A DASH of History
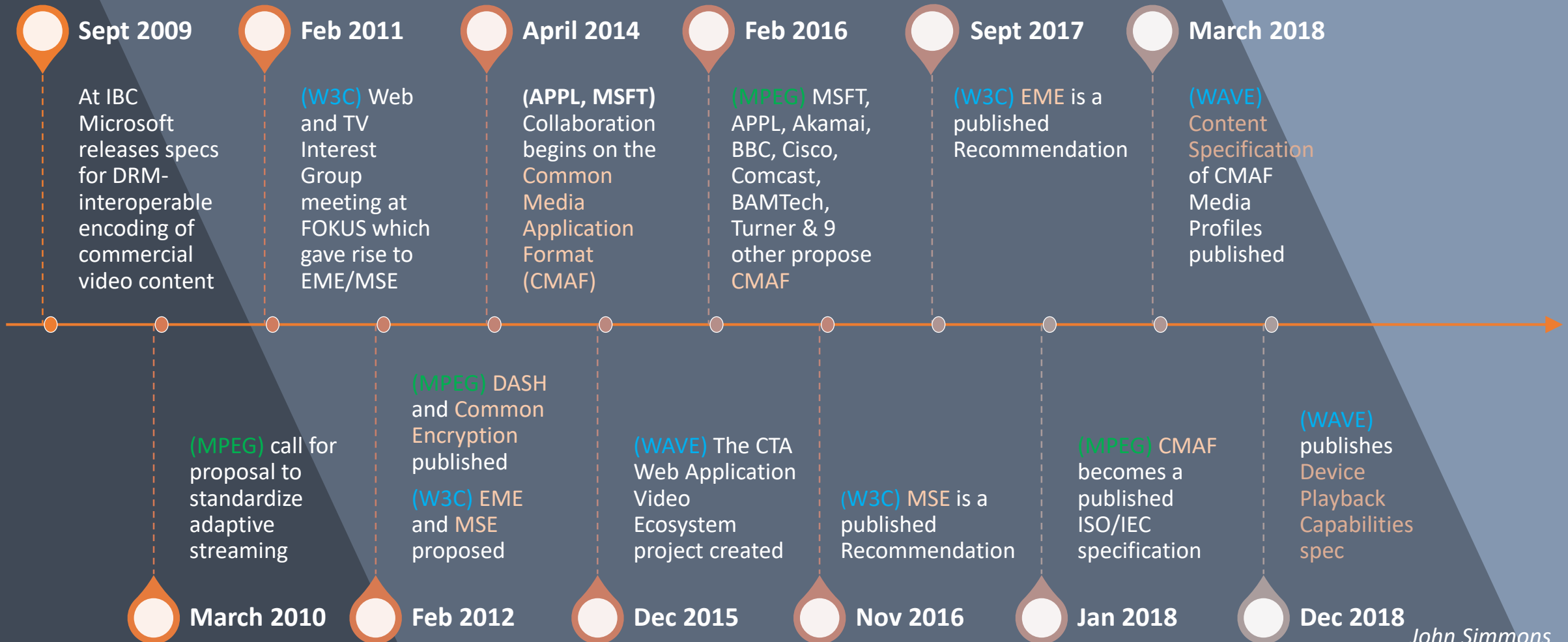*a short history & status of DASH-IF*

Iraj Sodagar

12/010/2019

Milestones for Web Media Portability

Sept 2009

At IBC Microsoft releases specs for DRM-interoperable encoding of commercial video content

Feb 2011

(W3C) Web and TV Interest Group meeting at FOKUS which gave rise to EME/MSE

April 2014

(APPL, MSFT) Collaboration begins on the Common Media Application Format (CMAF)

Feb 2016

(MPEG) MSFT, APPL, Akamai, BBC, Cisco, Comcast, BAMTech, Turner & 9 other propose CMAF

Sept 2017

(W3C) EME is a published Recommendation

March 2018

(WAVE) Content Specification of CMAF Media Profiles published

March 2010

(MPEG) call for proposal to standardize adaptive streaming

Feb 2012

(MPEG) DASH and Common Encryption published

(W3C) EME and MSE proposed

Dec 2015

(WAVE) The CTA Web Application Video Ecosystem project created

Nov 2016

(W3C) MSE is a published Recommendation

Jan 2018

(MPEG) CMAF becomes a published ISO/IEC specification

Dec 2018

(WAVE) publishes Device Playback Capabilities spec

John Simmons
Microsoft Corp.
May 22, 2019

DASH Promoters Group

(Version 1.0)

1. The Purpose of this Agreement. This Agreement sets forth the terms under which I will participate in the development of the Output.   The "DASH Promoters Group" (DASH-PG) is a group of interested parties collaborating on promotion of MPEG's DASH specification (ISO/IEC 23009) in the industry and other standard organizations and consortia. DASH-PG is not a standardization group and will not develop any specific technical output that can be referenced by industry. Capitalized terms are defined in the Agreement's last section.

   DASH-PG will focus on the following tasks in particular (collectively, the "Purpose"):

   - Promoting the utilization of MPEG's DASH standard in various standard organizations and consortia;

   - Aligning, harmonizing and coordinating of DASH standard development and its related standard developments in various standard organizations,

   - Seeking to avoid fragmentation of the multimedia HTTP streaming market by promoting careful and limited profiling of DASH standards [to be created by other standards development organizations] and by promoting the use of common profiles across industry and various standard organizations; and

   - Facilitating interoperability tests and plug-fests to demonstrate the usability and completeness of the DASH standard.

   DASH-PG will not engage in any of the following practices in particular (collectively, the "Excluded Activities"):

   - Developing any technical specification;

   - Defining and/or promoting any de-facto profile, i.e. a profile that is not endorsed by a standard body or industry forum;

   - Defining any specific logos and/or certification program

2. Additional Participants. If I wish to invite new parties to enter into this Agreement, I must first provide all parties who have already entered into this Agreement with written notice of my desire to invite the specified party. If no objections to my invitation are raised within 14 days of my sending that written notice to all such parties, I may extend the invitation.   In addition, if all

12.2. Contribution. "Contribution" means any original work of authorship, including any modifications or additions to an existing work, that I intentionally submit for inclusion in the Output. For the purposes of this definition, "submit" means any form of electronic, oral, or written communication for the purpose of discussing and improving the Output, but excluding communication that I conspicuously designate in writing as not a contribution.

12.3. Control. "Control" means direct or indirect control of more than 50% of the voting power to elect directors of that corporation, or for any other entity, the power to direct management of such entity.

12.4. I, Me, or My. "I," "me," or "my" refers to the Organization signatory below and any entity it Controls.

12.5 Output. "Output" means a Contributions or collection of Contributions produced subject to this Agreement for the Purpose. Output explicitly excludes any materials for Excluded Activities.

12.6. You or Your. "You," "you," or "your" means any person or entity who exercises copyright rights granted under this Agreement, and any person or entity you Control.

By: _____

(Authorized Signature)

Paul Mitchell_____
 (Print Name)

Microsoft Corporation_____
(Organization)

Date: July 6, 2011_____

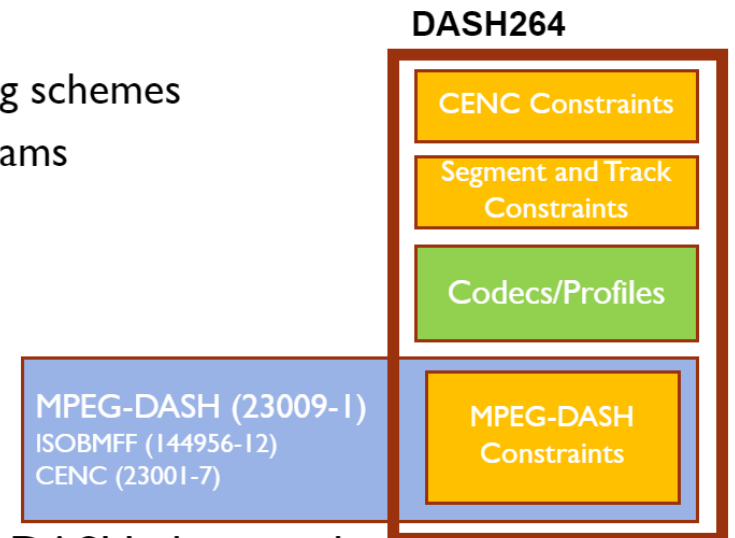# DASH 264: Objective and Approach

2011

▶ Objective:
  ▶ Assist consortia to converge on the same set of solutions
  ▶ Avoid market fragmentation and improve interoperability
▶ Approach:
  ▶ Recommend additional code-points needed for interoperable HTTP streaming solutions
  ▶ Provide clear guidelines for client implementers manufacturers on what needs to be implemente
  ▶ Provides clear guidelines for test cases
▶ DASH264 ideally would be the bounding sol for consortia.

What is in DASH264?

▶ MPEG-DASH ISO BMFF Live and On-Demand Profile of DASH
  ▶ Constraints on addressing schemes
  ▶ Only un-multiplexed streams
  ▶ Closed GOP switching
▶ Codecs
  ▶ AVC , AAC , Timed Text
▶ Common Encryption
▶ Content Profiles
▶ Optionally: API between DASH client and media engine

DASH264

CENC Constraints

Segment and Track Constraints

Codecs/Profiles

MPEG-DASH (23009-1)
ISOBMFF (144956-12)
CENC (23001-7)

MPEG-DASH Constraints

8/15/2012

BYLAWS
OF
DASH INDUSTRY FORUM
A nonprofit nonstock corporation

1. OFFICES

1.1 Principal Office.

The principal office of the Corporation shall be located at 835 Market Street, San Francisco, California, Suite 700, 94103, Attention Iraj Sodagar. The designation of the Corporation's principal office may be changed from time to time by the Board of Directors, which change of address shall be effective upon written notice to all Members.

1.2 Other Offices.

The Corporation may also have offices at such other places, within or without of the State of Delaware, where it is qualified to do business, as its business and activities may require, and as the Board of Directors may, from time to time, designate.

2. PURPOSES

The Corporation shall be a business league not organized for profit within the meaning of Section 501(c)(6) of the Internal Revenue Code of 1986, as amended (the "Code"), or any successor provision, for purposes including, but not limited to the following:

2.1 Promoting the utilization of MPEG-DASH in various standards organizations and consortia;

2.2 Aligning, harmonizing and coordination of MPEG-DASH standard development and related standard developments in various standard organizations and consortia;

2.3 Assisting in avoiding fragmentation of the multimedia HTTP streaming market by creating and promoting careful and limited profiling of the MPEG-DASH standard and by promoting the use of common profiles across industry, consortia and various standard organizations;

2.4 Facilitating interoperability tests and plug-fests to demonstrate the usability and comprehensiveness of the DASH standard; and

2.5 Promoting the adoption and use of MPEG-DASH standards in the industry.

DASH INDUSTRY FORUM

Charter Member Agreement

By the signature of its authorized representative below, the undersigned Charter Member ("Applicant"), including its Affiliates, as defined in the DASH Industry Forum Bylaws ("Bylaws"), agrees to be bound by the terms hereof, as well as the terms and conditions stated in the Certificate of Incorporation, Bylaws, and Intellectual Property Rights Policy of the Dash Industry Forum, any amendments thereto, and the terms of any policies and/or procedures that are adopted by the Board of Directors pursuant to the Bylaws ("Organizational Documents") as may apply to the membership classification stated in the Bylaws. Copies of the DASH Industry Forum Organizational Documents are available for review at the DASH Industry Forum website.

No Charter Member Agreement is binding on the DASH Industry Forum unless accompanied by a first year membership fee of Seventy Five Hundred ($7500.00) dollars (which fee may be deferred by action of the Board of Directors of the Dash Industry Forum for up to thirty (30) days from acceptance hereof)Membership in the DASH Industry Forum is generally open to any entity supportive of DASH Industry Forum's Purpose as defined in the Bylaws, that has executed the Charter Agreement, and paid the appropriate fees.

This Agreement must be signed by a representative of the Applicant that is authorized to commit the Applicant to all of the terms of this Agreement. By signing this Agreement, the Applicant hereby represents and warrants that the person signing this Agreement has been so authorized, has read and understood this Agreement and all other Organizational Documents, and has sought or waived the right to seek legal counsel prior to executing this Agreement.

The initial membership term ("Initial Term") shall be for a period of two years although the second year membership fee dollars will not be due and payable until Applicant's first anniversary date. After the Initial Term, the term of membership shall be on a year to year basis. Annually, the DASH Industry Forum will invoice the then current renewal fee to Applicant ninety (90) days prior to the anniversary date of Applicant's membership and Applicant's payment thereof shall constitute a renewal of membership as a Member, as defined in the Bylaws. Failure to make a timely renewal payment shall be cause for suspension and termination of membership and member benefits in accordance with the relevant provisions of the Bylaws.

1ˢᵗ Board Meeting

DASH Industry Forum

Meeting Minutes
August 17, 2012

Opening:

The first meeting of the Board of Directors of the DASH Industry Forum was held via Teleconference on Friday, August 17, 2012, at 8:00 a.m. PST.

Present:

Will Law	Akamai Technologies
David Price	Ericsson Television Inc.
Iraj Sodagar	Microsoft Corporation
Mark Watson	Netflix
Michael Luby	Qualcomm Incorporated
Jaeyeon Song	Samsung Electronic
Peggy Moloney	Microsoft Corporation
David Rudin	Microsoft Corporation
David Daggett	Davis Wright Tremaine

A. Agenda

    a. Incorporator's Appointment of the Company Representatives to the Board of Directors

    b. DASH IF Meeting Resolutions

        i. Approval of Appointment of Temporary Secretary to Conduct Organization Meeting

        ii. Approval for Filing of Articles of Incorporation

IBC 2012

Industry Leaders Transform DASH Promoters Group into DASH Industry Forum to Further Accelerate the MPEG-DASH Standard for Internet Streaming —

AMESTERDAM, The Netherlands, SEPT 07, 2012 -- Today the members of DASH Promoters Group announced the establishment of a new legal entity, the DASH Industry Forum (DASH-IF), to advocate and accelerate further adoption of the MPEG-DASH (Dynamic Adaptive Streaming over HTTP) standard. All activities of the DASH Promoters Group were transferred to DASH-IF, which is now responsible for the promotion and adoption of DASH. MPEG-DASH published by ISO/IEC as ISO/IEC 23009-1 in April 2012. This standard is designed to address the dramatic growth of broadband video by defining a universal delivery format that provides end users with the best possible video experience by dynamically adapting to changing network conditions. DASH-IF will promote the market adoption of MPEG-DASH, publish interoperability and deployment guidelines, facilitate interoperability tests and collaborate with standard bodies and industry consortia in aligning ongoing DASH standards development and the use of common profiles across industry organizations.

The DASH Promoters Group (DASH-PG) was established in February 2012, by several industry leaders who contributed to the MPEG-DASH standard. Since its membership grew rapidly to over 60 members, the group believed that a formal entity could better serve the promotion of MPEG-DASH and therefore, established the DASH-IF. DASH-IF is an incorporated non-profit organization overseen by its Board of Directors and currently consists of three working groups. The Interoperability Working Group currently focuses on the development of DASH264, a set of interoperability guidelines, associated test vectors and software tools for building interoperable streaming solutions. DASH264 will provide a rich set of test cases, test vectors and software tools that enables service providers, operators, encoding and client vendors to build and deploy MPEG-DASH compliant solutions. The Promotion Working Group uses solutions from various members to demonstrate the real-world end-to-end Internet streaming deployment scenarios. Finally the Liaison Working Group coordinates DASH-IF activities with standard bodies and industry consortia through formal communications.

DASH Industry Forum

□ Founded with completion of MPEG standard in 08/12

□ Mission

    — Addressing the dramatic growth of broadband video by recommending a universal delivery format that provides end users with the best possible media experience by dynamically adapting to changing network conditions.

□ Objectives:

    — Promote and catalyze market adoption of MPEG-DASH

    — Publish interoperability and deployment guidelines

    — Facilitate interoperability tests

    — Collaborate with standard bodies and industry consortia in aligning ongoing DASH standards development and the use of common profiles across industry organizations

□ Please check and join at http://dashif.org

MPEG DASH 3rd Edition

International Organization for Standardization

- **Publication date :** 2019-07

3rd Edition: ISO/IEC 23009-1:2019

2nd Edition
ISO/IEC 23009-1:2014

1. Server-client NTP sync
2. Extended profiles
3. SRD
4. URL param insertion
5. Role extensions
6. AuthN/AuthZ
7. NTP anchor
8. External MPD link
9. Period continuity
10. Generalized HTTP header extensions & queries tracks in DASH

11. Content annotation & client selection
12. Server-client NTP sync
13. Content annotation & client selection
14. Signaling for quality
15. Flexible segment & Broadcast TV profile
16. MPD chaining
17. MPD fallback
18. Preselections
19. Data URLs in MPD
20. Labels
21. Switching cross adaptation sets

✓

Revisions / Corrigenda

Previously
⊙ ISO/IEC 23009-1:2014
⊙ ISO/IEC 23009-1:2014/Amd 1:2015
⊙ ISO/IEC 23009-1:2014/Amd 2:2015
⊙ ISO/IEC 23009-1:2014/Amd 3:2016
⊙ ISO/IEC 23009-1:2014/Cor 1:2015
⊙ ISO/IEC 23009-1:2014/Cor 2:2015

Now
⊙ ISO/IEC 23009-1

Corrigenda/Amendments
⊗ ISO/IEC 23009-1/DAmd 1

The MPEG Standard Update

MPEG DASH 4th Edition

4th Edition: ISO/IEC 23009-1:20XX

3rd Edition
ISO/IEC 23009-1:2019

Amd 5

COR3

- Amendment 5 and COR 3 developed in 2018 and 2019

MPEG DASH 4th Edition

4th Edition: ISO/IEC 23009-1:20XX

3rd Edition
ISO/IEC 23009-1:2019

✔

1. Service Description
2. Initialization Sets, Groups and Presentation
3. Failover Content
4. Missing content segment signaling
5. Producer Reference Time
6. Leap second information
7. Content Popularity Rate
8. Device information metrics
9. Additional Role values
10. SegmentTimeline for low latency
11. Exact placement of content in Period
12. Preselection conformance rules
13. Representations' quality equivalent signaling
14. Improving Inband events timing signaling
15. Reference resolution w.r.t. Location element

- FDIS: Issued in September 2019

MPEG DASH beyond 4ᵗʰ edition

4ᵗʰ Edition: ISO/IEC 23009-1:20XX

> **3ʳᵈ Edition**
> ISO/IEC 23009-1:2019
>
> ✓

ISO/IEC 23009-8: Session Based DASH operations
- Forensic water marking

AMD1
- Event and timed metadata processing model
- DASH profile for CMAF content
- Random access signaling for low latency

Technologies under consideration
- Pro-roll ad support
- Ads with Early Termination capabilities
- Dynamic storytelling
- VBR signaling

CMAF Specifications

ISO — International Organization for Standardization

Common media application format (CMAF)

- CMAF data and timing model
- File format constraints
- Chunk, Fragment, Segment, Track constraints
- Media profiles (video, audio, subtitle)
- Common encryption modes
- Media presentation profiles

23000-19:2018 ✓

AMD1
- Scalable HEVC media profile
- MPEG-H audio profile

✓

AMD2
- xHE-AAC media profile
- IMSC1.1 media profiles
- Supplemental data brands
  - CEA-608/708 SEI

✓

AMD3
- cmf2 brand
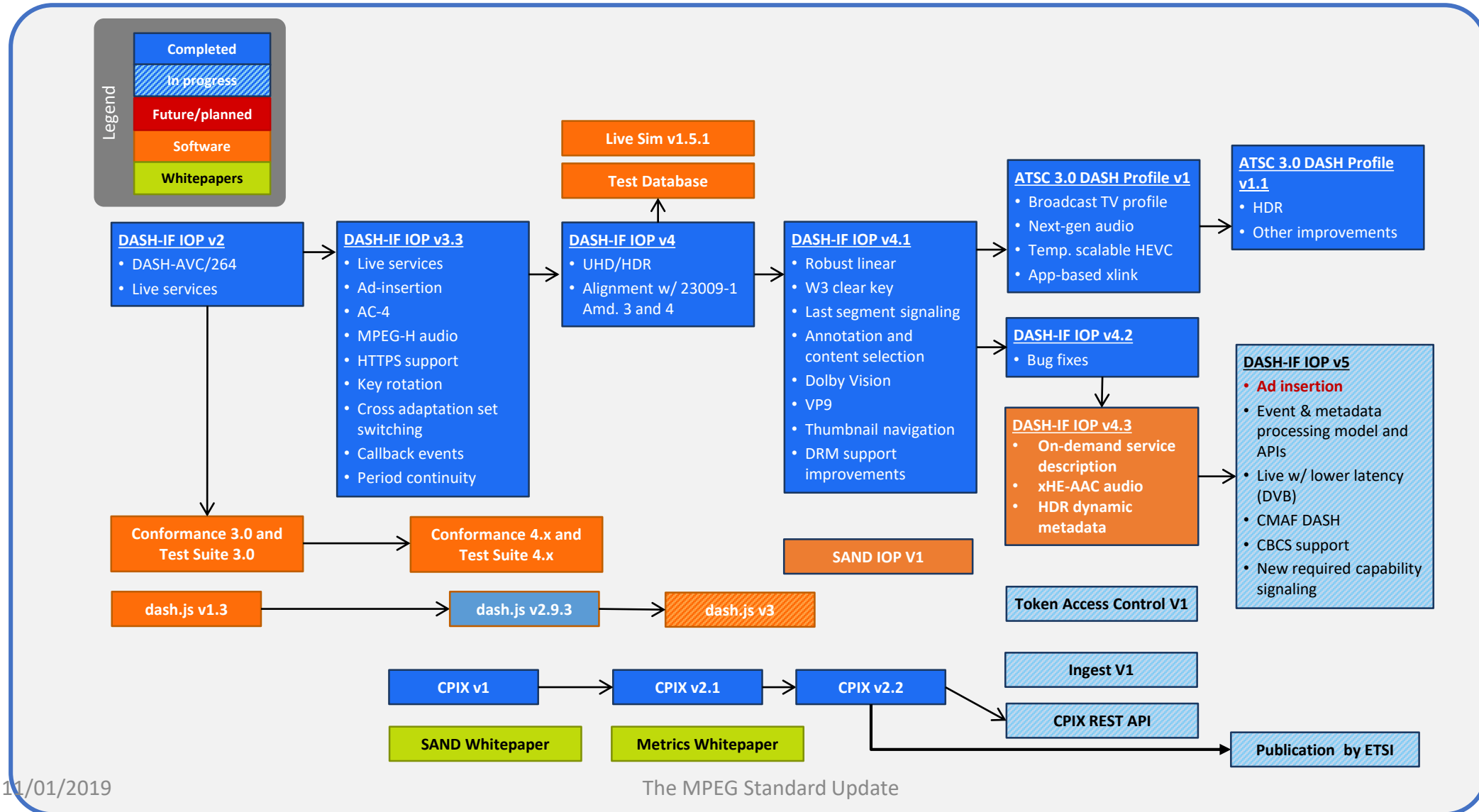- Fixes on HEVC profiles

✓

2nd Edition 23000-19:201x

TuC
- Sequencing & slicing CMAF presentation
- Random access vs Switching addressable objects
- Sparse timed metadata tracks
- New media profiles

Exploration
- Multistream support

DASH-IF Current Workplan

Legend:
- **Completed**
- **In progress**
- **Future/planned**
- **Software**
- **Whitepapers**

Live Sim v1.5.1

Test Database

DASH-IF IOP v2
- DASH-AVC/264
- Live services

DASH-IF IOP v3.3
- Live services
- Ad-insertion
- AC-4
- MPEG-H audio
- HTTPS support
- Key rotation
- Cross adaptation set switching
- Callback events
- Period continuity

DASH-IF IOP v4
- UHD/HDR
- Alignment w/ 23009-1 Amd. 3 and 4

DASH-IF IOP v4.1
- Robust linear
- W3 clear key
- Last segment signaling
- Annotation and content selection
- Dolby Vision
- VP9
- Thumbnail navigation
- DRM support improvements

ATSC 3.0 DASH Profile v1
- Broadcast TV profile
- Next-gen audio
- Temp. scalable HEVC
- App-based xlink

ATSC 3.0 DASH Profile v1.1
- HDR
- Other improvements

DASH-IF IOP v4.2
- Bug fixes

DASH-IF IOP v4.3
- On-demand service description
- xHE-AAC audio
- HDR dynamic metadata

DASH-IF IOP v5
- Ad insertion
- Event & metadata processing model and APIs
- Live w/ lower latency (DVB)
- CMAF DASH
- CBCS support
- New required capability signaling

Conformance 3.0 and Test Suite 3.0

Conformance 4.x and Test Suite 4.x

SAND IOP V1

Token Access Control V1

dash.js v1.3

dash.js v2.9.3

dash.js v3

CPIX v1

CPIX v2.1

CPIX v2.2

Ingest V1

CPIX REST API

SAND Whitepaper

Metrics Whitepaper

Publication by ETSI

Where to Find DASH-IF's Resources

- Website: http://dashif.org

- Guidelines: http://dashif.org/guidelines/

- Test assets: https://testassets.dashif.org/

- Conformance: https://conformance.dashif.org/

- Software and document projects : https://github.com/Dash-Industry-Forum/

- Academic events: https://dashif.org/academic/

- For joining: https://dashif.org/membership/

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To lead and impact:
Join DASH-IF!