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Adaptive Transport Stream

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1 INTRODUCTION

1.1 Overview

There are a variety of Adaptive Streaming wire formats. Some are based on an MPEG-2 Transport Stream container such as HLS (HTTP Live Streaming: Apple) and others on a fragmented MP4 container such as HSS (HTTP Smooth Streaming: Microsoft) and HDS (HTTP Dynamic Streaming: Adobe); whereas DASH (Dynamic Adaptive Streaming over HTTP: MPEG) supports both containers. While different, they utilize common video and audio compression formats; namely: ISO/IEC 14496-10 (AVC) and ISO/IEC 14496-3 (AAC). Additional audio formats, such as Dolby Digital Plus and DTS-HD, *may* also be supported by these or a subset of these Adaptive Bit Rate (ABR) formats.

In a unified ABR encoding and packaging system, video and audio data are encoded and conditioned for adaptive streaming purposes and the resultant elementary compressed access units are fed to one or more ABR packagers or encapsulators to be formatted into ABR-specific wire formats.

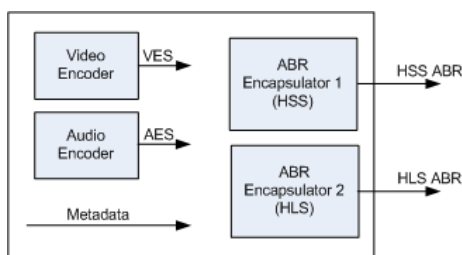


Figure 1 - Unified Transcoder/Packager

The Adaptive Transport Stream (ATS) format described in this specification allows for streaming/storage of adaptive streaming content originating as Transport Streams in a generic manner without restricting this to a particular adaptive streaming delivery technology (HSS/HLS/HDS). As Figure 2 illustrates, this allows for a separation of the transcoding process from the encapsulation process that produces ABR-specific formats.

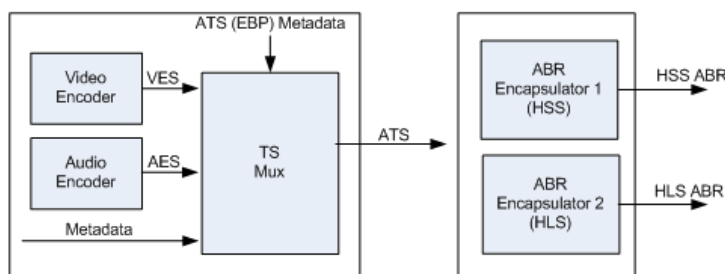


Figure 2 - Separate Transcoder/Packager with ATS between

This specification defines a fully **compliant** continuous single program MPEG-2 Transport Stream which follows the HRD model and provides markers in the stream through the use of PES frame encapsulated af_descriptors (adaptation field descriptors) [11]. These markers identify conditioned points in the stream that are virtual segments that can be partitioned into segments used for ABR applications [11]. Downstream encapsulation is expected to re-encapsulate an ATS, which *may* involve partial or complete de-encapsulation (demux) prior to encapsulating into a target ABR format. Since this downstream encapsulation does no re-encoding of the media data, the video and audio access units in the ATS need to be pre-conditioned for adaptive streaming purposes [in accordance with section 8 of this specification]. Additionally this specification defines af_descriptor metadata, Boundary Descriptor /Labeling Descriptor/Timeline Descriptor and collectively called Encoder Boundary Points (EBP) data [as defined in section 7.5], that are injected and carried in the transport stream layer to provide adaptive boundary information to downstream processing tasks. The EBP data provides a hinting mechanism for taking continuous streams conditioned for adaptive streaming and creating discrete chunks of decodable content with boundaries in one

component stream in the multiplex (Fragment) or across the multiplex (Segment). This specification also references additional PMT descriptors as specified in 13818-1 [11] that may be carried in the ATS for informative purposes to describe the various conditioning and boundary points used in the stream(s). Lastly, structural information on a related set of ATS streams *may* be carried through an ATS Source Description.

The EBP data contained within an ATS stream is carried as data descriptors of the public adaptation field (af_descriptors) of an MPEG-2 TS packet for video or audio and can be applied to each video packetized elementary stream (PES) and audio PES packet, resolved down in many cases to a single Video access unit (AU) or a group of audio AUs [11]. It contains a set of af_descriptors to indicate Boundary, Labeling, and Timeline information.

1.2 Purpose of Document

The purpose of this document is to define an ATS stream, the boundary points within it, both explicit and implicit, how boundary points map to various ABR formats such as HSS Fragments and HLS Segments (both in the video and audio domain), and the time stamps, durations and byte ranges of these chunks.

To that end, a significant portion of this document describes the basic requirements for adaptive video and audio conditioning. These sections detail conditioning considerations such as varying frame rates, advertising splice points and input loss handling.

1.3 Scope

This standard describes the requirements and constraints on a single program transport stream (SPTS) that allow it to be used as an Adaptive Transport Stream, including stream conditioning and signaling of segment boundary points. Typically, multiple ATSs will be generated from a single input and sent to a packager, recorder or other device. The EBP structure can be inserted at the time of encoding or added during the transcoding process. This specification does not describe how an ATS is stored or how it *may* be converted to target delivery formats.

This document describes the wrapping, chunking, and conditioning of packetized elementary streams carried over MPEG-2 TS. These elementary streams are codec independent and could carry AVC, HEVC, or even MPEG-2 video. Reference is made to SCTE 128 [3][33] to be compliant with MPEG-2 Systems layer constraints on the use of adaptation field public data.

These created ATS streams are then sent to a packager(also called a fragmentor or encapsulator) directly or stored to be sent to a packager upon request at a later time. Upon receiving such streams, a packager then processes these streams with EBP data and produces chunks according to the one or more adaptive streaming encapsulating technologies.

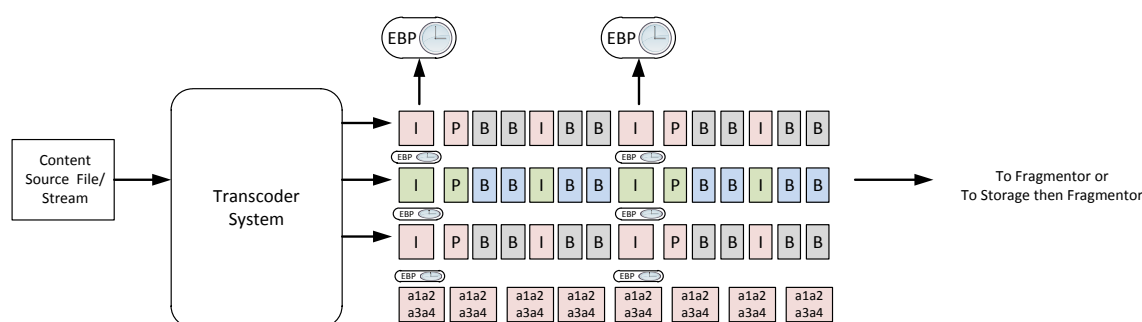


Figure 3 – ATS Streams with EBP data inserted at transcoder

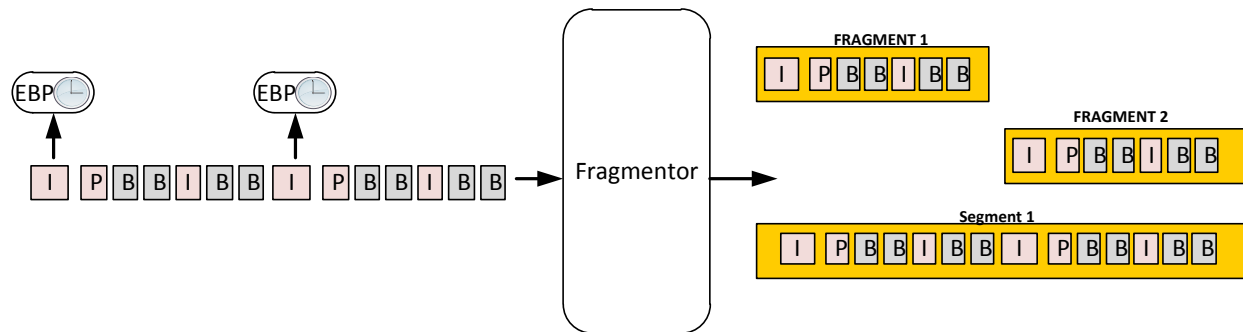


Figure 4 – Fragmentation of an ATS generated stream

In addition, this standard describes both the static and time-sensitive metadata that describes the ATS stream and where this information is located through EBP, PMT, SCTE 35, private metadata, and configuration information. The collection and aggregation of static metadata is defined in a metadata format, the ATS Source Description that describes the attributes of a set of ATSs. The purpose of the ATS Source Description is to provide information needed to configure a downstream device to package or record the set of ATSs and only carries information related to that task, for example, bitrates, codec parameters, etc. The ATS Source Description is based on the DASH MPD schema, but does not carry any time variant data such as Segment names or Periods. This specification does not describe how a device obtains an ATS Source Description.

1.4 Requirements

Throughout this document, the words that are used to define the significance of particular requirements are capitalized. These words are:

shall	This word or the adjective “ required ” means that the item is an absolute requirement of this specification.
shall not	This phrase means that the item is an absolute prohibition of this specification.
should	This word or the adjective “ recommended ” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighted before choosing a different course.
should not	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
may	This word or the adjective “ optional ” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

2 REFERENCES

2.1 Normative References

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

- [1] IETF RFC 5905, Network Time Protocol Version 4: Protocol and Algorithm Specification, June 2010.
- [2] ANSI/SCTE 54 2015, Digital Video Service Multiplex and Transport System Standard for Cable Television.
- [3] ANSI/SCTE 128-2 2013, AVC Video Constraints for Cable Television Part 2 – Transport.
- [4] ISO/IEC 14496-12:2015, Information technology - Coding of audio-visual objects - Part 12: ISO base media file format.
- [5] ANSI/SCTE 193-1 2014, MPEG-4 AAC Family Audio System – Part 1 Coding Constraints for Cable Television.
- [6] ANSI/ 35 2016, Digital Program Insertion Cueing Message for Cable.
- [7] IETF STD 66 Uniform Resource Identifier (URI): Generic Syntax, January 2005.
- [8] ANSI/SCTE 214-1 2016, MPEG DASH for IP-Based Cable Services Part1: MPD Constraints and Extensions.
- [9] ANSI/SCTE 214-2 2016, MPEG DASH for IP-Based Cable Services Part 2: DASH/TS Profile.
- [10] ANSI/SCTE 215-2 2015, HEVC Video Constraints for Cable Television Part 2- Transport.
- [11] ISO/IEC 13818-1:2017 , Information Technology- Generic coding of Moving picture and associated audio information—Part 1: Systems.

2.2 Informative References

The following documents *may* provide valuable information to the reader but are not required when complying with this standard.

- [12] ITU-T Recommendation H.264 | ISO/IEC 14496-10:2014, Information Technology - Coding of audio visual objects - Part 10: Advanced Video Coding.
- [13] ISO/IEC 23001-8:2015, Information Technology—MPEG Systems Technologies—Part 8: Coding-Independent Code Points.
- [14] ISO/IEC 23009-1:2014, Information technology - Dynamic adaptive streaming over HTTP (DASH) - Part 1: Media presentation description and segment formats.
- [15] DASH-IF Implementation Guidelines: Interoperability Points; Version 3.1, <http://dashif.org/wp-content/uploads/2015/10/DASH-IF-IOP-v3.3.pdf>.
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- [19] Timed Metadata for HTTP Live Streaming
https://developer.apple.com/library/ios/documentation/AudioVideo/Conceptual/HTTP_Live_Streaming_Metadata_Spec/HTTP_Live_Streaming_Metadata_Spec.pdf.
- [20] Smooth Streaming Transport Protocol, <http://learn.iis.net/page.aspx/684/smooth-streaming-transport-protocol>.

- [21] [MS-SSTR]: Smooth Streaming Protocol, <http://msdn.microsoft.com/en-us/library/ff469518.aspx>.
- [22] IETF RFC 7230: Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing, June 2014.
- [23] IETF RFC 7231: Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content, June 2014.
- [24] IETF RFC 7232: Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests, June 2014.
- [25] IETF RFC 7233: Hypertext Transfer Protocol (HTTP/1.1): Range Requests, June 2014.
- [26] IETF RFC 7234: Hypertext Transfer Protocol (HTTP/1.1): Caching, June 2014.
- [27] IETF RFC 7235: Hypertext Transfer Protocol (HTTP/1.1): Authentication, June 2014.
- [28] IETF BCP 47, Tags for Identifying Languages, September 2009.
- [29] IETF RFC 6381, The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types, August 2011.
- [30] ANSI/SCTE 104 2015, Automation System to Compression System Communications Applications Program Interface (API).
- [31] ETSI TR 101 154 V2.2.1 (2015-06), Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream.
- [32] ISO/IEC 13818-2:2013, Information technology – Generic coding of moving pictures and associated audio information – Part 2: Video.
- [33] ANSI/SCTE 128-1 2013, AVC Video Constraints for Cable Television Part 1- Coding.
- [34] ANSI/SCTE 193-2 2014, MPEG-4 AAC Family Audio System - Part 2 Constraints for Carriage over MPEG-2 Transport.
- [35] ANSI/SCTE 194-2 2014, DTS-HD AUDIO SYSTEM- Part 2: Constraints for carriage over MPEG-2 Transport.
- [36] Encoder Boundary Point Specification, <http://www.cablelabs.com/wp-content/uploads/specdocs/OC-SP-EBP-I01-130118.pdf>
- [37] Adaptive Transport Stream Specification, <http://www.cablelabs.com/wp-content/uploads/specdocs/OC-SP-ATS-I01-140214.pdf>
- [38] OpenCable Enhanced TV Application messaging Protocol Specification, OC-SP-ETV-AM1.0.1, <http://cablelabs.com/specification/opencable-enhanced-tv-application-messaging-protocol-specification/>
- [39] OpenCable Enhanced TV Binary Interchange Format 1.0 Specification, OC-SP-ETV-BIF1.0.1, <http://cablelabs.com/specification/opencable-enhanced-tv-binary-interchange-format-1-0-specification/>

2.3 Reference Acquisition

- Internet Engineering Task Force (IETF) Secretariat, 48377 Fremont Blvd., Suite 117, Fremont, California 94538, USA, Phone: +1-510-492-4080, Fax: +1-510-492-4001, <http://www.ietf.org>
- ISO Central Secretariat: International Organization for Standardization (ISO), 1, rue de Varembé, Case postale 56, CH-1211 Geneva 20, Switzerland; Internet: <http://www.iso.ch/>
- SCTE - Society of Cable Telecommunications Engineers Inc., 140 Philips Road, Exton, PA 19341 Phone: +1-610-363-6888 / +1-800-542-5040; Fax: +1-610-363-5898; <http://www.scte.org/>
- ETSI - <http://www.etsi.org>

3 TERMS AND DEFINITIONS

This standard uses the following terms:

Acquisition Time	An NTP-derived time which <i>may</i> be carried within an EBP data field to indicate the time at which the Transcoder/Encoder acquired this Access Unit (AU). Acquisition Time <i>may</i> be carried in EBP structures of linear media streams to identify time-based recording boundaries, and provide a record of actual content acquisition time. Acquisition Time has no normative use in packaged or VOD content.
Adaptation Streams	Set of interchangeable encoded versions of one or several media content components.
Adaptive Sync	ATS streams that are both Time Synced and Chunk Synced.
Adaptive Transport Stream	MPEG-2 continuous (virtually segmented) compliant single-program Transport Stream conditioned as defined in DVS 1196
AF Descriptor	One of a set of descriptor in the adaptation field as defined in MPEG-2 Systems specification e.g. TEMI [11]
ATS File	ATS stream stored as file. (AN ATS stream physically written into separate segments is a DASH/TS)
ATS Set	ATS Set is a group of ATS streams in different bit rate and resolution, but with same content and well aligned with EBP data.
ATS Source Description	XML document providing descriptive and retrieval information for one or more ATS streams. NOTE: ATS SD closely resembles a DASH MPD.
Boundary Descriptor	af_descriptor to indicate accurate boundary points of PES frames. These often indicate first frame of a fragment and can be used by packagers to signal chunking of fixed or variable duration chunks.
Boundary Structure	Structure of the Boundary af_descriptor
Boundary Data	Data in the boundary af_descriptor
Chunk	A discrete section of content that can be independently decoded, possibly given additional initialization information.
Chunk Boundary Point	A specialized Encoder Boundary Point that indicates the beginning of a chunk, and is a stream access point.
Chunk Sync	Chunk sync implies the identical AUs across representations at boundaries indicated by EBP.
Chunk Type	Refers to a specific partition that is contained in the ATS stream. Segment and fragment are examples of different types of chunks.
Conditioned Stream	A transcoded stream that contains independently decodable sections of content (e.g., Fragments and Segments). This stream can be sent to an packager to create fragments and segments in specific ABR formats.
DASH/TS	A profile of MPEG DASH which uses MPEG-TS segments.
Encoder	A subsystem that compresses digital media. The input can be uncompressed digital media or a mezzanine level packetized elementary stream, and output is a compressed stream for delivery to consumers in real-time or via storage media.

Encoder Boundary Point	An indicated point in the stream that is assigned to a PES packet containing one or more access units. Often indicates the frame of a chunk or segment.
EBP Structures	Collective af_descriptor data structures (Boundary Descriptor, Labeling Descriptor, Timeline Descriptor) in the public adaptation field of MPEG packet with the PES Header Information which boundary markers to create different size chunks through partitions, labeling of those chunks, and time information indicators. When referring to the collective structure, it is usually referring to data positioning within the stream.
EBP Data	Referring to the collective data contained in the EBP structure (boundary markers, labeling, timing) without the need to referring to each data descriptor within the stream.
Explicit EBP Stream	The elementary stream carries the EBP structure in the adaptation public data field associated with boundary point AU. Chunks containing an EBP structure in these types of streams can be called "explicit chunks".
Explicit Partition	A partition which references EBP structures carried on its own stream PID.
Fragment	A chunk that is aligned with boundaries in one component stream in the source multiplex. Fragment boundaries are typically explicit for each component. Smooth Streaming [20][21] is an example ABR format that uses fragments.
Identical AUs	Access Units in multiple encoded bitstreams that represent the same content period. These access units represent the same content period. The access units may represent different encodings of the same source content.
Implicit EBP Stream	The elementary stream does not carry the EBP structure in the adaptation public data field associated with a boundary point AU. It <i>may</i> depend on another elementary stream to reference this information. The EBP PMT descriptor <i>may</i> be used to indicate if the elementary stream is an implicit EBP stream. Chunks that do not contain an EBP structure in these types of streams can be called "implicit chunks".
Implicit Partition	A partition that references the EBP structure of an explicit partition carried on a different stream PID (and, possibly, in a different multiplex).
Labeling Descriptor	af_descriptor to indicate labeling of PES frames. These can contain UPID labels and identifiers.
Labeling Structure	Structure of the Labeling af_descriptor
Labeling Data	Data in the Labeling af_descriptor
Media Content Component	A single type of media such as audio, video, or text as defined in section 3.1.16 of DASH Standard [14]

Packager	Processes a conditioned continuous group of elementary streams to create specific ABR-format chunks of mixed or separated elementary streams that are stored in a file or transmitted. Each file is wrapped to be in one or more adaptive streaming formats. A packager does not normally perform any transcoding functions but depends on the conditioned stream to create those independently decodable sections. A packager can also be known as a fragmenter, encapsulator, or segmentor.
Partition	A set of continuous chunks within a media stream. A stream can be partitioned in several ways. For example, Partition A corresponds to 2-second chunks, while Partition B corresponds to 5-second chunks. A partition is represented by a series of boundary points across a group of elementary streams.
SAP type	Defines the properties of a Stream Access Point as specified in Annex I of ISO-BMFF [4] SAP Types 1 and 2 correspond to what is known in some coding schemes as a "Closed GOP random access point".
Segment	A chunk with boundaries aligned to include all component streams in the source multiplex across the target presentation time range. Segment boundaries are typically explicit for only one main component (video, for example), and other component boundaries are implicitly derived from this main component. A segment is typically used when packaging content in HLS.
Stream Access Point (SAP)	Enables random access into a media stream as defined in Annex I of ISO-BMFF [4].
Time Sync	Indicates identical AUs across representations have the same presentation time stamp.
Timeline Descriptor	af_descriptor to indicate Timeline of PES frames. These can contain "wall clock" timeline of the stream
Timeline Structure	Structure of the Timeline af_descriptor
Timeline Data	Data in the Timeline af_descriptor
Transcoder	A subsystem that converts a packetized elementary stream of one bitrate to one or more lower bitrate streams by changing coding parameters, including media resolution. In a broader sense, it can change from one codec format to another.
Virtual Segment	A section of an MPEG elementary stream that is defined by boundary af_descriptors [11]

4 ABBREVIATIONS AND ACRONYMS

This document uses the following abbreviations and acronyms.

AAC	Advanced Audio Coding
AAC-LC	Low Complexity AAC
ABR	Adaptive Bit Rate
ASC	Audio Specific Config
ATS	Adaptive Transport Stream
AU	Access Unit
AVC	Advanced Video Coding
DASH	Dynamic Adaptive Streaming over HTTP
DRC	Dynamic Range Control
DTS	Decoding Time Stamp
EBP	Encoder Boundary Point
ESAM	Event Signaling and Management
ENC	Encoder
EPT	Earliest Presentation Time
ES	Elementary Stream
GOP	Group of Pictures
HDS	HTTP Dynamic Streaming (Adobe) [17]
HLS	HTTP Live Stream [18]
HRD	Hypothetical Reference Decoder
HSS	HTTP Smooth Streaming (Microsoft)[20][21]
MBR	Multi-Bit Rate
MPD	Media Presentation Description
NTP	Network Time Protocol
PCR	Program Clock Reference
PID	Program Identifier or Packet Identifier per 13818-1[11].
PES	Packetized Elementary Stream
PMT	Program Map Table
POIS	Placement Opportunity Information System
PS	Parametric Stereo
PTS	Presentation Time Stamp
RAP	Random Access Point
SAP	Stream Access Point
SATS	Segmented Adaptive Transport Stream
SBR	Spectral Band Replication
SD	Source Description
SDI	Serial Digital Interface
SPTS	Single Program Transport Stream
TS	Transport Stream
VES	Video Elementary Stream
VOD	Video on Demand

5 ATS METADATA OVERVIEW

ATS Metadata refers to a description of the ATS bitstream. Metadata can be categorized as:

- static metadata, where the description remains the same over the entire bitstream; for example, structural metadata describing the number of ATS streams and their relationships
- time-variant metadata, where the description can vary and change at different points of relative time in the bitstream, (either stream or wall clock time), for example EBP structures describing chunk boundaries
- event metadata, such as ad insertion points or program start/end.

ATS supports several mechanisms to carry this metadata. In the elementary stream, metadata can be carried through the EBP structure, located in its transport MPEG packet header, which can convey time variant metadata such as location of chunk boundaries in the stream, types of chunks, and chunk labels as well as wall-clock media time at chunk boundaries. In the transport stream, the PMT descriptors can describe metadata at the transport level and elementary stream level and can describe PID, stream type (video descriptor, audio descriptor, captioning, language, bandwidth), and supported chunk cadences through the EBP PMT descriptor. The PMT information is usually static until a major event that changes the media experience occurs in the stream. Lastly, event metadata can be conveyed through the SCTE 35 descriptors and triggers (see Section 8.5) or through a private metadata mechanism on a separate pid (see Section 7.14.1). The information carried is used to indicate alternate content such as ad insertion, campaigns, and blackout events. Additionally, static metadata is carried out of band or alternatively inband in the ATS Source Description (see Section 0).

6 ATS SOURCE DESCRIPTION

6.1 Introduction

An ATS Source Description is used to describe the properties of a set of related ATSS. The primary use of the ATS Source Description is to provide information about the location of the source ATSS, for example a set of multicast addresses for a group of ATSS that are intended to be combined into a DASH AdaptationSet. It carries static metadata in addition to content source location such as program service metadata, MPEG-2 TS structure and attributes, etc. This metadata *may* be used by downstream devices to configure packaging or recording tasks.

The ATS Source Description follows the MPD schema of MPEG DASH [14] with enhancements to describe sources that are streams rather than files.

The information conveyed by an ATS Source Description *should* be created while or before the media transcoding task is started. ATS Source Description *may* be updated at a programming boundary. The publication and delivery of ATS Source Description is beyond the scope of this specification.

All restrictions and extensions defined in SCTE 214-1 [8] and SCTE 214-2[9] **shall** apply.

Extensions and restrictions specified in section 0 of this apply to an MPD otherwise compliant to SCTE 214-1 [8] and SCTE 214-2 [9]. ATS source description is thus based on the DASH/TS profile as defined in SCTE 214-1[8] and SCTE 214-2[9] but is not a proper subset of it. Hence there *should* be no expectation on behalf of DASH/TS client to be able to present it.

6.2 Identification

ATS Source Description document is a DASH MPD document with MPD@profiles value "urn:scte:ats:source:2015".

6.3 Non-HTTP URIs

6.3.1 General

ISO/IEC 23009-1 limits BaseURL values to HTTP(S) URLs only.

ATS Source Description require support for `file://` and `udp://` schemes in addition to HTTP(S).

When multiple URI schemes are used simultaneously, BaseURL **shall not** be present at any level except for Representation.

6.3.2 MPEG-2 TS over UDP

A URI with scheme value "udp " identifies an MPEG-2 TS packets embedded into UDP.

The `udp://` scheme syntax is as follows:

`udp://[<localaddress>@]<destination|multicastgroup>[:<port>]`

Each UDP packet typically contains 1 to 7 complete 188 byte TS packets with no additional headers or footers. This is consistent with the definition of the scheme given by <http://www.iana.org/assignments/uri-schemes/prov/udp>.

NOTE: `local address` corresponds to the multicast source

Each UDP packet payload contains only complete MPEG-2 TS packets

6.3.3 File

File URI format is defined in Uniform Resource Identifier (URI): Generic Syntax [7].

6.4 Anchor addressing

6.4.1 Introduction

The fragment part of a URI used in this specification is one or more ampersand-separated key-value pairs.

Each key-value pair can be viewed as a filter – a client is supposed only to include subset of MPEG-2 TS identified by a combination of parameters in the fragment part of the URI.

6.4.2 MPEG-2 TS Addressing

The following parameters *may* be used for any resource consisting of a sequence of MPEG-2 TS packets

Table 1- Parameters for MPEG-2 TS Anchors

Key	Value	Semantics
pid	PID value (decimal)	Packets with PID value specified in this parameter shall be kept.
program	Program number (decimal)	Packets with PID values associated with this program shall be kept. In context of this parameter "associated" PIDs include PIDs 0..4, PMT PID (only for the relevant program) and all PIDs mentioned in the PMT.

Packet Identifiers (PID) in the MPEG-2 TS indicate Video, Audio, PAT, or PMT information. Additional information a PID could indicate is SCTE 35, EBIF (ETV, EISS) data.

Anchoring Example:

Video: www.example.com/stream.ts#pid=481

6.4.3 EBP Addressing

The following parameters can be used to address parts of adaptive transport stream. Note that they can be used in combination with MPEG-2 TS parameters defined in 6.4.2.

Table 2- Parameters for EBP Anchors

Key	Value	Semantics
ebp_pid	PID carrying EBP structures for a selected partition	Shall be used if EBP parameters are used and more than one EBP PID is present, optional otherwise.
partition_id	ID of EBP partition addressed	ID of partition referred to. This parameter shall appear any time a subset of ATS is addressed.
Sequence_number	number (decimal)	Chunk number, as specified in the EBP structure. Needed for use with \$Number\$ template addressing. Corresponds to a value of sequence number in Boundary Descriptor
abs_time	EPT of a chunk (decimal)	Chunk time, as specified in the EBP structure. Corresponds to media time in TEMI. (Number of seconds according to EPOCH time format. Use W3C media Fragment+ add reference http://www.w3.org/2008/WebVideo/Fragments/WD-media-fragments-spec/#naming-time)

6.5 Carriage of video parameter sets

6.5.1 AVC parameter sets

Base64-coded representations of SPS and PPS *may* be carried in a SupplementalProperty at either Representation or AdaptationSet level.