

SMPTE STANDARD

Digital Cinema Distribution Master – Subtitle



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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 428-7 was prepared by Technology Committee 21DC.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. 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.

1 Scope

This document specifies the format of a DCDM Subtitle file. A DCDM Subtitle file contains a set of instructions for placing rendered text or graphical overlays at precise locations on distinct groups of motion picture frames. A DCDM Subtitle File is an integral component of a D-Cinema composition and may be present in Digital Cinema Package (DCP) file sets. Consequently, its design reflects features of other DCP file formats. The DCDM Subtitle file format is not intended for use in streaming applications.

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 section 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; followed by formal languages; then figures; and then any other language forms.

3 Normative References

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

World Wide Web Consortium (W3C) (2004, February 4). Extensible Markup Language (XML) 1.0 (Third Edition)

World Wide Web Consortium (W3C) (2004, October 28). XML Schema Part 1: Structures (Second Edition)

World Wide Web Consortium (W3C) (2004, October 28). XML Schema Part 2: Datatypes (Second Edition)

Internet Engineering Task Force (IETF) (1996, November). RFC 2396 — Uniform Resource Identifiers (URI): Generic Syntax

Internet Engineering Task Force (IETF) (2005, July). RFC 4122 — A Universally Unique Identifier (UUID) URN Namespace

ISO/IEC 15948:2004, Information Technology — Computer Graphics and Image Processing — Portable Network Graphics (PNG): Functional Specification

ISO/IEC 14496, Part 22, 2009 Information Technology — Coding of Audio-Visual Objects — Open Font Format

ISO/IEC 10646-1, 2000 Information Technology — Universal Multiple-Octet Coded Character Set (UCS) Unicode Consortium, (2012, January 16). Unicode Standard Annex #9 – Unicode Bidirectional Algorithm.

4 Overview

A DCDM Subtitle file, depicted in block form in Figure 1, is a representation of a series of *subtitle instances*: rendered text or graphical overlays on a primary picture in a D-Cinema work, such as a motion picture, trailer, or advertisement. A subtitle track file contains a set of file-global metadata and a set of subtitle structures which encode the content and temporal and spatial locations of the subtitles to be displayed over the primary picture.

A virtual timeline provides the temporal dimension of the DCDM Subtitle file. The timeline is a contiguous set of *editable units*. Spatial positions are expressed as percentages of the primary picture's size relative to a chosen border or center axis. The primary picture source shall have constant size.

The DCDM Subtitle file may reference external font resources for rendered text, and external image resources for graphical overlays. The font and image resource formats are specified in this document's normative references.

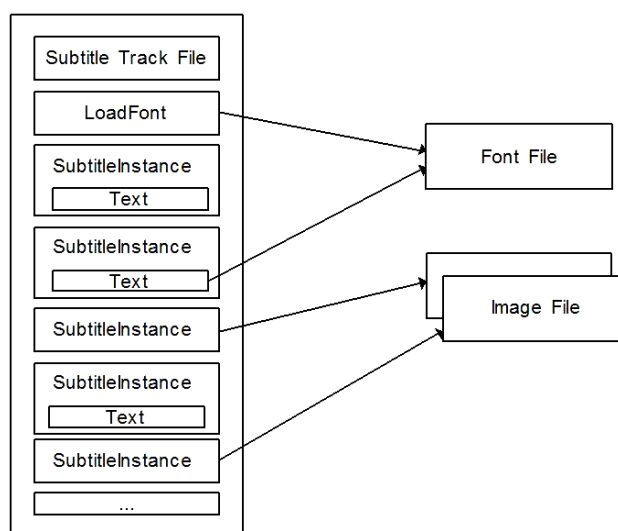


Figure 1 – Prototypical DCDM Subtitle File (Informative)

The structures defined in this document are represented using the *Extensible Markup Language* [XML 1.0], and specified using XML Schema [XML Schema Part 1: Structures] and [XML Schema Part 2: Datatypes].

This specification shall be associated with a unique XML namespace name [Namespaces in XML]. The namespace name shall be the string value “http://www.smp-te-ra.org/schemas/428-7/2014/DCST”.

In addition, the namespace name defined in the 2010 version of this standard, the string value “http://www.smp-te-ra.org/schemas/428-7/2010/DCST”, shall be supported by decoders and is available for use by content creators that do not wish to use the features specific to the 2014 schema. More information on the differences between these two schemas is presented in Section 8 below. To be clear, use of the 2010 schema is recommended for applications that do not need features of the 2014 schema and which are intent on compatibility with legacy implementations of this standard.

Table 1 lists the XML namespace names used in this specification. Namespace names are represented as Uniform Resource Identifier (URI) values [RFC 2396]¹.

The MIME type for a document containing a single `SubtitleReel` element as its root shall be `text/xml`.

Table 1 – XML Namespaces (URIs are Normative)

<i>Qualifier</i>	<i>URI</i>
dcst	http://www.smp-te-ra.org/schemas/428-7/2014/DCST
dcst	http://www.smp-te-ra.org/schemas/428-7/2010/DCST
xs	http://www.w3.org/2001/XMLSchema

An XML document must be parsed in its entirety before it can be considered valid, thus the format defined by this document is not suitable for streaming applications.

The URIs found in Table 1 are normative. The namespace qualifier values (also called namespace prefixes in XML jargon) used in Table 1 and elsewhere in this document, namely “dcst” and “xs”, are not normative meaning that they may be replaced in instance documents by any XML compliant namespace qualifier value. In other words, implementations shall expect any arbitrary XML compliant namespace qualifier value that is associated with a URI from Table 1.

Datatypes from other schemas that are used in this document will be prefixed with the appropriate namespace qualifier (e.g., `xs:dateTime`). See [XML Schema Part 2: Datatypes] and [XML-Signature Syntax and Processing] for further information about these types.

¹ Although an XML namespace URI value begins with a “method” element (“http” in this case), the value is designed primarily to be a unique string and does not necessarily correspond to an actual on-line resource. URI values are not intended to be resolved.

4.1 Deprecated Namespace Name

The namespace name listed below was defined by a previous version of this standard. Documents conforming to that version shall be considered conformant to this standard, and decoders conforming to this standard shall decode such documents, but this namespace name is not intended for new documents.

<http://www.smpte-ra.org/schemas/428-7/2007/DCST>

4.2 Definitions

4.2.1

Primary Picture

The primary picture shall be the DCDM picture over which the rendered subtitle instances will be displayed. It has a height and a width, defining its size.

Note: The projected picture size could be different from the size of the primary picture (e.g., in the case of scaling).

4.2.2

Point

A “point” is a unit of length, commonly abbreviated as “pt”². Fonts shall be rendered so that a 72-point font shall be 1/11 primary picture height.

4.2.3

em

An “em” is a unit of measurement. 1 em shall be equal to the currently specified point size, meaning that 1 em in a 16-point typeface shall be 16 points. Therefore, 2 em in a 16-point typeface shall be 32 points and 0.5 em in a 16-point typeface shall be 8 points.

4.2.4

Baseline

For a given font, the baseline shall be the line upon which most letters “sit” and below which descenders extend (e.g., the following lower case letters have descenders: g, j, p, q, y).

The baseline of a Ruby container (see Section 6.5) shall be the baseline of the characters contained within the Rb element.

4.2.5

Subtitle Time Code

Subtitle time code shall be a value of the form HH:MM:SS:E+, or, hours, minutes, seconds and subtitle editable units, respectively. It is a representation of a count of subtitle editable units. The HH:MM:SS portion is an approximation of real time — it matches real time only if the EditRate element’s ratio (see Section 5.8) corresponds to an integer (e.g., “24 1” corresponds to 24 which is an integer, while “24000 1001” corresponds to 23.98 which is not an integer).

The HH field shall be encoded using two digits, with a value between 00 and 23 (inclusive). The MM and SS fields shall each be encoded using two digits, with a value between 00 and 59 (inclusive).

The subtitle editable units field (E+) of a subtitle time code shall have a value between zero and “TimeCodeRate – 1” (inclusive). The number of digits to use for the E+ field shall match the minimum number of digits required to encode the value “TimeCodeRate – 1” (see Section 5.9). For example:

² The concept of “point” comes from the printing industry.

- if the `TimeCodeRate` element's value is between 11 and 100 (inclusive), the E+ field shall be encoded using two digits – allowing the encoding of a value between 00 and 99 (inclusive).
- if the `TimeCodeRate` element's value is between 101 and 1000 (inclusive), the E+ field shall be encoded using three digits – allowing the encoding of a value between 000 and 999 (inclusive).

All 'E+' fields within a given DCDM Subtitle document shall be encoded using the same number of digits.

The maximum value that can be expressed by a subtitle time code shall be 23:59:59:MaxE, where 'MaxE' is one number less than the value of `TimeCodeRate` element - encoded with the appropriate number of digits as defined above.

Note: The formula to convert the above HH:MM:SS:E+ encoded value into the actual count of subtitle editable units is provided below:

$$\text{Count of subtitle editable units} = (((((\text{HH} \times 60) + \text{MM}) \times 60) + \text{SS}) \times \text{TimeCodeRate}) + \text{E+}$$

4.2.6

Instance Optional

An XML element or attribute that is not required to be present in a document instance conforming to this standard shall be identified by the clause "instance optional" and in the schemas by the attribute `minOccurs="0"` for elements, and by the attribute `use="optional"` for attributes.

A DCDM subtitle instance document does not need to contain any "instance optional" elements or attributes to be compliant with this standard. Unless otherwise specified, implementations shall decode "instance optional" items when present, and shall implement default behaviors when "instance optional" items are not present.

4.2.7

Current Font

The nearest ancestor `Font` element, or if no ancestor `Font` element is present, the font identified by the first `LoadFont` element.

5 DCDM Subtitle Structure (Normative)

A DCDM Subtitle file shall be an XML document consisting of a single `SubtitleReel` element as defined by this document.

5.1 SubtitleReel Element

The `SubtitleReel` element (Figure 2) shall be the top level container of XML data in a DCDM Subtitle file. The `SubtitleReel` element shall contain a set of elements which define the global parameters of the track file, followed by the `SubtitleList` element which shall contain the set of elements describing the individual subtitle instances.

5.1.1 IntrinsicPictureResolution Attribute [instance optional]

When present, the `IntrinsicPictureResolution` attribute of the `SubtitleReel` element shall be a string that shall indicate the resolution of the primary picture for which the PNG images, referenced by the `Image` elements present in the DCDM Subtitle file, were generated. For example, if 4K is specified, the decoded bitmap from the PNG referenced by the DCDM Subtitle file will match the expected size and position when displayed over a 4K picture.

The possible values of this attribute are outside the scope of this document and should be defined by accompanying specification (e.g., in an operational constraints document).

Note: This attribute is intended for mastering asset management purposes, not for playback processing.

5.2 Id Element

The Id element shall uniquely identify the reel for asset management purposes. It shall be encoded in the element body as a urn:uuid [RFC 4122].

5.3 ContentTitleText Element

The ContentTitleText element shall contain an unbounded string value encoding of the subtitle file's title (e.g., "Gone With the Wind"). It is meant strictly for display to the user.

5.3.1 Language Attribute [instance optional]

When present, the language attribute of the ContentTitleText element shall indicate the primary language represented by the text in the ContentTitleText element. It shall be encoded as an xs:language type. The default value shall be en (English).

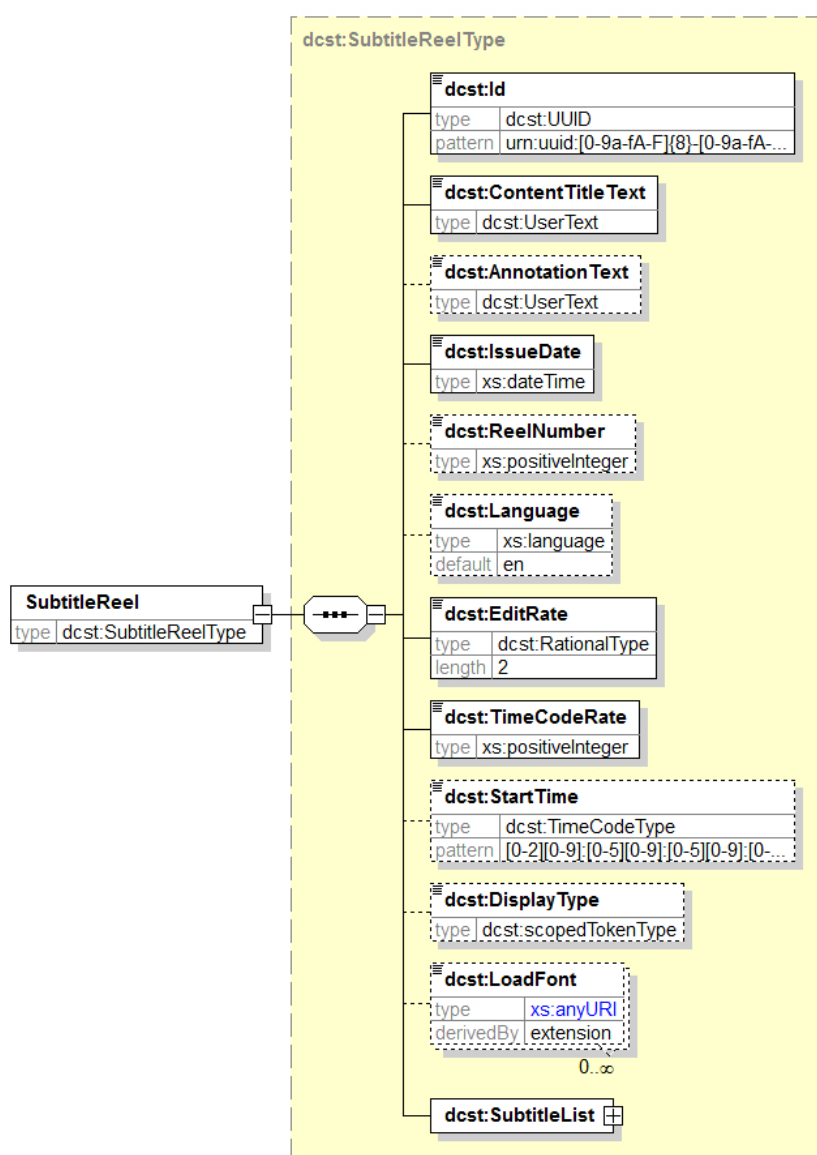


Figure 2 – DCDM Subtitle file structure. The dotted lines denote optional elements. (Informative)

5.4 AnnotationText Element [instance optional]

When present, the `AnnotationText` element shall contain an unbounded string value, which describes the subtitle reel essence. It is meant strictly for display to the user.

5.4.1 Language Attribute [instance optional]

When present, the `language` attribute of the `AnnotationText` element shall indicate the primary language represented by the text in the `AnnotationText` element. It shall be encoded as an `xs:language` type. The default value shall be `en` (English).

5.5 IssueDate Element

The `IssueDate` parameter shall indicate the time and date at which the subtitle file was created. It may be displayed to the user. It shall be encoded as an XML `xs:dateTime` type.

5.6 ReelNumber Element [instance optional]

When present, the `ReelNumber` element shall denote the ordered placement of this file in a set of DCDM Subtitle files. The value shall only be used for informative purposes and shall not influence the reproduction of the subtitle instances. The value shall be a positive integer.

5.7 Language Element [instance optional]

When present, the `Language` element shall denote the primary language used in the text elements and/or image resources. The value shall be encoded as an `xs:language` type. The default value shall be `en` (English).

5.8 EditRate Element

The `EditRate` element shall encode the rate at which the virtual timeline progresses. It shall be expressed as a ratio of two integers giving the number of editable units per second of real time.

5.9 TimeCodeRate Element

The value of the `TimeCodeRate` element shall be equal to the value of the `EditRate` element rounded to the nearest integer. For example: If the value of the `EditRate` element is “24000 1001”, then the value of the `TimeCodeRate` element will be 24. If the value of the `EditRate` element is “200 11”, then the value of the `TimeCodeRate` element will be 18. In case where the `EditRate` ratio corresponds exactly to the mid-point of two integer values (e.g., 23.5), then the value of the `TimeCodeRate` element shall be equal to the value of the `EditRate` element rounded to the nearest higher integer (e.g., 24 in this example).

The `TimeCodeRate` element shall encode the count of subtitle editable units for each increment of the seconds field (SS) of a subtitle time code — see Section 4.2.5. It shall be expressed as a positive (non-zero) integer value.

5.10 StartTime Element [instance optional]

When present, the `StartTime` element shall specify the starting time of the DCDM Subtitle file’s timeline. The timeline extends forward in time in discrete increments (subtitle editable units).

The value of the `StartTime` element shall be encoded as a subtitle time code as defined in Section 4.2.5.

The default value of the `StartTime` element shall be `01:00:00:ZeroE`, where 'ZeroE' is the zero value encoded using the appropriate number of digits (e.g., '00' for a two-digit encoding, or '000' for a three-digit encoding — see Section 4.2.5 for more details).

5.11 LoadFont Element [instance optional]

When present, the `LoadFont` element shall be used to declare an OpenType [ISO/IEC 14496, Part 22] font resource for use within the DCDM Subtitle file. The font shall be identified by a `urn:uuid` value [RFC 4122] in the element's body. The mapping of `urn:uuid` values to actual font resources is beyond the scope of this document.

At no time shall the presence of a character outside the font's character set be visible in the rendered subtitle instance. For the purpose of this standard, Unicode [ISO/IEC 10646-1] control codes (the 65 characters in the ranges U+0000..U+001F and U+007F..U+009F) shall be considered outside the character set of any font (control codes shall not be displayed). Implementations shall support UTF-8 character encodings up to three bytes in length. Implementations may support four-byte UTF-8 character encoding. Note: legacy implementations might not render four-byte UTF-8 encoded characters. In the case where four-byte encodings are desired, it is strongly advised that prospective playback equipment be surveyed to assure support for this feature.

To achieve the behavior defined above, the rendering device may assume that the font conforms to the recommendation titled "First four glyphs in fonts" from [ISO/IEC 14496, Part 22], Section 7. Operation of the rendering device when using fonts otherwise constructed is not defined.

When one or more `Text` elements are present, at least one `LoadFont` element shall also be present. The first `LoadFont` element shall identify the font to be used for any text that is not explicitly styled with a `Font` element (see Section 6.4 below).

5.11.1 ID Attribute

The ID attribute shall be a string of one or more characters that shall define an identifier, unique within the scope of the parent `SubtitleReel` element, to be referenced by `Font` elements in the `SubtitleList`. Each `LoadFont` element in a DCDM Subtitle file shall have a distinct ID attribute value.

5.12 SubtitleList Element

The `SubtitleList` element shall contain the set of elements that defines subtitle instances. Any combination of `Font` and `Subtitle` elements may be present. Figure 3 illustrates this structure.

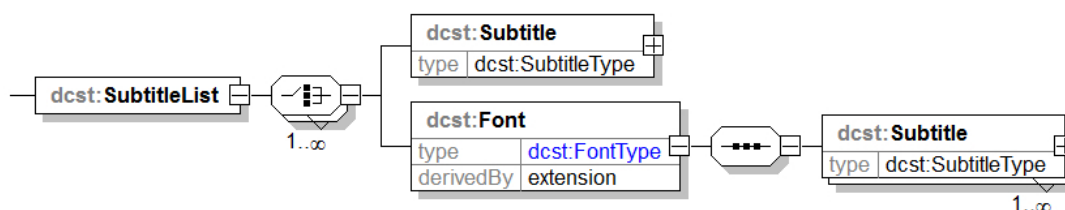


Figure 3 – `SubtitleList` contents (Informative)

5.12.1 Ordering of Subtitle Elements

Subtitle elements shall be ordered within the SubtitleList element in ascending temporal order (least recent first). The TimeIn attribute of a given Subtitle element shall be equal to or greater than that of the preceding element. The first Subtitle element in the SubtitleList shall have a TimeIn value equal to or greater than the value of the StartTime element (or the default start time if the StartTime element is not present). This ordering shall not be affected by the presence of enclosing Font elements.

5.12.2 Display Precedence

Subtitle instances shall appear to be rendered in ascending temporal order. The instance having the most recent TimeIn value shall occlude those in the same screen area having earlier TimeIn values. In the case of two or more instances having the same TimeIn value, the instance that occurs latest in the track file shall be considered most recent.

In the case of two or more Text and/or Image elements within a given Subtitle instance, the element that occurs latest in the Subtitle instance shall be considered most recent and shall occlude the other element(s) in the same screen area.

The Zposition attribute and the content of any LoadVariableZ element shall not be used to determine display precedence.

Note: This specification allows using different Zposition and/or LoadVariableZ/VariableZ values for different Text and/or Image elements — whether located in concurrent Subtitle instances or within the same Subtitle instance. Constraints on Zposition and LoadVariableZ/VariableZ values can be defined in accompanying specification (e.g., in an operational constraints document). The display precedence rules listed above are independent of any Zposition or LoadVariableZ/VariableZ values — meaning that Zposition and LoadVariableZ/VariableZ values will not impact the definition of “more recent” element provided by the above display precedence rules.

5.13 DisplayType Element [instance optional]

When present, the DisplayType element shall indicate the intended use of the content of the XML document. The element value shall be a text string that is meant to be both human and machine-readable. An instance optional “scope” attribute with default URI value as indicated in the Sections 5.13.1 and 5.13.2 below shall determine the permissible values of the element.

When the DisplayType element is not present, the display affinity for that document is not defined.

5.13.1 2014 DisplayType Element

When the namespace name is `http://www.smpte-ra.org/schemas/428-7/2014/DCST`:

- the scope attribute shall have the following default URI value “`http://www.smpte-ra.org/schemas/428-7/2014/DCST#display-type`”.
- if the scope attribute is absent, or set to its default value, the content of the element shall be one of the values listed in Table 2.
- The value of the scope attribute shall not be “`http://www.smpte-ra.org/schemas/428-7/2010/DCST#display-type`”

Table 2 – 2014 Default scope Attribute: Possible DisplayType Values (Normative)

DisplayType Value	DisplayType Value Meaning
MainSubtitle	Subtitle content, either on-screen or off-screen (the prefix "Main" is present for historical reason only – it was used in SMPTE ST 428-7:2010)
Caption	Caption content, either on-screen or off-screen

5.13.2 2010 DisplayType Element

When the namespace name is <http://www.smpte-ra.org/schemas/428-7/2010/DCST>:

- the scope attribute shall have the following default URI value “<http://www.smpte-ra.org/schemas/428-7/2010/DCST#display-type>”.
- if the scope attribute is absent, or set to its default value, the content of the element shall be the value listed in Table 3.
- The value of the scope attribute shall not be “<http://www.smpte-ra.org/schemas/428-7/2014/DCST#display-type>”

Table 3 – 2010 DisplayType Default scope Attribute Value (Normative)

DisplayType Value	DisplayType Value Meaning
MainSubtitle	Subtitle content, either on-screen or off-screen.

6 Subtitle Instances (Normative)

A subtitle instance is an auxiliary image to be displayed over a series of identically sized primary pictures. Subtitle instance images are given either directly in externally referenced Portable Network Graphics [PNG] image resources, or are rendered from integral text using externally referenced OpenType font resources.

PNG images shall be authored with a 1:1 spatial relationship to the primary picture.

Note: If the primary picture is re-sized prior to projection on screen, the PNG images must be re-sized equivalently.

Subtitle instances in a DCDM Subtitle file shall be contained within the SubtitleList XML element (see Section 5.12). The Subtitle element shall be the XML container of a subtitle instance. Each Subtitle element shall contain one or more Image, Text or Font elements. Font elements shall be allowed to appear at any level within the Subtitle content hierarchy, except as a child of an Image, Ruby, Rb, Rt, HGroup, Space, Rotate or LoadVariableZ element, or as an immediate child of another Font element. Figure 4 illustrates this structure.

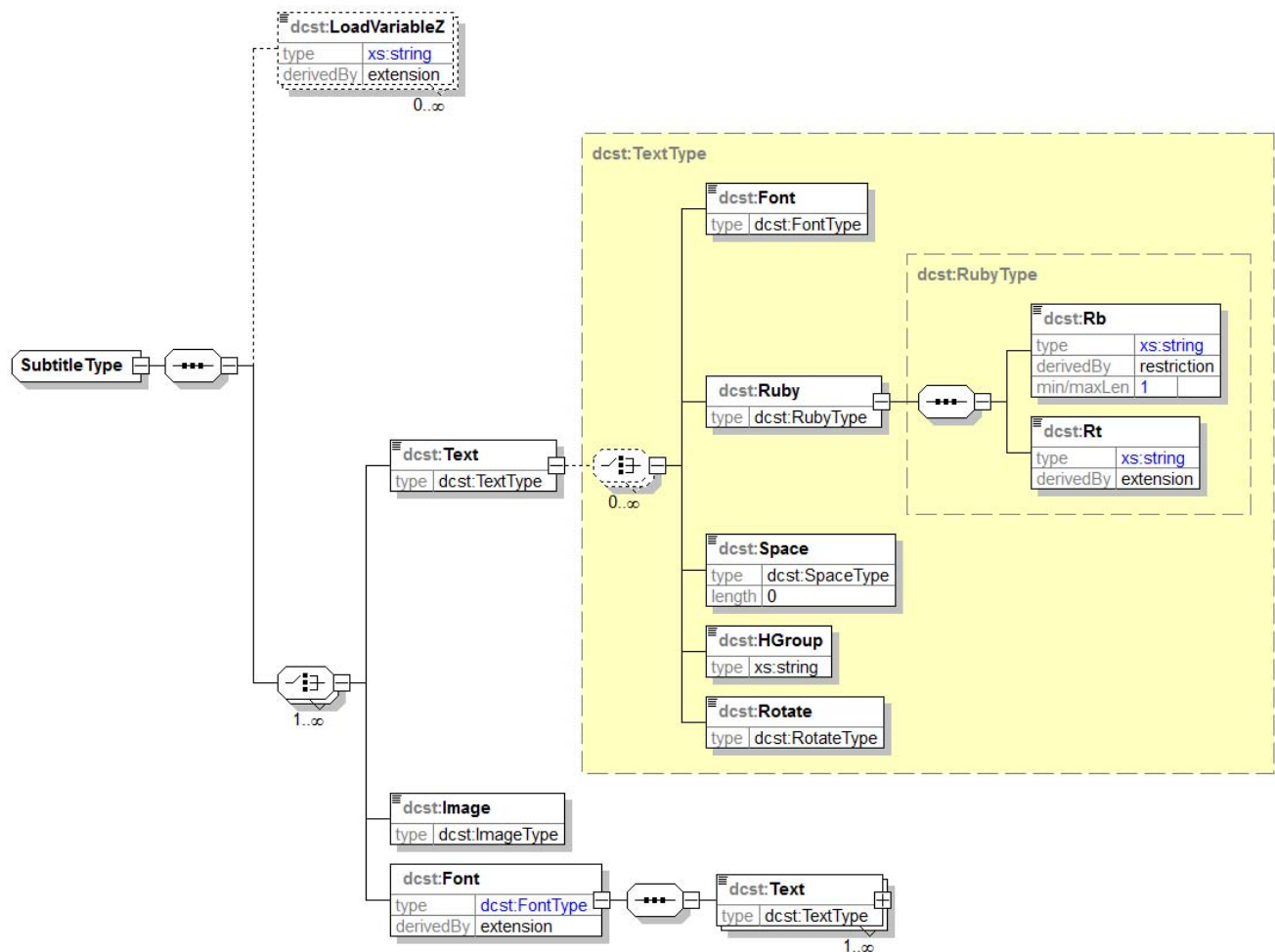


Figure 4 – Subtitle instance structure (Informative)

6.1 Subtitle Element

The Subtitle element shall have attributes, defined below, which specify the start time, duration, and fade characteristics of the subtitle instance. Subtitle elements must be ordered in ascending temporal order within the SubtitleList element, and could have overlapping temporal regions as defined in Section 5.12.1.

6.1.1 SpotNumber Attribute [instance optional]

When present, the SpotNumber attribute shall be a string value, which shall identify the instance in some other notation system, such as a spotting list.

6.1.2 TimeIn Attribute

The TimeIn attribute shall define the position on the DCDM subtitle timeline, expressed as hours, minutes, seconds and subtitle editable units (HH:MM:SS:E+, see Section 4.2.5), at which the subtitle instance shall begin to fade in. See additional TimeIn related provisions in Section 6.1.6.

Example 1:

Given the following set of DCDM Subtitle file parameters:

- The `EditRate` element value is equal to 24 1
- The `StartTime` element value is equal to 06:00:00:00
- The `TimeIn` attribute value of the first `Subtitle` element is equal to 06:00:05:00

Then, the first text or image of the DCDM Subtitle file is expected to appear 5 seconds from the start of its timeline.

Example 2:

Given the following set of DCDM Subtitle file parameters:

- The `EditRate` element value is equal to 24 1
- The `StartTime` element is not present, meaning that its default value (01:00:00:00) is used
- The `TimeIn` attribute's value of the first `Subtitle` element equals 02:00:05:00

Then, the first text or image of the DCDM Subtitle file is expected to appear 1 hour, 5 seconds from the start of its timeline.

6.1.3 TimeOut Attribute

The `TimeOut` attribute shall define the position on the DCDM subtitle timeline, expressed as hours, minutes, seconds and subtitle editable units (HH:MM:SS:E+, see Section 4.2.5), at which the subtitle instance shall complete the fade out. This value shall be greater than the `TimeIn` value of the same element. See additional `TimeOut` related provisions in Section 6.1.6.

6.1.4 FadeUpTime Attribute [instance optional]

When present, the `FadeUpTime` attribute shall define the duration, expressed as hours, minutes, seconds and subtitle editable units (HH:MM:SS:E+, see Section 4.2.5), of the fade of the subtitle instance from 100% transparent to the full specified opacity, with the possible overlap-related exception presented below in Section 6.1.6. The default value shall be 00:00:00:TwoE, where TwoE is the value '2' encoded using the appropriate number of digits (e.g., '02' for a two-digit encoding, or '002' for a three-digit encoding — see Section 4.2.5), with the possible overlap-related exception presented below in Section 6.1.6.

For example (in the case of a subtitle instance that does not overlap any other subtitle instance), if `FadeUpTime="00:00:00:02"`, `FadeDownTime="00:00:00:02"`, `TimeIn="00:00:00:00"` and `TimeOut="00:00:00:20"`, then:

- Editable unit 00 is expected to have 0% of the full specified opacity
- Editable unit 01 is expected to have 50% of the full specified opacity
- Editable unit 02 is expected to have 100% of the full specified opacity

See additional `FadeUpTime` related provisions in Section 6.1.6.

6.1.5 FadeDownTime Attribute [instance optional]

When present, the `FadeDownTime` attribute shall define the duration, expressed as hours, minutes, seconds and subtitle editable units (HH:MM:SS:E+, see Section 4.2.5), of the fade of the subtitle instance from full specified opacity to 100% transparent, with the possible overlap-related exception presented below in Section 6.1.6. The default value shall be 00:00:00:TwoE, where TwoE is the value '2' encoded

using the appropriate number of digits (e.g., '02' for a two-digit encoding, or '002' for a three-digit encoding – see Section 4.2.5), with the possible overlap-related exception presented below in Section 6.1.6.

For example (in the case of a subtitle instance that does not overlap any other subtitle instance), if `FadeUpTime="00:00:00:02"`, `FadeDownTime="00:00:00:02"`, `TimeIn="00:00:00:00"` and `TimeOut="00:00:00:20"`, then:

- Editable unit 18 is expected to have 100% of the full specified opacity
- Editable unit 19 is expected to have 50% of the full specified opacity
- Editable unit 20 is expected to have 0% of the full specified opacity

See additional `FadeDownTime` related provisions in Section 6.1.6.

6.1.6 Subtitle Element Constraints

For any given Subtitle element, $(\text{TimeOut} - \text{FadeDownTime})$ shall be greater than or equal to $(\text{TimeIn} + \text{FadeUpTime})$.

When two subtitle instances have overlapping time windows, their respective `FadeUpTime` and `FadeDownTime` attributes values (or their default values if absent) may be considered by the rendering device to be equal to "00:00:00:ZeroE" (where 'ZeroE' is the zero value encoded using the appropriate number of digits — see Section 4.2.5), even if the fading operations are specified outside of the overlapping period.

When the time window of a subtitle instance does not overlap the time window of any other subtitle instance, its `FadeUpTime` and `FadeDownTime` attribute values (or their default values if absent) shall be respected.

Note: The overlapping of the time window (defined by the `TimeIn` and `TimeOut` values) of subsequent subtitle instances is allowed by this specification. Constraints on the number of simultaneous subtitle instances can be defined in accompanying specification (e.g., in an operational constraints document). A persistent subtitle instance (meaning a subtitle instance meant to stay on screen while more than one subsequent subtitle is displayed and removed) can be an issue for some equipment. The effect of a persistent subtitle can be accomplished by repeating the persistent text or image into subsequent subtitle instances.

6.2 Image Element

When present, the Image element shall identify an external image resource to be displayed over the primary picture. The image resource shall be identified by a `urn:uuid` value [RFC 4122] in the element's body. The mapping of `urn:uuid` values to actual image resources is beyond the scope of this document. Images shall be encoded in Portable Network Graphics [PNG] format, and shall have a size no larger than that of the respective primary picture. Transparent regions of images shall be rendered transparently. If there is a portion of the content from another Text or Image element located underneath such transparent region, it shall be visible – meaning that the transparent region shall not show only the primary picture. The image position over the primary picture shall be determined by the Image element attributes values.

Content creators should make sure that all the content enclosed within the Image element fits entirely within the primary picture boundary, especially when the `VariableZ` and/or `Zposition` attribute(s) are/is present (in which case both left- and right-eye images shall fit entirely within this boundary).