

DASH Player's Application Events and Timed Metadata Processing Models and APIs (Community Review)

Living Document, 27 June 2019

This version:

<https://dashif.org/guidelines/Events-CR-v1.pdf>

Issue Tracking:

[GitHub](#)

Editors:

DASH Industry Forum

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DASH-IF IOP	CR	rev	-	Current version:	V4.3
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Title:	DASH Player's Application Events and Timed Metadata Processing Models and APIs		
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<p>Use <u>one</u> of the following categories:</p> <p>C (correction)</p> <p>A (addition of feature)</p> <p>B (editorial modification)</p>			

Reason for change:	For the proper usage of Events and Timed Metadata distributed in DASH Media Presentations, APIs pertaining to subscription and notification delivery are beneficially defined between the DASH client and the application consuming the Events.
Summary of change:	Addition of a client processing model for Events
Consequences if not approved:	Inconsistent implementations
Sections affected:	New section X
Other comments:	This document contains several notes. Feedback during community review is welcome specifically on these topics.

Disclaimer:	This document is not yet final. It is provided for public review until the deadline mentioned below. If you have comments on the document, please submit comments by way of the
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below. If you have comments on the document, please submit comments by one of the following means:

- at the github repository: <https://github.com/Dash-Industry-Forum/Events/issues>, or
- dashif+iop@groupspheres.com with a subject tag [Events]

Please add a detailed description of the problem and the comment.

Based on the received comments a final document will be published latest by the expected publication date below, integrated in a new version of DASH-IF IOP, if the following additional criteria are fulfilled:

- All comments from community review are addressed
- The relevant aspects for the Conformance Software are provided
- Verified IOP test vectors are provided

**Commenting
Deadline:**

July 31st, 2019

**Expected
Publication:**

August 31st, 2019

1. DASH Player architecture for processing DASH events and timed metadata tracks

This Figure demonstrates a generic architecture of DASH Player including DASH Events and timed metadata tracks processing models.

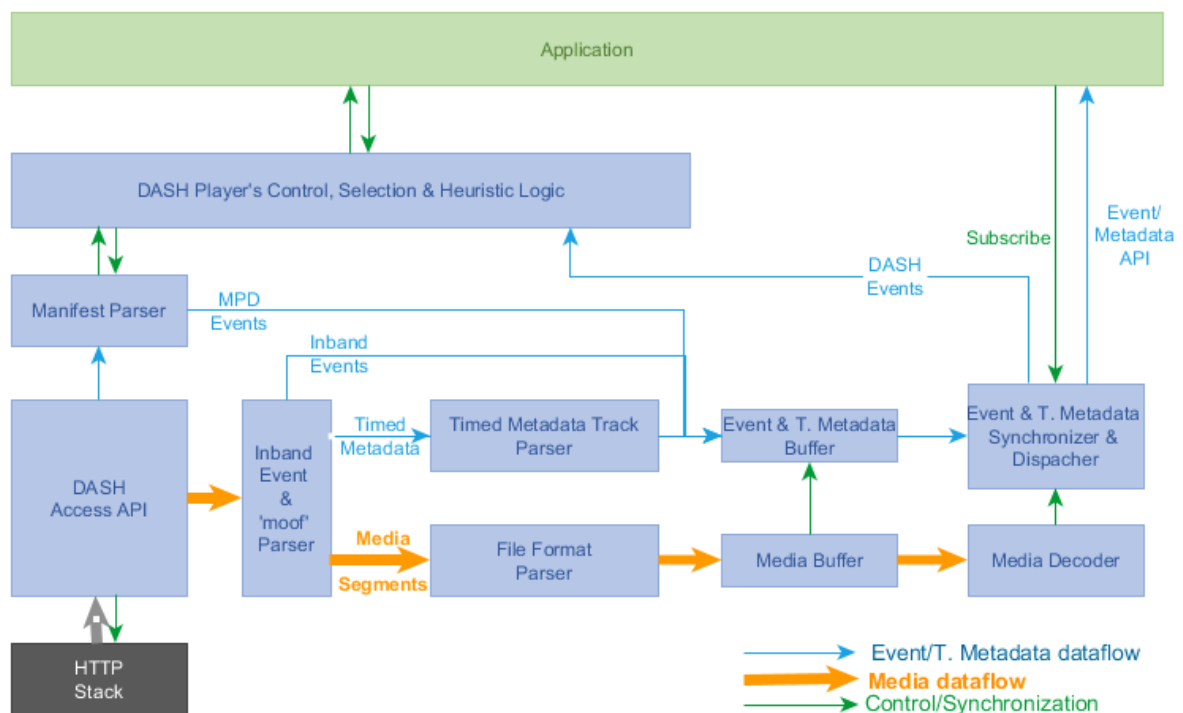


Figure 1 DASH Player architecture including the inband Event and Application-related timed metadata handling

In the above figure:

1. DASH Player processes the received MPD. The manifest information including the list of events schemes and values, and timed metadata track schemes are passed to Application.
2. Application subscribes to the event and timed metadata track schemes in which is interested, with the desired dispatch mode.
3. If the manifest includes any MPD Events, DASH Player parses them and appends them to Event & Timed Metadata Buffer.
4. Based on the MPD, DASH Player manages fetching and parsing the Segments before appending them to Media Buffer.
5. Parsing a Segment includes:
 1. Parse the high-level boxes such as Segment Index (sidx) and Event Message boxes, and append Event Message boxes to the Event & Metadata Buffer.
 2. For an Application-related timed metadata track, extracting the data samples, and appending them to Event & Metadata Buffer.
 3. For media segments, parse the segments and append them to Media Buffer.
6. Event & Metadata Buffer is a FIFO buffer, passing the events and timed metadata samples to Event & Metadata Synchronizer and Dispatcher function.
7. The DASH Player-specific Events are dispatched to DASH Player's Control, Selection & Heuristic Logic, while the Application-related Events and timed metadata track samples are dispatched to Application as the following. If an Application is subscribed to a specific Event or timed metadata stream, dispatch the corresponding event instances or timed metadata samples, according to the dispatch mode:
 1. For on-receive dispatch mode, dispatch the Event information or timed metadata samples as soon as they are received(or no later than AT).
 2. For on-start dispatch mode, dispatch the Event information or timed metadata samples at their associated presentation time, using the synchronization signal from the media decoder.

2. Event and Timed metadata sample timing models§

2.1. Inband Event timing parameters§

Figure 2 presents the timing of an inband Event along the media timeline:

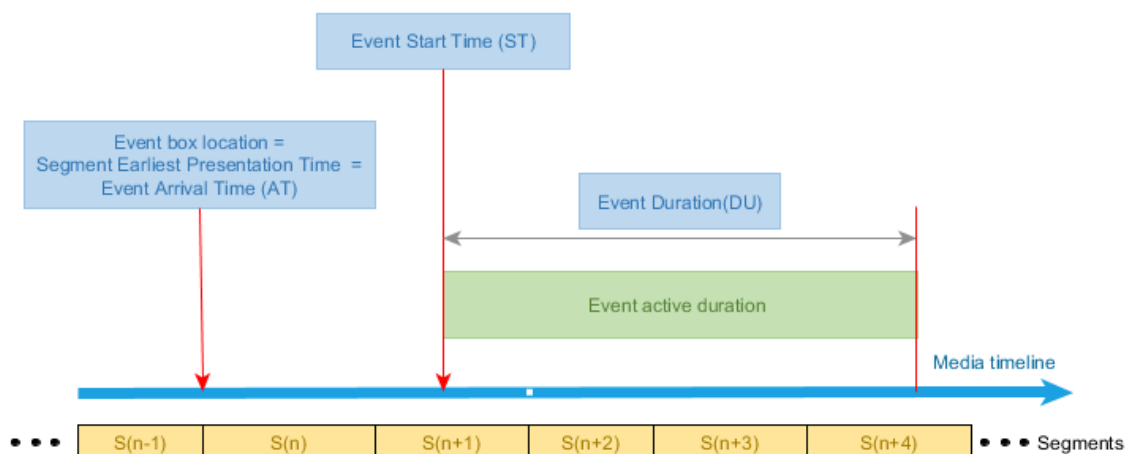


Figure 2 The inband event timing parameter on the media timeline

As shown in Figure 2, every inband Event can be described with three timing parameters on the media timeline:

1. Event Arrival Time (*AT*) which is the earliest presentation time of the Segment containing the Event Message box.
2. Event Presentation/Start Time (*ST*) which is the moment in the media timeline that the Event becomes active.
3. Event duration (*DU*): the duration for which the Event is active

An inband Event is inserted in the beginning of a Segment. Since each media segment has an earliest presentation time equal to (*AT*), *AT* of the Segment carrying the Event Message box can be considered as the location of that box on the media timeline. DASH Player has to fetch and parse the Segment before or at its *AT* (at *AT* when it's assumed that the decoding and rendering of the segment incurs practically zero delay). Therefore, the Event inserted in a Segment at its *AT* time will be ready to be processed and fetched no later than *AT* on the media timeline.

The second timing parameter is Event Presentation/Start Time (*ST*). *ST* is the moment in the media timeline that the Event becomes active. This value can be calculated using the parameters included in Event Message box.

The third parameter is Event Duration (*DU*), the duration for which the Event is considered to be active. *DU* is also signaled in the Event Message box using a specific value.

2.2. Event message box format and event timing parameters§

Table 1 shows the emsg box format in DASH:

```
aligned(8) class DASHEventMessageBox extends FullBox('emsg', version, flags = 0){
  if (version==0) {
    string                scheme_id_uri;
    string                value;
    unsigned int(32)      timescale_v0;
    unsigned int(32)      presentation_time_delta;
    unsigned int(32)      event_duration;
    unsigned int(32)      id;
  } else if (version==1) {
    unsigned int(32)      timescale_v1;
    unsigned int(64)      presentation_time;
    unsigned int(32)      event_duration;
    unsigned int(32)      id;
    string                scheme_id_uri;
    string                value;
  }
  unsigned int(8)        message_data();
}
```

Figure 3 The emsg box format and parameters

Note: In the table above, parameters with timescale_v0 and timescale_v1 are same parameters. The additional suffixes are for purpose of clear referencing in the equation below. These parameters are defined as [timescale](#) in [\[MPEGDASH\]](#).

The *ST* of an event can be calculated using values in its emsg box:

	default: onRequest	present.
@schemeIdUri	M	identifies the message scheme. The string may use URN or URL syntax. When a URL is used, it is recommended to also contain a month-date in the form mmyyyy; the assignment of the URL must have been authorized by the owner of the domain name in that URL on or very close to that date. A URL may resolve to an Internet location, and a location that does resolve may store a specification of the message scheme.
@value	O	specifies the value for the event stream element. The value space and semantics must be defined by the owners of the scheme identified in the @schemeIdUri attribute.
@timescale	O	specifies the timescale in units per seconds to be used for the derivation of different real-time duration values in the Event elements. If not present on any level, it shall be set to 1.
@presentationTimeOffset	OD Default: 0	specifies the presentation time offset of this Event Stream that aligns with the start of the Period. Any Event contained in this Event Stream is mapped to the Period timeline by using the Event presentation time corrected by the value of the presentation time offset. The value of the presentation time offset in seconds is the division of the value of this attribute and the value of the @timescale attribute.
<Event>	0 ... N	specifies one event. For details see Table 5.31. Events in Event Streams shall be ordered such that their presentation time is non-decreasing.
<p>Legend:</p> <p>For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory.</p> <p>For elements: <minOccurs>...<maxOccurs> (N=unbounded)</p> <p>Elements are bold; attributes are non-bold and preceded with an @.</p>		

Element or Attribute Name	Use	Description
Event		specifies an event and contains the message of the event, formatted as a string. The content of this element depends on the event scheme.
@presentationTime	OD default: 0	specifies the presentation time of the event relative to the start of the Period. The value of the presentation time in seconds is the division of the value of this attribute and the value of the @timescale attribute. If not present, the value of the presentation time is 0.
@duration	O	specifies the presentation duration of the event. The value of the duration in seconds is the division of the value of this attribute and the value of the @timescale attribute.

		If not present, the value of the duration is unknown.
@id	O	<p>specifies an identifier for this instance of the event. Events with equivalent content and attribute values in the Event element shall have the same value for this attribute.</p> <p>The scope of the @id for each Event is with the same @schemeIdURI and @value pair.</p>
@contentEncoding	O	<p>specifies if the information in the body and the information in the @messageData is encoded.</p> <p>If present, the following values are possible:</p> <p>"base64" the content is encoded as described in IETF RFC 4648 prior to adding it to the field.</p> <p>If this attribute is present, the DASH client is expected to decode the message data and only provide the decoded message to Application.</p>
@messageData	O	<p>specifies the value for the event stream element. The value space and semantics must be defined by the owners of the scheme identified in the @schemeIdUri attribute.</p> <p>NOTE: this attribute is an alternative to specifying a complete XML element(s) in the Event. It is useful when an event leans itself to a compact string representation</p>
<p>Legend:</p> <p>For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory.</p> <p>For elements: <minOccurs>...<maxOccurs> (N=unbounded)</p> <p>Elements are bold; attributes are non-bold and preceded with an @.</p>		

Figure 5 MPD Event elements

As is shown in Figure 3, each MPD Event has three associated timing parameters along the media timeline:

1. The PeriodStart Time (*AT*) of the Period element containing the EventStream element.
2. Event Start Time (*ST*): the moment in the media timeline that a given MPD Event becomes active and can be calculated from the attribute [Event@presentationTime](#).
3. Event duration (*DU*): the duration for which the event is active that can be calculated from the attribute [Event@duration](#).

Note that the first parameter is inherited from the Period containing the Events and only the 2nd and 3rd parameters are explicitly included in the [<Event>](#) element. Each [<EventStream>](#) also has [EventStream@timescale](#) to scale the above parameters.

Figure 3 demonstrates these parameters in the media timeline.

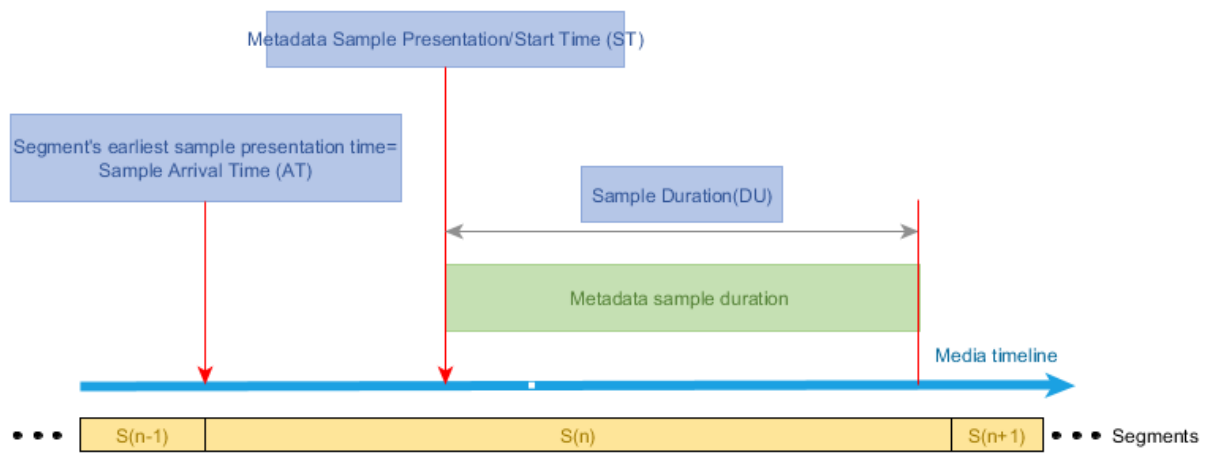


Figure 9 Timing parameters of a timed metadata sample on the media timeline

As shown in this figure, the metadata sample timing including metadata sample presentation time (ST) and metadata sample duration (DU). Also one or multiple metadata samples are included in a segment with Segment start time (AT).

Note that the metadata sample duration can not go beyond segment duration, i.e. to the next segment. In the case of [CMAF](#), the same constraints is maintained for CMAF Chunks.

In this document, we use the following common variable names instead of some of above variables to harmonize parameters between Inband events, MPD events, and timed metadata samples:

- $scheme_id$ = **timed metadata track URI**
- $timescale$ = timed metadata track timescale in mdhd box.
- $presentation_time$ = **timed metadata sample presentation time**/ $timescale$
- $duration$ = **timed metadata sample duration**/ $timescale$
- $message_data$ = **timed metadata sample data in mdat**

3. Events and timed metadata sample dispatch timing modes§

Figure 5 shows two possible dispatch timing models for DASH events and timed metadata samples.

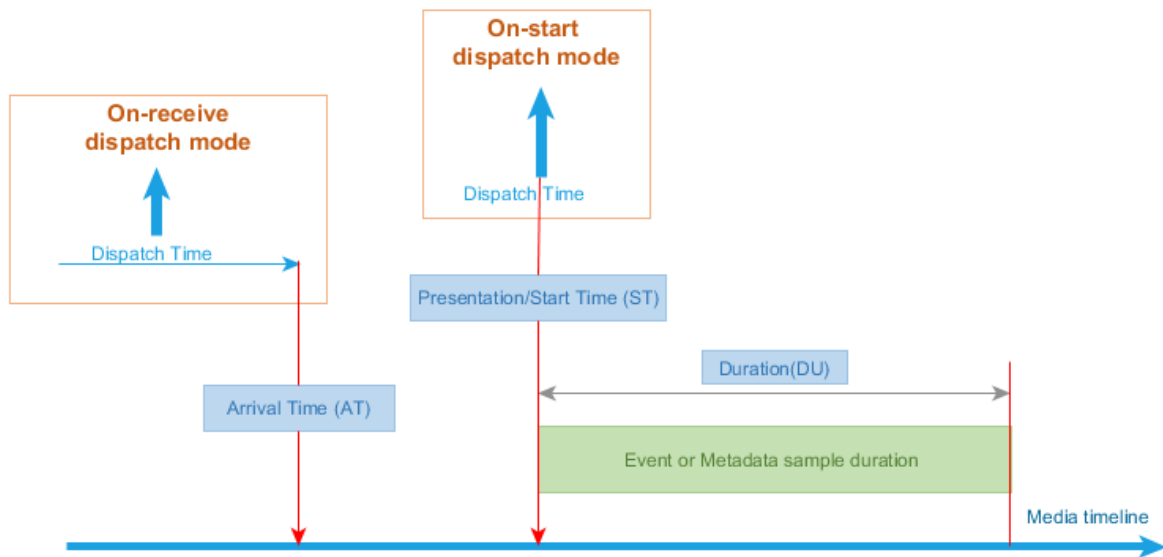


Figure 10 The Application events and timed metadata dispatch modes

In this figure, two modes are shown:

1. **on-receive** Dispatch Mode: Dispatching at *AT* or earlier. Since the segment carrying an emsg/metadata sample has to be parsed before (or assuming zero decode/rendering delay as the latest at) *AT* on the media timeline, the event/metadata sample shall be dispatched at this time or before to Application in this mode. Application has a duration of *ST-AT* for preparing for the event. In this mode, the client doesn't need to maintain states of Application events or metadata samples either. Application may have to maintain the state for any event/metadata sample, its *ST* and *DU*, and monitor its activation duration, if it needs to. Application also needs to schedule each event/sample at its *ST*, so it must be time-aware to properly make use of these timing parameters.
2. **on-start** Dispatch Mode: Dispatching exactly at *ST*, which is the start/presentation time of the event/metadata sample. DASH Player shall calculate the *ST* for each parsed event/metadata sample and dispatch the *message_data* at this exact moment. In this mode, since Application receives the event/sample at its start/presentation time, it needs to act on the received data right away, i.e. no advanced notice is given to Application in this mode. Application however may not need to maintain a state for the events and timed metadata samples, if the durations and/or the sequence and order of events/samples are not important to Application. Depending on the nature, meaning and relationship between different event instances/metadata samples, Application may need to maintain the state for them.

Note: According to ISO/IEC 23009-1, the parameter *duration* has a different meaning in each dispatch mode. In the case of on-start, *duration* defines the duration starting from *ST* in which DASH Player shall dispatch the event exactly once. In the normal playback, the player dispatches the event at *ST*. However if DASH Player for instance seek to a moment after *ST* and during the above duration, then it must dispatch the event immediately. In the case of on-receive, *duration* is a property of event instance and is defined by the *scheme_id* owner.

3.1. The Dispatch Processing Model§

3.1.1. Prerequisite§

Application subscribes to specific event stream as described in [§ 4 Prose description of APIs](#).

The processing model varies depending on *dispatch_mode*.

DASH Player shall follow the processing model outlined in this section.

DASH Player shall set up an [Active Event Table](#) for each subscribed *scheme_uri(value)* in the case of *dispatch_mode = on_start*. **Active Event Table** maintains a single list of emsg's *id* that have been dispatched.

3.1.2. Common process§

DASH Player shall implement the following process:

1. Parse the emsg/timed metadata sample and retrieve *scheme_uri(value)*.
2. If Application is not subscribed to the *scheme_uri(value)* pair, end the processing of this emsg.

3.1.3. [on-receive](#) processing§

DASH Player shall implement the following process when *dispatch_mode = on_receive*:

- Dispatch the event/timed metadata, including *ST*, *id*, *DU*, *timescale* and *message_data* as described in [§ 4 Prose description of APIs](#).

3.1.4. [on-start](#) processing§

DASH Player shall implement the following process when *dispatch_mode = on_start*:

1. Derive the event instance/metadata sample's *ST*
2. If the current presentation time value is smaller than *C*, then go to Step 5.
3. Derive the ending time $ET = ST + DU$.
4. If the current presentation time value is greater than *ET*, then end processing.
5. In the case of event: Compare the event's *id* with the entries of [Active Event Table](#) of the same *scheme_uri(value)* pair:
 - If an entry with the identical *id* value exists, end processing;
 - If not, add emsg's *id* to the corresponding [Active Event Table](#).
6. Dispatch the event/metadata *message_data* at time *ST*, or immediately if current presentation time is larger than *ST*, as described in [§ 4 Prose description of APIs](#).

3.2. The event/metadata buffer model§

Along with the media samples, the event instances and timed metadata samples are buffered. The event/metadata buffer should be managed with same scheme as the media buffer, i.e. as long as a media sample exists in the media buffer, the corresponding events and/or metadata samples should be maintained in the event/metadata buffer.

4. Prose description of APIs§

The event/timed metadata API is an interface defined between a "DASH player" as defined in DASH-IF, or a "DASH client" as defined in 3GPP TS 26.247 or ISO/IEC 23009-1 and a device application in the exchange of subscription data and dispatch/transfer of matching DASH Event or timed metadata information between these entities. The Event/timed metadata API is shown at Figure 1.

Note: In this document, the term "DASH Player" is used.

The description of the API below is strictly functional, i.e. implementation-agnostic, is intended to be employed for the

specification of the API in Javascript for the dash.js open source DASH Player, and in IDL such as the OMG IDL or WebIDL. For example, the subscribeEvent() method as defined below may be mapped to the existing **on(type,listener,scope)** method as defined for the dash.js under **MediaPlayerEvents**.

As part of this API and prior to any operations, DASH Player provides a list of *scheme_id/(value)* listed in MPD when it receives it. This list includes all events as well as *scheme_id* of all timed metadata tracks. At this point Application is aware of the possible events and metadata delivered by DASH Player.

The subscription state diagram of DASH Player associated with the API is shown below in Figure 6:

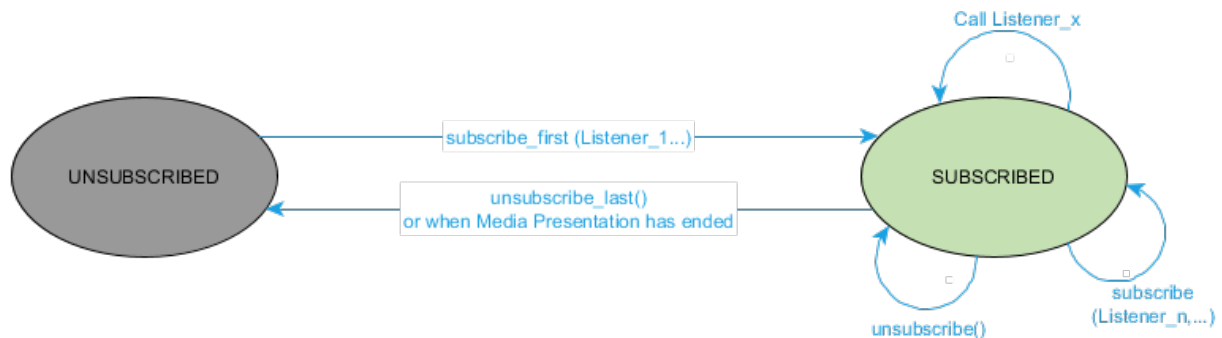


Figure 11 State Diagram of DASH Player for the event/timed metadata API.

The scope of the above state diagram is the entire set of applicable events/timed metadata streams being subscribed/unsubscribed, i.e. it is not indicating the state model of DASH Player in the context of a single Event/timed metadata stream subscription/un-subscription.

The application subscribes to the reception of the desired event/timed metadata and associated information by the **subscribeEvent()** method. The parameters to be passed in this method are:

- *app_id* – (Optional) A unique ID for the Application subscribing to data dispatch from DASH Player. Depending on the platform/implementation this identifier may be used by DASH Player to maintain state information.
- *scheme_uri* – A unique identifier scheme for the associated DASH Event/metadata stream of interest to the Application. This string may use a URN or a URL syntax, and may correspond to either an MPD Event, an inband Event, or a timed metadata stream identifier. The *scheme_uri* may be formatted as a regular expression (regex). If a value of NULL is passed for *scheme_uri*, then Application subscribes to all existing event and metadata schemes described in the MPD. In this case, the value of *value* is irrelevant.
- *value* – A value of the event or timed metadata stream within the scope of the above *scheme_uri*, optional to include. When not present, no default value is defined – i.e., no filtering criterion is associated with the Event scheme identification.
- *dispatch_mode* – Indicates when the event handler function identified in the *callback_function* argument should be called:
 - *dispatch_mode* = *on_receive* – provide the event/timed metadata sample data to the Application as soon as it is detected by DASH Player;
 - *dispatch_mode* = *on_start* – provide the event/timed metadata sample data to the App at the start time of Event message or at the presentation time of timed metadata sample.

The default mode for *dispatch_mode* should to be set to *on_receive*, i.e. if the *dispatch_mode* is not passed during the *subscribe_first* operation, DASH Player should assume *dispatch_mode* = *on_receive* for that specific subscription.

- *callback_function* – the name of the function to be (asynchronously) called for an event corresponding to the specified *scheme_uri/(value)*. The callback function is invoked with the arguments described below.

Note: ISO/IEC 23009-1 does not include any explicit signaling for the desired dispatch mode in MPD or timed metadata track. In the current design, Application relay its desired dispatch mode to DASH Player when it subscribes to an event stream or timed metadata track. In this approach, the scheme owner should consider the dispatch mode as part of the scheme design and define whether any specific dispatch mode should be selected during the design of the scheme.

Note: (Editor's Note-to be removed at the end of Community Review Period) If any service provider or application developer believes an explicit signaling of dispatch mode is needed for some use-cases, they are requested to provide such use-case during Community Review Period of this document to DASH-IF for considering introducing a @dispatchMode attribute in MPD and submitting the request to MPEG.

the DASH-IF believes an explicit signaling of the dispatch mode is beneficial and will request MPEG to add the support for it. Otherwise, either DASH-IF adds extensions or signaling of the dispatch mode would be considered out-of-band.

Upon successful execution of the event/timed metadata subscription call (for which DASH Player will return a corresponding acknowledgment), DASH Player shall monitor the source of potential Event stream information, i.e., the MPD or incoming DASH Segments, for matching values of the subscribed *scheme_uri(value)*. The parentheses around value is because this parameter may be absent in the event/timed metadata subscription call. When a matching event/metadata sample is detected, DASH Player invokes the function specified in the callbackFunction argument with the following parameters. It should additionally provide to the Application the current presentation time at DASH Player when performing the dispatch action. The parameters to be passed in this method are shown in Table 3 below:

API Parameter	MPD event	Inband emsg	Metadata	Data Type	'on-receive'	'on-start'
scheme_id	EventStream@schemeIdUri	scheme_id_uri	timed metadata track URI		Y	Y
value	EventStream@value	value			Y	Y
<i>presentation_time</i>	Event@presentationTime	presentation_time	timed metadata sample presentation time	unsigned int(64) in milliseconds	Y	N
duration	Event@duration	event_duration	timed metadata sample duration	unsigned int(32) in milliseconds	Y	N
id	Event@id	id		unsigned int(32)	Y	N
message_data	Event@messageData	message_data()	timed metadata sample data in mdat	unsigned int(8) x messageSize	Y	Y
Y= Yes, N= NO, O= Optional						

Figure 12 Event/timed metadata API parameters and datatypes

When the duration of the event is unknown, the variable *duration* shall be set to its maximum value (0xFFFFFFFF = 4,294,967,295).

Note: In the case of 'emsg' version 0, DASH Player is expected to calculate [presentation_time](#) from [presentation_time_delta](#).

In order to remove a listener the **unsubscribeEvent()** function is called with the following arguments:

- *app_id* (Optional)
- *scheme_uri* - A unique identifier scheme for the associated DASH Event stream of interest to the Application.
- *value*
- *callback_function*

If a specific listener is given in the *callback_function* argument, then only that listener is removed for the specified *scheme_uri*(*value*). Omitting or passing null to the *callback_function* argument would remove all event listeners for the specified *scheme_uri*(*value*).

5. Externally defined terms§

cmaf

See [\[MPEGDASH\]](#)

Event@contentEncoding

See [\[MPEGDASH\]](#)

Event@duration

See [\[MPEGDASH\]](#)

Event@id

See [\[MPEGDASH\]](#)

Event@messageData

See [\[MPEGDASH\]](#)

Event@presentationTime

See [\[MPEGDASH\]](#)

EventStream@schemeldUri

See [\[MPEGDASH\]](#)

EventStream@timescale

See [\[MPEGDASH\]](#)

EventStream@value

See [\[MPEGDASH\]](#)

event_duration

See [\[MPEGDASH\]](#)

id

See [\[MPEGDASH\]](#)

message_data()

See [\[MPEGDASH\]](#)

presentation_time

See [\[MPEGDASH\]](#)

presentation_time_delta

See [\[MPEGDASH\]](#)

scheme_id_uri

See [\[MPEGDASH\]](#)

SegmentBase@presentationTimeoffset

See [\[MPEGDASH\]](#)

SegmentBase@timescale

See [\[MPEGDASH\]](#)

timescale

See [\[MPEGDASH\]](#)

value

See [\[MPEGDASH\]](#)

Conformance§

Conformance requirements are expressed with a combination of descriptive assertions and RFC 2119 terminology. The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in the normative parts of this document are to be interpreted as described in RFC 2119. However, for readability, these words do not appear in all uppercase letters in this specification.

All of the text of this specification is normative except sections explicitly marked as non-normative, examples, and notes. [\[RFC2119\]](#)

Examples in this specification are introduced with the words “for example” or are set apart from the normative text with `class="example"`, like this:

EXAMPLE 1

This is an example of an informative example.

Informative notes begin with the word “Note” and are set apart from the normative text with `class="note"`, like this:

Note, this is an informative note.

Index§

Terms defined by this specification§

[Active Event Table](#)

[cmf](#)

[Event](#)

[Event@contentEncoding](#)

[event_duration](#)

[Event@duration](#)

[Event@id](#)

[Event@messageData](#)

[Event@presentationTime](#)

[EventStream](#)

[EventStream@schemeldUri](#)

[EventStream@timescale](#)

[EventStream@value](#)

[id](#)

[message_data\(\)](#)

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[SegmentBase@presentationTimeoffset](#)

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[timed metadata sample duration](#)

[timed metadata sample presentation time](#)

[timed metadata track URI](#)

[timescale](#)

[value](#)

References§

Normative References§

[MPEGDASH]

[Information technology -- Dynamic adaptive streaming over HTTP \(DASH\) -- Part 1: Media presentation description and segment formats](#). May 2014. Published. URL: <https://www.iso.org/standard/65274.html>

[RFC2119]

S. Bradner. [Key words for use in RFCs to Indicate Requirement Levels](#). March 1997. Best Current Practice. URL: <https://tools.ietf.org/html/rfc2119>



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