DASH Industry Forum

Meeting live broadcast requirements – the latest on DASH Low Latency

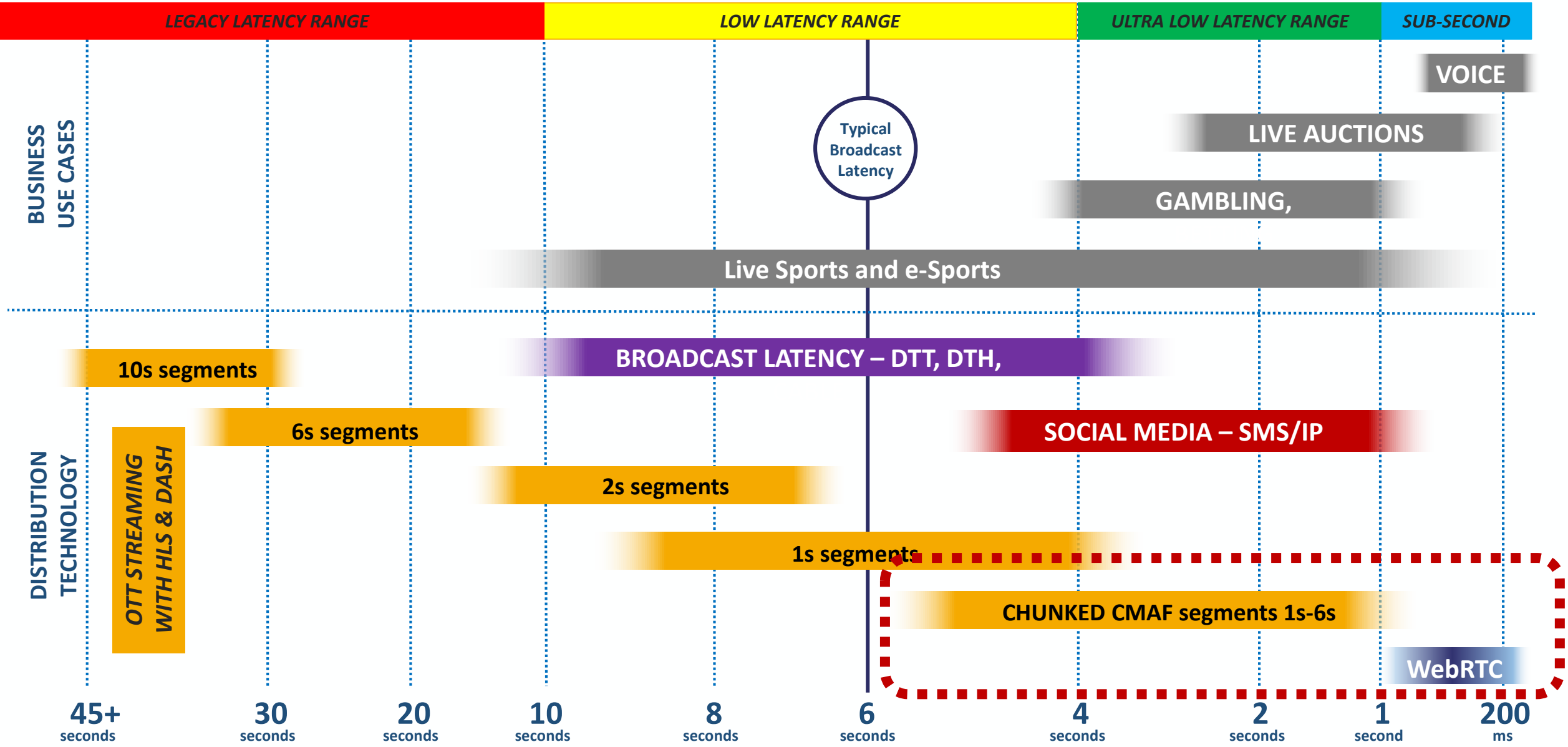
DVB World Online Presentation – March 2020

Will Law

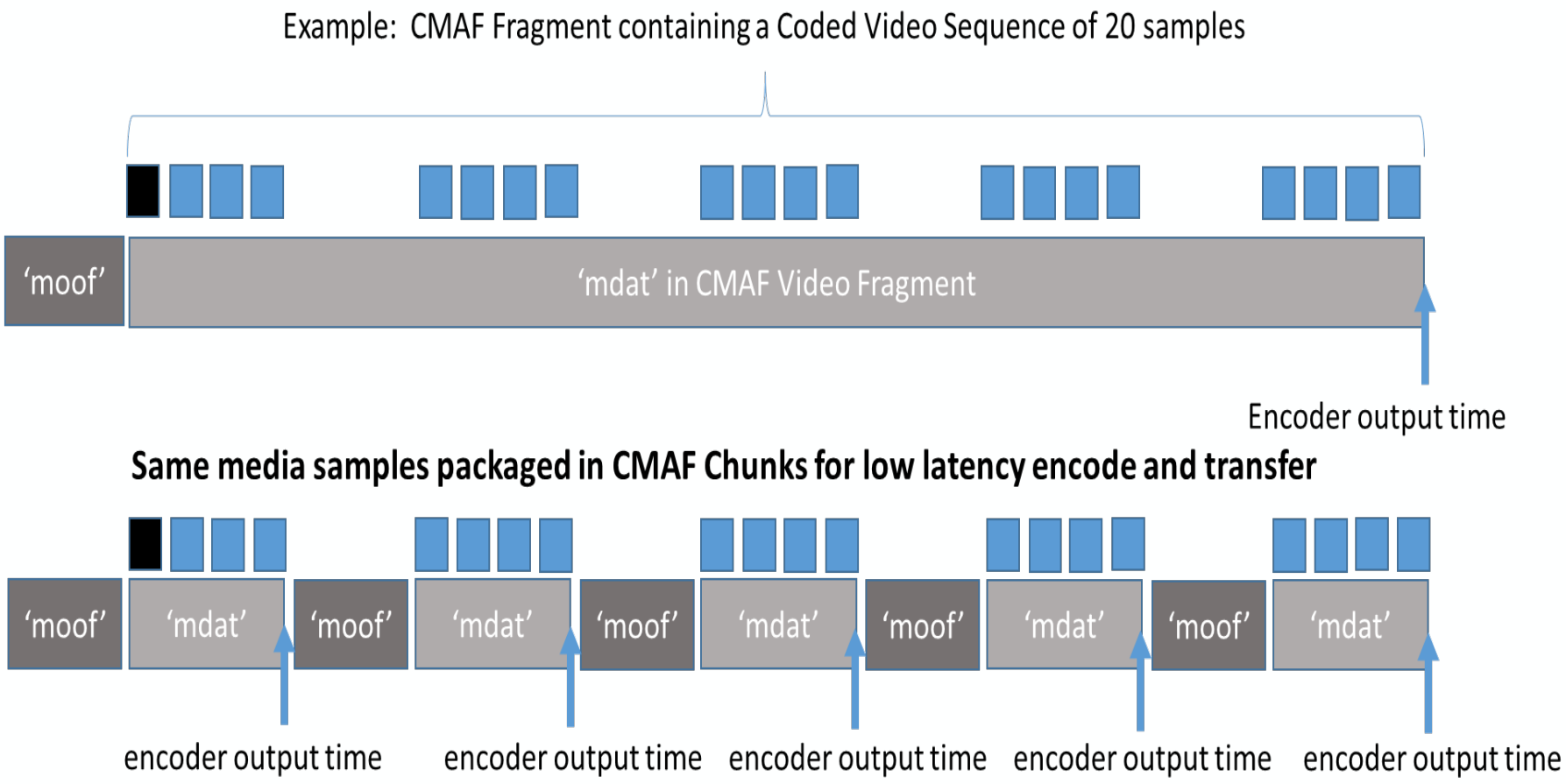
Chief Architect, Akamai

Akamai
Experience the Edge

Latency Achievable at Scale Via Mainstream CDN Streaming Technologies



CMAF Low Latency Chunks



[Image credit deep inside MPEG somewhere, I suspect Kilroy Hughes]

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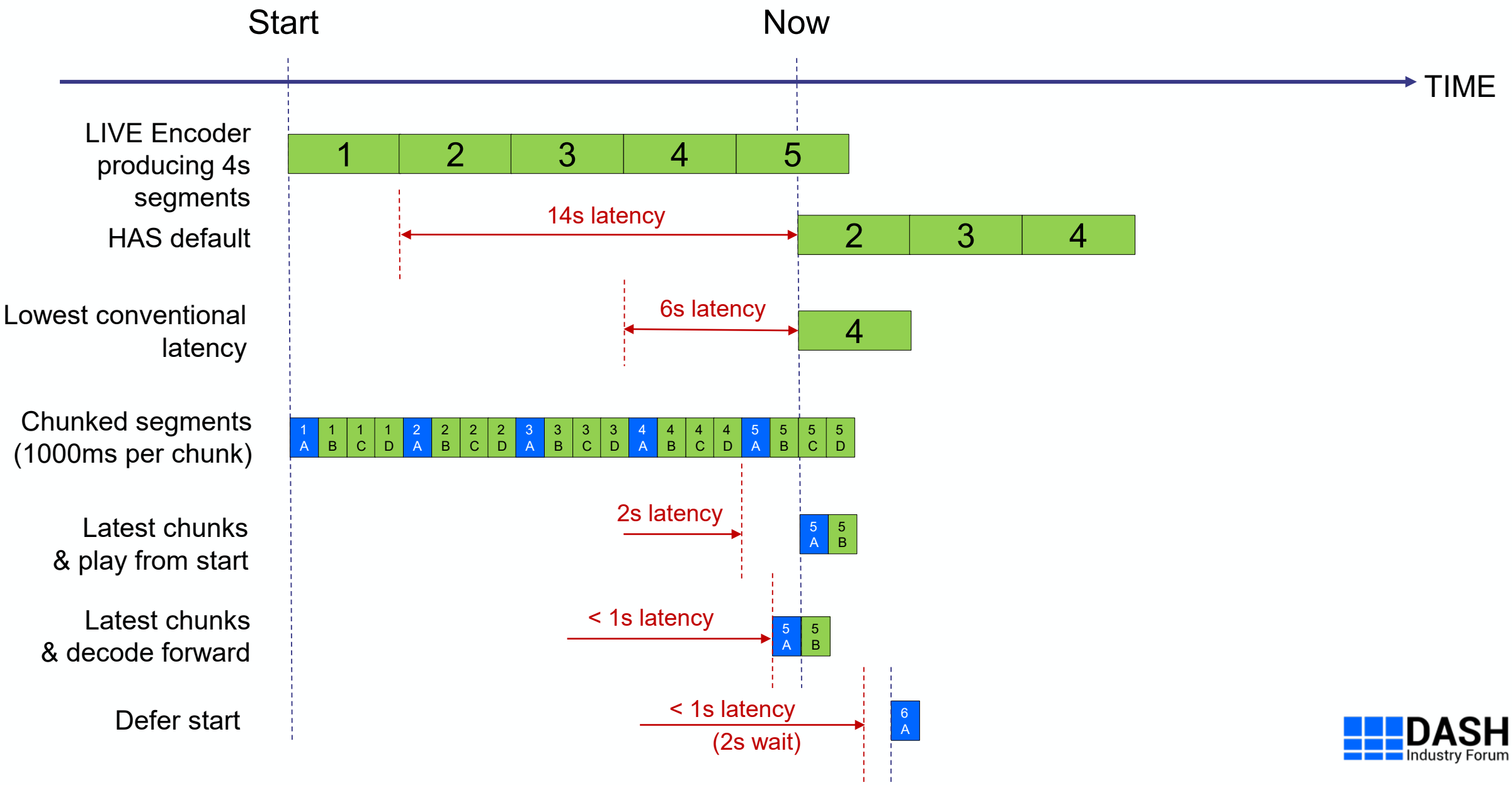
Why does chunking reduce latency?



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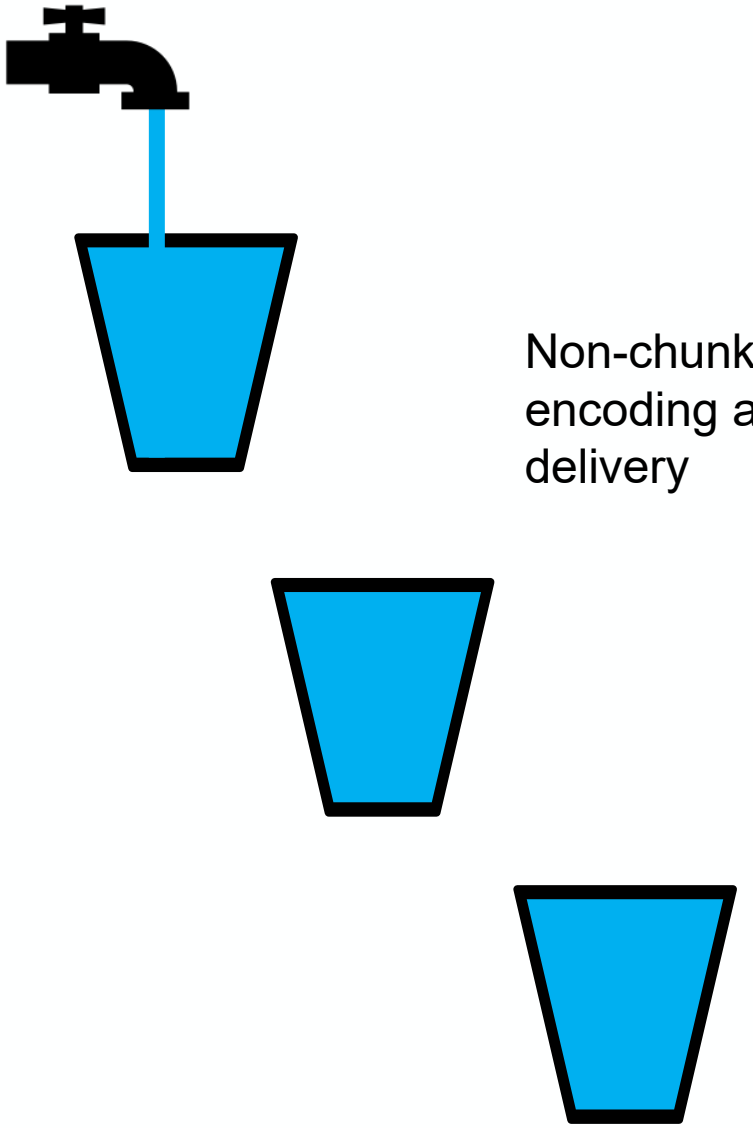
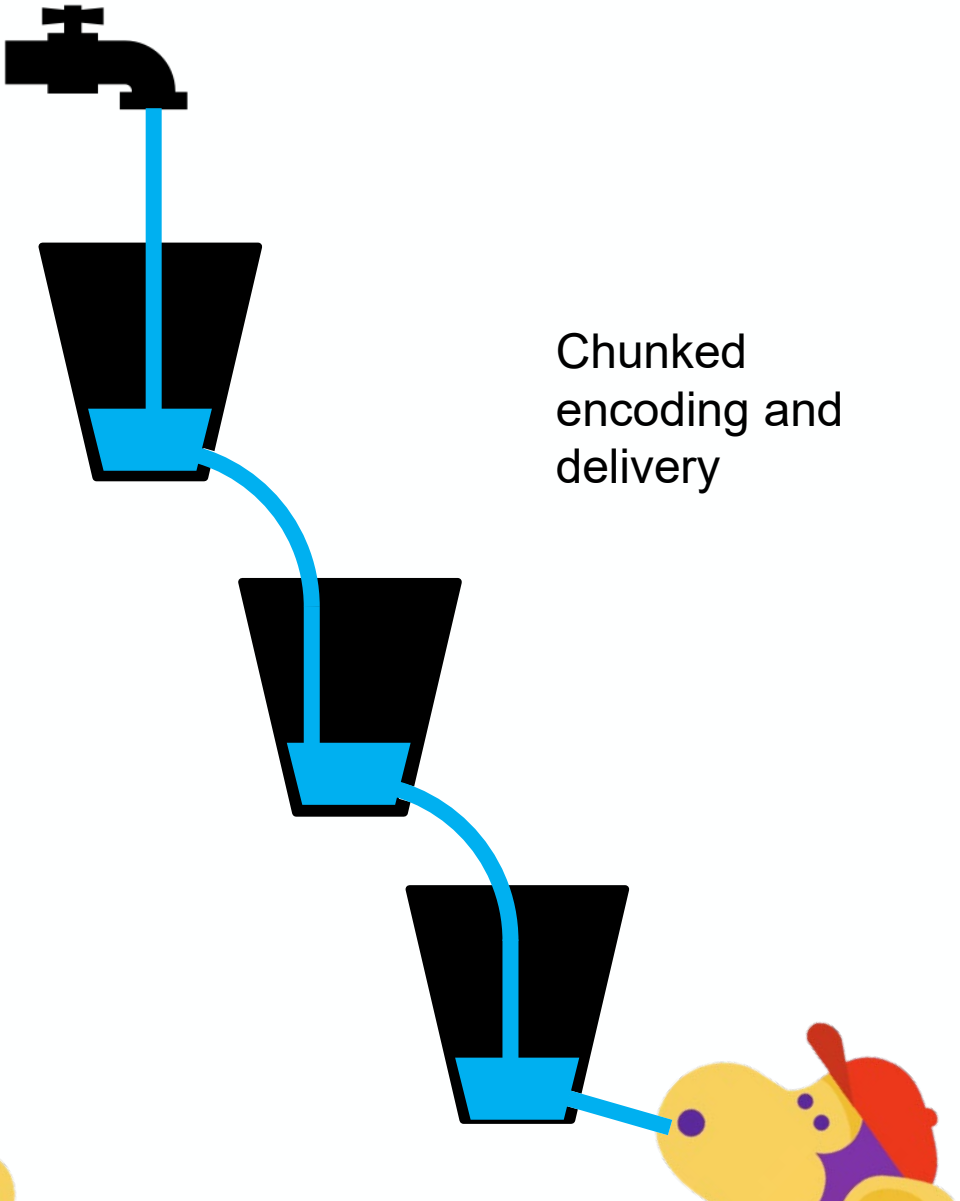
Bucket analogy for chunked encoding and transfer



Non-chunked encoding and delivery



Chunked encoding and delivery

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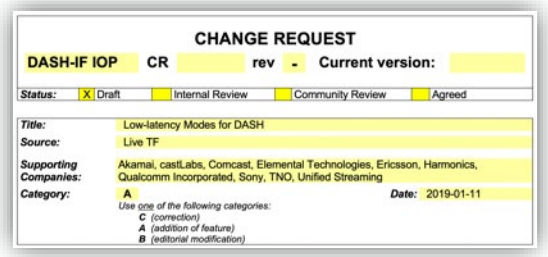
Low latency timeline within DASH IF

- A Live Task Force was established under the IOP working group in late 2017.
- This task force began work Change Request (CR) on ‘Low latency Modes for DASH’, building on work done under the ATSC-DASH project.
- The Live Task issued a request https://github.com/Dash-Industry-Forum/dash.js/issues/1474 to the dash.js project in Dec 2017 to develop low latency streaming capabilitiesGoal is to ensure that the end-to-end latency of the streams will be comparable to broadcast latency ~ 3.5 seconds of end-to-end latency
- First version of the ULL behavior demonstrated in April 2018
- Low latency guidelines available for community review June 2019
- Low latency Guidelines published March 2020.



CHANGE REQUEST

DASH-IF IOP CR rev - Current version:

Status: X Draft | Internal Review | Community Review | Agreed

Title: Low-latency Modes for DASH

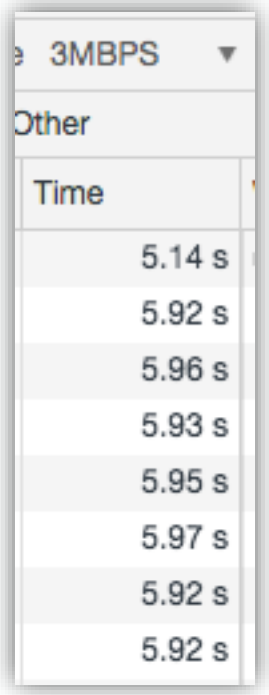
Source: Live TF

Supporting Companies: Akamai, castLabs, Comcast, Elemental Technologies, Ericsson, Harmonics, Qualcomm Incorporated, Sony, TNO, Unified Streaming

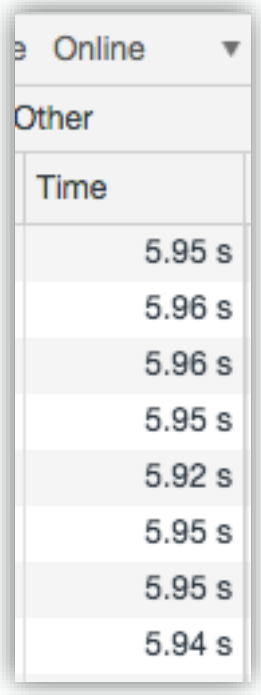
Category: A Date: 2019-01-11

Use one of the following categories:
C (correction)
A (addition of feature)
B (editorial modification)

Player issues: Bandwidth estimation problem



Client with **3Mbps** of throughput to CDN edge



Client with **50Mbps** of throughput to CDN edge

- One consequence of segment data being delivered as fast as it is produced is that the **segment download time is ~ equal to the segment duration**.
- Conventional throughput estimation algorithms will always produce the answer that **throughput equals bandwidth** and hence the player **will never switch up**.
- We need other ideas for estimating bandwidth under these conditions
- Ali Begen will address this problem and its solution in a subsequent presentation in this webinar.

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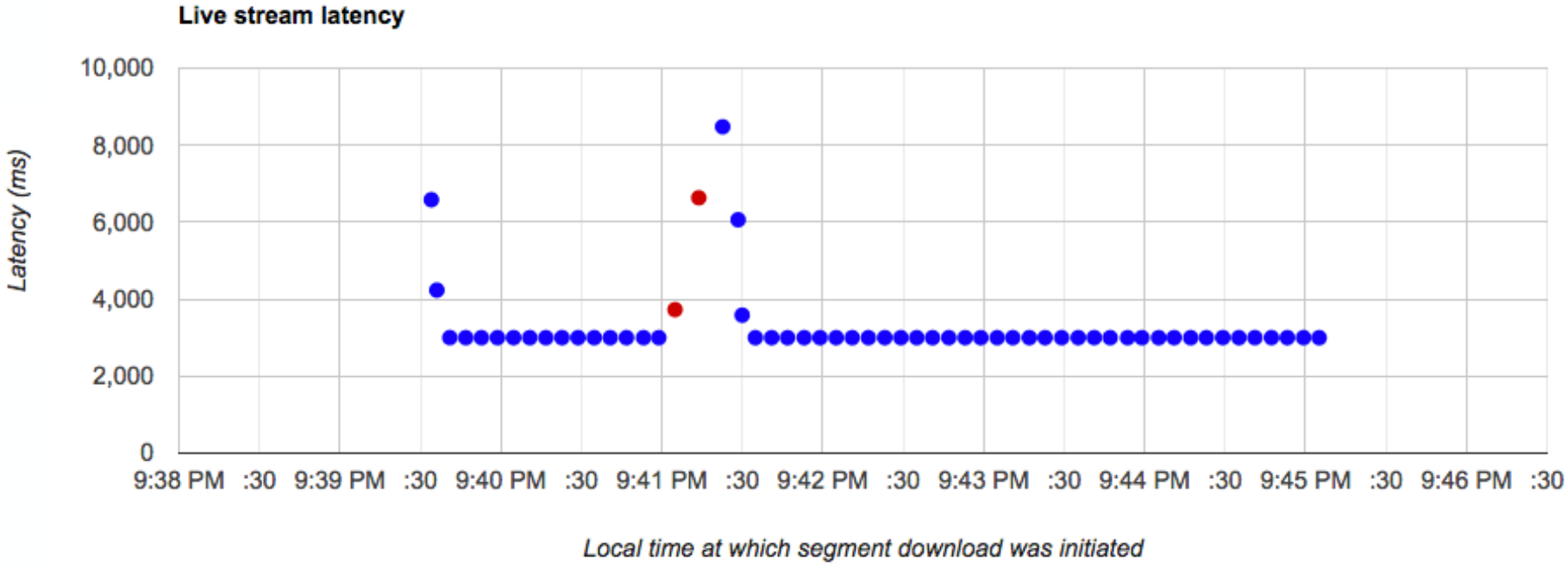
Player issues: Catch up and rate adjustment

- Once started, a live player cannot adjust its latency …
- Unless its speeds or slows down its playback rate
- This turns out to be a very useful tool for a player which is dealing with very low buffers and variability in throughput.



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01:51:52.403
SNOW
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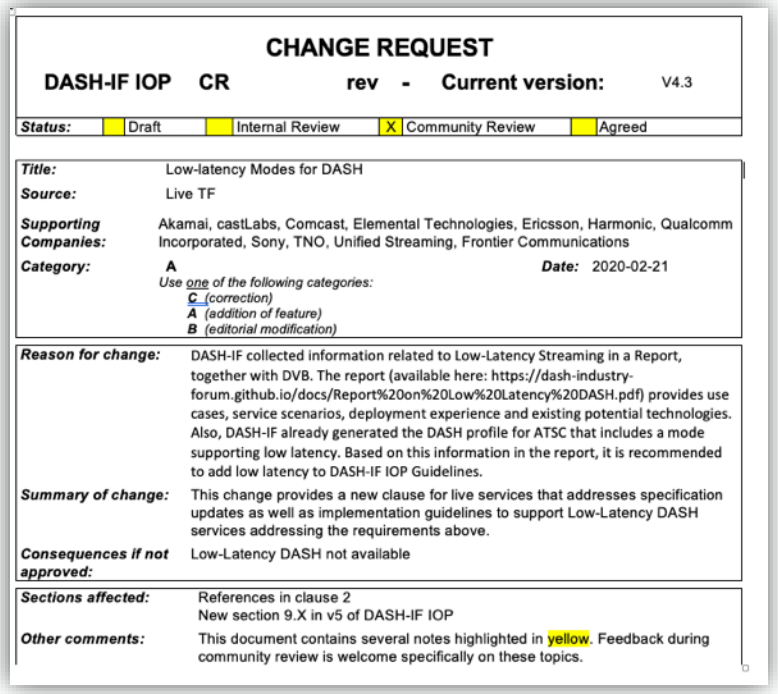
MacBook Air

DASH IF Guidelines on Low Latency

- Published March 27 2020
- Now available at https://dashif.org/guidelines/
- (PDF at https://dash-industry-forum.github.io/docs/CR-Low-Latency-Live-r8.pdf)
- A deep technical resource on how to conduct low latency streaming with DASH.



CHANGE REQUEST

DASH-IF IOP CR rev - Current version: V4.3

Status:		Draft		Internal Review	X	Community Review		Agreed

Title:	Low-latency Modes for DASH
Source:	Live TF
Supporting Companies:	Akamai, castLabs, Comcast, Elemental Technologies, Ericsson, Harmonic, Qualcomm Incorporated, Sony, TNO, Unified Streaming, Frontier Communications
Category:	**A** ***Date:*** 2020-02-21 *Use one of the following categories:* ***C*** *(correction)* ***A*** *(addition of feature)* ***B*** *(editorial modification)*
Reason for change:	DASH-IF collected information related to Low-Latency Streaming in a Report, together with DVB. The report (available here: https://dash-industry-forum.github.io/docs/Report%20on%20Low%20Latency%20DASH.pdf) provides use cases, service scenarios, deployment experience and existing potential technologies. Also, DASH-IF already generated the DASH profile for ATSC that includes a mode supporting low latency. Based on this information in the report, it is recommended to add low latency to DASH-IF IOP Guidelines.
Summary of change:	This change provides a new clause for live services that addresses specification updates as well as implementation guidelines to support Low-Latency DASH services addressing the requirements above.
Consequences if not approved:	Low-Latency DASH not available
Sections affected:	References in clause 2 New section 9.X in v5 of DASH-IF IOP
Other comments:	This document contains several notes highlighted in yellow. Feedback during community review is welcome specifically on these topics.

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What will you find in the low latency guidelines?

- Scenario and architecture
- Low latency service offering
- Chunked and on-chunked low latency adaption sets
- Delta with DVB Low latency DASH
- Informative low latency client guidelines for operation
- ABR Encoder, Encryption and MP4/CMAF Packaging
- Encoding and CMAF Chunk Duration Recommendations
- Latency calculations and use of Producer Reference Time
- Resynchronization Points
- Service Configuration Parameters for Low Latency
- Example FFmpeg Configuration
- Example live MPDs
- MPD Generator and Packager Operation for Low-Latency Content

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Noteworthy items from DASH IF Guidelines

- Two operational modes are permitted
  - Simple live offering is used by applying @duration signaling and $Number$ based templating
  - Main live offering with the SegmentTimeline as either $Number$ or $Time$ is supported by the proposed updates in MPEG-DASH fourth edition.
- At least one ServiceDescription element shall be present as follows:
  - A Latency element - specifying min, target and max latencies
  - A PlaybackSpeed element – min, max playback speeds for latency correction.
- At least one UTCTiming element with millisecond precision.
- A low latency adaption set can be built in two ways
  - Using non-chunked segments whose duration < 30% of target latency
  - Using chunked segments

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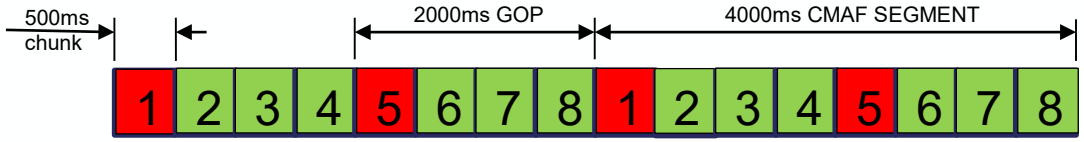
Resync elements

- Resynchronization Points are defined in the 4th Edition of MPEG DASH ISO/IEC 23009-1:2020/Amd.1
- Their purpose is to define the location of intermediate resynchronization points within media segments.



Service offering: DASH-LL streams with 4s CMAF segments with 2s GOP, 500ms chunks.

- Benefits are
  - Fast random access while maintaining low latency
  - Quick Resynchronization after buffer underruns
  - In-Segment down-switching in case buffer draining is observed
  - Understanding the applied chunk size and duration and hence support for the rate adaptation.

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Resync elements – how to find them

- By providing a binary map for each Resynchronization Point in a Resynchronization Index Segment for each Media Segment.
  - This is most easily used for Segments that are fully available on the network.
  - So not very useful for live, especially low latency
- By signalling in the mpd the existence of Resynchronization Points in a Media Segment. This permits the player to parse the segment to locate the Resynchronization Point.

Resync elements – example 1

```
<Resync type="0" dT="500000" dImin="0.03125" dImax="0.09375"/>
```

```
<SegmentTemplate timescale="1000000" duration="8000000"
availabilityTimeOffset="7.500" availabilityTimeComplete="false"
initialization="init-stream$RepresentationID$.m4s" media="chunk-
stream$RepresentationID$-$Number%05d$.m4s" startNumber="1"/>
```

```
<Representation id="0" mimeType="video/mp4" codecs="avc1.640016"
bandwidth="500000" width="960" height="400" sar="1:1" qualityRanking="5"/>
```

Indicates that

- The point is of type 0 – a CMAF chunk without any promise for specific random-access capabilities.
- The maximum chunk duration is 500ms (500,000/1,000,000)
- The minimum distance in bytes between two Resynchronization Points is 15,625B (0.03125x500,000)
- The maximum distance in bytes between two Resynchronization Points is 46,875B (0.09375x500,000)

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Resync elements – example 2

```
 <Representation id="2" mimeType="video/mp4" codecs="avc1.640016" bandwidth="300000"
width="720" height="300" sar="1:1" qualityRanking="1">

    <Resync type="2" dT="1000000" dImin="0.1" dImax="0.15” marker="TRUE"/>

 </Representation>
```

Indicates that

- The point is of type 2 – a CMAF chunk that can be used for fast access or switching
- The maximum time delta between these points is 1s (1,000,000/1,000,000)
- The minimum distance in bytes between two Resynchronization Points is 30,000B (0.1x300,000)
- The maximum distance in bytes between two Resynchronization Points is 45,000B (0.15x300,000)
- As the @marker flag is set to true, a DASH client may search for the resync point using a box-parsing algorithm.

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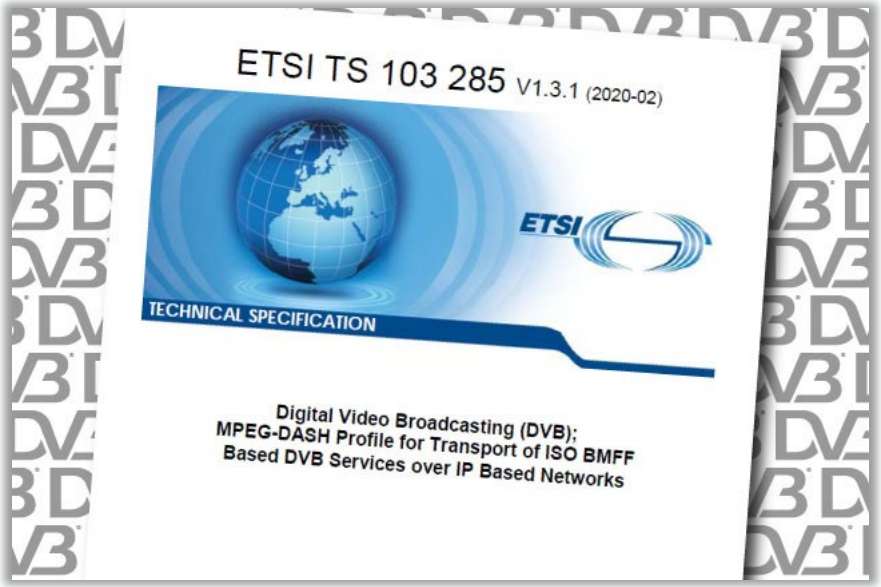
DVB DASH - TS 103 285 V1.3.1

- ETSI has published TS 103 285 V1.3.1, a new version of DVB's *MPEG-DASH profile for transport of ISO BMFF based DVB services over IP based networks*. The main changes are the inclusion a low latency mode and HDR dynamic mapping.
- https://dvb.org/news/etsi-publishes-dvb-dash-with-low-latency-and-hdr-dm/



ETSI publishes DVB-DASH with low latency and HDR DM

25.02.2020

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Difference between DVB and DASH-IF for low latency DASH

- DVB-DASH in clause 11.18.2 recommends the use of @duration together with $Number$, whereas DASH-IF does not make any of such recommendations.
- DVB DASH does not mention the **Resync** element, but the presence of the element would not break a DVB-DASH client.
- DVB DASH signals Adaptation Sets that are for low latency purposes with an **EssentialProperty** or **SupplementalProperty** descriptor with the @schemeIdUri attribute of "urn:dvb:dash:lowlatency:critical:2019" and the @value attribute set to "true". If the **SupplementalProperty** descriptor is used, then this does not impact regular low-latency DASH clients.

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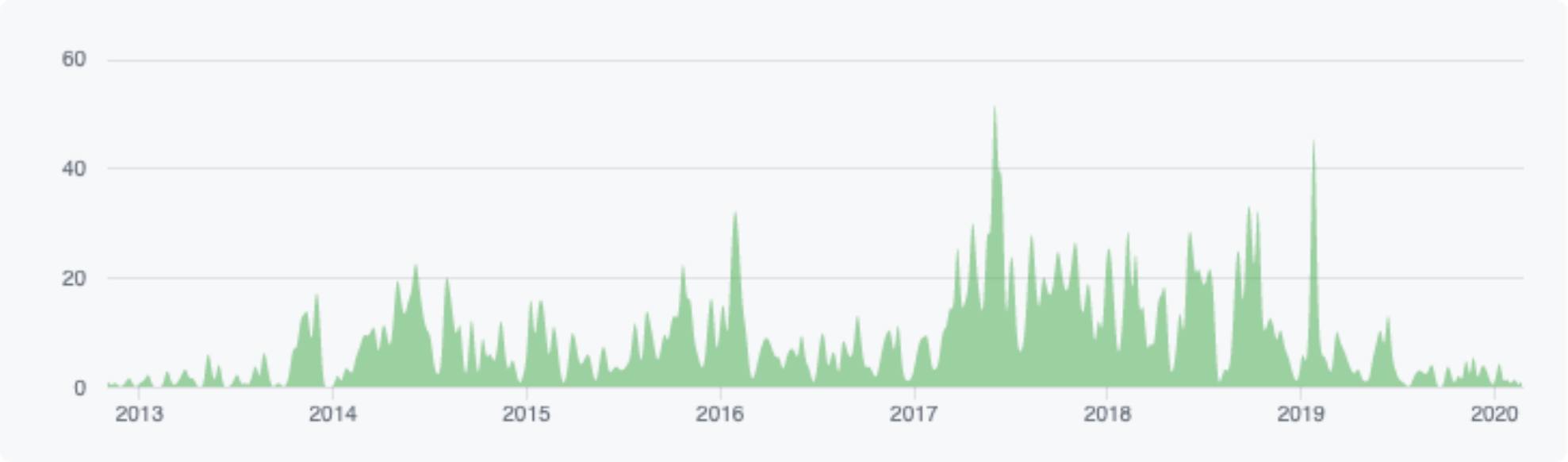
DASH.js
BERLIN – May 2019
what the hack
<MPD>

What is the dash.js client?

- A open-source MSE/EME player library, written in Javascript, which serves as a robust DASH player for commercial applications as well as a reference player implementation for the DASH Industry Forum
- It is an open-source project on Github - https://github.com/Dash-Industry-Forum/dash.js/



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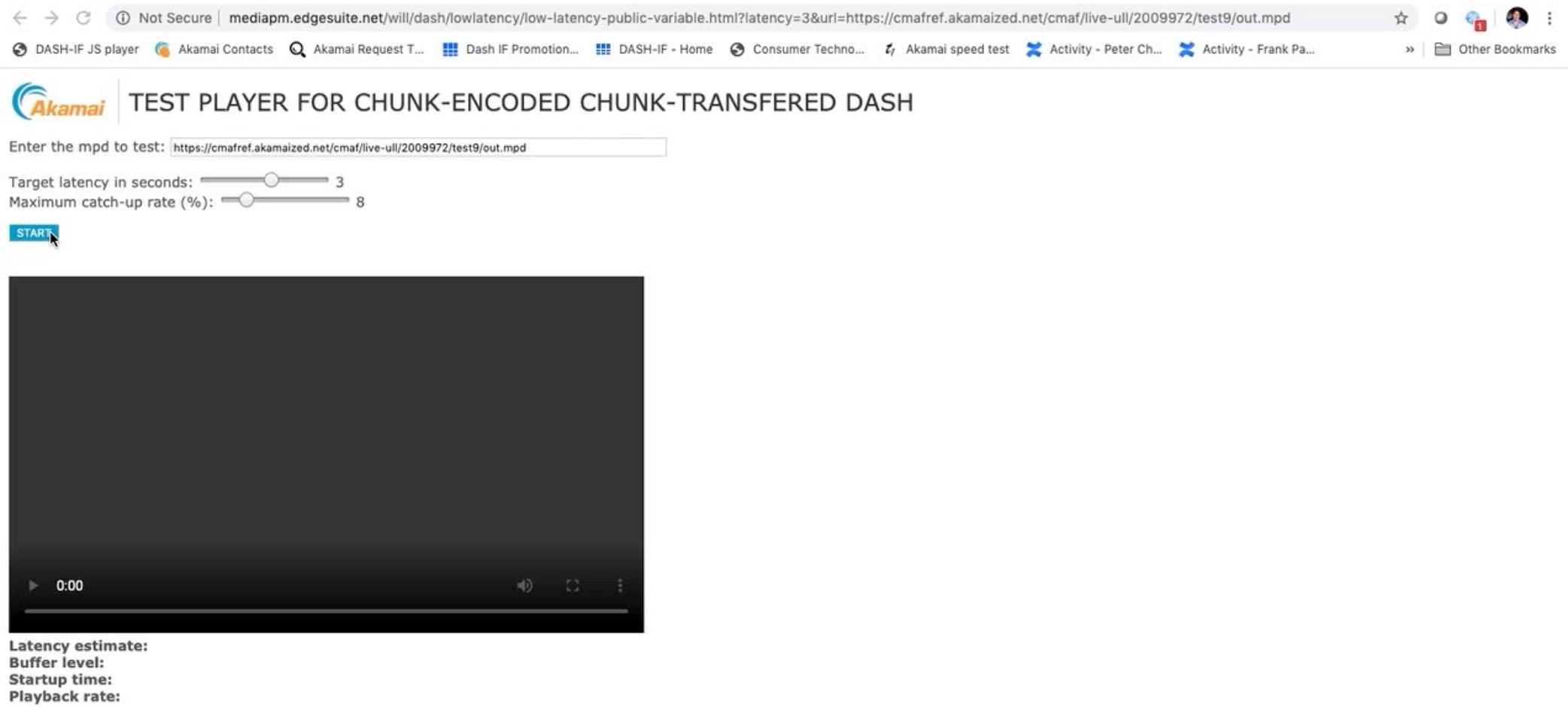
New APIs to support low latency playback

- mediaplayer.setLowLatencyEnabled() – activates low latency behaviors around start-up, bandwidth estimation and buffer management and ABR
- mediaplayer.setLiveDelay() – sets the target latency in seconds
- Mediaplayer.setCatchUpPlaybackRate() – sets the maximum rate at which the player will adjust its playback speed in order to modify the latency without interrupting stream playback.
- mediaPLayer.setLowLatencyMinDrift() – sets the allowable variance from the target delay before the playback rate adjustment kicks in.

Public example

ffmpeg, Akamai CDN, dash.js player

http://mediapm.edgesuite.net/will/dash/lowlatency/low-latency-public-variable.html?latency=3&url=https://cmafref.akamaized.net/cmaf/live-ull/2009972/test9/out.mpd.net/cmaf/live/657078/akasource/out.mpd



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Thank you!

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