SMPTE ST 2021-4:2023
Revision of SMPTE ST 2021-4:2022

SMPTE STANDARD

BROADCAST EXCHANGE FORMAT (BXF) - SCHEMA DOCUMENTATION

Table of Contents

Approved September 15, 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. This SMPTE Engineering Document was prepared by Technology Committee 34CS Media Systems, Control and Services.

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.

SMPTE draws attention to the fact that it is claimed that compliance with this Standard may involve the use of one or more patents or other intellectual property rights (collectively, "IPR"). The Society takes no position concerning the evidence, validity, or scope of this IPR.

Each holder of claimed IPR has assured the Society that it is willing to License all IPR it owns, and any third party IPR it has the right to sublicense, that is essential to the implementation of this Standard to those (Members and non-Members alike) desiring to implement this Standard under reasonable terms and conditions, demonstrably free of discrimination. Each holder of claimed IPR has filed a statement to such effect with SMPTE. Information may be obtained from the Director, Standards & Engineering at SMPTE Headquarters.

Attention is also drawn to the possibility that elements of this Standard may be subject to IPR other than those identified above. The Society shall not be responsible for identifying any or all such IPR.

1 Scope

This document provides documentation of the BXF schemas specified in the ST2021-4a-2023.zip (the collection of XSD files that constitute the normative schema). See Annex A for the list of additional elements, which includes ST2021-4a-2023.zip.

Summary of changes:
The changes to this document (and the accompanying schema) come from direct requests for enhancement from the North American Broadcasters Association (NABA). In addition, as the group considered these changes, several errors/typos were found and corrected, and those too are included. All changes are backward-compatible and are additive in nature to the schema.

2 Terms and Definitions

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

2.1
Programming Metadata Communication Protocol
PMCP

protocol defined for exchange of programming data, as specified in ATSC A/76B

3 Description of BXF schema

This documentation does not contain the actual schema, but instead provides a reference to the individual files that can be viewed with any number of tools, including most commonly-used browsers as well as other third-party tools. In addition to the XML Schema Files (*.xsd), the user can also browse the schema using the HTML (*.html) files found in ST2021-4b-2023.zip. See Annex A for the list of additional elements, which includes ST2021-4b-2023.zip.

Depending on the tools you use, different parts of the schema might appear in different formatting. Clause 4 describes the meaning of various parts of the schema as you would see them in the HTML version.

If any differences exist between the non-schema text in this document and the schema, then the schema shall take precedence.

4 Schema Documentation

4.1 Graphic and Symbol Conventions

A number of graphics and symbols are used in the documentation to help describe the various elements of the schema and how the elements are related. These represent components and the relationships between schema components. The different components are represented by the following:

Single element – mandatory: Indicated by a rectangle with a solid border. The element name is inside the shape, as shown in Figure 1.

Figure 1 — Single element – mandatory.

Single element – optional: Indicated by a rectangle with a dashed border. The element name is inside the shape, as shown in Figure 2.

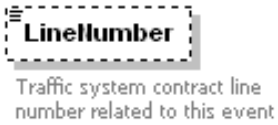


Figure 2 — Single element – optional.

Multiple elements: Indicated by a rectangle with a solid border with a number range representing the minimum and maximum number of occurrences possible, as shown in Figure 3. In the example, 0 to infinity (0..∞) is shown.

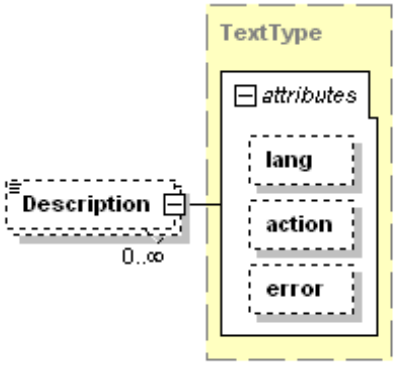


Figure 3 — Multiple elements.

Elements containing child elements: Indicated by a [+] or [-] on the element, representing an element containing additional attributes or elements. The [+] indicates that additional elements are available for display. The [-] indicates that the child elements are displayed, as shown in Figure 4.

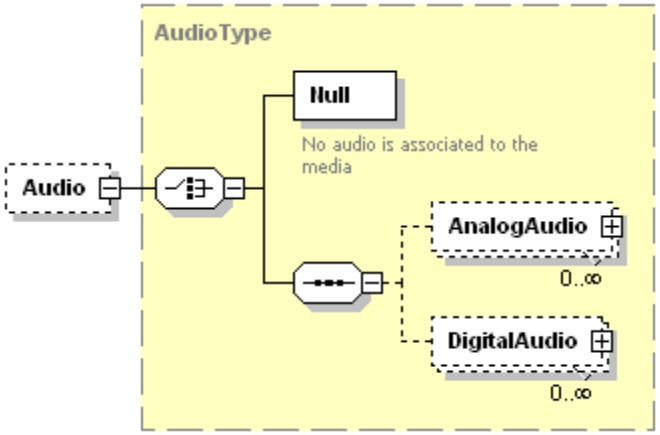


Figure 4 — Elements containing child elements.

Complex type: Indicated by a partial hexagon and a child element symbol, as shown in Figure 5.

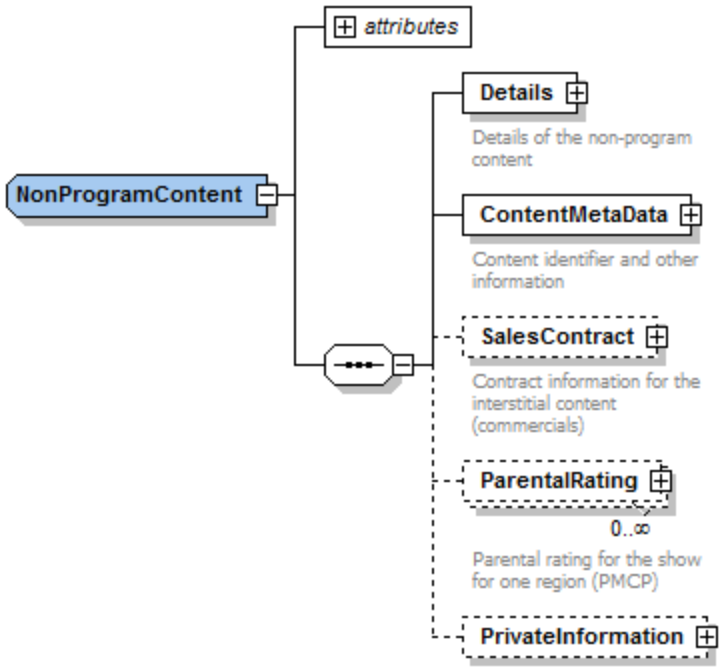


Figure 5 — Complex type.

Wildcards: Indicated by an octagon with ‘any’ at the left, as shown in Figure 6.

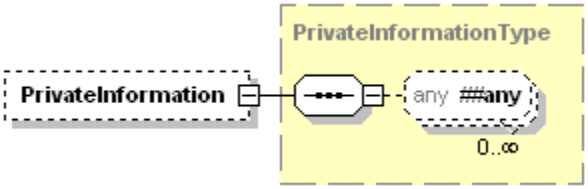


Figure 6 — Wildcards.

Attributes: Indicated by the word ‘attributes’, as shown in Figure 7.

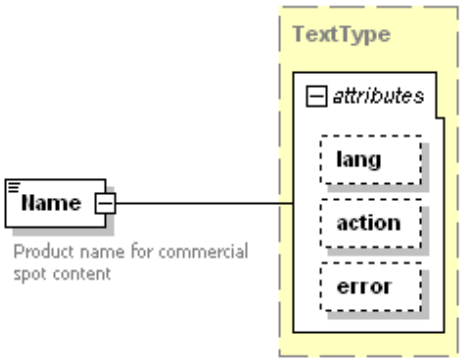


Figure 7 — Attributes.

The relationships between components are represented by symbols for sequence and choice.

Sequence: The sequence compositor shows that all elements occur in sequence, as shown in Figure 8.

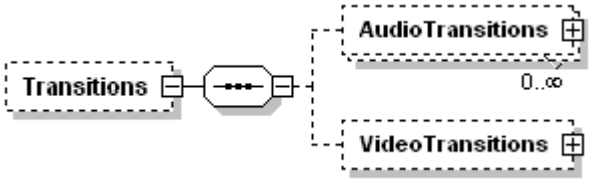


Figure 8 — Sequence.

Choice: The choice compositor shows the ‘or’ relationship between associated components (only one choice may be made), as shown in Figure 9.

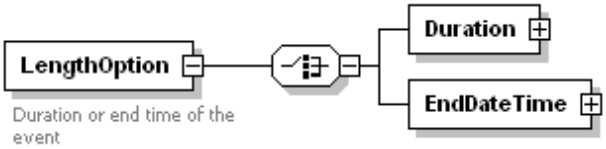


Figure 9 — Choice.

Solid lines: Solid lines connecting elements represent mandatory connections within the schema diagrams, as shown in Figure 10.

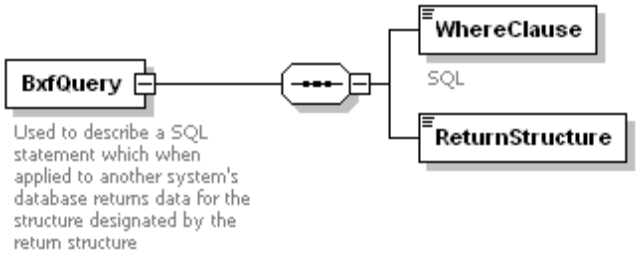


Figure 10 — Solid lines.

Dashed lines: Dashed lines between elements represent optional connections within the schema diagrams, as shown in Figure 11.

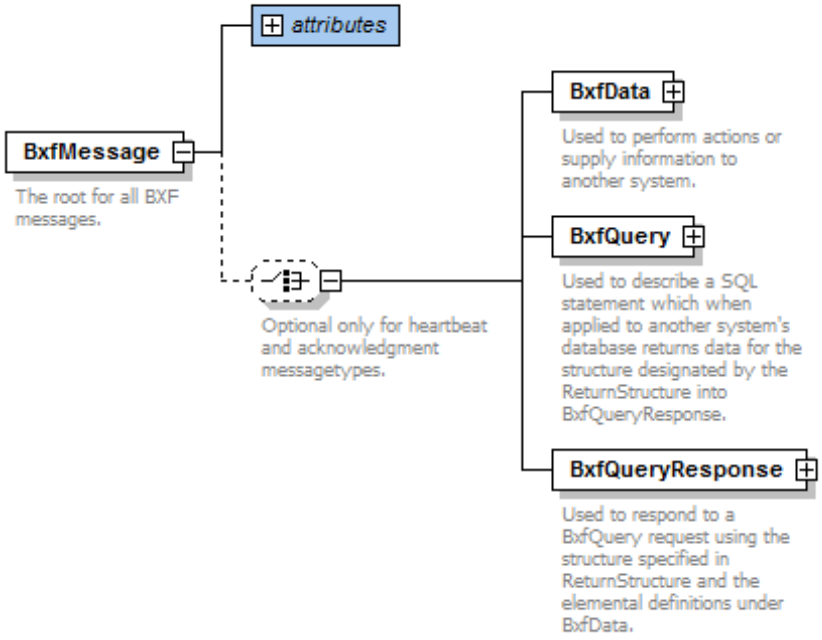


Figure 11 — Dashed lines.

4.2 Schema File List

The schema is composed of 33 files, as shown in Figure 12. The root file (starting point) is bxfschema.xsd and all other files are referenced from this file. A brief description of each file is given in 4.3.2 through 4.3.7 in alphabetical order. This same description may also be contained in the schema for major elements, but some elements do not contain a description and were segregated into separate files for the convenience of managing the schema. Note that no new XSDs have been added as part of BXF version 8.1, but there is a new simpleType in BxfTypes for LMTLanguageType which is then referenced as a new element in both BxfCaption.xsd and Video.xsd. A new attribute has been added to the complexType Location found in the Location.xsd to allow the entry of a fileSize value in bytes. Some minor typos are cleaned up in Audio.xsd.

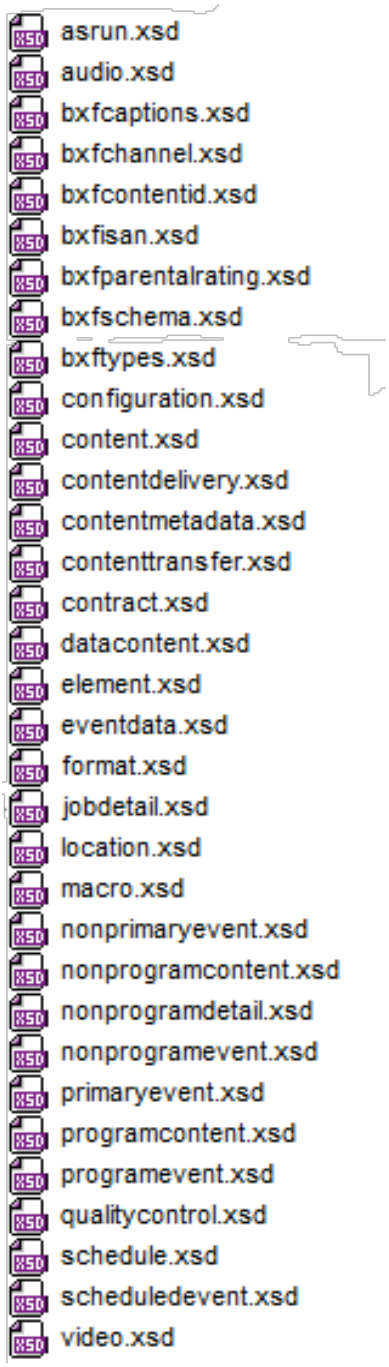


Figure 12 — Schema file list.

4.3 Header Change in BXF 8.1

4.3.1 Schema Headers

All XSD file headers have the same change regarding copyright and targetNamespace:

```
<!-- Copyright 2023 Society of Motion Picture and Television Engineers. All rights reserved. -->
<xs:schema xmlns="http://smpte-ra.org/schemas/2021/2023/BXF"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:pmcp="http://www.atsc.org/XMLSchemas/pmcp/2007/3.1"
targetNamespace="http://smpte-ra.org/schemas/2021/2023/BXF"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="8.100">
```

As a reminder, starting with v8.0, a change has been made to require that all associated PMCP files should be stored in a PMCP folder located within the main BXF folder. This will localize these files and remove the need to access the PMCP XSDs from a remote server hosted by the ATSC. At times, it has been reported that accessing the ATSC server had been inconsistent and resulted in errors for those using the BXF schema in their systems. As there is no expectation that any of these PMCP reference files will be modified in the future, SMPTE felt it best to fully incorporate them into the BXF distribution structure. ATSC is in full agreement with this change and has authorized SMPTE to distribute the appropriate PMCP files with v8.1.

Note also that the <xs:import> located in the header of all the XSDs is the following:

```
<xs:import namespace="http://www.atsc.org/XMLSchemas/pmcp/2007/3.1"
schemaLocation="PMCP/pmcp31.xsd"/>
```

Most of the BXF XSDs (27) had only their header changed as detailed above and are listed here. There are six (6) XSDs with more substantial changes and these changes are detailed in 4.3.2 through 4.3.7.

Header Only Changes for these XSDs:

Asrun.xsd

BXFChannel.xsd

BXFContentID.xsd

BXFISAN.xsd

BXFParentalRating.xsd

BXFSchema.xsd

Configuration.xsd

Content.xsd

ContentMetaData.xsd

ContentTransfer.xsd

Contract.xsd

DataContent.xsd

Element.xsd

EventData.xsd

Format.xsd

JobDetail.xsd

Macro.xsd

NonPrimaryEvent.xsd

NonProgramContent.xsd

NonProgramDetail.xsd

NonProgramEvent.xsd

PrimaryEvent.xsd

ProgramContent.xsd

ProgramEvent.xsd

QualityControl.xsd

Schedule.xsd

ScheduleEvent.xsd

4.3.2 Audio.xsd

4.3.2.1 Audio.xsd Overview

The base for all audio definitions, as shown in Figure 13. This figure is high-resolution and can be zoomed up to 400% to improve readability.

Contains:

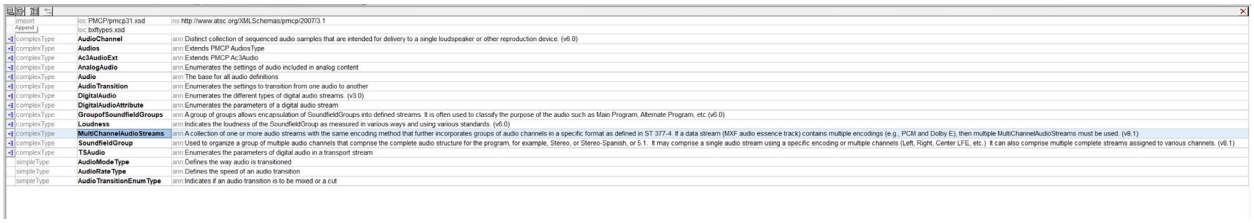


Figure 13 — Audio.xsd

4.3.2.2 BXF 8.1 Changes

Description of change: Three element/attribute name inconsistencies and typos were discovered and corrected in v8.1, Changes are highlighted in yellow:

- "SoundFieldGroup" was changed to "SoundfieldGroup" for consistency throughout the documentation and general use.
- "GroupofSounfieldGroupLinkID" was changed to "GroupofSoundfieldGroupsLinkID" to correct the misspelling.
- The attribute, "numberOfSoundFieldGroups" was changed to "numberOfSoundfieldGroups" for consistency throughout the documentation and general use.

In addition, minor typos were discovered in the following `complexType` annotations and corrected in v8.1.

- **`MultiChannelAudioStreams`:** "`encodeing:` and "`than`" were corrected to "`encoding`" and "`then`", respectively, so that the annotation states: "`If a data stream (MXF audio essence track) contains multiple encodings (e.g., PCM and Dolby E), then multiple MultiChannelAudioStreams must be used.`"
- **`SoundfieldGroup`:** "`conprise`" was corrected to "comprise, and grammar was corrected, so that the annotation states: "`Used to organize a group of multiple audio channels that comprise the complete audio structure for the program, for example, Stereo, or Stereo-Spanish, or 5.1. It may comprise a single audio stream using a specific encoding or multiple channels (Left, Right, Center LFE, etc.). It can also comprise multiple complete streams assigned to various channels.`"
- **`numberOfSoundfieldGroups`**: "`Soundfield groups`" was corrected to "`SoundfieldGroups`", so that the annotation states: "`The number of SoundfieldGroups contained in the stream.`"

The changes are also shown in Figure 14.

Text representation:

```
<xs:complexType name="SoundfieldGroup">
<xs:annotation>
<xs:documentation>Used to organize a group of multiple audio channels that comprise the complete audio structure for the program, for example, Stereo, or Stereo-Spanish, or 5.1.  It may comprise a single audio stream using a specific encoding or multiple channels (Left, Right, Center LFE, etc.)  It can also comprise multiple complete streams assigned to various channels. (v8.1)</xs:documentation>
</xs:annotation>
     <xs:sequence>
     <xs:element name="GroupofSoundfieldGroupsLinkID" type="Uuid" minOccurs="0" maxOccurs="unbounded">
     <xs:annotation>
     <xs:documentation>Used to link a SoundfieldGroup to a specific Group of SoundfieldGroups. (v8.1)</xs:documentation>
     </xs:annotation>
     </xs:element>
     <xs:element name="MultichannelType" minOccurs="0">
     <xs:annotation>
     <xs:documentation>Describes the multichannel type of SoundfieldGroup.  For example MONO, STEREO, 5.1, etc. Can be sourced from MXF MCATagname of a SoundfieldGroup (e.g., AS-11 X1 MXF) if it contains this information.
(ST 428-12:2013 and ST2067-8:2013)</xs:documentation>
     </xs:annotation>
<xs:simpleType>
               <xs:restriction base="xs:string">
                    <xs:enumeration value="Mono"/>
                    <xs:enumeration value="Dual Mono"/>
                    <xs:enumeration value="Stereo"/>
                    <xs:enumeration value="Lt-Rt"/>
                    <xs:enumeration value="3.0"/>
                    <xs:enumeration value="4.0"/>
                    <xs:enumeration value="5.0"/>
                    <xs:enumeration value="5.1"/>
                    <xs:enumeration value="5.1EX"/>
                    <xs:enumeration value="6.0"/>
                    <xs:enumeration value="6.1"/>
                    <xs:enumeration value="7.0"/>
                    <xs:enumeration value="7.1DS"/>
                    <xs:enumeration value="7.1SDS"/>
```

```
                    <xs:enumeration value="Other"/>
                </xs:restriction>
            </xs:simpleType>
</xs:element>
<xs:element name="AudioContent" minOccurs="0">
<xs:element name="Loudness" minOccurs="0">
<xs:element name="AudioMetadata" minOccurs="0">
<xs:element name="PrivateInformation" type="BxfPrivateInformation" minOccurs="0"/>
</xs:sequence>
<xs:attribute name="soundfieldGroupID" type="Uuid">
<xs:attribute name="numberOfChannels" type="xs:integer">
<xs:attribute name="firstPCMTrack" type="xs:positiveInteger">
<xs:attribute name="firstPCMTrackID" type="Uuid">
<xs:attribute name="lastPCMTrack" type="xs:positiveInteger">
<xs:attribute name="lastPCMTrackID" type="Uuid">
<xs:attributeGroup ref="Action-ErrorGroup"/>
</xs:complexType>
```

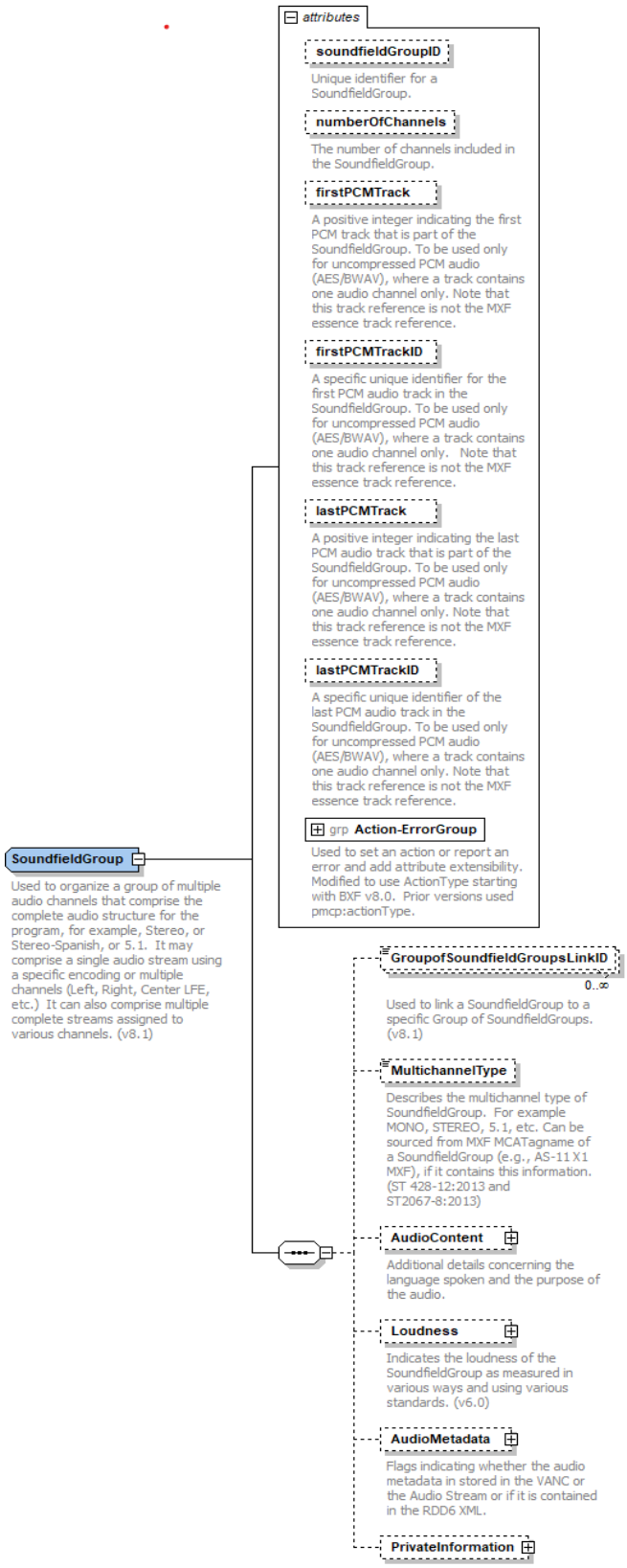


Figure 14 — SoundfieldGroup

4.3.3 BxfCaptions.xsd

4.3.3.1 BxfCaptions.xsd Overview

The base for all captions, as shown in Figure 15. This figure is high-resolution and can be zoomed up to 400% to improve readability.

Contains:

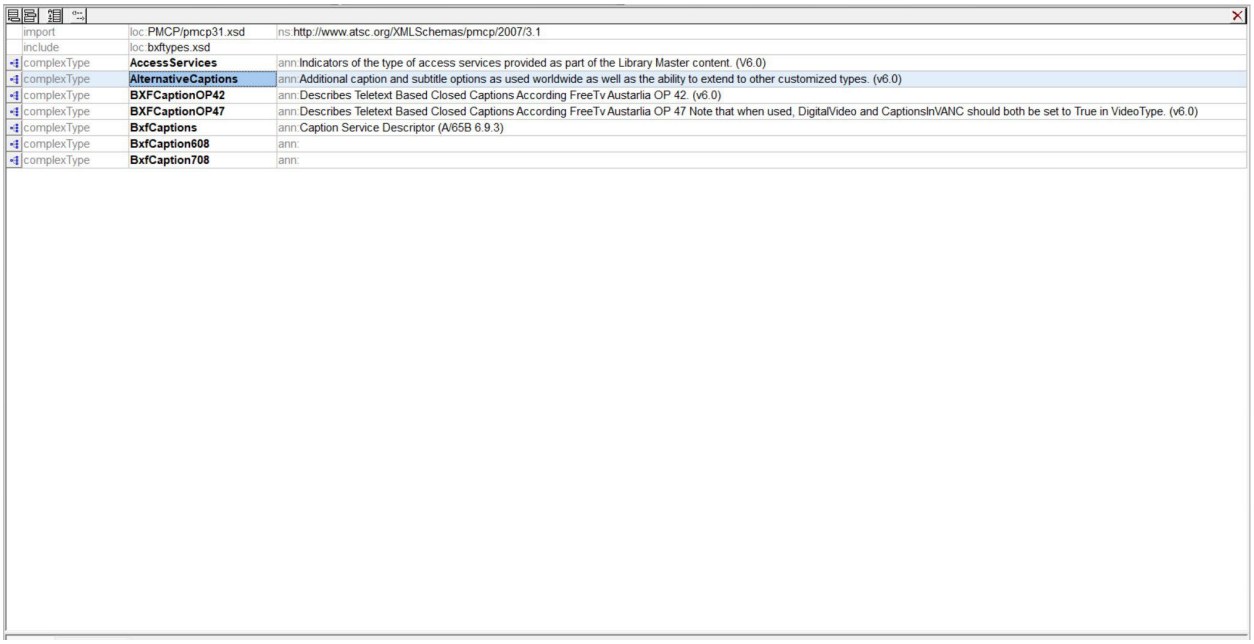


Figure 15 — BxfCaptions.xsd

4.3.3.2 BXF 8.1 Changes

Description of change: Several changes were made in BxfCaptions, as shown in Figure 16 and Figure 17. The AlternativeCaptions complexType had a new enumeration added to an existing attribute, captionTypeName. The new enumeration is “SMPTE-TT”. In addition to this, LMTLanguage was added as a new optional complexType, referencing the new simpleType added to BxfTypes (see 4.3.4.2), for AlternativeCaptions, Caption608 and Caption708. Caption608 was also given a new optional element, CaptionChannel, with four enumerations, “CC-1”, “CC-2”, “CC-3”, and “CC-4”.

Text representation:

```
<xs:complexType name="AlternativeCaptions">
<xs:annotation>
<xs:documentation>Additional caption and subtitle options as used worldwide as well as the ability to extend to other customized types. (v6.0)</xs:documentation>
</xs:annotation>
<xs:sequence>
<xs:element name="LMTLanguage" type="LMTLanguageType" minOccurs="0">
<xs:annotation>
```

```
<xs:documentation>Language used for the caption service, more specific than
captionLanguage attribute. (v8.1)</xs:documentation>
</xs:annotation>
</xs:element>
<xs:element name="PrivateInformation" type="BxfPrivateInformation" minOccurs="0"/>
</xs:sequence>
<xs:attribute name="captionID" type="Uuid">
<xs:annotation>
<xs:documentation>Unique identifier assigned to the caption.</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="captionTypeName">
<xs:annotation>
<xs:documentation>The name associated with the caption type being used such as EBU-
STL, EBU-TT or IMSC.</xs:documentation>
</xs:annotation>
<xs:simpleType>
<xs:restriction base="xs:string">
<xs:enumeration value="EBU-STL"/>
<xs:enumeration value="EBU-TT"/>
<xs:enumeration value="IMSC"/>
<xs:enumeration value="SAMI"/>
<xs:enumeration value="SMPTE-TT"/>
<xs:enumeration value="SRT"/>
<xs:enumeration value="WebVTT"/>
<xs:enumeration value="Other"/>
</xs:restriction>
</xs:simpleType>
</xs:attribute>
<xs:attribute name="captionName" type="xs:string">
<xs:annotation>
<xs:documentation>If the captionTypeName is Other, use this to provide actual
name.</xs:documentation>
</xs:annotation>
</xs:attribute>
```

```
<xs:attribute name="captionServiceType">
<xs:annotation>
<xs:documentation>Type of caption service: hard of hearing or
translation.</xs:documentation>
</xs:annotation>
<xs:simpleType>
<xs:restriction base="xs:string">
<xs:enumeration value="Hard of Hearing"/>
<xs:enumeration value="Translation"/>
</xs:restriction>
</xs:simpleType>
</xs:attribute>
<xs:attribute name="captionProfile" type="xs:string">
<xs:annotation>
<xs:documentation>Specific profile of the caption type.</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="captionLanguage" type="xs:language">
<xs:annotation>
<xs:documentation>The language that the caption is using.</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attribute name="captionVersion" type="xs:string">
<xs:annotation>
<xs:documentation>Some caption services have versions that must be explicit and can
be placed here in an acceptable format.</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attributeGroup ref="Action-ErrorGroup"/>
</xs:complexType>
<xs:element name="Caption608" minOccurs="0" maxOccurs="4">
<xs:annotation>
<xs:documentation>Indicates that analog captions present with the option to indicate
which channel is being used. If not designated, CC-1 is assumed.
(v8.1)</xs:documentation>
</xs:annotation>
```

```
<xs:complexType>
<xs:complexContent>
<xs:extension base="BxfCaption608">
<xs:sequence minOccurs="0">
<xs:element name="CaptionChannel" minOccurs="0">
<xs:annotation>
<xs:documentation>Indicates which caption channel is being used for the caption (1-4). (v8.1)</xs:documentation>
</xs:annotation>
<xs:simpleType>
<xs:restriction base="xs:string">
<xs:enumeration value="CC-1"/>
<xs:enumeration value="CC-2"/>
<xs:enumeration value="CC-3"/>
<xs:enumeration value="CC-4"/>
</xs:restriction>
</xs:simpleType>
</xs:element>
<xs:element name="LMTLanguage" type="LMTLanguageType"minOccurs="0">
<xs:annotation>
<xs:documentation>Language used for the caption service, more specific than lang attribute. (v8.1)</xs:documentation>
</xs:annotation>
</xs:element>
</xs:sequence>
</xs:extension>
</xs:complexContent>
</xs:complexType>
</xs:element>
<xs:element name="Caption708" minOccurs="0" maxOccurs="16">
<xs:annotation>
<xs:documentation>Describe digital captions services. Note that when used, DigitalVideo and CaptionsInVANC should both be set to True in VideoType.</xs:documentation>
</xs:annotation>
<xs:complexType>
```

```
<xs:complexContent>
<xs:extension base="BxfCaption708">
<xs:sequence minOccurs="0">
<xs:element name="LMTLanguage" type="LMTLanguageType"minOccurs="0">
<xs:annotation>
<xs:documentation>Language used for the caption service, more specific than lang
attribute. (v8.1)</xs:documentation>
</xs:annotation>
</xs:element>
</xs:sequence>
</xs:extension>
</xs:complexContent>
</xs:complexType>
</xs:element>
```

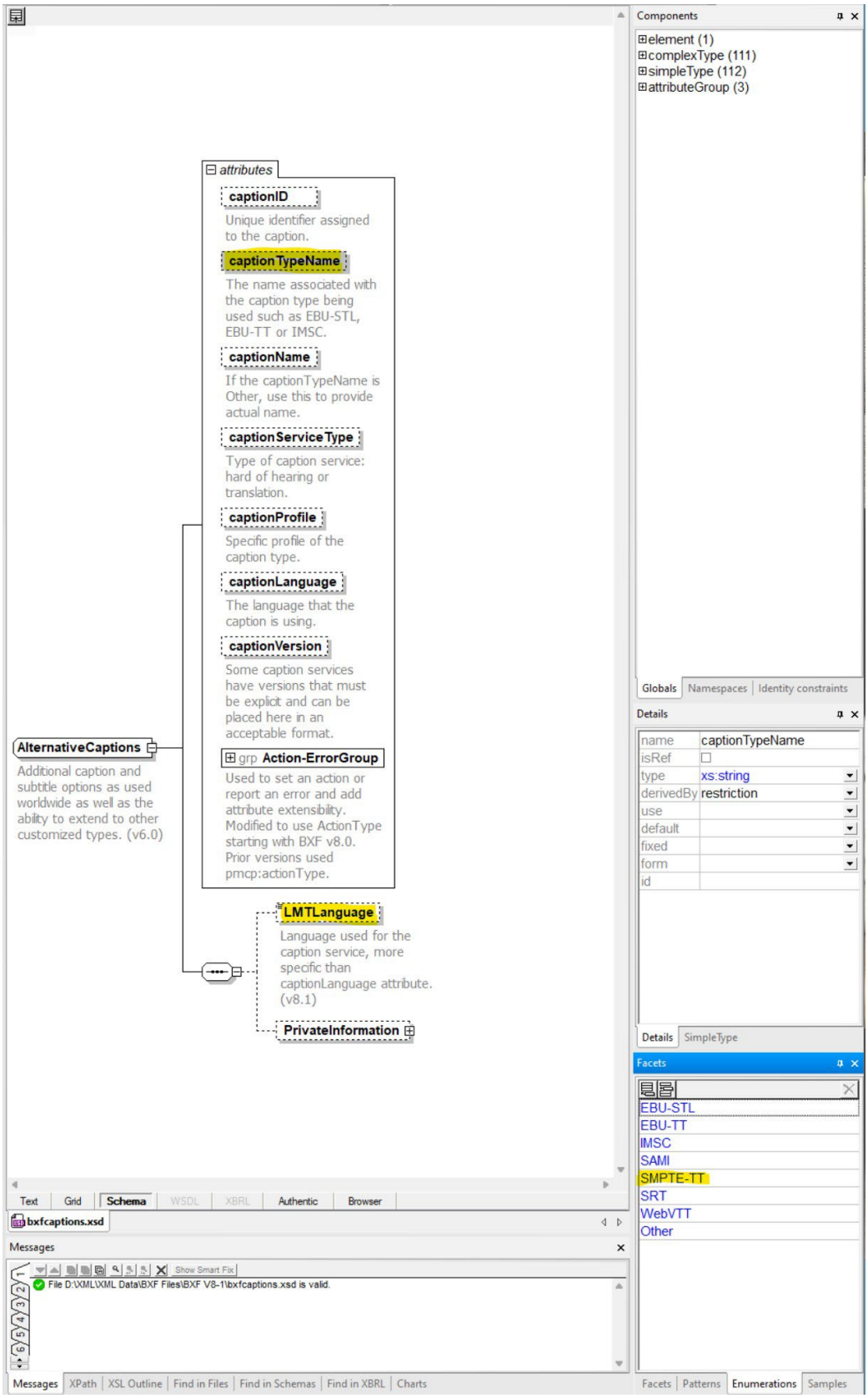


Figure 16 — AlternativeCaptions

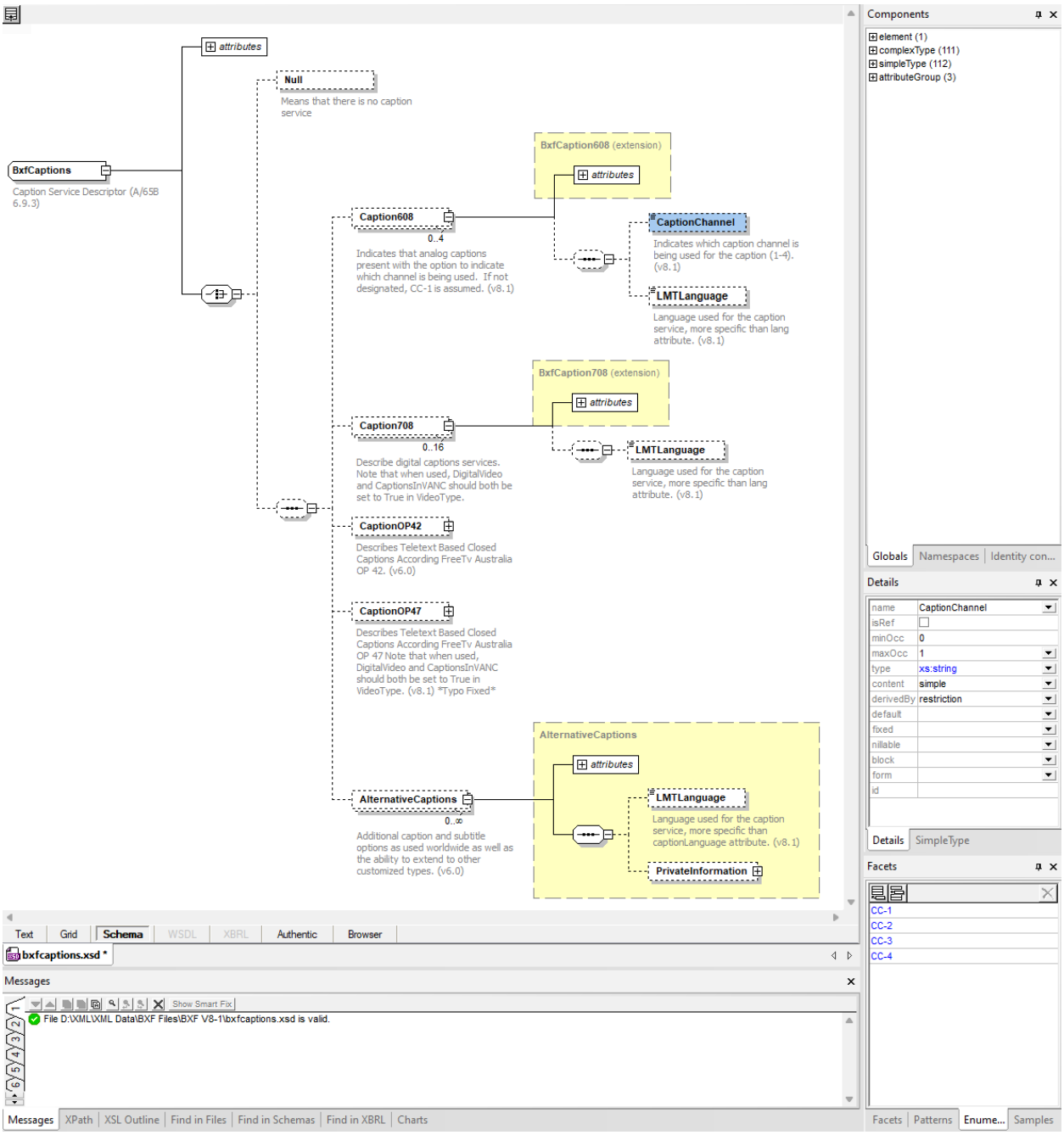


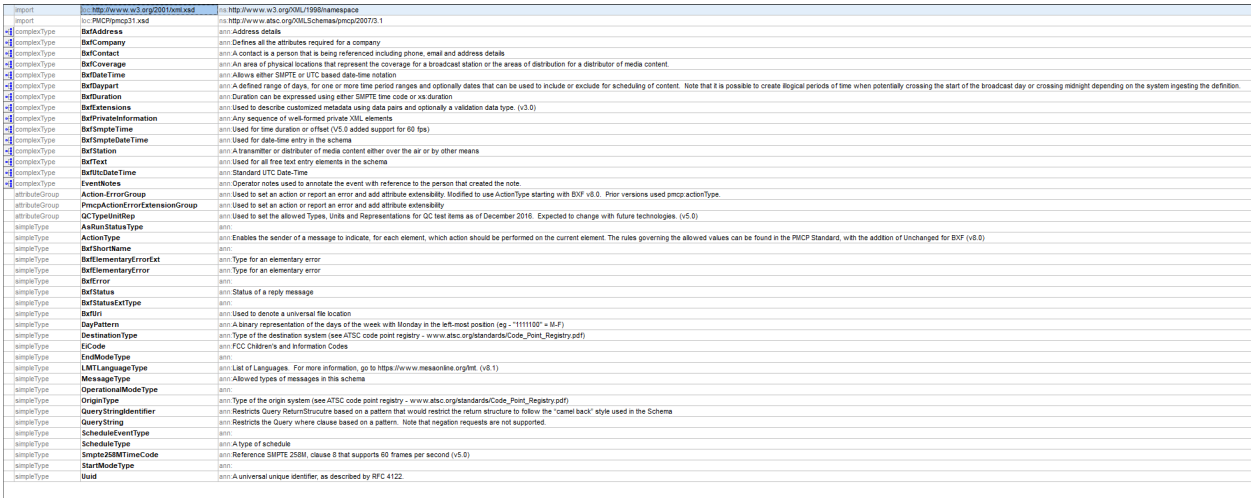
Figure 17 — BxfCaptions.xsd detail.

4.3.4 BxfTypes.xsd

4.3.4.1 BxfTypes.xsd Overview

Used to organize all the utility elements that are referenced by most of the other schema files, as shown in Figure 18. This figure is high-resolution and can be zoomed up to 400% to improve readability.

Contains:



	import	loc: http://www.w3.org/2001/xml.xsd	ns: http://www.w3.org/XML/1998/namespace
	import	loc: PMCP/pmcp31.xsd	ns: http://www.atsc.org/XMLSchemas/pmcp/2007/3.1
+	complexType	**BxfAddress**	ann: Address details
+	complexType	**BxfCompany**	ann: Defines all the attributes required for a company
+	complexType	**BxfContact**	ann: A contact is a person that is being referenced including phone, email and address details
+	complexType	**BxfCoverage**	ann: An area of physical locations that represent the coverage for a broadcast station or the areas of distribution for a distributor of media content.
+	complexType	**BxfDateTime**	ann: Allows either SMPTE or UTC based date-time notation
+	complexType	**BxfDaypart**	ann: A defined range of days, for one or more time period ranges and optionally dates that can be used to include or exclude for scheduling of content. Note that it is possible to create illogical periods of time when potentially crossing the start of the broadcast day or crossing midnight depending on the system ingesting the definition.
+	complexType	**BxfDuration**	ann: Duration can be expressed using either SMPTE time code or xs:duration
+	complexType	**BxfExtensions**	ann: Used to describe customized metadata using data pairs and optionally a validation data type. (v3.0)
+	complexType	**BxfPrivateInformation**	ann: Any sequence of well-formed private XML elements
+	complexType	**BxfSmpteTime**	ann: Used for time duration or offset (V5.0 added support for 60 fps)
+	complexType	**BxfSmpteDateTime**	ann: Used for date-time entry in the schema
+	complexType	**BxfStation**	ann: A transmitter or distributer of media content either over the air or by other means
+	complexType	**BxfText**	ann: Used for all free text entry elements in the schema
+	complexType	**BxfUtcDateTime**	ann: Standard UTC Date-Time
+	complexType	**EventNotes**	ann: Operator notes used to annotate the event with reference to the person that created the note.
	attributeGroup	**Action-ErrorGroup**	ann: Used to set an action or report an error and add attribute extensibility. Modified to use ActionType starting with BXF v8.0. Prior versions used pmcp:actionType.
	attributeGroup	**PmcpActionErrorExtensionGroup**	ann: Used to set an action or report an error and add attribute extensibility
	attributeGroup	**QCTypeUnitRep**	ann: Used to set the allowed Types, Units and Representations for QC test items as of December 2016. Expected to change with future technologies. (v5.0)
	simpleType	**AsRunStatusType**	ann:
	simpleType	**ActionType**	ann: Enables the sender of a message to indicate, for each element, which action should be performed on the current element. The rules governing the allowed values can be found in the PMCP Standard, with the addition of Unchanged for BXF (v8.0)
	simpleType	**BxfShortName**	ann:
	simpleType	**BxfElementaryErrorExt**	ann: Type for an elementary error
	simpleType	**BxfElementaryError**	ann: Type for an elementary error
	simpleType	**BxfError**	ann:
	simpleType	**BxfStatus**	ann: Status of a reply message
	simpleType	**BxfStatusExtType**	ann:
	simpleType	**BxfUri**	ann: Used to denote a universal file location
	simpleType	**DayPattern**	ann: A binary representation of the days of the week with Monday in the left-most position (eg - "1111100" = M-F)
	simpleType	**DestinationType**	ann: Type of the destination system (see ATSC code point registry - www.atsc.org/standards/Code_Point_Registry.pdf)
	simpleType	**EiCode**	ann: FCC Children's and Information Codes
	simpleType	**EndModeType**	ann:
	simpleType	**LMTLanguageType**	ann: List of Languages. For more information, go to https://www.mesaonline.org/lmt. (v8.1)
	simpleType	**MessageType**	ann: Allowed types of messages in this schema
	simpleType	**OperationalModeType**	ann:
	simpleType	**OriginType**	ann: Type of the origin system (see ATSC code point registry - www.atsc.org/standards/Code_Point_Registry.pdf)
	simpleType	**QueryStringIdentifier**	ann: Restricts Query ReturnStrucutre based on a pattern that would restrict the return structure to follow the "camel back" style used in the Schema
	simpleType	**QueryString**	ann: Restricts the Query where clause based on a pattern. Note that negation requests are not supported.
	simpleType	**ScheduleEventType**	ann:
	simpleType	**ScheduleType**	ann: A type of schedule
	simpleType	**Smpte258MTimeCode**	ann: Reference SMPTE 258M, clause 8 that supports 60 frames per second (v5.0)
	simpleType	**StartModeType**	ann:
	simpleType	**Uuid**	ann: A universal unique identifier, as described by RFC 4122.

Figure 18 — BxfTypes.xsd

4.3.4.2 BXF 8.1 Changes

Description of change: In v8.1, a new simpleType, LMTLanguageType, was added to extend the sophistication of the schema to include additional language codes. Note that "moh" (Mohawk) has been added due to a recent update of these codes. For more information, go to https://www.mesaonline.org/lmt. These are referenced in BxfCaptions.xsd (see further changes in 4.3.3).

Text representation:

```
<xs:simpleType name="LMTLanguageType">
<xs:annotation>
<xs:documentation>List of Languages. For more information, go
to https://www.mesaonline.org/lmt. (v8.1)</xs:documentation>
</xs:annotation>
<xs:restriction base="xs:string">
<xs:enumeration value="ab"/>
<xs:enumeration value="af"/>
<xs:enumeration value="ak"/>
<xs:enumeration value="tw"/>
<xs:enumeration value="sq"/>
<xs:enumeration value="arp"/>
```

```
<xs:enumeration value="am"/>
<xs:enumeration value="ar"/>
<xs:enumeration value="arq"/>
<xs:enumeration value="ar-BH"/>
<xs:enumeration value="ar-KM"/>
<xs:enumeration value="ar-DJ"/>
<xs:enumeration value="ar-ER"/>
<xs:enumeration value="ar-IQ"/>
<xs:enumeration value="ar-IL"/>
<xs:enumeration value="ar-JO"/>
<xs:enumeration value="ar-KW"/>
<xs:enumeration value="apc"/>
<xs:enumeration value="ar-LY"/>
<xs:enumeration value="ar-MR"/>
<xs:enumeration value="ary"/>
<xs:enumeration value="ar-OM"/>
<xs:enumeration value="ar-PS"/>
<xs:enumeration value="ar-QA"/>
<xs:enumeration value="ar-SA"/>
<xs:enumeration value="ar-SD"/>
<xs:enumeration value="ar-SY"/>
<xs:enumeration value="ar-AE"/>
<xs:enumeration value="aeb"/>
<xs:enumeration value="ar-EH"/>
<xs:enumeration value="ar-YE"/>
<xs:enumeration value="arz"/>
<xs:enumeration value="arb"/>
<xs:enumeration value="hy"/>
<xs:enumeration value="hyw"/>
<xs:enumeration value="as"/>
<xs:enumeration value="ay"/>
<xs:enumeration value="az-Latn"/>
```

```
<xs:enumeration value="bgq"/>
<xs:enumeration value="bm"/>
<xs:enumeration value="bnt"/>
<xs:enumeration value="hz"/>
<xs:enumeration value="ki"/>
<xs:enumeration value="tog"/>
<xs:enumeration value="toi"/>
<xs:enumeration value="eu"/>
<xs:enumeration value="be"/>
<xs:enumeration value="bn"/>
<xs:enumeration value="ber"/>
<xs:enumeration value="bho"/>
<xs:enumeration value="bi"/>
<xs:enumeration value="bs"/>
<xs:enumeration value="bg"/>
<xs:enumeration value="my"/>
<xs:enumeration value="ca"/>
<xs:enumeration value="ca-FR"/>
<xs:enumeration value="ca-ES"/>
<xs:enumeration value="chr"/>
<xs:enumeration value="zh-Hans"/>
<xs:enumeration value="zh-Hans"/>
<xs:enumeration value="zh-Hant"/>
<xs:enumeration value="zh-Hant-HK"/>
<xs:enumeration value="zh-Hant"/>
<xs:enumeration value="co"/>
<xs:enumeration value="cs"/>
<xs:enumeration value="da"/>
<xs:enumeration value="nl"/>
<xs:enumeration value="nl-NL"/>
<xs:enumeration value="vls"/>
<xs:enumeration value="dz"/>
```

```
<xs:enumeration value="en"/>
<xs:enumeration value="en-AU"/>
<xs:enumeration value="en-CA"/>
<xs:enumeration value="en-HK"/>
<xs:enumeration value="en-IE"/>
<xs:enumeration value="en-MY"/>
<xs:enumeration value="en-MS"/>
<xs:enumeration value="en-NZ"/>
<xs:enumeration value="en-CN"/>
<xs:enumeration value="en-SG"/>
<xs:enumeration value="en-ZA"/>
<xs:enumeration value="en-PH"/>
<xs:enumeration value="en-GB"/>
<xs:enumeration value="en-US"/>
<xs:enumeration value="en-001"/>
<xs:enumeration value="eo"/>
<xs:enumeration value="ekk "/>
<xs:enumeration value="fo"/>
<xs:enumeration value="fj"/>
<xs:enumeration value="fil"/>
<xs:enumeration value="fi"/>
<xs:enumeration value="fr"/>
<xs:enumeration value="fr-BE"/>
<xs:enumeration value="fr-CA"/>
<xs:enumeration value="fr-FR"/>
<xs:enumeration value="fr-CH"/>
<xs:enumeration value="fr-001"/>
<xs:enumeration value="frs"/>
<xs:enumeration value="frr"/>
<xs:enumeration value="fy"/>
<xs:enumeration value="gd"/>
<xs:enumeration value="gl"/>
```

```
<xs:enumeration value="lg"/>
<xs:enumeration value="ka"/>
<xs:enumeration value="de"/>
<xs:enumeration value="de-AT"/>
<xs:enumeration value="de-DE"/>
<xs:enumeration value="de-CH"/>
<xs:enumeration value="gsw"/>
<xs:enumeration value="grc"/>
<xs:enumeration value="el-CY"/>
<xs:enumeration value="el"/>
<xs:enumeration value="gn"/>
<xs:enumeration value="gu"/>
<xs:enumeration value="saz"/>
<xs:enumeration value="ha"/>
<xs:enumeration value="haw"/>
<xs:enumeration value="hwc"/>
<xs:enumeration value="he"/>
<xs:enumeration value="hi"/>
<xs:enumeration value="awa"/>
<xs:enumeration value="bra"/>
<xs:enumeration value="bns"/>
<xs:enumeration value="bgc"/>
<xs:enumeration value="hif"/>
<xs:enumeration value="hu"/>
<xs:enumeration value="is"/>
<xs:enumeration value="ig"/>
<xs:enumeration value="id"/>
<xs:enumeration value="iu"/>
<xs:enumeration value="ik"/>
<xs:enumeration value="ga"/>
<xs:enumeration value="it"/>
<xs:enumeration value="nap"/>
```

```
<xs:enumeration value="it-CH"/>
<xs:enumeration value="jam"/>
<xs:enumeration value="ja"/>
<xs:enumeration value="ja-Jpan-JP"/>
<xs:enumeration value="ja-Hira-JP"/>
<xs:enumeration value="ja-Kata-JP"/>
<xs:enumeration value="kl"/>
<xs:enumeration value="kn"/>
<xs:enumeration value="kfa"/>
<xs:enumeration value="kr"/>
<xs:enumeration value="kk"/>
<xs:enumeration value="rw"/>
<xs:enumeration value="ky-Cyrl"/>
<xs:enumeration value="tlh"/>
<xs:enumeration value="ko"/>
<xs:enumeration value="ku"/>
<xs:enumeration value="lbj"/>
<xs:enumeration value="lad-Latn"/>
<xs:enumeration value="lo"/>
<xs:enumeration value="la"/>
<xs:enumeration value="lv"/>
<xs:enumeration value="lt"/>
<xs:enumeration value="lb"/>
<xs:enumeration value="mk"/>
<xs:enumeration value="mg"/>
<xs:enumeration value="ms"/>
<xs:enumeration value="ml"/>
<xs:enumeration value="pcg"/>
<xs:enumeration value="mt"/>
<xs:enumeration value="mi"/>
<xs:enumeration value="mr"/>
<xs:enumeration value="ahr"/>
```

```
<xs:enumeration value="moh"/>
<xs:enumeration value="myn"/>
<xs:enumeration value="km"/>
<xs:enumeration value="mn-Cyrl"/>
<xs:enumeration value="khk-Cyrl"/>
<xs:enumeration value="mos"/>
<xs:enumeration value="meu"/>
<xs:enumeration value="na"/>
<xs:enumeration value="nv"/>
<xs:enumeration value="ne"/>
<xs:enumeration value="nso"/>
<xs:enumeration value="no"/>
<xs:enumeration value="nn"/>
<xs:enumeration value="nb"/>
<xs:enumeration value="ny"/>
<xs:enumeration value="or"/>
<xs:enumeration value="dso"/>
<xs:enumeration value="pau"/>
<xs:enumeration value="ps"/>
<xs:enumeration value="fa"/>
<xs:enumeration value="prs"/>
<xs:enumeration value="pih"/>
<xs:enumeration value="pl"/>
<xs:enumeration value="pt"/>
<xs:enumeration value="pt-BR"/>
<xs:enumeration value="pt-PT"/>
<xs:enumeration value="pa"/>
<xs:enumeration value="ro"/>
<xs:enumeration value="rm"/>
<xs:enumeration value="rn"/>
<xs:enumeration value="ru"/>
<xs:enumeration value="sm"/>
```

```
<xs:enumeration value="sa"/>
<xs:enumeration value="sh-Latn"/>
<xs:enumeration value="hr"/>
<xs:enumeration value="cnr-Latn"/>
<xs:enumeration value="sr-Latn"/>
<xs:enumeration value="crs"/>
<xs:enumeration value="ase"/>
<xs:enumeration value="asf"/>
<xs:enumeration value="bzs"/>
<xs:enumeration value="sgn-bfi"/>
<xs:enumeration value="fsl"/>
<xs:enumeration value="ins"/>
<xs:enumeration value="rsl"/>
<xs:enumeration value="si"/>
<xs:enumeration value="sk"/>
<xs:enumeration value="sl"/>
<xs:enumeration value="so"/>
<xs:enumeration value="st"/>
<xs:enumeration value="es"/>
<xs:enumeration value="es-ES"/>
<xs:enumeration value="es-001"/>
<xs:enumeration value="es-AR"/>
<xs:enumeration value="es-BO"/>
<xs:enumeration value="es-CL"/>
<xs:enumeration value="es-CO"/>
<xs:enumeration value="es-CR"/>
<xs:enumeration value="es-CU"/>
<xs:enumeration value="es-EC"/>
<xs:enumeration value="es-SV"/>
<xs:enumeration value="es-HN"/>
<xs:enumeration value="es-419"/>
<xs:enumeration value="es-MX"/>
```

```
<xs:enumeration value="es-NI"/>
<xs:enumeration value="es-PA"/>
<xs:enumeration value="es-PY"/>
<xs:enumeration value="es-PE"/>
<xs:enumeration value="es-PR"/>
<xs:enumeration value="es-US"/>
<xs:enumeration value="es-UY"/>
<xs:enumeration value="zxx"/>
<xs:enumeration value="und"/>
<xs:enumeration value="srn"/>
<xs:enumeration value="sw"/>
<xs:enumeration value="ss"/>
<xs:enumeration value="sv"/>
<xs:enumeration value="tl"/>
<xs:enumeration value="ty"/>
<xs:enumeration value="tg-Cyrl"/>
<xs:enumeration value="ta"/>
<xs:enumeration value="bfq"/>
<xs:enumeration value="iru"/>
<xs:enumeration value="te"/>
<xs:enumeration value="th"/>
<xs:enumeration value="tts"/>
<xs:enumeration value="bo"/>
<xs:enumeration value="ti"/>
<xs:enumeration value="tpi"/>
<xs:enumeration value="to"/>
<xs:enumeration value="ts"/>
<xs:enumeration value="tn"/>
<xs:enumeration value="tcy"/>
<xs:enumeration value="tr"/>
<xs:enumeration value="tk"/>
<xs:enumeration value="tvl"/>
```

```
<xs:enumeration value="uk"/>
<xs:enumeration value="ur"/>
<xs:enumeration value="com"/>
<xs:enumeration value="uz"/>
<xs:enumeration value="vi"/>
<xs:enumeration value="cy"/>
<xs:enumeration value="wo"/>
<xs:enumeration value="xh"/>
<xs:enumeration value="yi"/>
<xs:enumeration value="yo"/>
<xs:enumeration value="zu"/>
</xs:restriction>
</xs:simpleType>
```

4.3.5 ContentDelivery.xsd

4.3.5.1 ContentDelivery.xsd Overview

Describes the various ways that media content using industry-standard methods can be delivered from one location to another, as shown in Figure 19. This figure is high-resolution and can be zoomed up to 400% to improve readability.

Contains:

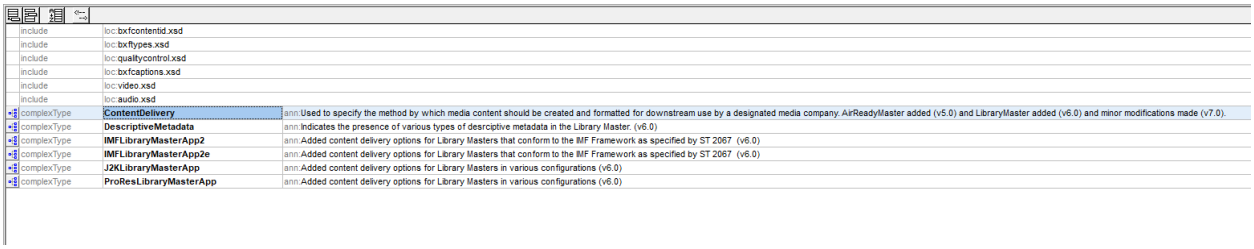


Figure 19 — ContentDelivery.xsd

4.3.5.2 BXF 8.1 Changes

Description of change: MultiChannelAudioStreams described in the Audio.xsd are also referenced in this XSD and contain the same modifications as described previously under the Audio.xsd. In addition, under the element J2KLibraryMasterApp, the use of MultiChannelAudioStreams has been changed from being an optional entry to a required entry. The changes are also shown in Figure 20.

Text representation:

```
<xs:complexType name="J2KLibraryMasterApp">
<xs:annotation>
<xs:documentation>Added content delivery options for Library Masters in various configurations (v6.0)</xs:documentation>
</xs:annotation>
<xs:sequence>
     <xs:element name="ImageEssence" minOccurs="0">
     <xs:annotation>
     <xs:documentation>Description of the video image essence for J2K content.(v6.0 and updated in v7.0 to remove 4-2-0 that was not appropriate and fix other labeling errors). </xs:documentation>
     </xs:annotation>
     <xs:complexType>
          <xs:complexContent>
               <xs:extension base="J2KImageEssence">
                    <xs:sequence>
                         <xs:element name="J2KEncodingProfile" type="J2KEncodingProfile">
                         <xs:annotation>
                         <xs:documentation>Implementations shall support the combinations of JPEG 2000 IMF profiles (as specified in ISO/IEC 15444-1:2016). (v7.0)</xs:documentation>
                         </xs:annotation>
                         </xs:element>
                    </xs:sequence>
               </xs:extension>
          </xs:complexContent>
     </xs:complexType>
</xs:element>
<xs:element name="MultiChannelAudioStreams" type="MultiChannelAudioStreams">
<xs:annotation>
```

```
<xs:documentation>A collection of one or more audio streams with the same encoding
method that further incorporates groups of audio channels in a specific format as
defined in ST 377-4. If a data stream (MXF audio essence track) contains multiple
encodings (e.g., PCM and Dolby E), then multiple MultiChannelAudioStreams must be
used. (v8.1)</xs:documentation>
</xs:annotation>
```

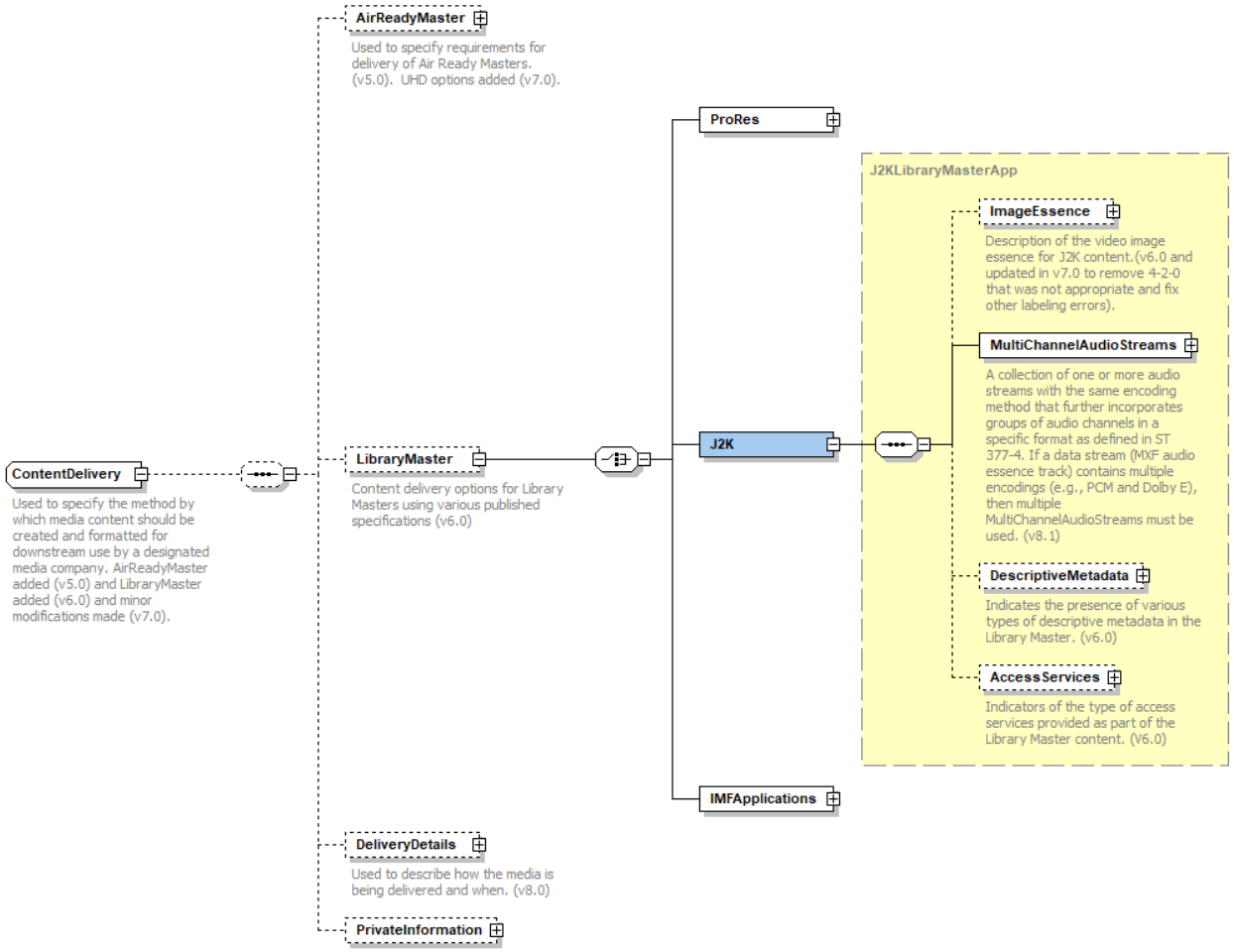


Figure 20 — ContentDelivery.xsd detail.

4.3.6 Location.xsd

4.3.6.1 Locations.xsd Overview

Identification of where the media is stored, as shown in Figure 21. Used by systems to notify locations of essence instance.

Contains:

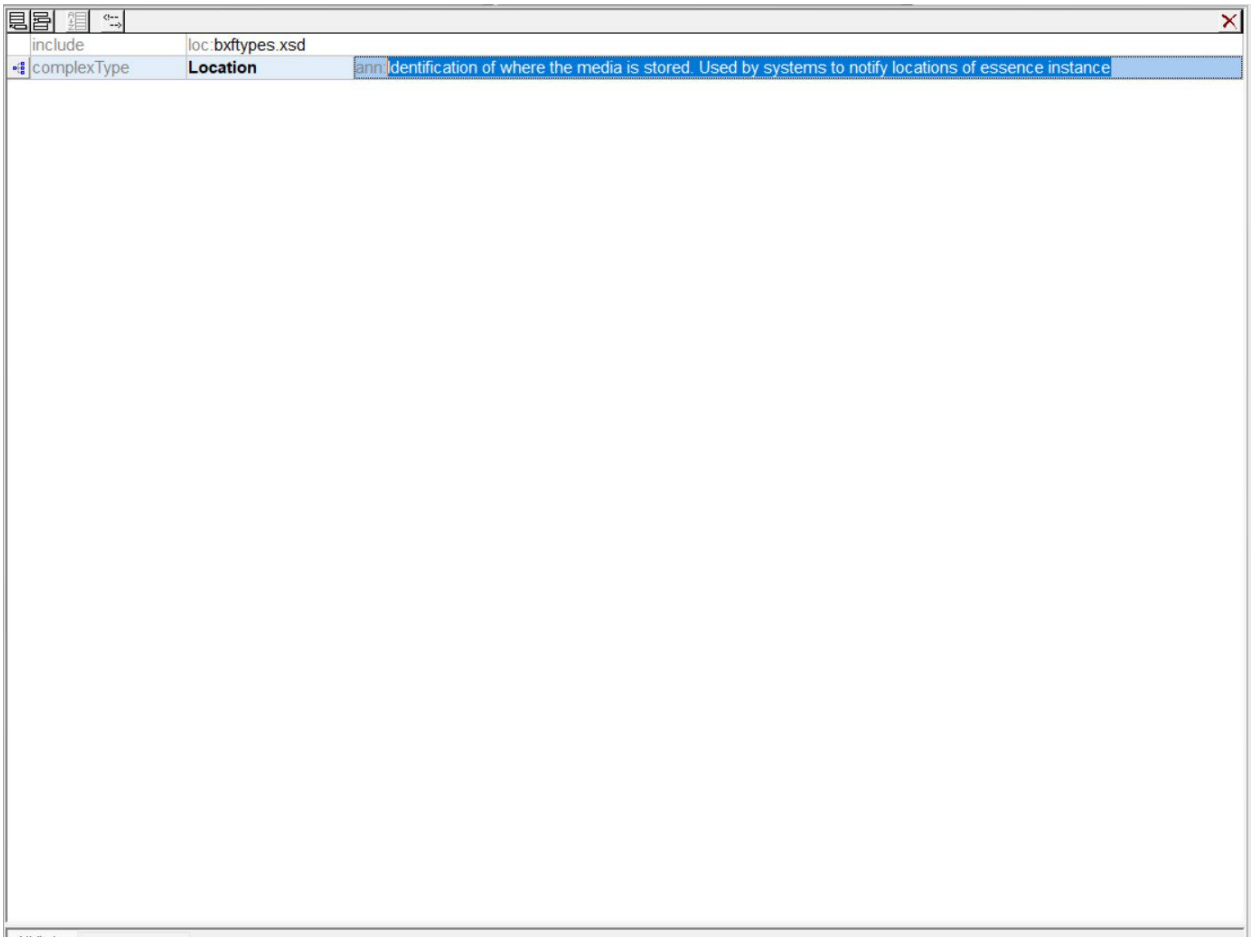


Figure 21 — Location.xsd

4.3.6.2 BXF 8.1 Changes

Description of change: Added a new attribute to the complexType, Location, called fileSize, which is an integer and may indicate the number of total bytes that the media asset file that is referenced in Location has, as shown in Figure 22.

Text representation:

```
<xs:complexType name="Location">
<xs:annotation>
<xs:documentation>Identification of where the media is stored. Used by systems to notify locations of essence instance</xs:documentation>
</xs:annotation>
<xs:sequence>...
<xs:choice>...
...
<xs:attribute name="fileSize" type="xs:integer">
<xs:annotation>
<xs:documentation>Total size of the media asset in bytes. (v8.1)</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attributeGroup ref="Action-ErrorGroup"/>
</xs:complexType>
```

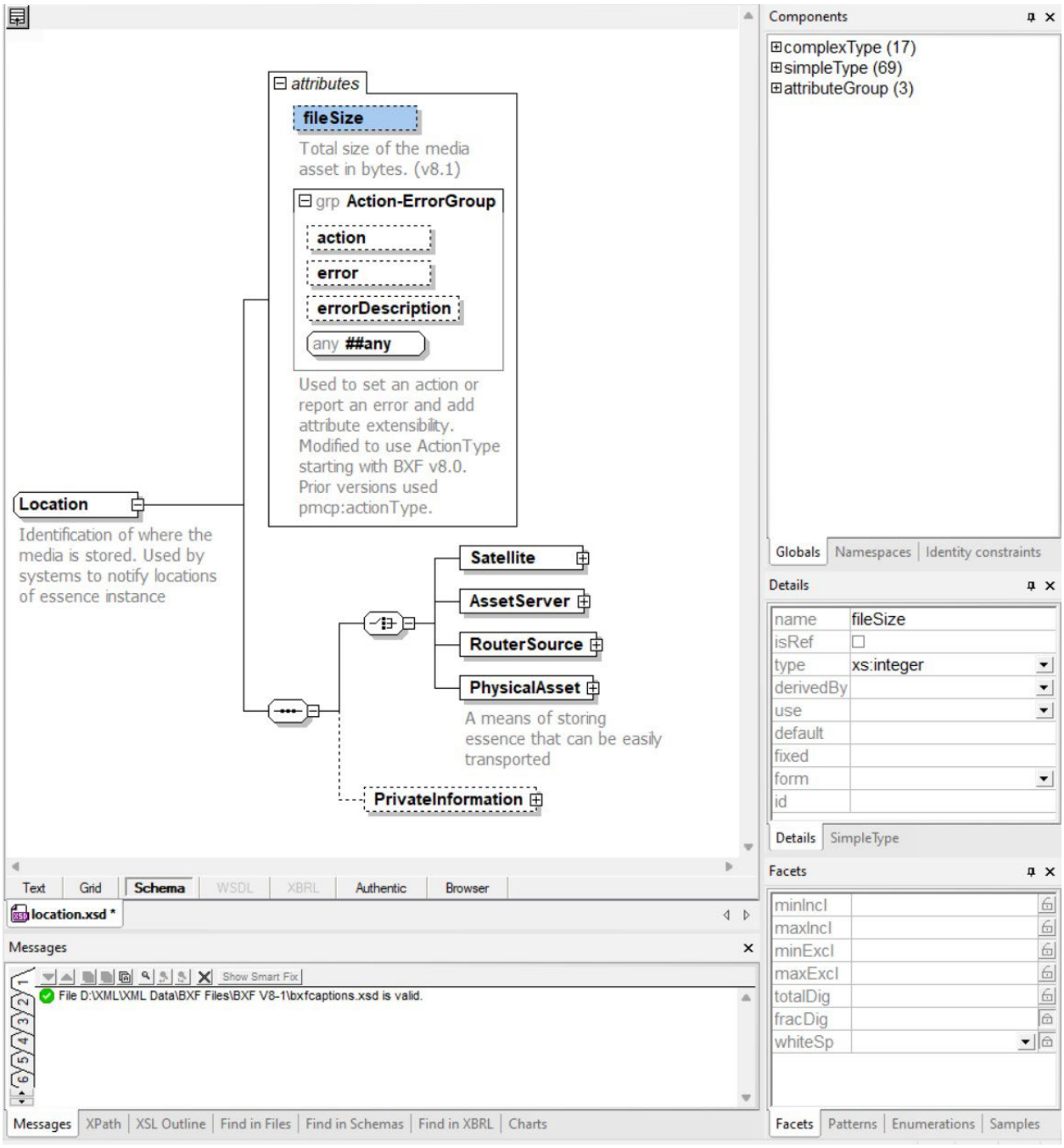


Figure 22 — Location.xsd detail.

4.3.7 Video.xsd

4.3.7.1 Video.xsd Overview

Enumerates the various values relating to the presentation of video, as shown in Figure 23.

Contains:

import	loc:PMCP/pmcp31.xsd	ns:http://www.atsc.org/XMLSchemas/pmcp/2007/3.1
include	loc:bxftypes.xsd	
complexType	**AFDData**	ann:Used to describe both Active Format Description Codes, Shorthand Text Descriptions and Bar Data options. (v3.0)
complexType	**AFDDetails**	ann:
complexType	**ChromaSubsampling**	ann:The practice of encoding images by implementing less resolution for chroma information than for luma information, taking advantage of the human visual system's lower acuity for color differences than for luminance. (v6.0)
complexType	**DynamicRange**	ann:Used to indicate whether the video content has either a standard dynamic range (SDR) or a high dynamic range (HDR). (v7.0)
complexType	**ImageEssence**	ann:Description of the video image essence for ProRes, J2K and others. (v6.0)
complexType	**IMFChromaSubsample4-2-2**	ann:The two chroma components are sampled at half the sample rate of luma: the horizontal chroma resolution is halved. This reduces the bandwidth of an uncompressed video signal by one-third with little to no visual difference. (v6.0)
complexType	**IMFImageEssenceApp2**	ann:Description of the video image essence for IMF Applications as a specialization of the IMF Framework. (v6.0)
complexType	**IMFImageEssenceApp2e**	ann:Description of the video image essence for IMF Applications as a specialization of the IMF Framework. All references are taken from SMPTE ST 2067-21:2016 Clause 5.1 and reference Table 3. (v6.0).
complexType	**J2KChromaSubsampling**	ann:The practice of encoding images by implementing less resolution for chroma information than for luma information, taking advantage of the human visual system's lower acuity for color differences than for luminance. (v7.0)
complexType	**J2KEncodingProfile**	ann:JPEG-2000 Encoding Options (v6.0)
complexType	**J2KEncodingProfile-SD**	ann:Implementations shall support the profile and level combinations utilizing JPEG 2000 Profiles as specified in ISO/IEC 15444-1 Amendment 3. (v6.0)
complexType	**J2KImageEssence**	ann:Description of the video image essence for ProRes, J2K and others. (v7.0)
complexType	**TSVideo**	ann:Enumerates the various values relating to the presentation of video in a transport stream
complexType	**Video**	ann:Enumerates the various values relating to the presentation of video
complexType	**VideoTransition**	ann:Allows the user to specify specific actions to be used by the automation system to transition the video from one event to another
simpleType	**AspectRatioType**	ann:Enumerates either 4:3 or 16:9 video presentation formats
simpleType	**TSVideoEncodingType**	ann:Enumerates various methods used to compress video in a transport stream
simpleType	**VideoEncodingType**	ann:Enumerates various methods of compressing video (v6.0)
simpleType	**VideoFormatType**	ann:Enumerates the different video presentation formats (v6.0)
simpleType	**VideoRateType**	ann:Enumerates the speed of a video transition
simpleType	**VideoTransitionEnumType**	ann:Enumerates various transition options

Figure 23 — Video.xsd

4.3.7.2 BXF 8.1 Changes

Description of change: A new optional element, BurnedInText, was added to Video that can be used to indicate the presence of text that is "burned into" the video. It includes an element referencing the new LMTLanguage and an attribute to enter the language of the text – lang as shown Figure 23 and Figure 24.

In addition, minor typos were discovered in several annotations and corrected in v8.1, specifically, the following:

- **`ActiveImageAspectRatio`:** "`it's`" was corrected to "`its`", so that the annotation states: "`Width of the active video image divided by its height`".
- **`DynamicRange`:** "`hign`" was corrected to "`high`", so that the annotation states: "`Used to indicate whether the video content has either a standard dynamic range (SDR) or a high dynamic range (HDR).`"
- **`TSVideoEncodingType`**: "`methids`" was corrected to "`methods`", so that the annotation states: "`Enumerates various methods used to compress video in a transport stream`".

The changes are also shown in Figure 23 and Figure 24.

Text representation:

```
<xs:element name="BurnedInText" minOccurs="0">
<xs:annotation>
<xs:documentation>Indicates the presence of text that is burned into the video in order to comply with accessibility requirements. (v8.1)</xs:documentation>
</xs:annotation>
<xs:complexType>
<xs:sequence minOccurs="0">
<xs:element name="LMTLanguage" type="LMTLanguageType" minOccurs="0">
<xs:annotation>
```

```
<xs:documentation>Language used for the Burned In Text, more specific than lang
attribute.</xs:documentation>
</xs:annotation>
</xs:element>
</xs:sequence>
<xs:attribute name="lang" type="pmcp:languageType">
<xs:annotation>
<xs:documentation>Language of the Burned In Text.</xs:documentation>
</xs:annotation>
</xs:attribute>
<xs:attributeGroup ref="Action-ErrorGroup"/>
</xs:complexType>
</xs:element>
```

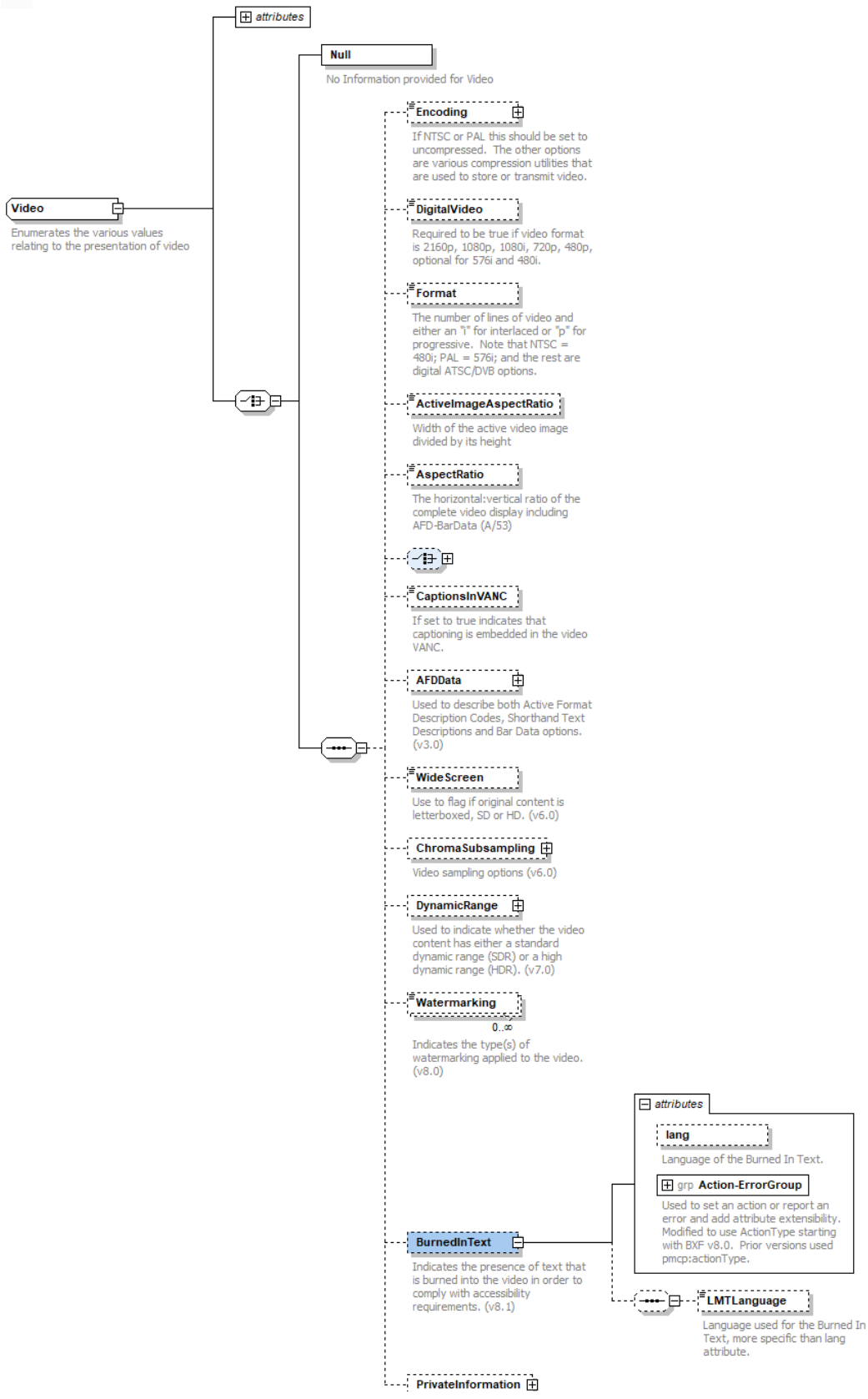


Figure 24 — Video.xsd detail.

Annex A
(Informative)

Additional Elements

This annex lists non-prose elements of this document, as shown in Table A.1.

Table A.1 — Non-prose Elements

Non-prose Elements	Description
ST2021-4a-2023.zip	Schema XSD files (Normative)
ST2021-4b-2023.zip	HTML representation of the schema (Informative)