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**MPEG DASH for IP-Based Cable Services Part 4:
SCTE Common Intermediate Format (CIF/TS)
Manifest for ATS Streams**

SCTE-CIF-TS-I01.0

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1. Introduction

The purpose of this document is to describe the Common Intermediate Format MPD including its elements, attributes, and values. The CIF MPD or CIF manifest is created from the parsing of an MPEG Transport Stream that is marked up and conditioned for virtual segmentation. A downstream device such as a packager can then use the CIF MPD to request and extract segments that can be modified to support various types of adaptive streaming technologies in the client.

The CIF MPD is used for processing of virtual segmented content streamed for linear services or stored for cDVR and VoD services. The CIF MPD is the DASH-like manifest as described in the reference architecture in Section 7 of SCTE 217 [16]. This document is an extension of DASH as constrained by SCTE 214-1 [2], 214-2 [3], and 214-3 [4]. The scope of this document is to describe the structure of the CIF MPD. The CIF MPD contains enough information to create client manifest and segment conditioning for the supporting end-client player adaptive streaming technologies.

The Common Intermediate Format (CIF) is based on DASH's Manifest Presentation Description (MPD) for MPEG-TS profiles, but with some extensions. The CIF MPD is created from parsing ATS or DASH-TS conditioned streams or generated while encoding video files as specified in SCTE 223 [6].

2. Normative References

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

2.1. SCTE References

- [1] ANSI/SCTE 128 2013-2, AVC Video Systems and Transport Constraints for Cable Television
- [2] ANSI/SCTE 214-1 2016, MPEG DASH for IP-Based Cable Services, Part 1: MPD Constraints and Extensions
- [3] ANSI/SCTE 214-2 2016, MPEG DASH for IP-Based Cable Services, Part 2: DASH/TS Profile
- [4] ANSI/SCTE 214-3 2015, MPEG DASH for IP-Based Cable Services, Part 3: DASH ISO BMFF Profile
- [5] ANSI/SCTE 215-2 2015, HEVC Video Constraints for Cable Television Part 2- Transport
- [6] ANSI/SCTE 223 2017, Adaptive Transport Stream.

2.2. Standards from Other Organizations

- [7] ANSI/CEA-708-E, Digital Television (DTV) Closed Captioning, August 23 2013
- [8] ISO/IEC 23009-1:2014 2nd edition, Dynamic adaptive streaming over HTTP (DASH), Part 1: Media presentation description and segment formats
- [9] W3C Sourcing In-band Media Resource Tracks from Media Containers into HTML;
<http://dev.w3.org/html5/html-sourcing-inband-tracks>
Note: It is likely this link will change as the specification advances in the W3C process.
- [10] W3C Media Source Extensions; <http://www.w3.org/TR/media-source/>
- [11] ISO/IEC 23009-4:2013, Segment encryption and authentication.
- [12] IETF RFC 2045:1996 Multipurpose Internet Mail Extensions (MIME) Part one: Format of Internet Message Bodies

2.3. Published Materials

- No normative references are applicable.

3. Informative References

3.1. SCTE References

- [13] ANSI/SCTE 35, Digital Program Insertion Cueing Message for Cable.
- [14] ANSI/SCTE 104, Automation System to Compression System Communications Applications Program Interface (API)
- [15] ANSI/SCTE 215-1, HEVC Coding Constraints for Cable Television Part 1- Coding
- [16] ANSI/SCTE 217, MPEG DASH Reference Architecture for IP-based Cable services.

3.2. Standards from Other Organizations

- [17] Digital living network alliance (DLNA) home networked device interoperability guidelines – Part 5: Device Profiles; <https://spirespark.com/dlna/guidelines/> : June 2016
- [18] Guidelines for Implementation: [DASH-IF Interoperability Points DASH V4.1](http://dashif.org/wp-content/uploads/2017/09/DASH-IF-IOP-v4.1-clean.pdf),
<http://dashif.org/wp-content/uploads/2017/09/DASH-IF-IOP-v4.1-clean.pdf>
- [19] Real-time Event Signaling and Management API, OC-SP-ESAM-API-I03-131025, October 25, 2013, Cable Television Laboratories, Inc.
- [20] ADOBE HTTP Dynamic Streaming, <http://www.adobe.com/products/hds-dynamic-streaming.html>
- [21] IETF RFC 8216: HTTP Live Streaming, <https://tools.ietf.org/html/rfc8216>.
- [22] Smooth Streaming Transport Protocol, <http://learn.iis.net/page.aspx/684/smooth-streaming-transport-protocol>
- [23] IETF RFC 7230: Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing.
- [24] IETF RFC 7231: Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content.

- [25] IETF RFC 7232: Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests.
- [26] IETF RFC 7233: Hypertext Transfer Protocol (HTTP/1.1): Range Requests.
- [27] IETF RFC 7234: Hypertext Transfer Protocol (HTTP/1.1): Caching.
- [28] IETF RFC 7235: Hypertext Transfer Protocol (HTTP/1.1): Authentication.
- [29] ISO/IEC 13818-1, (2015), “Information Technology – Generic coding of moving pictures and associated audio – Part 1: Systems”
- [30] IETF RFC 4151: The ‘tag’ URI Scheme.
- [31] ETSI TS 102 366 V1.4.1, (2017-09), Digital Audio Compression (AC-3, Enhanced AC-3) Standard.
- [32] ISO/IEC 23091-3:2017, (2016), “Information Technology – MPEG Systems Technologies – Coding independent code-points Part3:Audio”

3.3. Published Materials

- No informative references are applicable.

4. Compliance Notation

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5. Abbreviations and Definitions

5.1. Abbreviations

ABR	adaptive bitrate video
Ads	ad service
API	Application Program Interface
ATS	adaptive transport stream

AVC	advanced video coding
C2G	Cloud to Ground Service
CC	closed captioning
CDN	content delivery network
cDVR	Cloud Digital Video Recorder
CIF	common intermediate format
CKM	cryptographic key management
DASH	dynamic adaptive streaming over HTTP
DASH-IF	DASH Industry Forum
DLNA	Digital Living Network Alliance
DRM	digital rights management
DVR	digital video recorder
DTV	digital television
EBP	encoder boundary point
EIDR	entertainment ID registry
ESAM	event signaling and messaging
GOP	group of pictures
GUID	globally unique identifier
HDS	HTTP dynamic streaming (Adobe)
HEVC	High Efficiency Video Coding
HI	hearing impaired
HLS	HTTP live streaming (Apple)
HSS	HTTP smooth streaming (Microsoft)
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
IETF	Internet Engineering Task Force
IP	Internet protocol
ISO-BMFF	ISO based media file format
MPD	media presentation description
MPEG	moving pictures experts group
nDVR	network digital video recorder
NPT	normal playback time
NTP	network time protocol
NSfCM	not set for client manifests
PAT	program association table
PES	packetized elementary stream
PID	packet identifier
PMT	program map table
PPS	picture parameter set
PSI	program specific information
PTS	presentation time stamp
QAM	quadrature amplitude modulation
RAP	random access point
RFC	request for comments
SAP	stream access point
SCTE	Society of Cable Telecommunications Engineers
SPS	sequence parameter set
SPTS	single program transport stream
TKHD	track header

URI	uniform resource identifier
URL	uniform resource locator
UTC	universal time coordinated
VI	visually impaired
VoD	video on demand
XML	extensible markup language

5.2. Definitions

Accessibility	The degree to which a media content or certain media content components are available to as many people as possible.
Adaptation Set	A set of interchangeable encoded versions of one or several media content components as defined in the DASH specification [8].
ATS	Adaptive transport stream. A conditioned MPEG-TS that is suitable for segmentation by a Packager.
Bitstream Switching Segment	Segment that if present contains essential data to switch to the Representation to which it is assigned as defined in the DASH specification [8].
Segment	A discrete section of content that can be independently decoded, possibly given additional initialization information. A packager can take virtual segments in the streams and create segments.
CIF Client	Software consumer of a CIF MPD. Primarily this is a Packager. Alternatively, a CIF client can be a dynamic ad insertion system, a blackout manager, a digital video recorder, or a video monitoring system.
CIF MPD	Formalized description for a media presentation for the purpose of providing segmentation of MPEG-TS file in a common intermediate format to a CIF client. Can also be know as a CIF manifest.
Client Manifest	Formalized description for a media presentation for the purpose of providing a streaming service to a client player.
Client Player	Media player using a specific adaptive streaming delivery (such as HLS, DASH, HDS, HSS) for content viewing purposes. The client player consumes a client manifest converted from the CIF MPD.
Cold cDVR	A completed cloud recording that can be viewed of a linear asset that has finished streaming.
Content Component Type	A single type of media content such as audio, video, or text as defined in the DASH specification [8] as media content component type.
DASH	Dynamic Adaptive Streaming over HTTP. In the CIF Specification, DASH is used to refer to concepts that are created in the 23009-1 specification [8] in MPEG-DASH group.
DASH Client	Client that consumes a DASH manifest. A CIF client consumes a CIF MPD, which uses DASH constructs.
DOM	W3C Document Object Model.
EPOCH	1-Jan-1900 00:00:00 and a 32-bit fraction field. Post EPOCH is 25-05-1977 18:00:00Z.
Early Terminated Period	A period that ends earlier than anticipated. This can happen when an inserted Ad is too short for the intended period.
Functionally Identical	Manifests index a collection of media segments. It can index the same collection of media segments more than one time in the manifest. For

	instance, the same representation could be listed in two different AdaptationSets. If their point to the same collection of segments, then it is known as being functionally identical.
Hot cDVR	An in-progress cloud recording that can be viewed of a linear asset that is still being streamed.
Initialization segment	Segment containing metadata that is necessary to present the media streams encapsulated in Media segments as defined in the DASH specification [8].
MBR Set	Set of representations that belong to the same AdaptationSet. Each representation is comprised of a group of segments that represents the encapsulated media stream.
MPD	Collection of data that establishes a bounded or unbounded presentation of media content as defined in the DASH specification [8]. An MPD is represented as an XML document.
MSE	W3C Media Source Extensions.
Muxed or Multiplexed	In the transport stream, this generally refers to a single program transport (SPTS) unless otherwise specified. In the segment case, this would refer to a section of the muxed transport stream containing both the video, audio, and data for that point in time.
Packager	A packager processes a conditioned continuous group of elementary streams to create specific ABR-format segments of mixed or separated elementary streams that are stored in a file or transmitted. 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.
Period	Time-based interval of the media presentation, where a contiguous sequence of all periods constitutes the media presentation as defined in the DASH specification [8].
Recorder	Device that stores ABR playback of content collected from a linear stream in a real-time or non real-time fashion. The recorder processes the content and creates an in-sequence number or stream byte offset record of the stream. Recordings can be played back after the entirety of the recording is complete (cold) or while it is being recorded (hot).
Representation	Collection and encapsulation of one or more media streams in a delivery format and associated with the descriptive metadata as defined in the DASH specification [8]
RUI-H	DLNA Remote User Interface – HTML5.
SubRepresentation	Part of a representation described in the MPD that is present in the entire period as defined in the DASH specification [8].
Virtual Content Component	One continuous component of the media content with an assigned media component type that can be encoded individually into a media stream as defined in the DASH specification [8] as media content component

6. CIF Architecture

6.1. High level Architecture

The CIF Specification describes the manifest presentation description for an MPEG-TS linear stream or stored file. Through the manifest, a CIF Client (e.g. a Packager or Transcoder) can request one or more particular section(s) of the MPEG-TS file or stream. To standardize the details in the manifest, the DASH standard [8] is used as it describes a rich and precise vocabulary for manifest description. In the DASH taxonomy, *representation* conceptually means single media (one or more elementary streams), comprised of multiple short *segments*. An *adaptation set* is a set of seamlessly switchable representations, and a *period* is a time box within which representations exist. Each period can be viewed as an independent playlist (similar to a master m3u8 in HLS) or a completely different program, and a period border can be seen as a splice point.

Using CIF MPDs does not require end-customer DASH clients. Packagers will retrieve content based on CIF MPD, and create client manifests of appropriate technology (HLS, DASH, HDS, HSS) as shown in Figure 3. A linear packager may ingest an ATS stream [6] and output a segmented DASH-TS stream, while parsing the stream to create a CIF MPD for the stream. A downstream packaging device may be used to retrieve specific segments from a content asset based upon cache miss request from a CDN or a client request for cDVR material.

6.1.1. DASH Overview and Attribute Descriptions

The DASH standard provides a method for retrieving media segments [8]. The authors of DASH included participation from Apple and Microsoft, who contributed the MPEG2-TS Live and ISO-BMFF Live Profiles respectively. These two profiles are used as examples by which the HLS and HSS ABR Fragments/Segments are indexed.

In current applications, the DASH standard [8] is used for server (an HTTP server) – client distribution of media to an end customer. A DASH MPD [8] describes the construction of a URL for each DASH segment. DASH segments are indexed by time or segment number and described by a number of properties including bitrate, codec, and resolution. A DASH client [8] is capable of processing an MPD and performing HTTP GET requests to retrieve a media asset. MPDs should be compressed during transfer using the gzip transfer encoding toolset that is part of the HTTP 1.1 server. Use of other compression tools for MPD transfer other than those specified in HTTP 1.1 is strongly discouraged to avoid complexities in maintaining toolset updates across servers.

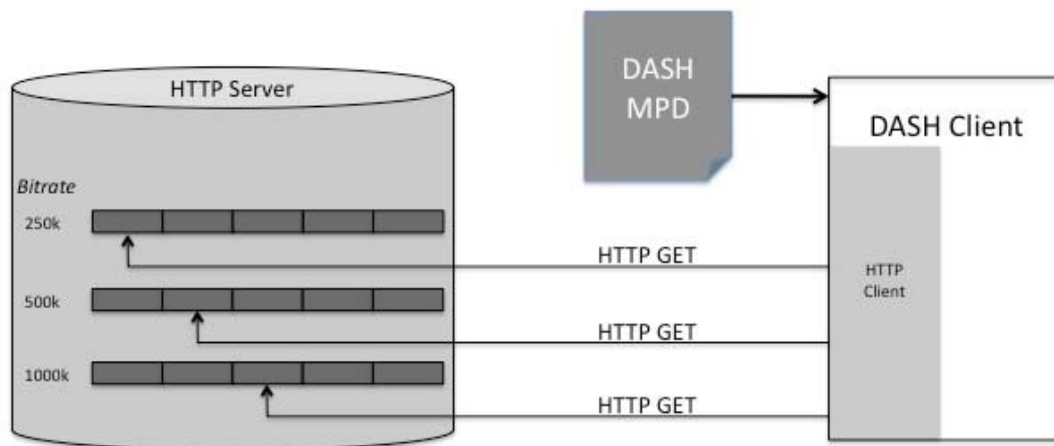


Figure 1 - DASH Client Side MPD and Segment Retrieval

In the CIF architecture case, the current application is expanded to include the use of DASH-like structures to deliver media segments to downstream devices in the network. The JIT packager or other intra-network downstream CIF client uses a DASH-like MPD to find and request segments from the file or linear stream for further segment and manifest processing. Modifications to the CIF MPD are needed so that relevant information contained in the CIF MPD can be converted to a compliant client manifest used by a DASH or HLS client. The CIF client packager creates a client manifest from the CIF MPD for the client player in one or more formats: HLS, HDS, HSS, ISO-BMFF DASH, or less commonly MPEG-TS DASH. The CIF MPD is used by the packager to retrieve DASH segments from an internal facing network storage system and to create the appropriate client manifest for the specific type of end client player.

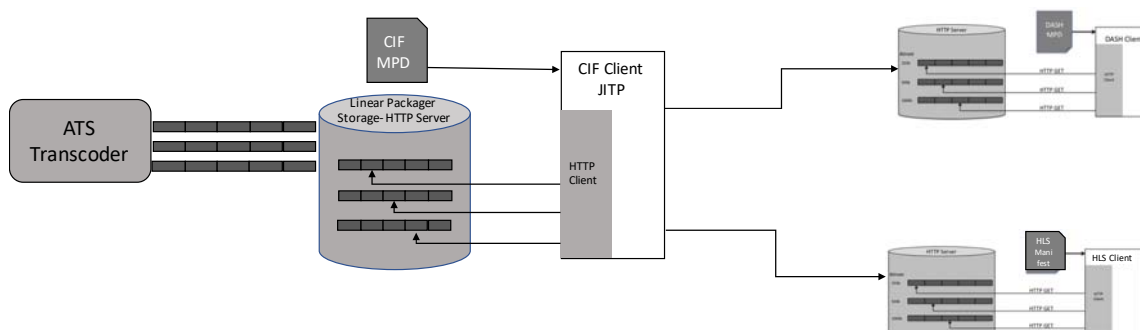


Figure 2 - CIF Architecture using DASH-like Structures

Since the creation of the CIF MPD for packager purposes is not a traditional use of the DASH specification there are some additional constructs detailed in this document that are extensions to the DASH specification. The intent is to keep the CIF MPD as closely aligned with the DASH specification but to allow for extensions such that different types of client manifests can be created to support different type of end-client adaptive streaming delivery technologies. This allows for storage/retrieval in the network in one format while still supporting several end-client delivery technologies. For the purposes of packager encapsulation, these DASH MPD constructs are used as described below. Refer to the example MPDs in the appendices while reading this text.

6.1.2. DASH CIF Level Architecture

The packager will retrieve assets from a distributed service network storage systems. Storage systems may be distributed based on services: linear program storage for linear channel services, recorder storage for cDVR services, and VoD file storage for VoD services. The packager system (linear packager in combination with a JITP) transforms assets from ATS format into an end-client supported format (e.g., HLS, HSS), and generates an appropriate end-client-specific manifest. To retrieve the requested segments from the embedded ATS file, the packager can retrieve sections of the ATS file (sections of a muxed transport stream or specific audio or video segments) using the CIF MPD [6]. The packager has a choice of several AdaptationSet elements within the manifest to retrieve the essential media components for the client or CDN request in a compact manner.

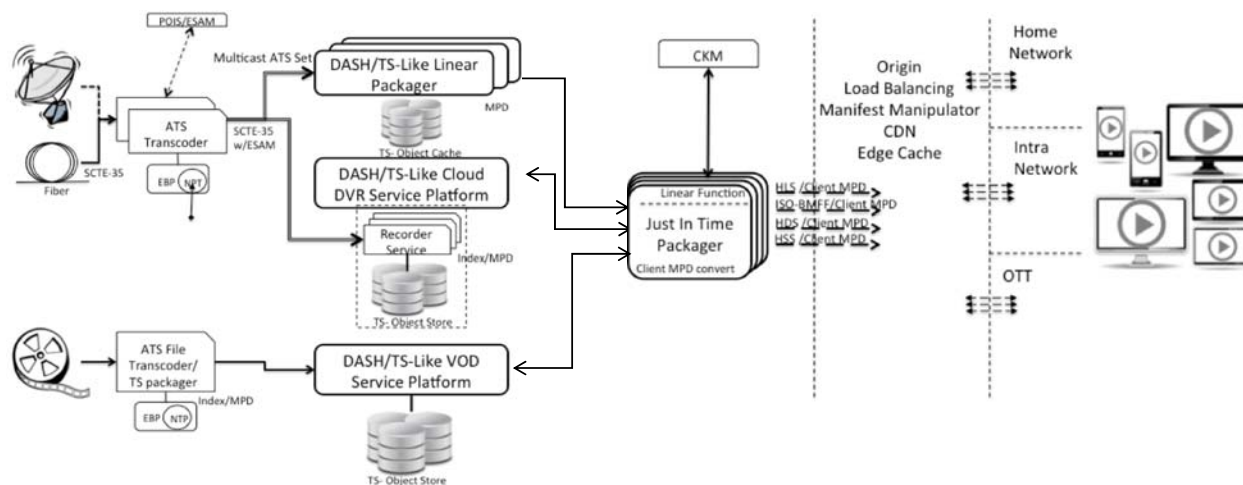


Figure 3 - Linear/ cDVR/ VoD Content Workflows and Delivery Chain

The JITP SHOULD communicate with a network facing DASH CDN on the upstream side to retrieve sections of the ATS as needed for JIT re-encapsulation into client formats, as well as a CIF MPD that indexes DASH, HSS, HLS, and HDS timelines within the ATS assets [6].

The CIF MPD is based upon the DASH standard but with extensions. Both HLS and HSS proprietary formats can be easily described in a common manifest format. HDS can also be described by a manifest as well. Requests made from the JITP to the DASH origin/CDN happen through HTTP GET requests for DASH segments. The CIF MPD can be “static” or “dynamic” and SHALL be updateable to a new content manifest as content segments are added to the asset. Versioning of content manifests is managed through clock based indexing approaches. The packager can use URL requests to make these requests.

6.2. CIF MPD Creation

The CIF MPD is created either by a linear packager or by VoD file preparation for linear, cDVR, or VoD services as described in reference architecture in Section 7 of SCTE 217 [16]. In the linear service workflow, the linear packager tunes into a UDP multicast session containing an ATS set of SPTS streams [6]. It then writes a CIF MPD in a live rolling window format (e.g., a 30-second rolling window) with the segmentation determined by received EBP fields, parsed information in the stream (e.g., SCTE-35 tags), or out-of-band information (e.g., a configuration file or just hardcoded). In the cDVR or VoD file-based workflows, the CIF MPD is created by sectioning out the linear CIF or made during the file transcoding process. Where possible, the CIF MPD will adhere to the DASH MPD constructs and SCTE

214-1 [2] and 214-2[3] constraints, though it may carry additional information as defined in this specification that needs to be passed to downstream devices (e.g., user agents and browsers).

6.3. Conventions of Use for CIF MPD

Elements and attributes that are part of the CIF MPD contain information necessary for a CIF client to select a specific segment. Examples of this are fetching segments based on time, format, or bandwidth. However, additional elements and attributes are added to the manifest to enhance the operation of the client player. It is important though to minimize the amount of data being carried through the manifest. The following are guidelines for when it is acceptable to add data to the CIF MPD.

- Information needed for creation of client manifests (e.g., specific information to enable HLS, HDS, HSS or DASH ISO-BMFF clients)
- Information needed for subsequent manifest conditioning or remote period operations that may alter the client manifest (e.g., identifiers or relative path URLs)
- Parameter information needed by clients players to interface with other systems (e.g., browsers, side program insertion)
- Information whose retrieval/extraction would result in a noticeable delay to the end customer client (e.g., identification of CC language, descriptive video, DRM info). Note that the sum of additional payload size in the MPD SHOULD have a restriction in the size of 10% (within a tolerance) of the MPD size at the period level.

6.4. CIF Conversions for Cloud-to-Ground Client Player Applications

At the packager, the CIF MPD needs to be converted to a client manifest suitable for cloud-to-ground client applications using an ISO-BMFF format [17]. The CIF MPD may need to carry additional information intended to be passed to the client player/application or constrain its format according to SCTE 214-3 [4] to allow for simple conversions to this client manifest format.

Client player applications will vary based on the client type being an MVPD client (e.g., Xi3) or VidiPath™ client, which may be an MVPD conformant client [17]. A VidiPath™ client device conforms to all the mandatory guidelines in a DVR architecture and can download and run an RUI-H service provider application that is constrained to the APIs mandated in a DVR architecture.

6.5. CIF Carriage of User Agent Information

A VidiPath™ client device includes a user agent that is similar to most browsers in that it supports HTML5 [17] and may have been developed from an open source browser. The user agent also supports media formats that browsers may not including MPEG-2 TS container with AVC video, and MP4 (ISO-BMFF) container with an AVC video. These formats are typically used for streaming within the home. The user agent will also support DASH MPEG-2 Simple and ISO-BMFF Live and On-demand profiles. The user agent will process the metadata from the video stream and the manifest and map it to API (DOM) structures that an RUI-H application can access. Respective to media format type, the W3C in-band sourcing specification [9] defines how the metadata in the manifest, container metadata, or video metadata is mapped to an HTML MediaElement API.

The CIF MPD may need to carry additional information not found in DASH manifest that may in turn may be passed onto other carriage mechanisms to reach the user agent. Some information carried in this manner is to avoid presentation data problems due to delay of parsing the stream.

6.6. Source Origins of Timing Elements and Attributes

The CIF MPD for linear services is created by the linear packager which processes information ingested from an MBR set of ATS streams. A transcoder ingests a source linear stream and transcodes the source stream to an MBR set of ATS conditioned streams [6]. These ATS streams are then processed by a linear packager and the CIF MPD is created. For VoD services, the CIF MPD is created at the time of transcode of the source file.

Each ATS stream contains timing, boundary point, and labeling information for each segment as well as SCTE 35 messages and PTS stream times [6]. This information along with its own clock time is what the manifest creator (either linear packager or VoD transcoder) uses to create the CIF MPD.

The source stream into the transcoder can contain two timing mechanisms. One is the SCTE 35 Time Descriptor element that originates from the content provider and is a wall clock time that is inserted at least once every five seconds using an SCTE 104 mechanism [14]. The transcoder can use this time descriptor as a basis for the wall-clock time to create the EBP time for each virtual segment in the stream or if not present it can create the wall-clock time from the transcoder device network time clock. This wall-clock information is then processed by the manifest creator and becomes a source for the period level start attribute and supplemental property UTC-time, and AdaptationSet level S@d and S@r attributes.

The second timing mechanism in the source stream is PTS. This can be passed through or reclocked at the transcoder. The PTS information is then processed by the manifest creator and becomes a source for period level presentationTimeOffset element and AdaptationSet level S@t attribute.

The transcoder itself initializes the sequence number at the startup of the ATS stream using the wall-clock time set to the EPOCH time divided by the regular segment duration (SD) (e.g., two seconds) as defined for the period [6]. This number is used as the startNumber attribute of the segment template and sources the adaptationSet S@n attribute.

For linear services, there is also a clock signal at the linear packager which can also be used as a potential time source that can be used for determining the availability time of the first available segment since the linear packager does create the CIF MPD. In linear services, a rolling window is used to maintain a cached pool of segments that represents live linear streaming. In this approach, segments may fall off the manifest as well be added on without changing the period structure which means the first available segment will also change.

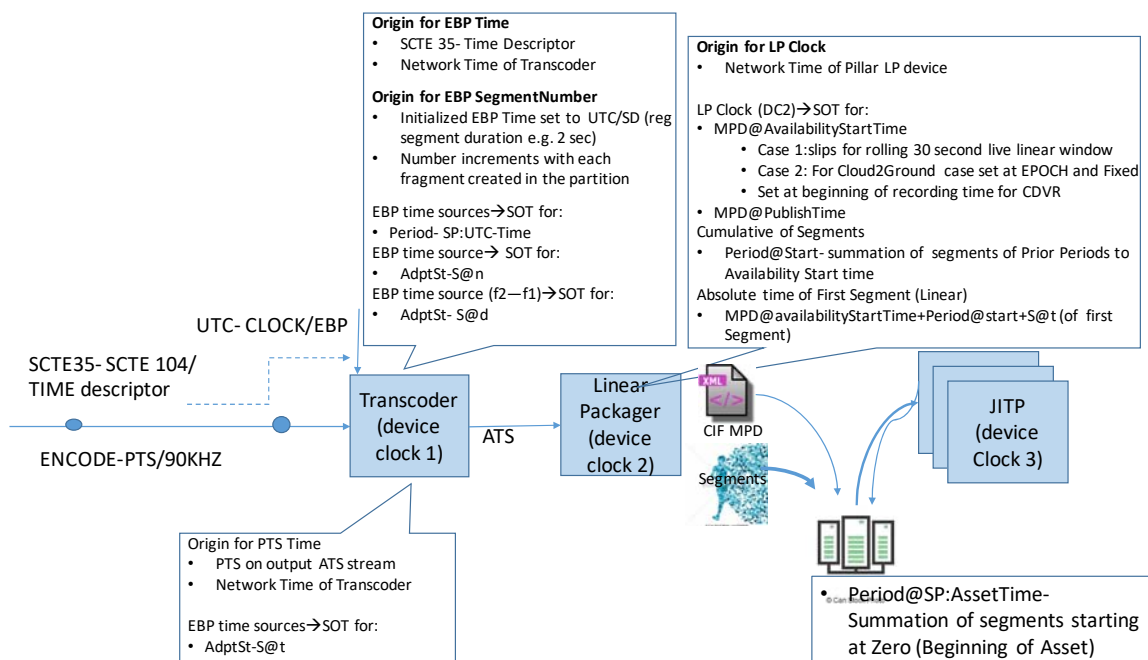


Figure 4 - Time Signals in Network Segmented Content Workflows

Once the CIF MPD and the segments are stored, the JITP fetches content segments based on a client request that comes through by CDNs or directly through the client itself. This initializes the client workflow (Figure 4), where the CIF MPD is read by the JITP to fetch content segments and JITP also creates the client manifest derived from the CIF MPD into a format that the client player accepts. Time signals in this case are carried over from the CIF MPD with things like PTS overflow handled in the client manifest according to the type of adaptive streaming format used the client. Additionally, the player is operating using a clock on its device platform. Sometimes this clock can be misaligned from the clock of the manifest creator. This can create complexities in linear services if the client clock is ahead of the manifest creator clock. The client can avoid these complexities through some behavior strategies such as not taking the current available segment in the manifest, but taking a segment a few segments back from the current segment.

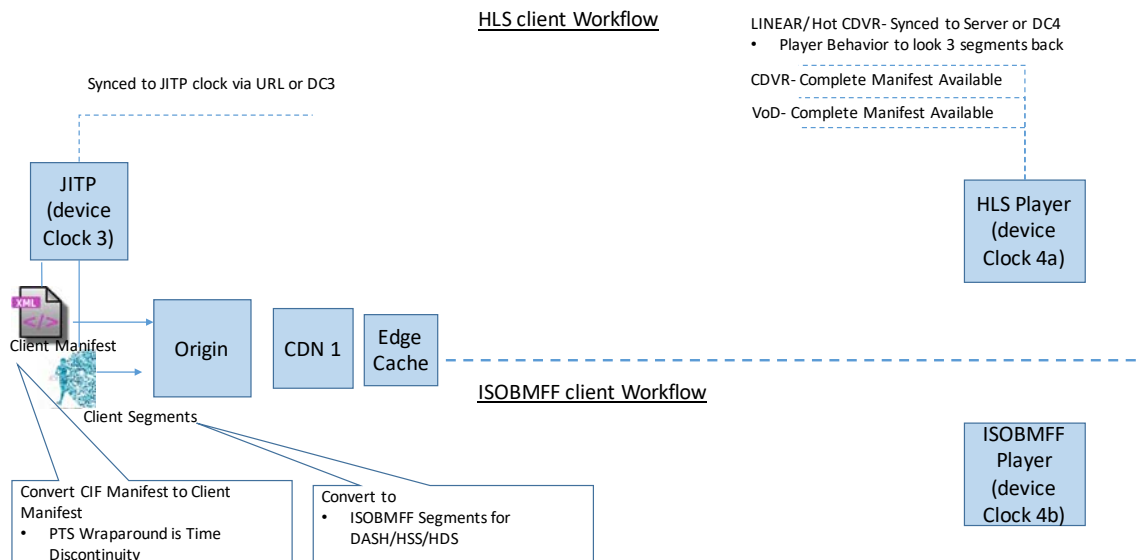


Figure 5 - Time Signals in Client Segmented Content Workflows

6.7. Identifiers in CIF

Identifiers (@id) exists at the MPD, Period, AdaptationSet, and Representation levels of the CIF MPD. These @ids attributes have constraints which are listed in the description of the table row entry which are helpful to JITP conversions to client manifests. Many of these values for the attributes assist in uniquely identifying different hierarchy levels in the manifest which can be specific to asset and/or service. Value assignments for this identifier attributes can be specific to the implementation of the specification. In these cases, the value entries will be identified as “TBA-MVPD” (To Be Assigned by the MVPD) and the actual values for these entries will be decided upon by the MVPD implementing the CIF specification.

6.8. Handling of Errors

If an outage occurs due to a recording error or an actual error on the ATS stream, the transcoder or recorder creates an outage in time that can differ across the ATS set of streams [6]. The packager handles this in the CIF MPD in two approaches: (1) the MPD does not index for that missing period of time, or (2) the MPD creates a new period but without the missing representation and updates this through an event message. For approach one, when a request for the DASH segment cannot be successfully completed by a packager or origin server, it SHALL return an appropriate error code (e.g., 404, 410, 503; see HTTP error codes in the appendix). CIF client behaviors SHOULD accommodate for this by requesting an alternate segment representation for that period. For approach two, the resulting conditioned output client manifest format created by the JIT packager SHOULD accommodate for the missing representation by creating a new period with an event message. Approach one is to be used for initial outages (in the seconds range). Approach two is for longer outages where a decision is made to create a new period or the MPD is updated to reflect this. The decision to use approach two instead of approach one depends on the duration of outage and the configurable threshold criteria determined for this.

7. CIF MPD Specification

Tables for MPD, Period, AdaptationSet, and Representation are based off of tables in the DASH specification [8], but add constraints or additional information that is needed to create the MPD instance that is the CIF MPD. If an attribute is described and it is optionally defined in a second location, then the location in the lowest level in the MPD hierarchy takes precedence.

7.1. Table Format

This section defines the general Table format layout for Attributes and Elements in the manifest as described in Table 1.

Table 1 - Table General Format

Element or Attribute Name <Hierarchical Level of Table in Manifest> <DASH Table Reference [8] >	CIF Use <M,O,CM> <CIF Use of Attributes/Elements>	Description
<Attribute-left justified> [DASH Defined Use [8]] <additional information>	<Conditions of Use> “ _ “<Not used>	< Additional descriptions and constraints of Attributes and Elements in this CIF document. Definitions of attributes and Elements that are listed in DASH Document [8] are not repeated here>
<Element-left justified> [# of Instances]		
<Sub Attribute>		
<Sub Element>		
	General Constraints Default	
	Components Constraints ONLY or EXCEPT	
	Service Constraints ONLY or EXCEPT	
Essential or Supplemental Property	Property 1 Use	Property 1 Description
	Property 2 Use	Property 2 Description
	Property 3 Use	Property 3 Description

7.2. DASH MPD Element

This section describes MPD level related information for usage in the CIF MPD.

Note: MPDs should be compressed during transfer using the gzip transfer encoding that is part of the HTTP server. Use of other compression tools for MPD transfer is discouraged since it is not part of the HTTP toolset.

7.2.1. DASH MPD Semantics

CIF MPD level semantics shall be as specified in Table 2.

Table 2 - CIF MPD Semantics

Element or Attribute Name <MPD> Table 3 in section 5.3.1.2 [8]	CIF Use	Description
MPD		The root element that carries the Media Presentation Description for a media presentation.
@id [O]	M	The ID of the asset. A URI qualified ID can be used to identify the type of service the MPD represents. (e.g., “urn.xxx.linear.stream:xxxx”) • Linear: TBA-MVPD • cDVR: TBA-MVPD • VoD: TBA-MVPD
@profiles [M]	M	see Section 6.1 of SCTE 214-2 [4]
@type [OD] Default = “static”	M	If set to “dynamic”, it means the MPD is expected to be updated periodically. • Linear – “dynamic” • CDVR (hot recording) – “dynamic” • CDVR (completed) – “static” with dynamic attributes removed • VoD – “static”
@availabilityStartTime [CM for type= “dynamic”]	M C2G Default Value set to POST EPOCH Time (1977-05-25T18:00:00.000000Z)	Expressed in the time frame of the system clock on the packager, this attribute contributes to the calculation of when the first listed segment in the MPD is available for download by a CIF client. For @type=‘dynamic’ this attribute SHALL be present. In this case it specifies the anchor for the computation of the earliest availability time (in UTC) for any segment in the media presentation.
	ANY	For @type=“static” if present, it specifies the segment availability start time for all segments referred to in this MPD. If not present, all segments described in the MPD SHALL become available at the time the MPD becomes available. For linear channel applications, the availabilityStartTime on MPD updates may change according to a sliding window of time that is based on the timestamp of the system that generated the MPD.

Element or Attribute Name <MPD> Table 3 in section 5.3.1.2 [8]	CIF Use	Description
	EXCEPT For cDVR Cold and VOD use DEFAULT NSfCM	For cDVR recordings, the periods that were in the MPD at recording start remain in the recording. When a recording starts, the CIF MPD@availabilityStartTime is set to the value of the calculated availabilityStartTime of the first segment in the recording. Thereafter the value of the attribute does not change, but segments are added to those indexed in the MPD. To handle cloud-to-ground delivery, the availabilityStartTime should be fixed. In these cases, the availabilityStartTime starts at the POST EPOCH time.
@publishTime [OD] Must be present for type = “Dynamic”	M	The publishTime indicates the timestamp of the system that generated the MPD when member segments are written to storage and accessible to consumers of the MPD. If at the CIF client the publishTime between two retrievals is the same, then the MPD is considered “not updated”. When converting to a static MPD, use the last dynamic MPD publishTime.
@availabilityEndTime [O]	—	Not used.
@mediaPresentationDuration [O]	M <u>DEFAULT</u> Set to PT1S	Provides the total duration of the media presentation. It can determine how much period time that has elapsed for the entire media presentation. This can be used in a dynamic mode for linear content that can append new periods and thereby track increasing time for the entire presentation duration. This handles the live case where one does not know the end of the current period duration but can keep increasing it during each MPD update as it grows.
	ANY	This can be useful for ad splicing, so that players joining mid-break can splice an ad for the remainder of the break.
	Linear Use DEFAULT NSfCM	
@minimumUpdatePeriod [O]	M <u>DEFAULT</u> Set to P420Y	The creator of the MPD chooses the minimum update period. The MPD@minimumUpdatePeriod specifies the smallest period between potential changes to the MPD. Once an asset is complete, the <i>minimumUpdatePeriod</i> field uses the default value.

Element or Attribute Name <MPD> Table 3 in section 5.3.1.2 [8]	CIF Use	Description
	ANY	In regards to MPD update restrictions, see Section 6.8 of SCTE 214-1[2]. In live scenarios, MPD updates can add new MPD events but SHALL NOT remove existing MPD events in order to provide system consistency. As a consequence, a cancellation of a previous event SHOULD be done via MPD update adding a new event.
	cDVR Cold or VOD use DEFAULT NSfCM	
@minBufferTime [M]	M	The minimum amount of time a client player SHOULD buffer content before beginning playout. See Section 6.1 bullet 1 of SCTE 214-1 [2]. Note: This merely suggests to downstream systems how big the regular duration segments could be. It may be possible that multiple irregular segment duration could fit in minbuffertime duration, but that is not the usual case.
@timeShiftBufferDepth [O]	M <u>DEFAULT</u> Set to P420Y	The duration of the time shift buffer that is guaranteed to be available for this asset. The creator of the MPD assigns this value as well. See Section 6.1 of SCTE 214-1 [2].
	ANY	Once an asset is complete, the <i>mimimumUpdatePeriod</i> and <i>timeShiftBufferDepth</i> field uses default value.
	cDVR cold and VoD use DEFAULT NSfCM	
@suggestedPresentationDelay [O]	—	Not used.
@maxSegmentDuration [O]	M	The maximum duration of any segment in the MPD.
	DEFAULT 30.03	See Section 9.2.1 of SCTE 214-1 [2].
	ANY EXCEPT for VOD with SIDX	
@maxSubsegmentDuration [O]	—	The maximum duration of any subsegment in the MPD.
	ANY	

Element or Attribute Name <MPD> Table 3 in section 5.3.1.2 [8]	CIF Use	Description
	ONLY for VOD with SIDX	
ProgramInformation [0..N]	[1]	Carries the Segmentation UPID identifiers at the MPD level through ContentIdentifier element, see Section 8.2 of SCTE 214-1 [2]
	ANY	schemeIdUri “urn:scte:dash:asset-id:upid:2018”
	EXCEPT for VOD = [0..1]	At the period level, this identifier will be carried in the Period AssetIdentifier element and extracted thru payload schema. Applications reading the MPD MAY need to be aware of identifiers at both the MPD and period level.
scte214:ContentIdentifier	[1..N]	Each element carries a separate segmentation UPID in textual format For Linear/cDVR: TBA-MVPD For VoD (Optional): TBA-MVPD For Ads: (Optional): AdId
BaseURL [0..1]	—	Not used. Note: This element at this manifest level is reserved for future use.
Location [0..N]	—	Not used.
Period [1..N]	[1 ..N]	Specifies the information of a period.
Metrics [0..N]	—	Not used.
EssentialProperty [0..N]	—	Not used.
SupplementalProperty [0..N]	[1]	powered-by See Section 13.1 of SCTE 214-1 [2].