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**Event Scheduling and Notification Interface
(ESNI)**

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Introduction

1.1. Executive Summary

Video distribution is transitioning from Quadrature Amplitude Modulation (QAM) to delivery over Internet Protocol (IP) networks. These IP networks are delivering video content to subscribers via many distribution paths to many IP-connected devices, including mobile phones, tablets and game consoles for video content of all forms, including Video on Demand (VOD) and linear, live content.

Many QAM systems were developed to enable programmers to inform and affect the content delivery to subscribers. For example, during a regional sports blackout, a video provider may use an Integrated Receiver and Decoder (IRD) to provide alternate content to a unique geographic area serving a set of subscribers.

As distributors migrate to IP-delivered content, systems must be created to replicate the traditional functional systems in order to create a contiguous service capability between QAM and IP video delivery. Additionally, providers are also delivering single mezzanine quality feeds to the distributor. This requires the distributor to also replicate the functionality on the traditional delivery system.

1.2. Scope

This document defines the Event Scheduling and Notification Interface (ESNI), which is a web interface facilitating the transmission of event and policy information. ESNI provides a functional method for providers to communicate upcoming schedule or signal-based events and corresponding policy to distributors. This interface allows existing content distribution controls traditionally performed via manual control in IRD's by providers to be replaced with a programmatic interface (this standard). ESNI policy enables control of content distributed to audiences based on attributes of that audience including (but not limited to) geographic location and device type.

1.3. Benefits

ESNI can be used to communicate details regarding regional blackout/alternate content selection, market protection, or other content restrictions as they may relate to a defined audience. This method can also inform the distributor of other events such as advertising breaks and availability for digital ad insertion, network PVR record times and restrictions, or program information (i.e. improve accuracy of electronic program guide). SCTE 268 (Operational Practice of SCTE 224 for Advertising Information) expands upon the use of SCTE 224 to enable addressable and enhanced advertising. Additionally, ESNI supports an audit method that allows the provider to query the status of policy execution and verify the execution result.

1.4. Intended Audience

Content Providers, Multi-Channel Video Program Distributors, TV Everywhere Providers/Distributors.

This standard uses Extensible Markup Language (XML) extensively. A markup language defines a set of rules for encoding documents in a format that is both human-readable and machine-

readable. The reader is referred to the normative XML references for additional background and definitions.

1.5. Areas for Further Investigation or to be Added in Future Versions

There are two areas for further investigation and potential future versions. One area would be providing the ability to verify the audiences accessible on the distributor execution platform. Another would be further definition, enhancement, and standardization of the metadata fields in this standard.

2. Normative References

The following documents contain provisions, which, through reference in this text, constitute provisions of this document. At the time of Subcommittee approval, the editions indicated were valid. All documents are subject to revision; and while parties to any agreement based on this document are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents might not be compatible with the referenced version.

2.1. SCTE References

- SCTE 35 2020, Digital Program Insertion Cueing Message.
- ANSI/SCTE 236 2017, Content Metadata.

2.2. Standards from Other Organizations

- ISO 8601:2004, Data elements and interchange formats -- Information interchange -- Representation of dates and times (Coordinated Universal Time).
- IETF RFC 2119, Key words for use in RFCs to Indicate Requirement Levels. S. Bradner. March 1997.
- IETF RFC 3986, Uniform Resource Identifier (URI): Generic Syntax. T. Berners-Lee, R. Fielding, L. Masinter. January 2005.
- IETF RFC 4684, Constrained Route Distribution for Border Gateway Protocol/MultiProtocol Label Switching (BGP/MPLS) Internet Protocol (IP) Virtual Private Networks (VPNs). P. Marques, R. Bonica, L. Fang, L. Martini, R. Raszkuk, K. Patel, J. Guichard. November 2006.
- IETF RFC 5246, The Transport Layer Security Protocol Version 1.2. T. Dierks. August 2008.
- IETF RFC 6749, The OAuth 2.0 Authorization Framework. D. Hardt. October 2012.
- IETF RFC 7230, Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing. R. Fielding, J. Reschke. June 2014.
- IETF RFC 7231, Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content. R. Fielding, J. Reschke. June 2014.
- IETF RFC 8446, The Transport Layer Security (TLS) Protocol Version 1.3.
- W3C XML Base (Second Edition). W3C Recommendation 28 January 2009. <http://www.w3.org/TR/xmlbase/>.
- W3C XML Schema Part 2: Datatypes Second Edition. W3C Recommendation 28 October 2004. <http://www.w3.org/TR/xmlschema-2/>.

- W3C XML Path Language (XPath) 2.0 (Second Edition). W3C Recommendation 14 December 2010. <http://www.w3.org/TR/xpath20/>.
- W3C XML Linking Language (XLink) Version 1.1. W3C Recommendation 06 May 2010. <http://www.w3.org/TR/xlink11/>.

2.3. Published Materials

- No normative references are applicable.

3. Informative References

The following documents might provide valuable information to the reader but are not required when complying with this document.

3.1. SCTE References

- ANSI/SCTE 250 Real-time Event Signaling and Management API
- SCTE 268 Operational Practice of SCTE 224 for Advertising Information

3.2. Standards from Other Organizations

- Real-time Event Signaling and Management OC-SP-ESAM-API-C01-161021, 10/21/2016, Cable Television Laboratories, Inc.
- A/335 “Video Watermark Emission” with Amendment 1: <https://www.atsc.org>
- Entertainment ID Registry Association (EIDR) – <http://eidr.org>

3.3. Published Materials

- No informative references are applicable.

4. Compliance Notation

<i>shall</i>	This word or the adjective “ <i>required</i> ” means that the item is an absolute requirement of this document.
<i>shall not</i>	This phrase means that the item is an absolute prohibition of this document.
<i>forbidden</i>	This word means the value specified shall never be used.
<i>should</i>	This word or the adjective “ <i>recommended</i> ” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighted before choosing a different course.
<i>should not</i>	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
<i>may</i>	This word or the adjective “ <i>optional</i> ” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.
<i>deprecated</i>	Use is permissible for legacy purposes only. Deprecated features may be removed from future versions of this document. Implementations should avoid use of deprecated features.

5. Abbreviations and Definitions

5.1. Abbreviations

Ad-ID	Advertisement Identifier Registry
EIDR	Entertainment Identifier Registry
ESAM	Event Signaling and Management
ESNI	Event Scheduling and Notification Interface
HMAC-SHA256	Hashed Message Authentication Code with Secure Hash Algorithm, 256 bits
HREF	Hypertext REference
HTTP	Hypertext Transfer (or Transport) Protocol
IRD	integrated receiver/decoder
MVPD	multichannel video programming distributor
NPT	normal play time
QAM	quadrature amplitude modulation
TZD	time zone designator
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Number
UTC	Coordinated Universal Time (or Universal Time Coordinated)
VIRD	virtual IRD
VOD	video on demand
XML	eXtensible Markup Language

5.2. Definitions

ESNI Event	Point of interest relative to the timeline of a media presentation. In this standard, it is represented by an in-band signal, wall clock time, or offset from the start of the media.
Event Scheduling and Notification Service	Receives ESNI event and policy information and provides feedback on the application of the events and policies.
Scheduler	Also referred to as the Alternate Content Scheduling System, it maintains the metadata associated with alternate content events, such as program information, duration, and affected geo-location.
Virtual IRD	A logical grouping of subscribers loosely associated with their geographic location and conceptually similar to an IRD coverage area.
eXtensible Markup Language (XML)	A markup language defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. The reader is referred to the normative XML references for additional background and definitions.

5.3. Style Conventions

The following conventions are used within this document.

- XML Elements names are capitalized and are represented in the document in bold, fixed-width font as in **Element**. When expressing an element hierarchy, a forward slash is used as in **Element1/Element2**. Element names comprised of multiple words are expressed using upper-camel-case as in **ThisElement**. Element cardinality is expressed in this document as <minOccurs>...<maxOccurs>, where the values are the minimum and maximum occurrences of the element respectively.
- XML Attribute names are preceded by an '@' character, begin with a lower-case letter and represented in the document as a fixed-width font as in @attribute. When expressing an attribute as a child of a specific element, a forward slash is used as in **Element/@attribute**. Attribute names comprised of multiple words are expressed using lower-camel-case as in @thisAttribute. Attributes *may* be characterized as mandatory (M), optional (O), optional with default value (OD) or conditionally mandatory (CM). The reader should see the Description column in the table or the section containing the table to determine the criteria associated with the CM identifier.
- XML Type names are enclosed in "<" and ">" characters and are represented in the document in bold, fixed-width font as in **<Type>**.

6. Overview (Informative)

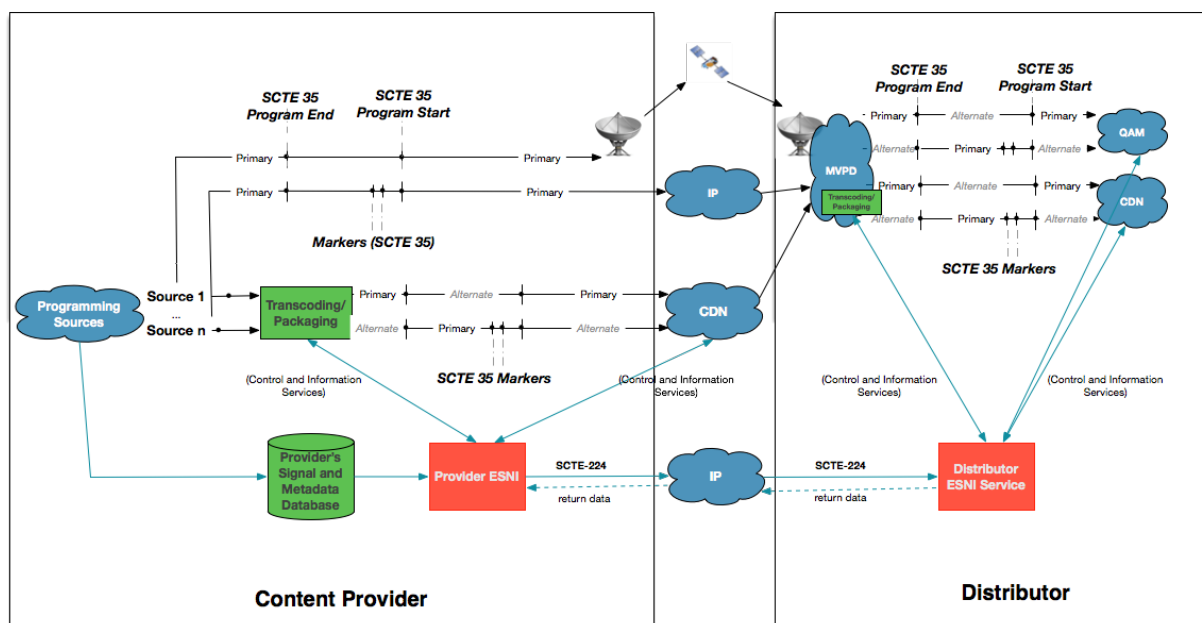


Figure 1 - Conceptual Cable Alternate Content Ecosystem (Non-Normative)

Table 1 - Alternate Content Element Descriptions

Alternate Content Elements	Description
Provider ESNI	Provides ESNI events and policy information to distributor systems. <i>May</i> optionally provide program information. <i>May</i> also provide direct to consumer event directives.
Distributor ESNI Service	Receives ESNI event and policy information from a provider and makes feedback available on the application of the events and policies back to the provider. Interacts with delivery systems to detect ESNI events and apply policies.
Programming Sources	Video/audio sources that <i>may</i> contain SCTE 35 signals.
Transcoding/Packaging	Sends and receives signal data and <i>may</i> receive directives to affect the video/audio stream, if necessary, for downstream processing and/or event decision-making.
Provider Signal and Metadata Database	Houses signal and/or programming metadata that <i>may</i> be used by the Provider ESNI service for the purposes of policy distribution and/or event directive enforcement.

7. XML Practices

The ESNI data model is specified in the XML Schema, and the reader is assumed to be reasonably informed on practices associated with XML processing. Note, for the SCTE 224 schema, versions of the schema are identified by the “version” attribute of the schema in the form of “yyyymmdd”. With such general practice and understanding, throughout the document there *may* be expressly identified XML areas of practice to which attention is called to eliminate possible ambiguity or lack of clarity.

7.1. Document Order

One such topic as it relates to this standard is the preservation of strict document order throughout the processing of a XML documents. Strict document order *shall* be both preserved during transfer as well as during processing.

7.2. Representation of time

Unless otherwise specified, all duration and date and time values in this data model *shall* use the formats specified in [XMLSCHEMA2], which are closely related to [ISO8601].

The XML Schema dateTime data type allows for values to include a Time Zone Designator (TZD). If a TZD is not present, the time is assumed to be local relative to the end-user, as represented by the user-agent or device. While it *may* be safe to assume local time when communicating within the same time zone, it is ambiguous when used in communicating across different time zones. Time values in this data model *should* include a time zone designator. When a TZD is present, the time is specified as a local time followed by a numeric offset from UTC. If the time zone is UTC (i.e. an offset of zero), the special designator “Z” *may* be used. The following values represent the same instant in time

- 18:30:00Z
- 18:30:00+00:00
- 22:30:00+04:00
- 11:30:00−07:00

The XML Schema duration data type is the appropriate format for carrying a time period.

7.3. Use of identifiers and references

All elements defined in this specification *shall* be identified by a Uniform Resource Identifier (URI) using the @id attribute. The @id *shall* be expressed in a relative form and *shall not* be combined with an @xml:base and *shall* be relative to the defined service. The @id values are not meant to imply any mandatory convention outside of the basic URI format and *may* be defined by the provider.

Reusable elements defined in this standard *shall* be locatable by their @id attribute and therefore their @id attributes *shall* result in a URL relative to the service base.

7.4. Use of namespaces

All documents based on this standard *shall* declare the following namespaces as part of the document element or use fully qualified namespaces.

Table 2 - Namespaces

Recommended Prefix	Namespace
<default>	http://www.scte.org/schemas/224
xlink	http://www.w3.org/1999/xlink
action	urn:scte:224:action
audience	urn:scte:224:audience

Example **Media** element with namespace declarations:

```
<Media xmlns="http://www.scte.org/schemas/224"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  id="/media/1" description="TRU" lastUpdated="2018-02-03T19:31:32.3280038Z">
  <MediaPoint id="/mpl" description="Start of Program 1">
```

```

<Apply>
  <Policy xlink:href="/p/1"></Policy>
</Apply>
</MediaPoint>
</Media>

```

7.5. Use of XLink

Elements of type **<ReusableType>** or **<AuditType>**, and their derivatives, allow the use XLink to reference existing resources. These XLink references shall be type "simple" as defined in the XLink Recommendation.

8. Data Model (Normative)

A provider manages the ESNI data using the interface defined in Section 9 on a distributor's Event Scheduling and Notification Interface set of services. The provider manages data model entities for **Media**, **Policy**, **ViewingPolicy**, and **Audience** and associated dependent elements of which an overview is shown in Figure 2.

The data model also supports an Audit element, which can be accessed by the provider on the distributor's Event Scheduling and Notification Interface service to audit the application of ESNI data.

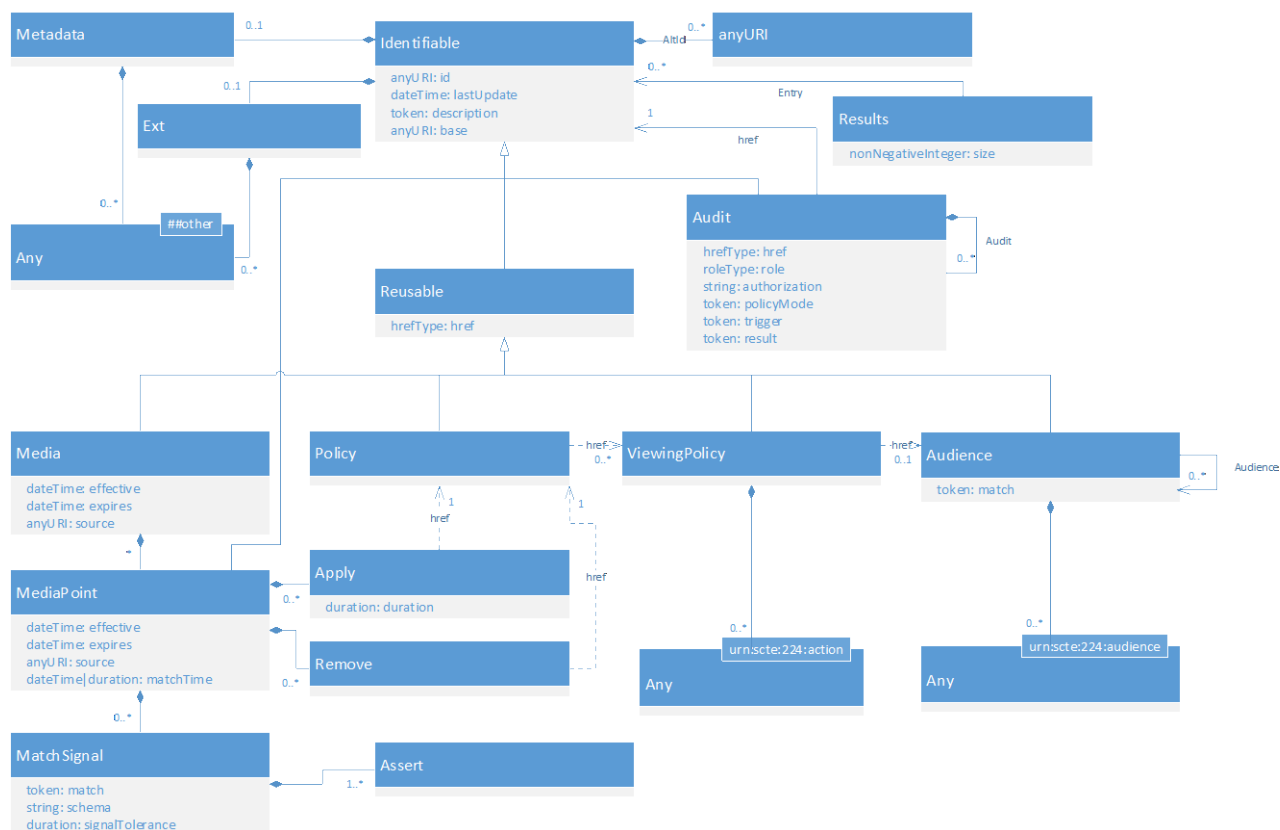


Figure 2 - Data Model UML Class Diagram

8.1. IdentifiableType

IdentifiableType is an abstract base type, which includes basic attributes for identification, description, and versioning, as well as a collection of alternative ID values to support correlation with other identification schemes and an Ext element for general extensibility.

Table 3 - Semantics of the IdentifiableType Complex Type

Element or Attribute Name	Use	Description
@id	M	A Uniform Resource Identifier (URI). This value <i>shall</i> directly identify the resource that it represents and <i>may</i> also locate the identified resource, however, it <i>shall not</i> be presumed to do so unless provided as a URL per 7.3. (See Table 7 for more information on the use of this attribute.)
@description	O	A common description used for the resource. See the derived types for guidance on how to use this attribute. This value is not required to be unique and <i>shall not</i> be used to definitively identify the content. The language of this attribute content <i>shall</i> be consistent throughout the document. Additional language descriptions <i>may</i> be provided through the Metadata element.
@lastUpdated	M	The date and time when the resource was last modified. Primary versioning is only mutable by the provider. (See Table 7 for more information on the use of this attribute.)
@xml:base	O	Explicitly provides the base URI for the purpose of resolving the relative URIs contained in @xlink:href attributes. See 7.3 for more details.
AltID	0..N	<i>May</i> be used to express additional identifiers (e.g. EIDR for entertainment or Ad-ID for advertisements) that identify the associated content. Alternative identification <i>may</i> be used for house identifiers or identification that does not possess a global namespace or uniqueness. The values used in this element are contextual to its parent element.
Metadata	0..1	Allows for descriptive metadata associated with this resource. Important to note that it allows for any metadata from any namespace and does not prescribe a specific metadata format nor validate the structure of that metadata.
Ext	0..1	This element is provided for extensibility. It <i>may</i> be used to contain any attribute or element from any other namespace.
Conventions used in the tables: For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory. For elements: <minOccurs>..<>maxOccurs>, where N=unbounded		

8.1.1. AltID

The Alternate Identifier *may* be used to express additional identifiers (e.g. EIDR, Ad-ID, etc.) that identify the associated content. Alternative identification *may* be used for house identifiers or identification that does not possess a global namespace or uniqueness. The values used in this element are contextual to its parent element. Details of a provider's implementation of the **AltID** element should be described in the provider's User's Guide (see Appendix C).

Table 4 - Semantics of the AltID element

Element or Attribute Name	Use	Description
@description	O	A freetext description or label for the alternate identifier being provided.
@type	O	Use the values below exactly as shown when appropriate. • CallSign • EIDR • Ad-ID • private:* (where asterisk is a wild card for any set of characters)

Example AltID element of a Media, with “description” attribute.

```
<MediaPoint id="media/tbs" description="Some Program" lastUpdated="2017-08-09T14:58:21.7767975Z">
  <AltID description="Series Id" type="private:Gracenote">Tribune/EP002741720000</AltID>
  <AltID description="Episode Id" type="private:Gracenote">Tribune/EP002741720023</AltID>
</MediaPoint>
```

Example AltID element of a Media, with “type” attribute for an EIDR video stream ID.

```
<MediaPoint id="media/tbs" description="Some Program" lastUpdated="2017-08-09T14:58:21.7767975Z">
  <AltID type="EIDR">10.5239/6BCD-37E0</AltID>
</MediaPoint>
```

Example AltID element of a Media, with “type” attribute.

```
<MediaPoint id="media/tbs" description="Some Program" lastUpdated="2017-08-09T14:58:21.7767975Z">
  <AltID type="Ad-ID">CNPA0484000H</AltID>
</MediaPoint>
```

8.1.2. Metadata

Metadata allows for descriptive metadata associated with a resource. Metadata allows for any metadata in any format ranging from the standard urn:scte:224:metadata, or SCTE 236, or a proprietary namespace. The values used in this element are contextual to its parent element. Details of a provider's implementation of the **Metadata** element should be described in the provider's User's Guide (see Appendix C).

Table 5 - Semantics of the Metadata element

Element or Attribute Name	Use	Description
Any	0..N	An element provided using either the standard urn:scte:224:metadata namespace or a proprietary namespace and expressing a property of the containing resource. Common metadata properties are defined by SCTE external to this specification.

8.2. ReusableType

ReusableType is an abstract base type extended from IdentifiableType. ReusableType adds an optional attribute `@xlink:href` to be used when the element is provided as a reference to a resource of the same type.

ReusableType elements can be expressed in two modes: Globally Reusable or Reference. Globally Reusable elements have a unique identifier, provided in the `@id` attribute, and are intended to be referenced and reused from other elements, but managed separately. Reference elements occur within another identifiable element and include an `@xlink:href` attribute, which identifies a globally reusable element.

This approach allows a flexible application of reuse modes for **Media**, **Policy**, **ViewingPolicy** and **Audience** elements to support efficient and concise data model maintenance.

Table 6 - Reusable Modes

	Child of IdentifiableType	<i>shall have</i> @id	<i>shall have</i> @xlink:href	<i>may have</i> child elements
Globally Reusable	No	Yes	No	Yes
Reference	Yes	No	Yes	No

Table 7 - Semantics of the ReusableType Complex Type

Element or Attribute Name	Use	Description
@id	CM	Inherited from <i>IdentifiableType</i> (See 8.1) This attribute <i>shall</i> be provided unless xlink:href is present.
@description	O	Inherited from <i>IdentifiableType</i> (See 8.1)
@lastUpdated	CM	Inherited from <i>IdentifiableType</i> (See 8.1) This value is mandatory if the @id attribute is also provided. If the element contains an external resource that has been updated, the provider <i>shall</i> update this value.
@xml:base	O	Inherited from <i>IdentifiableType</i> (See 8.1)
@xlink:href	CM	Presence of this attribute indicates that this element is a reference to an existing resource. The resource is both identifiable and locatable using the URL provided in this attribute. The presence of this attribute explicitly indicates a reference to a globally defined element. Therefore, it <i>shall not</i> be present along with the @id attribute and further, any other attribute that is expressed <i>shall</i> be ignored as it <i>may</i> conflict with the identified referenced element.
AltID	0..N	Inherited from <i>IdentifiableType</i> (See 8.1.1)
Metadata	0..1	Inherited from <i>IdentifiableType</i> (See 8.1.2)
Ext	0..1	Inherited from <i>IdentifiableType</i> (See 8.1)
Conventions used in the tables: For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory. For elements: <minOccurs>..<maxOccurs>, where N=unbounded		

8.3. Media

The term, Media, is purposely broad and is applicable to all forms of on-demand, time-shifted and linear content, as well as other forms of media not explicitly mentioned here. Media is instantiated as a global **Media** element, which contains a collection of **MediaPoint** elements. When a **Media** element is used to represent a linear source, it *should* represent the network over a defined time period (e.g. one or more days) and not an individual program.

A **Media** element *may* be associated with one or more sources of content that comprise a branded presentation experience. The source identifier is important for matching signals (time or in-band), which *may* trigger the application (or removal) of a given Policy. In the case where a subscriber presentation is drawn from multiple sources, the definition of the set of sources comprising a given subscriber experience is out of scope of this standard. For a linear service, one AltID *should* be an EIDR Video Service ID.

The primary identification mechanism of the **Media** element is the @id attribute. The **Media** element *may* carry or provide alternative identifiers by means of the contained child **AltID** element. The @description attribute provides expanded descriptive text. The **Metadata** child element *may* be used for carrying more complex descriptive metadata data structures, potentially from other namespaces.

The main purpose of the **Media** element is to provide contextual encapsulation for **MediaPoint** elements, which are defined in section 8.4.

Table 8 - Semantics of the Media element

Element or Attribute Name	Use	Description
@id	CM	Inherited from <i>ReusableType</i> (See 8.2) This value <i>may</i> directly identify the content feed that it represents, but it shall not be presumed to do so. If this value does not directly identify the associated content feed then at least one AltID shall be provided that does identify the content, network or asset.
@description	O	Inherited from <i>IdentifiableType</i> (See 8.1) A common description used for the Media, which <i>may</i> be a call-sign commonly used for a linear network such as “ESPN” or an asset title such as “Titanic”.
@lastUpdated	CM	Inherited from <i>ReusableType</i> (See 8.2)
@xml:base	O	Inherited from <i>IdentifiableType</i> (See 8.1)
@xlink:href	CM	Inherited from <i>ReusableType</i> (See 8.2)
@effective	O	The date and time when any contained child MediaPoint element first becomes eligible for consideration. This value shall not be greater than the start of any explicit MediaPoint /@effective attribute value.
@expires	O	The date and time when any contained child MediaPoint element is no longer eligible for consideration. This value shall not be less than any explicit MediaPoint /@expires attribute value.
@source	O	This value <i>may</i> be used to explicitly identify the default URI of the content associated with this Media element. Providing a default @source attribute would be helpful if this Media element is used to reference multiple content sources.
AltID	0..N	Inherited from <i>IdentifiableType</i> (See 8.1.1)