	Yes	Yes	Yes; see note for cell G32	Yes	MXF options exist; detailed study of implementation in BBC White Paper 241 to be performed	Yes	Yes	Yes
33			*Metadata:* describe line count and frame rate	Is there metadata to do this?	FFV1: horizontal sample, vertical lines, and active frame data are part of the picture_structure data element in the Slice Header.	?	?	Picture Essence Descriptors and Subdescriptors	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 to be performed	Yes. Picture Essence Descriptors and Subdescriptors	[prob via Picture Essence Descriptors and Subdescriptors]	FFV1: horizontal sample, vertical lines, and active frame data are part of the picture_structure data element in the Slice Header.
34		Support for different bit depths	*Capability:* Picture component samples carried at 8 or 10 bits Comment: This table for reformatting old tapes, will not require 12 or 16 bits.	With comment or citation	Yes	n/a [10 bit encoding]	n/a [10 bit encoding]	Yes	Yes; detailed study of implementation in BBC White Paper 241 to be performed	Yes	[assume yes]	Yes
35			*Metadata:* describe the bit depth	Is there metadata to do this?	OpenDML: [?] FFV1: Inferred via pix_fmt value	Typically inferred from fourCC code stored in the fccHandler element "v210" which stands for "Uncompressed Y´CbCr, 10-bit-per-component 4:2:2"	Typically inferred through the Data Format Field fourCC code value "v210" which stands for "Uncompressed Y´CbCr, 10-bit-per-component 4:2:2"	Picture Essence Descriptors and Subdescriptors	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 to be performed	Yes. Picture Essence Descriptors and Subdescriptors	[prob via Picture Essence Descriptors and Subdescriptors]	FFV1: Inferred via pix_fmt value If value is carried over to MKV, then MKV value is master
36		Support for primary and secondary timecodes	*Capability:* Support for (a) continuous high-integrity master timecode and (b) carriage of additional "legacy" timecodes (may be discontinuous) for future reference or study	With comment or citation	Partial	Partial	Yes; see note for cell G36.	Yes	MXF options exist; detailed study of implementation in BBC White Paper 241 to be performed	Yes	[assume no]	Timecode data storage and metadata not fully supported in MKV.
37			*Metadata:* Labeling of timecodes, type and source (if "legacy")	Is there metadata to do this?	OpenDML AVI: Spec includes Timecode Discontinuity Table (tcdl); not typically implemented. FFV1 does not address timecode.	OpenDML AVI: Spec includes Timecode Discontinuity Table (tcdl); not typically implemented. FFV1 does not address timecode.	Yes; see note for cell G37.	Special set of Timecode Descriptors and Subdescriptors	MXF options exist; detailed study of implementation in BBC White Paper 241 to be performed	Special set of Timecode Descriptors and Subdescriptors	[n/a]	Timecode data storage and metadata not fully supported in MKV.
38		Support for closed captioning and subtitles	*Capability:* Pertains to captions and subtitles not burned into picture; carriage may be as stream- or packet-embedded binary data and/or as XML timed text	With comment or citation	Subtitles are possible in theory (via a stream chunk) but may not be commonly implemented. (http://www.alexander-noe.com/video/documentation/avi.pdf)	Subtitles are possible in theory (via a stream chunk) but may not be commonly implemented. (http://www.alexander-noe.com/video/documentation/avi.pdf)	Yes; see note for cell G38.	Yes, as binary packets and as Timed Text	MXF options exist; detailed study of implementation in BBC White Paper 241 to be performed	Yes, as binary packets and as Timed Text	Carried "in the raster" [and as binary packet-ized data?]	Yes (https://matroska.org/technical/specs/subtitles/index.html)
39			*Metadata:* indicates if captions/subtitles are present, which type(s), language tagging	Is there metadata to do this?	Not found in OpenDML AVI or FFV1 specifications.	No	Partial	AS_07_GSP_TD_DMS including primary and secondary languages	MXF options exist; detailed study of implementation in BBC White Paper 241 to be performed	Yes. AS_07_GSP_TD_DMS including primary and secondary languages	No	Caption languages are declared via tags
40		Support for multipart (multisegment) essences	*Capability:* Format capable of carrying a sequence of segments (e.g., shots on a reel, not treated as a unified stream). Likely to be an exception in most archives.	With comment or citation	No	No	May be possible; not widely adopted; see note for cell G40.	Yes; see note for cell H40-J40.	Possible; not widely implemented	Yes; see note for cell H40-J40	[assume no]	Yes, via Chapters

B.3 Appendix, part 2. Full Detail Target Format Comparison Table

For contextual information and explanation, see section B.3.4

	A	B	C	D	E	F	G	H	I	J	K	L
1	Cate-gory	Factor	Explanatory comment	What kind of information is sought in the cells?	Marketplace wrappers with FFV1 or uncompressed v210			Uncompressed v210 in MXF		JPEG 2000 in MXF		FFV1 in Matroska
2					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	AS-07 Baseband Shim	Standards-compliant v210 in MXF	AS-07 baseband shim	SAMMA profile (versions not distinguished here)	FFV1 in Matroska (Active IETF Internet Drafts)
32		Support for different line counts and frame rates	*Capability:* able to carry image data with varying numbers of lines and frame rates, including NTSC, PAL, and SECAM picture	With comment or citation	Yes	Yes	Yes; see note for G32	Yes	MXF options exist; detailed study of implementation in BBC White Paper 241 to be performed	Yes	Yes	Yes
			Metadata: describe line count and frame rate	Is there metadata to do this?	FFV1		?	Picture Essence Descriptors and Subdescriptors	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 to be performed	Yes. Picture Essence Descriptors and Subdescriptors	[prob via Picture Essence Descriptors and Subdescriptors]	FFV1: horizontal sample, vertical lines, and active frame data are part of the picture_structure data element in the Slice Header.
33		Support for different bit depths	*Capability:* Pictu... samples carri... Comme... old ta... bits									
34			*M...*						...ailed ...ation ...241	Yes. Picture Essence Descriptors and Subdescriptors	[prob via Picture Essence Descriptors and Subdescriptors]	FFV1: Inferred via pix_fmt value If value is carried over to MKV, then MKV value is master
35		Support for primary and secondary timecodes	h... (b... time... future							...es	[assume no]	Timecode data storage and metadata not fully supported in MKV.
36			*Metadata:* type and sou...						...ons exist; ...ed study of ...plementation in BBC White Paper 241 to be performed	Special set of Timecode Descriptors and Subdescriptors	[n/a]	Timecode data storage and metadata not fully supported in MKV.
37		Support for closed captioning and subtitles	*Capability:* Pertains to captions and subtitles not burned into picture; carriage may be as stream- or packet-embedded binary data and/or as XML timed text	With comment or citation	theory (... chunk) but may not be commonly implemented. (http://www.alexander-noe.com/video/documentation/avi.pdf)	chunk) but may not be commonly implemented. (http://www.alexander-noe.com/video/documentation/avi.pdf)	...Note for cell G38.	Yes, as binary packets and as Timed Text	MXF options exist; detailed study of implementation in BBC White Paper 241 to be performed	Yes, as binary packets and as Timed Text	Carried "in the raster" [and as binary packet-ized data?]	Yes (https://matroska.org/technical/specs/subtitles/index.html)
38			*Metadata:* indicates if captions/subtitles are present, which type(s), language tagging	Is there metadata to do this?	Not found in OpenDML AVI or FFV1 specifications.	No	Partial	AS_07_GSP_TD_DMS including primary and secondary languages	MXF options exist; detailed study of implementation in BBC White Paper 241 to be performed	Yes. AS_07_GSP_TD_DMS including primary and secondary languages	No	Caption languages are declared via tags
39		Support for multipart (multisegment) essences	*Capability:* Format capable of carrying a sequence of segments (e.g., shots on a reel, not treated as a unified stream). Likely to be an exception in most archives.	With comment or citation	No	No	May be possible; not widely adopted; see note for cell G40.	Yes; see note for cell H40-J40.	Possible; not widely implemented	Yes; see note for cell H40-J40	[assume no]	Yes, via Chapters
40												

Part C. Video Carriers and Signal Extraction

- Quadruplex 2-inch Reels
- EIAJ and Sony CV ½-inch Open Reel Videotapes
- 1-inch Helical-Scan Open Reel Videotapes (types A, B, C)
- U-matic ¾-inch Videocassettes
- ½-inch Analogue Consumer and Semi-Professional Videocassettes
- Betacam ½-inch Professional Videocassette Family

C.6 ½-INCH ANALOGUE CONSUMER AND SEMI-PROFESSIONAL VIDEOCASSETTES

C.6.1 Introduction

The introduction of ½-inch analogue cassette tape formats marked the beginning of a consumer revolution in home recording [technology] for domestic video recording was pioneered in the 1960s with the r[eel-to-reel formats described in section C.2, EIAJ and Sony CV ½-inch Open-Reel Vide]o section, launched in the 1970s, the ½-i[nch cassette] speeds brought about a dramatic re[duction in this] formats, as well as ease of use of thr[ee]

C.6 Table 1. Chronology of ½-inch consumer and semi-professional formats

Format name	Manufacturer/s	Years in use
VCR (N1500) VCR-LP (N1700) SVR	Philips Grundig/ITT	1970–1977
Cartridge National	National/Panasonic	1971–1980
Cartrivision	Avco	1972–1973
V-Cord V-Cord II	Sanyo	1972–1976
VX	Quasar/Panasonic	1974–1978
VK	Akai	1975–early 1980s
Betamax	Sony/Sanyo/Toshiba	1975–2002
VHS	JVC/Matsushita/Mitsubishi, many others	1976–2008
Video2000/VCC/ V2000XL	Philips/Grundig/ITT	1979–1988

C.7.3 Typology of Betacam for equipment (playback VTRs)

- C.7.3.1 Betacam
- C.7.3.2 Betacam SP
- C.7.3.3 Digital Betacam
- C.7.3.4 Betacam SX
- C.7.3.5 MPEG IMX
- C.7.3.6 HDCAM
- C.7.3.7 HDCAM SR

C.7.3.4 Betacam SX

Betacam SX is a digital version of Betacam SP introduced in 1996. It utilises 8-bit MPEG-2 4:2:2 compression with four channels of 48 KHz, 16-bit pulse code modulation (PCM) audio. This format was the first to employ the MPEG-2 compression algorithm capable of outputting high-quality pictures at a relatively low data rate of 18 Mbit/s. Additional features included dynamic motion control, error correction coding, serial data transport interface (SDTI), SX interface for external MPEG connectivity of compressed data, and compatibility with legacy Betacam/SP playback (Sony: 2000 and Sony: 2001).

Betacam SX tapes are commonly in recordable lengths of S (62 minutes) and L (194 minutes).

C.7.3.5 MPEG IMX

MPEG IMX is a 2001 development of the Digital Betacam format. The format was introduced when SMPTE issued two standards on which MPEG IMX is based.[84] The first of these (SMPTE ST 356) specifies a particular H.262/MPEG-2 Part 2 video stream: 422P@ML (4.2.2 chroma subsampling *profile* at main *level*), with an intra-frame compressed video signal, i.e., "all I-frame" encoding with no temporal inter-frame compression.

Depending on the compression setting, D-10/IMX streams can be encoded at data rates higher than Betacam SX, with resulting superior quality. D-10/IMX digital video compression offers data rates at 30 Mbit/s (6:1 compression), 40 Mbit/s (4:1 compression) or 50 Mbit/s (3.3:1 compression). The video payload also includes up to eight channels of audio and a time code track. Although our focus here is on videotape recording, it is also possible (and today, it is more widespread) to record the D-10 stream in file form, carried either in a MXF wrapper or as an .mpg (MPEG) file.

Some MPEG IMX devices can record as many as eight channels of 48kHz 16-bit digital audio or can be switched to provide four channels of 48kHz 24-bit audio.[85]

The IMX format offers long recording times, depending upon tape size, as much as 220 minutes on the larger cassette and 71 minutes on the smaller. Some IMX VTRs are able to play Betacam SP/SX and Digital Betacam videocassettes.

Typical subsections for section C

- Intro and history
- Selection of best copy
- Typology of tapes and VTRs
- Compatibility and availability of VTRs
- Tape coating formulations
- Maintenance and alignment of VTRs
- Sound tracks
- Time code
- Time base correction and dropout compensation
- How much time to prep and digitise each tape?

C.4.4.3.3 **Waveform monitors, vectorscopes, and calibrated monitors**

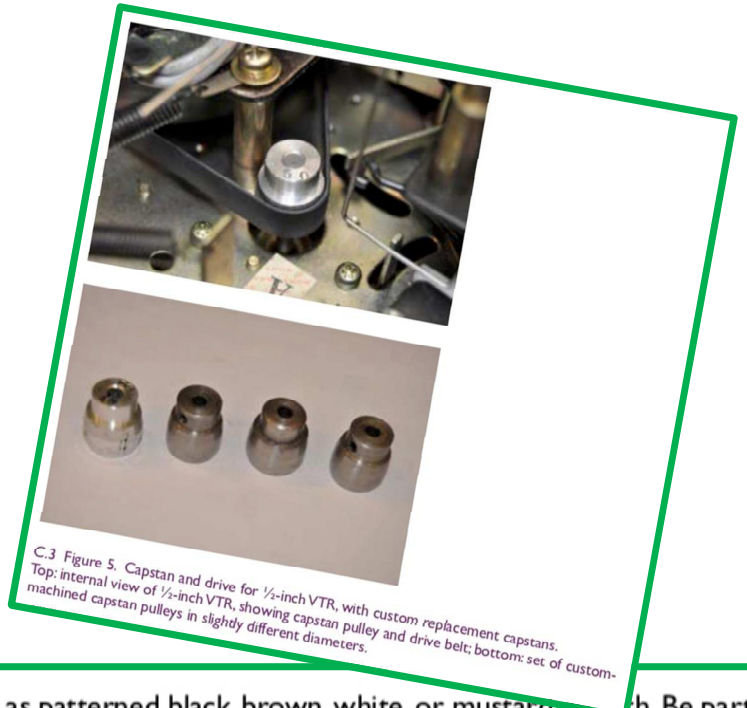
Technical monitoring equipment such as waveform monitors and vectorscopes are also critical when replaying type C tapes. The BCN 51 and 52 comes with these tools integrated. This equipment is needed to calibrate luma and chroma signals, to view sync and burst signals, and to check for vertical interval information.

Professional calibrated CRT monitors are also useful for monitoring the output from the VTR, as they have under scan capabilities, and reproduce the composite image output in its original analogue format. This is especially useful when determining the difference between a recorded artefact, and an artefact generated on playback.

The small, lightweight "spot reels" caused problems on some of the machines and required a weight attachment to mimic the mass of the larger reels. The Scotch 3M video spot reel box states:

Some VTRs require a weight attachment for lightweight reels when used in 'editing' type applications. The Scotch Brand VRB-1-150 Video Spot Reel has been designed for use in conjunction with the Scotch Brand VWB-150 Inertia Balance Weight in these applications. This weight attachment is precision made of stainless steel and cannot be magnetised. It fits simply onto the front of the reel, is locked in place by the VTR spindle clamp during operation, and is easily removed when desired.[55]

Some operators have created their own carefully balanced weight or similar.



C.3 Figure 5. Capstan and drive for ½-inch VTR, with custom replacement capstans. Top: internal view of ½-inch VTR, showing capstan pulley and drive belt; bottom: set of custom-machined capstan pulleys in slighdy different diameters.

Mould can appear as patterned black, brown, white, or mustard g[illegible]h. Be particularly careful when handling mouldy tapes as some moulds can be extremely harmful and always wear personal protective equipment (i.e., gloves, eye protection, and face mask). When working with mould, it is preferable to use a ventilation hood to reduce the chance of contamination. Any conservation work undertaken with mould requires the practitioner to exercise extreme care when handling the cassette.

Remove the red tab from the underside of the cassette to prevent accidently recording on the tape. If the cassette is physically damaged, e.g., the cassette is broken, or affected by fire or flood, the tape will need to be removed from the cassette and housed in a replacement cassette shell.

Re-house the tape into a clean cassette shell. Used cleaning cassettes are convenient for this exercise.

Wear gloves while performing the operation.

Selected notes from the text:

- operating a 1-inch type C VTR
- replacing capstan on a 1/2-inch open reel player
- treating mould on U-matic cassettes

Part D. Planning, Setup, and Workflows for Video digitisation

Part D. Planning, Setup, and Workflows for Video digitisation

1. Introduction
2. Planning, preparing collection materials for digitisation
3. Setting up and testing a digitising facility and system
4. Operating a digitising facility and system

D.1 PLANNING, SETUP, AND WORKFLOWS FOR VIDEO DIGITISATION

D.1.1 Introduction

D.1.1.1 Applicability to in-house and outsourced operations

This section has two audiences. First, it is intended to be helpful to someone setting up and operating a digitising facility. It is not, however, a facility-builder's how-to document. Production facilities are purpose-built, cater to a given organization's needs, and vary from instance to instance. Nevertheless, some useful things can be said about setup, operations, and quality control that apply to a range of production arrangements.

The design and build of a large-scale video facility must take into account all of the components described as parts of the video infrastructure (D.1.3.1.3). Proper execution of such a design-build activity requires solid technical expertise and experience, and many large archives have engaged specialist system integrators (often from the broadcast realm) to support planning and development.

Second, this section is intended to be helpful to those who outsource digitisation, understood to include what the contractor Memnon calls *insourcing*, work executed on an archive's premises with archive staff participation. The concepts and practices described in this section apply to work performed by a contractor, and some level of description of operations and quality control ought to be part of the contract's terms and conditions.

The concepts and practices described in this section also apply to work performed by a contractor, and some level of description of operations and quality control ought to be part of the contract's terms and conditions.

Video production tech infrastructure

1. VTRs and intimate supporting elements
2. Other components that support VTRs
3. Playback and signal monitoring tools
4. Cabling, connectors, patch panels
5. Patch Panels
6. Support for multi-stream & robotic transfer
7. Electrical power
8. Environmental factors
   (air quality, temperature, humidity)
9. Environmental safeguards
   (smoke detectors, other detectors)
10. Availability of compressed air
11. Digitisation systems
12. IT infrastructure
13. Digitisation and IT system safeguards
14. Interim storage system
    "in the conversion lab"
15. Long-term storage and data management
16. Technical library
17. Service personnel, staff and on-call

D.I TABLE 2. The video infrastructure

Row	Infrastructure component	Required or very desirable for factory operation	Required or very desirable for artisanal operation
2	Other components that support VTRs	Sync pulse generators and distribution amplifiers that provide external reference to genlocked VTRs. Some encoders benefit from signal stability utilising reference input. If house reference is not available, set VTRs and encoders to *internal reference* (Cape and Smith: 2005, and Weise and Weynand: 2007). The VTR output may require a composite-component transform (see notes in cell above). In modern digitising setups, the chip-based devices generally employed for this purpose carry out a dual transform: (a) composite to colour-difference component and (b) analogue to digital. These devices are employed in close association with the VTR. Some VTR models require specialized supportive equipment. For example, 2-inch quad needs an air compressor and an air dryer; 1-inch type B requires a sync pulse generator.	Set VTRs and encoders to *internal reference*. The VTR output may require a composite-component transform (see notes in cell above). In modern digitising setups, the chip-based devices generally employed for this purpose carry out a dual transform: (a) composite to colour-difference component and (b) analogue to digital. These devices are employed in close association with the VTR. Some VTR models require supportive equipment. For example, 2-inch quad needs an air compressor and an air dryer, 1-inch type B requires a sync pulse generator.

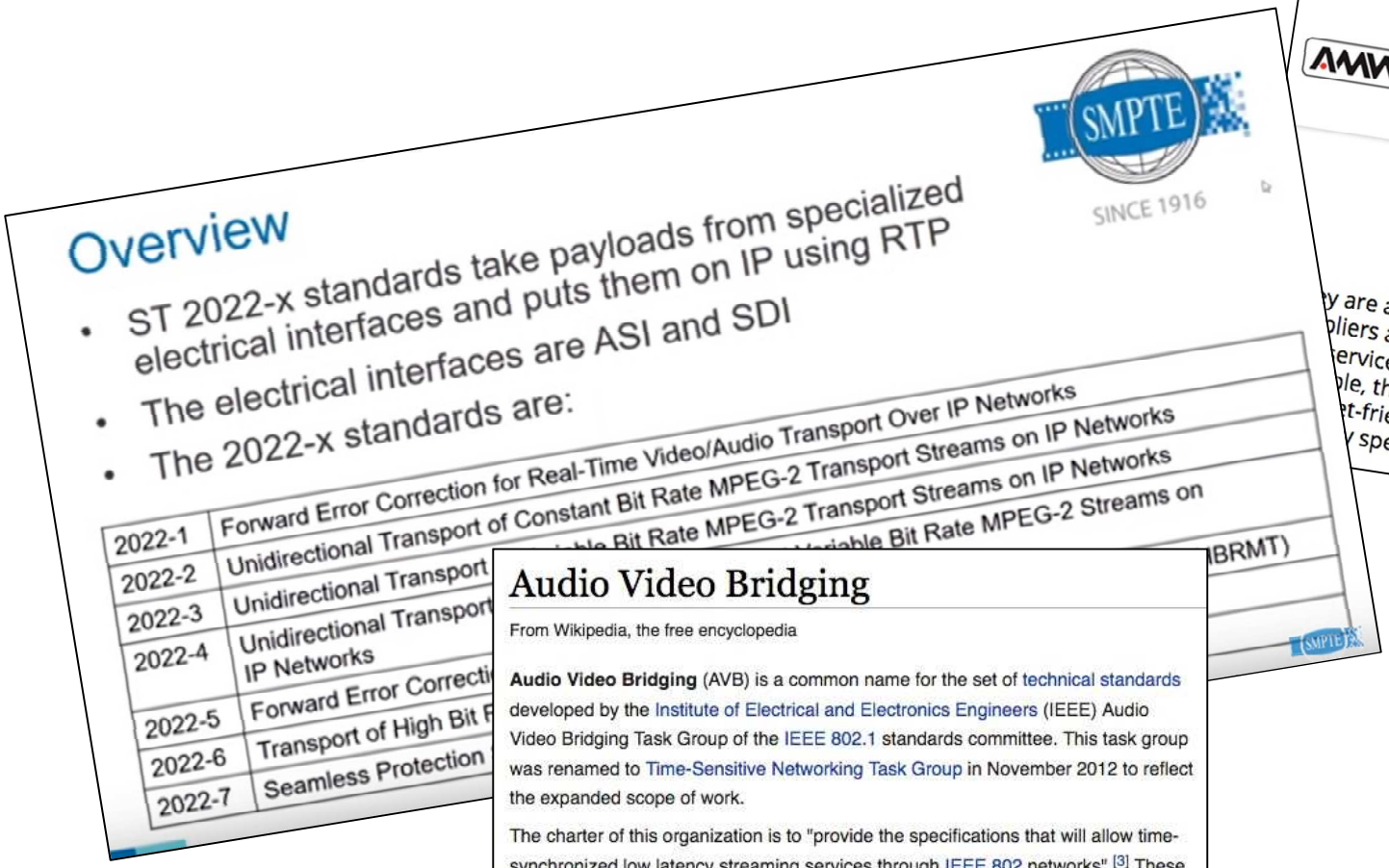
D.1.3.1.6 Direct patch compared to passive and active routing

Routing technology adds efficiencies and ease of use for operators, but also has considerations depending on the system chosen. Hardwired is always the preferred method of connection, as it will provide the highest quality signal path, and is more reliable since an active router is also a possible point of failure in the signal path. Passive routing through a high bandwidth patch bay could be used with quality connectors, and this might be especially helpful in a large-scale operation.

- *Hardwired Encoders.* With good quality cabling, direct connections will reduce the amount of introduced noise to a signal path, if the correct video format is used, such as component or Y/C, balanced or unbalanced audio. Direct connection may cause inefficiencies for large collections if they are multi format due to manual cable work. This is the recommended method for single stream encoding.

- *Passive Routing.* Passive routing can be unpowered patch bay style, which could increase noise level influence depending on the length and quality of caballing, and the amount of connections through the signal path. There is also potential complexity in patching format combinations such as component, composite, and Y/C video. The tradeoff is this does add convenience for operators when changing source VTRs.

- *Active Routing.* As SD VTR technology is becoming obsolete, so is the supportive technology. Active routers that enable operators to switch analogue and digital video, audio, and remote commands through a digital interface are hard to come by and potentially are not supported by the manufacturers if bought second hand. This technology adds ease of operation for multi format operations, however does add an electronic manipulation of the signal.



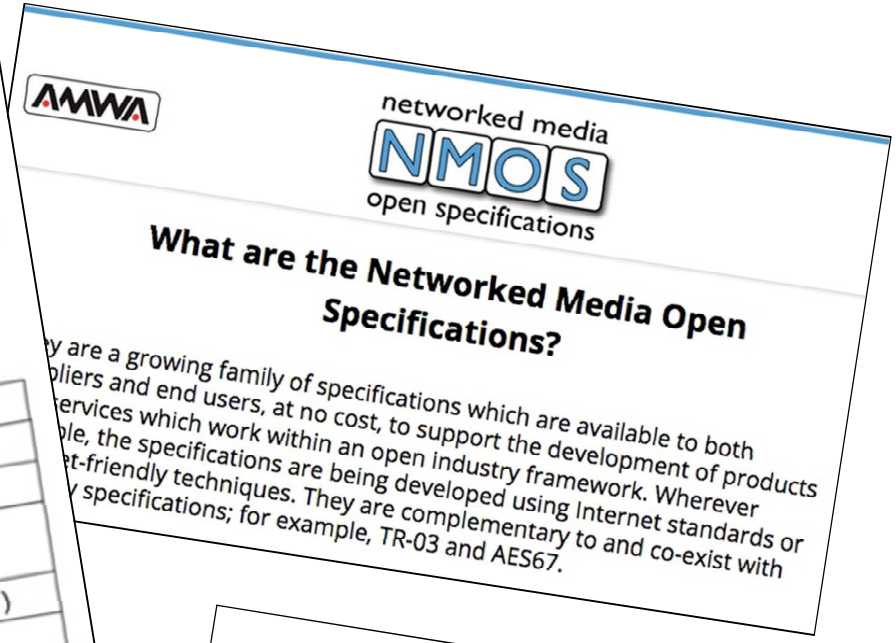
Audio Video Bridging

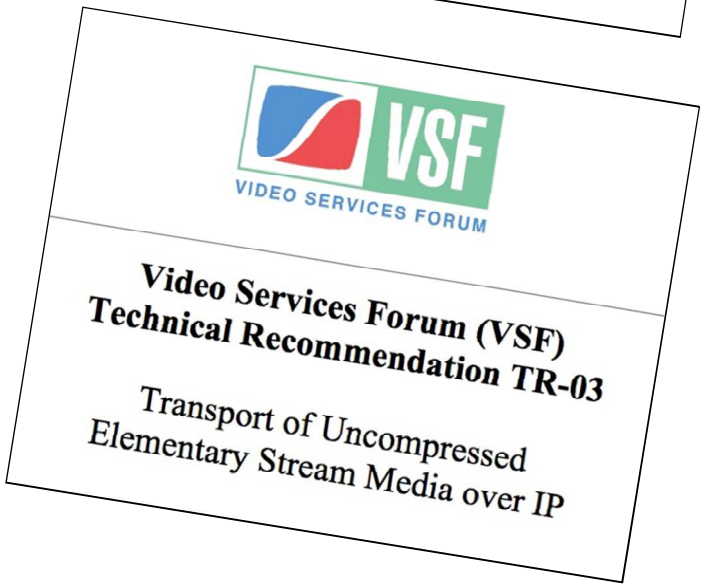
From Wikipedia, the free encyclopedia

Audio Video Bridging (AVB) is a common name for the set of technical standards developed by the Institute of Electrical and Electronics Engineers (IEEE) Audio Video Bridging Task Group of the IEEE 802.1 standards committee. This task group was renamed to Time-Sensitive Networking Task Group in November 2012 to reflect the expanded scope of work.

The charter of this organization is to "provide the specifications that will allow time-synchronized low latency streaming services through IEEE 802 networks".[3] These consist of:

- **IEEE 802.1BA**:[4] Audio Video Bridging (AVB) Systems;
- IEEE 802.1AS: Timing and Synchronization for Time-Sensitive Applications (gPTP);
- IEEE 802.1Qat: Stream Reservation Protocol (SRP); and
- IEEE 802.1Qav: Forwarding and Queuing for Time-Sensitive Streams (FQTSS).





D.1.1.4 Quality assurance, control, and critical control points

D.1.1.4.1 Quality assurance and quality control

In ordinary English, *quality assurance* and *quality control* are often used interchangeably to refer to the methods or approaches used to ensure the quality of a service or product. For many businesses, especially in the field of manufacturing, these words become *terms*, and the practices associated with *quality assurance* have been enshrined in the well-respected international standard ISO 9000.[1]

Quality assurance pertains to the prevention of mistakes or defects in manufactured products and avoiding problems when delivering services, with a strong dependency on what ISO 9000 defines as "part of quality management focused on providing confidence that quality requirements will be fulfilled"[2]. Thus quality assurance can be seen as an overall process guarantee that depends on a variety of factors ranging from good administrative management to the specific actions categorized as *quality control*.

D.1 TABLE 1. Operational "zones" and quality control

Name of zone	Comment on quality control for this zone
D.1.2 Planning and preparing collection materials for digitisation	Generally, a matter of "good housekeeping," good administration; technology metrics are not significant.
D.1.3 Setting up and testing a digitising facility and system	Generally, a matter of (a) good design when assembling and interfacing devices, together with (b) performance testing of devices and systems, which includes technology metrics for some devices.
D.1.4 Operating a digitising facility and system	Quality control in this zone is complex and multifaceted; commercial and open source tools exist, each of which offers similar-but-not-identical coverage; technology metrics are significant. Attentive observation by technical staff is also always necessary; no archive should rely solely on reports from automated tools.

Types of automated QC tools

- Open source applications, with no cost licenses
- Applications from non-profit organizations, fee for license
- Commercial applications
- Commercial applications with integrated open source tools

Types of automated QC tools

- Open source applications, with no cost licenses
- Applications from non-profit organizations, fee for license
- Commercial applications
- Commercial applications with integrated open source tools

- Applications independent of specific hardware or systems
- Applications integrated with hardware and/or other systems
- Applications that depend upon specific hardware or systems

Types of automated QC tools

- Open source applications, with no cost licenses
- Applications from non-profit organizations, fee for license
- Commercial applications
- Commercial applications with integrated open source tools

- Applications independent of specific hardware or systems
- Applications integrated with hardware and/or other systems
- Applications that depend upon specific hardware or systems

- Applications that inspect finished files and generate reports
- Applications that inspect finished files, generate reports, and correct errors
- Applications that monitor signal and/or bitstreams as playback and transfer proceeds

QC applications developed to support archives digitising video for content preservation

- Association of Moving Image Archivists (AMIA): vrecord
- Cube-Tec: Quadriga Video
- Cube-Tec: MXF Legalizer
- Dance Heritage Coalition and the Bay Area Video Coalition (BAVC): QCTools
- GrayMeta: Iris (multiple versions)
- Joanneum Research: VidiCert Essence QC
- Matroska.org: mkvalidator
- MediaArea: MediaConch
- NOA: FrameLector, Video Migration QC, and QualityChecker

QC applications developed to support professional production, broadcast, and online content

- Drastic Technologies: videoQC suite
- Interra Systems: Baton Media Player, Baton Content Corrector
- Metaglue: MXFixer
- Mividi Inc: IMS120 Multiviewer Monitor
- Quales.tv: Video Quality Check system
- Tektronix: Aurora, successor to the Cerify QC tool, AutoFix correction tools
- Telestream: Vidchecker
- Venera Technologies: Pulsar and Quasar

IASA-TC 06 Authors and Contributors

- George Blood (George Blood LP, Philadelphia)
- John Bostwick (George Blood LP)
- Kevin Bradley (National Library of Australia), general editor
- Charles Churchman (C.W. Churchman Television, Pennsylvania)
- Carl Fleischhauer (Library of Congress, retired), general editor
- Ross Garrett (NFSA, Australia)
- Lars Gaustad (National Library of Norway and Chair IASA TC)
- Dinah Handel (Stanford University)
- Andrew Martin (DAMsmart, Canberra)
- Andrew Pearson (British Library)
- James Snyder (Library of Congress)
- Tom Sprague (Museum of Broadcast Technology)

https://www.iasa-web.org/tc06/guidelines-preservation-video-recordings

An improved version of TC 06 is planned. Help us fill in omissions and correct errors.

Send comments to Lars Gaustad (lars.gaustad@nb.no)

Thank you