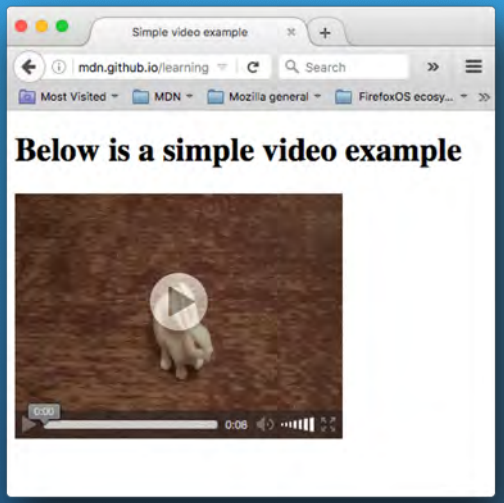
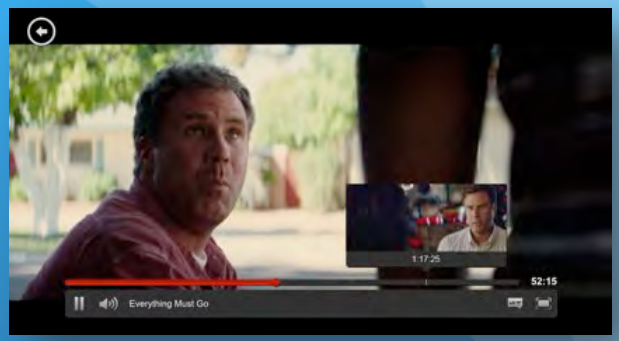
Open-Source JavaScript Client for MPEG DASH playback

Mile High Video Conference
Denver, August 2018

Will Law
Chair – DASH Industry Forum
Chief Architect - Akamai

HTML5 Video – inauspicious beginnings





DASH Industry Forum

Media Source Extensions (MSE)

1. https://www.w3.org/TR/media-source/
2. This specification extends HTMLMediaElement to allow JavaScript to generate media streams for playback.
3. Allows the creation of <audio>, <video> and <text> source buffers.
4. Delivery is format agnostic.

DASH Industry Forum

Encrypted Media Extensions (EME)

1. W3C standard https://www.w3.org/TR/encrypted-media/
2. This proposal extends HTMLMediaElement providing APIs to control playback of protected content.
3. The API supports use cases ranging from simple clear key decryption to high value video (given an appropriate user agent implementation). License/key exchange is controlled by the application, facilitating the development of robust playback applications supporting a range of content decryption and protection technologies.

DASH Industry Forum

Brief History

- In late 2012 Akamai realized that the draft MSE API was more complicated than most HTML5 developers were comfortable with at the time. Additionally DASH has

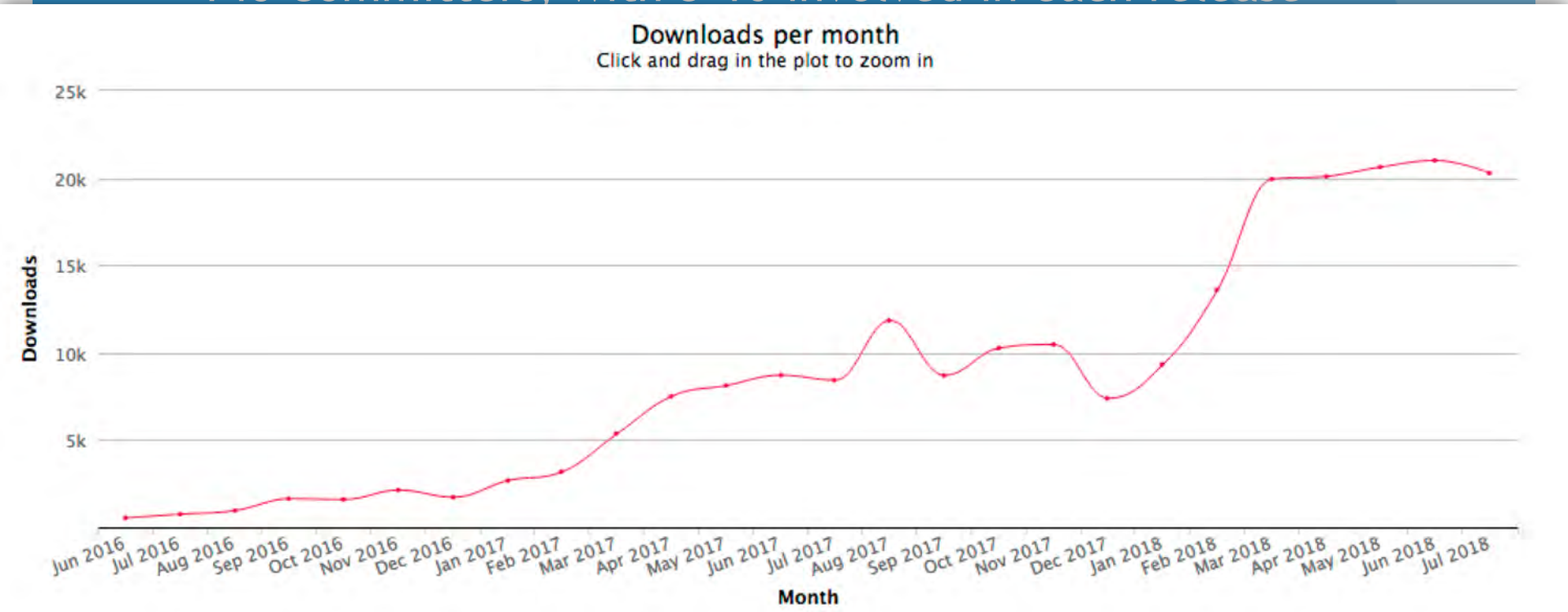
```
sfo-mphdc:dash.js wilaw$ git log --reverse
commit 9e05e84313a2abc6efe95a2ba0cd7a3a04cbc07e
Author: wilaw <wilaw@akamai.com>
Date:   Fri Nov 9 14:28:38 2012 -0800

    Initial commit
```

looking for a reference player. They chose to use this dash.js library to build their **reference player**.

DASH Industry Forum

Today – a thriving project

- 146 Committers, with 3-10 involved in each release



DASH Industry Forum

Technology

- The client is written in ES6 and transpiled and minified to ES5 for release
- Makes use of the W3C Media Source Extensions and Encrypted Media Extensions to the VideoElement.
- Fully adaptive MBR playback of DASH and MSS content
- Flexible segment requesting, buffering and bitrate switching logic
- Library is headless – it provides the complete logic for playback but must be linked to a videoElement for rendering. A UI element has been contributed so that a complete player can be obtained.
- Current client works on Chrome v30+, IE11 under Win8.1, Edge under Win10, Safari under Yosemite, Firefox 39+.

Recent Features/Improvements

- Captioning (IMSC1, TTML, 608/708, webvtt)
- DRM Management
  - ClearKey support
  - Multikey
  - Persistent licenses
- Playback experience
  - Smooth period transitions
  - Jump gaps feature
  - New buffer management mechanism
  - ABR algorithm improvements
- EMSG support
- Seek speed
- Robustness & stability
- Preload mechanism
- Improved MSS support
- Thumbnail tracks
- MultiTrack support and track switching speed
- Multi-period support
- Control bar UI
- Low latency chunked CMAF support in the 2s E2E range

DASH Industry Forum

License

- BSD-3 https://opensource.org/licenses/BSD-3-Clause
- Basically this allows you almost unlimited freedom with the software so long as you include the BSD copyright and license notice in it .

You can

- Commercial Use
- Modify
- Distribute
- Place Warranty

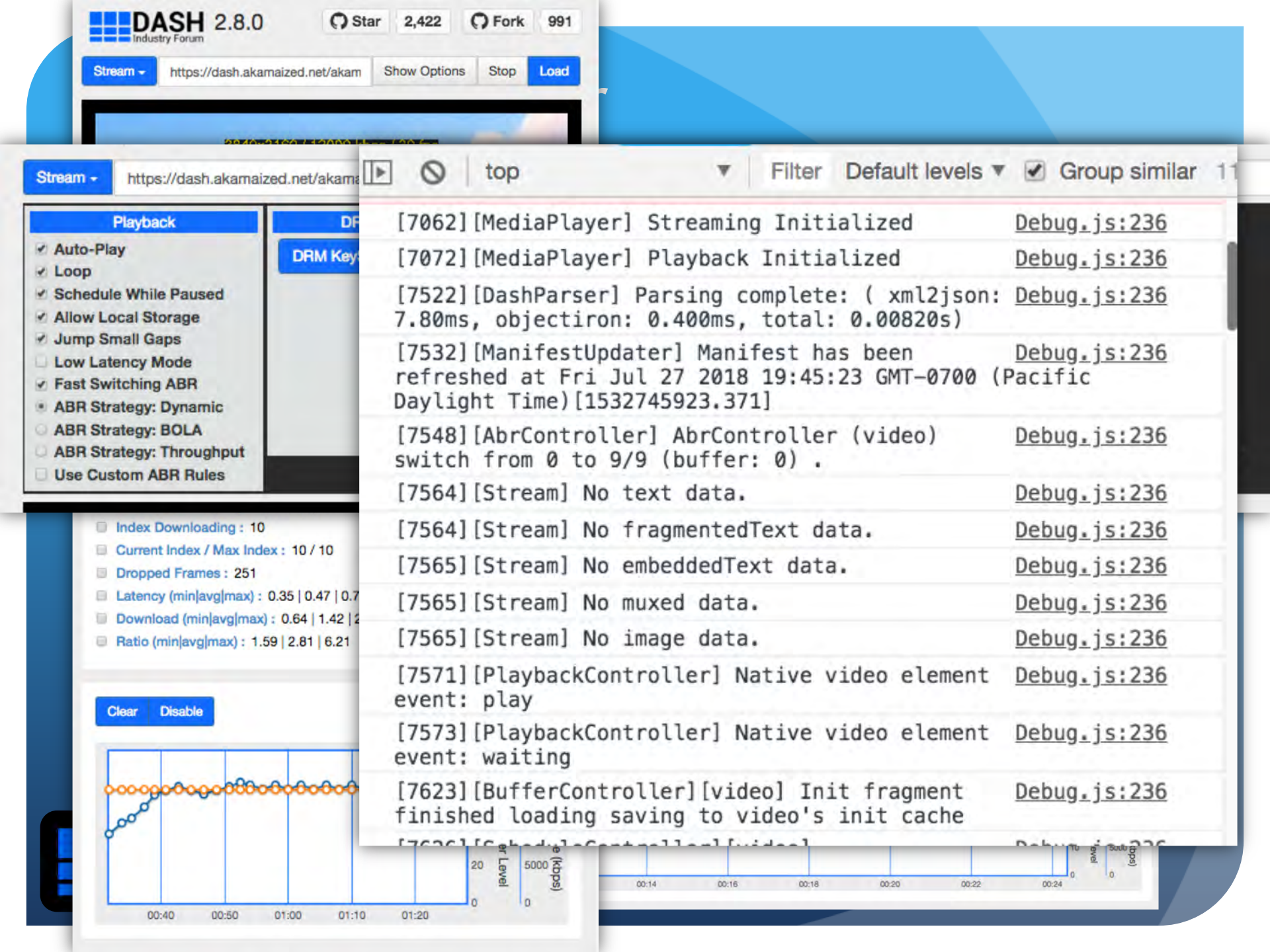
You cannot

- Use trade mark
- Hold liable

You must

- Include the copyright
- Include the license

DASH Industry Forum


DASH 2.8.0
Industry Forum
Star 2,422
Fork 991
Stream
https://dash.akamaized.net/akam
Show Options
Stop
Load
Playback
Auto-Play
Loop
Schedule While Paused
Allow Local Storage
Jump Small Gaps
Low Latency Mode
Fast Switching ABR
ABR Strategy: Dynamic
ABR Strategy: BOLA
ABR Strategy: Throughput
Use Custom ABR Rules
DRM Key
Index Downloading : 10
Current Index / Max Index : 10 / 10
Dropped Frames : 251
Latency (min|avg|max) : 0.35 | 0.47 | 0.7
Download (min|avg|max) : 0.64 | 1.42 |
Ratio (min|avg|max) : 1.59 | 2.81 | 6.21
Clear
Disable
00:40
00:50
01:00
01:10
01:20
00:14
00:16
00:18
00:20
00:22
00:24
top
Filter
Default levels
Group similar
[7062][MediaPlayer] Streaming Initialized Debug.js:236
[7072][MediaPlayer] Playback Initialized Debug.js:236
[7522][DashParser] Parsing complete: (xml2json: 7.80ms, objectiron: 0.400ms, total: 0.00820s) Debug.js:236
[7532][ManifestUpdater] Manifest has been refreshed at Fri Jul 27 2018 19:45:23 GMT-0700 (Pacific Daylight Time)[1532745923.371] Debug.js:236
[7548][AbrController] AbrController (video) switch from 0 to 9/9 (buffer: 0) . Debug.js:236
[7564][Stream] No text data. Debug.js:236
[7564][Stream] No fragmentedText data. Debug.js:236
[7565][Stream] No embeddedText data. Debug.js:236
[7565][Stream] No muxed data. Debug.js:236
[7565][Stream] No image data. Debug.js:236
[7571][PlaybackController] Native video element event: play Debug.js:236
[7573][PlaybackController] Native video element event: waiting Debug.js:236
[7623][BufferController][video] Init fragment finished loading saving to video's init cache Debug.js:236

https://reference.dashif.org/dash.js/latest/samples/index.html

Source code:

```
<div>
    <video data-dashjs-player=""
</div>
```

```
ntrols="true"></video>
```

load" refers to the fact that this page
Dash.createAll() method onLoad in or
automatically convert all video elemen
'dashjs-player' in to a functioning DAS

eate() in four different
arget video element with a
specifies a target video
ird specifies the video
element and a dynamically generated source object. The fourth specifies the video element, a source object and a custom DashContext object.

Key Links

- The latest docs are also available here:
  http://cdn.dashjs.org/latest/jsdoc/index.html
- DASH-IF Hosted Player:
  http://reference.dashif.org/dash.js/latest/samples/dash-if-reference-player/index.html
- Samples Page
  http://reference.dashif.org/dash.js/latest/samples/
- Archived versions of the Reference Player
  http://reference.dashif.org/dash.js/
- Official NPM Project
  https://www.npmjs.com/package/dashjs

DASH Industry Forum

Academic Use

- Dash.js is the most common player used in academia for DASH research.
- 3 of the 4 winners of the Excellence in DASH awars at ACM MMSys 2018 used dash.js player in their research - https://multimediacommunication.blogspot.com/2018/06/dash-if-awarded-excellence-in-dash.html
- Many ABR algorithms are tested and deployed with dash.js

DASH Industry Forum

Commercial use

- Dash.js is both a refence player for the DASH Industry Forum and also a **commercial player framework** for **production** use.

Aggregate usage:

> 7 million hours per month

> 21 million users per month

24 Open ✓ 26 Closed | Author | Labels | Projects | Milestones | Assignee | Sort

- **Handling missing segments "gracefully"** Feature Request — 33
  #651 opened on Jul 21, 2015 by orcaman v2.5.0
- **preloading segments with the dash.js player** 0 - Backlog Feature Request Investigate — 16
  #265 opened on Oct 26, 2014 by orcaman
- **Low latency streaming capabilities using <availabilityTimeOffset> and partial segments** Feature Request Feature request from DASH IF IOP — 12
  #1474 opened on Jul 4, 2016 by smedegaard v2.6.7
- **Is there a way to show a progress bar on buffer?** Feature Request Reference Player — 7
  #1266 opened on Mar 21, 2016 by bennyvlam
- **Local playback / download support** Feature Request Question — 7
  #1629 opened on Oct 15, 2016 by danrossi
- **Prevent "buffering out" of a DVR window** Feature Request Pri-High — 6
  #1499 opened on Jul 13, 2016 by dsparacio
- **Implement `jsnext:main` for ES2015 use in projects** Feature Request — 3
  #1632 opened on Oct 17, 2016 by andykenward
- **Check dash.js browser support** Feature Request — 3
  #2055 opened on Jul 5, 2017 by broodjekipburger
- **minimum buffer time feature** 0 - Backlog Feature Request — 2
  #1158 opened on Feb 10, 2016 by gberkman v2.5.0
- **Ignore aspect ratio and allow stream to stretch to the size of the container.** 0 - Backlog Feature Request — 2
  #1223 opened on Feb 25, 2016 by keithnolan00
- **Support for playing multi-tracks simultaneously** Feature Request — 2
  #1972 opened on May 29, 2017 by alonfixler
- **Use AES128 encryption and keyUriTemplate** Feature Request — 2
  #1993 opened on Jun 7, 2017 by HugoCrd 5 of 5

Current Lead Admin – Jesús Oliva

- ☐ Product Manager
- ☑ Software Architect
- ☐ Scrum Master
- ☑ Frontend Engineer
- ☑ Backend Engineer
- ☑ Data Engineer
- ☐ UX / Designer
- ☐ DevOps
- ☐ Sys Admin

Software Technologies

Docker, Docker Swarm	★★★★★
AWS, Azure, Google Cloud	★★★★☆
CouchBase, MongoDB	★★★★☆
Oracle, PosgreSQL, MySQL	★★★★☆
Key/value DBs	★★★★☆
RabbitMQ, ZeroMQ, Kafka	★★★★☆
Mesos, Kubernetes	★★★☆☆
MapReduce	★★★☆☆
Spark	★★★☆☆

More than 15 professional years of software engineering experience; including 5 serving as a CTO.

Video/audio streaming protocols/codecs expert: HLS, DASH, HDS, Smooth Streaming. H.264, AAC, WebM.

Implementation of streaming protocols/demuxers/decoders for mobile devices and web players. Mobile & devices development expert: Android, Chromecast, Windows Mobile, iPhone.

Expertise on distributed architectures, scale up/scale out systems and video streaming solutions.

Frameworks, Programming languages

C#, C/C++	★★★★★
JavaScript	★★★★★
Java Spring	★★★★☆
Node.JS, Express	★★★★☆
Go, Gorilla Framework	★★★★☆
Python	★★★☆☆

https://www.linkedin.com/in/jesusoliva/

https://github.com/jeoliva

https://github.com/jeoliva/ExoPlayer

A community of real people

Participate!

- Find us on github at https://github.com/Dash-Industry-Forum/dash.js
- Join the email list server: dashjs@googlegroups.com
- Join the Slack channel: https://dashif-slack.azurewebsites.net
- Annual face-to-face meeting in Berlin in May. Prost!

DASH Industry Forum

Consumer Technology Association™

Standardization of Statistics from Media Players

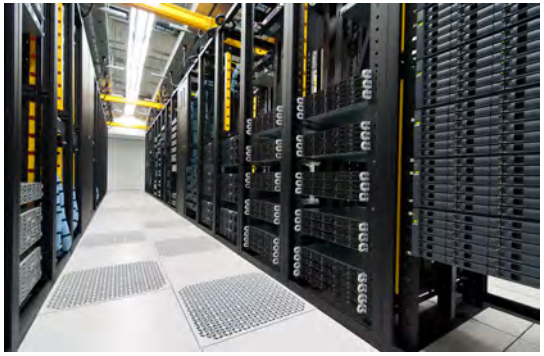
Will Law – Akamai
Representing the CTA R4WG20 Working Group

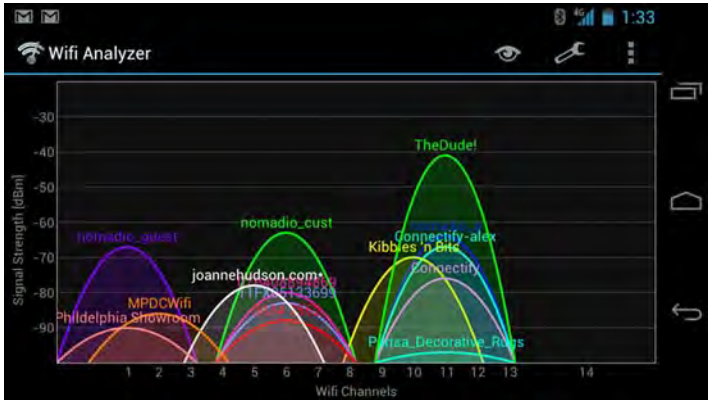
What is QoE?

Quality of Experience - The degree of delight or annoyance of the user of an application or service (ITU-T P.10/G.100).

It is a measure of the viewer's perceived improvement and degradation of the audio and video and the viewer's satisfaction with the media experience.

What is QoS?





- **QoS** - A measure of the performance of the different components in the ecosystem that may or may not contribute to the Quality of Experience. For instance, "time-to-first-byte" would be an example of quality of service where a CDN being the component and a measure of latency. QoS may not always have an impact on the user experience.

Many analytics providers

MUX

conviva

NICE PEOPLE AT WORK

Akamai

JWPLAYER

Consumer Technology Association CES

Ambiguous data

Rebuffer rate is 5%

- Does this mean the average viewer spent 5% of their view time rebuffering?
- Or did 5% of viewers have at least one rebuffer?
- Was this calculated as a mean or median value?
- How long does a rebuffer event have to be to be counted?
- What about rebuffers that persist to the end of the session?
- For a live stream, does this value pertain to the last minute, last 5 minutes, viewers currently still viewing, or the entire viewing duration since the stream started?
- Does this include viewers who have started or finished their sessions?

Player APIs

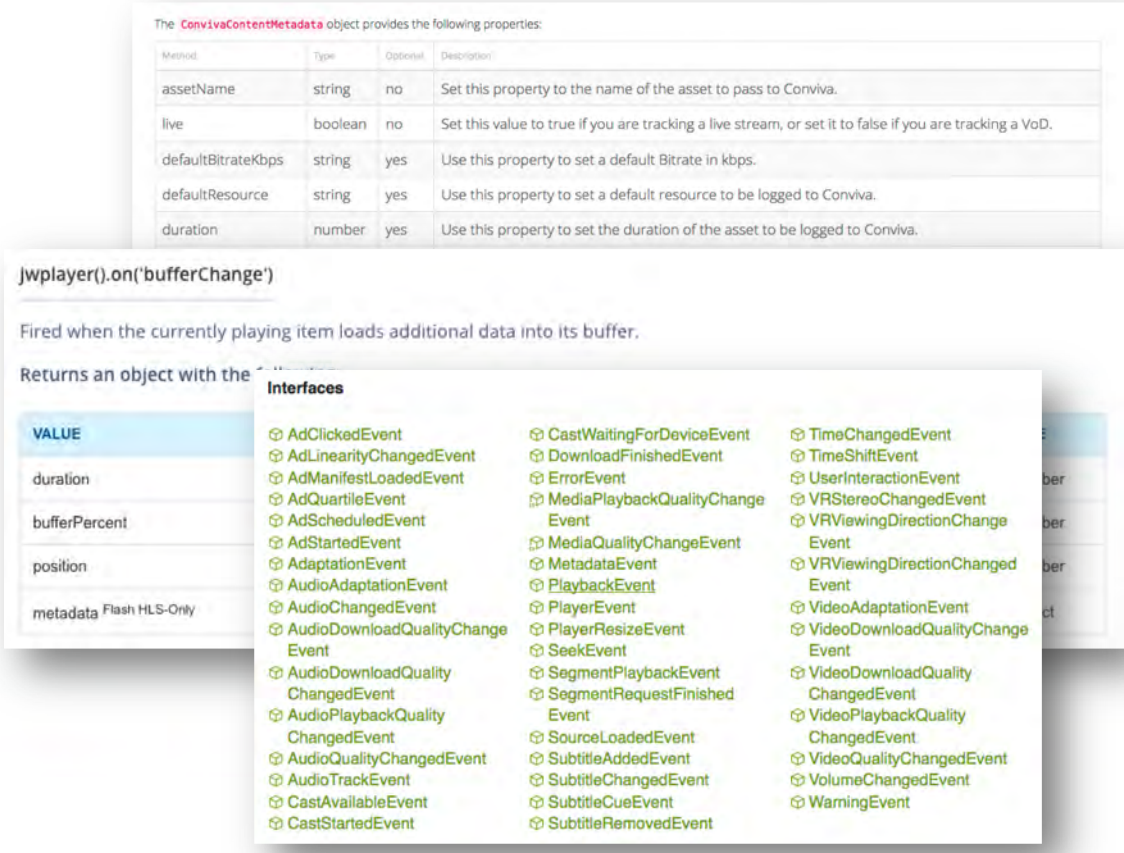
BITMOVIN

THEOplayer

JWPLAYER

dash.js

Shaka



Consumer Technology Association CES

Two main problems with OTT metrics

- Inconsistent events and properties available in players
- Inconsistent calculation and definition of QoE metrics between providers

R04 WG20 Streaming Media Quality of Experience (QoE)

- The CTA established the **R04 WG20 Streaming Media Quality of Experience (QoE)** group in Nov 2016 to create a standard to address the two aforementioned problems in OTT metrics
- Who is the CTA? - The **Consumer Technology Association** (**CTA**), formerly **Consumer Electronics Association** (**CEA**), is a standards and trade organization for the consumer electronics industry in the United States. CTA works to influence public policy, holds events such as the International CES and SINOCES, conducts market research, and helps its members and regulators implement technical standards.
- The goal of this specification is to define a set of device events, properties, *Quality of Experience (QoE)* metrics, associated terminology, and attribute access for representing streaming media quality of experience across systems, players and analytics vendors.

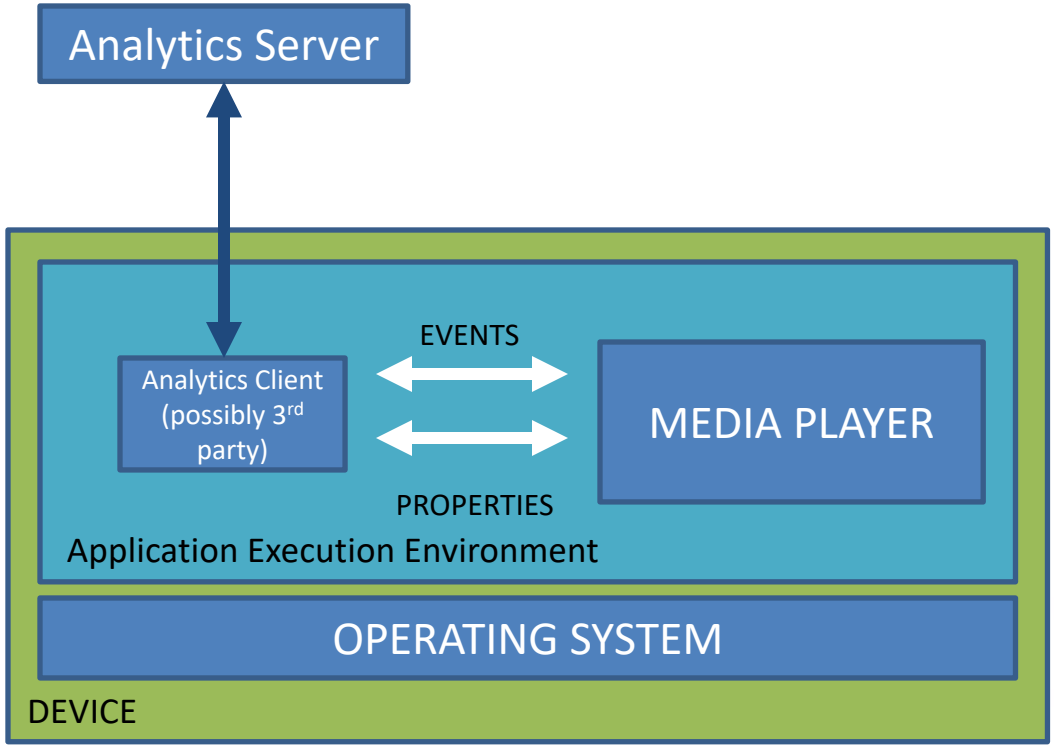
Who's working on the Project?

Initial Input

- Streaming Video Alliance (SVA) produced a white paper on "*Quality of Experience (QoE) Working Group – Recommendations for Standardized Streaming Metrics*" www.streamingvideoalliance.org/download/4482/

- DASH Industry Forum produced a whitepaper on "*Proposed Media metrics for Segmented Media Delivery*" - http://dashif.org/proposedmediametricsforsegmentedmediadelivery-r12/

Generic Player and Analytics Agent



Hierarchy

- Media Player Metadata, Properties and Events
  - How should players provide the information necessary for an analytics client to measure the QoE experience
- Standardized Video View Measurements
  - How to measure the QoE experience within a video view
- Standardized Aggregate Metrics
  - How to collect data across many views

Name	Type	Definition
Device User Agent	String	Contained in the HTTP headers and intended to identify devices requesting online content
assetID	String	An identifier for the video asset being played

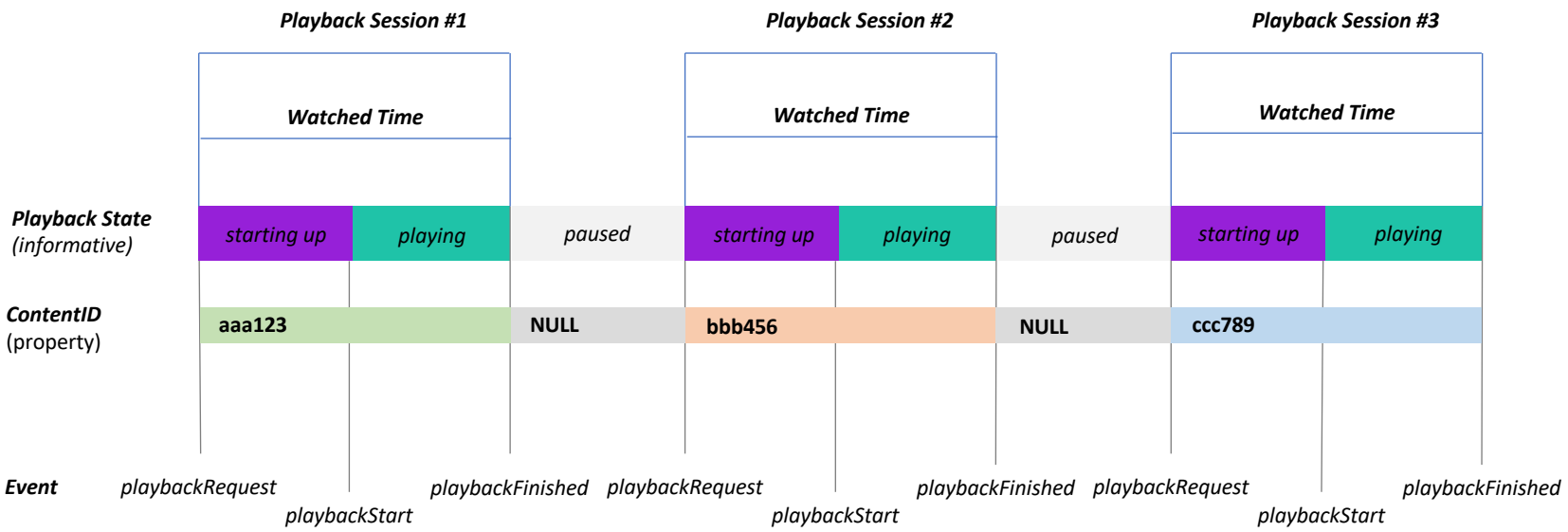
Name	Type	Definition
videoWidth	Integer	The width in pixels of the currently playing video source.
videoHeight	Integer	The height in pixels of the currently playing video source.
playerWidth	Integer	The width of the player viewport.
playerHeight	Integer	The height of the player viewport

Name	Type	Definition
videoWidth	Integer	The width in pixels of the currently playing video source.
videoHeight	Integer	
playerWidth	Integer	
playerHeight	Integer	
sourceReportedBitrate	Integer	
playbackRate	Float	

urce (audio and video

Event name	Definition
playbackFail	Fired when an error occurs that prevents further playback, at any point in a video view. Should only fire once per video view.
playbackRequest	Fired any time the user presses play, or when the media is requested to start automatically.
playbackStart	When the first frame of media (including any inserted ads) is rendered after the player previously was not playing
playbackPause	When the user pauses playback
playbackStall	When the media unintentionally stops playing, usually due to lack of data in the media buffer.
playerResize	The player width, height, or both have changed.
renditionUpdate	The *sourceWidth*, *sourceHeight* or *sourceReportedBitrate* has been updated.

Playback of three independent assets



Note: The time between *playbackFinished* and *playbackRequest,* or *playbackRequest* and *playbackStart* of later assets may be 0ms, but playback still transitions between those states.

Work is not complete yet

Target for spec pub is **Q4 2018**.

Bi weekly calls open to any CTA member – usually on a Thursday at 11am PT. To participate , please contact

- Group Chair: Mr. Olivier Wellmann, Conviva olivier@conviva.com or
- Manager: Mr. Mark Levine, Consumer Technology Association mlevine@cta.tech

</Presentation>