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HTTP Live Streaming 2nd Edition
draft-pantos-hls-rfc8216bis-22

Abstract

This document obsoletes RFC 8216. It describes a protocol for transferring unbounded streams of multimedia data. It specifies the data format of the files and the actions to be taken by the server (sender) and the clients (receivers) of the streams. It describes version 13 of this protocol.

Status of This Memo

skipping to change at *page 1, line 35*

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skipping to change at *page 3, line 14*

4.4.4.5. EXT-X-MAP 29
4.4.4.6. EXT-X-PROGRAM-DATE-TIME 30
4.4.4.7. EXT-X-GAP 30
4.4.4.8. EXT-X-BITRATE 30
4.4.4.9. EXT-X-PART 31
4.4.5. Media Metadata Tags 32
4.4.5.1. EXT-X-DATERANGE 32
4.4.5.1.1. Mapping SCTE-35 into EXT-X-DATERANGE 35
4.4.5.2. EXT-X-SKIP 37
4.4.5.3. EXT-X-PRELOAD-HINT 38
4.4.5.4. EXT-X-RENDITION-REPORT 39
4.4.6. Multivariant Playlist Tags 40
4.4.6.1. EXT-X-MEDIA 40
4.4.6.1.1. Rendition Groups 45
4.4.6.2. EXT-X-STREAM-INF 46
4.4.6.2.1. Alternative Renditions 54
4.4.6.3. EXT-X-I-FRAME-STREAM-INF 55
4.4.6.4. EXT-X-SESSION-DATA 55
4.4.6.5. EXT-X-SESSION-KEY 57
4.4.6.6. EXT-X-CONTENT-STEERING 57
5. Key Files 58
5.1. Structure of Key Files 58
5.2. IV for AES encryption methods 58
6. Client/Server Responsibilities 58
6.1. Introduction 59
6.2. Server Responsibilities 59
6.2.1. General Server Responsibilities 59
6.2.2. Live Playlists 63
6.2.3. Encrypting Media Segments 64
6.2.4. Providing Variant Streams and Renditions 65
6.2.5. Delivery Directives Interface 66
6.2.5.1. Playlist Delta Updates 67
6.2.5.2. Blocking Playlist Reload 68
6.2.6. Providing Preload Hints 69
6.3. Client Responsibilities 70
6.3.1. General Client Responsibilities 70
6.3.2. Loading the Media Playlist File 71
6.3.3. Playing the Media Playlist File 72
6.3.4. Reloading the Media Playlist File 73
6.3.5. Determining the Next Segment to Load 74
6.3.6. Decrypting Encrypted Media Segments 75
6.3.7. Requesting Playlist Delta Updates 76
6.3.8. Issuing Blocking Requests 76
7. Content Steering 77
7.1. Mapping Content Steering to HLS 77
7.2. Steering Manifest 78
7.3. Pathway Cloning 78
7.4. Steering Query Parameters 80
7.5. Steering Client Responsibilities 80
8. Protocol Version Compatibility 81
9. Playlist Examples 83
9.1. Simple Media Playlist 83
9.2. Live Media Playlist Using HTTPS 83
9.3. Playlist with Encrypted Media Segments 83
9.4. Multivariant Playlist 84

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This document obsoletes RFC 8216. It describes a protocol for transferring unbounded streams of multimedia data. It specifies the data format of the files and the actions to be taken by the server (sender) and the clients (receivers) of the streams. It describes version 13 of this protocol.

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skipping to change at *page 1, line 35*

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skipping to change at *page 3, line 14*

4.4.4.5. EXT-X-MAP 29
4.4.4.6. EXT-X-PROGRAM-DATE-TIME 30
4.4.4.7. EXT-X-GAP 30
4.4.4.8. EXT-X-BITRATE 30
4.4.4.9. EXT-X-PART 31
4.4.5. Media Metadata Tags 32
4.4.5.1. EXT-X-DATERANGE 32
4.4.5.1.1. Mapping SCTE-35 into EXT-X-DATERANGE 35
4.4.5.2. EXT-X-SKIP 37
4.4.5.3. EXT-X-PRELOAD-HINT 38
4.4.5.4. EXT-X-RENDITION-REPORT 40
4.4.6. Multivariant Playlist Tags 40
4.4.6.1. EXT-X-MEDIA 41
4.4.6.1.1. Rendition Groups 46
4.4.6.2. EXT-X-STREAM-INF 47
4.4.6.2.1. Alternative Renditions 55
4.4.6.3. EXT-X-I-FRAME-STREAM-INF 55
4.4.6.4. EXT-X-SESSION-DATA 56
4.4.6.5. EXT-X-SESSION-KEY 57
4.4.6.6. EXT-X-CONTENT-STEERING 58
5. Key Files 58
5.1. Structure of Key Files 58
5.2. IV for AES encryption methods 59
6. Client/Server Responsibilities 59
6.1. Introduction 59
6.2. Server Responsibilities 59
6.2.1. General Server Responsibilities 59
6.2.2. Live Playlists 63
6.2.3. Encrypting Media Segments 64
6.2.4. Providing Variant Streams and Renditions 65
6.2.5. Delivery Directives Interface 67
6.2.5.1. Playlist Delta Updates 67
6.2.5.2. Blocking Playlist Reload 68
6.2.6. Providing Preload Hints 69
6.3. Client Responsibilities 70
6.3.1. General Client Responsibilities 70
6.3.2. Loading the Media Playlist File 71
6.3.3. Playing the Media Playlist File 72
6.3.4. Reloading the Media Playlist File 73
6.3.5. Determining the Next Segment to Load 74
6.3.6. Decrypting Encrypted Media Segments 75
6.3.7. Requesting Playlist Delta Updates 76
6.3.8. Issuing Blocking Requests 76
7. Content Steering 77
7.1. Mapping Content Steering to HLS 78
7.2. Steering Manifest 78
7.3. Pathway Cloning 78
7.4. Steering Query Parameters 80
7.5. Steering Client Responsibilities 80
8. Protocol Version Compatibility 81
9. Playlist Examples 83
9.1. Simple Media Playlist 83
9.2. Live Media Playlist Using HTTPS 83
9.3. Playlist with Encrypted Media Segments 83
9.4. Multivariant Playlist 84

skipping to change at *page 4, line 31*

```
   10.  Contributors  . . . . . . . . . . . . . . . . . . . . . . . .  90
   11.  IANA Considerations . . . . . . . . . . . . . . . . . . . . .  91
     11.1.  vnd.apple.mpegurl . . . . . . . . . . . . . . . . . . . .  91
   12.  Security Considerations . . . . . . . . . . . . . . . . . . .  92
   13.  References  . . . . . . . . . . . . . . . . . . . . . . . . .  92
     13.1.  Normative References  . . . . . . . . . . . . . . . . . .  92
     13.2.  Informative References  . . . . . . . . . . . . . . . . .  97
   Appendix A.  Changes from RFC 8216  . . . . . . . . . . . . . . .  98
   Appendix B.  Server Configuration Profiles  . . . . . . . . . . . 100
     B.1.  Low-Latency Server Configuration Profile  . . . . . . . . 100

   Appendix C.  Low-Latency CDN Tune-in  . . . . . . . . . . . . . . 103
   Appendix D.  Interstitials  . . . . . . . . . . . . . . . . . . . 104
     D.1.  Overview  . . . . . . . . . . . . . . . . . . . . . . . . 104
     D.2.  EXT-X-DATERANGE Schema for Interstitials  . . . . . . . . 105
     D.3.  Skip button control for an Interstitial . . . . . . . . . 110
     D.4.  Interstitial query parameters . . . . . . . . . . . . . . 110
     D.5.  Client Behavior . . . . . . . . . . . . . . . . . . . . . 111
     D.6.  Example: Interstitial EXT-X-DATERANGE . . . . . . . . . . 112
     D.7.  Example: Skip button control for an Interstitial  . . . . 112
   Appendix E.  Displaying Rendition Names . . . . . . . . . . . . . 113

     E.1.  Localization Dictionary . . . . . . . . . . . . . . . . . 114
     E.2.  Base Name Selection . . . . . . . . . . . . . . . . . . . 114
     E.3.  Name Decoration . . . . . . . . . . . . . . . . . . . . . 115
     E.4.  Example localization dictionary . . . . . . . . . . . . . 115
   Appendix F.  Preloading HLS Date Range Resources  . . . . . . . . 116
   Appendix G.  Custom Media Selection . . . . . . . . . . . . . . . 118
     G.1.  Custom Media Selection Scheme . . . . . . . . . . . . . . 118
     G.2.  Example Custom Media Selection Scheme  . . . . . . . . . . 121
   Appendix H.  Glossary . . . . . . . . . . . . . . . . . . . . . . 125
   Author's Address  . . . . . . . . . . . . . . . . . . . . . . . . 126




1.  Introduction to HTTP Live Streaming

   HTTP Live Streaming provides a reliable, cost-effective means of
   delivering continuous and long-form video over the Internet.  It
   allows a receiver to adapt the bit rate of the media to the current
   network conditions in order to maintain uninterrupted playback at the
   best possible quality.  It supports interstitial content boundaries.
   It provides a flexible framework for media encryption.  It can
   efficiently offer multiple renditions of the same content, such as
```

```
   10.  Contributors  . . . . . . . . . . . . . . . . . . . . . . . .  90
   11.  IANA Considerations . . . . . . . . . . . . . . . . . . . . .  91
     11.1.  vnd.apple.mpegurl . . . . . . . . . . . . . . . . . . . .  91
   12.  Security Considerations . . . . . . . . . . . . . . . . . . .  92
   13.  References  . . . . . . . . . . . . . . . . . . . . . . . . .  92
     13.1.  Normative References  . . . . . . . . . . . . . . . . . .  92
     13.2.  Informative References  . . . . . . . . . . . . . . . . .  97
   Appendix A.  Changes from RFC 8216  . . . . . . . . . . . . . . .  98
   Appendix B.  Server Configuration Profiles  . . . . . . . . . . . 100
     B.1.  Low-Latency Server Configuration Profile  . . . . . . . . 100
       B.1.1.  Content Steering and Low-Latency  . . . . . . . . . . 103
   Appendix C.  Low-Latency CDN Tune-in  . . . . . . . . . . . . . . 103
   Appendix D.  Interstitials  . . . . . . . . . . . . . . . . . . . 104
     D.1.  Overview  . . . . . . . . . . . . . . . . . . . . . . . . 104
     D.2.  EXT-X-DATERANGE Schema for Interstitials  . . . . . . . . 105
     D.3.  Preloading Interstitials  . . . . . . . . . . . . . . . . 109
     D.4.  Skip button control for an Interstitial . . . . . . . . . 110
     D.5.  Interstitial query parameters . . . . . . . . . . . . . . 111
     D.6.  Client Behavior . . . . . . . . . . . . . . . . . . . . . 112
     D.7.  Example: Interstitial EXT-X-DATERANGE . . . . . . . . . . 112
     D.8.  Example: Skip button control for an Interstitial  . . . . 113
   Appendix E.  Displaying Rendition Names . . . . . . . . . . . . . 114
     E.1.  Localization Dictionary . . . . . . . . . . . . . . . . . 114
     E.2.  Base Name Selection . . . . . . . . . . . . . . . . . . . 114
     E.3.  Name Decoration . . . . . . . . . . . . . . . . . . . . . 115
     E.4.  Example localization dictionary . . . . . . . . . . . . . 116
   Appendix F.  Preloading HLS Date Range Resources  . . . . . . . . 117
   Appendix G.  Custom Media Selection . . . . . . . . . . . . . . . 118
     G.1.  Custom Media Selection Scheme . . . . . . . . . . . . . . 118
     G.2.  Example Custom Media Selection Scheme  . . . . . . . . . . 122
     G.3.  Example Language Decoration Element . . . . . . . . . . . 126

   Appendix H.  Date Range Schedules . . . . . . . . . . . . . . . . 126
     H.1.  Scheduled Date Ranges . . . . . . . . . . . . . . . . . . 127
     H.2.  Behavior  . . . . . . . . . . . . . . . . . . . . . . . . 128
   Appendix I.  Glossary . . . . . . . . . . . . . . . . . . . . . . 129
   Author's Address  . . . . . . . . . . . . . . . . . . . . . . . . 131

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   best possible quality.  It supports interstitial content boundaries.
   It provides a flexible framework for media encryption.  It can
   efficiently offer multiple renditions of the same content, such as
```

skipping to change at *page 10, line 49*

```
   e.g., X-TIMESTAMP-MAP=LOCAL:00:00:00.000,MPEGTS:900000

   indicating the media time to which the cue time MUST be mapped.  The
   cue timestamp in the LOCAL attribute MAY fall outside the range of
   time covered by the segment.

   The MPEGTS media timestamp MUST use a 90KHz timescale, even when non-
   WebVTT Media Segments use a different timescale.

   If a WebVTT Segment does not have the X-TIMESTAMP-MAP, the client
   MUST assume that the WebVTT cue time of 0 maps to an media timestamp
   of 0.

   When synchronizing WebVTT with PES timestamps, clients SHOULD account
   for cases where the 33-bit PES timestamps have wrapped and the WebVTT
   cue times have not.  When the PES timestamp wraps, the WebVTT Segment
   SHOULD have a X-TIMESTAMP-MAP header that maps the current WebVTT
   time to the new (low valued) PES timestamp.

3.1.5.  IMSC Subtitles
```

```
   e.g., X-TIMESTAMP-MAP=LOCAL:00:00:00.000,MPEGTS:900000

   indicating the media time to which the cue time MUST be mapped.  The
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   time covered by the segment.

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   WebVTT Media Segments use a different timescale.

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   for cases where the 33-bit PES timestamps have wrapped and the WebVTT
   cue times have not.  When the PES timestamp wraps, the WebVTT Segment
   SHOULD have a X-TIMESTAMP-MAP header that maps the current WebVTT
   time to the new (low valued) PES timestamp.

3.1.5.  IMSC Subtitles
```

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```
      length of a hexadecimal-sequence depends on its AttributeNames.

   *  decimal-floating-point: an unquoted string of characters from the
      set [0-9] and '.' that expresses a non-negative floating-point
      number in decimal positional notation.

   *  signed-decimal-floating-point: an unquoted string of characters
      from the set [0-9], '-', and '.' that expresses a signed floating-
      point number in decimal positional notation.

   *  quoted-string: a string of characters within a pair of double
      quotes (0x22).  The following characters MUST NOT appear in a
      quoted-string: line feed (0xA), carriage return (0xD), or double
      quote (0x22).  The string MUST be non-empty, unless specifically
      allowed.  Quoted-string AttributeValues SHOULD be constructed so
      that byte-wise comparison is sufficient to test two quoted-string
      AttributeValues for equality.  Note that this implies case-
      sensitive comparison.


   *  enumerated-string: an unquoted character string from a set that is
      explicitly defined by the AttributeName.  An enumerated-string
      will never contain double quotes ("), commas (,), or whitespace.

   *  enumerated-string-list: a quoted-string containing a comma-
      separated list of enumerated-strings from a set that is explicitly
      defined by the AttributeName.  Each enumerated-string in the list
      is a string consisting of characters valid in an enumerated-
      string.  The list SHOULD NOT repeat any enumerated-string.  To
      support forward compatibility, clients MUST ignore any
      unrecognized enumerated-strings in an enumerated-string-list.

   *  decimal-resolution: two decimal-integers separated by the "x"
```

```
      length of a hexadecimal-sequence depends on its AttributeNames.

   *  decimal-floating-point: an unquoted string of characters from the
      set [0-9] and '.' that expresses a non-negative floating-point
      number in decimal positional notation.

   *  signed-decimal-floating-point: an unquoted string of characters
      from the set [0-9], '-', and '.' that expresses a signed floating-
      point number in decimal positional notation.

   *  quoted-string: a sequence of characters with double-quotes (0x22)
      delimiting its start and end.  The following characters MUST NOT
      appear in a quoted-string: line feed (0xA), carriage return (0xD),
      or double-quote (0x22).  The string MUST be non-empty, unless
      specifically allowed.  Quoted-string AttributeValues SHOULD be
      constructed so that byte-wise comparison is sufficient to test two
      quoted-string AttributeValues for equality.  Note that this
      implies case-sensitive comparison.  The value of a quoted-string
      does not include the double-quote delimiters.

   *  enumerated-string: an unquoted character string from a set that is
      explicitly defined by the AttributeName.  An enumerated-string
      will never contain double-quotes ("), commas (,), or whitespace.

   *  enumerated-string-list: a quoted-string containing a comma-
      separated list of enumerated-strings from a set that is explicitly
      defined by the AttributeName.  Each enumerated-string in the list
      is a string consisting of characters valid in an enumerated-
      string.  The list SHOULD NOT repeat any enumerated-string.  To
      support forward compatibility, clients MUST ignore any
      unrecognized enumerated-strings in an enumerated-string-list.

   *  decimal-resolution: two decimal-integers separated by the "x"
```

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```
      change the value of the EXT-X-DISCONTINUITY-SEQUENCE tag.

      RECENTLY-REMOVED-DATERANGES
```

```
      change the value of the EXT-X-DISCONTINUITY-SEQUENCE tag.

      RECENTLY-REMOVED-DATERANGES
```

The value is a quoted-string consisting of a tab (0x9) delimited list of EXT-X-DATERANGE IDs that have been removed from the Playlist recently. See Section 6.2.5.1 for more information. This attribute is REQUIRED if the Client requested an update that skips EXT-X-DATERANGE tags. The quoted-string MAY be empty.	The value is a quoted-string consisting of a tab (0x9) delimited list of EXT-X-DATERANGE IDs that have been removed from the Playlist recently. See Section 6.2.5.1 for more information. This attribute is REQUIRED if the Client requested an update that skips EXT-X-DATERANGE tags. The quoted-string MAY be empty.
	The IDs of Scheduled Date Ranges (see Appendix H) MUST NOT be included in the RECENTLY-REMOVED-DATERANGES list. Only Date Range Schedules that occur in the Playlist MUST be added.
4.4.5.3. EXT-X-PRELOAD-HINT	4.4.5.3. EXT-X-PRELOAD-HINT
The EXT-X-PRELOAD-HINT tag allows a Client loading media from a live stream to reduce the time to obtain a resource from the Server by issuing its request before the resource is available to be delivered. The server will hold onto the request ("block") until it can respond.	The EXT-X-PRELOAD-HINT tag allows a Client loading media from a live stream to reduce the time to obtain a resource from the Server by issuing its request before the resource is available to be delivered. The server will hold onto the request ("block") until it can respond.
Its format is:	Its format is:
#EXT-X-PRELOAD-HINT:<attribute-list>	#EXT-X-PRELOAD-HINT:<attribute-list>
The following attributes are defined:	The following attributes are defined:
TYPE	TYPE
The value is an enumerated-string that specifies the type of the hinted resource. If the value is PART, the resource is a Partial Segment. If the value is MAP, the resource is a Media Initialization Section. This attribute is REQUIRED.	The value is an enumerated-string that specifies the type of the hinted resource. If the value is PART, the resource is a Partial Segment. If the value is MAP, the resource is a Media Initialization Section. If the value is KEY, the resource is a decryption key. This attribute is REQUIRED.
URI	URI
The value is a quoted-string containing a URI identifying the hinted resource. It MUST match the URI that will be subsequently added to the Playlist as a non-hinted resource (for example, the URI of an EXT-X-PART tag). The URI MAY be relative to the URI of the Playlist or it MAY be absolute. The hostname MAY differ from the hostname of the Playlist URI. This attribute is REQUIRED.	The value is a quoted-string containing a URI identifying the hinted resource. It MUST match the URI that will be subsequently added to the Playlist as a non-hinted resource (for example, the URI of an EXT-X-PART tag). The URI MAY be relative to the URI of the Playlist or it MAY be absolute. The hostname MAY differ from the hostname of the Playlist URI. This attribute is REQUIRED.
BYTERANGE-START	BYTERANGE-START
The value is a decimal-integer specifying the byte offset of the	The value is a decimal-integer specifying the byte offset of the
skipping to change at *page 39, line 21*	**skipping to change at *page 39, line 27***
BYTERANGE-LENGTH	BYTERANGE-LENGTH
The value is a decimal-integer specifying the length of the hinted resource. This attribute is OPTIONAL. Its absence indicates that the last byte of the hinted resource is the last byte of the resource identified by the URI attribute. In this case, you SHOULD use the recommended last-byte-pos [RFC8673] value of 2^^53-1 (9007199254740991) in the HTTP Range request.	The value is a decimal-integer specifying the length of the hinted resource. This attribute is OPTIONAL. Its absence indicates that the last byte of the hinted resource is the last byte of the resource identified by the URI attribute. In this case, you SHOULD use the recommended last-byte-pos [RFC8673] value of 2^^53-1 (9007199254740991) in the HTTP Range request.
	METHOD, KEYFORMAT, KEYFORMATVERSIONS
	The semantics of these attributes are as described for the EXT-X-KEY tag (Section 4.4.4.4). The values MUST match the values in an EXT-X-KEY tag that will be subsequently added to the Playlist. These attributes are only allowed when the TYPE=KEY.
	DATE-OF-FIRST-USE
	A quoted-string containing what is estimated to be the date/time [ISO_8601] of the first media for which the resource will be needed. The client SHOULD preload the resource at a randomly-selected point between the time the EXT-X-PRELOAD-HINT is first seen and how much time remains until the first use. The client SHOULD project the time until first use by estimating the end date of the last (Partial) Segment in the Playlist and subtracting that value from the attribute value.
Note that when a hinted Partial Segment eventually appears in the Playlist as an EXT-X-PART tag, it MAY have a different Discontinuity Sequence Number, Media Initialization Section, or encryption configuration. In other words, the Partial Segment can be preceded by an EXTINF tag indicating the end of the previous Parent Segment and an EXT-X-DISCONTINUITY, EXT-X-MAP, or EXT-X-KEY tag.	Note that when a hinted Partial Segment eventually appears in the Playlist as an EXT-X-PART tag, it MAY have a different Discontinuity Sequence Number, Media Initialization Section, or encryption configuration. In other words, the Partial Segment can be preceded by an EXTINF tag indicating the end of the previous Parent Segment and an EXT-X-DISCONTINUITY, EXT-X-MAP, or EXT-X-KEY tag.
A Playlist containing an EXT-X-ENDLIST tag MUST NOT contain an EXT-X-PRELOAD-HINT tag.	A Playlist containing an EXT-X-ENDLIST tag MUST NOT contain an EXT-X-PRELOAD-HINT tag.
skipping to change at *page 55, line 41*	**skipping to change at *page 56, line 24***
The provisions in Section 4.4.6.2.1 also apply to EXT-X-I-FRAME-STREAM-INF tags with a VIDEO attribute.	The provisions in Section 4.4.6.2.1 also apply to EXT-X-I-FRAME-STREAM-INF tags with a VIDEO attribute.
A Multivariant Playlist that specifies alternative VIDEO Renditions and I-frame Playlists SHOULD include an alternative I-frame VIDEO Rendition for each regular VIDEO Rendition, with the same NAME and LANGUAGE attributes.	A Multivariant Playlist that specifies alternative VIDEO Renditions and I-frame Playlists SHOULD include an alternative I-frame VIDEO Rendition for each regular VIDEO Rendition, with the same NAME and LANGUAGE attributes.
4.4.6.4. EXT-X-SESSION-DATA	4.4.6.4. EXT-X-SESSION-DATA
The EXT-X-SESSION-DATA tag allows arbitrary session data to be carried in a Multivariant Playlist.	The EXT-X-SESSION-DATA tag enables arbitrary data associated with the session as a whole to be carried in a Multivariant Playlist.
Its format is:	Its format is:
#EXT-X-SESSION-DATA:<attribute-list>	#EXT-X-SESSION-DATA:<attribute-list>
The following attributes are defined:	The following attributes are defined:
DATA-ID	DATA-ID
The value of DATA-ID is a quoted-string that identifies a particular data value. The DATA-ID SHOULD conform to a reverse DNS naming convention, such as "com.example.movie.title"; however, there is no central registration authority, so Playlist authors SHOULD take care to choose a value that is unlikely to collide with others. This attribute is REQUIRED.	The value of DATA-ID is a quoted-string that identifies a particular data value. The DATA-ID SHOULD conform to a reverse DNS naming convention, such as "com.example.movie.title"; however, there is no central registration authority, so Playlist authors SHOULD take care to choose a value that is unlikely to collide with others. This attribute is REQUIRED.

VALUE VALUE is a quoted-string. It contains the data identified by	VALUE VALUE is a quoted-string. It contains the data identified by
skipping to change at ***page 67, line 10***	**skipping to change at** ***page 67, line 17***
A server MAY provide a set of services to its clients by implementing support for Delivery Directives. Delivery Directives are transmitted by the Client to the Server as Query Parameters in Playlist request URIs. Servers advertise the availability of Delivery Directives using the EXT-X-SERVER-CONTROL tag (Section 4.4.3.8). Query parameters for Playlist requests that begin with the string "_HLS_" are reserved by this specification. Currently-defined Delivery Directives are _HLS_skip, _HLS_msn and _HLS_part. 6.2.5.1. Playlist Delta Updates Live presentations involve frequent Playlist downloads. When Playlists are large and a Client already has the previous version, the transfer cost can be reduced considerably by sending only the newest information in response to a Playlist update request. A Server advertises support for Playlist Delta Updates that skip older Media Segments by adding the CAN-SKIP-UNTIL attribute to the	A server MAY provide a set of services to its clients by implementing support for Delivery Directives. Delivery Directives are transmitted by the Client to the Server as Query Parameters in Playlist request URIs. Servers advertise the availability of Delivery Directives using the EXT-X-SERVER-CONTROL tag (Section 4.4.3.8). Query parameters for Playlist requests that begin with the string "_HLS_" are reserved by this specification. Currently-defined Delivery Directives are _HLS_skip, _HLS_msn, and _HLS_part. 6.2.5.1. Playlist Delta Updates Live presentations involve frequent Playlist downloads. When Playlists are large and a Client already has the previous version, the transfer cost can be reduced considerably by sending only the newest information in response to a Playlist update request. A Server advertises support for Playlist Delta Updates that skip older Media Segments by adding the CAN-SKIP-UNTIL attribute to the
skipping to change at ***page 69, line 48***	**skipping to change at** ***page 70, line 6***
an ad. The server SHOULD respond to client requests for those resources with "Not Found" (such as HTTP 404). If a Partial Segment is created as a sub-range of a larger resource and its length is not known at the time that its hint is added to the Playlist, the BYTERANGE-LENGTH attribute SHOULD be omitted. The BYTERANGE-OFFSET SHOULD indicate the Partial Segment's starting offset into the larger resource. The Server SHOULD NOT add more than one EXT-X-PRELOAD-HINT tag with the same TYPE to a Playlist. 6.3. Client Responsibilities 6.3.1. General Client Responsibilities How the client obtains the URI to the Playlist file is outside the scope of this document; it is presumed to have done so. The client obtains the Playlist file from the URI. If the Playlist file so obtained is a Multivariant Playlist, the client can select a	an ad. The server SHOULD respond to client requests for those resources with "Not Found" (such as HTTP 404). If a Partial Segment is created as a sub-range of a larger resource and its length is not known at the time that its hint is added to the Playlist, the BYTERANGE-LENGTH attribute SHOULD be omitted. The BYTERANGE-OFFSET SHOULD indicate the Partial Segment's starting offset into the larger resource. The Server SHOULD NOT add more than one EXT-X-PRELOAD-HINT tag with the same TYPE (or the same TYPE and KEYFORMAT if TYPE=KEY) to a Playlist. 6.3. Client Responsibilities 6.3.1. General Client Responsibilities How the client obtains the URI to the Playlist file is outside the scope of this document; it is presumed to have done so. The client obtains the Playlist file from the URI. If the Playlist file so obtained is a Multivariant Playlist, the client can select a
skipping to change at ***page 77, line 7***	**skipping to change at** ***page 77, line 7***
Partial Segments) to obtain Playlist updates in preference to the polling regime described in Section 6.3.4. If up-to-date information on the next expected Media Sequence Number of a Rendition is not available, a Client SHOULD use a tune-in algorithm such as the one described in Appendix C to obtain a recent version of the Playlist. Clients MUST ignore EXT-X-PRELOAD-HINT tags with unrecognized TYPE attributes. Clients SHOULD ignore all but the first EXT-X-PRELOAD-HINT tag in a Playlist with a particular TYPE attribute. When processing a Playlist containing an EXT-X-PRELOAD-HINT tag with TYPE=PART, a Client with sufficient space in its download pipeline that is not already loading the hinted resource SHOULD request it. This will typically happen at the same time as its blocking request for the next Playlist update. When processing a Playlist containing an EXT-X-PRELOAD-HINT tag with TYPE=MAP, a Client with sufficient space in its download pipeline that has not already cached the hinted Media Initialization	Partial Segments) to obtain Playlist updates in preference to the polling regime described in Section 6.3.4. If up-to-date information on the next expected Media Sequence Number of a Rendition is not available, a Client SHOULD use a tune-in algorithm such as the one described in Appendix C to obtain a recent version of the Playlist. Clients MUST ignore EXT-X-PRELOAD-HINT tags with unrecognized TYPE attributes. Clients SHOULD ignore all but the first EXT-X-PRELOAD-HINT tag in a Playlist with a particular TYPE attribute (or TYPE and KEYFORMAT in the case where TYPE=KEY). When processing a Playlist containing an EXT-X-PRELOAD-HINT tag with TYPE=PART, a Client with sufficient space in its download pipeline that is not already loading the hinted resource SHOULD request it. This will typically happen at the same time as its blocking request for the next Playlist update. When processing a Playlist containing an EXT-X-PRELOAD-HINT tag with TYPE=MAP, a Client with sufficient space in its download pipeline that has not already cached the hinted Media Initialization
skipping to change at ***page 83, line 11***	**skipping to change at** ***page 83, line 11***
* An EXT-X-MEDIA tag with INSTREAM-ID attribute for non CLOSED-CAPTIONS TYPE. The EXT-X-MEDIA tag and the AUDIO, VIDEO, and SUBTITLES attributes of the EXT-X-STREAM-INF tag are backward compatible to protocol version 1, but playback on older clients may not be desirable. A server MAY consider indicating an EXT-X-VERSION of 4 or higher in the Multivariant Playlist but is not required to do so. The PROGRAM-ID attribute of the EXT-X-STREAM-INF and the EXT-X-I-FRAME-STREAM-INF tags was removed in protocol version 6. The EXT-X-ALLOW-CACHE tag was removed in protocol version 7. 9. Playlist Examples In some examples a '\' is used for readability to indicate that the tag continues on the following line. 9.1. Simple Media Playlist	* An EXT-X-MEDIA tag with INSTREAM-ID attribute for non CLOSED-CAPTIONS TYPE. The EXT-X-MEDIA tag and the AUDIO, VIDEO, and SUBTITLES attributes of the EXT-X-STREAM-INF tag are backward compatible to protocol version 1, but playback on older clients may not be desirable. A server MAY consider indicating an EXT-X-VERSION of 4 or higher in the Multivariant Playlist but is not required to do so. The PROGRAM-ID attribute of the EXT-X-STREAM-INF and EXT-X-I-FRAME-STREAM-INF tags was removed in protocol version 6. The EXT-X-ALLOW-CACHE tag was removed in protocol version 7. 9. Playlist Examples In some examples a '\' is used for readability to indicate that the tag continues on the following line. 9.1. Simple Media Playlist
skipping to change at ***page 93, line 45***	**skipping to change at** ***page 93, line 45***
International Organization for Standardization, "Information technology -- MPEG systems technologies -- Part 7: Common encryption in ISO base media file format files", ISO/IEC International Standard 23001-7:2016, February 2016, <http://www.iso.org/iso/catalogue_detail.htm?csnumber=68042>.	International Organization for Standardization, "Information technology -- MPEG systems technologies -- Part 7: Common encryption in ISO base media file format files", ISO/IEC International Standard 23001-7:2016, February 2016, <http://www.iso.org/iso/catalogue_detail.htm?csnumber=68042>.

[Content-Steering] Pantos, R., Ed. and E. Vershen, "Pathway-based Content Steering", Work in Progress, Internet-Draft, draft-pantos-content-steering-04, May 2026, <https://datatracker.ietf.org/doc/html/draft-pantos-content-steering-04>.

[HDCP] Digital Content Protection LLC, "High-bandwidth Digital Content Protection System - Mapping HDCP to HDMI", February 2013, <http://www.digital-cp.com/sites/default/files/specifications/HDCP%20on%20HDMI%20Specification%20Rev2_2_Final1.pdf>.

[H_264] International Telecommunications Union, "Advanced video coding for generic audiovisual services", January 2012, <http://www.itu.int/rec/T-REC-H.264>.

skipping to change at *page 103, line 17*

cached for one Target Duration.

Origin servers should use Cache-Control headers to communicate the desired cache lifetime.

The recommended Target Duration is six seconds.

The recommended GOP size is between one and two seconds. Smaller GOPs allow faster switching between Renditions.

Appendix C. Low-Latency CDN Tune-in

Clients SHOULD support delivery of low-latency streams through CDNs and other HTTP caches. Correctly implementing PART-HOLD-BACK, the server-recommended playback delay from live, requires that the client first obtain a reasonably up-to-date version of the Media Playlist.

There are various approaches that a client may take to obtain a recent version of a Media Playlist. The following algorithm typically requires two Playlist requests to obtain a Playlist that is

skipping to change at *page 105, line 33*

following attributes:

X-ASSET-URI

The value of the X-ASSET-URI is a quoted-string absolute URI for a single interstitial asset. An Interstitial EXT-X-DATERANGE tag MUST have either the X-ASSET-URI attribute or the X-ASSET-LIST attribute. It MUST NOT have both.

X-ASSET-LIST

The value of the X-ASSET-LIST is a quoted-string URI to a JSON object. The URI MAY be absolute, or it MAY be relative to the URI of the Playlist. Note that since every Playlist with Date Ranges MUST have identical EXT-X-DATERANGE tags (see Section 6.2.4), a relative URI MUST resolve successfully against every Playlist URI.

The JSON object MUST contain a key/value pair whose key is "ASSETS" and whose value is a JSON array of Asset-Description JSON objects. The JSON object MAY also contain a key/value pair whose key is "SKIP-CONTROL" and whose value is a Skip-Control JSON object. (Note that keys in a JSON object are case-sensitive.)

Each Asset-Description JSON object MUST have a "URI" member whose value is a quoted-string absolute URI for a single interstitial asset, and a "DURATION" member whose value is a decimal-floating-point indicating the duration of the interstitial asset in seconds.

The keys for the Skip-Control object are described in Appendix D.3. These key/value pairs can be used to control the Skip button behavior.

The client SHOULD play the interstitial assets back-to-back in the order that they appear in the ASSETS array.

X-RESUME-OFFSET

The value of X-RESUME-OFFSET is a signed-decimal-floating-point of seconds that specifies where primary playback is to resume following the playback of the interstitial. It is expressed as a

skipping to change at *page 109, line 5*

interstitial(s) then that interstitial or group of interstitials SHOULD NOT be played again unless the user explicitly moves the playhead back to a position prior to the start time of the interstitial(s).

If present, the duration (or planned duration) of the Date Range SHOULD be the duration of the interstitial asset(s), even if a CUE attribute allows the interstitial to start at some time other than the START-DATE.

[Content-Steering] Pantos, R., Ed. and E. Vershen, "Pathway-based Content Steering", Work in Progress, Internet-Draft, draft-pantos-content-steering-05, May 2026, <https://datatracker.ietf.org/doc/html/draft-pantos-content-steering-05>.

[HDCP] Digital Content Protection LLC, "High-bandwidth Digital Content Protection System - Mapping HDCP to HDMI", February 2013, <http://www.digital-cp.com/sites/default/files/specifications/HDCP%20on%20HDMI%20Specification%20Rev2_2_Final1.pdf>.

[H_264] International Telecommunications Union, "Advanced video coding for generic audiovisual services", January 2012, <http://www.itu.int/rec/T-REC-H.264>.

skipping to change at *page 103, line 17*

cached for one Target Duration.

Origin servers should use Cache-Control headers to communicate the desired cache lifetime.

The recommended Target Duration is six seconds.

The recommended GOP size is between one and two seconds. Smaller GOPs allow faster switching between Renditions.

B.1.1. Content Steering and Low-Latency

With Content Steering, an individual server may not provide the entire set of Variant Streams in the Multivariant Playlist. This makes providing the entire set of Rendition Reports problematic.

If the Multivariant Playlist uses Content Steering, then each Media Playlist MAY restrict the required EXT-X-RENDITION-REPORT tags to those Media Playlists associated with the same Pathway.

If the server uses a restricted set of Rendition Reports, a missing Rendition Report will require the client to perform a tune-in when switching Pathways. This increases the risk of playback stalls.

Appendix C. Low-Latency CDN Tune-in

Clients SHOULD support delivery of low-latency streams through CDNs and other HTTP caches. Correctly implementing PART-HOLD-BACK, the server-recommended playback delay from live, requires that the client first obtain a reasonably up-to-date version of the Media Playlist.

There are various approaches that a client may take to obtain a recent version of a Media Playlist. The following algorithm typically requires two Playlist requests to obtain a Playlist that is

skipping to change at *page 106, line 4*

following attributes:

X-ASSET-URI

The value of the X-ASSET-URI is a quoted-string absolute URI for a single interstitial asset. An Interstitial EXT-X-DATERANGE tag MUST have either the X-ASSET-URI attribute or the X-ASSET-LIST attribute. It MUST NOT have both.

X-ASSET-LIST

The value of the X-ASSET-LIST is a quoted-string URI to a JSON object. The URI MAY be absolute, or it MAY be relative to the URI of its container. (The container is either a Playlist or a Date Range Schedule (Appendix H).) Note that since every Playlist with Date Ranges MUST have identical EXT-X-DATERANGE tags (see Section 6.2.4), a URI that is relative to a Playlist MUST resolve successfully against every Playlist URI.

The JSON object MUST contain a key/value pair whose key is "ASSETS" and whose value is a JSON array of Asset-Description JSON objects. The JSON object MAY also contain a key/value pair whose key is "SKIP-CONTROL" and whose value is a Skip-Control JSON object. (Note that keys in a JSON object are case-sensitive.)

Each Asset-Description JSON object MUST have a "URI" member whose value is a quoted-string absolute URI for a single interstitial asset, and a "DURATION" member whose value is a decimal-floating-point indicating the duration of the interstitial asset in seconds.

The keys for the Skip-Control object are described in Appendix D.4. These key/value pairs can be used to control the Skip button behavior.

The client SHOULD play the interstitial assets back-to-back in the order that they appear in the ASSETS array.

X-RESUME-OFFSET

The value of X-RESUME-OFFSET is a signed-decimal-floating-point of seconds that specifies where primary playback is to resume following the playback of the interstitial. It is expressed as a

skipping to change at *page 109, line 24*

interstitial(s) then that interstitial or group of interstitials SHOULD NOT be played again unless the user explicitly moves the playhead back to a position prior to the start time of the interstitial(s).

If present, the duration (or planned duration) of the Date Range SHOULD be the duration of the interstitial asset(s), even if a CUE attribute allows the interstitial to start at some time other than the START-DATE.

If the X-RESUME-OFFSET is not present and X-PLAYOUT-LIMIT specifies a value less than the total duration of the Interstitial, then the value of the resumption offset will be the playout limit.

A Server MAY add a Preload EXT-X-DATERANGE tag to indicate that the client SHOULD preload the URI specified by the X-ASSET-URI or X-ASSET-LIST attribute of an existing or upcoming Interstitial EXT-X-DATERANGE tag. See Appendix F for more information.

The server SHOULD specify a preload range that ends at or shortly before the interstitial is expected to be scheduled. The duration of the period SHOULD be as long as the preload could be considered valid before that point (even if practically the client will not be able to issue it that far in advance).

The client SHOULD choose a random point inside the Preload Date Range and preload the URI when the current playhead position passes that point. A client SHOULD NOT load an Interstitial any later than it would have in the absence of the Preload EXT-X-DATERANGE tag.

After obtaining the preload date range but before selecting a random point within it, the client SHOULD:

A. Ensure that the effective start of the preload range is greater than or equal to the current playhead position, to avoid selecting a preload time in the past.

B. Ensure that the effective end of the preload range occurs before the client expects to normally resolve the interstitial.

   1. If the START-DATE of the interstitial is already known, the client SHOULD predict how long it would wait before resolving the interstitial if it were not preloaded, and ensure that the end of the preload range is no greater than the current playhead position plus that wait time.

   2. In the case where the START-DATE of the interstitial is not yet known, the client SHOULD assume that it will appear the next time that the Playlist is reloaded, with the same date as the end of the preload range, and then proceed as in the first case.

Clients SHOULD ignore Preload EXT-X-DATERANGE tags if the Playlist contains an EXT-X-ENDLIST tag.

If the X-RESUME-OFFSET is not present and X-PLAYOUT-LIMIT specifies a value less than the total duration of the Interstitial, then the value of the resumption offset will be the playout limit.

D.3. Skip button control for an Interstitial

Content producers can allow clients to skip an Interstitial. This section describes how to configure a Skip button. The following attributes are defined to help control the skip button behavior.

X-SKIP-CONTROL-OFFSET

The value of the X-SKIP-CONTROL-OFFSET is a decimal-integer of seconds of an interstitial content that should be played until a skip button is displayed. If this value is 0, the skip button

The schedule clipping semantics (see Appendix H) for an interstitial are to treat it as if it contained an X-PLAYOUT-LIMIT limiting the interstitial playout to the end date of its parent Schedule (but to do nothing if it already has an earlier X-PLAYOUT-LIMIT).

D.3. Preloading Interstitials

A Server MAY add a Preload EXT-X-DATERANGE tag to indicate that the client SHOULD preload the URI specified by the X-ASSET-URI or X-ASSET-LIST attribute of an existing or upcoming Interstitial EXT-X-DATERANGE tag. See Appendix F for more information.

The server SHOULD specify a Preload Date Range that ends at or shortly before the interstitial is expected to be scheduled. The duration of the period SHOULD be as long as the preload could be considered valid before that point (even if practically the client will not be able to issue it that far in advance).

If a client begins playing a Media Playlist without an EXT-X-ENDLIST tag and sees a Preload EXT-X-DATERANGE tag with an X-DURATION-AT-JOIN attribute, the client MUST use the date of the first content to be loaded upon joining the stream as START-DATE of the Preload Date Range and the value of the DURATION-AT-JOIN attribute as its DURATION.

The client SHOULD choose a random point inside the Preload Date Range and preload the URI when the current playhead position passes that point. A client SHOULD NOT load an Interstitial any later than it would have in the absence of the Preload EXT-X-DATERANGE tag.

After obtaining the Preload Date Range but before selecting a random point within it, the client SHOULD:

A. Ensure that the effective start of the Preload Date Range is greater than or equal to the current playhead position, to avoid selecting a preload time in the past.

B. Ensure that the effective end of the Preload Date Range occurs before the client expects to normally resolve the interstitial.

   1. If the START-DATE of the interstitial is already known, the client SHOULD predict how long it would wait before resolving the interstitial if it were not preloaded, and ensure that the end of the Preload Date Range is no greater than the current playhead position plus that wait time.

   2. In the case where the START-DATE of the interstitial is not yet known, the client SHOULD assume that it will appear the next time that the Playlist is reloaded, with the same date as the end of the Preload Date Range, and then proceed first case.

D.4. Skip button control for an Interstitial

Content producers can allow clients to skip an Interstitial. This section describes how to configure a Skip button. The following attributes are defined to help control the skip button behavior.

X-SKIP-CONTROL-OFFSET

The value of the X-SKIP-CONTROL-OFFSET is a decimal-integer of seconds of an interstitial content that should be played until a skip button is displayed. If this value is 0, the skip button

skipping to change at *page 110, line 26*

skipping to change at *page 111, line 4*

should be displayed immediately upon entering the interstitial.

X-SKIP-CONTROL-DURATION

The value of the X-SKIP-CONTROL-DURATION is a decimal-integer of seconds of an interstitial content that a skip button should be displayed for. In the absence of this attribute, the skip button will be displayed for the entire duration of the interstitial.

X-SKIP-CONTROL-LABEL-ID

The value of X-SKIP-CONTROL-LABEL-ID is a quoted-string which acts as a key that a client application uses to render a localized label for the skip button. In the absence of this attribute, a default label SHOULD be applied by the client application. All characters in the quoted-string MUST be from the following set: [a-z], [A-Z], '-', and '_'.

One or more attributes defined in this section MAY be overridden by supplying a Skip-Control object in the X-ASSET-LIST JSON object. The keys of the Skip-Control object are the attribute names above with "X-SKIP-CONTROL-" removed. That is, "OFFSET", "DURATION", and "LABEL-ID".

See Appendix D.7 for details.

D.4. Interstitial query parameters

Packagers producing Interstitial EXT-X-DATERANGE tags SHOULD ensure that X-ASSET-URI and X-ASSET-LIST requests contain an _HLS_interstitial_id query parameter whose value is the ID attribute value of the EXT-X-DATERANGE tag with the quotation marks removed. This supports interoperability between content producers and decisioning servers. To prevent conflicts with future versions of this specification packagers SHOULD NOT define query parameters that begin with the string "_HLS_".

should be displayed immediately upon entering the interstitial.

X-SKIP-CONTROL-DURATION

The value of the X-SKIP-CONTROL-DURATION is a decimal-integer of seconds of an interstitial content that a skip button should be displayed for. In the absence of this attribute, the skip button will be displayed for the entire duration of the interstitial.

X-SKIP-CONTROL-LABEL-ID

The value of X-SKIP-CONTROL-LABEL-ID is a quoted-string which acts as a key that a client application uses to render a localized label for the skip button. In the absence of this attribute, a default label SHOULD be applied by the client application. All characters in the quoted-string MUST be from the following set: [a-z], [A-Z], '-', and '_'.

One or more attributes defined in this section MAY be overridden by supplying a Skip-Control object in the X-ASSET-LIST JSON object. The keys of the Skip-Control object are the attribute names above with "X-SKIP-CONTROL-" removed. That is, "OFFSET", "DURATION", and "LABEL-ID".

See Appendix D.8 for details.

D.5. Interstitial query parameters

Packagers producing Interstitial EXT-X-DATERANGE tags SHOULD ensure that X-ASSET-URI and X-ASSET-LIST requests contain an _HLS_interstitial_id query parameter whose value is the ID attribute value of the EXT-X-DATERANGE tag with the quotation marks removed. This supports interoperability between content producers and decisioning servers. To prevent conflicts with future versions of this specification packagers SHOULD NOT define query parameters that begin with the string "_HLS_".

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Interstitial requests are X-ASSET-URI requests, X-ASSET-LIST requests, and requests for a URI from an X-ASSET-LIST Asset-Description JSON object.

Clients starting playback of a live stream in an interstitial SHOULD ensure that X-ASSET-LIST requests contain an _HLS_start_offset query parameter whose value is the offset in seconds of the playback start point from the beginning of the interstitial. This allows servers to customize interstitial content based on the starting offset.

D.5. Client Behavior

If an interstitial specifies a non-zero resume offset and the user tries to seek to a time between the start of the interstitial and its resumption point on the primary asset timeline, the client SHOULD begin playback from the start of the interstitial.

If a request for either an interstitial asset URI or an asset list URI returns an error, the client SHOULD cancel playback of the interstitial with a resume offset of 0.

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Interstitial requests are X-ASSET-URI requests, X-ASSET-LIST requests, and requests for a URI from an X-ASSET-LIST Asset-Description JSON object.

Clients starting playback of a live stream in an interstitial SHOULD ensure that X-ASSET-LIST requests contain an _HLS_start_offset query parameter whose value is the offset in seconds of the playback start point from the beginning of the interstitial. This allows servers to customize interstitial content based on the starting offset.

D.6. Client Behavior

If an interstitial specifies a non-zero resume offset and the user tries to seek to a time between the start of the interstitial and its resumption point on the primary asset timeline, the client SHOULD begin playback from the start of the interstitial.

If a request for either an interstitial asset URI or an asset list URI returns an error, the client SHOULD cancel playback of the interstitial with a resume offset of 0.

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as the value of the "ASSETS" key, the client SHOULD apply the resume offset without playing any interstitial content. A resume offset of 0 SHOULD be used when no Interstitials are played, unless a value was specified with X-RESUME-OFFSET.

Clients SHOULD allow a generous amount of time (up to a minute) for a server to respond to requests for interstitial assets or asset lists, to enable the server to perform back-end decisioning. Servers MUST respond quickly enough to avoid playback disruptions on the client.

D.6. Example: Interstitial EXT-X-DATERANGE

In this playlist an EXT-X-DATERANGE tag schedules a 15-second ad to play four seconds into a six-second primary asset. The client will play the interstitial and then resume playback of the primary asset where it left off. Seeking and scanning forward will be disabled during interstitial playback. The EXT-X-DATERANGE tag includes a vendor-defined beacon attribute that can be processed by the client.

```
#EXTM3U
#EXT-X-TARGETDURATION:6
#EXT-X-PROGRAM-DATE-TIME:2020-01-02T21:55:40.000Z
#EXTINF:6,
main1.0.ts
#EXT-X-ENDLIST
#EXT-X-DATERANGE:ID="ad1",CLASS="com.apple.hls.interstitial",
    START-DATE="2020-01-02T21:55:44.000Z",DURATION=15.0,
    X-ASSET-URI="http://example.com/ad1.m3u8",X-RESUME-OFFSET=0,
    X-RESTRICT="SKIP,JUMP",X-COM-EXAMPLE-BEACON=123
```

D.7. Example: Skip button control for an Interstitial

In this playlist an EXT-X-DATERANGE tag schedules two 15-second ads to play four seconds into a six-second primary asset. The client will play these two interstitial assets one after the other and then resume playback of the primary asset where it left off. A Skip-Control overrides values of X-SKIP-CONTROL-OFFSET and X-SKIP-CONTROL-DURATION. A Skip button will show after 5 seconds into the interstitial and will be displayed for 20 seconds, or 10 seconds into the second asset, before being taken down. "Exit-Label" is the key an application will use to render localized label for the skip

skipping to change at *page 112, line 33*

as the value of the "ASSETS" key, the client SHOULD apply the resume offset without playing any interstitial content. A resume offset of 0 SHOULD be used when no Interstitials are played, unless a value was specified with X-RESUME-OFFSET.

Clients SHOULD allow a generous amount of time (up to a minute) for a server to respond to requests for interstitial assets or asset lists, to enable the server to perform back-end decisioning. Servers MUST respond quickly enough to avoid playback disruptions on the client.

D.7. Example: Interstitial EXT-X-DATERANGE

In this playlist an EXT-X-DATERANGE tag schedules a 15-second ad to play four seconds into a six-second primary asset. The client will play the interstitial and then resume playback of the primary asset where it left off. Seeking and scanning forward will be disabled during interstitial playback. The EXT-X-DATERANGE tag includes a vendor-defined beacon attribute that can be processed by the client.

```
#EXTM3U
#EXT-X-TARGETDURATION:6
#EXT-X-PROGRAM-DATE-TIME:2020-01-02T21:55:40.000Z
#EXTINF:6,
main1.0.ts
#EXT-X-ENDLIST
#EXT-X-DATERANGE:ID="ad1",CLASS="com.apple.hls.interstitial",
    START-DATE="2020-01-02T21:55:44.000Z",DURATION=15.0,
    X-ASSET-URI="http://example.com/ad1.m3u8",X-RESUME-OFFSET=0,
    X-RESTRICT="SKIP,JUMP",X-COM-EXAMPLE-BEACON=123
```

D.8. Example: Skip button control for an Interstitial

In this playlist an EXT-X-DATERANGE tag schedules two 15-second ads to play four seconds into a six-second primary asset. The client will play these two interstitial assets one after the other and then resume playback of the primary asset where it left off. A Skip-Control overrides values of X-SKIP-CONTROL-OFFSET and X-SKIP-CONTROL-DURATION. A Skip button will show after 5 seconds into the interstitial and will be displayed for 20 seconds, or 10 seconds into the second asset, before being taken down. "Exit-Label" is the key an application will use to render localized label for the skip

skipping to change at *page 117, line 29*

The value is a quoted-string that identifies the ID of the Date Range for which the resource should be preloaded. This attribute is REQUIRED.

X-TARGET-CLASS

The value is a quoted-string that identifies the target class, which is the CLASS of the Date Range with the specified X-TARGET-ID. This attribute is REQUIRED.

A Preload EXT-X-DATERANGE tag MUST contain a DURATION or END-DATE attribute. A Preload EXT-X-DATERANGE tag MUST NOT contain a CUE attribute or an END-ON-NEXT attribute.

The semantics of when a client should preload the resource specified by a Preload EXT-X-DATERANGE tag is determined by the target class.

A client MAY ignore a Preload EXT-X-DATERANGE tag, unless otherwise specified by the target class.

If the X-TARGET-ID of a Preload EXT-X-DATERANGE tag matches the ID of an EXT-X-DATERANGE tag but the X-TARGET-CLASS does not match its CLASS, the X-URI SHOULD NOT be preloaded, or if preloaded, SHOULD NOT be used.

If a Preload EXT-X-DATERANGE tag is removed from a Playlist, a client SHOULD discard any resource preloaded for that tag.

Appendix G. Custom Media Selection

skipping to change at *page 117, line 36*

The value is a quoted-string that identifies the ID of the Date Range for which the resource should be preloaded. This attribute is REQUIRED.

X-TARGET-CLASS

The value is a quoted-string that identifies the target class, which is the CLASS of the Date Range with the specified X-TARGET-ID. This attribute is REQUIRED.

X-DURATION-AT-JOIN

The value is a non-zero decimal-floating-point number of seconds that modifies the DURATION and START-DATE of the Preload Date Range for clients joining a live or event stream. This attribute is OPTIONAL.

A Preload EXT-X-DATERANGE tag MUST contain a DURATION or END-DATE attribute. A Preload EXT-X-DATERANGE tag MUST NOT contain a CUE attribute or an END-ON-NEXT attribute.

The semantics of when a client should preload the resource specified by a Preload Date Range is determined by the target class.

A client MAY ignore a Preload Date Range, unless otherwise specified by the target class.

If the X-TARGET-ID of a Preload EXT-X-DATERANGE tag matches the ID of an EXT-X-DATERANGE tag but the X-TARGET-CLASS does not match its CLASS, the X-URI SHOULD NOT be preloaded, or if preloaded, SHOULD NOT be used.

If a Preload EXT-X-DATERANGE tag is removed from a Playlist, a client SHOULD discard any resource preloaded for that tag.

Clients SHOULD ignore Preload EXT-X-DATERANGE tags if the Playlist contains an EXT-X-ENDLIST tag.

Appendix G. Custom Media Selection

While groups of Renditions are typically organized by language, they can be organized for presentation and selection in other ways. For example, a Multivariant Playlist might include audio Renditions for the Home and Away broadcasts of a sporting event, in both English and Spanish. Specifying these relationships between Renditions allows a client to construct a custom selection interface for the user that is based on characteristics of the content. The server MAY specify these relationships by providing a Custom Media Selection Scheme.

While groups of Renditions are typically organized by language, they can be organized for presentation and selection in other ways. For example, a Multivariant Playlist might include audio Renditions for the Home and Away broadcasts of a sporting event, in both English and Spanish. Specifying these relationships between Renditions allows a client to construct a custom selection interface for the user that is based on characteristics of the content. The server MAY specify these relationships by providing a Custom Media Selection Scheme.

skipping to change at ***page 119, line 26*** | **skipping to change at** ***page 119, line 26***

```
        "SETTINGS": [
          {
            "CHARACTERISTIC": string,
            "DISPLAY-NAMES": {
              JSON object where keys are language tags
              and values are localized names for the setting
            }
          }
        ]
      }
    ]
  }
]
```

```
        "SETTINGS": [
          {
            "CHARACTERISTIC": string,
            "DISPLAY-NAMES": {
              JSON object where keys are language tags
              and values are localized names for the setting
            }
          }
        ]
      }
    ],
    "LANGUAGE-DECORATION" : [  // OPTIONAL - see below
      {
        "CHARACTERISTIC": string,
        "DISPLAY-NAMES": {
          JSON object where keys are language tags
          and values are localized names for the characteristic
        }
      }
    ]
  }
]
```

Each member of the top-level array is a Media Presentation Type object. The array SHOULD be non-empty.

Each Media Presentation Type object has these elements:

TYPE: The value is a string that contains a valid attribute value

Each member of the top-level array is a Media Presentation Type object. The array SHOULD be non-empty.

Each Media Presentation Type object has these elements:

TYPE: The value is a string that contains a valid attribute value

skipping to change at ***page 119, line 48*** | **skipping to change at** ***page 120, line 9***

REQUIRED.

MEDIA-PRESENTATION-SETTINGS: This is an array of Presentation Selector objects. The array SHOULD be non-empty. This element is REQUIRED.

LANGUAGE-DISPLAY: This element is OPTIONAL. Language can be offered as a preference that's separate from all of the available Selectors. If this element is present and has the string value "NONE", then language SHOULD NOT be offered as a preference. Otherwise, lnaguage SHOULD be offered as a preference. When offered, lanugage has the highest priority among the user's selected preferences.

Each Presentation Selector object has these elements:

SELECTOR: The value is a UTF8 string which is a unique short name for the Selector. This element is REQUIRED.

DISPLAY-NAMES: The value is a set of name/value pairs, where each name is a primary language subtag tag [RFC5646] and each value is a UTF-8 string containing the name of the Selector localized in that language. This element is REQUIRED.

REQUIRED.

MEDIA-PRESENTATION-SETTINGS: This is an array of Presentation Selector objects. The array SHOULD be non-empty. This element is REQUIRED.

LANGUAGE-DISPLAY: This element is OPTIONAL. Language can be offered as a preference that's separate from all of the available Selectors. If this element is present and has the string value "NONE", then language SHOULD NOT be offered as a preference. Otherwise, language SHOULD be offered as a preference. When offered, language has the highest priority among the user's selected preferences.

LANGUAGE-DECORATION: This is an array of Language Decoration objects. The array SHOULD be non-empty. This element is OPTIONAL.

Each Presentation Selector object has these elements:

SELECTOR: The value is a UTF8 string which is a unique short name for the Selector. This element is REQUIRED.

DISPLAY-NAMES: The value is a set of name/value pairs, where each name is a primary language subtag tag [RFC5646] and each value is a UTF-8 string containing the name of the Selector localized in that language. This element is REQUIRED.

skipping to change at ***page 120, line 29*** | **skipping to change at** ***page 120, line 42***

identifier of the value. The value is considered a match for one of the entries in the CHARACTERISTICS list of an EXT-X-MEDIA only if they are exact string matches. This element is REQUIRED.

DISPLAY-NAMES: Similar to the Selector element, the value is a set of name/value pairs, where each name is a primary language subtag tag [RFC5646] and each value is a UTF-8 string containing the name of the value localized in that language. This element is REQUIRED.

If a language subtag occurs in one DISPLAY-NAMES dictionary (either in a Presentation Selector or a Presentation Setting) then the same subtag SHOULD be present in all the DISPLAY-NAMES elements.

The declaration of Presentation Selector objects in the JSON is ordered from most important to the least important. If each combination of mutually exclusive media characteristics for the separate Settings resolves to a specific EXT-X-MEDIA tag, this ordering has no effect except to influence the arrangement of the display of choices in a user interface. However, if no EXT-X-MEDIA tag possesses any specific combination of media characteristics, this order SHOULD dictate the priority of honoring the user's choices.

While Settings for any given Selector are offered to the user as a mutually exclusive choice among the Settings' media characteristics, any given EXT-X-MEDIA tag MAY possess more than one of the characteristics, in order to permit multiple combinations of characteristics to resolve to the same EXT-X-MEDIA tag.

identifier of the value. The value is considered a match for one of the entries in the CHARACTERISTICS list of an EXT-X-MEDIA only if they are exact string matches. This element is REQUIRED.

DISPLAY-NAMES: Similar to the Selector element, the value is a set of name/value pairs, where each name is a primary language subtag tag [RFC5646] and each value is a UTF-8 string containing the name of the value localized in that language. This element is REQUIRED.

If a language subtag occurs in one DISPLAY-NAMES dictionary (either in a Presentation Selector, a Presentation Setting, or a Language Decoration) then the same subtag SHOULD be present in all the DISPLAY-NAMES elements.

The declaration of Presentation Selector objects in the JSON is ordered from most important to the least important. If each combination of mutually exclusive media characteristics for the separate Settings resolves to a specific EXT-X-MEDIA tag, this ordering has no effect except to influence the arrangement of the display of choices in a user interface. However, if no EXT-X-MEDIA tag possesses any specific combination of media characteristics, this order SHOULD dictate the priority of honoring the user's choices.

While Settings for any given Selector are offered to the user as a mutually exclusive choice among the Settings' media characteristics, any given EXT-X-MEDIA tag MAY possess more than one of the characteristics, in order to permit multiple combinations of characteristics to resolve to the same EXT-X-MEDIA tag.

The LANGUAGE-DECORATION element is used to list characteristics that should modify a selection's displayed language to reflect the characteristic. Because the LANGUAGE-DECORATION element is intended to customize a language selection user interface, it is primarily, but not exclusively, intended for use when all of the media selection options with a given language have the indicated characteristic.

Each Language Decoration object has the same format as a Presentation Setting object, except that the DISPLAY-NAMES element is OPTIONAL.

Implementations MAY support decorations for common characteristics such as "public.original-content" and "public.machine-generated". An implementation is not required to support any particular set of characteristics.

G.2. Example Custom Media Selection Scheme

This example shows English and Spanish audio Renditions with two custom Selectors (in addition to language), namely "Origin" and "Medium". In this example, not all combinations of Selector Settings are available. For instance, there is no Away team English radio audio.

Here is a Multivariant Playlist:

skipping to change at *page 125, line 5*

```
   ✓ National network             ✓ Red nacional

Audio feed                     Fuente de audio
   ✓ Television                   ✓ Televisión
     Radio                          Radio
```

Appendix H. Glossary

If no Language Decoration is supplied for a characteristic, the client SHOULD NOT add any decoration, even if it has one.

If a CHARACTERISTIC is supplied with DISPLAY-NAMES, the client MAY use its own decoration if it has one for that characteristic and language, otherwise the client SHOULD use the value supplied for that language in the DISPLAY-NAMES element.

If a CHARACTERISTIC is supplied without DISPLAY-NAMES, the client SHOULD add a decoration if it has one.

A Language Decoration SHOULD specify where the decoration is to be displayed relative to the localized name for the language. This is done with the string "${language}". Note that this is not a general variable substitution scheme for display names. Only this one string substitution need be supported, If "${language}" is not present then just the localized value from DISPLAY-NAMES SHOULD be displayed.

If multiple characteristics of a Rendition each have a Language Decoration object, only the Language Decoration that occurs earliest in the LANGUAGE-DECORATION array SHOULD be applied.

Language Decorations modify the language Selector entries. They have no effect on any other Selector.

G.2. Example Custom Media Selection Scheme

This example shows English and Spanish audio Renditions with two custom Selectors (in addition to language), namely "Origin" and "Medium". In this example, not all combinations of Selector Settings are available. For instance, there is no Away team English radio audio.

Here is a Multivariant Playlist:

skipping to change at *page 126, line 5*

✓ National network ✓ Red nacional
Audio feed Fuente de audio
✓ Television ✓ Televisión
Radio Radio

G.3. Example Language Decoration Element

This example shows how a content producer could mark language alternates so that the selection UI displays them as pre-production.

```
    "LANGUAGE-DECORATION": [
      {
        "CHARACTERISTIC": "com.production-studio.non-final",
        "DISPLAY-NAMES": {
          "en": "${language} (Non-final)",
          "de": "${language} (Unfertig)"
        },
      },
      {
        "CHARACTERISTIC": "public.original-content",
      }
    ]
```

The example shows the use of implementation supported characteristics and the use of the "${language}" string substitution mechanism.

Appendix H. Date Range Schedules

The Date Range Schedule is a mechanism that allows content producers to add multiple Date Ranges to an asset in response to a single EXT-X-DATERANGE request. It provides more flexibility for server-driven interstitial insertion.

A Date Range Schedule EXT-X-DATERANGE tag MUST have a CLASS attribute whose value is "com.apple.hls.daterange-schedule". This class defines the following attributes:

X-URI

The value is a quoted-string URI to a JSON object. The URI MAY be absolute, or it MAY be relative to the URI of its container. The container is either a Playlist or another Date Range Schedule. This attribute is REQUIRED.

A Date Range Schedule is a JSON object containing a "DATERANGES" key whose value is an array of DateRange Objects.

A Date Range Schedule object has the form:

```
{
  "DATERANGES": [
    // One or more DateRange Objects, for example:
    {
      "CLASS" : string,
      "ID" : string,
      // ... any other EXT-X-DATERANGE attribute applicable to the CLASS
    }
  ]
}
```

H.1. Scheduled Date Ranges

A DateRange Object is a JSON object where each key is an attribute that can occur in an EXT-X-DATERANGE tag and and the key value is a legal attribute value. If the value is a hexadecimal-sequence then the value MUST be written as a string, since JSON does not have that type. The Date Ranges defined by these objects are referred to as Scheduled Date Ranges.

The DateRange Object MUST include all REQUIRED attributes of the equivalent Date Range. Note that subsequent augmentation of a Date Range with new attributes is not possible with Scheduled Date Ranges.

The restrictions on keys and values for individual DateRange Objects are slightly different than for the attributes of tags, as detailed here. Numeric AttributeValues SHOULD be JSON numbers. All other AttributeValues from EXT-X-DATERANGE tags SHOULD be strings, with those values normally without quotes simply being quoted. However, some X-<extension-attribute> values can be more complex, see the discussion below.

CLASS

Same semantics as the CLASS attribute of the EXT-X-DATERANGE tag, but this key is REQUIRED.

START-DATE

Same semantics as the START-DATE attribute of the EXT-X-DATERANGE tag, but a DateRange Object MUST have either a START-DATE key or a X-SCHEDULE-OFFSET key. It MUST NOT have both.

X-SCHEDULE-OFFSET

The value of X-SCHEDULE-OFFSET is a decimal-floating-point of seconds that specifies start of the Date Range relative to the start of its parent Date Range Schedule.

X-<extension-attribute>

If the attribute is defined in this document then it MUST have a value as defined. If it is not then its value MAY be any legal JSON value. Note that this includes arrays and objects. However, if you use that same attribute in an EXT-X-DATERANGE tag, then its value MUST be an AttributeValue allowed in an an EXT-X-DATERANGE tag.

Note that the syntax allows the DATERANGES array to contain any CLASS of Date Range. That said, which classes a client supports is implementation-specific. At a minimum, clients SHOULD support members of the "com.apple.hls.interstitial" CLASS and the "com.apple.hls.daterange-schedule" CLASS. Note that this permits nested Date Range Schedules; Servers SHOULD limit the nesting depth to three or fewer.

H.2. Behavior

A Date Range Schedule is scheduled the same way that interstitials (Appendix D) are, based on the playhead position. It will be ordered among regular interstitial Date Ranges. It will block the scheduling of any existing subsequent interstitial within its specified Date Range until it is resolved. When a Date Range Schedule is resolved, the Scheduled Date Ranges in its array are considered to be ordered immediately after the Date Range Schedule in the order that they appear in the array.

The start date of a Scheduled Date Range MUST fall within the date range of its parent Date Range Schedule. (A Date Range Schedule that does not have an established end date is considered to end arbitrarily far in the future until its end date is established.) The client SHOULD ignore any Scheduled Date Range whose start date falls outside the date range of its parent.

A Scheduled Date Range whose end date exceeds the end date of its parent Date Range Schedule is subject to its schedule clipping semantics. Schedule clipping semantics are specific to the CLASS of the child Date Range. If the child is a Schedule, the schedule clipping semantics are to treat it as if it had the same end date as its parent, and apply the resulting limit to its children also. If the child CLASS does not define schedule clipping semantics the client SHOULD NOT modify its treatment of the child Date Range.

As with EXT-X-DATERANGE tags, the order in the array will be used to determine playback order in the case of matching start dates.

The lifetime of Scheduled Date Ranges is tied to that of its parent Date Range. When the parent is removed from the Playlist, its children are likewise removed. Jumping backward to before a Date Range Schedule will reset the resolution and remove children, allowing re-decisioning.

All IDs produced by a Date Range Schedule MUST be unique to that Date Range Schedule. A Scheduled Date Range MUST NOT have an ID that appears in either the Playlist or in any other Scheduled Date Range.

A Date Range Schedule MUST have CUE=PRE to schedule PRE Date Ranges. A Date Range Schedule with CUE=POST MUST only schedule POST Date Ranges.

A server can directly populate abutting interstitials with X-ASSET-URI when producing the schedule to avoid a second trip to the server, or if a second trip is desired for whatever reason, it can provide an X-ASSET-LIST URL instead.

If a client joins a stream in the middle of a Date Range Schedule, the client SHOULD add the _HLS_start_offset query parameter to its URL request to allow the server to modify its schedule accordingly.

Appendix I. Glossary

Asset-Description (Appendix D.2 under X-ASSET-LIST)	Asset-Description (Appendix D.2 under X-ASSET-LIST)
attribute-list (Section 4.2)	attribute-list (Section 4.2)
AttributeName (Section 4.2)	AttributeName (Section 4.2)
AttributeValue (Section 4.2)	AttributeValue (Section 4.2)
Audio Coding Identifier (Section 4.4.6.1 under CHANNELS)	Audio Coding Identifier (Section 4.4.6.1 under CHANNELS)
Availability Duration (Section 6.2.2)	Availability Duration (Section 6.2.2)
Base Name Selection (Appendix E.2)	Base Name Selection (Appendix E.2)
Base Pathway (Section 7.3)	Base Pathway (Section 7.3)
Blocking Playlist Reload (Section 6.2.5.2)	Blocking Playlist Reload (Section 6.2.5.2)
Content Description (Section 7.1)	Content Description (Section 7.1)
Content Protection Configuration Labels (Section 4.4.6.2 under	Content Protection Configuration Labels (Section 4.4.6.2 under
ALLOWED-CPC)	ALLOWED-CPC)
Content Steering (Section 7)	Content Steering (Section 7)
Custom Media Selection Scheme (Appendix G)	Custom Media Selection Scheme (Appendix G)
Date Range (Section 4.4.5.1)	Date Range (Section 4.4.5.1)
	DateRange Object (Appendix H.1)
	Date Range Schedule (Appendix H.1)
decimal-floating-point (Section 4.2)	decimal-floating-point (Section 4.2)
decimal-integer (Section 4.2)	decimal-integer (Section 4.2)
decimal-resolution (Section 4.2)	decimal-resolution (Section 4.2)
Delivery Directive (Section 6.2.5)	Delivery Directive (Section 6.2.5)
Discontinuity Sequence Number (Section 4.4.3.3)	Discontinuity Sequence Number (Section 4.4.3.3)
enumerated-string (Section 4.2)	enumerated-string (Section 4.2)
enumerated-string-list (Section 4.2)	enumerated-string-list (Section 4.2)
Following Range (Section 4.4.5.1 under END-ON-NEXT)	Following Range (Section 4.4.5.1 under END-ON-NEXT)
Group (Section 4.4.6.1.1)	Group (Section 4.4.6.1.1)
hexadecimal-sequence (Section 4.2)	hexadecimal-sequence (Section 4.2)
I-frame Playlist (Section 4.4.6.3)	I-frame Playlist (Section 4.4.6.3)
IMSC Segment (Section 3.1.5)	IMSC Segment (Section 3.1.5)
Interstitials (Appendix D)	Interstitials (Appendix D)
	Language Decoration (Appendix G.1)
Localization Dictionary (Appendix E.1)	Localization Dictionary (Appendix E.1)
Low-Latency Mode (Section 2)	Low-Latency Mode (Section 2)
Media Characteristic Tag (Section 4.4.6.1 under CHARACTERISTICS)	Media Characteristic Tag (Section 4.4.6.1 under CHARACTERISTICS)
Media Initialization Section (Section 3.1)	Media Initialization Section (Section 3.1)
Media Metadata (Section 4.4.5)	Media Metadata (Section 4.4.5)
Media Playlist (Section 4.1)	Media Playlist (Section 4.1)
Media Presentation Type (Appendix G.1)	Media Presentation Type (Appendix G.1)
Media Segment (Section 3)	Media Segment (Section 3)
Media Sequence Number (Section 3)	Media Sequence Number (Section 3)
Multivariant Playlist (Section 4.1)	Multivariant Playlist (Section 4.1)
skipping to change at ***page 126, line 9***	**skipping to change at** ***page 130, line 35***
Packed Audio Segment (Section 3.1.3)	Packed Audio Segment (Section 3.1.3)
Parent Segment (Section 3.2)	Parent Segment (Section 3.2)
Part Index (Section 3.2)	Part Index (Section 3.2)
Part Target Duration (Section 4.4.3.7)	Part Target Duration (Section 4.4.3.7)
Partial Segment (Section 3.2)	Partial Segment (Section 3.2)
Pathway (Section 4.4.6.2)	Pathway (Section 4.4.6.2)
Pathway Clone (Section 7.3)	Pathway Clone (Section 7.3)
Pathway Cloning (Section 7.3)	Pathway Cloning (Section 7.3)
Playlist (Section 4)	Playlist (Section 4)
Playlist Delta Update (Section 6.2.5.1)	Playlist Delta Update (Section 6.2.5.1)
	Preload Date Range (Appendix F)
Presentation Selector (Appendix G.1)	Presentation Selector (Appendix G.1)
Presentation Setting (Appendix G.1)	Presentation Setting (Appendix G.1)
Projection Specifier (Section 4.4.6.2 under REQ-VIDEO-LAYOUT)	Projection Specifier (Section 4.4.6.2 under REQ-VIDEO-LAYOUT)
quoted-string (Section 4.2)	quoted-string (Section 4.2)
Rendition (Section 4.4.6.1)	Rendition (Section 4.4.6.1)
Rendition Group (Section 4.4.6.1.1)	Rendition Group (Section 4.4.6.1.1)
Rendition Report (Section 4.4.5.4)	Rendition Report (Section 4.4.5.4)
	Scheduled Date Range (Appendix H)
Segment (Section 3)	Segment (Section 3)
Server Configuration (Appendix B)	Server Configuration (Appendix B)
signed-decimal-floating-point (Section 4.2)	signed-decimal-floating-point (Section 4.2)
Skip Boundary (Section 4.4.3.8 under CAN-SKIP-UNTIL)	Skip Boundary (Section 4.4.3.8 under CAN-SKIP-UNTIL)
Skip-Control (Appendix D.2. under X-ASSET-LIST)	Skip-Control (Appendix D.2. under X-ASSET-LIST)
Snap Identifiers (Appendix D.2 under X-SNAP)	Snap Identifiers (Appendix D.2 under X-SNAP)
Special Usage Identifier (Section 4.4.6.1 under CHANNELS)	Special Usage Identifier (Section 4.4.6.1 under CHANNELS)
Steering Manifest (Section 7.2)	Steering Manifest (Section 7.2)
Steering Server (Section 4.4.6.6)	Steering Server (Section 4.4.6.6)
Tag (Section 4.1)	Tag (Section 4.1)
End of changes. 62 change blocks.	
88 lines changed or deleted	***377 lines changed or added***

This html diff was produced by rfcdiff 1.49. The latest version is available from https://github.com/ietf-tools/rfcdiff