IASA
Technical Committee
Standards, Recommended Practices, and Strategies

Guidelines for the Preservation of Video Recordings
IASA-TC 06

Part B-App. Appendix to section B.3

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B-App. Appendix to section B.3

B.3 Appendix, part 1. Summary Target Format Comparison Table

For contextual information and explanation, see section B.3.4

Cate-gory	Includes these factors	Marketplace wrappers with FFV1 or uncompressed v210			Uncompressed v210 in MXF		Lossless JPEG 2000 in MXF		FFV1 in Matroska
		FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA Profile	Next evolved versions (IETF standards)
Sustainability factors (individually assessed)									
	Disclosure (documentation of the format)	Acceptable	Acceptable	Acceptable	Good	Good	Good	Acceptable minus	Good
	Adoption (how widely used)	Wide	Wide	Wide	Limited/little implemented	No survey for this guideline	Limited/little implemented	Moderate	Growing
	Transparency (how easy to decipher, how complex)	Slightly more Transparent	Slightly more Transparent	Slightly more Transparent	Medium trans-parency	Medium trans-parency	Slightly less transparent	Slightly less Transparent	Slightly less Transparent
	Self-documentation (extent of metadata carried)	Minimal plus	Minimal plus	Minimal minus	Extensive	Extensive	Extensive	Mid-level	Mid-level plus
Quality factor (individually assessed)									
	Picture and sound encoded without loss	Good	Good	Good	Good	Good	Good	Good	Good
Functionality factors (individual notes, assessed as a group)									
	Support for:								
	4:2:2 chroma subsampling	Capable, metadata ?	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes
	Broadcast and wide video range, ITU-R indication	Capable, metadata ?	Capable, metadata no	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes
	Scan types and field cadence	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes
	Various aspect ratios	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes
	Different line counts and frame rates	Capable, metadata yes	Capable, metadata ?	Capable, metadata ?	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes
	Different bit depths	Capable, metadata ?	n/a [10-bit en-coding], metadata yes	n/a [10-bit encoding], metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes

Cate-gory	Includes these factors	Marketplace wrappers with FFV1 or uncompressed v210			Uncompressed v210 in MXF		Lossless JPEG 2000 in MXF		FFV1 in Matroska
		FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA Profile	Next evolved versions (IETF standards)
Functionality factors (individual notes, assessed as a group), continued									
	Primary and secondary timecode	Capability partial, metadata partial	Capability partial, metadata partial	Capable, tagging metadata yes	Capable, tagging metadata yes	Capable, tagging metadata yes	Capable, tagging metadata yes	Capable, tagging metadata yes	Not capable
	Closed captioning and subtitles	Capable but implementa-tion limited, metadata no	Capable but implementa-tion limited, metadata no	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes
	Multipart (multisegment) essences	Not capable	Not capable	Capable but implementa-tion limited, metadata ?	Capable, metadata yes	Not capable	Capable, metadata yes	Not capable	Capable, metadata yes
	Multiple audio tracks	Capable, tagging metadata no	Capable, tagging metadata no	Capable, tagging metadata yes	Capable, tagging metadata yes	Capable, tagging metadata yes	Capable, tagging metadata yes	Capable, tagging metadata ?	Capable, tagging metadata yes
	Carriage of associated components	Not capable	Not capable	Capable, metadata yes	Capable, metadata yes	Not capable	Capable, metadata yes	Not capable	Capable, tagging metadata yes
	Fixity data	TBD	Not capable	Not capable	Capable, metadata yes	Capable, metadata yes	Capable, metadata yes	Not capable	Capable, tagging metadata yes
	Summary assessment	Acceptable minus	Poor	Acceptable minus	Good	Good	Good	Acceptable	Good

Cate-gory	Includes these factors	Marketplace wrappers with FFV1 or uncompressed v210			Uncompressed v210 in MXF		Lossless JPEG 2000 in MXF		FFV1 in Matroska
		FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA Profile	Next evolved versions (IETF standards)
Production and QC factors (assessed as a group)									
	Efficiency of production								
	Availability and relative cost of production systems								
	Ease of use of production systems								
	Availability of tools for production support (other than quality control)								
	Availability of quality control tools								
	Summary assessment	Relatively easier	Relatively easier	Relatively easier	Relatively more difficult	Relatively more difficult	Relatively more difficult	Relatively more difficult	Relatively easier
Data-management, data-preservation factors (assessed as a group)									
	Availability and cost of maintenance/retention/ future-migration systems								
	Storage and network cost								
	Summary assessment	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Good	Good	Good

B.3 Appendix, part 2. Full Detail Target Format Comparison Table   For contextual information and explanation, see section B.3.4

	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
					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA profile (see first footnote on page B-app-14)	FFV1 in Matroska (Active IETF Internet Drafts)
3	**Sustainability factors**											
4	*Disclosure*											
5		Specification for the wrapper	Documentation and level/type of standardization for the file wrapper.	- -	AVI: Multimedia Programming Interface & Data Specs 1.0, IBM - Microsoft, Aug 1991 OpenDML ext req due to typical file size > 2 GB. Not clear how many OpenDML features implemented in practice. OpenDML ext from the OpenDML AVI M-JPEG File Format Subcomm, 1996-97; at http://www.jmcgowan.com/odmlff2.pdf & elsewhere	AVI: Multimedia Programming Interface & Data Specs 1.0, IBM - Microsoft, Aug 1991 OpenDML ext req due to typical file size > 2 GB. Not clear how many OpenDML features implemented in practice. OpenDML ext from the OpenDML AVI M-JPEG File Format Subcomm, 1996-97; at http://www.jmcgowan.com/odmlff2.pdf & elsewhere	QT: open public spec from Apple, major update 2012, minor updates thru 2015, website update 2016: https://developer.apple.com/library/content/documentation/QuickTime/QTFF/.	SMPTE standards: Various, including ST 377-1:2011. Also relevant is ST 384:2005 (Mapping of Uncompressed Pictures into the [MXF] Generic Container).	SMPTE standards: Various, including ST 377-1:2011. Also relevant is ST 384:2005 (Mapping of Uncompressed Pictures into the [MXF] Generic Container).	SMPTE standards: Various, including ST 377-1:2011. Also relevant is ST 422:2014 (Mapping JPEG 2000 Codestreams into the MXF Generic Container).	SMPTE standards: Various, including ST 377-1:2011. Also relevant is ST 422:2014 (Mapping JPEG 2000 Codestreams into the MXF Generic Container).	Matroska Specifications [main specification], draft-ietf-cellar-matroska-02 (draft version 02, 9 January 2019, expires 13 July 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-matroska-02. - See also footnote for this cell on page B-app-14.
6		Specification for the picture encoding	Documentation and level/type of standardization for the picture encoding. Note: this table assumes widespread use in preservation contexts of LCPM encoding for sound and audio encoding is not reported here.	- -	FFV1 Video Coding Format Version 4 [main specification], draft-ietf-cellar-ffv1-v4-03 (draft version 03, 18 Oct 2018, expires 21 Apr 2019) in various formats: https://tools.ietf.org/html/ draft-ietf-cellar-ffv1-v4/; related to earlier FFV1 Video Coding Format Version 0, 1, and 3 (draft version 06, 18 Oct 2018, expires 21 Apr 2019) in various formats: https://tools.ietf.org/html/ draft-ietf-cellar-ffv1/. URLs accessed 19 Jan 2019; updating con-tinues; to identify latest, consult https://datatracker.ietf.org/.	v210: included in Apple Technical Note TN2162, originally published 1999, https://developer.apple.com/library/mac/technotes/tn2162/. SMPTE memorialized the format in ST 377-1:2011.	v210: included in Apple Tech Note TN2162, originally pub 1999, https://developer.apple.com/library/mac/technotes/tn2162/. SMPTE memorialized format in ST 377-1:2011. See also footnote for this cell on page B-app-14.	v210: included in Apple Tech Note TN2162, originally pub 1999, https://developer.apple.com/library/mac/technotes/tn2162/. SMPTE memorialized format in ST 377-1:2011.	v210: included in Apple Tech Note TN2162, originally pub 1999, https://developer.apple.com/library/mac/technotes/tn2162/. SMPTE memorialized format in ST 377-1:2011. NOTE: files may also be 8 bit UYVY, not desc here.	Lossless JPEG: ISO 15444-1:2004 incl amd 3:2010 (Bcst profiles)	Lossless JPEG: ISO 15444-1:2004 (no specific profile identified)	FFV1 Video Coding Format Version 4 [main specification], draft-ietf-cellar-ffv1-v4-03 (draft version 03, 18 October 2018, expires 21 April 2019) in various formats: https://tools.ietf.org/html/draft-ietf-cellar-ffv1-v4/; related to earlier version FFV1 Video Coding Format Version 0, 1, and 3 (draft version 06, 18 October 2018, expires 21 April 2019) in various formats: https://tools.ietf.org/html/draft-ietf-cellar-ffv1/. All preceding URLs accessed 19 January 2019; updating of all specifications continues; to identify latest versions, consult https://datatracker.ietf.org/.
7		Formal specification for the combined wrapper and encoding format, if any	Publication formality for the combined format, e.g., standard or profile (application specification); what auspices.	- -	No formal specification for the combo May be referred to as *FFV1 in OpenDML AVI*.	No formal specification for the combo May be referred to as *v210 in OpenDML AVI*.	No formal specification for the combo in a fully realized sense. See also footnote for this cell on page B-app-14. May be referred to as *v210 in QuickTime*.	SMPTE RDD 48 (former AS-07), Baseband Shim (appendix J). Latest version linked from http://www.digitizationguidelines.gov/guidelines/MXF_app_spec.html. Final AS-07 version, 2017; RDD 48 published 2019. May be referred to as *RDD 48 with uncompressed picture*.	No formal specification for generic implement of MXF/v210. May be referred to as *v210 in MXF*. For details on the BBC implement, see BBC White Paper WHP 241, 2013, http://downloads.bbc.co.uk/rd/pubs/whp/whp-pdf-files/WHP241.pdf. Ref here as *BBC Archive MXF format*.	SMPTE RDD 48 (former AS-07), Baseband Shim (appendix J). Latest version linked from http://www.digitizationguidelines.gov/guidelines/MXF_app_spec.html. Final AS-07 version, 2017; RDD 48 published 2019. May be referred to as *RDD 48 with lossless JPEG 2000*.	No formal specification for the combo. May be referred to as *SAMMA MXF format*; there are two common versions of the application (v.3 and v.4), and some archives may distinguish files on that basis.	No formal specification for the combo. May be referred to as *FFV1 in Matroska*.

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

For contextual information and explanation, see section B.3.4

	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
					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA profile (see first footnote on page B-app-14)	FFV1 in Matroska (Active IETF Internet Drafts)
		Disclosure score	Evaluative comment, taking all disclosure elements into account	Scoring: Good, Acceptable, Poor Factor carries high weight	Acceptable Specifications in place for subsidiary formats; no formal specification for the combo, established in practice, which varies.	Acceptable Specifications in place for subsidiary formats; no formal specification for the combo, established in practice, which varies.	Acceptable Specifications in place for subsidiary formats; partial specification for the combo, which varies.	Good	Good	Good	Acceptable minus Somewhat established through practice, but variation from one version to the next with little documentation is a drawback	Good Specifications in place for subsidiary formats; no formal specification for the combo.
Adoption												
		Adoption	Degree to which the format is already used by the primary creators, disseminators, or users of information resources.	How widely adopted is the format in the user and vendor communities?	OpenDML AVI w/FFV1 used at Austrian Mediathek and other archives.	OpenDML AVI w/v210 used at NARA, Rutgers, and other archives.	Stanford University [probably others, not identified for this survey]	RDD 48 published 2019; AS-07 published September 2017, adoption limited, use with uncompressed picture less likely than JPEG 2000 picture encoding.	Extent of use of generic MXF/v210 not surveyed for this guideline. BBC MXF Archive Format in use at BBC, other use unknown.	RDD 48 published 2019; AS-07 published September 2017, adoption limited, use with JPEG 2000 picture encoding more likely than uncompressed picture.	Moderate use in large [national] institutions (e.g., national libraries of US, Norway, Australia, Smithsonian Institution)	FFV1 in Matroska is used by or planned for use at Indiana University, University of Illinois, New York Public Library, and University of Texas, as well as in other archives.
		Supporting community	Description of the community that has developed and/or employs the format	- -	Memory institutions	Memory institutions	Memory institutions (?)	Memory institutions	Broadcasters	Memory institutions	Memory institutions	Memory institutions
		Adoption score	Evaluative comment	Scoring: Wide adoption, Moderate adoption, Growing adoption, Limited/little implementation Factor carries high weight	Wide	Wide	Wide	Limited/little implementation	No survey for this guideline	Limited/little implementation	Moderate	Growing
Transparency												
		Transparency	Defined as the degree to which the digital object is open to direct analysis with basic tools. *Explanatory comment:* Degree of complexity of the picture and sound essence as encoded, plus added complexity due to added features offered *Additional comment:* This factor may be moot in this context, although some feel that uncompressed video offers greater transparency and is preferable to compressed.		Lossless compression and more features; greater complexity	Uncompressed picture; fewer features, less complexity	Uncompressed picture; fewer features, less complexity	Uncompressed picture; more features, greater complexity	Uncompressed picture; more features, greater complexity	Lossless compression and more features; greater complexity	Lossless compression and more features; greater complexity	Lossless compression and more features; greater complexity

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
	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
1–2					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA profile (see first footnote on page B-app-14)	FFV1 in Matroska (Active IETF Internet Drafts)
15		Transparency score	Evaluative comment	Scoring: More transparent, less transparent

Factor carries low weight | Slightly less transparent | Slightly more transparent | Slightly more transparent | Medium transparency | Medium transparency | Slightly less transparent | Slightly less transparent | Slightly less transparent |
| 16 | *Self documentation* | | | | | | | | | | | |
| 17 | | Embedded descriptive, administrative, and provenance metadata | Descriptive and administrative metadata (terms as used in libraries) | Does the format offer ways to embed descriptive and administrative metadata? | Includes basic technical metadata that make the digital object relatively self-describing. Optional descriptive and administrative elements can be included as well.

Reported to permit inclusion of EXIF technical metadata; may not be widely supported. | Includes basic technical metadata that make the digital object relatively self-describing. Optional descriptive and administrative elements can be included as well.

Reported to permit inclusion of EXIF technical metadata; may not be widely supported. | Includes basic technical metadata that make the digital object relatively self-describing. Optional descriptive and administrative elements can be included as well.

Can include IPTC fields; may not be widely supported. | Metadata in multiple locations: DMS-1, AS-07_Core_DMS, also in format-specific manifest and supplementary metadata carried in Generic Stream Partitions. | MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey. | Metadata in multiple locations: DMS-1, AS-07_Core_DMS, also in format-specific manifest and supplementary metadata carried in Generic Stream Partitions. | unknown to compiler of this table | Includes technical metadata in wrapper and encoded picture stream that make the digital object self-describing. Optional descriptive and administrative elements can be included as attachments in MKV. |
| 18 | | Embedded special tech metadata | Information about the digital file required for a reader or device to play or interpret the file properly. This metadata is strongly associated with the capabilities of the file, and it is described in pairing of rows with those capabilities in the functionality section below. | See functionality section below | | | | | | | | |
| 19 | | Self documentation score | Evaluative comment, taking all self documentation elements into account | Scoring: Extensive, Mid-level, Minimal

Factor carries medium weight | Mid-level | Minimal minus | Minimal plus | Extensive | Extensive | Extensive | Mid-level | Mid-level plus |
| 20 | *Quality factor* | | | | | | | | | | | |
| 21 | | Picture and sound encoded without loss | Comparison to the arriving baseband signal | Assert "no loss of quality." Since the format types in this comparison forbid lossy compression and support 10-bit or greater sampling, moot factor in this table. | No loss of quality | No loss of quality | No significant loss of quality.

See also footnote for this cell on page B-app-14. | No loss of quality | No loss of quality | No loss of quality | No loss of quality | No loss of quality |
| 22 | | Quality score | Evaluative comment | Scoring: Good, Acceptable, Poor

[Moot factor] | Good | Good | Good | Good | Good | Good | Good | Good |
23	*Functionality factors*											
24		Support for 4:2:2 chroma subsampling	*Capability:* Reassure that 4:2:2 is supported	- -	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
25			*Metadata:* Metadata indicates type of chroma subsampling present	Is there metadata to do this?	Not in wrapper; declared in pix_fmt field in FFV1 (allowable values at https://github.com/FFmpeg/FFmpeg/blob/master/libavcodec/ffv1enc.c#L1288)	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 not performed for this survey	Picture Essence Descriptors and Subdescriptors	[prob via picture essence Descriptors and Subdescriptors]	Not in wrapper; declared in pix_fmt field in FFV1 (allowable values at https://github.com/FFmpeg/FFmpeg/blob/master/libavcodec/ffv1enc.c#L1288)

	A	B	C	D	Marketplace wrappers with FFV1 or uncompressed v210			Uncompressed v210 in MXF		Lossless JPEG 2000 in MXF		L
1	Cate-gory	Factor	Explanatory comment	What kind of information is sought in the cells?								FFV1 in Matroska
2					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA profile (see first footnote on page B-app-14)	FFV1 in Matroska (Active IETF Internet Drafts)
26		Support for broadcast and wide video range, and ITU-R indication	*Explanatory note:* Video range (in terms of 8-bit data) has a 16-235 levels for Y and 16-240 levels for Cr and Cb; wide range carries values from 0 to 255, e.g., for some video created using computer-based graphics applications. For analog video, the ITU-R (former CCIR) specification is BT.601. *Capability:* Capable of carrying video and wide range; wide range not likely for analog video	Can this format carry the relevant video range types?	Yes	Yes	Yes	Wide range as exception: AS-07 baseband shim limited to BT.601 and BT.709; could add custom ranges in other shims	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey	Wide range as exception: AS-07 baseband shim limited to BT.601 and BT.709; could add custom ranges in other shims	?	Yes
27			*Metadata:* indicate video range, indicate ITU-R type (if applicable)	Is there metadata to do this?	FFV1 declares video range in RangeCoding	No	Uses a 'gama' field to specify the levels at which the image was captured.	Picture Essence Descriptors and Subdescriptors	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 not performed for this survey	Picture Essence Descriptors and Subdescriptors	[prob via Picture Essence Descriptors and Subdescriptors]	FFV1 declares video range in RangeCoding
28		Support for scan types and different dominant fields, if interlaced	*Capability:* able to carry progressive and interlaced scan types and (if interlaced) either field dominance	With comment or citation	Yes	Yes	Yes	Yes	Yes	Yes. In addition, JPEG 2000 handling is governed by SMPTE ST 422:2104.	Yes	Yes
29			*Metadata* : describe scan type and (if interlaced) field dominance	Is there metadata to do this?	OpenDML AVI: The Number of Fields per Frame field in the Video Properties Header allows the user to specify '1' for progressive or '2' for interlaced; not typically implemented. FFV1: field information is part of the picture_structure data element in the Slice Header. But field dominance not recorded. [May be updated in future version]	OpenDML AVI: The Number of Fields per Frame field in the Video Properties Header allows the user to specify '1' for progressive or '2' for interlaced; not typically implemented.	The 'fiel' element In the Video Media Atom can specify interlaced or progressive can be specified, as well as field order if the data is interlaced. See also footnote for this cell on page B-app-15.	Picture Essence Descriptors and Subdescriptors	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 not performed for this survey	Picture Essence Descriptors and Subdescriptors JPEG 2000 limited to certain profiles	[prob via Picture Essence Descriptors and Subdescriptors]	FFV1: field information is part of the picture_structure data element in the Slice Header. But field dominance not recorded. [May be updated in future version]
30		Support for various aspect ratios	*Capability:* able to carry various display aspect ratios	With comment or citation	Yes	Yes	Yes	Yes	Yes; detailed study of implementation in BBC White Paper 241 not performed for this survey	Yes	unknown to compiler of this table	Yes
31			*Metadata:* describe aspect ratio facts	Is there metadata to do this?	OpenDML: Video properties Header (vprp) includes "tokens" for NTSC and PAL, and other coding options, not typically implemented. FFV1: horizontal sample, vertical lines, and active frame data are part of the picture_structure data element in the Slice Header.	OpenDML: Video properties Header (vprp) includes "tokens" for NTSC and PAL, and other coding options, not typically implemented.	Display aspect ratio: data elements to specify pixel and display aspect ratios: 'pasp' (pixel aspect ratio; required if non-square) and 'clap' meaning clean aperture (always required).	Support for AFD from SMPTE ST 2016-1 and 3	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey	Support for AFD from SMPTE ST 2016-1 and -3	unknown to compiler of this table	Matroska: if data stored in mkv, overrides data stored in ffv1, if conflict. FFV1: horizontal sample, vertical lines, and active frame data are part of the picture_structure data element in the Slice Header.

	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
					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA profile (see first footnote on page B-app-14)	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 also footnote for this cell on page B-app-15.	Yes	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey	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 not performed for this survey	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 not performed for this survey	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 not performed for this survey	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 also footnote for this cell on page B-app-15.	Yes	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey	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 also footnote for this cell on page B-app-15.	Special set of Timecode Descriptors and Subdescriptors	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey	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 also footnote for this cell on page B-app-15.	Yes, as binary packets and as Timed Text	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey	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 not performed for this survey	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 also footnote for this cell on page B-app-15.	Yes. See also footnote for this cell on page B-app-15.	Possible; not widely implemented	Yes. See also footnote for this cell on page B-app-15.	[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

	Category	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
					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA profile (see first footnote on page B-app-14)	FFV1 in Matroska (Active IETF Internet Drafts)
41			*Metadata:* identifies and describes the segments	Is there metadata to do this?	n/a	n/a	Probably not	Yes: AS_07_Segmentation_DMS	[n/a]	Yes: AS_07_Segmentation_DMS	[n/a]	Chapters are described with appropriate tags
42		Support for multiple audio tracks	*Capability:* Quantity of tracks supported (greater than stereo/two channels, which is assumed in all cases)	With comment or citation	Supports up to 8 channels of audio by relying on the Microsoft Extensible Wave-Format.	Supports up to 8 channels of audio by relying on the Microsoft Extensible Wave-Format.	Good support for different audio configurations. Specification doesn't give an upper limit on the number of audio channels.	Unlimited channels; as many tracks as needed to represent the channels.	Unlimited channels; as many tracks as needed to represent the channels; detailed study of implementation in BBC White Paper 241 not performed for this survey	Unlimited channels; as many tracks as needed to represent the channels.	unknown to compiler of this table	MKV: Unlimited channels; as many tracks as needed to represent the channels.
43			*Metadata:* describe audio track layout; label tracks as to type, role, language, etc.	Is there metadata to do this?	Probably no	Probably no	Yes. See also footnote for this cell on page B-app-15.	Yes. Track layout: AS_07_Core_DMS_AudioTrackLayout Language (primary & secondary): AS_07_Core_DMS_AudioTrackPrimaryLanguage and AS_07_Core_DMS_AudioTrackSecondaryLanguage	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey	Yes. Track layout: AS_07_Core_DMS_AudioTrackLayout Language (primary & secondary): AS_07_Core_DMS_AudioTrackPrimaryLanguage and AS_07_Core_DMS_AudioTrackSecondaryLanguage	unknown to compiler of this table	MKV: Channels and Channel Positions elements. Languages are described via tags.
44		Support for carriage of associated components	*Capability:* carry associated objects or information such as images of tape boxes or documents and supplementary metadata. (See also embedded descriptive, administrative, and provenance metadata in self-description section above.)	With comment or citation	No	No	Yes. See also footnote for this cell on page B-app-15.	Yes. Uses Generic Stream Partitions, SMPTE ST 410	Possible; not widely implemented	Yes. Uses Generic Stream Partitions, SMPTE ST 410	No	MKV: Data can be included as attachments.
45			*Metadata:* describe the objects or information carried	Is there metadata to do this?	n/a	n/a	Yes; the user data can link back to such objects for description.	Yes. AS_07_GSP_DMS.	[n/a]	Yes. AS_07_GSP_DMS.	n/a	MKV: data can be described via tags.
46		Support for fixity data	*Capability:* carry fixity data (e.g., checksums) that pertains to data units with the file, typically frames of picture	With comment or citation	[may be supported via FFV1 and ffmpeg tool ??]	No	No	Uses elements from BBC WP 241 and SMPTE ST 429-6.	[Yes]	Yes. Uses elements from BBC WP 241 and SMPTE ST 429-6.	No	CRC-32 element is defined in the EBML specification.
47			*Metadata* : indicates if fixity data is present, which type(s), etc.	Is there metadata to do this?	[if present, would have to be declared ??]	n/a	n/a	In array in GC SysItem	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey	In array in GC SysItem	n/a	Declared in the CRC-32 element
48		Functionality score	Evaluative comment, taking all functionality elements into account	Scoring: Good, Acceptable, Poor Factor carries high weight	Acceptable-minus	Poor	Acceptable-minus	Good	Good	Good	Acceptable	Good

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	Marketplace wrappers with FFV1 or uncompressed v210 (E)	(F)	(G)	Uncompressed v210 in MXF (H)	(I)	Lossless JPEG 2000 in MXF (J)	(K)	FFV1 in Matroska (L)
1-2	Cate-gory	Factor	Explanatory comment	What kind of information is sought in the cells?	FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA profile (see first footnote on page B-app-14)	FFV1 in Matroska (Active IETF Internet Drafts)
49	**Production and QC factors**											
50		Efficiency of production	Practical assessment of how feasible and easy it is to implement production systems	Prose comments	Many production tools exist; no real difficulty for basic implementations; not all wrapper specification features may be supported	Many production tools exist; no real difficulty for basic implementations; not all wrapper specification features may be supported	Many production tools exist; no real difficulty for basic implementations; not all wrapper specification features may be supported	Commercial systems likely to support efficient parallel-stream production.	Various tools exist for generic MXF/v210; commercial systems support efficient parallel-stream production. BBC Archive Format implementations typically employ the BBC open-source INGEX tools; extent of adoption unk to compiler.	Commercial systems likely support efficient parallel-stream production. Peter Bubestinger study indicates that when using open source software, JPEG 2000 encoding/decoding is significantly slower than, say, FFV1. See also http://download.das-werkstatt.com/pb/mt hk/info/video/compar ison_video_codecs_co ntainers.html	JPEG 2000 encoding relatively fast with the parallel-stream SAMMA and other commercial systems. Peter Bubestinger study indicates that when using open source software, JPEG 2000 encoding/decoding is significantly slower than, say, FFV1. See also http://download.das-werkstatt.com/pb/m thk/info/video/comp arison_video_codecs_containers.html	Production tools exist, both open source and commercial. Peter Bubestinger study indicates that when using open source software, FFV1 encoding/decoding is significantly faster than JPEG 2000. See also http://download.das-werkstatt.com/pb/mthk/inf o/video/comparison_video_codecs_containers.html
51		Availability and relative cost of production systems (rough and ready)	[rough and ready]	Prose comments	Many modest-cost systems exist, as well as more costly commercial systems.	Many modest-cost systems exist, as well as more costly commercial systems.	Many modest-cost systems exist, as well as more costly commercial systems.	Commercial production systems coming on the market in 2018. Support in open source tools unknown.	Commercial systems represent moderate-to-high costs; open-source applications exist but implementation depends upon well-chosen hardware, operating systems, middleware, and capable installation staff for low-to-moderate total cost.	Commercial production systems coming on the market in 2018. Level of support in open source tools unknown.	Some non-SAMMA commercial systems continue in marketplace.	Strong adoption of open source community-created tools, some commercial systems exist.

	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
					FFV1 in OpenDML AVI	v210 in OpenDML AVI	v210 in QuickTime	SMPTE RDD 48 (former AS-07) Baseband Shim	Standards compliant v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SAMMA profile (see first footnote on page B-app-14)	FFV1 in Matroska (Active IETF Internet Drafts)
52		Ease of use of production systems	[rough and ready]	Prose comments	Should be relatively easy; setup for some OpenDML special features will require skill.	Should be relatively easy; setup for some OpenDML special features will require skill.	Should be relatively easy; setup for some special features will require skill.	Commercial products offer user and operator support.	Commercial products are user friendly but complexity of formatting means that operations benefit from skilled staff.	Commercial products offer user and operator support.	Commercial products offer user and operator support.	Open source tools may require setup skills; commercial products offer user and operator support.
53		Availability of quality control tools	QC tools may be part of production systems, or in independent applications. NOTE: This topic is treated in IASA-TC 06 section D.1.4.3.	Prose comments	Tools exist, especially to check finished files.	Tools exist, especially to check finished files.	Tools exist, especially to check finished files.	Tools exist to check finished MXF files; some commercial MXF-capable production systems, as well as independent applications, include tools to QC during and after production.	Tools exist to check finished MXF files; some commercial MXF-capable production systems, as well as independent applications, include tools to QC during and after production.	Tools exist to check finished MXF files; some commercial MXF-capable production systems, as well as independent applications, include tools to QC during and after production.	Tools exist to check finished MXF files; some commercial MXF-capable production systems, as well as independent applications, include tools to QC during and after production.	Tools exist, especially to check finished files.
56		Storage and network cost	Rough and ready place to indicate higher costs associated with uncompressed files	Prose comments	Approximately 50 percent smaller files than uncompressed	Very large files	Very large files	Very large files	Very large files	Approximately 50 percent smaller files than uncompressed	Approximately 50 percent smaller files than uncompressed	Approximately 50 percent smaller files than uncompressed
57		Data-management score	Evaluative comment, taking all functionality elements into account	Scoring: Good, Acceptable, Poor Factor carries low weight	Good	Acceptable	Acceptable	Acceptable	Acceptable	Good	Good	Good

B.3 Appendix, part 2. Notes for the *Full Detail Target Format Comparison Table*
Added explanatory notes for the format comparison table
For contextual information and explanation, see section B.3.4

Cell	Note
Hdr	For header *SAMMA profile*: multiple versions not distinguished here; the sale of SAMMA systems ceased in about 2015; information about SAMMA features is provided because a number of archives continue to employ the system (or other systems that produce the same output).
L5	Cell content abbreviated in table; full cell content follows: *Matroska Specifications* [main specification], draft-ietf-cellar-matroska-02 (draft version 02, 9 January 2019, expires 13 July 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-matroska-02. Supported by additional specifications: *Matroska Codec* [mapping for codecs in Matroska] draft-ietf-cellar-codec-01 (draft version 01, 9 January 2019, expires 13 July 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-codec-01; and by *Matroska Tags* [about metadata], draft-ietf-cellar-tags-01 (draft version 01, 9 January 2019, expires 13 July 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-tags-01. Also relevant is *Extensible Binary Meta Language* [EBML specification], draft-ietf-cellar-ebml-08 (draft version 08, 27 November 2018, expires 31 May 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-ebml-08. All preceding URLs accessed 19 January 2019; updating of all specifications continues, to identify latest versions, consult https://datatracker.ietf.org/.
G6 and G7	Some technical notes from Apple describe this wrapper and encoding, including Technical Note TN2162 (https://developer.apple.com/library/mac/technotes/tn2162/). Regarding TN2162, the video expert Dave Rice has reported slight flaws regarding interlaced picture. See also table 4-2 in the QuickTime File Format Specification (consulted January 30, 2016; online version marked as updated 2015-02-14): https://developer.apple.com/library/mac/documentation/QuickTime/QTFF/QTFFChap3/qtff3.html.
G21	In the case of v210-encoded uncompressed video in the QuickTime wrapper, in some circumstances picture-data values at the very high and very low end (outside of broadcast range) may be lost. This could have a slight impact the ability to post-process or correct video recorded with luma clipping. Apple Tech Note TN2162 (https://developer.apple.com/library/mac/technotes/tn2162/, under the heading "Scheme B: 'Video-Range' Mapping with Unsigned Y´, Offset Binary Cb, Cr") includes the following: Certain Y´, Cb, and Cr component values v are reserved as synchronization signals and must not appear in a buffer … For n=8 bits, these are values 0 and 255. For n=10 bits, these are values 0, 1, 2, 3, 1020, 1021, 1022, and 1023. The writer of a QuickTime image is responsible for omitting these values. The reader of a QuickTime image may assume that they are not present. The video expert Dave Rice adds this information: "A 10-bit source may use 1,024 possible sample values but a valid v210 encoding would only use 1,016 values. Certainly, the lost data is outside of broadcast range, so it doesn't impact the decoded data; however, it would (slightly) impact the ability to post-process or correct video that

	is recorded with luma clipping. I helped [an American univ] with some tests as they tried v210->ffv1 then ffv1->v210 and found the v210 input and v210 output differed, but this was because their input v210 was invalid and utilized the restricted sample values while the output was valid and clipped them. Also, this requirement may be specific to v210 in QuickTime, it's possible (haven't checked), that v210 in AVI may not be lossy."
G29	The video expert Dave Rice reports that the specification for the QuickTime *fiel* atom provides incorrect information regarding interlacing.
G32	The video expert Dave Rice provided this information: "v210 in QuickTime can use any frame rate where the numerator and denominator fit into the atom structure. For some large-ratio values it may reduce the possible duration. For instance, a QuickTime file at 30000/1001 (NTSC) can only hold about 18 hours of timestamps before overflowing whereas 29.97 (not quite NTSC) can manage a far longer duration. v210 could handle any line count, limited by the container storage. v210 does require even width QuickTime because of the chroma subsampling."
G36	The video expert Dave Rice adds this information: "The tmcd atom stores the initial value only and then runs an edit list to deal with offsets and nonconsecutive values. MOV files can also store a synthetic timecode with a user-specified start value that counts up at a user-specified rate; it seems that this data goes into a timecode track. However, timecode data is not always treated the same by various applications, inhibiting interoperability."
G37	QuickTime does support the use of the 'name' atom to reference the source of the timecode; see https://developer.apple.com/library/mac/documentation/QuickTime/QTFF/QTFFChap3/qtff3.html. This was well integrated into Final Cut 7. In addition, information can be placed in the user data section with a link to the track id of the relevant timecode track.
G38	Captions and subtitles are carried in separate tracks labeled 'clcp' and 'sbtl' respectively. The QuickTime specification only mentions support for the CEA-608 format (i.e., may not support XML Timed Text).
G40	The video expert Dave Rice adds this information: "Although not impossible, this would be somewhat unorthodox and at risk of not being understood or properly implemented. The method would employ a sprite track that toggled the enabled flag on a track level and thus switch between tracks."
G43	The Handler Description will include the track type, called Component subtype. The wrapper will carry channel arrangement metadata that maps channels to places like "Left" or "Rear Surround Left" or "Discrete-2". In addition, language data in association with any track may be provided in the 'mdhd' atom.
G44	QuickTime has a 'meta' atom and the user data atom and methods to store XML such as XMP. It also has methods to store supplemental images, most widely used to add movie thumbnails or posters, but could be used for pictures of tape boxes too.
H40-J40	The MXF standards include Operational Patterns 2a, 2b, and 2c, which would permit the wrapping of segments, with timeline track metadata to identify the segment and manage playout. The OP2 series, however, is rarely or never implemented in production systems and, for this reason, Application Specifications like AS-11 and SMPTE RDD 48 (former AS-07) use an alternate segmentation approach that employs a special segmentation Descriptive Metadata Scheme.

B.3 Appendix, part 3. Full Detail Target Format Comparison Table
This is the subdivided version, suitable for printing on typing paper.
For contextual information and explanation, see section B.3.4

TEMPLATE FOR THE COMPARISON INFORMATION

This is the template for the pages that follow. The information provided here is identical to that in the main table (the detailed matrix). Many readers will find this "typing paper" version of the information to be more printable than the large table, designed for 11x17 -inch (U.S.) or A3 (European) paper.

ATTRIBUTE: Main Heading Section

Factor within the attribute section

- *Category:* Repeats main attribute heading for reference
- *Table row:* Reference to the row in the main table (the detailed matrix)
- *Explanatory comment:* In some cases, this includes (a) secondary comments, (b) the "questions" being answered in the comparison data, and for functionality factors, (c) information about relevant metadata.
- *Scoring:* Scoring is generally provided at the end of each attribute section, as a summary for all of that attribute's factors.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	
	v210 in OpenDML AVI	
	v210 in QuickTime	
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	
	Standards compliant v210 in MXF	
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	
	SAMMA Profile[1]	
FFV1 in Matroska	Active IETF Internet Drafts	

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[1] The sale of SAMMA systems ceased in about 2015; information about SAMMA features is provided because a number of archives continue to employ the system (or other systems that produce the same output).

ATTRIBUTE: Sustainability Factors: Disclosure

Factor: **Specification for the wrapper**
- *Category:* Sustainability Factors: Disclosure
- *Table row:* 5
- *Explanatory comment:* Documentation and level/type of standardization for the file wrapper. *Scoring:* Disclosure factors scored together, see row 8.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	AVI: Multimedia Programming Interface & Data Specs 1.0, IBM and Microsoft, August 1991 OpenDML extension required due to typical file size > 2 GB. Not clear how many other OpenDML features are implemented in practice. OpenDML extensions from the OpenDML AVI M-JPEG File Format Subcommittee, 1996-1997; posted at http://www.jmcgowan.com/odmlff2.pdf and elsewhere.
	v210 in OpenDML AVI	AVI: Multimedia Programming Interface & Data Specs 1.0, IBM and Microsoft, August 1991 OpenDML extension required due to typical file size > 2 GB. Not clear how many other OpenDML features are implemented in practice. OpenDML extensions from the OpenDML AVI M-JPEG File Format Subcommittee, 1996-1997; posted at http://www.jmcgowan.com/odmlff2.pdf and elsewhere.
	v210 in QuickTime	QT: open public spec from Apple, major update 2012, minor updates thru 2015, website update 2016: *link in footnote*[2]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SMPTE standards: Various, including ST 377-1:2011. Also relevant is ST 384:2005 (Mapping of Uncompressed Pictures into the [MXF] Generic Container).
	Standards compliant v210 in MXF	SMPTE standards: Various, including ST 377-1. Also relevant is ST 384:2005 (Mapping of Uncompressed Pictures into the [MXF] Generic Container).
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SMPTE standards: Various, including ST 377-1:2011. Also relevant is ST 422:2014 (Mapping JPEG 2000 Codestreams into the MXF Generic Container).

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[2] https://developer.apple.com/library/content/documentation/QuickTime/QTFF

	SAMMA Profile	SMPTE standards: Various, including ST 377-1:2011. Also relevant is ST 422:2014 (Mapping JPEG 2000 Codestreams into the MXF Generic Container).
FFV1 in Matroska	Active IETF Internet Drafts	*Matroska Specifications* [main specification], draft-ietf-cellar-matroska-02 (draft version 02, 9 January 2019, expires 13 July 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-matroska-02. Supported by additional specifications: *Matroska Codec* [mapping for codecs in Matroska] draft-ietf-cellar-codec-01 (draft version 01, 9 January 2019, expires 13 July 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-codec-01; and by *Matroska Tags* [about metadata], draft-ietf-cellar-tags-01 (draft version 01, 9 January 2019, expires 13 July 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-tags-01. Also relevant is *Extensible Binary Meta Language* [the EBML specification] draft-ietf-cellar-ebml-08 (draft version 08, 27 November 2018, expires 31 May 2019) in various document formats: https://tools.ietf.org/html/draft-ietf-cellar-ebml-08. All preceding URLs accessed 19 January 2019; updating of all specifications continues, to identify latest versions, consult https://datatracker.ietf.org/.

Factor: **Specification for the picture encoding**

- *Category:* Sustainability Factors: Disclosure
- *Table row:* 6
- *Explanatory comment:* Documentation and level/type of standardization for the picture encoding. Note: this table assumes widespread use in preservation contexts of LCPM encoding for sound and audio encoding is not reported here.
- *Scoring:* Disclosure factors scored together, see row 8.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	*FFV1 Video Coding Format Version 4* [main specification], draft-ietf-cellar-ffv1-v4-03 (draft version 03, 18 October 2018, expires 21 April 2019) in various formats: https://tools.ietf.org/html/draft-ietf-cellar-ffv1-v4/; related to earlier version *FFV1 Video Coding Format Version 0, 1, and 3* (draft version 06, 18 October 2018, expires 21 April 2019) in various formats: https://tools.ietf.org/html/draft-ietf-cellar-ffv1/. All preceding URLs accessed 19 January 2019; updating of all specifications continues; to identify latest versions, consult https://datatracker.ietf.org/.

	v210 in OpenDML AVI	v210: Included in Apple Technical Note TN2162, originally published 1999: *link in footnote*.[3] SMPTE memorialized the format in ST 377-1:2011.
	v210 in QuickTime	v210: Included in Apple Technical Note TN2162, originally published 1999: *link in footnote[2]; see also footnote*.[4] SMPTE memorialized the format in ST 377-1:2011.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	v210: Included in Apple Technical Note TN2162, originally published 1999: *link in footnote*.[2] SMPTE memorialized the format in ST 377-1:2011.
	Standards compliant v210 in MXF	v210: Included in Apple Technical Note TN2162, originally published 1999: *link in footnote*.[2] SMPTE memorialized the format in ST 377-1:2011. NOTE: Conformant files may also be 8-bit UYVY, not described here
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Lossless JPEG: ISO 15444-1:2004 incl amd 3:2010 (Bcst profiles)
	SAMMA Profile	Lossless JPEG: ISO 15444-1:2004 (no specific profile identified)
FFV1 in Matroska	Active IETF Internet Drafts	*FFV1 Video Coding Format Version 4* [main specification], draft-ietf-cellar-ffv1-v4-03 (draft version 03, 18 October 2018, expires 21 April 2019) in various formats: https://tools.ietf.org/html/draft-ietf-cellar-ffv1-v4/; related to earlier version *FFV1 Video Coding Format Version 0, 1, and 3* (draft version 06, 18 October 2018, expires 21 April 2019) in various formats: https://tools.ietf.org/html/draft-ietf-cellar-ffv1/. All preceding URLs accessed 19 January 2019; updating of all specifications continues; to identify latest versions, consult https://datatracker.ietf.org/.

Factor: **Formal specification for the combined wrapper and encoding format, if any**

- *Category:* Sustainability Factors: Disclosure
- *Table row:* 7
- *Explanatory comment:* Publication formality for the format being described, e.g., standard or profile (application specification); what auspices.
- *Scoring:* Disclosure factors scored together, see row 8.

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[3] https://developer.apple.com/library/mac/technotes/tn2162/
[4] Some technical notes from Apple describe this wrapper and encoding, including Technical Note TN2162 (https://developer.apple.com/library/mac/technotes/tn2162/). Regarding TN2162, the video expert Dave Rice has reported slight flaws regarding interlaced picture. See also table 4-2 in the QuickTime File Format Specification (consulted January 30, 2016; online version marked as updated 2015-02-14): https://developer.apple.com/library/mac/documentation/QuickTime/QTFF/QTFFChap3/qtff3.html.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	No formal specification for the combo May be referred to as *FFV1 in OpenDML AVI*
	v210 in OpenDML AVI	No formal specification for the combo May be referred to as *v210 in OpenDML AVI*
	v210 in QuickTime	No formal specification for the combo in a fully realized sense.[5] May be referred to as *v210 in QuickTime*
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SMPTE RDD 48 (former AS-07), Baseband Shim (appendix J). Latest version linked from: *link in footnote.[6]* Final AS-07 version, 2017; RDD 48 published 2019. May be referred to as *RDD 48 with uncompressed picture*.
	Standards compliant v210 in MXF	No formal specification for generic implementations of MXF/v210. May be referred to as *v210 in MXF*. For details on the BBC implementation, see Guide to Understanding BBC Archive MXF Files, BBC White Paper WHP 241, published 2013, http://downloads.bbc.co.uk/rd/pubs/whp/whp-pdf-files/WHP241.pdf. Referred to here as *BBC Archive MXF format*.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	SMPTE RDD 48 (former AS-07), Baseband Shim (appendix J). Latest version linked from: *link in footnote.[5]* Final AS-07 version, 2017; RDD 48 published 2019. May be referred to as *RDD 48 with lossless JPEG 2000*.
	SAMMA Profile	No formal specification for the combo. May be referred to as *SAMMA MXF format*; there are two common versions of the application (v.3 and v.4), and some archives may distinguish files on that basis.
FFV1 in Matroska	Active IETF Internet Drafts	No format specification for the combo. May be referred to as *FFV1 in Matroska*.

Factor: **Summary evaluation: disclosure factors**

- *Explanatory comment:* Factor carries high weight

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[5] See footnote 3.
[6] http://www.digitizationguidelines.gov/guidelines/MXF_app_spec.html

- *Table row:* 8
- *Scoring:* Good, Acceptable, Poor

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Acceptable Specifications in place for subsidiary formats; no formal specification for the combo, established in practice, which varies.
	v210 in OpenDML AVI	Acceptable Specifications in place for subsidiary formats; no formal specification for the combo, established in practice, which varies.
	v210 in QuickTime	Acceptable Specifications in place for subsidiary formats; partial specification for the combo, which varies.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Good
	Standards compliant v210 in MXF	Good
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Good
	SAMMA Profile	Acceptable minus Somewhat established through practice, but variation from one version to the next with little documentation is a drawback
FFV1 in Matroska	Active IETF Internet Drafts	Good Specifications in place for subsidiary formats; no formal specification for the combo.

ATTRIBUTE: Sustainability Factors: Adoption

Factor: **Adoption**
- *Category:* Sustainability Factors: Adoption
- *Explanatory comment:* Degree to which the format is already used by the primary creators, disseminators, or users of information resources.
- *Table row:* 10
- *Scoring:* Adoption factors scored together, see row 12.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	OpenDML AVI w/FFV1 used at Austrian Mediathek and other archives.
	v210 in OpenDML AVI	OpenDML AVI w/v210 used at NARA, Rutgers, and other archives.
	v210 in QuickTime	Stanford University [probably others, not identified for this survey]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	RDD 48 published 2019; AS-07 published September 2017, adoption limited, use with uncompressed picture less likely than JPEG 2000 picture encoding.
	Standards compliant v210 in MXF	Extent of use of generic MXF/v210 not surveyed for this guideline. BBC MXF Archive Format in use at BBC, other use unknown.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	RDD 48 published 2019; AS-07 published September 2017, adoption limited, use with JPEG 2000 picture encoding more likely than uncompressed picture.
	SAMMA Profile	Moderate use in large [national] institutions (e.g., national libraries of US, Norway, Australia, Smithsonian Institution)
FFV1 in Matroska	Active IETF Internet Drafts	FFV1 in Matroska is used by or is planned for use at the University of Indiana, University of Illinois, New York Public Library, and University of Texas, as well as in other archives.

Factor: **Supporting community**

- *Category:* Sustainability Factors: Adoption
- *Explanatory comment:* Description of the community that has developed and/or employs the format, e.g., "broadcasters"
- *Table row:* 11
- *Scoring:* Adoption factors scored together, see row 12.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Memory institutions
	v210 in OpenDML AVI	Memory institutions
	v210 in QuickTime	Memory institutions (?)
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Memory institutions
	Standards compliant v210 in MXF	Broadcasters

Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Memory institutions
	SAMMA Profile	Memory institutions
FFV1 in Matroska	Active IETF Internet Drafts	Memory institutions

Factor: **Summary evaluation: adoption factors**

- *Category:* Sustainability Factors: Adoption
- *Explanatory comment:* Factor carries high weight
- *Table row:* 12
- *Scoring:* Wide adoption, Moderate adoption, Growing adoption, Limited/little implementation

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Wide
	v210 in OpenDML AVI	Wide
	v210 in QuickTime	Wide
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Limited/little implementation
	Standards compliant v210 in MXF	Not surveyed for this guideline
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Limited/little implementation
	SAMMA Profile	Moderate
FFV1 in Matroska	Active IETF Internet Drafts	Growing

ATTRIBUTE: Sustainability Factors: Transparency

Factor: **Transparency**

- *Category:* Sustainability Factors: Transparency
- *Explanatory comment:* The degree to which the digital object is open to direct analysis with basic tools; degree of complexity of the picture and sound essence as encoded, plus added complexity due to added features offered
  - *Additional explanatory comment:* This factor may be moot in this context, although some feel that uncompressed video offers greater transparency and is preferable to compressed
- *Table row:* 14
- *Scoring:* Transparency factors scored together, see row 15

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Lossless compression and more features; greater complexity
	v210 in OpenDML AVI	Uncompressed picture; fewer features, less complexity
	v210 in QuickTime	Uncompressed picture; fewer features, less complexity
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Uncompressed picture; fewer features, less complexity
	Standards compliant v210 in MXF	Uncompressed picture; fewer features, less complexity
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Lossless compression and more features; greater complexity
	SAMMA Profile	Lossless compression and more features; greater complexity
FFV1 in Matroska	Active IETF Internet Drafts	Lossless compression and more features; greater complexity

Factor: **Summary evaluation: transparency factor**

- *Category:* Sustainability Factors: Transparency
- *Explanatory comment:* Factor carries low weight
- *Table row:* 15
- *Scoring:* More transparent, less transparent

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Slightly less transparent
	v210 in OpenDML AVI	Slightly more transparent
	v210 in QuickTime	Slightly more transparent
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Medium transparency
	Standards compliant v210 in MXF	Medium transparency
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Slightly less transparent
	SAMMA Profile	Slightly less transparent
FFV1 in Matroska	Active IETF Internet Drafts	Slightly less transparent

ATTRIBUTE: Sustainability Factors: Self Documentation

Factor: **Embedded descriptive, administrative, and provenance metadata**
- *Category:* Sustainability Factors: Self Documentation
- *Explanatory comment:* Descriptive and administrative metadata (terms as used in libraries)
  - *Question:* Does the format offer ways to embed descriptive and administrative metadata?
- *Table row:* 17
- *Scoring:* Self documentation factors scored together, see row 19.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Includes basic technical metadata that make the digital object fairly self-describing. Optional descriptive and administrative elements can be included as well. Reported to permit inclusion of EXIF technical metadata; may not be widely supported.
	v210 in OpenDML AVI	Includes basic technical metadata that make the digital object fairly self-describing. Optional descriptive and administrative elements can be included as well. Reported to permit inclusion of EXIF technical metadata; may not be widely supported.
	v210 in QuickTime	Includes basic technical metadata that make the digital object fairly self-describing. Optional descriptive and administrative elements can be included as well. Can include IPTC fields; may not be widely supported.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Metadata in multiple locations: DMS-1, AS-07_Core_DMS, also in format-specific manifest and supplementary metadata carried in Generic Stream Partitions.
	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Metadata in multiple locations: DMS-1, AS-07_Core_DMS, also in format-specific manifest and supplementary metadata carried in Generic Stream Partitions.
	SAMMA Profile	unknown to the compiler of this table
FFV1 in Matroska	Active IETF Internet Drafts	Includes basic technical metadata that make the digital object fairly self-describing. Optional descriptive and

		administrative elements can be included as attachments in MKV.

Factor: **Embedded special tech metadata**

- *Category:* Sustainability Factors: Self Documentation
- *Explanatory comment:* Information about the digital file required for a reader or device to play or interpret the file properly. This metadata is strongly associated with the capabilities of the file, and it is described in pairing of rows with those capabilities in the functionality section below.
- *Table row:* 18
- *Scoring:* See functionality section below

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	See functionality section below
	v210 in OpenDML AVI	See functionality section below
	v210 in QuickTime	See functionality section below
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	See functionality section below
	Standards compliant v210 in MXF	See functionality section below
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	See functionality section below
	SAMMA Profile	See functionality section below
FFV1 in Matroska	Active IETF Internet Drafts	See functionality section below

Factor: **Summary evaluation: self documentation factors**

- *Explanatory comment:* Factor carries medium weight
- *Table row:* 19
- *Scoring:* Extensive, Mid-level, Minimal

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Mid-level
	v210 in OpenDML AVI	Minimal minus
	v210 in QuickTime	Minimal plus
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Extensive

	Standards compliant v210 in MXF	Extensive
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Extensive
	SAMMA Profile	Mid-level
FFV1 in Matroska	Active IETF Internet Drafts	Mid-level plus

ATTRIBUTE: Quality Factor

Factor: **Picture and sound encoded without loss**

- *Category:* Quality Factor
- *Explanatory comment:* Comparison to the arriving baseband signal
  - *Additional comment:* Assert "no loss of quality." Since the format types in this comparison forbid lossy compression and support 10-bit or greater sampling, this is a moot factor in this table.
- *Table row:* 21
- *Scoring:* Quality factor scored in row 22

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	No loss of quality
	v210 in OpenDML AVI	No loss of quality
	v210 in QuickTime	No significant loss of quality[7]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	No loss of quality

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[7] In the case of v210-encoded uncompressed video in the QuickTime wrapper, in some circumstances picture-data values at the very high and very low end (outside of broadcast range) may be lost. This could have a slight impact the ability to post-process or correct video recorded with luma clipping. Apple Tech Note TN2162 (https://developer.apple.com/library/mac/technotes/tn2162/), under the heading "Scheme B: 'Video-Range' Mapping with Unsigned Y′, Offset Binary Cb, Cr") includes the following: Certain Y′, Cb, and Cr component values v are reserved as synchronization signals and must not appear in a buffer … For n=8 bits, these are values 0 and 255. For n=10 bits, these are values 0, 1, 2, 3, 1020, 1021, 1022, and 1023. The writer of a QuickTime image is responsible for omitting these values. The reader of a QuickTime image may assume that they are not present.

The video expert Dave Rice adds this information: "A 10 bit source may use 1,024 possible sample values but a valid v210 encoding would only use 1,016 values. Certainly the lost data is outside of broadcast range, so it doesn't impact the decoded data; however, it would (slightly) impact the ability to post-process or correct video that is recorded with luma clipping. I helped [an American university] with some tests as they tried v210->ffv1 then ffv1->v210 and found the v210 input and v210 output differed, but this was because their input v210 was invalid and utilized the restricted sample values while the output was valid and clipped them. Also this requirement may be specific to v210 in QuickTime, it's possible (haven't checked), that v210 in AVI may not be lossy."

	Standards compliant v210 in MXF	No loss of quality
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	No loss of quality
	SAMMA Profile	No loss of quality
FFV1 in Matroska	Active IETF Internet Drafts	No loss of quality

Factor: **Summary evaluation: quality factor**

- *Explanatory comment:* Moot factor
- *Table row:* 22
- *Scoring:* Good, Acceptable, Poor

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Good
	v210 in OpenDML AVI	Good
	v210 in QuickTime	Good
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Good
	Standards compliant v210 in MXF	Good
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Good
	SAMMA Profile	Good
FFV1 in Matroska	Active IETF Internet Drafts	Good

ATTRIBUTE: Functionality Factors

Factor: **Support for 4:2:2 chroma subsampling**

Subfactor: capability

- *Category:* Functionality factors
- *Capability:* Reassure that 4:2:2 is supported
- *Table row:* 24
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Yes
	v210 in OpenDML AVI	Yes
	v210 in QuickTime	Yes
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	Standards compliant v210 in MXF	Yes
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	SAMMA Profile	Yes
FFV1 in Matroska	Active IETF Internet Drafts	Yes

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Indicates type of chroma subsampling present
- *Table row:* 25
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Not in wrapper; declared in pix_fmt field in FFV1, allowable values at GitHub site: *link in footnote*[8]
	v210 in OpenDML AVI	Typically inferred from fourCC code stored in the fccHandler element "v210" which stands for "Uncompressed Y´CbCr, 10-bit-per-component 4:2:2"
	v210 in QuickTime	Typically inferred through the Data Format Field fourCC code value "v210" which stands for "Uncompressed Y´CbCr, 10-bit-per-component 4:2:2"
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	Standards compliant v210 in MXF	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	SAMMA Profile	[prob via Picture Essence Descriptors and Subdescriptors]

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[8] https://github.com/FFmpeg/FFmpeg/blob/master/libavcodec/ffv1enc.c#L1288

| FFV1 in Matroska | Active IETF Internet Drafts | Not in wrapper; declared in pix_fmt field in FFV1, allowable values at GitHub site: *link in footnote*[7] |

Factor: **Support for broadcast and wide video range, and ITU-R indication**

Subfactor: capability

- *Category:* Functionality factors
- *Capability:* Capable of carrying video and wide range; wide range not likely for analog video
- *Explanatory comment:* Video range (in terms of 8-bit data) has a 16-235 levels for Y and 16-240 levels for Cr and Cb; wide range (if encountered) carries values from 0 to 255, e.g., for some video created using computer-based graphics applications. For analog video, the ITU-R (former CCIR) specification is BT.601.
- *Table row:* 26
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Yes
	v210 in OpenDML AVI	Yes
	v210 in QuickTime	Yes
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Wide range as exception: SMPTE RDD 48 (former AS-07) Baseband Shim limited to BT.601 and BT.709; could add custom ranges in other shims
	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Wide range as exception: Baseband shim limited to BT.601 and BT.709; could add custom ranges in other shims
	SAMMA Profile	?
FFV1 in Matroska	Active IETF Internet Drafts	Yes

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Indicates video range, indicates ITU-R type (if applicable)
- *Table row:* 27
- *Scoring:* Functionality factors scored together, see row 48.

| Marketplace wrappers with FFV1 or | FFV1 in OpenDML AVI | FFV1 declares video range in RangeCoding |
| | v210 in OpenDML AVI | No |

uncompressed v210	v210 in QuickTime	Uses a 'gama' field to specify the levels at which the image was captured.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	Standards compliant v210 in MXF	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	SAMMA Profile	[probably via Picture Essence Descriptors and Subdescriptors]
FFV1 in Matroska	Active IETF Internet Drafts	FFV1 declares video range in RangeCoding

Factor: **Support for scan types and different dominant fields, if interlaced**

Subfactor: capability
- *Category:* Functionality factors
- *Capability:* Able to carry progressive and interlaced scan types and (if interlaced) either field dominance
- *Table row:* 28
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Yes
	v210 in OpenDML AVI	Yes
	v210 in QuickTime	Yes
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	Standards compliant v210 in MXF	Yes
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes. In addition, JPEG 2000 handling is governed by SMPTE ST 422:2014.
	SAMMA Profile	Yes
FFV1 in Matroska	Active IETF Internet Drafts	Yes

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Describes scan type and (if interlaced) field dominance
- *Table row:* 29
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	OpenDML AVI: The Number of Fields per Frame field in the Video Properties Header allows the user to specify '1' for progressive or '2' for interlaced; not typically implemented. FFV1: field information is part of the picture_structure data element in the Slice Header. But field dominance not recorded. [May be updated in future version]
	v210 in OpenDML AVI	OpenDML AVI: The Number of Fields per Frame field in the Video Properties Header allows the user to specify '1' for progressive or '2' for interlaced; not typically implemented.
	v210 in QuickTime	The 'fiel' element In the Video Media Atom can specify interlaced or progressive can be specified, as well as field order if the data is interlaced.[9]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	Standards compliant v210 in MXF	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors JPEG 2000 limited to certain profiles
	SAMMA Profile	[prob via picture essence Descriptors and Subdescriptors]
FFV1 in Matroska	Active IETF Internet Drafts	FFV1: field information is part of the picture_structure data element in the Slice Header. But field dominance not recorded. [May be updated in future version]

Factor: **Support for various aspect ratios**

Subfactor: capability

- *Category:* Functionality factors
- *Capability:* Able to carry various display aspect ratios
- *Table row:* 30
- *Scoring:* Functionality factors scored together, see row 48.

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[9] The video expert Dave Rice reports that the specification for the QuickTime *fiel* atom provides incorrect information regarding interlacing.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Yes
	v210 in OpenDML AVI	Yes
	v210 in QuickTime	Yes
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	Standards compliant v210 in MXF	Yes; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	SAMMA Profile	Unknown to the compiler of this table
FFV1 in Matroska	Active IETF Internet Drafts	Yes

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Describes aspect ratio facts
- *Table row:* 31
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	OpenDML: Video properties Header (vprp) includes "tokens" for NTSC and PAL, and other coding options, not typically implemented. FFV1: horizontal sample, vertical lines, and active frame data are part of the picture_structure data element in the Slice Header.
	v210 in OpenDML AVI	OpenDML: Video properties Header (vprp) includes "tokens" for NTSC and PAL, and other coding options, not typically implemented.
	v210 in QuickTime	Display aspect ratio: data elements to specify pixel and display aspect ratios: 'pasp' (pixel aspect ratio; required if non-square) and 'clap' meaning clean aperture (always required).
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Support for AFD from SMPTE ST 2016-1 and -3

	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Support for AFD from SMPTE ST 2016-1 and -3
	SAMMA Profile	Unknown to the compiler of this document
FFV1 in Matroska	Active IETF Internet Drafts	Matroska: if data stored in MKV, overrides data stored in FFV1, if conflict. FFV1: horizontal sample, vertical lines, and active frame data are part of the picture_structure data element in the Slice Header.

Factor: **Support for different line counts and frame rates**

Subfactor: capability
- *Category:* Functionality factors
- *Capability:* Able to carry image data with varying numbers of lines and frame rates, including NTSC, PAL, and SECAM picture
- *Table row:* 32
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Yes
	v210 in OpenDML AVI	Yes
	v210 in QuickTime	Yes[10]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	SAMMA Profile	Yes

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[10] The video expert Dave Rice provided this information: "v210 in QuickTime can use any frame rate where the numerator and denominator fit into the atom structure. For some large ratio values it may reduce the possible duration. For instance a QuickTime file at 30000/1001 (NTSC) can only hold about 18 hours of timestamps before overflowing whereas 29.97 (not quite NTSC) can manage a far longer duration. v210 could handle any line count, limited by the container storage. v210 does require even width QuickTime because of the chroma subsampling."

FFV1 in Matroska	Active IETF Internet Drafts	Yes

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Describes line count and frame rate
- *Table row:* 33
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	FFV1: horizontal sample, vertical lines, and active frame data are part of the picture structure data element in the Slice Header.
	v210 in OpenDML AVI	?
	v210 in QuickTime	?
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	Standards compliant v210 in MXF	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	SAMMA Profile	[probably via Picture Essence Descriptors and Subdescriptors]
FFV1 in Matroska	Active IETF Internet Drafts	FFV1: horizontal sample, vertical lines, and active frame data are part of the picture structure data element in the Slice Header.

Factor: Support for different bit depths

Subfactor: capability

- *Category:* Functionality factors
- *Capability:* Picture component samples carried at 8 or 10 bits
  - *Comment:* This table for reformatting old tapes, will not require 12 or 16 bits
- *Table row:* 34
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or	FFV1 in OpenDML AVI	Yes
	v210 in OpenDML AVI	n/a [10 bit encoding]

uncompressed v210	v210 in QuickTime	n/a [10 bit encoding]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	Standards compliant v210 in MXF	Yes; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	SAMMA Profile	[assume yes]
FFV1 in Matroska	Active IETF Internet Drafts	Yes

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Describe the bit depth
- *Table row:* 35
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	OpenDML: [?] FFV1: Inferred via pix_fmt value
	v210 in OpenDML AVI	Typically inferred from fourCC code stored in the fccHandler element "v210" which stands for "Uncompressed Y´CbCr, 10-bit-per-component 4:2:2"
	v210 in QuickTime	Typically inferred through the Data Format Field fourCC code value "v210" which stands for "Uncompressed Y´CbCr, 10-bit-per-component 4:2:2"
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	Standards compliant v210 in MXF	Picture Essence Descriptors and Subdescriptors; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Picture Essence Descriptors and Subdescriptors
	SAMMA Profile	[probably via Picture Essence Descriptors and Subdescriptors]
FFV1 in Matroska	Active IETF Internet Drafts	FFV1: Inferred via pix_fmt value If value is carried over to MKV, this overrides data stored in FFV1, if conflict.

Factor: **Support for primary and secondary timecodes**

Subfactor: capability

- *Category:* Functionality factors
- *Capability:* Support for (a) continuous high-integrity master timecode and (b) carriage of additional "legacy" timecodes (may be discontinuous) for future reference or study
- *Table row:* 36
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Partial
	v210 in OpenDML AVI	Partial
	v210 in QuickTime	Yes[11]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes
	SAMMA Profile	[assume no]
FFV1 in Matroska	Active IETF Internet Drafts	Timecode data storage and metadata not fully supported in MKV

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Labeling of timecodes, type and source (if "legacy")
- *Table row:* 37
- *Scoring:* Functionality factors scored together, see row 48.

| Marketplace wrappers with FFV1 or uncompressed v210 | FFV1 in OpenDML AVI | OpenDML AVI: Spec includes Timecode Discontinuity Table (tcdl); not typically implemented.

FFV1 does not address timecode. |
| | v210 in OpenDML AVI | OpenDML AVI: Spec includes Timecode Discontinuity Table (tcdl); not typically implemented. |

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[11] The video expert Dave Rice adds this information: "The tmcd atom stores the initial value only and then runs an edit list to deal with offsets and nonconsecutive values. MOV files can also store a synthetic timecode with a user-specified start value that counts up at a user-specified rate; it seems that this data goes into a timecode track. However, timecode data is not always treated the same by various applications, inhibiting interoperability."

		FFV1 does not address timecode.
	v210 in QuickTime	Yes[12]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Special set of Timecode Descriptors and Subdescriptors
	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Special set of Timecode Descriptors and Subdescriptors
	SAMMA Profile	[n/a]
FFV1 in Matroska	Active IETF Internet Drafts	Timecode data storage and metadata not fully supported in MKV

Factor: **Support for closed captioning and subtitles**

Subfactor: capability
- *Category:* Functionality factors
- *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
- *Table row:* 38
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Subtitles are possible in theory (via a stream chunk) but may not be commonly implemented. (http://www.alexander-noe.com/video/documentation/avi.pdf)
	v210 in OpenDML AVI	Subtitles are possible in theory (via a stream chunk) but may not be commonly implemented. (http://www.alexander-noe.com/video/documentation/avi.pdf)
	v210 in QuickTime	Yes[13]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes, as binary packets and as Timed Text

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[12] QuickTime does support the use of the 'name' atom to reference the source of the timecode; see https://developer.apple.com/library/mac/documentation/QuickTime/QTFF/QTFFChap3/qtff3.html. This was well-integrated into Final Cut 7.   In addition, information can be placed in the user data section with a link to the track id of the relevant timecode track.

[13] Captions and subtitles are carried in separate tracks labeled 'clcp' and 'sbtl' respectively. The QuickTime specification only mentions support for the CEA-608 format (i.e., may not support XML Timed Text).

	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes, as binary packets and as Timed Text
	SAMMA Profile	Carried "in the raster" [and as binary packet-ized data?]
FFV1 in Matroska	Active IETF Internet Drafts	Yes (https://matroska.org/technical/specs/subtitles/index.html)

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Indicates if captions/subtitles are present, which type(s), language tagging
- *Table row:* 39
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Not found in OpenDML AVI or FFV1 specifications.
	v210 in OpenDML AVI	No
	v210 in QuickTime	Partial
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	AS_07_GSP_TD_DMS including primary and secondary languages
	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	AS_07_GSP_TD_DMS including primary and secondary languages
	SAMMA Profile	No
FFV1 in Matroska	Active IETF Internet Drafts	Caption languages are declared via tags

Factor: Support for multipart (multisegment) essences

Subfactor: capability

- *Category:* Functionality factors
- *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.
- *Table row:* 40
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	No
	v210 in OpenDML AVI	No
	v210 in QuickTime	May be possible; not widely adopted[14]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes[15]
	Standards compliant v210 in MXF	Possible; not widely adopted
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes[16]
	SAMMA Profile	[assume no]
FFV1 in Matroska	Active IETF Internet Drafts	Yes, via Chapters

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* Identifies and describes the segments.
- *Table row:* 41
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	n/a
	v210 in OpenDML AVI	n/a
	v210 in QuickTime	Probably not
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes: AS_07_Segmentation_DMS

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[14] The video expert Dave Rice adds this information: "Although not impossible, this would be somewhat unorthodox and at risk of not being understood or properly implemented. The method would employ a sprite track that toggled the enabled flag on a track level and thus switch between tracks."

[15] The MXF standards include Operational Patterns 2a, 2b, and 2c, which would permit the wrapping of segments, with timeline track metadata to identify the segment and manage playout. The OP2 series, however, is rarely or never implemented in production systems and, for this reason, Application Specifications like AS-11 and SMPTE RDD 48 (former AS-07) use the alternate segmentation approach, which employ a special segmentation Descriptive Metadata Scheme.

[16] See footnote 10.

	Standards compliant v210 in MXF	[n/a]
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes: AS_07_Segmentation_DMS
	SAMMA Profile	[n/a]
FFV1 in Matroska	Active IETF Internet Drafts	Chapters are described with appropriate tags

Factor: **Support for multiple audio tracks**

Subfactor: capability

- *Category:* Functionality factors
- *Capability:* Quantity of tracks supported (greater than stereo/two channels, which is assumed in all cases)
- *Table row:* 42
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Supports up to 8 channels of audio by relying on the Microsoft Extensible Wave-Format.
	v210 in OpenDML AVI	Supports up to 8 channels of audio by relying on the Microsoft Extensible Wave-Format.
	v210 in QuickTime	Good support for different audio configurations. Specification doesn't give an upper limit on the number of audio channels.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Unlimited channels; as many tracks as needed to represent the channels.
	Standards compliant v210 in MXF	Unlimited channels; as many tracks as needed to represent the channels; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Unlimited channels; as many tracks as needed to represent the channels.
	SAMMA Profile	unknown to compiler of this table
FFV1 in Matroska	Active IETF Internet Drafts	MKV: Unlimited channels; as many tracks as needed to represent the channels.

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* describe audio track layout; label tracks as to type, role, language, etc.
- *Table row:* 43
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Probably no
	v210 in OpenDML AVI	Probably no
	v210 in QuickTime	Yes[17]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes. Track layout: AS_07_Core_DMS_AudioTrackLayout Language (primary & secondary): AS_07_Core_DMS_AudioTrackPrimaryLanguage and AS_07_Core_DMS_AudioTrackSecondaryLanguage
	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes. Track layout: AS_07_Core_DMS_AudioTrackLayout Language (primary & secondary): AS_07_Core_DMS_AudioTrackPrimaryLanguage and AS_07_Core_DMS_AudioTrackSecondaryLanguage
	SAMMA Profile	unknown to the compiler of this table
FFV1 in Matroska	Active IETF Internet Drafts	MKV: Channels and Channel Positions elements. Languages are described via tags.

Factor: **Support for carriage of associated components**

Subfactor: capability
- *Category:* Functionality factors
- *Capability:* carry associated objects or information such as images of tape boxes or documents and supplementary metadata. (See also embedded descriptive, administrative, and provenance metadata in self-description section above.)
- *Table row:* 44
- *Scoring:* Functionality factors scored together, see row 48.

| Marketplace wrappers with FFV1 or | FFV1 in OpenDML AVI | No |
| | v210 in OpenDML AVI | No |

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[17] The Handler Description will include the track type, called Component subtype. The wrapper will carry channel arrangement metadata that maps channels to places like "Left" or "Rear Surround Left" or "Discrete-2". In addition, language data in association with any track may be provided in the 'mdhd' atom.

uncompressed v210	v210 in QuickTime	Yes[18]
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes. Uses Generic Stream Partitions, SMPTE ST 410
	Standards compliant v210 in MXF	Possible; not widely implemented
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes. Uses Generic Stream Partitions, SMPTE ST 410
	SAMMA Profile	No
FFV1 in Matroska	Active IETF Internet Drafts	MKV: Data can be included as attachments.

Subfactor: metadata

- *Category:* Functionality factors
- *Metadata:* describe the objects or information carried
- *Table row:* 45
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	n/a
	v210 in OpenDML AVI	n/a
	v210 in QuickTime	Yes; the user data can link back to such objects for description.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes. AS_07_GSP_DMS.
	Standards compliant v210 in MXF	[n/a]
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Yes. AS_07_GSP_DMS.
	SAMMA Profile	n/a
FFV1 in Matroska	Active IETF Internet Drafts	MKV: data can be described via tags.

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[18] QuickTime has a 'meta' atom and the user data atom and methods to store XML such as XMP. It also has methods to store supplemental images, most widely used to add movie thumbnails or posters, but could be used for pictures of tape boxes too.

Factor: **Support for fixity data**

Subfactor: capability
- *Category:* Functionality factors
- *Capability:* carry fixity data (e.g., checksums) that pertains to data units with the file, typically frames of picture
- *Table row:* 46
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	[may be supported via FFV1 and ffmpeg tool ??]
	v210 in OpenDML AVI	No
	v210 in QuickTime	No
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Uses elements from BBC WP 241 and SMPTE ST 429-6.
	Standards compliant v210 in MXF	[Yes]
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Uses elements from BBC WP 241 and SMPTE ST 429-6.
	SAMMA Profile	No
FFV1 in Matroska	Active IETF Internet Drafts	CRC-32 element is defined in the EBML specification.

Subfactor: metadata
- *Category:* Functionality factors
- *Metadata:* indicates if fixity data is present, which type(s), etc.
- *Table row:* 47
- *Scoring:* Functionality factors scored together, see row 48.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	[if present, would have to be declared ??]
	v210 in OpenDML AVI	n/a
	v210 in QuickTime	n/a
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	In array in GC SysItem

	Standards compliant v210 in MXF	MXF options exist; detailed study of implementation in BBC White Paper 241 not performed for this survey.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	In array in GC SysItem
	SAMMA Profile	n/a
FFV1 in Matroska	Active IETF Internet Drafts	Declared in the CRC-32 element

Factor: **Summary evaluation: functionality factors**

- *Explanatory comment:* Factor carries high weight
- *Table row:* 48
- *Scoring:* Good, Acceptable, Poor

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Acceptable-minus
	v210 in OpenDML AVI	Poor
	v210 in QuickTime	Acceptable-minus
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Good
	Standards compliant v210 in MXF	Good
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Good
	SAMMA Profile	Acceptable
FFV1 in Matroska	Active IETF Internet Drafts	Good

ATTRIBUTE: Production and QC Factors

Factor: **Efficiency of production**

- *Category:* Production and QC Factors
- *Explanatory comment:* Practical assessment of how feasible and easy it is to implement production systems
- *Table row:* 50
- *Scoring:* Production and QC factors scored together, see row 54.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Many production tools exist; no real difficulty for basic implementations; not all wrapper specification features may be supported
	v210 in OpenDML AVI	Many production tools exist; no real difficulty for basic implementations; not all wrapper specification features may be supported
	v210 in QuickTime	Many production tools exist; no real difficulty for basic implementations; not all wrapper specification features may be supported
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Commercial systems likely to support efficient parallel-stream production.
	Standards compliant v210 in MXF	Various tools exist for generic MXF/v210; commercial systems support efficient parallel-stream production. BBC Archive Format implementations typically employ the BBC open-source INGEX tools; extent of adoption unk to compiler.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Commercial systems likely to support efficient parallel-stream production. Peter Bubestinger study indicates that when using open source software encoding, JPEG 2000 encoding/decoding is significantly slower than, say, FFV1. *Reference in link in footnote*[19]
	SAMMA Profile	JPEG 2000 encoding relatively fast with the parallel-stream SAMMA and other commercial systems. Peter Bubestinger study indicates that when using open source software encoding, JPEG 2000 encoding/decoding is significantly slower than, say, FFV1. *Reference in link in footnote*[18]
FFV1 in Matroska	Active IETF Internet Drafts	Production tools exist, both open source and commercial. Peter Bubestinger study indicates that when using open source software encoding, FFV1 encoding/decoding is significantly faster than JPEG 2000. *Reference in link in footnote*[19]

Factor: **Availability and relative cost of production systems (rough and ready)**
- *Category:* Production and QC Factors
- *Explanatory comment:* [rough and ready]
- *Table row:* 51
- *Scoring:* Production and QC factors scored together, see row 54.

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[19] http://download.das-werkstatt.com/pb/mthk/info/video/comparison_video_codecs_containers.html

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Many modest-cost systems exist, as well as more costly commercial systems.
	v210 in OpenDML AVI	Many modest-cost systems exist, as well as more costly commercial systems.
	v210 in QuickTime	Many modest-cost systems exist, as well as more costly commercial systems.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Commercial production systems coming on the market in 2018. Level of support in open source tools cannot be predicted at this writing.
	Standards compliant v210 in MXF	Commercial systems represent moderate-to-high costs; open-source applications exist but implementation depends upon well-chosen hardware, operating systems, middleware, and capable installation staff for low-to-moderate total cost.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Commercial production systems coming on the market in 2018. Level of support in open source tools cannot be predicted at this writing.
	SAMMA Profile	Some non-SAMMA commercial systems continue in the marketplace.
FFV1 in Matroska	Active IETF Internet Drafts	Strong adoption of open source community-created tools, some commercial systems exist.

Factor: **Ease of use of production systems**
- *Category:* Production and QC Factors
- *Explanatory comment:* [rough and ready]
- *Table row:* 52
- *Scoring:* Production and QC factors scored together, see row 54.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Should be relatively easy; setup for some OpenDML special features will require skill.
	v210 in OpenDML AVI	Should be relatively easy; setup for some OpenDML special features will require skill.
	v210 in QuickTime	Should be relatively easy; setup for some OpenDML special features will require skill.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Commercial products hoped to be user friendly but complexity of formatting means that setup will require skill.
	Standards compliant v210 in MXF	Commercial products are user friendly but complexity of formatting means that operations benefit from skilled staff.

Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Commercial products hoped to be user friendly but complexity of formatting means that setup will require skill.
	SAMMA Profile	Reasonably user friendly commercial product but complexity of formatting and operation means that setup requires skill.
FFV1 in Matroska	Active IETF Internet Drafts	Open source tools may require setup skills; commercial products offer user and operator support.

Factor: **Availability of quality control tools**

- *Category:* Production and QC Factors
- *Explanatory comment:* QC tools may be part of production systems, or in independent applications. NOTE: This topic is treated in IASA-TC 06 section D.1.4.3.
- *Table row:* 53
- *Scoring:* Production and QC factors scored together, see row 54.

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Tools exist, especially to check finished files.
	v210 in OpenDML AVI	Tools exist, especially to check finished files.
	v210 in QuickTime	Tools exist, especially to check finished files.
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Tools exist to check finished MXF files; some commercial MXF-capable production systems, as well as independent applications, include tools to QC during and after production.
	Standards compliant v210 in MXF	Tools exist to check finished MXF files; some commercial MXF-capable production systems, as well as independent applications, include tools to QC during and after production.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Tools exist to check finished MXF files; some commercial MXF-capable production systems, as well as independent applications, include tools to QC during and after production.
	SAMMA Profile	Tools exist to check finished MXF files; some commercial MXF-capable production systems, as well as independent applications, include tools to QC during and after production.
FFV1 in Matroska	Active IETF Internet Drafts	Tools exist, especially to check finished files.

Factor: **Summary Evaluation: Production and QC Factors**

- *Explanatory comment:* Factor carries moderate weight
- *Table row:* 54
- *Scoring:* Relatively easier, relatively more difficult

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Relatively easier: well-established format means easier and cheaper implementation
	v210 in OpenDML AVI	Relatively easier: well-established format means easier and cheaper implementation
	v210 in QuickTime	Relatively easier: well-established format means easier and cheaper implementation
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Relatively more difficult; issues are of types familiar to professionals.
	Standards compliant v210 in MXF	Relatively more difficult; issues are of types familiar to professionals.
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Relatively more difficult; issues are of types familiar to professionals.
	SAMMA Profile	Relatively more difficult; issues are of types familiar to professionals.
FFV1 in Matroska	Active IETF Internet Drafts	Relatively more difficult; support via strong adoption in open source community.

ATTRIBUTE: Data-management Factors

Factor: **Storage and network cost**
- *Category:* Data-management Factors
- *Explanatory comment:* Rough and ready place to indicate higher costs associated with uncompressed files
- *Table row:* 56
- *Scoring:* Production and QC factors scored together, see row 57

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Approximately 50 percent smaller files than uncompressed
	v210 in OpenDML AVI	Very large files
	v210 in QuickTime	Very large files
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Very large files
	Standards compliant v210 in MXF	Very large files

Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Approximately 50 percent smaller files than uncompressed
	SAMMA Profile	Approximately 50 percent smaller files than uncompressed
FFV1 in Matroska	Active IETF Internet Drafts	Approximately 50 percent smaller files than uncompressed

Factor: **Summary evaluation: data-management factors**

- *Explanatory comment:* Factor carries low weight
- *Table row:* 57
- *Scoring:* Good, Acceptable, Poor

Marketplace wrappers with FFV1 or uncompressed v210	FFV1 in OpenDML AVI	Good
	v210 in OpenDML AVI	Acceptable
	v210 in QuickTime	Acceptable
Uncompressed v210 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Acceptable
	Standards compliant v210 in MXF	Acceptable
Lossless JPEG 2000 in MXF	SMPTE RDD 48 (former AS-07) Baseband Shim	Good
	SAMMA Profile	Good
FFV1 in Matroska	Active IETF Internet Drafts	Good