SMPTE ST 2094-2:2023
Revision of SMPTE ST 2094-2:2017

SMPTE STANDARD

Dynamic Metadata for Color Volume Transform — KLV Encoding and MXF Mapping

Table of Contents

Approved April 5, 2023

Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in its Standards Operations Manual.

SMPTE ST 2094-2 was prepared by Technology Committee 31FS.

The 2023 revision is updated to comply with updates to normative references. Examples were updated accordingly, and the **Application 4** example is updated to illustrate **ApplicationVersion 1**.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Engineering Document. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This clause is entirely informative and does not form an integral part of this Engineering Document.

The SMPTE ST 2094 suite of documents defines metadata for use in color volume transforms of content. This document specifies:

- The encoding of SMPTE ST 2094 metadata sets using Key-Length-Value (KLV) structures,
- The MXF essence container for using this essence with MXF files.

Metadata items are encoded in data types corresponding to those used in referenced SMPTE ST 2094 documents, with some exceptions. Value ranges, array bounds, and allowed item combinations are specified in the referenced SMPTE ST 2094 documents and are not duplicated in this document.

Clause 6 specifies the encoding of SMPTE ST 2094 metadata sets using the Key-Length-Value data encoding protocol (KLV), defined in SMPTE ST 336.

Clause 7 defines the coding of the metadata essence element, the essence container label, and the essence descriptor, for MXF Essence Containers containing DMCVT Application Sets.

1 Scope

The SMPTE ST 2094 suite of documents defines metadata for use in color volume transforms of content.

SMPTE ST 2094-2 specifies Key-Length-Value (KLV) representations of metadata sets defined in SMPTE ST 2094-10, SMPTE ST 2094-20, SMPTE ST 2094-30, and SMPTE ST 2094-40.

SMPTE ST 2094-2 specifies frame-based mapping of KLV-encoded SMPTE ST 2094 metadata sets into the MXF Generic Container. SMPTE ST 2094-2 specifies the key and value fields of the essence elements, the essence container label and the essence descriptor.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any clause explicitly labeled as "Informative" or individual paragraphs that start with "Note:”

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; tables shall be next; then formal languages; then figures; and then any other language forms.

3 Normative References

The following standards contain provisions, which, through reference in this text, constitute provisions of this engineering document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this engineering document are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE ST 298:2009, Universal Labels for Unique Identification of Digital Data

SMPTE ST 335:2012, Metadata Elements Dictionary

SMPTE ST 336:2017, Data Encoding Protocol Using Key-Length-Value

SMPTE ST 377-1:2019, Material Exchange Format (MXF) — File Format Specification

SMPTE ST 379-2:2010, Material Exchange Format (MXF) — MXF Constrained Generic Container

SMPTE ST 395:2014, Metadata Groups Register

SMPTE ST 400:2012, SMPTE Labels Structure

SMPTE ST 2094-1:2016, Dynamic Metadata for Color Volume Transform — Core Components

SMPTE ST 2094-10:2021, Dynamic Metadata for Color Volume Transform — Application 1

SMPTE ST 2094-20:2016, Dynamic Metadata for Color Volume Transform — Application 2

SMPTE ST 2094-30:2016, Dynamic Metadata for Color Volume Transform — Application 3

SMPTE ST 2094-40:2020, Dynamic Metadata for Color Volume Transform — Application 4

4 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

4.1
DMCVT

SMPTE ST 2094 (Dynamic Metadata for Color Volume Transform)

4.2
SMPTE ST 2094 Application document

SMPTE ST 2094 document defining a SMPTE ST 2094 application, such as one of SMPTE ST 2094-10, SMPTE ST 2094-20, SMPTE ST 2094-30, SMPTE ST 2094-40

4.3
SMPTE Metadata Elements Dictionary

SMPTE Metadata Elements Dictionary as defined by SMPTE ST 335

4.4
SMPTE Labels Register

SMPTE Labels Register as defined by SMPTE ST 400

4.5
SMPTE Groups Register

SMPTE Groups Register as defined by SMPTE ST 395

4.6
SMPTE Universal Labels (ULs)

SMPTE Universal Labels as defined by SMPTE ST 298

5 Notations (Informative)

Table columns have the meanings as defined in Table 1. All columns are not present in all tables.

Table 1 — Definition of Table Headings

Table Header	Definition
Item Name	Name of this set or metadata item as indicated in the defining document
Type	Data type of the entry
Len	Length of the value field for this entry, in bytes, according to the data type, where n, if present, represents number of elements in an array
Local Tag	Hexadecimal value of the local tag that identifies this entry
Req	Req indicates that the item is always present. This indicator maps to the isOptional entry in the SMPTE Groups Register, where isOptional corresponds to table entry != "Req". Opt indicates that the item can be present or omitted. Opt* indicates that this item is present or omitted depending on the presence or value of other items. This is detailed in Clause 6.
Den	The denominator value of the Rational data type
Definition	Description of this entry
Symbol	The registry symbol that is associated with this item
Kind	The kind of the registry entry
Item UL	The SMPTE Universal Label associated with this item

6 Encoding of SMPTE ST 2094 Metadata Sets

6.1 KLV-Encoded DMCVT Application Sets

When a metadata set defined by a SMPTE ST 2094 Application document is KLV-encoded, it is KLV-encoded using an DMCVT Application Set, which is specific to the SMPTE ST 2094 Application. The DMCVT Application Sets for SMPTE ST 2094-10, SMPTE ST 2094-20, SMPTE ST 2094-30, and SMPTE ST 2094-40 shall be as defined in Clauses 6.3 through 6.6, respectively.

Each DMCVT Application Set shall encode exactly one metadata set as defined in the corresponding SMPTE ST 2094 Application document.

Each DMCVT Application Set shall be a local set, as defined in SMPTE ST 336. The set key indicates the Application Identifier and Application Version. The set length field shall be 4 bytes long. The local tag and local length fields, as defined in SMPTE ST 336, shall be 2 bytes long.

The local tag values shall map to SMPTE Universal Labels (ULs) and Symbols as specified in Table A.2 in Annex A.

NOTE Local tags in local sets outside MXF Header Metadata cannot be dynamically allocated.

Each DMCVT Application Set shall be a subclass of the DMCVT Generic Set 1, which is defined in Clause 6.2.

For each item defined in the DMCVT Application Set, the item's name, presence, value, and default value, if any, shall be as specified in the SMPTE ST 2094 Application document, unless otherwise specified for the DMCVT Application Set. The metadata group headings specified in the SMPTE ST 2094 Application document are not encoded.

Items can be in any order within the DMCVT Application Set, unless otherwise specified. Multi-byte values shall be coded as big-endian (most significant byte first), which is defined in SMPTE ST 377-1. Multi-dimensional items are represented as one-dimensional. The values of coordinates and sampled functions, defined in SMTE ST 2094-1, shall be ordered u', v', or x, y, or x_1, y_1, x_2, y_2… The values of matrices and two-input sampled functions, defined in SMTE ST 2094-1, shall be ordered z_{11}, z_{12} … z_{MN}, where the number of columns (N) is the number of elements (n) in the item, divided by the number of rows (M).

Decimal numbers with fractions are encoded using the Rational data type, unless otherwise stated. The denominator is specified in column Den, and corresponds to the increment value used in the SMPTE ST 2094 Application document. When comparing with representations using other increment values, the values should be rounded to the larger increment value before comparing.

EXAMPLE
Average MaxRGB is specified as a multiple of 0.00001, so that 0.004 is encoded as 400 / 100 000.

Sets and items are listed in the SMPTE Groups Register and the SMPTE Metadata Elements Dictionary using the names, symbols, types, kinds, ULs, and definitions found in this document.

Annex B provides examples of DMCVT Application Sets.

6.2 DMCVT Generic Set 1

The DMCVT Generic Set 1 shall be an abstract class as defined in SMPTE ST 377-1.

The metadata items defined in SMPTE ST 2094-1 shall be encoded as defined in Table 3.

The Application Version item defined in SMPTE ST 2094-1 shall be named Application Version Number in the DMCVT Generic Set 1. (An Application Version item already exists in the SMPTE Metadata Elements Dictionary.)

The Backwards Version item is not defined in any SMPTE ST 2094 Application document, may be present, and shall indicate the lowest Application Version for which this metadata set is valid. The value shall be in the range 0 to the value of the Application Version Number. The default value is the value of the Application Version Number.

For other items defined in the DMCVT Generic Set 1,

- The item shall be present, omitted, or optional, as specified in the SMPTE ST 2094 Application document that corresponds to the DMCVT Application Set using the DMCVT Generic Set 1, and
- The item's name, value and default value, if any, shall be as specified in SMPTE ST 2094-1, unless otherwise specified in the SMPTE ST 2094 Application document.

The group nodes and the set key shall have the ULs defined in Table 2. These are listed in the SMPTE Groups Register.

Table 2 — Group Node and Set Key for DMCVT Sets

Item Name	Symbol	Kind	Item UL
Color Transform Sets	ColorTransformSets	NODE	06.0E.2B.34.02.7F.01.01.05.31.00.00.00.00.00.00
DMCVT Generic Sets	DMCVTGenericSets	NODE	06.0E.2B.34.02.7F.01.01.05.31.01.00.00.00.00.00
DMCVT Generic Set 1	DMCVTGenericSet1	LEAF	06.0E.2B.34.02.7F.01.01.05.31.01.01.00.00.00.00
DMCVT Application Sets	DMCVTApplicationSets	NODE	06.0E.2B.34.02.7F.01.01.05.31.02.00.00.00.00.00

Table 3 — DMCVT Generic Set 1

Item Name	Type	Len	Local Tag	Req	Den	Definition
DMCVT Generic Set 1	Set key	16		Req		Identifies a DMCVT Generic Set 1
Length	BER length	4		Req		Set length (up to 180 bytes)
Application Identifier	UInt8	1	36.01	Req		Identifying an application and its defining document in the SMPTE ST 2094 suite
Application Version Number	UInt8	1	36.02	Req		The Application Version of the identified SMPTE ST 2094 application
Backwards Version	UInt8	1	36.03	Opt		The lowest Application Version for which this metadata set is valid
Time Interval Start	UInt32	4	36.04	Opt*		Start point of the portion of image essence for which the metadata set is specified, as an index
Time Interval Duration	UInt32	4	36.05	Opt*		Duration of the portion of image essence for which the metadata set is specified, as a count of index positions
Upper Left Corner	UInt16Array	8+ 2*2	36.06	Opt*		Coordinate of the top-left pixel of the Processing Window
Lower Right Corner	UInt16Array	8+ 2*2	36.07	Opt*		Coordinate of the bottom-right pixel of the Processing Window
Window Number	UInt8	1	36.08	Opt*		Identifier of the Processing Window
Targeted System Display Primaries	RationalArray	8+ 8*6	36.09	Opt*	10 000	xy chromaticity coordinates of the three primaries of the targeted system display
Targeted System Display White Point Chromaticity	RationalArray	8+ 8*2	36.0A	Opt*	10 000	xy chromaticity coordinate of the targeted system display’s white point
Targeted System Display Maximum Luminance	Rational	8	36.0B	Opt*	100	Maximum luminance of the targeted system's display
Targeted System Display Minimum Luminance	Rational	8	36.0C	Opt*	10 000	Minimum luminance of the targeted system's display

6.3 DMCVT Application 1 Set

The metadata set defined in SMPTE ST 2094-10 shall be encoded as defined in Table 5.

The set key shall be the UL defined in Table 4.

Table 4 — Set Key for DMCVT Application 1 Set

Item Name	Symbol	Kind	Item UL
DMCVT App1 Set	DMCVTApp1Set	LEAF	06.0E.2B.34.02.53.01.01.05.31.02.01.00.00.00.00

Table 5 — DMCVT Application 1 Set

Item Name	Type	Len	Local Tag	Req	Den	Definition
DMCVT App1 Set	Set key	16		Req		Identifies a DMCVT Application 1 Set
Length	BER length	4		Req		Set length (up to 324 bytes)
All items in DMCVT Generic Set 1 except Set key and Length						DMCVT Generic Set 1
Minimum PQ-encoded maxRGB	Rational	8	36.0D	Req	100 000	The lowest PQ-encoded maxRGB value of the reduced pixel set or the lowest PQ-encoded minRGB value of the reduced pixel set
Average PQ-encoded maxRGB	Rational	8	36.0E	Req	100 000	The average of the PQ-encoded maxRGB values of the reduced pixel set
Maximum PQ-encoded maxRGB	Rational	8	36.0F	Req	100 000	The highest PQ-encoded maxRGB value of the reduced pixel set
Minimum PQ-encoded maxRGB Offset	Rational	8	36.10	Opt	100 000	Offset to be added to Minimum PQ-encoded maxRGB
Average PQ-encoded maxRGB Offset	Rational	8	36.11	Opt	100 000	Offset to be added to Average PQ-encoded maxRGB
Maximum PQ-encoded maxRGB Offset	Rational	8	36.12	Opt	100 000	Offset to be added to Maximum PQ-encoded maxRGB
Tone Mapping Offset	Rational	8	36.13	Opt	100 000	Tone Mapping Offset
Tone Mapping Gain	Rational	8	36.14	Opt	10 000	Tone Mapping Gain
Tone Mapping Gamma	Rational	8	36.15	Opt	1 000	Tone Mapping Gamma
Chroma Compensation Weight	Rational	8	36.16	Opt	10 000	Amount of chroma adjustment
Saturation Gain	Rational	8	36.17	Opt	10 000	Amount of saturation adjustment
Tone Detail Factor	Rational	8	36.18	Opt	1 000	Contribution of the detail management function

6.4 DMCVT Application 2 Set

The metadata set defined in SMPTE ST 2094-20 shall be encoded as defined in Table 7.

The numerator of the Shadow Gain Control, Highlight Gain Control, and Mid-Tone Width Adjustment Factor items shall be a multiple of 2.

The set key shall be the UL defined in Table 6.

Table 6 — Set Key for DMCVT Application 2 Set

Item Name	Symbol	Kind	Item UL
DMCVT App2 Set	DMCVTApp2Set	LEAF	06.0E.2B.34.02.53.01.01.05.31.02.02.00.00.00.00

Table 7 — DMCVT Application 2 Set

Item Name	Type	Len	Local Tag	Req	Den	Definition
DMCVT App2 Set	Set key	16		Req		Identifies a DMCVT Application 2 Set
Length	BER length	4		Req		Set length (up to 638 bytes)
All items in DMCVT Generic Set 1 except Set key and Length						DMCVT Generic Set 1
Luminance Lower Bound	UInt16	2	36.19	Opt*		Encoding of a lower bound of luminance
Luminance Upper Bound	UInt16	2	36.1A	Opt*		Encoding of an upper bound of luminance
Luminance Range Selector	Boolean	1	36.1B	Opt*		True indicates inner luminance range
Chromaticity Disk Center	RationalArray	8+ 8*2	36.1C	Opt*	1 632	Center of the Chromaticity Disk
Chromaticity Disk Radius	Rational	8	36.1D	Opt*	1 632	Radius of the Chromaticity Disk
Chromaticity Area Selector	Boolean	1	36.1E	Opt*		True indicates the area of the Chromaticity Disk
Saturation Gain Function	RationalArray	8+ 8*n	36.1F	Req	255	Sampled function, mapping a luminance based input value to a saturation scaling factor
Tone Mapping Input Signal Weights	RationalArray	8+ 8*4	36.20	Req	255	Weights of R, G, B, and Y components
Tone Mapping Input Signal Black Level Offset	Rational	8	36.21	Req	255	Used to calculate the gain of the signal as a first step in the Tone Mapping process
Tone Mapping Input Signal White Level Offset	Rational	8	36.22	Req	255	Used to calculate the gain of the signal as a second step in the Tone Mapping process
Shadow Gain Control	Rational	8	36.23	Req	255	Control for the steepness of the curve in its shadow (darker) region
Highlight Gain Control	Rational	8	36.24	Req	255	Control for the steepness of the curve in its highlight (brighter) region
Mid-Tone Width Adjustment Factor	Rational	8	36.25	Req	255	Control for the width of the mid-tone region of the curve
Tone Mapping Output Fine Tuning Function	RationalArray	8+ 8*n	36.26	Req	255	Sampled function, for tone mapping

6.5 DMCVT Application 3 Set

The metadata set defined in SMPTE ST 2094-30 shall be encoded as defined in Table 9.

The Pre-Matrix Tone Mapping and Post-Matrix Tone Mapping items shall each be encoded as one item per component, and the code values shall be 16 383 times the actual value, i.e., in units of 1/16 383.

The set key shall be the UL defined in Table 8.

Table 8 — Set Key for DMCVT Application 3 Set

Item Name	Symbol	Kind	Item UL
DMCVT App3 Set	DMCVTApp3Set	LEAF	06.0E.2B.34.02.53.01.01.05.31.02.03.00.00.00.00

Table 9 — DMCVT Application 3 Set

Item Name	Type	Len	Local Tag	Req	Den	Definition
DMCVT App3 Set	Set key	16		Req		Identifies a DMCVT Application 3 Set
Length	BER length	4		Req		Set length (up to 1 084 bytes)
All items in DMCVT Generic Set 1 except Set key and Length						DMCVT Generic Set 1
Targeted System Display Signal Format	UInt8	1	36.27	Opt		Enumerator of the signal format of the targeted system display
Metadata Color Coding Workspace	UInt8	1	36.28	Opt		Enumerator of the color components and quantization range
Pre-Matrix Tone Mapping 1	UInt16Array	8+ 2*n	36.29	Opt		Sampled function for first input color component, in units of 1/16 383
Pre-Matrix Tone Mapping 2	UInt16Array	8+ 2*n	36.2A	Opt		Sampled function for second input color component, in units of 1/16 383
Pre-Matrix Tone Mapping 3	UInt16Array	8+ 2*n	36.2B	Opt		Sampled function for third input color component, in units of 1/16 383
Color Remapping Matrix	RationalArray	8+ 8*9	36.2C	Opt	4 096	A 3x3 matrix between tone mapping stages
Post-Matrix Tone Mapping 1	UInt16Array	8+ 2*n	36.2D	Opt		Sampled function for first post-matrix color component, in units of 1/16 383
Post-Matrix Tone Mapping 2	UInt16Array	8+ 2*n	36.2E	Opt		Sampled function for second post-matrix color component, in units of 1/16 383
Post-Matrix Tone Mapping 3	UInt16Array	8+ 2*n	36.2F	Opt		Sampled function for third post-matrix color component, in units of 1/16 383

6.6 DMCVT Application 4 Set

The metadata set defined in SMPTE ST 2094-40 shall be encoded as defined in Table 11.

The code values in the Targeted System Display Actual Peak Luminance and Mastering Display Actual Peak Luminance items shall be 15 times the actual values, i.e., in units of 1/15.

Rows In Targeted System Display Actual Peak Luminance shall be present if and only if Targeted System Display Actual Peak Luminance is present.

Rows In Mastering Display Actual Peak Luminance shall be present if and only if Mastering Display Actual Peak Luminance is present.

Distribution MaxRGB shall be encoded as two items: the first vector and the second vector.

The set key shall be the UL defined in Table 10.

Table 10 — Set Key for DMCVT Application 4 Set

Item Name	Symbol	Kind	Item UL
DMCVT App4 Set	DMCVTApp4Set	LEAF	06.0E.2B.34.02.53.01.01.05.31.02.04.00.00.00.00

Table 11 — DMCVT Application 4 Set

Item Name	Type	Len	Local Tag	Req	Den	Definition
DMCVT App4 Set	Set key	16		Req		Identifies a DMCVT Application 4 Set
Length	BER length	4		Req		Set length (up to 1 700 bytes)
All items in DMCVT Generic Set 1 except Set key and Length						DMCVT Generic Set 1
Center Of Ellipse	UInt16Array	8+ 2*2	36.30	Opt*		Center position of the ellipses
Rotation Angle	UInt8	1	36.31	Opt*		Clockwise rotation angle with respect to the positive direction of the x-axis of the ellipses
Semi-Major Axis Internal Ellipse	UInt16	2	36.32	Opt*		Semi-major axis value of the internal ellipse
Semi-Major Axis External Ellipse	UInt16	2	36.33	Opt*		Semi-major axis value of the external ellipse
Semi-Minor Axis External Ellipse	UInt16	2	36.34	Opt*		Semi-minor axis value of the external ellipse
Overlap Process Option	UInt8	1	36.35	Opt*		Enumerator that indicates one of the two methods of combining rendered pixels
Targeted System Display Actual Peak Luminance	UInt8Array	8+ n	36.36	Opt		Two-input sampled function representing the normalized actual peak luminance of the targeted system display, in units of 1 / 15. The four most significant bits in each UInt8 are zero.
Rows In Targeted System Display Actual Peak Luminance	UInt8	1	36.37	Opt*		Number of rows (M) in the Targeted System Display Actual Peak Luminance array

Item Name	Type	Len	Local Tag	Req	Den	Definition
Mastering Display Actual Peak Luminance	UInt8Array	8+ n	36.38	Opt		Two-input sampled function representing the normalized actual peak luminance of the mastering display, in units of 1 / 15. The four most significant bits in each UInt8 are zero.
Rows In Mastering Display Actual Peak Luminance	UInt8	1	36.39	Opt*		Number of rows (M) in the Mastering Display Actual Peak Luminance array
Maximum Scene Color Component Levels	RationalArray	8+ 8*3	36.3A	Req	100 000	Maximum of each component of linearized RGB values
Average MaxRGB	Rational	8	36.3B	Req	100 000	Average of linearized maxRGB values
Distribution MaxRGB Percentages	UInt8Array	8+n	36.3C	Req		First vector of DistributionMaxRGB with Integer percentage values
Distribution MaxRGB Percentiles	RationalArray	8+ 8*n	36.3D	Req	100 000	Second vector of DistributionMaxRGB with Linearized maxRGB value at given percentile
Fraction Bright Pixels	Rational	8	36.3E	Req	1 000	Fraction of pixels that contains the brightest pixel
Knee Point	RationalArray	8+ 8*2	36.3F	Opt*	4 095	Separation point (K_S, K_F) between the linear part and the curved part of the tone mapping function, ordered K_S, K_F
Bezier Curve Anchors	RationalArray	8+ 8*n	36.40	Opt*	1 023	Intermediate anchor parameters, ordered P_1 to P_{N-1}
Color Saturation Weight	Rational	8	36.41	Opt	8	Adjusts the color saturation gain

7 Mapping Metadata Sets to MXF Essence Container

7.1 Using The MXF Constrained Generic Container

This specification is compliant with both SMPTE ST 379-1 and SMPTE ST 379-2, and uses only provisions that are common to both. An essence container compliant with this specification can be used with applications that require compliance with SMPTE ST 379-1 and applications that require compliance with SMPTE ST 379-2.

The essence shall comprise DMCVT Application Sets only. These sets shall be for only one ST 2094 Application, and shall have the same set key, same application number, and same application version. DMCVT Application Sets for one or more Processing Windows and one or more Targeted System Displays, as defined in SMPTE ST 2094-1, may be present in the essence.

The essence shall be mapped to the MXF Constrained Generic Container as defined in SMPTE ST 379-2. The wrapping shall be frame-based only, as defined in SMPTE ST 379-2.

This specification applies to the case where this essence is associated with Picture Essence, and there exists a correspondence between each essence element and an Edit Unit of the associated Picture Essence, and the Edit Rate of this essence is the same as the Edit Rate of the associated Picture Essence. The content of an essence element shall be associated with one Edit Unit of the associated Picture Essence. The full content of the essence element shall apply equally to all fields, frames, and elements of the associated Picture Edit Unit.

NOTE 1 In the case where an associated Picture Edit Unit contains multiple Elements per Content Package, such as that used in mode I1 specified by SMPTE ST 422, the DMCVT Edit Unit contains a single DMCVT Element that applies to all Elements of the Picture Edit Unit (ST 379-2 forbids multiple Elements associated with the same Track in a single Content Package).

This specification does not specify a mechanism for linking this essence to a specific Picture track. The specification of such a mechanism is left to applications of this specification and might be needed if, for instance, multiple Picture Tracks are present in a single MXF file.

NOTE 2 SMPTE ST 2067-3 provides a mechanism for associating tracks with each other.

7.2 Metadata Essence Element Coding

7.2.1 Metadata Essence Element Key

The Metadata Essence Element key shall indicate DMCVT essence and its wrapping, and shall be the UL defined in Table 12. Values for bytes 14 and 16 (denoted cc and nn respectively) shall be as defined in SMPTE ST 379-2.

Table 12 — Item Name, Kind, and Item UL for Essence Elements

Item Name	Kind	Item UL
Frame-wrapped DMCVT Element	LEAF	06.0E.2B.34.01.02.01.01.0D.01.03.01.17.cc.0E.nn

7.2.2 Metadata Essence Element Length

The Metadata Essence Element length field shall be 4 bytes long.

7.2.3 Frame-wrapped Metadata Essence Element Value

When the essence container is frame-wrapped, SMPTE ST 379-2 specifies that the value field of the KLV-encoded essence element contains the metadata essence for the corresponding edit unit.

The value field shall comprise zero or more DMCVT Application Sets, as defined in Clause 6. The value field shall contain all DMCVT Application Sets applicable to the corresponding edit unit, and no other sets or data.

The number of DMCVT Application Sets in a value field shall not exceed 16 times the number of DMCVT Target SubDescriptors in the MXF Header Metadata.

NOTE ST 2094-1 permits up to 16 windows per targeted display.

When there are no DMCVT Application Sets for an edit unit, the value field shall have the length zero.

EXAMPLE
DMCVT Application Sets can be duplicated over multiple elements. The three DMCVT Application Sets in Table 13 with TimeIntervalDuration greater than 1 are mapped to a sequence of essence elements as shown in Figure 1, and the resulting essence elements contain 0, 1, or 2 DMCVT Application Sets. The original Time Interval values can be retained.

Table 13 — Example Metadata sets with Time Intervals

Example set	TimeIntervalStart	TimeIntervalDuration
DMCVT Application Set A	0	2
DMCVT Application Set B	0	3
DMCVT Application Set C	5	2

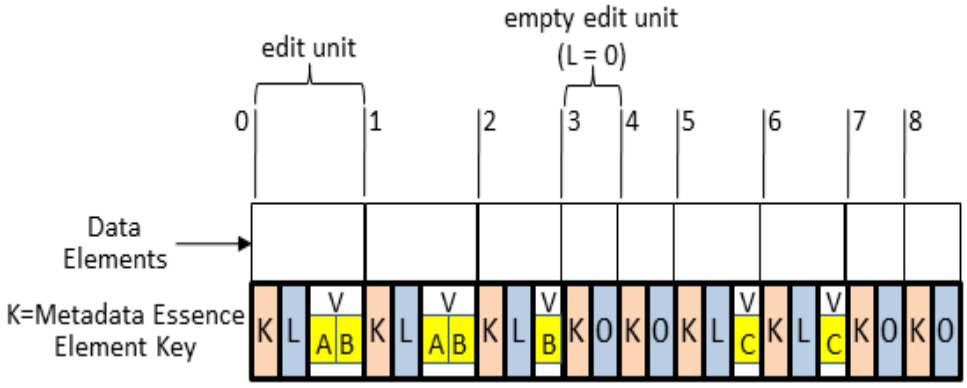

Figure 1 — Example essence elements populated with example metadata sets

7.3 SMPTE Essence Container Label

The Essence Container Label is carried in the Essence Containers Properties of the Partition Packs, Preface Set and File Descriptor in an MXF file and identifies the contents of essence container.

The Essence Container Label value shall indicate DMCVT essence and its wrapping, and shall be the UL of LEAF kind listed in Table 14. The items defined in Table 14 are listed in the SMPTE Labels Register.

Table 14 — Item Names, Symbols, Kinds, and Item ULs for Essence Container Labels

Item Name	Symbol	Kind	Item UL
MXF-GC DMCVT Data	MXFGCDMCVTData	NODE	06.0E.2B.34.04.01.01.0D.0D.01.03.01.02.1A.00.00
MXF-GC Frame-Wrapped DMCVT Data	MXFGCFrameWrappedDMCVTData	LEAF	06.0E.2B.34.04.01.01.0D.0D.01.03.01.02.1A.01.00

7.4 Data Essence Coding Item

The Data Essence Coding item in the Data Essence Descriptor, defined in SMPTE ST 377-1, shall be present and shall indicate the ST 2094 application that is present in the essence. Only one application can be present. The value shall be a UL of LEAF kind listed in Table 15 specifying the Application Identifier present in the essence. The items defined in Table 15 are listed in the SMPTE Labels Register.

Table 15 — Item ULs, Types, and Symbols for Data Essence Coding

Item Name	Symbol	Kind	Item UL
DMCVT Data Coding	DMCVTDataCoding	NODE	06.0E.2B.34.04.01.01.0D.04.04.01.02.02.00.00.00
DMCVT Application 1	DMCVTApplication1	LEAF	06.0E.2B.34.04.01.01.0D.04.04.01.02.02.01.00.00
DMCVT Application 2	DMCVTApplication2	LEAF	06.0E.2B.34.04.01.01.0D.04.04.01.02.02.02.00.00
DMCVT Application 3	DMCVTApplication3	LEAF	06.0E.2B.34.04.01.01.0D.04.04.01.02.02.03.00.00
DMCVT Application 4	DMCVTApplication4	LEAF	06.0E.2B.34.04.01.01.0D.04.04.01.02.02.04.00.00

7.5 DMCVT Target SubDescriptor

The essence can contain DMCVT Application Sets for one or more Targeted System Displays.

The set of Targeted System Display specifications present in the essence is indicated using a corresponding set of DMCVT Target SubDescriptors as defined below.

The Targeted System Display specification of a DMCVT Application Set comprises the metadata items Application Identifier, Application Version Number, Backwards Version and the metadata items that are members of the **TargetedSystemDisplay** metadata group, which is defined in the SMPTE ST 2094 Application document.

NOTE The set of unique Targeted System Display specifications can be obtained by first extracting all items of the DMCVT Application Sets that are Application Identifier, Application Version Number, Backwards Version, or members of the **TargetedSystemDisplay** metadata group, (intersecting each set with items in Table 17), then removing duplicate sets (a union of the reduced sets). The remaining sets are the unique Targeted System Display specifications of the essence. At least one set will remain.

Each unique Targeted System Display specification shall be encoded in exactly one DMCVT Target SubDescriptor, which shall encode only one Targeted System Display specification.

The DMCVT Target SubDescriptor shall be encoded as defined in Table 17. The DMCVT Target SubDescriptor shall be a subclass of the abstract SubDescriptor, which is defined in SMPTE ST 377-1.

The DMCVT Target SubDescriptor key shall be the UL defined in Table 16.

Items marked Req in Table 17 shall always be present. Items inherited from the SubDescriptor shall be as defined in SMPTE ST 377-1. Each item marked Opt* in Table 17 shall be present, if and only if the corresponding item (without the DMCVT prefix to the name) is present in the Targeted System Display specification. The data values of the items shall be the same as in the corresponding items in the DMCVT Application Sets.

The local tags in the DMCVT Target SubDescriptor shall be dynamically allocated, as defined in SMPTE ST 377-1.

The item names shall map to SMPTE Universal Labels (ULs) and Symbols as specified in Table A.3 in Annex A. The Cross Ref values in Table 17 are provided for cross-reference to Table A.3 in this document and are also used in the example in Table B.5 in Annex B.

All DMCVT Target SubDescriptors shall be referenced in the SubDescriptors item of the Data Essence Descriptor as specified in SMPTE ST 377-1. The SubDescriptors item, an array of strong references, is inherited from and defined in the Generic Descriptor. The ordering of the DMCVT Target SubDescriptors in the SubDescriptors item may be arbitrary.

An example DMCVT Target SubDescriptor is shown in Table B.5 in Annex B.

Table 16 — Set Key for DMCVT Target SubDescriptor

Item Name	Symbol	Kind	Item UL
DMCVT Target SubDescriptor	DMCVTTargetSubDescriptor	LEAF	06.0E.2B.34.02.53.01.01.0D.01.01.01.01.01.75.00

Table 17 — DMCVT Target SubDescriptor

Item Name	Type	Len	Cross Ref	Req	Den	Definition
DMCVT Target SubDescriptor	Set key	16		Req		Identifies a DMCVT Target SubDescriptor
Length	BER length	4		Req		Set length
All items in SubDescriptor except Group UL and Length						SubDescriptor from SMPTE ST 377-1
DMCVT Application Identifier	UInt8	1	80.01	Req		Identifying an application and its defining document in the SMPTE ST 2094 suite
DMCVT Application Version Number	UInt8	1	80.02	Req		The Application Version of the identified SMPTE ST 2094 application
DMCVT Backwards Version	UInt8	1	80.03	Opt*		The lowest Application Version for which this metadata set is valid
DMCVT Targeted System Display Primaries	RationalArray	8+ 8*6	80.09	Opt*	10 000	xy chromaticity coordinates of the three primaries of the targeted system display
DMCVT Targeted System Display White Point Chromaticity	RationalArray	8+ 8*2	80.0A	Opt*	10 000	xy chromaticity coordinate of the targeted system display’s white point
DMCVT Targeted System Display Maximum Luminance	Rational	8	80.0B	Opt*	100	Maximum luminance of the targeted system's display
DMCVT Targeted System Display Minimum Luminance	Rational	8	80.0C	Opt*	10 000	Minimum luminance of the targeted system's display
DMCVT Targeted System Display Signal Format	UInt8	1	80.27	Opt*		Enumerator of the signal format of the targeted system display

Item Name	Type	Len	Cross Ref	Req	Den	Definition
DMCVT Targeted System Display Actual Peak Luminance	UInt8Array	8+ n	80.36	Opt*		Two-input sampled function representing the normalized actual peak luminance of the targeted system display, in units of 1 / 15. The four most significant bits in each UInt8 are zero.
DMCVT Rows In Targeted System Display Actual Peak Luminance	UInt8	1	80.37	Opt*		Number of rows (M) in the DMCVT Targeted System Display Actual Peak Luminance array

NOTE The Cross Ref values in Table 17 are informative only, and are provided only for cross-reference to Table A.3 in this document.

Annex A
(Normative)

ULs for Local Tags

The Local Tags defined in Table 3 to Table 11 shall map to the ULs listed in Table A.2. The items defined in Table 17 shall map to the ULs listed in Table A.3. The group nodes are defined in Table A.1. The items are listed in the SMPTE Metadata Elements Dictionary.

Table A.1 — Group Nodes for ST 2094 Metadata Items

Item Name	Symbol	Kind	Item UL
Color Transform Information	ColorTransformInformation	NODE	06.0E.2B.34.01.01.01.0E.05.31.00.00.00.00.00.00
DMCVT Essence Items	DMCVTEssenceItems	NODE	06.0E.2B.34.01.01.01.0E.05.31.01.00.00.00.00.00
DMCVT SubDescriptor Items	DMCVTSubDescriptorItems	NODE	06.0E.2B.34.01.01.01.0E.05.31.02.00.00.00.00.00

Table A.2 — Item ULs and Symbols for Local Tags

Local Tag	Symbol	Item UL
36.01	ApplicationIdentifier	06.0E.2B.34.01.01.01.0E.05.31.01.01.00.00.00.00
36.02	ApplicationVersionNumber	06.0E.2B.34.01.01.01.0E.05.31.01.02.00.00.00.00
36.03	BackwardsVersion	06.0E.2B.34.01.01.01.0E.05.31.01.03.00.00.00.00
36.04	TimeIntervalStart	06.0E.2B.34.01.01.01.0E.05.31.01.04.00.00.00.00
36.05	TimeIntervalDuration	06.0E.2B.34.01.01.01.0E.05.31.01.05.00.00.00.00
36.06	UpperLeftCorner	06.0E.2B.34.01.01.01.0E.05.31.01.06.00.00.00.00
36.07	LowerRightCorner	06.0E.2B.34.01.01.01.0E.05.31.01.07.00.00.00.00
36.08	WindowNumber	06.0E.2B.34.01.01.01.0E.05.31.01.08.00.00.00.00
36.09	TargetedSystemDisplayPrimaries	06.0E.2B.34.01.01.01.0E.05.31.01.09.00.00.00.00
36.0A	TargetedSystemDisplayWhitePointChromaticity	06.0E.2B.34.01.01.01.0E.05.31.01.0A.00.00.00.00
36.0B	TargetedSystemDisplayMaximumLuminance	06.0E.2B.34.01.01.01.0E.05.31.01.0B.00.00.00.00
36.0C	TargetedSystemDisplayMinimumLuminance	06.0E.2B.34.01.01.01.0E.05.31.01.0C.00.00.00.00
36.0D	MinimumPqencodedMaxrgb	06.0E.2B.34.01.01.01.0E.05.31.01.0D.00.00.00.00
36.0E	AveragePqencodedMaxrgb	06.0E.2B.34.01.01.01.0E.05.31.01.0E.00.00.00.00
36.0F	MaximumPqencodedMaxrgb	06.0E.2B.34.01.01.01.0E.05.31.01.0F.00.00.00.00
36.10	MinimumPqencodedMaxrgbOffset	06.0E.2B.34.01.01.01.0E.05.31.01.10.00.00.00.00
36.11	AveragePqencodedMaxrgbOffset	06.0E.2B.34.01.01.01.0E.05.31.01.11.00.00.00.00
36.12	MaximumPqencodedMaxrgbOffset	06.0E.2B.34.01.01.01.0E.05.31.01.12.00.00.00.00
36.13	ToneMappingOffset	06.0E.2B.34.01.01.01.0E.05.31.01.13.00.00.00.00
36.14	ToneMappingGain	06.0E.2B.34.01.01.01.0E.05.31.01.14.00.00.00.00
36.15	ToneMappingGamma	06.0E.2B.34.01.01.01.0E.05.31.01.15.00.00.00.00
36.16	ChromaCompensationWeight	06.0E.2B.34.01.01.01.0E.05.31.01.16.00.00.00.00
36.17	SaturationGain	06.0E.2B.34.01.01.01.0E.05.31.01.17.00.00.00.00
36.18	ToneDetailFactor	06.0E.2B.34.01.01.01.0E.05.31.01.18.00.00.00.00
36.19	LuminanceLowerBound	06.0E.2B.34.01.01.01.0E.05.31.01.19.00.00.00.00
36.1A	LuminanceUpperBound	06.0E.2B.34.01.01.01.0E.05.31.01.1A.00.00.00.00

Local Tag	Symbol	Item UL
36.1B	LuminanceRangeSelector	06.0E.2B.34.01.01.01.0E.05.31.01.1B.00.00.00.00
36.1C	ChromaticityDiskCenter	06.0E.2B.34.01.01.01.0E.05.31.01.1C.00.00.00.00
36.1D	ChromaticityDiskRadius	06.0E.2B.34.01.01.01.0E.05.31.01.1D.00.00.00.00
36.1E	ChromaticityAreaSelector	06.0E.2B.34.01.01.01.0E.05.31.01.1E.00.00.00.00
36.1F	SaturationGainFunction	06.0E.2B.34.01.01.01.0E.05.31.01.1F.00.00.00.00
36.20	ToneMappingInputSignalWeights	06.0E.2B.34.01.01.01.0E.05.31.01.20.00.00.00.00
36.21	ToneMappingInputSignalBlackLevelOffset	06.0E.2B.34.01.01.01.0E.05.31.01.21.00.00.00.00
36.22	ToneMappingInputSignalWhiteLevelOffset	06.0E.2B.34.01.01.01.0E.05.31.01.22.00.00.00.00
36.23	ShadowGainControl	06.0E.2B.34.01.01.01.0E.05.31.01.23.00.00.00.00
36.24	HighlightGainControl	06.0E.2B.34.01.01.01.0E.05.31.01.24.00.00.00.00
36.25	MidToneWidthAdjustmentFactor	06.0E.2B.34.01.01.01.0E.05.31.01.25.00.00.00.00
36.26	ToneMappingOutputFineTuningFunction	06.0E.2B.34.01.01.01.0E.05.31.01.26.00.00.00.00
36.27	TargetedSystemDisplaySignalFormat	06.0E.2B.34.01.01.01.0E.05.31.01.27.00.00.00.00
36.28	MetadataColorCodingWorkspace	06.0E.2B.34.01.01.01.0E.05.31.01.28.00.00.00.00
36.29	PreMatrixToneMapping1	06.0E.2B.34.01.01.01.0E.05.31.01.29.00.00.00.00
36.2A	PreMatrixToneMapping2	06.0E.2B.34.01.01.01.0E.05.31.01.2A.00.00.00.00
36.2B	PreMatrixToneMapping3	06.0E.2B.34.01.01.01.0E.05.31.01.2B.00.00.00.00
36.2C	ColorRemappingMatrix	06.0E.2B.34.01.01.01.0E.05.31.01.2C.00.00.00.00
36.2D	PostMatrixToneMapping1	06.0E.2B.34.01.01.01.0E.05.31.01.2D.00.00.00.00
36.2E	PostMatrixToneMapping2	06.0E.2B.34.01.01.01.0E.05.31.01.2E.00.00.00.00
36.2F	PostMatrixToneMapping3	06.0E.2B.34.01.01.01.0E.05.31.01.2F.00.00.00.00
36.30	CenterOfEllipse	06.0E.2B.34.01.01.01.0E.05.31.01.30.00.00.00.00
36.31	RotationAngle	06.0E.2B.34.01.01.01.0E.05.31.01.31.00.00.00.00
36.32	SemiMajorAxisInternalEllipse	06.0E.2B.34.01.01.01.0E.05.31.01.32.00.00.00.00
36.33	SemiMajorAxisExternalEllipse	06.0E.2B.34.01.01.01.0E.05.31.01.33.00.00.00.00
36.34	SemiMinorAxisExternalEllipse	06.0E.2B.34.01.01.01.0E.05.31.01.34.00.00.00.00
36.35	OverlapProcessOption	06.0E.2B.34.01.01.01.0E.05.31.01.35.00.00.00.00
36.36	TargetedSystemDisplayActualPeakLuminance	06.0E.2B.34.01.01.01.0E.05.31.01.36.00.00.00.00
36.37	RowsInTargetedSystemDisplayActualPeakLuminance	06.0E.2B.34.01.01.01.0E.05.31.01.37.00.00.00.00
36.38	MasteringDisplayActualPeakLuminance	06.0E.2B.34.01.01.01.0E.05.31.01.38.00.00.00.00
36.39	RowsInMasteringDisplayActualPeakLuminance	06.0E.2B.34.01.01.01.0E.05.31.01.39.00.00.00.00
36.3A	MaxSCL	06.0E.2B.34.01.01.01.0E.05.31.01.3A.00.00.00.00
36.3B	AverageMaxRGB	06.0E.2B.34.01.01.01.0E.05.31.01.3B.00.00.00.00
36.3C	DistributionMaxRGBPercentages	06.0E.2B.34.01.01.01.0E.05.31.01.3C.00.00.00.00
36.3D	DistributionMaxRGBPercentiles	06.0E.2B.34.01.01.01.0E.05.31.01.3D.00.00.00.00
36.3E	FractionBrightPixels	06.0E.2B.34.01.01.01.0E.05.31.01.3E.00.00.00.00
36.3F	KneePoint	06.0E.2B.34.01.01.01.0E.05.31.01.3F.00.00.00.00
36.40	BezierCurveAnchors	06.0E.2B.34.01.01.01.0E.05.31.01.40.00.00.00.00
36.41	ColorSaturationWeight	06.0E.2B.34.01.01.01.0E.05.31.01.41.00.00.00.00

Table A.3 — Item ULs and Symbols for DMCVT Target SubDescriptor

Cross Ref	Symbol	Item UL
80.01	DMCVTApplicationIdentifier	06.0E.2B.34.01.01.01.0E.05.31.02.01.00.00.00.00
80.02	DMCVTApplicationVersionNumber	06.0E.2B.34.01.01.01.0E.05.31.02.02.00.00.00.00
80.03	DMCVTBackwardsVersion	06.0E.2B.34.01.01.01.0E.05.31.02.03.00.00.00.00
80.09	DMCVTTargetedSystemDisplayPrimaries	06.0E.2B.34.01.01.01.0E.05.31.02.09.00.00.00.00
80.0A	DMCVTTargetedSystemDisplayWhitePointChromaticity	06.0E.2B.34.01.01.01.0E.05.31.02.0A.00.00.00.00
80.0B	DMCVTTargetedSystemDisplayMaximumLuminance	06.0E.2B.34.01.01.01.0E.05.31.02.0B.00.00.00.00
80.0C	DMCVTTargetedSystemDisplayMinimumLuminance	06.0E.2B.34.01.01.01.0E.05.31.02.0C.00.00.00.00
80.27	DMCVTTargetedSystemDisplaySignalFormat	06.0E.2B.34.01.01.01.0E.05.31.02.27.00.00.00.00
80.36	DMCVTTargetedSystemDisplayActualPeakLuminance	06.0E.2B.34.01.01.01.0E.05.31.02.36.00.00.00.00
80.37	DMCVTRowsInTargetedSystemDisplayActualPeakLuminance	06.0E.2B.34.01.01.01.0E.05.31.02.37.00.00.00.00

NOTE The Cross Ref values in range 80.01 to 80.37 are informative only, and are provided for cross-reference to Table 17 in this document.

Annex B
(Informative)

DMCVT Application Set Examples

Table B.1 through Table B.5 in this clause provide annotated examples of the DMCVT Application Sets defined in Clause 6.3 through Clause 6.6. Several optional values are present for the purpose of showing their encodings.

Table B.1 — Example DMCVT Application Set for SMPTE ST 2094-10

Content (hexadecimal values)	Value (dec)	Item Name
06.0E.2B.34.02.53.01.01.05.31.02.0 1.00.00.00.00		DMCVT Application 1 Set
83 000144	324	Length
36.01 0001 01	1	Application Identifier
36.02 0001 00	0	Application Version Number
36.03 0001 00	0	Backwards Version
36.04 0004 00000000	0	Time Interval Start
36.05 0004 00000011	17	Time Interval Duration
36.06 000C 00000002 00000002 0000 0000	{0,0}	Upper Left Corner
36.07 000C 00000002 00000002 077F 0437	{1919,1079}	Lower Right Corner
36.08 0001 00	0	Window Number
36.09 0038 00000006 00000008 00001A90 00002710 00000C80 00002710 00000A5A 00002710 00001AF4 00002710 000005DC 00002710 00000258 00002710	{0.6800, 0.3200, 0.2650, 0.6900, 0.1500, 0.0600}	Targeted System Display Primaries
36.0A 0018 00000002 00000008 00000C37 00002710 00000CDA 00002710	{0.3127, 0.3290}	Targeted System Display WhitePoint Chromaticity
36.0B 0008 000186A0 00000064	1000.00	Targeted System Display Maximum Luminance
36.0C 0008 00000032 00002710	0.0050	Targeted System Display Minimum Luminance
36.0D 0008 000000AB 000186A0	0.00171	Minimum PQ-encoded maxRGB
36.0E 0008 0000E37D 000186A0	0.58237	Average PQ-encoded maxRGB
36.0F 0008 00012836 000186A0	0.75830	Maximum PQ-encoded maxRGB
36.10 0008 00000000 000186A0	0.00000	Minimum PQ-encoded maxRGB Offset
36.11 0008 00000000 000186A0	0.00000	Average PQ-encoded maxRGB Offset
36.12 0008 00000000 000186A0	0.00000	Maximum PQ-encoded maxRGB Offset
36.13 0008 00000000 000186A0	0.00000	Tone Mapping Offset
36.14 0008 00002A30 00002710	1.0800	Tone Mapping Gain
36.15 0008 000003E8 000003E8	1.000	Tone Mapping Gamma

Content (hexadecimal values)	Value (dec)	Item Name
36.16 0008 000007D0 00002710	0.2000	Chroma Compensation Weight
36.17 0008 000007D0 00002710	0.2000	Saturation Gain
36.18 0008 000000FA 000003E8	0.250	Tone Detail Factor

Table B.2 — Example DMCVT Application Set for SMPTE ST 2094-20

Content (hexadecimal values)	Value (dec)	Item Name
06.0E.2B.34.02.53.01.01.05.31.02.02.00.00.00.00		DMCVT Application 2 Set
83 0001B2	434	Length
36.01 0001 02	2	Application Identifier
36.02 0001 00	0	Application Version Number
36.03 0001 00	0	Backwards Version
36.04 0004 00000000	0	Time Interval Start
36.05 0004 00000011	17	Time Interval Duration
36.06 000C 00000002 00000002 0000 0000	{0,0}	Upper Left Corner
36.07 000C 00000002 00000002 077F 0437	{1919,1079}	Lower Right Corner
36.08 0001 01	1	Window Number
36.09 0038 00000006 00000008 00001900 00002710 00000CE4 00002710 00000BB8 00002710 00001770 00002710 000005DC 00002710 00000258 00002710	{0.6400, 0.3300, 0.3000, 0.6000, 0.1500, 0.0600}	Targeted System Display Primaries
36.0A 0018 00000002 00000008 00000C37 00002710 00000CDA 00002710	{0.3127, 0.3290}	Targeted System Display White Point Chromaticity
36.0B 0008 00002710 00000064	100.00	Targeted System Display Maximum Luminance
36.0C 0008 000001F4 00002710	0.0500	Targeted System Display Minimum Luminance
36.19 0002 0000	0	Luminance Lower Bound
36.1A 0002 0FFF	4095	Luminance Upper Bound
36.1B 0001 01	1	Luminance Range Selector
36.1C 0018 00000002 00000008 00000200 00000660 00000210 00000660	{0.3137, 0.3235}	Chromaticity Disk Center
36.1D 0008 00000330 00000660	0.500	Chromaticity Disk Radius
36.1E 0001 01	1	Chromaticity Area Selector
36.1F 0028 00000004 00000008 00000030 000000FF 00000040 000000FF 00000070 000000FF 00000080 000000FF	{0.188, 0.25, 0.44, 0.502}	Saturation Gain Function
36.20 0028 00000004 00000008 000000FF 000000FF 000000FF 000000FF 000000FF 000000FF 000000D0 000000FF	{1.00,1.00,1.00,0.816}	Tone Mapping Input Signal Weights
36.21 0008 00000000 000000FF	0.00	Tone Mapping Input Signal Black Level Offset
36.22 0008 00000000 000000FF	0.00	Tone Mapping Input Signal White Level Offset
36.23 0008 00000100 000000FF	1.004	Shadow Gain Control
36.24 0008 00000100 000000FF	1.004	Highlight Gain Control

Content (hexadecimal values)	Value (dec)	Item Name
36.25 0008 00000100 000000FF	1.004	Mid-Tone Width Adjustment Factor
36.26 0028 00000004 00000008 00000030 000000FF 00000040 000000FF 00000070 000000FF 00000080 000000FF	{0.188, 0.25, 0.44, 0.502}	Tone Mapping Output Fine Tuning Function

Table B.3 — Example DMCVT Application Set for SMPTE ST 2094-30

Content (hexadecimal values)	Value (dec)	Item Name
06.0E.2B.34.02.53.01.01.05.31.02.03.00.00.00.00		DMCVT Application 3 Set
83 000402	1026	Length
36.01 0001 03	3	Application Identifier
36.02 0001 00	0	Application Version Number
36.03 0001 00	0	Backwards Version
36.04 0004 00000000	0	Time Interval Start
36.05 0004 00000011	17	Time Interval Duration
36.06 000C 00000002 00000002 0000 0000	{0,0}	Upper Left Corner
36.07 000C 00000002 00000002 077F 0437	{1919,1079}	Lower Right Corner
36.08 0001 00	0	Window Number
36.27 0001 00	0	Targeted System Display Signal Format
36.28 0001 01	1	Metadata Color Coding Workspace
36.29 008C 00000042 00000002 0000 0000 0200 0230 0400 0470 0600 06A0 0800 0950 0A00 0C00 0C00 0E60 0E00 1040 1000 11F0 1200 13F0 1400 1630 1600 1830 1800 1AC0 1A00 1C50 1C00 1DF0 1E00 1F80 2000 209F 21FF 21CF 23FF 232F 25FF 24BF 27FF 265F 29FF 276F 2BFF 294F 2DFF 2B6F 2FFF 2CFF 31FF 2F1F 33FF 305F 35FF 318F 37FF 326F 39FF 322F 3BFF 36CF 3DFF 3B5F 3FFF 3FFF	33 pairs of values	Pre-Matrix Tone Mapping 1, in units of 1 / 16 383
36.2A 008C 00000042 00000002 0000 0000 0200 01D0 0400 0390 0600 0560 0800 0720 0A00 08F0 0C00 0AB0 0E00 0C80 1000 0E40 1200 13A0 1400 15E0 1600 16F0 1800 1820 1A00 1910 1C00 1B70 1E00 1E40 2000 217F 21FF 220F 23FF 239F 25FF 262F 27FF 28FF 29FF 29DF 2BFF 2C7F 2DFF 2E7F 2FFF 306F 31FF 325F 33FF 344F 35FF 363F 37FF 382F 39FF 3A2F 3BFF 3C1F 3DFF 3E0F 3FFF 3FFF	33 pairs of values	Pre-Matrix Tone Mapping 2, in units of 1 / 16 383
36.2B 008C 00000042 00000002 0000 0000 0200 0220 0400 0430 0600 0650 0800 0870 0A00 0A90 0C00 0CA0 0E00 0EC0 1000 10E0 1200 12F0 1400 1510 1600 1730 1800 1950 1A00 1B60 1C00 1B70 1E00 1CF0 2000 1FC0 21FF 20AF 23FF 22EF 25FF 23AF 27FF 276F 29FF 296F 2BFF 2A9F 2DFF 2D4F 2FFF 304F 31FF 323F 33FF 343F 35FF 362F 37FF 382F 39FF 3A1F 3BFF 3C0F 3DFF 3E0F 3FFF 3FFF	33 pairs of values	Pre-Matrix Tone Mapping 3, in units of 1 / 16 383

Content (hexadecimal values)	Value (dec)	Item Name
36.2C 0050 00000009 00000008 00001188 00001000 FFFFFEEC 00001000 FFFFFA68 00001000 0000002C 00001000 00000FF0 00001000 00000488 00001000 FFFFFF2C 00001000 FFFFFE64 00001000 0000191C 00001000	{1.0957, -0.0674, -0.3496, 0.0107, 0.9961, 0.2832, -0.0518, -0.1006, 1.5693}	Color Remapping Matrix
36.2D 008C 00000042 00000002 0000 0000 0200 01F0 0400 03F0 0600 05E0 0800 07D0 0A00 0A30 0C00 0B80 0E00 0D00 1000 0EF0 1200 1120 1400 1380 1600 1640 1800 1860 1A00 1A80 1C00 1C80 1E00 1E20 2000 1FF0 21FF 21CF 23FF 23DF 25FF 25FF 27FF 280F 29FF 2A1F 2BFF 2C0F 2DFF 2E2F 2FFF 309F 31FF 323F 33FF 347F 35FF 36CF 37FF 38CF 39FF 3A9F 3BFF 3C5F 3DFF 3E2F 3FFF 3FFF	33 pairs of value	Post-Matrix Tone Mapping 1, in units of 1 / 16 383
36.2E 008C 00000042 00000002 0000 0000 0200 0200 0400 0400 0600 0600 0800 0800 0A00 0A00 0C00 0C00 0E00 0E00 1000 1010 1200 1140 1400 13F0 1600 15B0 1800 1840 1A00 1A40 1C00 1AC0 1E00 1DF0 2000 2000 21FF 21CF 23FF 242F 25FF 25EF 27FF 27EF 29FF 2B6F 2BFF 287F 2DFF 2ADF 2FFF 2D2F 31FF 2F8F 33FF 31EF 35FF 343F 37FF 369F 39FF 38EF 3BFF 3B4F 3DFF 3D9F 3FFF 3FFF	33 pairs of value	Post-Matrix Tone Mapping 2, in units of 1 / 16 383
36.2F 008C 00000042 00000002 0000 0000 0200 01F0 0400 03F0 0600 05E0 0800 07D0 0A00 09D0 0C00 0BC0 0E00 0DB0 1000 0FB0 1200 11A0 1400 1390 1600 1590 1800 1790 1A00 1AD0 1C00 1C70 1E00 1DD0 2000 1FB0 21FF 229F 23FF 24BF 25FF 269F 27FF 277F 29FF 2A0F 2BFF 2B2F 2DFF 2D4F 2FFF 2F1F 31FF 303F 33FF 31EF 35FF 31EF 37FF 34BF 39FF 378F 3BFF 3A5F 3DFF 3D2F 3FFF 3FFF	33 pairs of value	Post-Matrix Tone Mapping 3, in units of 1 / 16 383

Table B.4 — Example DMCVT Application Set for SMPTE ST 2094-40

Content (hexadecimal values)	Value (dec)	Item Name
06.0E.2B.34.02.53.01.01.05.31.02.04.00.00.00.00		DMCVT Application 4 Set
83 000158	344	Length
36.01 0001 04	4	Application Identifier
36.02 0001 01	1	Application Version Number
36.04 0004 00000000	0	Time Interval Start
36.05 0004 00000011	17	Time Interval Duration
36.06 000C 00000002 00000002 0000 0000	{0,0}	Upper Left Corner
36.07 000C 00000002 00000002 1DFF 10DF	{7679, 4319}	Lower Right Corner
36.08 0001 01	0	Window Number
36.0B 0008 0000C350 00000064	500.00	Targeted System Display Maximum Luminance
36.3A 0020 00000003 00000008 0000C55C 000186A0 00007A03 000186A0 00004E82 000186A0	{0.50524, 0.31235, 0.20098}	Maximum Scene Color Component Levels
36.3B 0008 000003C5 000186A0	0. 00965	Average MaxRGB
36.3C 0059 00000009 00000001 00 05 0A 19 32 4B 5A 5F 63	{1, 5, 10, 25, 50, 75, 90, 95, 99}	Distribution MaxRGB Percentages
36.3D 0050 00000009 00000008 00000011 000186A0 00000000 000186A0 000000FF 000186A0 00000054 000186A0 000000C8 000186A0 000002D7 000186A0 00000945 000186A0 00001247 000186A0 00008BBB 000186A0	{0.00017, 0.00000, 0.00255, 0.00084, 0.00200, 0.00727, 0.02373, 0.04679, 0.35771}	Distribution MaxRGB Percentiles
36.3E 0008 00000000 000003E8	0.000	Fraction Bright Pixels
36.3F 0018 00000002 00000008 000003FF 00000FFF 00000333 00000FFF	{0.25, 0.20}	Knee Point
36.40 0050 00000009 00000008 000001EA 000003FF 000002D0 000003FF 0000030F 000003FF 00000347 000003FF 00000378 000003FF 000003A0 000003FF 000003BD 000003FF 000003D0 000003FF 000003D6 000003FF	{0.479, 0.704, 0.765, 0.820, 0.868, 0.907, 0.936, 0.954, 0.960}	Bezier Curve Anchors

Table B.5 — Example DMCVT Target SubDescriptor

Content (hexadecimal values)	Value (dec)	Item Name
06.0E.2B.34.02.53.01.01.0D.01.01.01.01.01.75.00		DMCVT Target SubDescriptor
83 00008E	142	Length
3C.0A 0010 76.79.37.2B.91.7C.4D.60.53.DB.B9.0A.0B.49.0A.F9		Instance UID
80.01 0001 01	1	DMCVT Application Identifier
80.02 0001 00	0	DMCVT Application Version Number
80.09 0038 00000006 00000008 00001A90 00002710 00000C80 00002710 00000A5A 00002710 00001AF4 00002710 000005DC 00002710 00000258 00002710	{0.6800, 0.3200, 0.2650, 0.6900, 0.1500, 0.0600}	DMCVT Targeted System Display Primaries
80.0A 0018 00000002 00000008 00000C37 00002710 00000CDA 00002710	{0.3127, 0.3290}	DMCVT Targeted System Display White Point Chromaticity
80.0B 0008 000186A0 00000064	1000.00	DMCVT Targeted System Display Maximum Luminance
80.0C 0008 00000032 00002710	0.0050	DMCVT Targeted System Display Minimum Luminance

Bibliography (Informative)

SMPTE ST 379-1:2009, Material Exchange Format (MXF) — MXF Generic Container

SMPTE ST 422:2014, Material Exchange Format — Mapping JPEG 2000 Codestreams into the MXF Generic Container

SMPTE ST 2067-3:2016, Interoperable Master Format – Composition Playlist