Robust SCTE 35 in the OTT Workflow

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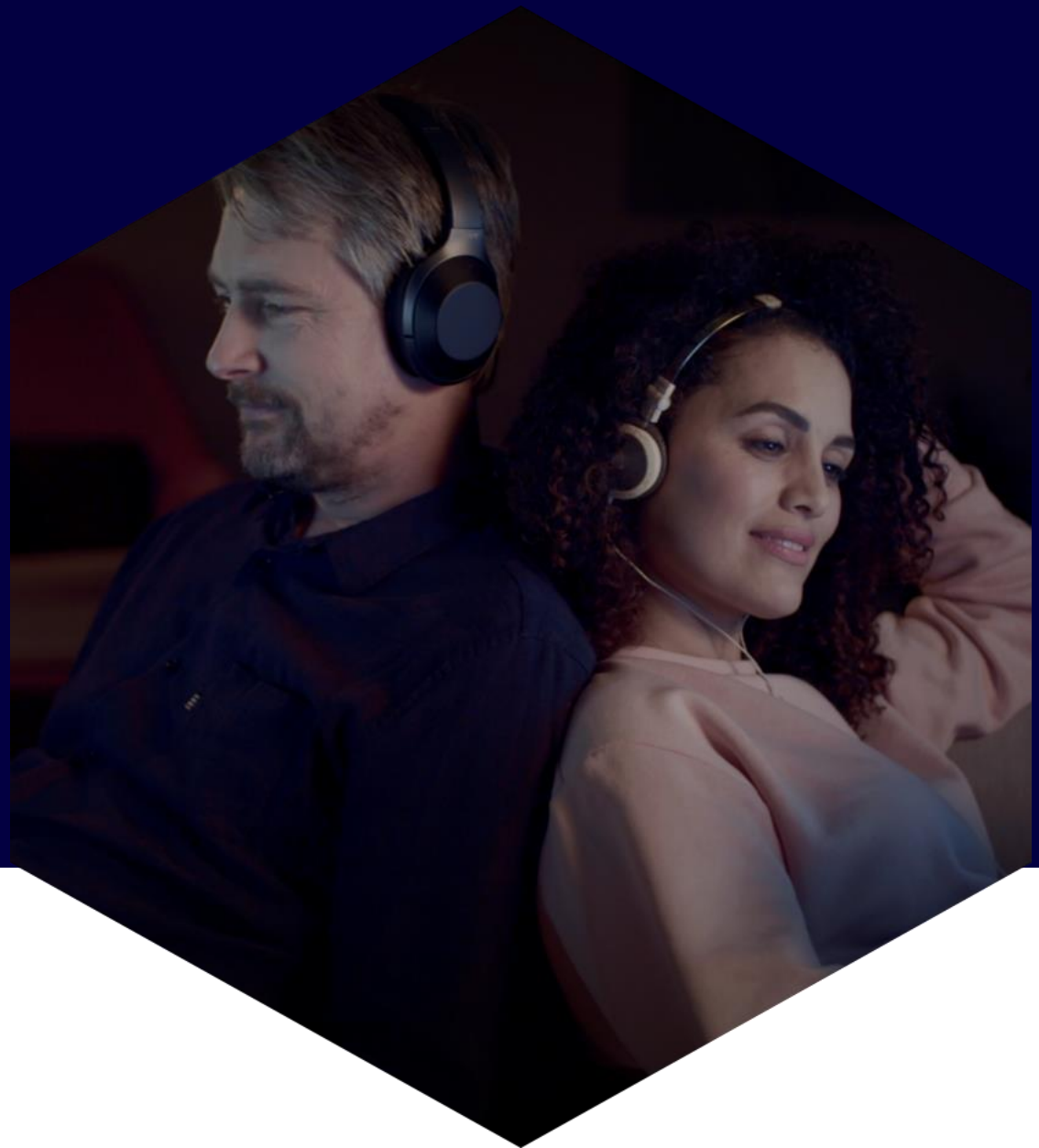
Dr. Rufael Mekuria (Unified Streaming)



COMCAST

Unified Streaming

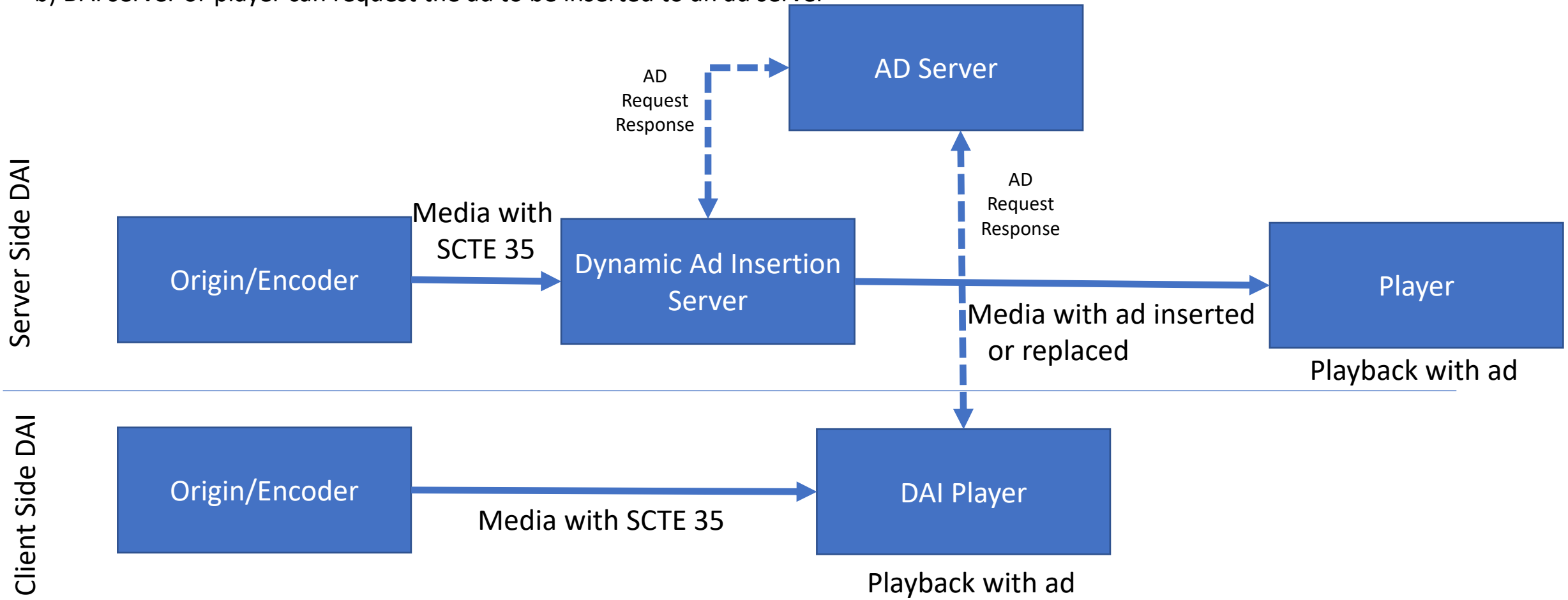
Introduction

- **Comcast** is an SCTE member and implements SCTE standards in practice
- **Yasser Syed** (PhD) is SCTE DVS WG 5 chair
- Unified Streaming is a DVB member and implements DVB standards in OTT workflows
- **Rufael Mekuria** (PhD) leads the TM-STREAM work group in DVB
- DVB and SCTE worked together to improve the robustness of SCTE 35 in DASH
- Today we will present some examples and overview of using SCTE 35 in the OTT workflow, for more details we refer to the **paper** published in ACM proceedings

SCTE 35 Call Flow

a) SCTE 35 in media is used to announce ad slots

b) DAI server or player can request the ad to be inserted to an ad server



Splice info section with splice_insert

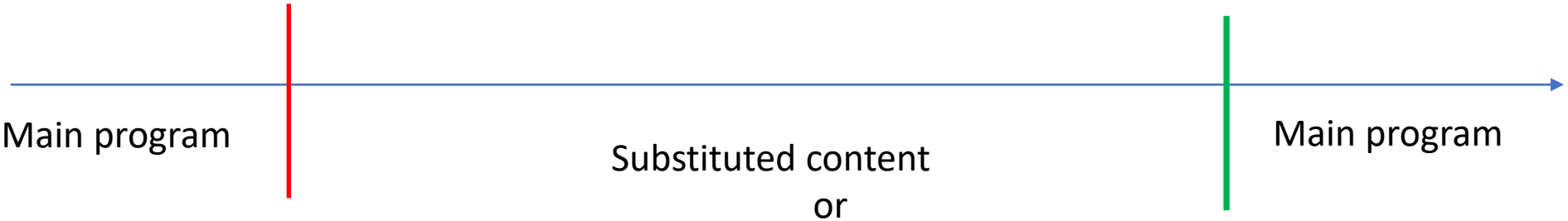

```
"info_section": {
    "table_id": "0xfc",
    "section_syntax_indicator": false,
    "private": false,
    "sap_type": "0x3",
    "sap_details": "No Sap Type",
    "section_length": 32,
    "protocol_version": 0,
    "encrypted_packet": false,
    "encryption_algorithm": 0,
    "pts_adjustment_ticks": 0,
    "pts_adjustment": 0.0,
    "cw_index": "0x0",
    "tier": "0xfff",
    "splice_command_length": 15,
    "splice_command_type": 5,
    "descriptor_loop_length": 0,
    "crc": "0xe4612424"    },
```

```
"command": {
"command_length": 15,
    "command_type": 5,
    "name": "Splice Insert",
    "break_auto_return": true,
    "break_duration": 38.4,
    "break_duration_ticks": 3456000,
    "splice_event_id": 13912629,
    "splice_event_cancel_indicator": false,
    "out_of_network_indicator": true,
    "program_splice_flag": true,
    "duration_flag": true,
    "splice_immediate_flag": true,
    "unique_program_id": 49152,
    "avail_num": 0,
    "avail_expected": 0
}
```

Splice info section with splice_insert

Splice point at T
(time derived from TS, SCTE 35 or DASH/HLS)

Return point at T + duration
(derived from duration and auto_return)



Main program

Substituted content
or
Main program (if no substitution)

Main program

SCTE 35 Marker in DASH MPD

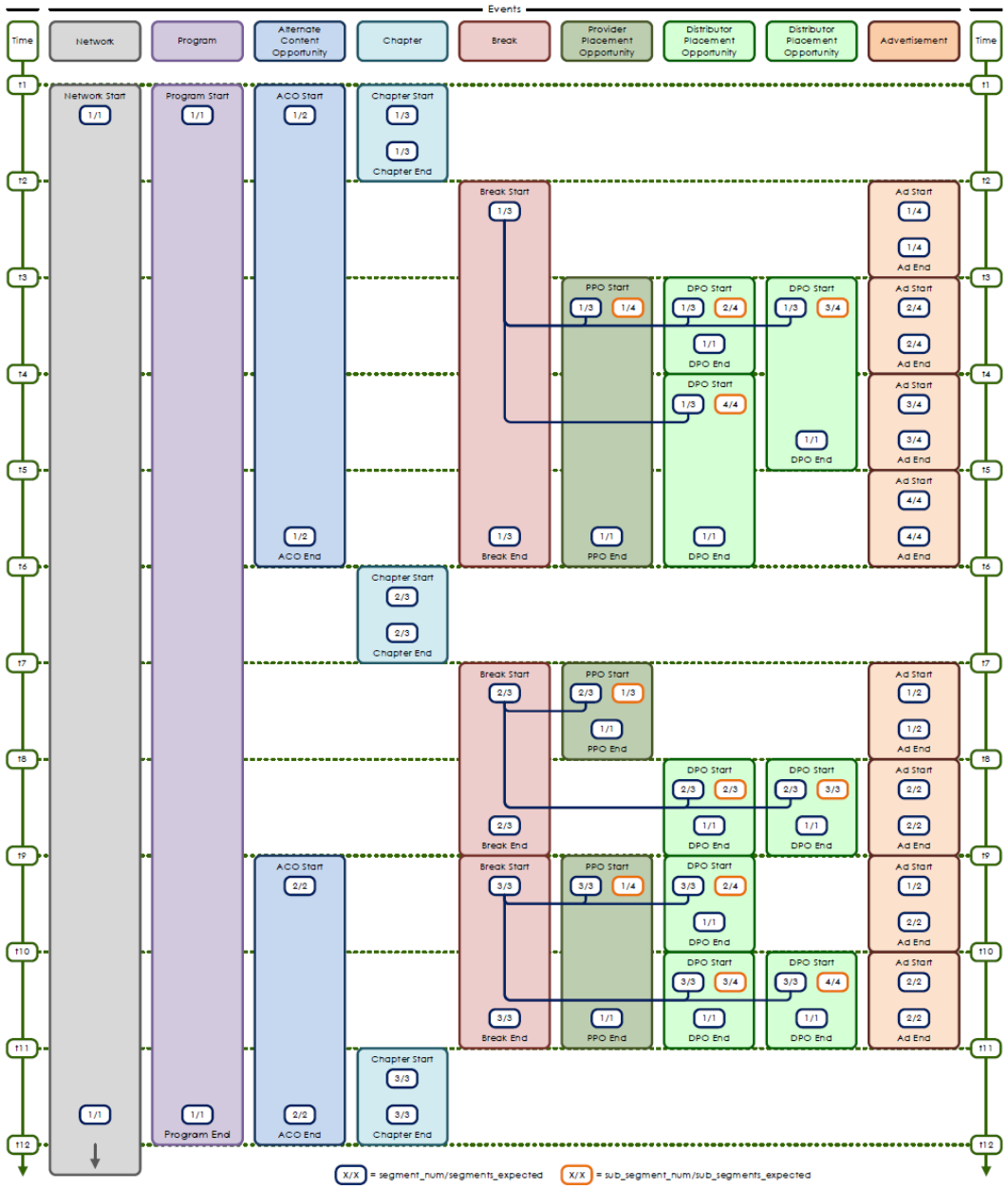

```
<?xml version="1.0" encoding="utf-8"?>
<MPD xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"  xmlns="urn:mpeg:dash:schema:mpd:2011"
xsi:schemaLocation="urn:mpeg:dash:schema:mpd:2011 http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-DASH_schema_files/DASH-
MPD.xsd"  type="dynamic"  availabilityStartTime="1970-01-01T00:00:00Z"  publishTime="2023-04-30T16:29:08.612392Z"
minimumUpdatePeriod="PT2S"  timeShiftBufferDepth="PT10M"  maxSegmentDuration="PT3S"  minBufferTime="PT10S"
profiles="urn:mpeg:dash:profile:isoff-live:2011,urn:com:dashif:dash264">
<Period    id="1"    start="PT0S">
 <BaseURL>dash/</BaseURL>
 <EventStream      schemeIdUri="urn:scte:scte35:2014:xml+bin"      timescale="1000">
 <!-- 2023-04-30T16:28:07.680000Z -->
<Event       presentationTime="1682872087680"       duration="38400"       id="13912633">
 <Signal        xmlns="http://www.scte.org/schemas/35/2016">
 <Binary>/DAgAAAAAAAAAP/wDwUA1Eo5f//+ADS8AMAAAAAAAORhJCQ=</Binary>
</Signal>
</Event>
 </EventStream>
<AdaptationSet      <!-- left out for brevity -->    </AdaptationSet>
<AdaptationSet     <!-- left out for brevity -->    </AdaptationSet>
</Period>
<UTCTiming    schemeIdUri="urn:mpeg:dash:utc:http-iso:2014"    value="https://time.akamai.com/?iso" />
</MPD>
```

SCTE 35 Marker in HLS M3U8

```
#EXTM3U#EXT-X-VERSION:4
#EXT-X-MEDIA-SEQUENCE:876496546
#EXT-X-INDEPENDENT-SEGMENTS
#EXT-X-TARGETDURATION:3
#USP-X-TIMESTAMP-MAP:MPEGTS=877149856,LOCAL=2023-04-30T16:49:26.400000Z
#EXT-X-PROGRAM-DATE-TIME:2023-04-30T16:49:26.400000Z## Auto Return Mode
#EXT-X-CUE-IN
#EXT-X-PROGRAM-DATE-TIME:2023-04-30T16:50:56.640000Z
## splice_insert(auto_return)
#EXT-X-DATERANGE:ID="13912645-1682873539",START-DATE="2023-04-30T16:52:19.200000Z",PLANNED-
DURATION=38.4,SCTE35-OUT=0xFC302000000000000000FFF00F0500D44A457FFFFE0034BC00C00000000000E4612424
#EXT-X-CUE-OUT:38.4
#EXT-X-PROGRAM-DATE-TIME:2023-04-30T16:52:19.200000Z
#EXTINF:1.92, no des
cscte35-video=500000-876496636.ts
#EXTINF:1.92, no desc
## segments omitted for brevity
## Auto Return Mode
#EXT-X-CUE-IN
#EXT-X-PROGRAM-DATE-TIME:2023-04-30T16:52:57.600000Z
#EXTINF:1.92, no descscte35-video=500000-876496656.ts
#EXTINF:1.92, no desc
```

Ad Slot Signalling in SCTE-35 Using Time_signal

SCTE 35 2020

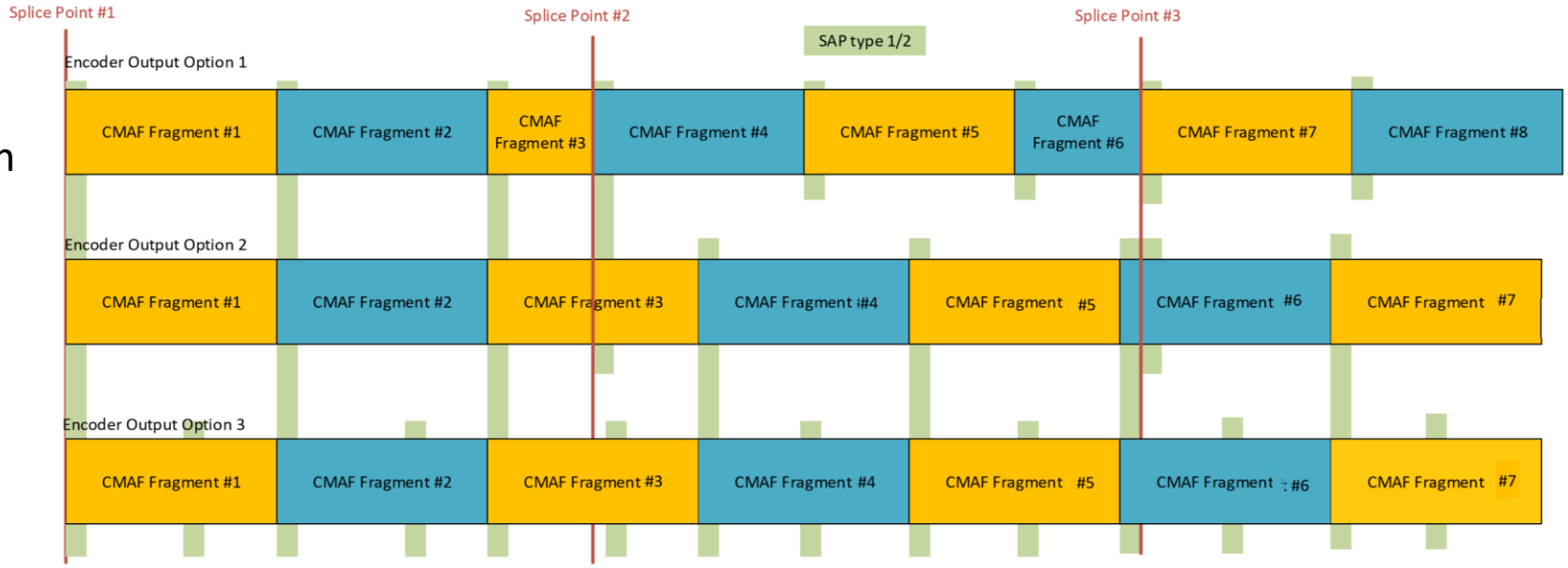


Signaling in advance and splicing the segment

- Typically the SCTE 35 splice point needs to be received 4-8 seconds in advance
- In DASH and HLS it usually corresponds to a splice point that is a segment boundary

Splice point is announced in advance in the MPD

Correct mode of operation



SCTE/DVB Joint Discussion Group Topics
(resulted in several liaisons with MPEG)

SCTE Society of Cable Telecommunications Engineers

- SCTE 214
- SCTE 35
- SCTE 224

DVB

- DVB-TA part 1
- DVB-DASH
- DVB-TA part 3

Topics to Improve Carriage of SCTE 35 in DASH

- On-receive and on start-handling (SCTE 35 needs on receive) and DASH client model
- Repeating and updating SCTE 35 messages
- Advance signaling of SCTE 35 announcements in DASH
- ESNI/ESAM usage
- Global timing: epoch locking anchoring and SP/MP duality,
- Events crossing period boundaries
- Constraints on SCTE 35 usage (DVB-TA part 1 and part 3), e.g. splice_immediate, event_cancel
- Mapping fields and durations from SCTE 35 to MPEG-DASH Event
- MPD update and timeShiftBufferDepth handling
- Supporting early returns example, with an IN marker
- Insertion use case for VoD versus replacement use case for live

214-1 2022 MPD Period Level EventStream/Event Constraints for SCTE Events

<u>Eventstream</u>

- @timescale granular enough to accommodate frame accurate access (240 KHz)
- @presentationTimeOffset should be present and allow for events starting in the past of the current period (Epoch-Locking/ No past period retentions needed)
- Operate On-Receive Mode
- One EventStream for a PID

<u>Events</u>

- Contain only 1 Splice_info_section
- Event@duration should be expected duration/Can be closed by 0 duration event
- Event retained as long as media segments under event is there
- No two events with same ID and same presentation time exists in the same EventStream
- @messageData not used

Test Stream and Single to Multi Period Example

- Input test stream: https://demo.unified-streaming.com/k8s/vod2live/stable/unified-learning.isml/.mpd
- Implementation: AWS Lambda function for manifest manipulation using python and lxml
- Output test stream: **https://2dg1x5gzd0.execute-api.eu-west-1.amazonaws.com/default/.mpd**
- More details on the performance in the paper

Epoch Anchoring and more test examples SP to MP

- Remix AVOD SCTE-35 Ad Insertion Platform DASH
- Remix AVOD SCTE-35 AWS Elemental MediaTailor HLS-TS
- Origin Live SCTE-35 Reference Stream
- Origin Live SCTE-35 Ad Insertion Platform DASH / HLS-TS
- Origin Live SCTE-35 AWS Elemental MediaTailor DASH / HLS-TS
- Origin Live SCTE-35 Google Ad Manager DASH / HLS-TS
- Origin Live SCTE-35 Serverside.ai DASH / HLS TS

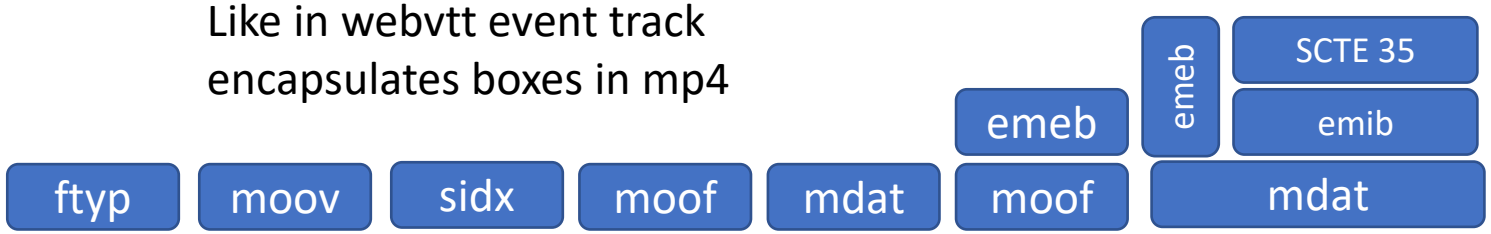
https://demo.unified-streaming.com/scte35/

Thanks to colleagues at Unified Streaming Jamie Fletcher and Mark Ogle for maintaining these streams.

Event Message Track

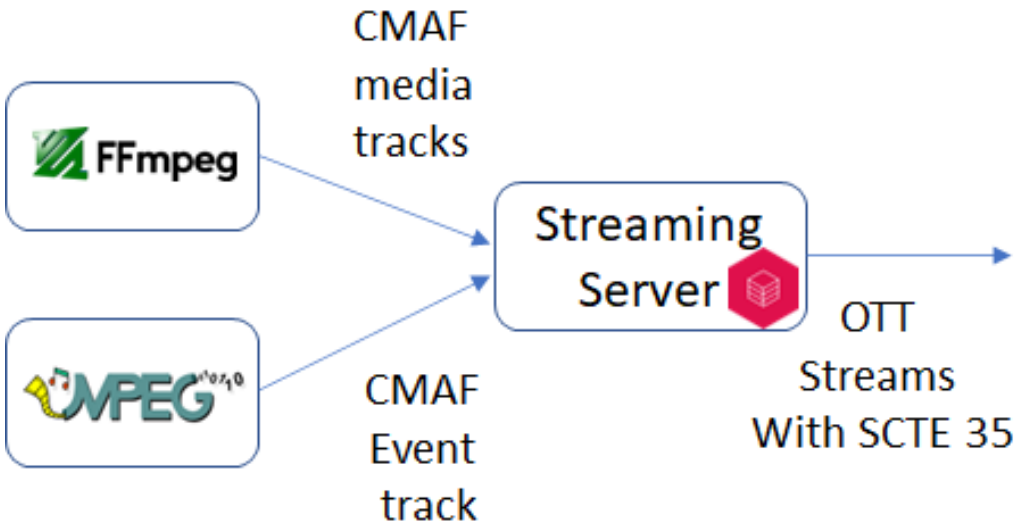
- MPEG file format specification https://www.iso.org/standard/82529.html
- Adopted in DASH-IF live media ingest
- Webvtt mp4 style track for upstream carriage
- Avoid carriage in each track, stateless model, model webvtt
- Example implementation available:
    - https://github.com/unifiedstreaming/EventMessageTrack
    - Includes gen_avail_track for generating metadata tracks containing splice_insert signalling

Like in webvtt event track encapsulates boxes in mp4



Event@id	Presentation time	Event@duration
4	2	18
0	3	0
1	14	9
2	136	11
3	136	7
Sample		payload
1	0	EventMessageEmtpyBox
2	2	EventMessageInstanceBox(id=4,presentation_time_delta=0,event_duration=18)
3	3	EventMessageInstanceBox(id=0,presentation_time_delta=0,event_duration=0) EventMessageInstanceBox(id=4,presentation_time_delta=-1,event_duration=18)
4	4	EventMessageInstanceBox(id=4,presentation_time_delta=-2,event_duration=18)
5	14	EventMessageInstanceBox(id=1,presentation_time_delta=0,event_duration=9) EventMessageInstanceBox(id=4,presentation_time_delta=-12,event_duration=18)
6	20	EventMessageInstanceBox(id=1,presentation_time_delta=-6,event_duration=9)
7	23	EventMessageEmtpyBox

Distributed workflows for metadata generation



https://demo.unified-streaming.com/scte35/

Conclusions/Summary

- Robust SCTE 35 implies adding constraints as specified in SCTE 214 and DVB-TA
- Recommendations on how and when to insert SCTE 35 metadata in streaming manifests are also provided
- Robust SCTE 35 can enable single to multi-period and enable integration with different DAI solutions and global timelines based on these recommendations
- Broad integration with server side and possible client-side DAI is possible for OTT
- Event Message Track is a technology for upstream storage and push-based transmission (e.g. live media ingest)
- Time_signal and hierarchical signalling, early termination, and insertion signaling are discussed in the paper, but not in this presentation for brevity