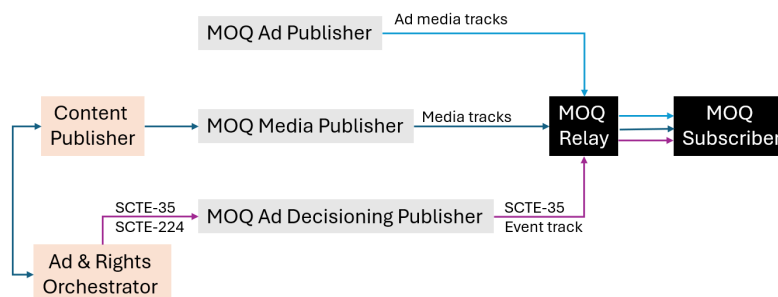


1. Introduction

This document describes the use of Media over QUIC (MOQ)¹ and MOQT Streaming Format (MSF)² to transport SCTE-35–based signaling for Server-Guided Ad Insertion (SGAI) and related control use cases (including regional blackout).

As illustrated in Figure 1, the proposed architecture separates media delivery from signaling by transporting SCTE-35–derived events over a dedicated MSF Event Timeline track. In this model, an Ad Decisioning system acts as a MOQ Publisher, emitting SCTE-35–equivalent signaling as structured Event Timeline records, while media content is delivered on independent MOQ media tracks. MOQ Subscribers consume both the media timeline and the associated Event Timeline, allowing them to apply SCTE-35–based ad insertion, blackout enforcement, or control logic without requiring in-band cueing.



This approach enables scalable distribution over MOQ while preserving SCTE-35 semantics, tooling, and operational practices. The Event Timeline is used strictly as a transport and synchronization mechanism and does not redefine SCTE-35 behavior.

2. Background

2.1. SCTE-35 Overview

SCTE-35³ is a signaling standard used in broadcast and streaming systems to indicate splice points, ad opportunities, and content control events (e.g., regional blackouts). SCTE-35 is designed to be synchronized with media playback. The messages are triggered by presentation time (e.g., PTS) or equivalent timing references and are evaluated in direct

¹ IETF MOQ datatracker <https://datatracker.ietf.org/group/moq/about/>

² GitHub MSF <https://github.com/moq-wg/msf>

³ SCTE-35 2023r1 specification <https://account.scte.org/standards/library/catalog/scte-35-digital-program-insertion-cueing-message/>

relation to the media timeline, whether carried in-band (e.g., MPEG-TS) or associated with adaptive streaming manifests.

In SCTE-35, ad insertion and blackout signaling are expressed through *segmentation descriptors*. These descriptors identify the type of event and associate related events through a segmentation event identifier.

2.2. SCTE-224 Overview

SCTE-224⁴ defines a configuration-oriented, out-of-band interface for describing content policies, audience definitions, and event schedules. Unlike SCTE-35, SCTE-224 is not time-coupled to media playback. Instead, it communicates event intent, policy logic, and decision rules ahead of time or asynchronously.

SCTE-224 is commonly used to express what should happen (e.g., blackout rules, alternate content selection, advertising permissions) and to whom (audiences), while SCTE-35 signals when an event occurs in the media timeline. In operational deployments, SCTE-224 and SCTE-35 are therefore complementary: SCTE-224 provides offline configuration and policy context, while SCTE-35 provides precise, time-synchronous triggers during playback.

2.3 Event Timeline in MSF

An *Event Timeline* is a MOQ track, whose objects carry application-defined events encoded as JSON. Each Event Timeline object is indexed using either a temporal reference (media presentation time or wall-clock time) or a MOQ *location* (groupID and Object ID). The three indices are interrelated in the MSF Media Timeline track. This flexibility allows events to be aligned with media playback.

Event Timeline tracks are advertised in the MSF Catalog. The entry identifies the track name, its packaging format, its dependencies on other tracks (including the media timeline), and the semantic type of events. In this document, the Event Timeline is used to transport SCTE-35-based signaling. Each Event Timeline object represents a SCTE-35 segmentation descriptor to be consumed by Subscribers.

2.4. MOQ URL

The MOQ URL is a URL-based identifier used to describe connections, namespaces, tracks, and related resources. A MOQ URL uses the `moqt://` scheme and may include a path and query parameters. Subscribers use MOQ URLs to establish connections and subscribe to tracks. Query parameters carried in a MOQ URL are commonly used to convey tokens, identifiers, or other contextual information.

The definition of MOQ URLs is still under discussion within MSF. This document relies on the emerging MSF definition for MOQ URLs, even though it is not incorporated into the published specification yet.

⁴ SCTE-224 2021 specification

<https://account.scte.org/standards/library/catalog/scte-224-event-scheduling-and-notification-interface/>

3. Definition of the Event Timeline Type

This section defines a dedicated Event Timeline type for transporting SCTE-35-like signaling using the MSF Event Timeline.

This Event Timeline type aims to allow SCTE-35 semantics to be carried outside of the media stream while remaining compatible with existing SCTE-35-based systems. In the envisioned architecture, SCTE-35 remains the signaling model at both the Ad Decisioning system (MOQ Publisher) and the MOQ Subscribers (typically Affiliate video headends). The only difference is that the SCTE-35 descriptors are signaled as structured JSON objects over MOQ rather than as in-band binary cues.

3.1 Event Timeline Type Identifier

The Event Timeline type (*eventType*) is identified by a unique string declared in the Catalog entry of the Event Timeline track. This identifier defines the semantic contract of the Event Timeline payload. The following identifier is defined:

```
org.scte.scte35.v1
```

This identifier denotes that the Event Timeline carries SCTE-35 semantics. The version suffix allows future evolution of the schema while keeping backward compatibility explicit.

3.2 Event Timeline Record Structure

Each Event Timeline object consists of a mandatory index and a data object carrying SCTE-35-derived fields. The index provides ordering and synchronization with the associated media timeline, while the data object carries the signaling semantics.

Event Timeline records use any MSF-defined index type (either temporal indices or location-based indices). When SCTE-35-derived signaling is transported, the index is used only for transport and does not modify SCTE-35 semantics. Since the semantic timing reference used by SCTE-35 splice and segmentation descriptors is the media presentation time (PTS), it is recommended to index Event Timeline records using media time (*m*).

```
{  
  "m": <media_time>,  
  "data": { <scte35_fields> }  
}
```

3.3 Core SCTE-35 Fields

Each Event Timeline record of this type represents a SCTE-35 segmentation descriptor and therefore carries a minimal set of mandatory identifiers.

The following fields MUST be present in every Event Timeline record:

Field name	Type	Description
segmentation_type_id	string (hex)	SCTE-35 segmentation type identifier (for example 0x34, 0x35, 0x18).
segmentation_event_id	integer	Identifier used to correlate related SCTE-35 events such as start and end boundaries.

These fields provide the linkage to SCTE-35 semantics and identify the nature of the event.

3.4 Extended SCTE-35 Fields

An Event Timeline record MAY include additional fields derived from the SCTE-35 segmentation descriptor structure. These fields are present only when required by the specific SCTE-35 message. Their presence, absence, and interpretation follow SCTE-35 rules and constraints. They do not change the structure of the Event Timeline record and are carried within the same data object.

Field name	Type	Description
segmentation_event_cancel_indicator	boolean	Indicates cancellation of a previously signaled event.
program_segmentation_flag	boolean	Indicates program-level segmentation.
segmentation_duration_flag	boolean	Indicates whether a duration is present.
segmentation_duration_ms	integer	Duration of the segment in milliseconds.
segment_num	integer	Segment number within a series.
segments_expected	integer	Total expected segments.
sub_segment_num	integer	Sub-segment number.
sub_segments_expected	integer	Total expected sub-segments.

3.5 Delivery Restriction and Control Fields

Some SCTE-35 messages convey delivery control information rather than ad insertion boundaries, in particular for regional blackout signaling and other rights-related overrides.

For these use cases, the Event Timeline type supports SCTE-35 delivery restriction flags as optional fields within the same data object. These fields are interpreted as defined in SCTE-35 and are typically associated with segmentation types such as Program Blackout Override.

Field name	Type	Description
delivery_not_restricted_flag	Boolean	Indicates unrestricted delivery.

Field name	Type	Description
<code>web_delivery_allowed_flag</code>	Boolean	Indicates whether web delivery is permitted.
<code>no_regional_blackout_flag</code>	Boolean	Indicates whether regional blackout applies.
<code>archive_allowed_flag</code>	Boolean	Indicates whether archiving is allowed.
<code>device_restrictions</code>	Integer	SCTE-35 device restriction value.

3.6 Segmentation UPID Representation

SCTE-35 segmentation descriptors may carry auxiliary identifiers using Segmentation UPIDs. The Event Timeline type provides a generic JSON representation for these identifiers. The UPID type is explicitly indicated using the `segmentation_upid_type` field. The interpretation of the associated value depends on the UPID type and follows SCTE-35 definitions. For URI-based UPIDs (`segmentation_upid_type = 0x0F`), the corresponding fields are:

Field name	Type	Description
<code>segmentation_upid_type</code>	string (hex)	SCTE-35 UPID type identifier.
<code>segmentation_upid_uri</code>	string	URI value carried by the UPID.

A URI-based UPID MAY identify content using an absolute or relative URI. The referenced content MAY be addressed using an HTTP(S) URL, a fully qualified MOQ URL, or an identifier resolved relative to an existing MSF Catalog, MOQ namespace, or track name. The referenced content MAY also correspond to media already available at the Subscriber. The resolution of the URI is implementation-specific and does not imply the establishment of a new connection.

4. Examples

4.1 Signaling an Ad Break with Two Ads

This section illustrates how an ad break composed of two sequential advertisements can be signaled using the Event Timeline type. The example assumes a live linear program distributed over MOQ. A Subscriber consumes the primary media tracks and an Event Timeline track emitted by an Ad Decisioning system. In SCTE-35, the ad break is represented by a *Provider Placement Opportunity Start*, followed by a sequence of *Provider Advertisement Start* and *End* events, and terminated by a *Provider Placement Opportunity End*. The same structure is preserved in the Event Timeline.

```
[
  {
    "m": 600000,
    "data": {
      "segmentation_type_id": "0x34",
```

```

        "segmentation_event_id": 1001
    }
},
{
    "m": 600000,
    "data": {
        "segmentation_type_id": "0x30",
        "segmentation_event_id": 2001,
        "segmentation_upid_type": "0x0F",
        "segmentation_upid_uri": "moqt://adserver.example/pub?c=ad-1"
    }
},
{
    "m": 620000,
    "data": {
        "segmentation_type_id": "0x31",
        "segmentation_event_id": 2001
    }
},
{
    "m": 620000,
    "data": {
        "segmentation_type_id": "0x30",
        "segmentation_event_id": 2002,
        "segmentation_upid_type": "0x0F",
        "segmentation_upid_uri": "urn:moq:trackid:example-team2-ads--ad_002"
    }
},
{
    "m": 640000,
    "data": {
        "segmentation_type_id": "0x31",
        "segmentation_event_id": 2002
    }
},
{
    "m": 640000,
    "data": {
        "segmentation_type_id": "0x35",
        "segmentation_event_id": 1001
    }
}
]

```

4.2 Signaling a Regional Blackout

This section illustrates how a regional blackout can be signaled using the Event Timeline mechanism. In this scenario, Subscribers are typically professional receivers such as Affiliate video headends. The example assumes that the primary program is already being distributed and that a blackout condition applies only to a subset of Subscribers. The Ad Decisioning emits SCTE-35-derived signaling to handle the blackout.

In SCTE-35, a regional blackout is commonly expressed using a *Program Blackout Override* segmentation descriptor. This descriptor updates delivery restriction flags associated with

the program and may be accompanied by a URI UPID identifying alternate content to be used during the blackout period.

```
[
  {
    "m": 900000,
    "data": {
      "segmentation_type_id": "0x18",
      "segmentation_event_id": 3001,
      "delivery_not_restricted_flag": false,
      "web_delivery_allowed_flag": true,
      "no_regional_blackout_flag": false,
      "archive_allowed_flag": true,
      "device_restrictions": 3,
      "segmentation_upid_type": "0x0F",
      "segmentation_upid_uri": "moqt://blackout.example/pub?c=alt-program"
    }
  }
]
```

To signal the end of the blackout, another Event Timeline record updates the delivery restriction flags to restore normal distribution conditions.

```
[
  {
    "m": 960000,
    "data": {
      "segmentation_type_id": "0x18",
      "segmentation_event_id": 3001,
      "delivery_not_restricted_flag": false,
      "web_delivery_allowed_flag": true,
      "no_regional_blackout_flag": true,
      "archive_allowed_flag": true,
      "device_restrictions": 3
    }
  }
]
```