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**HTTP Live Streaming**

**draft-pantos-http-live-streaming-16**

Abstract

This document 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 7 of this protocol.

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[12.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-12.1). Normative References . . . . . . . . . . . . . . . . . . [45](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#page-45)

[12.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-12.2). Informative References . . . . . . . . . . . . . . . . . [48](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#page-48)

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**[1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-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

audio translations. It offers compatibility with large-scale HTTP

caching infrastructure to support delivery to large audiences.

Since its first draft publication in 2009, HTTP Live Streaming has

been implemented and deployed by a wide array of content producers,

tools vendors, distributors, and device manufacturers.

The purpose of this document is to facilitate interoperability

between HTTP Live Streaming implementations by describing the media

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transmission protocol. Using this protocol, a client can receive a

continuous stream of media from a server for concurrent presentation.

This document describes version 7 of the protocol.

**[2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-2). Overview**

A multimedia presentation is specified by a Uniform Resource

Identifier (URI) [[RFC3986](https://tools.ietf.org/html/rfc3986)] to a Playlist.

A Playlist is either a Media Playlist or a Master Playlist. Both are

UTF-8 text files containing URIs and descriptive tags.

A Media Playlist contains a list of Media Segments, which when played

sequentially will play the multimedia presentation.

Here is an example of a Media Playlist:

#EXTM3U

#EXT-X-TARGETDURATION:10

#EXTINF:9.009,

http://media.example.com/first.ts

#EXTINF:9.009,

http://media.example.com/second.ts

#EXTINF:3.003,

http://media.example.com/third.ts

The first line is the format identifier tag #EXTM3U. The line

containing #EXT-X-TARGETDURATION says that all Media Segments will be

10 seconds long or less. Then three Media Segments are declared.

The first and second are 9.009 seconds long; the third is 3.003

seconds.

To play this Playlist, the client first downloads it and then

downloads and plays each Media Segment declared within it. The

client reloads the Playlist as described in this document to discover

any added segments. Data SHOULD be carried over HTTP [[RFC7230](https://tools.ietf.org/html/rfc7230)], but

in general a URI can specify any protocol that can reliably transfer

the specified resource on demand.

A more complex presentation can be described by a Master Playlist. A

Master Playlist provides a set of Variant Streams, each of which

describes a different version of the same content.

A Variant Stream includes a Media Playlist that specifies media

encoded at a particular bit rate, in a particular format, and at a

particular resolution for media containing video.

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A Variant Stream can also specify a set of Renditions. Renditions

are alternate versions of the content, such as audio produced in

different languages or video recorded from different camera angles.

Clients should switch between different Variant Streams to adapt to

network conditions. Clients should choose Renditions based on user

preferences.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",

"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this

document are to be interpreted as described in [RFC 2119](https://tools.ietf.org/html/rfc2119) [[RFC2119](https://tools.ietf.org/html/rfc2119)].

**[3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-3). Media Segments**

A Media Playlist contains a series of Media Segments which make up

the overall presentation. A Media Segment is specified by a URI and

optionally a byte range.

The duration of each Media Segment is indicated in the Media Playlist

by its EXTINF tag ([Section 4.3.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.1)).

Each segment in a Media Playlist has a unique integer Media Sequence

Number. The Media Sequence Number of the first segment in the Media

Playlist is either 0, or declared in the Playlist ([Section 4.3.3.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.3.2)).

The Media Sequence Number of every other segment is equal to the

Media Sequence Number of the segment that precedes it plus one.

Each Media Segment MUST be formatted as an MPEG-2 Transport Stream

[[ISO\_13818](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-ISO_13818)], a WebVTT [[WebVTT](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "ref-WebVTT" \o "\"WebVTT: The Web Video Text Tracks Format\")] file, or a Packed Audio file, which is

a file containing packed encoded audio samples and ID3 tags, such as

AAC with ADTS framing [[ISO\_13818\_7](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-ISO_13818_7)], MP3 [[ISO\_13818\_3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-ISO_13818_3)] or AC-3

[[AC\_3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-AC_3)]. Transport of other media file formats is not defined.

Some media formats require that a parser be initialized with a common

sequence of bytes before a Media Segment can be parsed. This format-

specific sequence is called the Media Initialization Section. The

Media Initialization Section of an MPEG-2 Transport Stream segment is

the Program Association Table (PAT) followed by the Program Map

Table (PMT). The Media Initialization Section of a WebVTT segment is

the WebVTT header. A Packed Audio segment has no Media

Initialization Section.

Transport Stream segments MUST contain a single MPEG-2 Program;

playback of Multi-Program Transport Streams is not defined. Each

Transport Stream segment SHOULD contain a PAT and a PMT at the start

of the segment - or have a Media Initialization Section declared in

the Media Playlist ([Section 4.3.2.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.5)).

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A Media Segment that contains video SHOULD have at least one key

frame and enough information to completely initialize a video

decoder.

Each Media Segment MUST be the continuation of the encoded media at

the end of the segment with the previous Media Sequence Number, where

values in a continuous series such as timestamps and Continuity

Counters continue uninterrupted. The only exceptions are the first

Media Segment ever to appear in a Media Playlist, and Media Segments

which are explicitly signaled as discontinuities ([Section 4.3.2.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.3)).

Unmarked media discontinuities can trigger playback errors.

Each Packed Audio segment MUST signal the timestamp of its first

sample with an ID3 PRIV tag [[ID3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-ID3)] at the beginning of the segment.

The ID3 PRIV owner identifier MUST be

"com.apple.streaming.transportStreamTimestamp". The ID3 payload MUST

be a 33-bit MPEG-2 Program Elementary Stream timestamp expressed as a

big-endian eight-octet number, with the upper 31 bits set to zero. A

Packed Audio segment without such an ID3 tag can trigger playback

errors.

Subtitle segments are formatted as WebVTT [[WebVTT](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "ref-WebVTT" \o "\"WebVTT: The Web Video Text Tracks Format\")] files. Each

subtitle segment MUST contain all subtitle cues that are intended to

be displayed during the period indicated by the segment EXTINF

duration. The start time offset and end time offset of each cue MUST

indicate the total display time for that cue, even if that time range

extends beyond the EXTINF duration. A WebVTT segment MAY contain no

cues; this indicates that no subtitles are to be displayed during

that period.

Each subtitle segment MUST either start with a WebVTT header or have

a Media Initialization Section declared in the Media Playlist

([Section 4.3.2.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.5)).

Within each WebVTT header there MUST be an X-TIMESTAMP-MAP metadata

header. This header synchronizes the cue timestamps in the WebVTT

file with the MPEG-2 (PES) timestamps in other Renditions of the

Variant Stream. Its format is:

X-TIMESTAMP-MAP=LOCAL:<cue time>,MPEGTS:<MPEG-2 time>

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

The cue timestamp in the LOCAL attribute MAY fall outside the range

of time covered by the segment.

A subtitle segment not meeting these requirements can be displayed

inconsistently, not display at all, or cause other playback errors.

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**[4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4). Playlists**

This section describes the Playlist files used by HTTP Live

Streaming. In this section, "MUST" and "MUST NOT" specify the rules

for the syntax and structure of legal Playlist files. Playlists that

violate these rules are invalid; clients MUST fail to parse them.

See [Section 6.3.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.2).

The format of the Playlist files is derived from the M3U [[M3U](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-M3U)]

playlist file format and inherits two tags from that earlier file

format: EXTM3U ([Section 4.3.1.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.1.1)) and EXTINF ([Section 4.3.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.1)).

In this section, tags are specified using a BNF-style syntax.

Each Playlist file MUST be identifiable by either the path component

of its URI or by HTTP Content-Type. In the first case, the path MUST

end with either .m3u8 or .m3u. In the second, the HTTP Content-type

MUST be "application/vnd.apple.mpegurl" or "audio/mpegurl". Clients

SHOULD refuse to parse Playlists that are not so identified.

**[4.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.1). Definition of a Playlist**

Playlist files MUST be encoded in UTF-8 [[RFC3629](https://tools.ietf.org/html/rfc3629)]. They MUST NOT

contain any byte order mark (BOM); Clients SHOULD reject Playlists

which contain a BOM or do not parse as UTF-8. Note that US-ASCII

[[US\_ASCII](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-US_ASCII)] is a proper subset of UTF-8.

Lines in a Playlist file are terminated by either a single line feed

character or a carriage return character followed by an line feed

character. Each line is a URI, blank, or starts with the character

'#'. Blank lines are ignored. White space MUST NOT be present,

except for elements in which it is explicitly specified.

Lines that start with the character '#' are either comments or tags.

Tags begin with #EXT. They are case-sensitive. All other lines that

begin with '#' are comments and SHOULD be ignored.

A URI line identifies a Media Segment or a Playlist file (see

[Section 4.3.4.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2)). Each Media Segment is specified by a URI and the

tags that apply to it.

A Playlist is a Media Playlist if all URI lines in the Playlist

identify Media Segments. A Playlist is a Master Playlist if all URI

lines in the Playlist identify Media Playlists. A Playlist MUST be

either a Media Playlist or a Master Playlist; all other Playlists are

invalid.

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A URI in a Playlist, whether it is a URI line or part of a tag, MAY

be relative. Any relative URI is considered to be relative to the

URI of the Playlist that contains it.

The duration of a Media Playlist file is the sum of the durations of

the Media Segments within it.

The segment bit rate of a Media Segment is the size of the Media

Segment divided by its EXTINF duration ([Section 4.3.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.1)). Note that

this includes container overhead but does not include overhead

imposed by the delivery system, such as HTTP, TCP or IP headers.

The peak bit rate of a Media Playlist is the largest segment bit rate

of all segments in the Media Playlist.

The average segment bit rate of a Media Playlist is the sum of the

sizes (in bits) of every Media Segment in the Media Playlist, divided

by the Media Playlist duration. Note that this includes container

overhead, but not HTTP or other overhead imposed by the delivery

system.

**[4.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.2). Attribute Lists**

Certain tags have values which are Attribute Lists. An Attribute

List is a comma-separated list of attribute/value pairs with no

whitespace.

An attribute/value pair has the following syntax:

AttributeName=AttributeValue

An AttributeName is an unquoted string containing characters from the

set [A..Z], [0..9] and '-'. Therefore, AttributeNames contain only

uppercase letters, not lowercase. There MUST NOT be any whitespace

between the AttributeName and the '=' character, nor between the '='

character and the AttributeValue.

An AttributeValue is one of the following:

o decimal-integer: an unquoted string of characters from the set

[0..9] expressing an integer in base-10 arithmetic in the range

from 0 to 2^64-1 (18446744073709551615). A decimal-integer may be

from 1 to 20 characters long.

o hexadecimal-sequence: an unquoted string of characters from the

set [0..9] and [A..F] that is prefixed with 0x or 0X. The maximum

length of a hexadecimal-sequence depends on its AttributeName.

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o decimal-floating-point: an unquoted string of characters from the

set [0..9] and '.' which expresses a non-negative floating-point

number in decimal positional notation.

o signed-decimal-floating-point: an unquoted string of characters

from the set [0..9], '-' and '.' which expresses a signed

floating-point number in decimal positional notation.

o 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). 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.

o enumerated-string: an unquoted character string from a set which

is explicitly defined by the Attribute. An enumerated-string will

never contain double-quotes ("), commas (,), or whitespace.

o decimal-resolution: two decimal-integers separated by the "x"

character. The first integer is a horizontal pixel dimension

(width); the second is a vertical pixel dimension (height).

The type of the AttributeValue for a given AttributeName is specified

by the Attribute definition.

A given AttributeName MUST NOT appear more than once in a given

Attribute List. Clients SHOULD refuse to play such Playlists.

**[4.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3). Playlist Tags**

Playlist tags specify either global parameters of the Playlist, or

information about the Media Segments or Media Playlists that appear

after them.

**[4.3.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.1). Basic Tags**

These tags are allowed in both Media Playlists and Master Playlists.

**[4.3.1.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.1.1). EXTM3U**

The EXTM3U tag indicates that the file is an Extended M3U [[M3U](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-M3U)]

Playlist file. It MUST be the first line of every Media Playlist and

every Master Playlist. Its format is:

#EXTM3U

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**[4.3.1.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.1.2). EXT-X-VERSION**

The EXT-X-VERSION tag indicates the compatibility version of the

Playlist file, its associated media, and its server.

The EXT-X-VERSION tag applies to the entire Playlist file. Its

format is:

#EXT-X-VERSION:<n>

where n is an integer indicating the protocol compatibility version

number.

It MUST appear in all Playlists containing tags or attributes that

are not compatible with protocol version 1 to support

interoperability with older clients. [Section 7](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-7) specifies the minimum

value of the compatibility version number for any given Playlist

file.

A Playlist file MUST NOT contain more than one EXT-X-VERSION tag. If

a client encounters a Playlist with multiple EXT-X-VERSION tags, it

MUST reject it.

**[4.3.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.2). Media Segment Tags**

Each Media Segment is specified by a series of Media Segment tags

followed by a URI. Some Media Segment tags apply to just the next

segment; others apply to all subsequent segments until another

instance of the same tag.

A Media Segment tag MUST NOT appear in a Master Playlist. Clients

MUST reject Playlists that contain both Media Segment Tags and Master

Playlist tags ([Section 4.3.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4)).

**[4.3.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.2.1). EXTINF**

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The EXTINF tag specifies the duration of a Media Segment. It applies

only to the next Media Segment. This tag is REQUIRED for each Media

Segment. Its format is:

#EXTINF:<duration>[,<title>]

where duration is a decimal-integer or decimal-floating-point number

(as described in [Section 4.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.2)) that specifies the duration of the

Media Segment in seconds. Durations that are reported as integers

SHOULD be rounded to the nearest integer. Durations MUST be integers

if the compatibility version number is less than 3 to support older

clients. Durations SHOULD be floating-point if the compatibility

version number is 3 or greater. The remainder of the line following

the comma is an optional human-readable informative title of the

Media Segment expressed as raw UTF-8 text.

**[4.3.2.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.2.2). EXT-X-BYTERANGE**

The EXT-X-BYTERANGE tag indicates that a Media Segment is a sub-range

of the resource identified by its URI. It applies only to the next

URI line that follows it in the Playlist. Its format is:

#EXT-X-BYTERANGE:<n>[@<o>]

where n is a decimal-integer indicating the length of the sub-range

in bytes. If present, o is a decimal-integer indicating the start of

the sub-range, as a byte offset from the beginning of the resource.

If o is not present, the sub-range begins at the next byte following

the sub-range of the previous Media Segment.

If o is not present, a previous Media Segment MUST appear in the

Playlist file and MUST be a sub-range of the same media resource, or

the Media Segment is undefined and the Playlist MUST be rejected.

A Media Segment without an EXT-X-BYTERANGE tag consists of the entire

resource identified by its URI.

Use of the EXT-X-BYTERANGE tag REQUIRES a compatibility version

number of 4 or greater.

**[4.3.2.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.2.3). EXT-X-DISCONTINUITY**

The EXT-X-DISCONTINUITY tag indicates a discontinuity between the

Media Segment that follows it and the one that preceded it.

Its format is:

#EXT-X-DISCONTINUITY

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The EXT-X-DISCONTINUITY tag MUST be present if there is a change in

any of the following characteristics:

o file format

o number, type and identifiers of tracks

o timestamp sequence

The EXT-X-DISCONTINUITY tag SHOULD be present if there is a change in

any of the following characteristics:

o encoding parameters

o encoding sequence

See [Section 3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-3), [Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1), and [Section 6.3.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.3) for more information

about the EXT-X-DISCONTINUITY tag.

**[4.3.2.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.2.4). EXT-X-KEY**

Media Segments MAY be encrypted. The EXT-X-KEY tag specifies how to

decrypt them. It applies to every Media Segment that appears between

it and the next EXT-X-KEY tag in the Playlist file with the same

KEYFORMAT attribute (or the end of the Playlist file). Two or more

EXT-X-KEY tags with different KEYFORMAT attributes MAY apply to the

same Media Segment if they ultimately produce the same decryption

key. The format is:

#EXT-X-KEY:<attribute-list>

The following attributes are defined:

METHOD

The value is an enumerated-string that specifies the encryption

method. This attribute is REQUIRED.

The methods defined are: NONE, AES-128, and SAMPLE-AES.

An encryption method of NONE means that Media Segments are not

encrypted. If the encryption method is NONE, other attributes MUST

NOT be present.

An encryption method of AES-128 signals that Media Segments are

completely encrypted using the Advanced Encryption Standard [[AES\_128](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-AES_128)]

with a 128-bit key, Cipher Block Chaining, and PKCS7 padding

[[RFC5652](https://tools.ietf.org/html/rfc5652)]. CBC is restarted on each segment boundary, using either

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the IV attribute value or the Media Sequence Number as the IV; see

[Section 5.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-5.2). The URI attribute is REQUIRED for this METHOD.

An encryption method of SAMPLE-AES means that the Media Segments

contain media samples, such as audio or video, that are encrypted

using the Advanced Encryption Standard [[AES\_128](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-AES_128)]. How these media

streams are encrypted and encapsulated in a segment depends on the

media encoding and the media format of the segment. The encryption

format for H.264 [[H\_264](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-H_264)], AAC [[ISO\_14496](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-ISO_14496)], and AC-3 [[AC\_3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-AC_3)] media

streams is described in the HLS Sample Encryption specification

[[SampleEnc](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "ref-SampleEnc" \o "\"MPEG-2 Stream Encryption Format for HTTP Live Streaming\")]. The IV attribute MAY be present; see [Section 5.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-5.2).

URI

The value is a quoted-string containing a URI that specifies how to

obtain the key. This attribute is REQUIRED unless the METHOD is

NONE.

IV

The value is a hexadecimal-sequence that specifies a 128-bit unsigned

integer Initialization Vector to be used with the key. Use of the IV

attribute REQUIRES a compatibility version number of 2 or greater.

See [Section 5.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-5.2) for when the IV attribute is used.

KEYFORMAT

The value is a quoted-string that specifies how the key is

represented in the resource identified by the URI; see [Section 5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-5) for

more detail. This attribute is OPTIONAL; its absence indicates an

implicit value of "identity". Use of the KEYFORMAT attribute

REQUIRES a compatibility version number of 5 or greater.

KEYFORMATVERSIONS

The value is a quoted-string containing one or more positive integers

separated by the "/" character (for example, "1", "1/2", or "1/2/5").

If more than one version of a particular KEYFORMAT is defined, this

attribute can be used to indicate which version(s) this instance

complies with. This attribute is OPTIONAL; if it is not present, its

value is considered to be "1". Use of the KEYFORMATVERSIONS

attribute REQUIRES a compatibility version number of 5 or greater.

If the Media Playlist file does not contain an EXT-X-KEY tag then

Media Segments are not encrypted.

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See [Section 5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-5) for the format of the key file, and [Section 5.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-5.2),

[Section 6.2.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.3) and [Section 6.3.6](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.6) for additional information on Media

Segment encryption.

**[4.3.2.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.2.5). EXT-X-MAP**

The EXT-X-MAP tag specifies how to obtain the Media Initialization

Section ([Section 3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-3)) required to parse the applicable Media Segments.

It applies to every Media Segment that appears after it in the

Playlist until the next EXT-X-MAP tag or until the end of the

playlist.

Its format is:

#EXT-X-MAP:<attribute-list>

The following attributes are defined:

URI

The value is a quoted-string containing a URI that identifies a

resource that contains the Media Initialization Section. This

attribute is REQUIRED.

BYTERANGE

The value is a quoted-string specifying a byte range into the

resource identified by the URI attribute. This range SHOULD contain

only the Media Initialization Section. The format of the byte range

is described in [Section 4.3.2.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.2). This attribute is OPTIONAL; if it

is not present, the byte range is the entire resource indicated by

the URI.

An EXT-X-MAP tag SHOULD be supplied for Media Segments in Playlists

with the EXT-X-I-FRAMES-ONLY tag when the first Media Segment (i.e.,

I-frame) in the Playlist (or the first segment following an EXT-

X-DISCONTINUITY tag) does not immediately follow the Media

Initialization Section at the beginning of its resource.

Use of the EXT-X-MAP tag in a Media Playlist that contains the EXT-

X-I-FRAMES-ONLY tag REQUIRES a compatibility version number of 5 or

greater. Use of the EXT-X-MAP tag in a Media Playlist that DOES NOT

contain the EXT-X-I-FRAMES-ONLY tag REQUIRES a compatibility version

number of 6 or greater.

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**[4.3.2.6](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.2.6). EXT-X-PROGRAM-DATE-TIME**

The EXT-X-PROGRAM-DATE-TIME tag associates the first sample of a

Media Segment with an absolute date and/or time. It applies only to

the next Media Segment.

The date/time representation is ISO/IEC 8601:2004 [[ISO\_8601](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-ISO_8601)] and

SHOULD indicate a time zone and fractional parts of seconds:

#EXT-X-PROGRAM-DATE-TIME:<YYYY-MM-DDThh:mm:ssZ>

For example:

#EXT-X-PROGRAM-DATE-TIME:2010-02-19T14:54:23.031+08:00

EXT-X-PROGRAM-DATE-TIME tags SHOULD provide millisecond accuracy.

See [Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1) and [Section 6.3.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.3) for more information on the EXT-

X-PROGRAM-DATE-TIME tag.

**[4.3.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.3). Media Playlist Tags**

Media Playlist tags describe global parameters of the Media Playlist.

There MUST NOT be more than one Media Playlist tag of each type in

any Media Playlist.

A Media Playlist Tag MUST NOT appear in a Master Playlist

**[4.3.3.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.3.1). EXT-X-TARGETDURATION**

The EXT-X-TARGETDURATION tag specifies the maximum Media Segment

duration. The EXTINF duration of each Media Segment in the Playlist

file, when rounded to the nearest integer, MUST be less than or equal

to the target duration; longer segments can trigger playback stalls

or other errors. It applies to the entire Playlist file. Its format

is:

#EXT-X-TARGETDURATION:<s>

where s is a decimal-integer indicating the target duration in

seconds. The EXT-X-TARGETDURATION tag is REQUIRED.

**[4.3.3.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.3.2). EXT-X-MEDIA-SEQUENCE**

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The EXT-X-MEDIA-SEQUENCE tag indicates the Media Sequence Number of

the first Media Segment that appears in a Playlist file. Its format

is:

#EXT-X-MEDIA-SEQUENCE:<number>

where number is a decimal-integer.

If the Media Playlist file does not contain an EXT-X-MEDIA-SEQUENCE

tag then the Media Sequence Number of the first Media Segment in the

Media Playlist SHALL be considered to be 0. A client MUST NOT assume

that segments with the same Media Sequence Number in different Media

Playlists contain matching content - see [Section 6.3.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.2).

A URI for a Media Segment is not required to contain its Media

Sequence Number.

See [Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1) and [Section 6.3.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.5) for more information on setting

the EXT-X-MEDIA-SEQUENCE tag.

The EXT-X-MEDIA-SEQUENCE tag MUST appear before the first Media

Segment in the Playlist.

**[4.3.3.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.3.3). EXT-X-DISCONTINUITY-SEQUENCE**

The EXT-X-DISCONTINUITY-SEQUENCE tag allows synchronization between

different Renditions of the same Variant Stream or different Variant

Streams that have EXT-X-DISCONTINUITY tags in their Media Playlists.

Its format is:

#EXT-X-DISCONTINUITY-SEQUENCE:<number>

where number is a decimal-integer.

If the Media Playlist does not contain an EXT-X-DISCONTINUITY-

SEQUENCE tag, then the Discontinuity Sequence Number of the first

Media Segment in the Playlist SHALL be considered to be 0.

The EXT-X-DISCONTINUITY-SEQUENCE tag MUST appear before the first

Media Segment in the Playlist.

The EXT-X-DISCONTINUITY-SEQUENCE tag MUST appear before any EXT-

X-DISCONTINUITY tag.

See [Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1) and [Section 6.2.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.2) for more information about

setting the value of the EXT-X-DISCONTINUITY-SEQUENCE tag.

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**[4.3.3.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.3.4). EXT-X-ENDLIST**

The EXT-X-ENDLIST tag indicates that no more Media Segments will be

added to the Media Playlist file. It MAY occur anywhere in the Media

Playlist file. Its format is:

#EXT-X-ENDLIST

**[4.3.3.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.3.5). EXT-X-PLAYLIST-TYPE**

The EXT-X-PLAYLIST-TYPE tag provides mutability information about the

Media Playlist file. It applies to the entire Media Playlist file.

It is OPTIONAL. Its format is:

#EXT-X-PLAYLIST-TYPE:<EVENT|VOD>

[Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1) defines the implications of the EXT-X-PLAYLIST-TYPE

tag.

If the EXT-X-PLAYLIST-TYPE value is EVENT, Media Segments can only be

added to the end of the Media Playlist. If the EXT-X-PLAYLIST-TYPE

value is VOD, the Media Playlist cannot change.

If the EXT-X-PLAYLIST-TYPE tag is omitted from a Media Playlist, the

Playlist can be updated according to the rules in [Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1) with

no additional restrictions. For example, a live Playlist

([Section 6.2.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.2)) MAY be updated to remove Media Segments in the order

that they appeared.

**[4.3.3.6](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.3.6). EXT-X-I-FRAMES-ONLY**

The EXT-X-I-FRAMES-ONLY tag indicates that each Media Segment in the

Playlist describes a single I-frame. I-frames (or Intra frames) are

encoded video frames whose encoding does not depend on any other

frame. I-frame playlists can be used for trick play, such as fast

forward, rapid reverse and scrubbing.

The EXT-X-I-FRAMES-ONLY tag applies to the entire Playlist. Its

format is:

#EXT-X-I-FRAMES-ONLY

In a Playlist with the EXT-X-I-FRAMES-ONLY tag, the Media Segment

duration (EXTINF tag value) is the time between the presentation time

of the I-frame in the Media Segment and the presentation time of the

next I-frame in the Playlist, or the end of the presentation if it is

the last I-frame in the Playlist.

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Media resources containing I-frame segments MUST begin with either a

Media Initialization Section ([Section 3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-3)) or be accompanied by an EXT-

X-MAP tag indicating the Media Initialization Section so that clients

can load and decode I-frame segments in any order. The byte range of

an I-frame segment with an EXT-X-BYTERANGE tag applied to it

([Section 4.3.2.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.2)) MUST NOT include its Media Initialization Section;

clients can assume that the Media Initialization Section is defined

by EXT-X-MAP tag, or is located from the start of the resource to the

offset of the first I-frame segment in that resource.

Use of the EXT-X-I-FRAMES-ONLY REQUIRES a compatibility version

number of 4 or greater.

**[4.3.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.4). Master Playlist Tags**

Master Playlist tags define the Variant Streams, Renditions, and

other global parameters of the presentation.

Master Playlist Tags MUST NOT appear in a Media Playlist; clients

MUST reject any Playlist that contains both a Master Playlist tag and

either a Media Playlist tag or a Media Segment tag.

**[4.3.4.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.4.1). EXT-X-MEDIA**

The EXT-X-MEDIA tag is used to relate Media Playlists that contain

alternative Renditions ([Section 4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2.1)) of the same content. For

example, three EXT-X-MEDIA tags can be used to identify audio-only

Media Playlists that contain English, French and Spanish Renditions

of the same presentation. Or two EXT-X-MEDIA tags can be used to

identify video-only Media Playlists that show two different camera

angles.

Its format is:

#EXT-X-MEDIA:<attribute-list>

The following attributes are defined:

TYPE

The value is an enumerated-string; valid strings are AUDIO, VIDEO,

SUBTITLES and CLOSED-CAPTIONS. This attribute is REQUIRED.

In Transport Streams, Closed captions [[CEA608](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-CEA608)] media is carried in

the video stream. Therefore, an EXT-X-MEDIA tag with TYPE of CLOSED-

CAPTION does not specify a Rendition; the closed caption media is

present in the Media Segments of every video Rendition.

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URI

The value is a quoted-string containing a URI that identifies the

Media Playlist file. This attribute is OPTIONAL; see

[Section 4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2.1). If the TYPE is CLOSED-CAPTIONS, the URI attribute

MUST NOT be present.

GROUP-ID

The value is a quoted-string which specifies the group to which the

Rendition belongs. See [Section 4.3.4.1.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.1.1). This attribute is

REQUIRED.

LANGUAGE

The value is a quoted-string containing one of the standard Tags for

Identifying Languages [[RFC5646](https://tools.ietf.org/html/rfc5646)], which identifies the primary

language used in the Rendition. This attribute is OPTIONAL.

ASSOC-LANGUAGE

The value is a quoted-string containing a language tag [[RFC5646](https://tools.ietf.org/html/rfc5646)] that

identifies a language that is associated with the Rendition. An

associated language is often used in a different role than the

language specified by the LANGUAGE attribute (e.g. written vs.

spoken, or as a fallback dialect). This attribute is OPTIONAL.

The LANGUAGE and ASSOC-LANGUAGE attributes can be used, for example,

to link Norwegian renditions that use different spoken and written

languages.

NAME

The value is a quoted-string containing a human-readable description

of the Rendition. If the LANGUAGE attribute is present then this

description SHOULD be in that language. This attribute is REQUIRED.

DEFAULT

The value is an enumerated-string; valid strings are YES and NO. If

the value is YES, then the client SHOULD play this Rendition of the

content in the absence of information from the user indicating a

different choice. This attribute is OPTIONAL. Its absence indicates

an implicit value of NO.

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AUTOSELECT

The value is an enumerated-string; valid strings are YES and NO.

This attribute is OPTIONAL. Its absence indicates an implicit value

of NO. If the value is YES, then the client MAY choose to play this

Rendition in the absence of explicit user preference because it

matches the current playback environment, such as chosen system

language.

If the AUTOSELECT attribute is present, its value MUST be YES if the

value of the DEFAULT attribute is YES.

FORCED

The value is an enumerated-string; valid strings are YES and NO.

This attribute is OPTIONAL. Its absence indicates an implicit value

of NO. The FORCED attribute MUST NOT be present unless the TYPE is

SUBTITLES.

A value of YES indicates that the Rendition contains content which is

considered essential to play. When selecting a FORCED Rendition, a

client SHOULD choose the one that best matches the current playback

environment (e.g. language).

A value of NO indicates that the Rendition contains content which is

intended to be played in response to explicit user request.

INSTREAM-ID

The value is a quoted-string that specifies a Rendition within the

segments in the Media Playlist. This attribute is REQUIRED if the

TYPE attribute is CLOSED-CAPTIONS, in which case it MUST have one of

the values: "CC1", "CC2", "CC3", "CC4", or "SERVICEn" where n MUST be

an integer between 1 and 63 (e.g."SERVICE3" or "SERVICE42").

The values "CC1", "CC2", "CC3", and "CC4" identify a Line 21 Data

Services channel [[CEA608](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-CEA608)]. The "SERVICE" values identify a Digital

Television Closed Captioning [[CEA708](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-CEA708)] service block number.

For all other TYPE values, the INSTREAM-ID MUST NOT be specified.

CHARACTERISTICS

The value is a quoted-string containing one or more Uniform Type

Identifiers [[UTI](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-UTI)] separated by comma (,) characters. This attribute

is OPTIONAL. Each UTI indicates an individual characteristic of the

Rendition.

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A SUBTITLES Rendition MAY include the following characteristics:

"public.accessibility.transcribes-spoken-dialog";

"public.accessibility.describes-music-and-sound"; "public.easy-to-

read" (which indicates that the subtitles have been edited for ease

of reading).

An AUDIO Rendition MAY include the following characteristics:

"public.accessibility.describes-video".

The CHARACTERISTICS attribute MAY include private UTIs.

**[4.3.4.1.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.4.1.1). Rendition Groups**

A set of one or more EXT-X-MEDIA tags with the same GROUP-ID value

and the same TYPE value defines a Group of Renditions. Each member

of the Group MUST be an alternative rendition of the same content;

otherwise playback errors can occur.

All EXT-X-MEDIA tags in a Playlist MUST meet the following

constraints:

o All EXT-X-MEDIA tags in the same Group MUST have different NAME

attributes.

o A Group MUST NOT have more than one member with a DEFAULT

attribute of YES.

o All members of a Group whose AUTOSELECT attribute has a value of

YES MUST have LANGUAGE [[RFC5646](https://tools.ietf.org/html/rfc5646)] attributes with unique values.

A Playlist MAY contain multiple Groups of the same TYPE in order to

provide multiple encodings of that media type. If it does so, each

Group of the same TYPE MUST have the same set of members, and each

corresponding member MUST have identical attributes with the

exception of the URI attribute.

Each member in a Group of Renditions MAY have a different sample

format. However, any EXT-X-STREAM-INF ([Section 4.3.4.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2)) tag or EXT-

X-I-FRAME-STREAM-INF ([Section 4.3.4.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.3)) tag which references that

Group MUST have a CODECS attribute that lists every sample format

present in any Rendition in the Group, or client playback failures

can occur.

**[4.3.4.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.4.2). EXT-X-STREAM-INF**

The EXT-X-STREAM-INF tag specifies a Variant Stream, which is a set

of Renditions which can be combined to play the presentation. The

attributes of the tag provide information about the Variant Stream.

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The URI line that follows the EXT-X-STREAM-INF tag specifies a Media

Playlist that carries a Rendition of the Variant Stream. The URI

line is REQUIRED. Clients that do not support multiple video

renditions SHOULD play this Rendition

Its format is:

#EXT-X-STREAM-INF:<attribute-list>

<URI>

The following attributes are defined:

BANDWIDTH

The value is a decimal-integer of bits per second. It represents the

peak segment bit rate of the Variant Stream.

If all the Media Segments in a Variant Stream have already been

created, the BANDWIDTH value MUST be the largest sum of peak segment

bit rates that is produced by any playable combination of Renditions.

(For a Variant Stream with a single Media Playlist, this is just the

peak segment bit rate of that Media Playlist.) An inaccurate value

can cause playback stalls or prevent clients from playing the

variant.

If the Master Playlist is to be made available before all Media

Segments in the presentation have been encoded, the BANDWIDTH value

SHOULD be the BANDWIDTH value of a representative period of similar

content, encoded using the same settings.

Every EXT-X-STREAM-INF tag MUST include the BANDWIDTH attribute.

AVERAGE-BANDWIDTH

The value is a decimal-integer of bits per second. It represents the

average segment bit rate of the Variant Stream.

If all the Media Segments in a Variant Stream have already been

created, the AVERAGE-BANDWIDTH value MUST be the largest sum of

average segment bit rates that is produced by any playable

combination of Renditions. (For a Variant Stream with a single Media

Playlist, this is just the average segment bit rate of that Media

Playlist.) An inaccurate value can cause playback stalls or prevent

clients from playing the variant.

If the Master Playlist is to be made available before all Media

Segments in the presentation have been encoded, the AVERAGE-BANDWIDTH

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value SHOULD be the AVERAGE-BANDWIDTH value of a representative

period of similar content, encoded using the same settings.

The AVERAGE-BANDWIDTH attribute is OPTIONAL.

CODECS

The value is a quoted-string containing a comma-separated list of

formats, where each format specifies a media sample type that is

present in one or more Renditions specified by the Variant Stream.

Valid format identifiers are those in the ISO Base Media File Format

Name Space defined by The 'Codecs' and 'Profiles' Parameters for

"Bucket" Media Types [[RFC6381](https://tools.ietf.org/html/rfc6381)].

Every EXT-X-STREAM-INF tag SHOULD include a CODECS attribute.

RESOLUTION

The value is a decimal-resolution describing the optimal pixel

resolution at which to display all the video in the Variant Stream.

The RESOLUTION attribute is OPTIONAL but is recommended if the

Variant Stream includes video.

AUDIO

The value is a quoted-string. It MUST match the value of the GROUP-

ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist

whose TYPE attribute is AUDIO. It indicates the set of audio

Renditions that SHOULD be used when playing the presentation. See

[Section 4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2.1).

The AUDIO attribute is OPTIONAL.

VIDEO

The value is a quoted-string. It MUST match the value of the GROUP-

ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist

whose TYPE attribute is VIDEO. It indicates the set of video

Renditions that SHOULD be used when playing the presentation. See

[Section 4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2.1).

The VIDEO attribute is OPTIONAL.

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SUBTITLES

The value is a quoted-string. It MUST match the value of the GROUP-

ID attribute of an EXT-X-MEDIA tag elsewhere in the Master Playlist

whose TYPE attribute is SUBTITLES. It indicates the set of subtitle

Renditions that can be used when playing the presentation. See

[Section 4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2.1).

The SUBTITLES attribute is OPTIONAL.

CLOSED-CAPTIONS

The value can be either a quoted-string or an enumerated-string with

the value NONE. If the value is a quoted-string, it MUST match the

value of the GROUP-ID attribute of an EXT-X-MEDIA tag elsewhere in

the Playlist whose TYPE attribute is CLOSED-CAPTIONS, and indicates

the set of closed-caption Renditions that can be used when playing

the presentation. See [Section 4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2.1).

If the value is the enumerated-string value NONE, all EXT-X-STREAM-

INF tags MUST have this attribute with a value of NONE, indicating

that there are no closed captions in any Variant Stream in the Master

Playlist. Having closed captions in one Variant Stream but not

another can trigger playback inconsistencies.

The CLOSED-CAPTIONS attribute is OPTIONAL.

**[4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.4.2.1). Alternative Renditions**

When an EXT-X-STREAM-INF tag contains an AUDIO, VIDEO, SUBTITLES, or

CLOSED-CAPTIONS attribute, it indicates that alternative Renditions

of the content are available for playback of that Variant Stream.

When defining alternative Renditions, the following constraints MUST

be met to prevent client playback errors:

o All playable combinations of Renditions associated with an EXT-X-

STREAM-INF tag MUST have an aggregate bandwidth less than or equal

to the BANDWIDTH attribute of the EXT-X-STREAM-INF tag.

o If an EXT-X-STREAM-INF tag contains a RESOLUTION attribute and a

VIDEO attribute, then every alternative video Rendition MUST have

an optimal display resolution matching the value of the RESOLUTION

attribute.

o Every alternative Rendition associated with an EXT-X-STREAM-INF

tag MUST meet the constraints for a Variant Stream described in

[Section 6.2.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.4).

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The URI attribute of the EXT-X-MEDIA tag is REQUIRED if the media

type is SUBTITLES, but OPTIONAL if the media type is VIDEO or AUDIO.

If the media type is VIDEO or AUDIO, a missing URI attribute

indicates that the media data for this Rendition is included in the

Media Playlist of any EXT-X-STREAM-INF tag referencing this EXT-

X-MEDIA tag. If the media TYPE is AUDIO and the URI attribute is

missing, clients MUST assume that the audio data for this Rendition

is present in every video Rendition specified by the EXT-X-STREAM-INF

tag.

The URI attribute of the EXT-X-MEDIA tag MUST NOT be included if the

media type is CLOSED-CAPTIONS.

**[4.3.4.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.4.3). EXT-X-I-FRAME-STREAM-INF**

The EXT-X-I-FRAME-STREAM-INF tag identifies a Media Playlist file

containing the I-frames of a multimedia presentation. It stands

alone, in that it does not apply to a particular URI in the Master

Playlist. Its format is:

#EXT-X-I-FRAME-STREAM-INF:<attribute-list>

All attributes defined for the EXT-X-STREAM-INF tag ([Section 4.3.4.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2))

are also defined for the EXT-X-I-FRAME-STREAM-INF tag, except for the

AUDIO, SUBTITLES and CLOSED-CAPTIONS attributes. In addition, the

following attribute is defined:

URI

The value is a quoted-string containing a URI that identifies the

I-frame Playlist file.

Every EXT-X-I-FRAME-STREAM-INF tag MUST include a BANDWIDTH attribute

and a URI attribute.

The provisions in [Section 4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2.1) also apply to EXT-X-I-FRAME-

STREAM-INF tags with a VIDEO attribute.

A Master 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.

**[4.3.4.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.4.4). EXT-X-SESSION-DATA**

The EXT-X-SESSION-DATA tag allows arbitrary session data to be

carried in a Master Playlist.

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Its format is:

#EXT-X-SESSION-DATA:<attribute list>

The following attributes are defined:

DATA-ID

The value of DATA-ID is a quoted-string which identifies that 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 which is unlikely to collide with others. This

attribute is REQUIRED.

VALUE

VALUE is a quoted-string. It contains the data identified by DATA-

ID. If the LANGUAGE is specified, VALUE SHOULD contain a human-

readable string written in the specified language.

URI

The value is a quoted-string containing a URI. The resource

identified by the URI MUST be formatted as JSON [[RFC7159](https://tools.ietf.org/html/rfc7159)]; otherwise,

clients may fail to interpret the resource.

LANGUAGE

The value is a quoted-string containing a language tag [[RFC5646](https://tools.ietf.org/html/rfc5646)] that

identifies the language of the VALUE. This attribute is OPTIONAL.

Each EXT-X-SESSION-DATA tag MUST contain either a VALUE or URI

attribute, but not both.

A Playlist MAY contain multiple EXT-X-SESSION-DATA tags with the same

DATA-ID attribute. A Playlist MUST NOT contain more than one EXT-X-

SESSION-DATA tag with the same DATA-ID attribute and the same

LANGUAGE attribute.

**[4.3.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.5). Media or Master Playlist Tags**

The tags in this section can appear in either Master Playlists or

Media Playlists. If one of these tags appears in a Master Playlist,

it SHOULD NOT appear in any Media Playlist referenced by that Master

Playlist. A tag that appears in both MUST have the same value;

otherwise, clients SHOULD ignore the value in the Media Playlist(s).

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These tags MUST NOT appear more than once in a Playlist. If a tag

appears more than once, clients MUST reject the playlist.

**[4.3.5.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.5.1). EXT-X-INDEPENDENT-SEGMENTS**

The EXT-X-INDEPENDENT-SEGMENTS tag indicates that all media samples

in a Media Segment can be decoded without information from other

segments. It applies to every Media Segment in the Playlist.

Its format is:

#EXT-X-INDEPENDENT-SEGMENTS

If the EXT-X-INDEPENDENT-SEGMENTS tag appears in a Master Playlist,

it applies to every Media Segment in every Media Playlist in the

Master Playlist.

**[4.3.5.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-4.3.5.2). EXT-X-START**

The EXT-X-START tag indicates a preferred point at which to start

playing a Playlist. By default, clients SHOULD start playback at

this point when beginning a playback session. This tag is OPTIONAL.

Its format is:

#EXT-X-START:<attribute list>

The following attributes are defined:

TIME-OFFSET

The value of TIME-OFFSET is a signed-decimal-floating-point number of

seconds. A positive number indicates a time offset from the

beginning of the Playlist. A negative number indicates a negative

time offset from the end of the last Media Segment in the Playlist.

This attribute is REQUIRED.

The absolute value of TIME-OFFSET SHOULD NOT be larger than the

Playlist duration. If the absolute value of TIME-OFFSET exceeds the

duration of the Playlist, it indicates either the end of the Playlist

(if positive) or the beginning of the Playlist (if negative).

If the Playlist does not contain the EXT-X-ENDLIST tag, the TIME-

OFFSET SHOULD NOT be within three target durations of the end of the

Playlist file.

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The value is an enumerated-string; valid strings are YES and NO. If

the value is YES, clients SHOULD start playback at the Media Segment

containing the TIME-OFFSET, but SHOULD NOT render media samples in

that segment whose presentation times are prior to the TIME-OFFSET.

If the value is NO, clients SHOULD attempt to render every media

sample in that segment. This attribute is OPTIONAL. If it is

missing, its value should be treated as NO.

**[5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-5). Key files**

**[5.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-5.1). Structure of Key files**

An EXT-X-KEY tag with a URI attribute identifies a Key file. A Key

file contains a cipher key that can decrypt Media Segments in the

Playlist.

[AES\_128] encryption uses 16-octet keys. If the KEYFORMAT of an EXT-

X-KEY tag is "identity", the Key file is a single packed array of 16

octets in binary format.

**[5.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-5.2). IV for [**[**AES\_128**](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#ref-AES_128)**]**

[AES\_128] REQUIRES the same 16-octet Initialization Vector (IV) to be

supplied when encrypting and decrypting. Varying this IV increases

the strength of the cipher.

An IV attribute on an EXT-X-KEY tag with a KEYFORMAT of "identity"

specifies an Initialization Vector that can be used when decrypting

Media Segments encrypted with that Key file. IV values for AES-128

are 128-bit numbers.

An EXT-X-KEY tag with a KEYFORMAT of "identity" that does not have an

IV attribute indicates that the Media Sequence Number is to be used

as the IV when decrypting a Media Segment, by putting its big-endian

binary representation into a 16-octet (128-bit) buffer and padding

(on the left) with zeros.

**[6](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6). Client/Server Responsibilities**

**[6.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.1). Introduction**

This section describes how the server generates the Playlist and

Media Segments and how the client should download them for playback.

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**[6.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.2). Server Responsibilities**

**[6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.2.1). General Server Responsibilities**

The production of the source media is outside the scope of this

document, which simply presumes a source of continuous encoded media

containing the presentation.

The server MUST divide the source media into individual Media

Segments whose duration is less than or equal to a constant target

duration. Segments that are longer than the planned target duration

can trigger playback stalls and other errors.

The server SHOULD attempt to divide the source media at points that

support effective decode of individual Media Segments, e.g. on packet

and key frame boundaries.

The server MUST create a URI for every Media Segment that enables its

clients to obtain the segment data. If a server supports partial

loading of resources (e.g. via HTTP Range requests), it MAY specify

segments as sub-ranges of larger resources using the EXT-X-BYTERANGE

tag.

Any Media Segment that is specified in a Playlist loaded by a client

MUST be available for immediate download within at least the segment

duration, or playback errors can occur.

HTTP servers SHOULD transfer text files - such as Playlists and

WebVTT segments - using the "gzip" Content-Encoding if the client

indicates that it is prepared to accept it.

The server must create a Media Playlist file ([Section 4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4)) that

contains a URI for each Media Segment that the server wishes to make

available, in the order in which they are to be played.

The value of the EXT-X-VERSION tag ([Section 4.3.1.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.1.2)) SHOULD NOT be

greater than what is required for the tags and attributes in the

Playlist - see [Section 7](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-7).

Changes to the Playlist file MUST be made atomically from the point

of view of the clients, or playback errors MAY occur.

The server MUST NOT change the Media Playlist file, except to:

Append lines to it ([Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1)).

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Remove Media Segment URIs from the Playlist in the order that they

appear, along with any tags that apply only to those segments

([Section 6.2.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.2)).

Increment the value of the EXT-X-MEDIA-SEQUENCE or EXT-X-

DISCONTINUITY-SEQUENCE tags ([Section 6.2.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.2)).

Add an EXT-X-ENDLIST tag to the Playlist ([Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1)).

A Media Playlist has further constraints on its updates if it

contains an EXT-X-PLAYLIST-TYPE tag. An EXT-X-PLAYLIST-TYPE tag with

a value of VOD indicates that the Playlist file MUST NOT change. An

EXT-X-PLAYLIST-TYPE tag with a value of EVENT indicates that the

server MUST NOT change or delete any part of the Playlist file; it

MAY append lines to it.

The value of the EXT-X-TARGETDURATION tag in the Media Playlist MUST

NOT change. A typical target duration is 10 seconds.

Playlist changes other than those allowed here can trigger playback

errors and inconsistent client behavior.

Each Media Segment in a Media Playlist has an integer Discontinuity

Sequence Number. The Discontinuity Sequence Number can be used in

addition to the timestamps within the media to synchronize Media

Segments across different Renditions.

A segment's Discontinuity Sequence Number is the value of the EXT-X-

DISCONTINUITY-SEQUENCE tag (or zero if none) plus the number of EXT-

X-DISCONTINUITY tags in the Playlist preceding the URI line of the

segment.

The server MAY associate an absolute date and time with a Media

Segment by applying an EXT-X-PROGRAM-DATE-TIME tag to it. This

defines an informative mapping of the (wall-clock) date and time

specified by the tag to the first media timestamp in the segment,

which may be used as a basis for seeking, for display, or for other

purposes. If a server provides this mapping, it SHOULD apply an EXT-

X-PROGRAM-DATE-TIME tag to every segment that has an EXT-

X-DISCONTINUITY tag applied to it.

If the Media Playlist contains the final Media Segment of the

presentation then the Playlist file MUST contain the EXT-X-ENDLIST

tag; this allows clients to minimize unproductive Playlist reloads.

If a Media Playlist does not contain the EXT-X-ENDLIST tag, the

server MUST make a new version of the Playlist file available that

contains at least one new Media Segment. It MUST be made available

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relative to the time that the previous version of the Playlist file

was made available: no earlier than one-half the target duration

after that time, and no later than 1.5 times the target duration

after that time. This allows clients to utilize the network

efficiently.

If the server wishes to remove an entire presentation, it SHOULD

provide a clear indication to clients that the Playlist file is no

longer available (e.g. with an HTTP 404 or 410 response). It MUST

ensure that all Media Segments in the Playlist file remain available

to clients for at least the duration of the Playlist file at the time

of removal to prevent interruption of in-progress playback.

**[6.2.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.2.2). Live Playlists**

The server MAY limit the availability of Media Segments by removing

Media Segments from the Playlist file ([Section 6.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.1)). If Media

Segments are to be removed, the Playlist file MUST contain an EXT-X-

MEDIA-SEQUENCE tag. Its value MUST be incremented by 1 for every

Media Segment that is removed from the Playlist file; it MUST NOT

decrease or wrap. Clients can malfunction if each Media Segment does

not have a consistent, unique Media Sequence Number.

Media Segments MUST be removed from the Playlist file in the order

that they appear in the Playlist; otherwise, client playback can

malfunction.

The server MUST NOT remove a Media Segment from a Playlist file

without an EXT-X-ENDLIST tag if that would produce a Playlist whose

duration is less than three times the target duration. Doing so can

trigger playback stalls.

When the server removes a Media Segment URI from the Playlist, the

corresponding Media Segment MUST remain available to clients for a

period of time equal to the duration of the segment plus the duration

of the longest Playlist file distributed by the server containing

that segment. Removing a Media Segment earlier than that can

interrupt in-progress playback.

If the server wishes to remove segments from a Media Playlist

containing an EXT-X-DISCONTINUITY tag, the Media Playlist MUST

contain an EXT-X-DISCONTINUITY-SEQUENCE tag. Without the EXT-X-

DISCONTINUITY-SEQUENCE tag, it can be impossible for a client to

locate corresponding segments between Renditions.

If the server removes an EXT-X-DISCONTINUITY tag from the Media

Playlist, it MUST increment the value of the EXT-X-DISCONTINUITY-

SEQUENCE tag so that the Discontinuity Sequence Numbers of the

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segments still in the Media Playlist remain unchanged. The value of

the EXT-X-DISCONTINUITY-SEQUENCE tag MUST NOT decrease or wrap.

Clients can malfunction if each Media Segment does not have a

consistent Discontinuity Sequence Number.

If a server plans to remove a Media Segment after it is delivered to

clients over HTTP, it SHOULD ensure that the HTTP response contains

an Expires header that reflects the planned time-to-live.

A Live Playlist MUST NOT contain the EXT-X-PLAYLIST-TYPE tag, as no

value of that tag allows Media Segments to be removed.

**[6.2.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.2.3). Encrypting Media Segments**

Media Segments MAY be encrypted. Every encrypted Media Segment MUST

have an EXT-X-KEY tag ([Section 4.3.2.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.4)) applied to it with a URI that

the client can use to obtain a Key file ([Section 5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-5)) containing the

decryption key.

A Media Segment can only be encrypted with one encryption METHOD,

using one encryption key and IV. However, a server MAY offer

multiple ways to retrieve that key by providing multiple EXT-X-KEY

tags, each with a different KEYFORMAT attribute value.

The server MAY set the HTTP Expires header in the key response to

indicate the duration for which the key can be cached.

If an encrypted Media Segment is followed by one or more unencrypted

Media Segments in the Playlist, the unencrypted Media Segments MUST

have an EXT-X-KEY tag whose METHOD is NONE applied to them.

Otherwise, the client will misinterpret those segments as encrypted.

If the encryption METHOD is AES-128 and the Playlist does not contain

the EXT-X-I-FRAMES-ONLY tag, AES encryption as described in

[Section 4.3.2.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.4) SHALL be applied to individual Media Segments.

If the encryption METHOD is AES-128 and the Playlist contains an EXT-

X-I-FRAMES-ONLY tag, the entire resource MUST be encrypted using

AES-128 CBC with PKCS7 padding [[RFC5652](https://tools.ietf.org/html/rfc5652)]. Encryption MAY be

restarted on 16-byte block boundaries, unless the first block

contains an I-frame. The IV used for encryption MUST be either the

Media Sequence Number of the Media Segment or the value of the IV

attribute of the EXT-X-KEY tag, as described in [Section 5.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-5.2). These

constraints allow a client to load and decrypt individual I-frames

specified as sub-ranges of regular encrypted Media Segments, and

their Media Initialization Sections.

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If the encryption METHOD is SAMPLE-AES, media samples MAY be

encrypted prior to encapsulation in a Media Segment. The encryption

format for H.264, AAC, and AC-3 media streams is described by the HLS

Sample Encryption specification [[SampleEnc](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "ref-SampleEnc" \o "\"MPEG-2 Stream Encryption Format for HTTP Live Streaming\")].

The server MUST NOT remove an EXT-X-KEY tag from the Playlist file if

it applies to any Media Segment in the Playlist file, or clients who

subsequently load that Playlist will be unable to decrypt those Media

Segments.

**[6.2.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.2.4). Providing Variant Streams**

A server MAY offer multiple Media Playlist files to provide different

encodings of the same presentation. If it does so it SHOULD provide

a Master Playlist file that lists each Variant Stream to allow

clients to switch between encodings dynamically.

Master Playlists describe regular Variant Streams with EXT-X-STREAM-

INF tags and I-frame Variant Streams with EXT-X-I-FRAME-STREAM-INF

tags.

If an EXT-X-STREAM-INF tag or EXT-X-I-FRAME-STREAM-INF tag contains

the CODECS attribute, the attribute value MUST include every media

format [[RFC6381](https://tools.ietf.org/html/rfc6381)] present in any Media Segment in any of the

Renditions specified by the Variant Stream.

The server MUST meet the following constraints when producing Variant

Streams in order to allow clients to switch between them seamlessly:

Each Variant Stream MUST present the same content.

Matching content in Variant Streams MUST have matching timestamps.

This allows clients to synchronize the media.

Matching content in Variant Streams MUST have matching

Discontinuity Sequence Numbers - see [Section 4.3.3.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.3.3).

Each Media Playlist in each Variant Stream MUST have the same

target duration. The only exception is that SUBTITLES Renditions

with an EXT-X-PLAYLIST-TYPE of VOD MAY have longer target

durations.

Content that appears in a Media Playlist of one Variant Stream but

not in another MUST appear either at the beginning or at the end

of the Media Playlist file and MUST NOT be longer than the target

duration.

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If any Media Playlists have an EXT-X-PLAYLIST-TYPE tag, all Media

Playlists MUST have the EXT-X-PLAYLIST-TYPE tag with the same

value.

If the Playlist contains an EXT-X-PLAYLIST-TYPE tag with the value

of VOD, the first segment of every Media Playlist in every Variant

Stream MUST start at the same media timestamp.

If any Media Playlist in a Master Playlist contains an EXT-X-

PROGRAM-DATE-TIME tag, then all Media Playlists in that Master

Playlist MUST contain EXT-X-PROGRAM-DATE-TIME tags with consistent

mappings of date and time to media timestamps.

In addition, for broadest compatibility, Variant Streams SHOULD

contain the same encoded audio bitstream. This allows clients to

switch between Variant Streams without audible glitching.

The rules for Variant Streams also apply to alternative Renditions -

see [Section 4.3.4.2.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.4.2.1).

**[6.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.3). Client Responsibilities**

**[6.3.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-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 Master Playlist, the client can select a

Variant Stream to load from the Master Playlist.

Clients MUST ensure that loaded Playlists comply with [Section 4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4) and

that the EXT-X-VERSION tag, if present, specifies a protocol version

supported by the client; if either check fails, the client MUST NOT

attempt to use the Playlist, or unintended behavior could occur.

If any URI element in a Playlist contains an URI scheme that the

client cannot handle, the client MUST stop playback. All clients

MUST support HTTP schemes.

To support forward compatibility, when parsing Playlists, Clients

MUST:

o ignore any unrecognized tags.

o ignore any Attribute/value pair with an unrecognized

AttributeName.

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o ignore any tag containing an attribute/value pair of type

enumerated-string whose AttributeName is recognized but whose

AttributeValue is not recognized, unless the definition of the

attribute says otherwise.

Algorithms used by the client to switch between Variant Streams are

beyond the scope of this document.

**[6.3.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.3.2). Loading the Media Playlist file**

Every time a Media Playlist is loaded or reloaded from a Playlist

URI, the client MUST determine the next Media Segment to load, as

described in [Section 6.3.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.5), if it intends to play the presentation

normally (i.e., in playlist order at the nominal playback rate).

If the Media Playlist contains the EXT-X-MEDIA-SEQUENCE tag, the

client SHOULD assume that each Media Segment in it will become

unavailable at the time that the Playlist file was loaded plus the

duration of the Playlist file.

A client MAY use the segment Media Sequence Number to track the

location of a Media Segment within a Playlist when the Playlist is

reloaded.

A client MUST NOT assume that segments with the same Media Sequence

Number in different Variant Streams or Renditions have the same

position in the presentation; Playlists MAY have independent Media

Sequence Numbers. Instead, a client MUST use the relative position

of each segment on the Playlist timeline and its Discontinuity

Sequence Number to locate corresponding segments.

A client MUST load the Media Playlist file of every Rendition

selected for playback in order to locate the media specific to that

Rendition. But, to prevent unnecessary load on the server, it SHOULD

NOT load the Playlist file of any other Rendition.

For some Variant Streams, it is possible to select Renditions that do

not include the Rendition specified by the EXT-X-STREAM-INF tag. As

noted above, the client SHOULD NOT load that Rendition in those

cases.

**[6.3.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.3.3). Playing the Media Playlist file**

The client SHALL choose which Media Segment to play first from the

Media Playlist when playback starts. If the EXT-X-ENDLIST tag is not

present and the client intends to play the media normally, the client

SHOULD NOT choose a segment which starts less than three target

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durations from the end of the Playlist file. Doing so can trigger

playback stalls.

Normal playback can be achieved by playing the Media Segments in the

order that they appear in the Playlist. The client MAY present the

available media in any way it wishes, including normal playback,

random access, and trick modes.

The encoding parameters for samples in a Media Segment and across

multiple Media Segments in a Media Playlist SHOULD remain consistent.

However, clients SHOULD deal with encoding changes as they are

encountered, for example by scaling video content to accommodate a

resolution change. If the Variant Stream includes a RESOLUTION

attribute, clients SHOULD display all video within a rectangle with

the same proportions as that resolution.

Clients SHOULD be prepared to handle multiple tracks of a particular

type (e.g. audio or video). A client with no other preference SHOULD

choose the track with the lowest numerical track identifier that it

can play.

Clients SHOULD ignore private streams inside Transport Streams that

they do not recognize. Private streams can be used to support

different devices with the same stream, although stream authors

SHOULD be sensitive to the additional network load that this imposes.

The client MUST be prepared to reset its parser(s) and decoder(s)

before playing a Media Segment that has an EXT-X-DISCONTINUITY tag

applied to it, otherwise playback errors can occur.

The client SHOULD attempt to load Media Segments in advance of when

they will be required for uninterrupted playback to compensate for

temporary variations in latency and throughput.

The client MAY use the value of the EXT-X-PROGRAM-DATE-TIME tag to

display the program origination time to the user. If the value

includes time zone information, the client SHALL take it into

account; if it does not the client MAY assume the time to be local.

The client MUST NOT depend upon the correctness or the consistency of

the value of the EXT-X-PROGRAM-DATE-TIME tag; its value is

informative.

**[6.3.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.3.4). Reloading the Media Playlist file**

The client MUST periodically reload a Media Playlist file to learn

what media is currently available, unless it contains an EXT-X-

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PLAYLIST-TYPE tag with a value of VOD, or a value of EVENT and the

EXT-X-ENDLIST tag is also present.

However the client MUST NOT attempt to reload the Playlist file more

frequently than specified by this section, in order to limit the

collective load on the server.

When a client loads a Playlist file for the first time or reloads a

Playlist file and finds that it has changed since the last time it

was loaded, the client MUST wait for at least the target duration

before attempting to reload the Playlist file again, measured from

the last time the client began loading the Playlist file.

If the client reloads a Playlist file and finds that it has not

changed then it MUST wait for a period of one-half the target

duration before retrying.

After reloading a Media Playlist, the client SHOULD verify that each

Media Segment in it has the same URI (and byte range, if specified)

as the Media Segment with the same Media Sequence Number in the

previous Media Playlist. It SHOULD halt playback if it does not, as

this normally indicates a server error.

In order to reduce server load, the client SHOULD NOT reload the

Playlist files of Variant Streams or alternate Renditions that are

not currently being played. If it decides to switch playback to a

different Variant Stream, it SHOULD stop reloading the Playlist of

the old Variant Stream and begin loading the Playlist of the new

Variant Stream. It can use the EXTINF durations and the constraints

in [Section 6.2.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.2.4) to determine the approximate location of

corresponding media. Once media from the new Variant Stream has been

loaded, the timestamps in the Media Segments can be used to

synchronize the old and new timelines precisely.

A client MUST NOT attempt to use the Media Sequence Number to

synchronize between streams - see [Section 6.3.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.2).

**[6.3.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.3.5). Determining the next segment to load**

The client MUST examine the Media Playlist file every time it is

loaded or reloaded to determine the next Media Segment to load, as

the set of available media MAY have changed.

The first segment to load is generally the segment that the client

has chosen to play first - see [Section 6.3.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-6.3.3).

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In order to play the presentation normally, the next Media Segment to

load is the one with the lowest Media Sequence Number that is greater

than the Media Sequence Number of the last Media Segment loaded.

**[6.3.6](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-6.3.6). Decrypting encrypted Media Segments**

If a Media Playlist file contains an EXT-X-KEY tag that specifies a

Key file URI, the client can obtain that Key file and use the key

inside it to decrypt all Media Segments to which that EXT-X-KEY tag

applies.

A client MUST ignore any EXT-X-KEY tag with an unsupported or

unrecognized KEYFORMAT attribute, to allow for cross-device

addressibility. If the Playlist contains a Media Segment to which

only EXT-X-KEY tags with unrecognized or unsupported KEYFORMAT

attributes are applied, playback SHOULD fail.

A client MUST NOT attempt to decrypt any segments whose EXT-X-KEY tag

has a METHOD attribute that it does not recognize.

If the encryption METHOD is AES-128, AES-128 CBC decryption SHALL be

applied to individual Media Segments, whose encryption format is

described in [Section 4.3.2.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.2.4).

If the encryption METHOD is AES-128 and the Media Segment is part of

an I-frame playlist ([Section 4.3.3.6](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4.3.3.6)) and it has an EXT-X-BYTERANGE

tag applied to it, special care needs to be taken in loading and

decrypting the segment, because the resource identified by the URI is

encrypted in 16-byte blocks from the start of the resource.

The decrypted I-frame can be recovered by first widening its byte

range, as specified by the EXT-X-BYTERANGE tag, so that it starts and

ends on 16-byte boundaries from the start of the resource.

Next, the byte range is widened further to include a 16-byte block at

the beginning of the range. This 16-byte block allows the correct IV

for the following block to be calculated.

The widened byte range can then be loaded and decrypted with AES-128

CBC using an arbitrary IV. The number of bytes added to the

beginning and the end of the original byte range are discarded from

the decrypted bytes; what remains is the decrypted I-frame.

If the encryption METHOD is SAMPLE-AES, AES-128 decryption SHALL be

applied to encrypted media samples within the Media Segment. The

format for encrypted H.264, AAC, and AC-3 media streams is described

by the HLS Sample Encryption specification [[SampleEnc](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "ref-SampleEnc" \o "\"MPEG-2 Stream Encryption Format for HTTP Live Streaming\")].

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An EXT-X-KEY tag with a METHOD of NONE indicates that the Media

Segments it applies to are not encrypted.

**[7](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-7). Protocol version compatibility**

Protocol compatibility is specified by the EXT-X-VERSION tag. A

Playlist that contains tags or attributes that are not compatible

with protocol version 1 MUST include an EXT-X-VERSION tag.

A client MUST NOT attempt playback if it does not support the

protocol version specified by the EXT-X-VERSION tag, or unintended

behavior could occur.

A Media Playlist MUST indicate a EXT-X-VERSION of 2 or higher if it

contains:

o The IV attribute of the EXT-X-KEY tag.

A Media Playlist MUST indicate a EXT-X-VERSION of 3 or higher if it

contains:

o Floating-point EXTINF duration values.

A Media Playlist MUST indicate a EXT-X-VERSION of 4 or higher if it

contains:

o The EXT-X-BYTERANGE tag.

o The EXT-X-I-FRAMES-ONLY tag.

A Media Playlist MUST indicate a EXT-X-VERSION of 5 or higher if it

contains:

o The KEYFORMAT and KEYFORMATVERSIONS attributes of the EXT-X-KEY

tag.

o The EXT-X-MAP tag.

A Media Playlist MUST indicate a EXT-X-VERSION of 6 or higher if it

contains:

o The EXT-X-MAP tag in a Media Playlist that does not contain EXT-

X-I-FRAMES-ONLY.

A Master Playlist MUST indicate a EXT-X-VERSION of 7 or higher if it

contains:

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o "SERVICE" values for the INSTREAM-ID attribute of the EXT-X-MEDIA

tag.

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 a EXT-X-VERSION of 4 or higher in the Master

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.

**[8](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8). Playlist Examples**

**[8.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8.1). Simple Media Playlist**

#EXTM3U

#EXT-X-TARGETDURATION:10

#EXTINF:9.009,

http://media.example.com/first.ts

#EXTINF:9.009,

http://media.example.com/second.ts

#EXTINF:3.003,

http://media.example.com/third.ts

#EXT-X-ENDLIST

**[8.2](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8.2). Live Media Playlist, using HTTPS**

#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:8

#EXT-X-MEDIA-SEQUENCE:2680

#EXTINF:7.975,

https://priv.example.com/fileSequence2680.ts

#EXTINF:7.941,

https://priv.example.com/fileSequence2681.ts

#EXTINF:7.975,

https://priv.example.com/fileSequence2682.ts

**[8.3](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8.3). Playlist with encrypted Media Segments**

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#EXTM3U

#EXT-X-VERSION:3

#EXT-X-MEDIA-SEQUENCE:7794

#EXT-X-TARGETDURATION:15

#EXT-X-KEY:METHOD=AES-128,URI="https://priv.example.com/key.php?r=52"

#EXTINF:2.833,

http://media.example.com/fileSequence52-A.ts

#EXTINF:15.0,

http://media.example.com/fileSequence52-B.ts

#EXTINF:13.333,

http://media.example.com/fileSequence52-C.ts

#EXT-X-KEY:METHOD=AES-128,URI="https://priv.example.com/key.php?r=53"

#EXTINF:15.0,

http://media.example.com/fileSequence53-A.ts

**[8.4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8.4). Master Playlist**

#EXTM3U

#EXT-X-STREAM-INF:BANDWIDTH=1280000,AVERAGE-BANDWIDTH=1000000

http://example.com/low.m3u8

#EXT-X-STREAM-INF:BANDWIDTH=2560000,AVERAGE-BANDWIDTH=2000000

http://example.com/mid.m3u8

#EXT-X-STREAM-INF:BANDWIDTH=7680000,AVERAGE-BANDWIDTH=6000000

http://example.com/hi.m3u8

#EXT-X-STREAM-INF:BANDWIDTH=65000,CODECS="mp4a.40.5"

http://example.com/audio-only.m3u8

**[8.5](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8.5). Master Playlist with I-Frames**

#EXTM3U

#EXT-X-STREAM-INF:BANDWIDTH=1280000

low/audio-video.m3u8

#EXT-X-I-FRAME-STREAM-INF:BANDWIDTH=86000,URI="low/iframe.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=2560000

mid/audio-video.m3u8

#EXT-X-I-FRAME-STREAM-INF:BANDWIDTH=150000,URI="mid/iframe.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=7680000

hi/audio-video.m3u8

#EXT-X-I-FRAME-STREAM-INF:BANDWIDTH=550000,URI="hi/iframe.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=65000,CODECS="mp4a.40.5"

audio-only.m3u8

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**[8.6](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8.6). Master Playlist with Alternative audio**

In this example, the CODECS attributes have been condensed for space.

A '\' is used to indicate that the tag continues on the following

line with whitespace removed:

#EXTM3U

#EXT-X-MEDIA:TYPE=AUDIO,GROUP-ID="aac",NAME="English", \

DEFAULT=YES,AUTOSELECT=YES,LANGUAGE="en", \

URI="main/english-audio.m3u8"

#EXT-X-MEDIA:TYPE=AUDIO,GROUP-ID="aac",NAME="Deutsch", \

DEFAULT=NO,AUTOSELECT=YES,LANGUAGE="de", \

URI="main/german-audio.m3u8"

#EXT-X-MEDIA:TYPE=AUDIO,GROUP-ID="aac",NAME="Commentary", \

DEFAULT=NO,AUTOSELECT=NO,LANGUAGE="en", \

URI="commentary/audio-only.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=1280000,CODECS="...",AUDIO="aac"

low/video-only.m3u8

#EXT-X-STREAM-INF:BANDWIDTH=2560000,CODECS="...",AUDIO="aac"

mid/video-only.m3u8

#EXT-X-STREAM-INF:BANDWIDTH=7680000,CODECS="...",AUDIO="aac"

hi/video-only.m3u8

#EXT-X-STREAM-INF:BANDWIDTH=65000,CODECS="mp4a.40.5",AUDIO="aac"

main/english-audio.m3u8

**[8.7](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8.7). Master Playlist with Alternative video**

This example shows 3 different video Renditions (Main, Centerfield

and Dugout), and 3 different Variant Streams (low, mid and high). In

this example, clients that did not support the EXT-X-MEDIA tag and

the VIDEO attribute of the EXT-X-STREAM-INF tag would only be able to

play the video Rendition "Main".

Since the EXT-X-STREAM-INF tag has no AUDIO attribute, all video

Renditions would be required to contain the audio.

In this example, the CODECS attributes have been condensed for space.

A '\' is used to indicate that the tag continues on the following

line with whitespace removed:

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#EXTM3U

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="low",NAME="Main", \

DEFAULT=YES,URI="low/main/audio-video.m3u8"

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="low",NAME="Centerfield", \

DEFAULT=NO,URI="low/centerfield/audio-video.m3u8"

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="low",NAME="Dugout", \

DEFAULT=NO,URI="low/dugout/audio-video.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=1280000,CODECS="...",VIDEO="low"

low/main/audio-video.m3u8

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="mid",NAME="Main", \

DEFAULT=YES,URI="mid/main/audio-video.m3u8"

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="mid",NAME="Centerfield", \

DEFAULT=NO,URI="mid/centerfield/audio-video.m3u8"

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="mid",NAME="Dugout", \

DEFAULT=NO,URI="mid/dugout/audio-video.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=2560000,CODECS="...",VIDEO="mid"

mid/main/audio-video.m3u8

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="hi",NAME="Main", \

DEFAULT=YES,URI="hi/main/audio-video.m3u8"

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="hi",NAME="Centerfield", \

DEFAULT=NO,URI="hi/centerfield/audio-video.m3u8"

#EXT-X-MEDIA:TYPE=VIDEO,GROUP-ID="hi",NAME="Dugout", \

DEFAULT=NO,URI="hi/dugout/audio-video.m3u8"

#EXT-X-STREAM-INF:BANDWIDTH=7680000,CODECS="...",VIDEO="hi"

hi/main/audio-video.m3u8

**[8.8](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-8.8). Session Data in a Master Playlist**

In this example, only the EXT-X-SESSION-DATA is shown:

#EXT-X-SESSION-DATA:DATA-ID="com.example.lyrics",URI="lyrics.json"

#EXT-X-SESSION-DATA:DATA-ID="com.example.title",LANGUAGE="en", \

VALUE="This is an example"

#EXT-X-SESSION-DATA:DATA-ID="com.example.title",LANGUAGE="sp", \

VALUE="Este es un ejemplo"

**[9](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-9). Contributors**

Significant contributions to the design of this protocol were made by

Jim Batson, David Biderman, Bill May, Roger Pantos, Alan Tseng, and

Eryk Vershen.

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**[10](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-10). IANA Considerations**

This memo requests that the following MIME type [[RFC2046](https://tools.ietf.org/html/rfc2046)] be

registered with the IANA:

Type name: "application"

Subtype name: "vnd.apple.mpegurl"

Required parameters: (none)

Optional parameters: (none)

Encoding considerations: encoded as UTF-8 text. See [Section 4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4) for

more information.

Security considerations: See [Section 11](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-11).

Compression: this media type does not employ compression.

Interoperability considerations: There are no byte-ordering issues,

since files are 7- or 8-bit text. Applications could encounter

unrecognized tags, which SHOULD be ignored.

Published specification: see [Section 4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4).

Applications that use this media type: Multimedia applications such

as the iPhone media player in iOS 3.0 and later and QuickTime Player

in Mac OS X version 10.6 and later.

Additional information: files begin with the magic number #EXTM3U.

Filenames normally end with .m3u8 or .m3u (see [Section 4](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-4)). No

Macintosh file type codes have been registered.

Person & email address to contact for further information: David

Singer, singer AT apple.com.

Intended usage: LIMITED USE

Restrictions on usage: (none)

Author: Roger Pantos

Change Controller: David Singer

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**[11](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-11). Security Considerations**

Since the protocol generally uses HTTP to transfer data, most of the

same security considerations apply. See [section 15](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16#section-15) of HTTP

[[RFC7230](https://tools.ietf.org/html/rfc7230)].

Media file parsers are typically subject to "fuzzing" attacks.

Implementors SHOULD pay particular attention to code that will parse

data received from a server and ensure that all possible inputs are

handled correctly.

Playlist files contain URIs, which clients will use to make network

requests of arbitrary entities. Clients SHOULD range-check responses

to prevent buffer overflows. See also the Security Considerations

section of Uniform Resource Identifier (URI): Generic Syntax

[[RFC3986](https://tools.ietf.org/html/rfc3986)].

Clients SHOULD limit each playback session to a reasonable number of

concurrent downloads (e.g. 4) to avoid contributing to denial-of-

service attacks.

HTTP requests often include session state ("cookies"), which may

contain private user data. Implementations MUST follow cookie

restriction and expiry rules specified by HTTP State Management

Mechanism [[RFC6265](https://tools.ietf.org/html/rfc6265)] to protect themselves from attack. See also the

Security Considerations section of that document, and Use of HTTP

State Management [[RFC2964](https://tools.ietf.org/html/rfc2964)].

Encryption keys are specified by URI. The delivery of these keys

SHOULD be secured by a mechanism such as HTTP Over TLS [[RFC2818](https://tools.ietf.org/html/rfc2818)]

(formerly SSL) in conjunction with a secure realm or a session token.

**[12](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-12). References**

**[12.1](https://tools.ietf.org/html/draft-pantos-http-live-streaming-16" \l "section-12.1). Normative References**

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