http://tools.ietf.org/html/draft-pantos-http-live-streaming-12

HTTP实时流
draft-pantos-http-live-streaming-12

抽象

    本文档介绍了用于传输无限制流的协议
    多媒体数据。它指定文件的数据格式，并
    服务器（发送方）和客户端要执行的操作
    （接收者）的流。它描述了此协议的版本6。

该备忘录的状态

    本互联网草案的提交完全符合
    BCP 78和BCP 79的规定。不得修改本文档，
    并且它的派生作品可能不会创建，也可能不会
    除作为互联网草案发布外。

    互联网草案是互联网工程的工作文件
    工作队（IETF）。请注意，其他群体也可能会分布
    工作文件作为Internet草案。当前的互联网列表-
    草稿位于http://datatracker.ietf.org/drafts/current/。

    互联网草案是文件草案，有效期最长为六个月
    并可能在任何时候被其他文档更新，替换或废弃
    时间。使用Internet草案作为参考是不合适的
    材料或引用它们，而不是将其作为"进行中的工作"。

    该互联网草案将于2014年4月17日到期。

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互联网草案HTTP实时流式传输，2013年10月

## 1.简介

本文档介绍了用于传输无限制流的协议
多媒体数据。该协议支持媒体加密
数据，并允许客户从以下的不同编码中进行选择
演示文稿。媒体数据可以在传输后立即传输
创建，使其可以近实时播放。数据通常是
通过HTTP ［RFC2616]承载。

描述诸如HTTP之类的相关标准的外部参考是
在第11节中列出。

## 2.总结

多媒体演示由URI ［RFC3986]指定给
播放列表文件，它是媒体URI和
信息标签。 URI及其相关标签指定了
系列媒体细分。

要播放演示文稿，客户端首先需要获取播放列表文件
然后获取并播放播放列表中的每个媒体片段。它
如本文档所述重新加载播放列表文件以发现
其他细分。

关键字"必须"，"必须"，"必须"，"应"，"应不"，
" SHOULD"，" SHOULD NOT"，"推荐"，" MAY"和" OPTIONAL"
文档将按照RFC 2119 ［RFC2119]中的说明进行解释。

## 3.播放列表文件

### 3.1。介绍

播放列表必须是扩展的M3U播放列表文件[M3U]。这个文件
通过定义其他标签进一步扩展了M3U文件格式。

M3U播放列表是一个由几行组成的文本文件。
行以单个LF字符或CR终止
字符后跟LF字符。每行是一个URI，空白或
以字符"＃"开头。空行将被忽略。空格
除非存在显式元素，否则不得存在
指定。

URI行标识媒体段或播放列表文件（请参见
第3.4.10节）。每个媒体段均由媒体URI和
适用于它的标签。

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如果播放列表中的所有URI行都包含在内，则该播放列表称为媒体播放列表。
播放列表标识媒体片段。播放列表被称为大师
如果播放列表中的所有URI行都标识了媒体播放列表，则为播放列表。

以字符"＃"开头的行是注释或标签。

标签以#EXT开头。以'＃'开头的所有其他行是
注释，应该忽略。

播放列表中的URI，无论是URI行还是标签的一部分，MAY
是相对的。相对URI必须相对于URI来解析
包含它的播放列表文件。

媒体播放列表文件的持续时间是以下内容的持续时间之和
其中的媒体细分。

名称以.m3u8结尾和/或具有HTTP Content-
类型" application / vnd.apple.mpegurl"以UTF-8 [RFC3629]编码。
名称以.m3u结尾和/或具有HTTP Content-Type的文件
[RFC2616]"音频/ mpegurl"以US-ASCII [US_ASCII]编码。

播放列表文件必须具有以.m3u8结尾的名称和/或具有
内容类型" application / vnd.apple.mpegurl"（如果通过
HTTP），或以.m3u结尾的名称和/或具有HTTP Content-
键入类型" audio / mpegurl"（出于兼容性考虑）。

3.2。属性列表

某些扩展的M3U标签具有作为属性列表的值。一个
属性列表是用逗号分隔的属性/值对列表
没有空格。

属性/值对具有以下语法：

AttributeName =属性值

AttributeName是未加引号的字符串，其中包含来自
设置[A..Z]和'-'。

AttributeValue是以下之一：

o十进制整数：集合中未引号的字符串
　　[0..9]以10为底的算术表示整数。

o十六进制整数：集合中未引用的字符串
　　[0..9]和[A..F]前缀为0x或0X，并且
　　表示以16为基数的整数。

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o十进制浮点数：
设置[0..9]和'。'在其中表示一个浮点数
小数点位置表示法。

o带引号的字符串：一对双引号中的字符串
引号（"），包括统一类型标识符[UTI]。
字符串中允许的字符以及任何转义规则
特殊字符由"属性"定义指定，但是
带引号的字符串中的字符不得包含换行符（0xA），
回车（0xD）或双引号（0x22）。的属性
希望携带这些角色必须以转义的形式携带，例如
作为URI的百分比编码。

o枚举字符串：集合中未引用的字符串
由属性明确定义。枚举字符串将
切勿包含双引号（"），逗号（，）或空格。

o十进制分辨率：两个十进制整数，用" x"分隔
字符。第一个整数是水平像素尺寸
（宽度）;第二个是垂直像素尺寸（高度）。

指定给定AttributeName的AttributeValue的类型
通过属性定义。

给定的AttributeName不得在给定的条件中出现多次
属性列表。

带有无法识别的AttributeName的Attribute / value对必须是
被客户忽略。

任何包含枚举字符串类型的属性/值对的标签
识别其AttributeName但不识别其AttributeValue
客户必须忽略已识别的内容。

3.3。标准标签

3.3.1。 EXTM3U

扩展M3U文件与基本M3U文件的区别在于
第一行，必须是标签＃EXTM3U。必须包含此标签
在媒体播放列表和主播放列表中。其格式为：

＃EXTM3U

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3.3.2。 EXTINF

EXTINF标签指定媒体段的持续时间。适用
只能跟随其后的媒体细分，并且必须跟在
媒体段URI。每个媒体段必须在EXTINF之后
标签。其格式为：

#EXTINF：〈持续时间〉，〈标题〉

其中duration为十进制整数或十进制浮点数
以秒为单位指定媒体段的持续时间。
报告为整数的持续时间应四舍五入为
最接近的整数。如果协议版本，则持续时间必须为整数
播放列表文件的小于3。播放时间应为浮动-
如果版本等于或大于3，则指向该点。
逗号后的行是可选的可读的
媒体部分的信息标题。

3.4。新标签

本文档定义了以下新标签：EXT-X-BYTERANGE，EXT-X-
TARGETDURATION，EXT-X-MEDIA-SEQUENCE，EXT-X-KEY，EXT-X-PROGRAM-DATE-
时间，EXT-X-ALLOW-CACHE，EXT-X-播放列表类型，EXT-X-STREAM-INF，EXT-
X-I-FRAME-STREAM-INF，仅EXT-X-I-FRAME，EXT-X-MEDIA，EXT-X-
ENDLIST，EXT-X不连续性，EXT-X不连续性顺序，EXT-X-
START和EXT-X-VERSION。

3.4.1.   EXT-X-BYTERANGE

EXT-X-BYTERANGE标记指示媒体段是子范围
由其媒体URI标识的资源。它仅适用于
播放列表中紧随其后的下一个媒体URI。其格式为：

＃EXT-X-BYTERANGE：〈n〉［@ 〈o〉]

其中n是十进制整数，指示子范围的长度
以字节为单位。如果存在，则o是一个十进制整数，表示开始于
子范围，从资源开始的字节偏移量。
如果不存在o，则子范围从下一个字节开始
上一个媒体细分的子范围。

如果不存在o，则前一个媒体段必须出现在
播放列表文件和必须是同一媒体资源的子范围。

没有应用EXT-X-BYTERANGE标签的媒体URI指定一个
包含整个资源的媒体段。

EXT-X-BYTERANGE标签出现在该协议的版本4中。它

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绝对不能出现在主播放列表中。

3.4.2.   EXT-X-TARGETDURATION

EXT-X-TARGETDURATION标记指定最大媒体段
持续时间。播放列表中每个媒体片段的EXTINF持续时间
文件，四舍五入到最接近的整数时，必须小于或等于
达到目标持续时间。该标签必须在媒体中出现一次
播放列表文件。它适用于整个播放列表文件。其格式
是：

＃EXT-X-TARGETDURATION：〈s〉

其中s是十进制整数，表示目标持续时间
秒。

EXT-X-TARGETDURATION标签不得出现在主播放列表中。

3.4.3.   EXT-X-MEDIA-SEQUENCE

播放列表中的每个媒体段都有一个唯一的整数序列
数。段的序列号等于序列
之前的段号加1。 EXT-X-MEDIA-
SEQUENCE标签指示第一个片段的序列号
出现在播放列表文件中。其格式为：

＃EXT-X-MEDIA-SEQUENCE：〈数字〉

其中number是十进制整数。序列号不得
减少。

媒体播放列表文件不得包含多个EXT-X-MEDIA-
SEQUENCE标签。如果媒体播放列表文件不包含EXT-X-
MEDIA-SEQUENCE标签，然后是第一个片段的序列号
播放列表应被视为0。客户不得假定
在不同媒体中具有相同序列号的片段
播放列表包含匹配的内容。

媒体URI不需要包含其序列号。

有关以下内容的信息，请参见第6.2.1节，第6.3.2节和第6.3.5节。
处理EXT-X-MEDIA-SEQUENCE标签。

EXT-X-MEDIA-SEQUENCE标签不得出现在主播放列表中。

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3.4.4。 EXT-X键

媒体段可以被加密。 EXT-X-KEY标记指定如何
解密它们。它适用于出现在
与播放列表文件中的下一个EXT-X-KEY标签相同
KEYFORMAT属性（或播放列表文件的末尾）。两个或更多
具有不同KEYFORMAT属性的EXT-X-KEY标签可以应用于
相同的媒体段，在这种情况下，它们必须解析为相同的密钥。
其格式为：

＃EXT-X-KEY：〈属性列表〉

定义了以下属性：

方法

该值是一个指定加密的枚举字符串。
方法。此属性是必需的。

定义的方法为：NONE，AES-128和SAMPLE-AES。

NONE的加密方法表示媒体段不是
加密。如果加密方法为NONE，则以下内容
属性必须不存在：URI；IV；KEYFORMAT；
键格式版本。

AES-128的加密方法意味着媒体段是
使用高级加密标准[AES_128]完全加密
带有128位密钥和PKCS7填充[RFC5652]。如果加密
方法是AES-128，则必须提供URI属性。四世
属性可以存在；请参阅第5.2节。

SAMPLE-AES的加密方法意味着媒体段

包含音频，视频或其他样本的基本流
使用高级加密标准[AES_128]进行加密。怎么
基本流的加密取决于媒体编码。的
H.264 [H_264]，AAC [ISO_14496]和AC-3 [AC_3]的加密格式
基本流由[SampleEnc]描述。 IV属性MAY
出席;请参阅第5.2节。

客户端不得禁止解密其EXT-X-KEY的任何段
标记具有无法识别的METHOD属性。

URI

该值是包含URI [RFC3986]的带引号的字符串，该字符串
指定如何获取密钥。该属性是必需的，除非
方法是无。


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IV

值为十六进制整数，用于指定初始化
与密钥一起使用的向量。 IV属性出现在
协议版本2。有关IV属性何时设置，请参见5.2节。
用过的。

键盘格式

该值是带引号的字符串，用于指定密钥的方式
在URI标识的资源中表示；参见第5节
更多详情。此属性是可选的；它的缺失表明，
"身份"的隐式值。 KEYFORMAT属性出现在
协议版本5。

关键格式版本

该值是包含一个或多个正整数的带引号的字符串
以" /"字符（例如" 1/3"）分隔。如果超过
定义了特定KEYFORMAT的一个版本，此属性可以
用于指示此实例符合哪个版本。
此属性是可选的；如果不存在，则其值为
被认为是" 1"。 KEYFORMATVERSIONS属性出现在
协议版本5。

如果媒体播放列表文件不包含EXT-X-KEY标签，则
媒体段未加密。

有关密钥文件的格式，请参见第5节；有关第5.2节，
有关媒体的其他信息，请参见第6.2.3节和第6.3.6节
段加密。

3.4.5。 EXT-X-PROGRAM-DATE-TIME

EXT-X-PROGRAM-DATE-TIME标记将的第一个样本关联
具有绝对日期和/或时间的媒体段。它仅适用于
下一个媒体细分。

日期/时间表示为ISO / IEC 8601：2004 [ISO_8601]和
应该指出一个时区：

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

例如：

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

有关EXT-的更多信息，请参见第6.2.1节和第6.3.3节。

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X-PROGRAM-DATE-TIME标签。

EXT-X-PROGRAM-DATE-TIME标记不得出现在主播放列表中。

### 3.4.6。 EXT-X-ALLOW-CACHE

EXT-X-ALLOW-CACHE标签指示客户端可以还是必须
不缓存下载的媒体片段以供以后重播。它可能发生
媒体播放列表文件中的任何位置；它一定不能出现多次。
EXT-X-ALLOW-CACHE标记适用于播放列表中的所有片段。
其格式为：

＃EXT-X-ALLOW-CACHE：〈是｜否〉

有关EXT-X-ALLOW-CACHE标签的更多信息，请参见第6.3.3节。

### 3.4.7。 EXT-X-播放列表类型

EXT-X-PLAYLIST-TYPE标记提供有关
播放列表文件。它适用于整个播放列表文件。它是
可选的。其格式为：

＃EXT-X-PLAYLIST-TYPE：〈事件｜视频〉

6.2.1节定义了EXT-X-PLAYLIST-TYPE的含义
标签。

EXT-X-PLAYLIST-TYPE标签不得出现在主播放列表中。

### 3.4.8。 EXT-X-ENDLIST

EXT-X-ENDLIST标记指示将不再有媒体段
已添加到媒体播放列表文件。它可能发生在
播放列表文件；它一定不能出现多次。其格式为：

＃EXT-X-ENDLIST

EXT-X-ENDLIST标签不得出现在主播放列表中。

### 3.4.9。 EXT-X-媒体

EXT-X-MEDIA标记用于关联包含以下内容的媒体播放列表
内容相同的替代格式。例如，三个EXT-
X-MEDIA标签可用于识别仅音频的媒体播放列表，
包含相同的英文，法文和西班牙文版本
介绍。或者可以使用两个EXT-X-MEDIA标签来识别视频-
仅显示两个不同摄像机角度的媒体播放列表。

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EXT-X-MEDIA标签独立存在，因为它不适用于
主播放列表中的特定URI。其格式为：

＃EXT-X-MEDIA：〈属性列表〉

定义了以下属性：

类型

该值是枚举字符串；有效字符串是AUDIO，VIDEO，
字幕和隐藏字幕。如果值为AUDIO，则播放列表
标签所描述的内容必须包含音频媒体。如果值为
视频，播放列表必须包含视频媒体。如果值为
字幕，播放列表必须包含字幕媒体。如果值为
CLOSED-CAPTIONS，视频片段的媒体片段可以
包括隐藏式字幕。此属性是必需的。

URI

该值是一个带引号的字符串，其中包含一个URI，用于标识
播放列表文件。此属性是可选的；参见3.4.10.1节。如果
如果TYPE为CLOSED-CAPTIONS，则URI属性必须不存在。

组ID

该值是带引号的字符串，表示互斥的组
演绎。此属性的存在表示成员资格
群组。参见第3.4.9.1节。此属性是必需的。

语言

该值是包含RFC 5646 [RFC5646]的带引号的字符串
语言标签，用于标识
移交。此属性是可选的。

社交语言

该值是包含RFC 5646 [RFC5646]的带引号的字符串
语言标签，用于标识与
移交。关联语言通常以不同的角色使用
比LANGUAGE属性指定的语言（例如
与口头表达或作为备用方言）。此属性是可选的。

名称

该值是包含人类可读描述的带引号的字符串
移交的。如果存在LANGUAGE属性，则此
说明应使用该语言。此属性是必需的。

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默认

该值是一个枚举字符串；有效字符串是YES和NO。如果
值是YES，则客户端应播放此演绎
在没有来自用户的信息的情况下表示内容
不同的选择。此属性是可选的。它的缺失表明
NO的隐式值。

自动选择

该值是一个枚举字符串；有效字符串是YES和NO。
此属性是可选的。如果存在，则其值必须为YES
如果DEFAULT属性的值为YES。如果值为YES，
然后客户可以选择在没有
明确的用户偏好设置，因为它与当前播放匹配
环境，例如选择的系统语言。

被迫

该值是一个枚举字符串；有效字符串是YES和NO。
此属性是可选的。不存在则表示隐含值
的NO。除非TYPE为
附属品。

值为YES表示呈现的内容为
被认为是必不可少的。选择强制演绎时，
客户应选择最匹配当前播放的内容
环境（例如语言）。

值为NO表示演绎中包含的内容为
旨在响应明确的用户请求播放。

INSTREAM-ID

该值是带引号的字符串，用于指定
媒体播放列表中的细分。如果
TYPE属性为CLOSED-CAPTIONS，在这种情况下，它必须具有以下一项
值："CC1"，"CC2"，"CC3"，"CC4"。对于所有其他TYPE值，
不应指定INSTREAM-ID。

特点

该值是包含一个或多个统一类型的带引号的字符串
标识符[UTI]以逗号（，）字符分隔。这个属性
是可选的。每个UTI都表明了
移交。

字幕翻译可以包括以下特征：

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"public.accessibility.transcribes-spoken-dialog"；
"public.accessibility.describes音乐和声音"；"公众容易
已读"（表示字幕已经过编辑
阅读）。

音频再现可以包括以下特征：
"public.accessibility.describes-video"。

CHARACTERISTICS属性可以包括私有的UTI。

EXT-X-MEDIA标签出现在该协议的版本4中。 EXT-
X-MEDIA标签不得出现在媒体播放列表中。

3.4.9.1。渲染组

一组具有相同GROUP-ID值的EXT-X-MEDIA标签形成一个组
演绎。组中的每个成员必须代表一个
相同内容的替代格式。

播放列表中的所有EXT-X-MEDIA标签必须符合以下条件
约束：

o同一组中的所有EXT-X-MEDIA标签必须具有相同的TYPE
属性。

o同一组中的所有EXT-X-MEDIA标签必须具有不同的名称
属性。

o一组成员的默认权限不得超过一个

YES的属性。

o其AUTOSELECT属性值为的组中的所有成员
是，必须具有带有唯一值的LANGUAGE [RFC5646]属性。

播放列表可能包含多个相同类型的组，以便
提供每个组的多种编码。如果这样做，每个组
相同类型的必须包含相同的属性，并且
URI属性的异常。

一组再现中的每个成员都可以有不同的样本
格式。但是，任何EXT-X-STREAM-INF标签或EXT-X-I-FRAME-STREAMINF
引用该组的标记必须具有CODECS属性，
列出组中任何形式的所有样本格式。
请参阅第3.4.10节和第3.4.15节。

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3.4.10。  EXT-X-STREAM-INF

EXT-X-STREAM-INF标签指定一个变体流，它是一个集合
可以组合播放演示文稿的演绎。的
标签的属性提供有关变体流的信息。

EXT-X-STREAM-INF标记标识播放列表中的下一个URI行
作为变体流的再现。

EXT-X-STREAM-INF标签不得出现在媒体播放列表中。

其格式为：

＃EXT-X-STREAM-INF：〈属性列表〉
〈URI〉

定义了以下属性：

带宽

该值是每秒位数的十进制整数。它一定是
每个媒体段的总比特率的上限（已计算
包括出现在或即将出现在
播放清单。

每个EXT-X-STREAM-INF标签必须包含BANDWIDTH属性。

编解码器

该值是用引号引起来的字符串，其中包含逗号分隔的列表
格式，其中每种格式指定的媒体样本类型为
出现在媒体播放列表文件的媒体片段中。有效格式
标识符是ISO基本媒体文件格式名称空间中的标识符
由RFC 6381 [RFC6381]定义。

每个EXT-X-STREAM-INF标签都应包含CODECS属性。

解析度

该值为十进制分辨率，描述近似编码
演示文稿中视频的水平和垂直分辨率。

RESOLUTION属性是可选的，但如果
变体流包括视频。

音效

该值是带引号的字符串。它必须与

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主机中其他位置的EXT-X-MEDIA标记的GROUP-ID属性
TYPE属性为AUDIO的播放列表。它指示了
播放演示文稿时可以使用的音频再现。看到
第3.4.10.1节。

AUDIO属性是可选的。

视频

该值是带引号的字符串。它必须与
主机中其他位置的EXT-X-MEDIA标记的GROUP-ID属性
TYPE属性为VIDEO的播放列表。它指示了
播放演示文稿时可以使用的视频副本。看到
第3.4.10.1节。

VIDEO属性是可选的。

附属品

该值是带引号的字符串。它必须与
主机中其他位置的EXT-X-MEDIA标记的GROUP-ID属性
TYPE属性为SUBTITLES的播放列表。它指示了
播放演示文稿时可以使用的字幕翻译。
参见3.4.10.1节。

SUBTITLES属性是可选的。

隐藏字幕

该值可以是带引号的字符串，也可以是带有枚举的字符串
值NONE。如果该值是带引号的字符串，则必须与
EXT-X-MEDIA标签的GROUP-ID属性的值
TYPE属性为CLOSED-CAPTIONS的播放列表，并指示
播放列表时可以使用的一组隐藏字幕再现
演示文稿。参见3.4.10.1节。

如果该值为枚举字符串值NONE，则所有EXT-X-STREAM-
INF标签必须具有此属性，其值为NONE。这个
表示的任何变体流中没有隐藏式字幕
主播放列表。

CLOSED-CAPTIONS属性是可选的。

3.4.10.1。替代性翻译

当EXT-X-STREAM-INF标签包含AUDIO，VIDEO，SUBTITLES或
CLOSED-CAPTIONS属性，它指示替代格式
的内容可用于播放该变体流。

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在定义替代格式时，必须遵守以下约束
被满足：

o 与EXT-X-相关的所有可演奏的演绎组合
　STREAM-INF标签的总带宽必须小于或等于
　到EXT-X-STREAM-INF标签的BANDWIDTH属性。

o 如果EXT-X-STREAM-INF标记包含RESOLUTION属性和
　VIDEO属性，则每个替代视频格式必须匹配
　RESOLUTION属性的值。

o 与EXT-X-STREAM-INF相关的每个替代音译
　标签必须满足以下所述的变体流的约束
　第6.2.4节。

如果媒体类型为SUBTITLES，则URI属性是必需的，但是
如果媒体类型是VIDEO或AUDIO，则为可选。如果媒体类型是
VIDEO或AUDIO，缺少URI属性表示媒体数据
任何EXT-X-
引用此MEDIA标签的STREAM-INF标签。如果媒体类型是
音频，此演绎的音频数据也必须存在于任何
EXT-X-STREAM-INF标签指定的视频再现。

如果媒体类型为CLOSED，则不得包含URI属性-
标题。

请注意，如果客户选择播放音频和视频的片段，
EXT-所描述的主要媒体播放列表中没有的内容
X-STREAM-INF标签，或者客户端选择播放音频再现
并且主播放列表是纯音频的，则客户端可以忽略
主要播放列表及其媒体。

## 3.4.11。 EXT-X不连续

EXT-X-DISCONTINUITY标签指示编码不连续
在其之后的媒体段与之前的媒体段之间
它。可以更改的特征集是：

o 文件格式

o 曲目的数量和类型

o 编码参数

o 编码顺序

o 时间戳序列

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其格式为：

＃EXT-X不连续

有关更多信息，请参见第4节，第6.2.1节和第6.3.3节。
关于EXT-X-DISCONTINUITY标签。

EXT-X-DISCONTINUITY标签不得出现在主播放列表中。

## 3.4.12。 EXT-X不连续性序列

EXT-X-DISCONTINUITY-SEQUENCE标签允许在

同一变体流或不同变体的不同演绎形式
在其媒体播放列表中具有EXT-X-DISCONTINUITY标签的流。

其格式为：

＃EXT-X-DISCONTINUITY-SEQUENCE：〈数字〉

其中number是十进制整数。间断序号
绝不能减少。

媒体播放列表不得包含多个EXT-X-DISCONTINUITY-
SEQUENCE标签。如果媒体播放列表不包含EXT-X-
DISCONTINUITY-SEQUENCE标签，然后是不连续序列号
播放列表中的第一段应视为0。

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

A media playlist MUST NOT contain a EXT-X-DISCONTINUITY-SEQUENCE if
its EXT-X-PLAYLIST-TYPE is VOD or EVENT.

An EXT-X-DISCONTINUITY-SEQUENCE tag MUST ONLY appear in a Media
Playlist.

See Section 6.2.1 and Section 6.2.2 for more information about the
EXT-X-DISCONTINUITY-SEQUENCE tag.

3.4.13.   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.

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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.

Media resources containing I-frame segments MUST begin with either a
Transport Stream PAT/PMT or be accompanied by an EXT-X-MAP tag
indicating the proper PAT/PMT.  The byte range of an I-frame segment
with an EXT-X-BYTERANGE tag applied to it (Section 3.4.1) MUST NOT
include a PAT/PMT.

The EXT-X-I-FRAMES-ONLY tag appeared in version 4 of the protocol.
The EXT-X-I-FRAMES-ONLY tag MUST NOT appear in a Master Playlist.

3.4.14.   EXT-X-MAP

The EXT-X-MAP tag specifies how to obtain header information required
to parse the applicable media segments, such as the Transport Stream
PAT/PMT or the WebVTT header.  It applies to every media segment that

appears after it in the Playlist until the next EXT-X-DISCONTINUITY
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 segment header information.  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 header information.  The format of the byte range is
described in Section 3.4.1.  This attribute is OPTIONAL; if it is not
present, the byte range is the entire resource indicated by the URI.


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The EXT-X-MAP tag appeared in version 5 of the protocol for use in
Media Playlist that contain the EXT-X-I-FRAMES-ONLY tag.  In protocol
version 6, it may appear in any Media Playlist.

The EXT-X-MAP tag MUST NOT appear in a Master Playlist.

3.4.15.  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 3.4.10)
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 3.4.10.1 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.

The EXT-X-I-FRAME-STREAM-INF tag appeared in version 4 of the
protocol.  Clients that do not implement protocol version 4 or higher

MUST ignore it.   The EXT-X-I-FRAME-STREAM-INF tag MUST NOT appear in
a Media Playlist.

### 3.4.16.  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.  It MUST NOT appear
more than once in a Playlist.  This tag is OPTIONAL.

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If the EXT-X-START tag appears in a Master Playlist, it indicates the
preferred starting point of every Media Playlist in the Master
Playlist.  If this tag appears in a Media Playlist that is referenced
by a Master Playlist, then every other Media Playlist in the Master
Playlist MUST also contain an EXT-X-START tag with the same
attributes and values.

Its format is:

#EXT-X-START:<attribute list>

The following attributes are defined:

TIME-OFFSET

The value of TIME-OFFSET is a 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 segment in the Playlist.这个
attribute is REQUIRED.

The absolute value of TIME-OFFSET MUST NOT be larger than the
Playlist duration.

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.

PRECISE

The value is an enumerated-string; valid strings are YES and NO.如果
the value is YES, clients SHOULD start playback at the 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.

The EXT-X-START tag appeared in version 6 of the protocol.

### 3.4.17.  EXT-X-VERSION

The EXT-X-VERSION tag indicates the compatibility version of the
Playlist file.  The Playlist file, its associated media, and its
server MUST comply with all provisions of the most-recent version of
this document describing the protocol version indicated by the tag
value.

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   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 version.

   A Playlist file MUST NOT contain more than one EXT-X-VERSION tag. 一个
   Playlist file that does not contain an EXT-X-VERSION tag MUST comply
   with version 1 of this protocol.

   The EXT-X-VERSION tag MAY appear in either Master Playlist or Media
   Playlist.  It MUST appear in all playlists containing tags or
   attributes that are not compatible with protocol version 1.


4.  Media segments

   Each media URI in a Playlist file specifies a media segment which is
   part of the overall presentation.  If a media URI has an EXT-X-
   BYTERANGE tag applied to it, the segment is a sub-range of the media
   file identified by the URI.  Otherwise, the segment is the entire
   media file.

   Each media segment MUST be formatted as an MPEG-2 Transport Stream
   [ISO_13818], an MPEG audio elementary stream [ISO_11172], or a WebVTT
   [WebVTT] file.

   Transport Stream segments MUST contain a single MPEG-2 Program.
   There SHOULD be a Program Association Table (PAT) and a Program Map
   Table (PMT) at the start of each segment.  A segment that contains
   video SHOULD have at least one key frame and enough information to
   completely initialize a video decoder.

   A Transport Stream or audio elementary stream segment MUST be the
   continuation of the encoded media at the end of the segment with the
   previous sequence number, where values in a continuous series, such
   as timestamps and Continuity Counters, continue uninterrupted –
   unless the media segment was the first ever to appear in the Playlist
   file or has an EXT-X-DISCONTINUITY tag applied to it.

   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 PID that it can play.

   Clients MUST ignore private streams inside Transport Streams that
   they do not recognize.



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   Each Elementary Audio Stream segment MUST signal the timestamp of its
   first sample with an ID3 PRIV tag [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.

   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.

Subtitle segments MUST be formatted as WebVTT [WebVTT] 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
an EXT-X-MAP tag applied to it in the Media Playlist.

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.


5.   Key files

5.1。介绍

An EXT-X-KEY tag with a URI attribute identifies a Key file.  A Key
file contains the cipher key that MUST be used to decrypt subsequent
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.


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5.2。 IV for [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.

If an EXT-X-KEY tag has a KEYFORMAT of "identity" and an IV attribute
is present, implementations MUST use the attribute value as the IV
when encrypting or decrypting with that key.  The value MUST be
interpreted as a 128-bit number.

If an EXT-X-KEY tag with a KEYFORMAT of "identity" does not have the
IV attribute, implementations MUST use the sequence number of the
media segment as the IV when encrypting or decrypting that media
segment.  The big-endian binary representation of the sequence number
SHALL be placed in a 16-octet buffer and padded (on the left) with
zeros.


6.   Client/Server Actions

## 6.1.介绍

This section describes how the server generates the Playlist and
media segments and how the client should download and play them.

## 6.2. Server Process

## 6.2.1.介绍

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.  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.

If WebVTT segments are distributed by HTTP, the server SHOULD support
client requests to use the "gzip" Content-Encoding.

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The server MUST create a Media Playlist file.  The Playlist file MUST
conform to the format described in Section 3.  A URI for each media
segment that the server wishes to make available MUST appear in the
Media Playlist in the order in which it is to be played.  The entire
media segment MUST be available to clients if its URI is in the
Playlist file.

The Media Playlist file MUST contain an EXT-X-TARGETDURATION tag.
Its value MUST be equal to or greater than the EXTINF duration of any
media segment that appears or will appear in the Playlist file,
rounded to the nearest integer. Its value MUST NOT change. 一个
typical target duration is 10 seconds.

The Playlist file SHOULD contain one EXT-X-VERSION tag which
indicates its compatibility version.  Its value MUST be the lowest
protocol version with which the server, Playlist file, and associated
media segments all comply.  Its value MUST NOT change.

The server MUST create a URI for the Playlist file that will allow
its clients to obtain the file.

If the Playlist file is distributed by HTTP, the server SHOULD
support client requests to use "gzip" Content-Encoding.

Changes to the Playlist file MUST be made atomically from the point
of view of the clients.

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

    Append lines to it (Section 6.2.1).

    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).

Increment the value of the EXT-X-MEDIA-SEQUENCE or EXT-X-
DISCONTINUITY-SEQUENCE tags (Section 6.2.2).

Add or remove EXT-X-STREAM-INF tags or EXT-X-I-FRAME-STREAM-INF
tags (Section 6.2.4).  Note that clients are not required to
reload Master Playlist files, so changing them may not have
immediate effect.

Add an EXT-X-ENDLIST tag to the Playlist (Section 6.2.1).

Furthermore, the Playlist file MAY contain an EXT-X-PLAYLIST-TYPE tag
with a value of either EVENT or VOD.  If the tag is present and has a
value of EVENT, the server MUST NOT change or delete any part of the

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Playlist file (although it MAY append lines to it).  If the tag is
present and has a value of VOD, the Playlist file MUST NOT change.

Every media segment in a Playlist MUST have an EXTINF tag applied to
it indicating the duration of the media segment.

Each 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.

A Media Playlist that contains an EXT-X-PLAYLIST-TYPE tag with a
value of EVENT or VOD MUST NOT contain an EXT-X-DISCONTINUITY-
SEQUENCE tag.

The server MAY associate an absolute date and time with a media
segment by applying an EXT-X-PROGRAM-DATE-TIME tag to it.这个
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.

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
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.

If the server wishes to remove an entire presentation, it MUST make
the Playlist file unavailable to clients.  It SHOULD 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.

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).   If media
   segments are to be removed, the Playlist file MUST contain exactly
   one EXT-X-MEDIA-SEQUENCE tag.   Its value MUST be incremented by 1 for
   every media segment that is removed from the Playlist file.

   Media segments MUST be removed from the Playlist file in the order
   that they appear in the Playlist.

   The server MUST NOT remove a media segment from the Playlist file if
   the duration of the Playlist file minus the duration of the segment
   is less than three times the target duration.

   When the server removes a media segment from the Playlist, the
   corresponding media URI SHOULD 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.

   If the server wishes to remove segments from a Media Playlist
   containing an EXT-X-DISCONTINUITY tag, the playlist MUST contain an
   EXT-X-DISCONTINUITY-SEQUENCE tag.

   If the server removes a 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
   segments still in the playlist remain unchanged.

   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.

6.2.3.   Encrypting media segments

   If media segments are to be encrypted the server MUST define a URI
   which will allow authorized clients to obtain a Key file containing a
   decryption key.   The Key file MUST conform to the format described in
   Section 5.

   The server MAY set the HTTP Expires header in the key response to
   indicate that the key may be cached.

   The server MUST encrypt every media segment in a Playlist according
   to the EXT-X-KEY tag that applies to its URI in the Playlist file.

   Media segments with an EXT-X-KEY tag whose METHOD is NONE, or which
   do not have an EXT-X-KEY tag applied to them, MUST NOT be encrypted.

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

the EXT-X-I-FRAMES-ONLY tag, AES-128 CBC encryption with PKCS7
padding [RFC5652] SHALL be applied to individual media segments.的
entire segment MUST be encrypted.  Cipher Block Chaining MUST NOT be
applied across media segments.  The IV used for encryption MUST be
either the 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.

If the encryption METHOD is AES-128 and the Playlist contains an EXT-
X-I-FRAMES-ONLY tag, AES-128 CBC encryption with PKCS7 padding
[RFC5652] MUST be applied to the entire resource.  The entire
resource MUST be encrypted.  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 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.

If the encryption METHOD is SAMPLE-AES, certain elementary streams
MAY be encrypted prior to encapsulation in a media segment.的
encryption format for H.264, AAC and AC-3 elementary streams is
described by [SampleEnc].

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.

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 MUST contain an EXT-X-STREAM-INF tag or EXT-X-I-
FRAME-STREAM-INF tag for each variant stream.

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 format
defined by [RFC6381] that is present in any media segment that is
part of the variant stream, including in any rendition.

The server MUST meet the following constraints when producing variant
streams:

   Each variant stream MUST present the same content, including EXT-
   X-DISCONTINUITY tags at the same points in each rendition.


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   Matching content in variant streams MUST have matching timestamps.
   This allows clients to synchronize the media.

   Each Media Playlist in each variant stream MUST have the same
   target duration.  The only exception is that SUBTITLES renditions
   with a 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.

   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 3.4.10.1.

6.3.   Client Process

6.3.1. 介绍

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 MUST obtain the Playlist file from the URI.如果
Playlist file so obtained is a Master Playlist, the client MUST
obtain the Media Playlist file from the Master Playlist.

This document does not specify the treatment of variant streams by
clients.

6.3.2.   Loading the Playlist file

Every time a Playlist file is loaded or reloaded from the Playlist
URI:

The client MUST ensure that the Playlist file begins with the
EXTM3U tag and that the EXT-X-VERSION tag, if present, specifies a
protocol version supported by the client; if not, the client MUST
NOT attempt to use the Playlist.


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The client SHOULD ignore any tags and attributes it does not
recognize.

The client MUST determine the next media segment to load, as
described in Section 6.3.5.

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.

6.3.3.   Playing the 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 regularly (i.e. in
playlist order at the nominal playback rate), the client SHOULD NOT
choose a segment which starts less than three target durations from
the end of the Playlist file.  Doing so can trigger playback stalls.

To achieve regular playback, media segments MUST be played in the
order that they appear in the Playlist file.  The client MAY present
the available media in any way it wishes, including regular playback,
random access, and trick modes.

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.

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.

If the Playlist file contains the EXT-X-ALLOW-CACHE tag and its value
is NO, the client MUST NOT cache downloaded media segments after they
have been played.  Otherwise the client MAY cache downloaded media
segments indefinitely for later replay.

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,
but if it does not the client MUST NOT infer an originating time
zone.

The client MUST NOT depend upon the correctness or the consistency of
the value of the EXT-X-PROGRAM-DATE-TIME tag.


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6.3.4.  Reloading the Playlist file

The client MUST periodically reload the Media Playlist file unless it
contains the EXT-X-ENDLIST tag.

However the client MUST NOT attempt to reload the Playlist file more
frequently than specified by this section.

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.

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 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
assume that segments with the same media sequence number in different
variant streams or different renditions contain matching content.

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.

The first segment to load MUST be the segment that the client has
chosen to play first, as described in Section 6.3.3.

If the first segment to be played has been loaded and the Playlist
file does not contain the EXT-X-MEDIA-SEQUENCE tag then the client
MUST verify that the current Playlist file contains the URI of the
last loaded media segment at the offset it was originally found at,

halting playback if it does not.  The next media segment to load MUST
be the first media segment following the last-loaded segment in the
Playlist.

If the first segment to be played has been loaded and the Playlist


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file contains the EXT-X-MEDIA-SEQUENCE tag then the next media
segment to load SHALL be the one with the lowest sequence number that
is greater than the sequence number of the last media segment loaded.

## 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 MUST 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 NOT attempt to use an EXT-X-KEY tag with an unsupported
or unrecognized KEYFORMAT attribute.  A client SHOULD fail playback
if the Playlist contains a media segment to which only EXT-X-KEY tags
with unrecognized or unsupported KEYFORMAT attributes are applied.

If the encryption METHOD is AES-128, AES-128 CBC decryption SHALL be
applied to individual media segments.  The entire segment MUST be
decrypted.  Cipher Block Chaining MUST NOT be applied across media
segments.  The IV used for decryption MUST be either the 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.

If the encryption METHOD is AES-128 and the media segment is part of
an I-frame playlist (Section 3.4.13) special care MUST 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 (offset 0).  The sub-range specified by the EXT-X-BYTERANGE
tag MUST be widened to include the 16-byte blocks in which the
beginning and end of the sub-range fall.  Next, it MUST be widened
further to include the previous 16-byte block.  That range MUST be
loaded and decrypted with AES-128 CBC using an arbitrary IV. 的
decrypted segment will then be in the original (unwidened) sub-range.

If the encryption METHOD is SAMPLE-AES, AES-128 decryption SHALL be
applied to encrypted elementary streams within the media segment.
The encryption format for H.264, AAC and AC-3 elementary streams is
described by [SampleEnc].

An EXT-X-KEY tag with a METHOD of NONE indicates that the media
segments it applies to are not encrypted.


## 7.   Protocol version compatibility

Clients and servers MUST implement protocol version 2 or higher to
use:


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

Clients and servers MUST implement protocol version 3 or higher to
use:

o  Floating-point EXTINF duration values.

Clients and servers MUST implement protocol version 4 or higher to
use:

o  The EXT-X-BYTERANGE tag.

o  The EXT-X-I-FRAME-STREAM-INF tag.

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

o  The EXT-X-MEDIA tag.

o  The AUDIO and VIDEO attributes of the EXT-X-STREAM-INF tag.

Clients and servers MUST implement protocol version 5 or higher to
use:

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

o  The EXT-X-MAP tag.

Clients and servers MUST implement protocol version 6 or higher to
use:

o  The EXT-X-MAP tag in a Media playlist that does not contain EXT-X-
   I-FRAMES-ONLY.

The PROGRAM-ID attribute of the EXT-X-STREAM-INF and the EXT-X-I-
FRAME-STREAM-INF tags has been removed in protocol version 6.

8.  Examples

8.1. 介绍

This section contains several example Playlist files.

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8.2.  Simple Media Playlist file

    #EXTM3U
    #EXT-X-VERSION:3
    #EXT-X-TARGETDURATION:5220
    #EXTINF:5219.2,
    http://media.example.com/entire.ts
    #EXT-X-ENDLIST

8.3.  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
```

## 8.4.   Playlist file with encrypted media segments

```
#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
```

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## 8.5.   Master Playlist file

```
#EXTM3U
#EXT-X-STREAM-INF:BANDWIDTH=1280000
http://example.com/low.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=2560000
http://example.com/mid.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=7680000
http://example.com/hi.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=65000,CODECS="mp4a.40.5"
http://example.com/audio-only.m3u8
```

## 8.6.   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
```

8.7.   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:

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   #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,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

8.8.   Master Playlist with Alternative video

   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

#EXT-X-STREAM-INF:BANDWIDTH=65000,CODECS="mp4a.40.5"
main/audio-only.m3u8
```

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.

10.  IANA Considerations

    This memo requests that the following MIME type [RFC2046] be
    registered with the IANA:

    Type name: "application"

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     Subtype name: "vnd.apple.mpegurl"

     Required parameters: (none)

     Optional parameters: (none)

     Encoding considerations: encoded as text.  See Section 3 for more
     information.

     Security considerations: See 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 3.

     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 3).  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


  11.  Security Considerations

     Since the protocol generally uses HTTP to transfer data, most of the
     same security considerations apply.  See section 15 of RFC 2616
     [RFC2616].

     Media file parsers are typically subject to "fuzzing" attacks.
     Clients SHOULD take care when parsing segments received from a server
     that non-compliant segments are rejected.



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     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 RFC 3986 [RFC3986].

     Clients SHOULD load resources identified by URI lazily 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 RFC 6265 [RFC6265].看到
also the Security Considerations section of RFC 6265, and RFC 2964
[RFC2964].

Encryption keys are specified by URI.  The delivery of these keys
SHOULD be secured by a mechanism such as HTTP over TLS [RFC5246]
(formerly SSL) in conjunction with a secure realm or a session
cookie.

## 12.  References

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