

CTA WAVE Streaming Media Test Suite - Devices

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What are CTA and WAVE?

- CTA = Consumer Technology Association
 - ANSI approved standards organisation
 - Trade association for the US market
- WAVE = a project hosted by CTA, "Web Application Video Ecosystem"
 - WAVE aims to improve how internet-delivered commercial video is handled on consumer electronics devices and to make it easier for content creators to distribute video to those devices.

Online: <https://www.cta.tech/Resources/Standards/WAVE-Project>

WAVE Deliverables Specifications and Test Suites / Test Tools

- Specifications - <https://www.cta.tech/Resources/Standards/WAVE-Project#specs>
 - Fast and Readable Geographical Hashing (CTA-5009-A) Published June, 2024
 - Device Playback Capabilities Specification (CTA-5003-A) Published Sept. 2023
 - Common Media Server Data (CTA-5006) Published Dec. 2022
 - Web Media API Snapshot 2023 (CTA-5000-F) Published Oct. 2023
 - Content Specification (CTA-5001-E) Published Dec. 2022
 - DASH-HLS Interoperability Specification (CTA-5005-A) Published June 2023
 - Common Media Client Data (CTA-5004) Published Sept. 2020
- Test suites and test tools
 - Web Media API Snapshot
 - Device Playback Capabilities
 - Contributor to updates to DASH-IF validator (with ATSC, DASH-IF, DVB, HbbTV)

Device Playback Capabilities Specification (CTA-5003-A)

5 Architecture and Device Reference Model

6 Media Playback Model

7 DRM Protected Media

8 **Single-Track Media Playback Requirements**

9 **WAVE Content Playback Requirements**

10 General CMAF Requirements and Tests

11 **Video Media Profiles**

12 Audio Media Profiles

13 Subtitle Media Profiles

14 Other Playback Requirements

15 Device Core Profiles

16 Device Extension Profiles

17 Configurations

Annex A Device Capability Discovery

Annex B Relevant HTML-5 APIs

Annex C Test Content Format Specification

- Sequential Track Playback

- Random Access to Fragment/Time

- Switching Set Playback

- Playback of Chunked Content

- Playback over WAVE Baseline Splice Constraints

- Out-Of-Order Loading

- Overlapping Fragments

- Full Screen Playback of Switching Sets

- Playback of Encrypted Content

- Source Buffer Re-Initialization

- Buffer Underrun and recovery

- Low Latency Playback

- Regular Playback of a CMAF Presentation

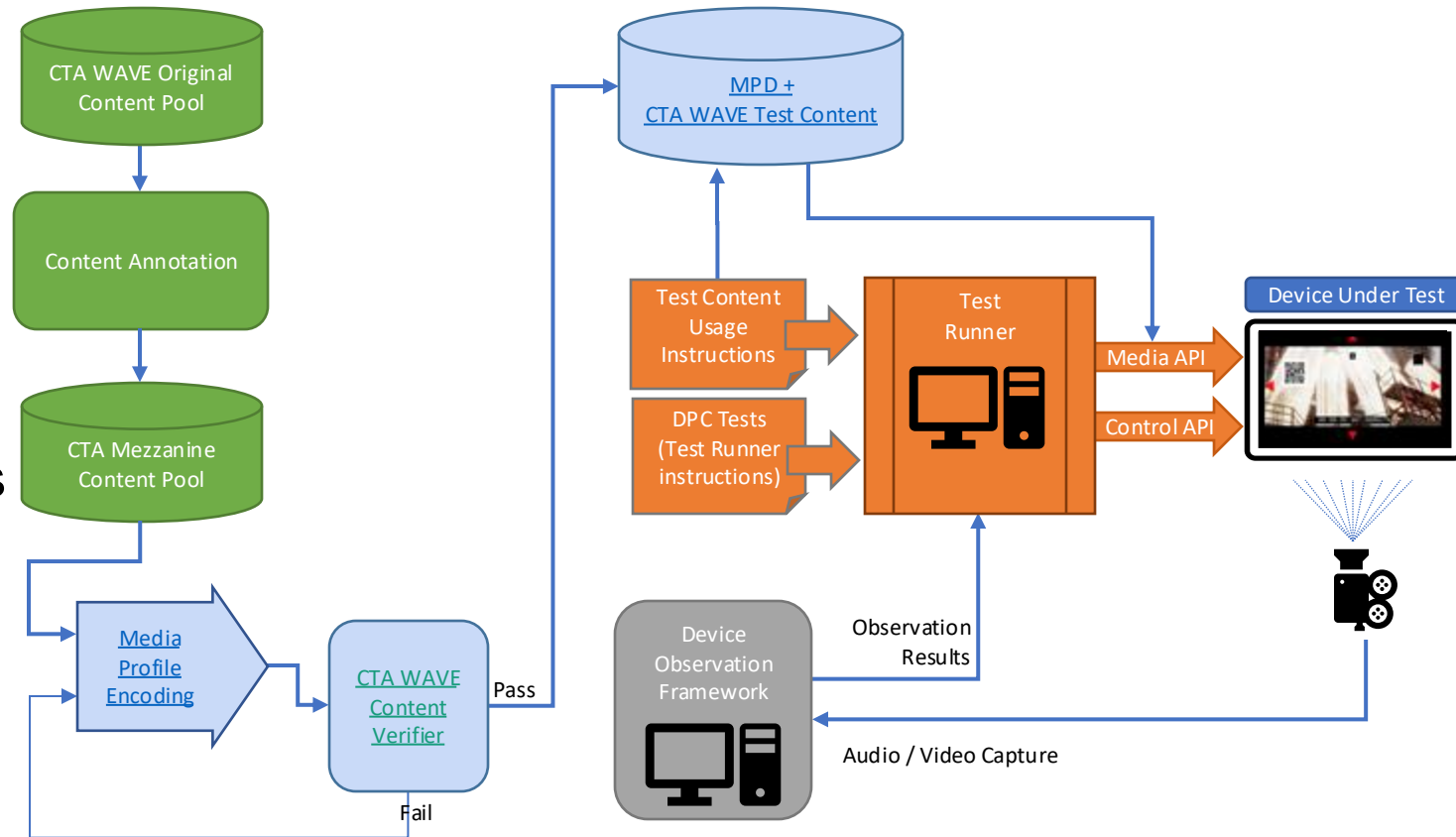
- Random Access of a CMAF Presentation

- Splicing of WAVE Program with Baseline Constraints

CTA WAVE Streaming Media Test Suite - Devices

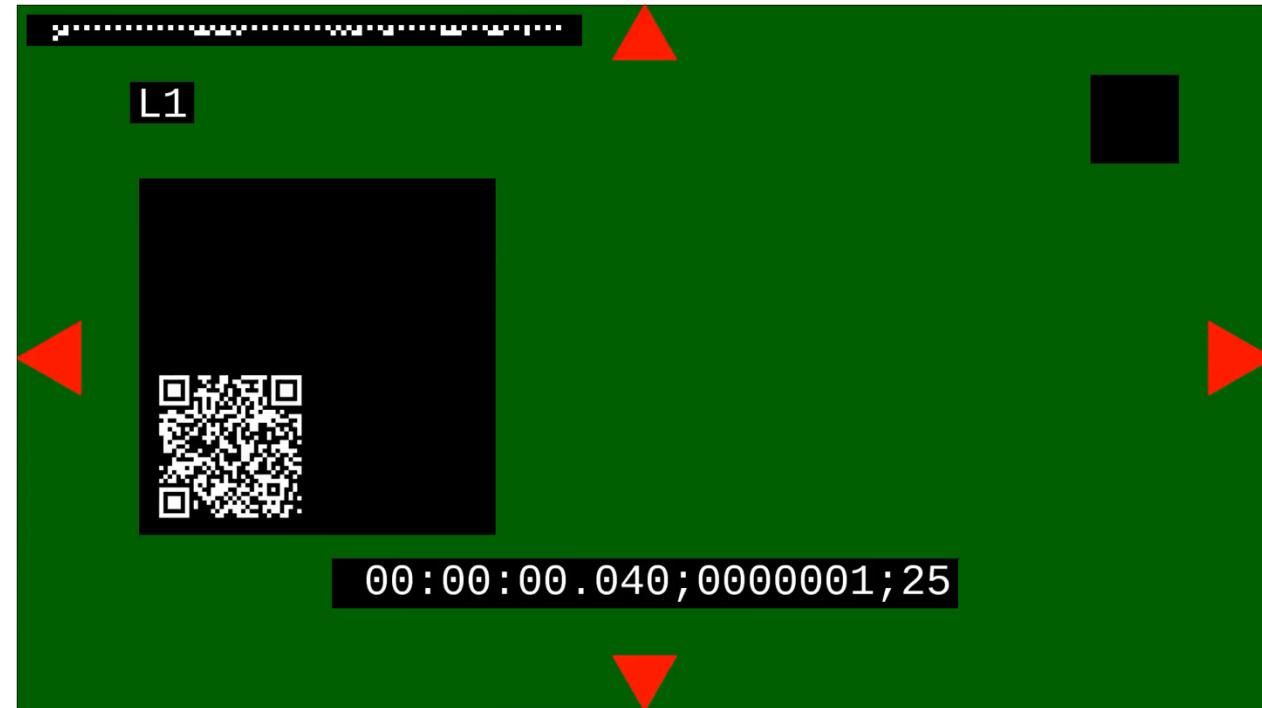
Main Components

1. Mezzanine Content
[[GitHub](#)]
2. CMAF Test Content
[[GitHub](#)]
3. Test Runner (TR)
[[GitHub](#)]
4. HTML & JavaScript Templates
[[GitHub](#)]
5. Observation Framework (OF)
[[GitHub](#)]



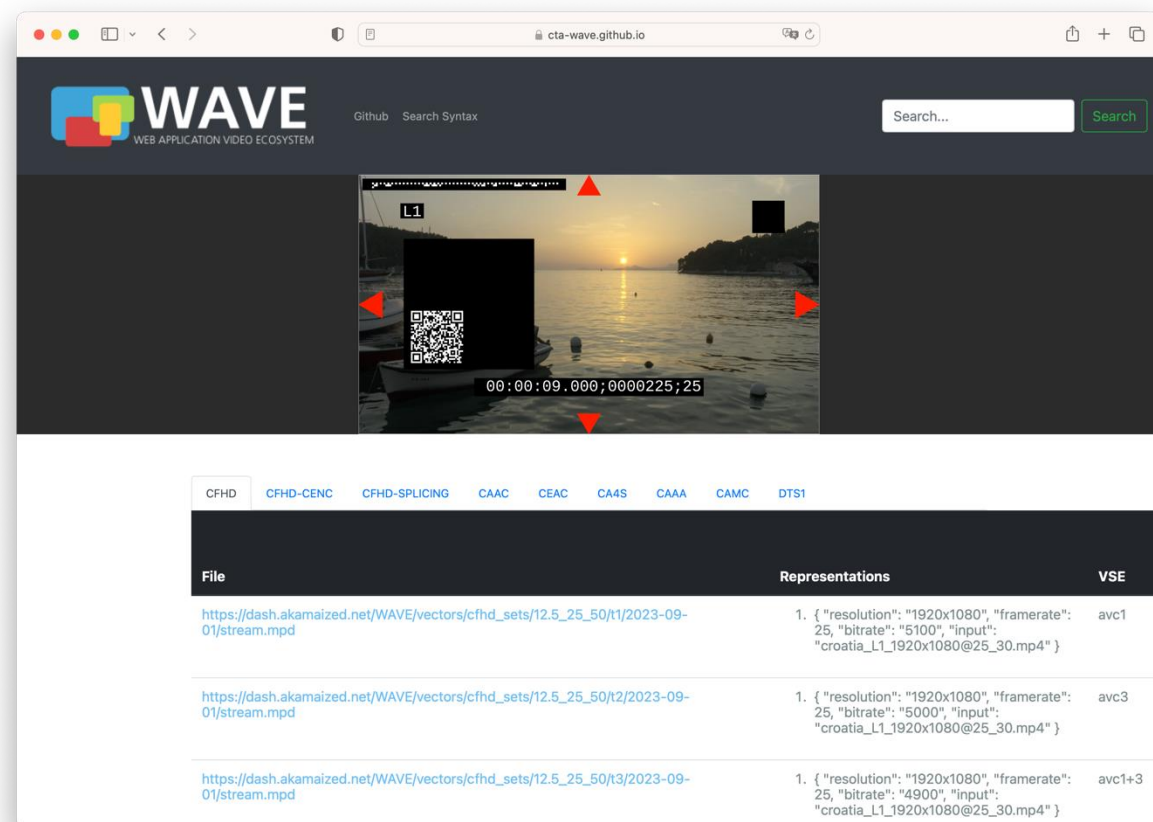
Mezzanine Content

- Annotated video content in many different resolutions
 - Based on big buck bunny for 60Hz and fractional frame rates & an EBU sequence from Croatia for 50Hz.
 - Green frame on the start and red frame on the end.
- Annotations burnt into the video
 - Rotating QR code for observation framework.
 - Human-readable text for debugging.
 - Same information as in the QR code.
 - Bit pattern for TV manufacturer in-house use.
 - Flashing square with beeps for simple A/V sync testing.
 - Red triangles to check all content is visible.
- Audio content based on pseudo-random noise.
 - Observation framework can reconstruct a timeline from this



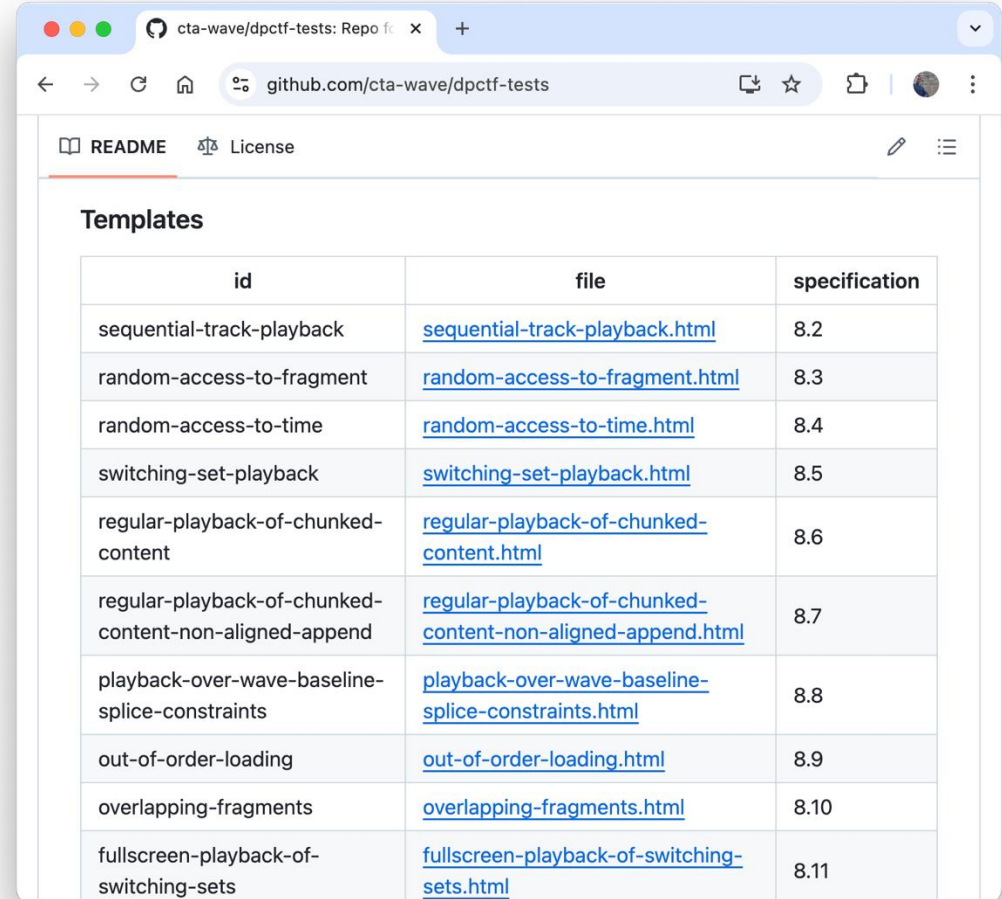
CMAF Test Content

- Encoded & validated mezzanine content.
 - CMAF media segments / fragments.
 - Metadata describing media segments provided in the form of a DASH MPD.
- 4 groups of streams encoded for each technology
 - Testing combinations of content options.
 - Testing content options individually for debugging.
 - Resolutions for testing CMAF switching sets.
 - Special content for testing splicing, encryption, ...
- For each codec, streams to encode are defined in a sparse matrix.
- Validation in two phases
 - DASH-IF aka 'JCCP' validator checks the content is valid CMAF.
 - Script reads in the sparse matrix & checks each stream has the correct content options, resolution, CMAF profile and other properties.



HTML & JavaScript Templates

- Media codec / technology independent
 - Exercise MSE (and EME) playback.
 - Algorithms documented in clauses 8 & 9 of WAVE Device Playback Specification.
 - Common library that reads and plays CMAF content based on metadata in DASH MPD.
- Mixture of templates for either video or audio or for both video+audio.
- Examples:
 - **Sequential Track Playback:** Play a CMAF video or audio track from beginning to end.
 - **Random Access to Fragment, Random Access to Time:** Play a CMAF video or audio track from somewhere in the middle.
 - **Switching Set Playback:** Play a CMAF switching set, switching between tracks at various points.
 - **Playback over WAVE Baseline Splice Constraints:** Playback switching from one CMAF track to a second and back again.
 - **Buffer Underrun and Recovery:** Playback terminating.



id	file	specification
sequential-track-playback	sequential-track-playback.html	8.2
random-access-to-fragment	random-access-to-fragment.html	8.3
random-access-to-time	random-access-to-time.html	8.4
switching-set-playback	switching-set-playback.html	8.5
regular-playback-of-chunked-content	regular-playback-of-chunked-content.html	8.6
regular-playback-of-chunked-content-non-aligned-append	regular-playback-of-chunked-content-non-aligned-append.html	8.7
playback-over-wave-baseline-splice-constraints	playback-over-wave-baseline-splice-constraints.html	8.8
out-of-order-loading	out-of-order-loading.html	8.9
overlapping-fragments	overlapping-fragments.html	8.10
fullscreen-playback-of-switching-sets	fullscreen-playback-of-switching-sets.html	8.11

Test Runner (TR)

- The CTA WAVE Test Runner is built on top of W3C Web Platform Tests (WPT) to make tests accessible on embedded devices (TVs/STBs)
 - Remote server manages test sessions and results
 - Custom wrapper executes tests in single window
 - Configure session using companion device by scanning QR code
 - REST API for full automation and integration into other systems and workflows
 - Companion web app to configure, run and monitor test sessions running on DUT (Device under Test)
 - Export test results as JSON or HTML

CTA WAVE Streaming Media Test Suite

[GitHub - DPCTF Specification](#)

New test 



Session Configuration

Token e7d95f7c-2416-11ef-bf33-0242ac110003
Expires 06/06/2024, 17:40:26
Labels
Filters
Exclude Filters
Test Groups

One or more beta test selected. For more information please see [the docs](#)

- > ca4s-local
- > ca4s-online
- > caaa_sets-local
- > caaa_sets-online
- > caac_sets-local
- > caac_sets-online
- > camc_sets-local
- > camc_sets-online
- > ceac-local
- > ceac-online
- > cfhd_12.5_25_50-local
 - /cfhd_12.5_25_50-local/buffer-underrun-and-recovery__t2.html validated
 - /cfhd_12.5_25_50-local/fullscreen-playback-of-switching-sets__ss1-1.html validated
 - /cfhd_12.5_25_50-local/fullscreen-playback-of-switching-sets__ss1-2.html validated
 - /cfhd_12.5_25_50-local/low-latency-initialization__t2.html validated
 - /cfhd_12.5_25_50-local/low-latency-playback-over-gaps__t2.html beta
 - /cfhd_12.5_25_50-local/low-latency-short-buffer-playback__t2.html validated
 - /cfhd_12.5_25_50-local/mse-appendwindow__t1.html validated

Resume

Last session

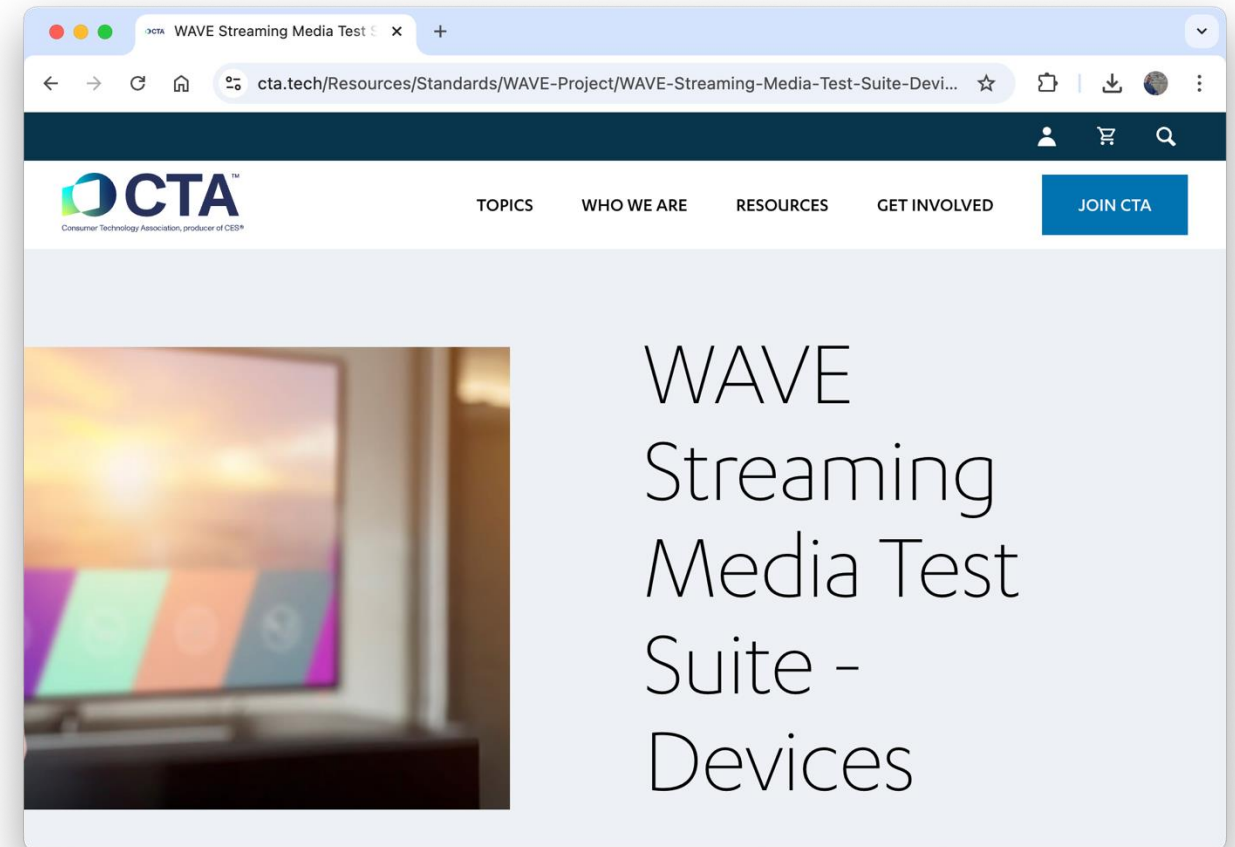
Observation Framework (OF)

- Processes recordings from the camera and reports results to the test runner.
 - Results are merged into the results from when the test was run.
- Two steps:
 - Extraction of QR codes from the recording.
 - Processing of data from QR codes against test procedures in the WAVE Device Playback Specification (CTA-5003).
- OF can be run on the same device as runs the test runner or a different (faster) device.
 - OF can be installed either as a docker image or directly.
- OF generates log files and debug output for developers to analyze when a device is reported as failing.



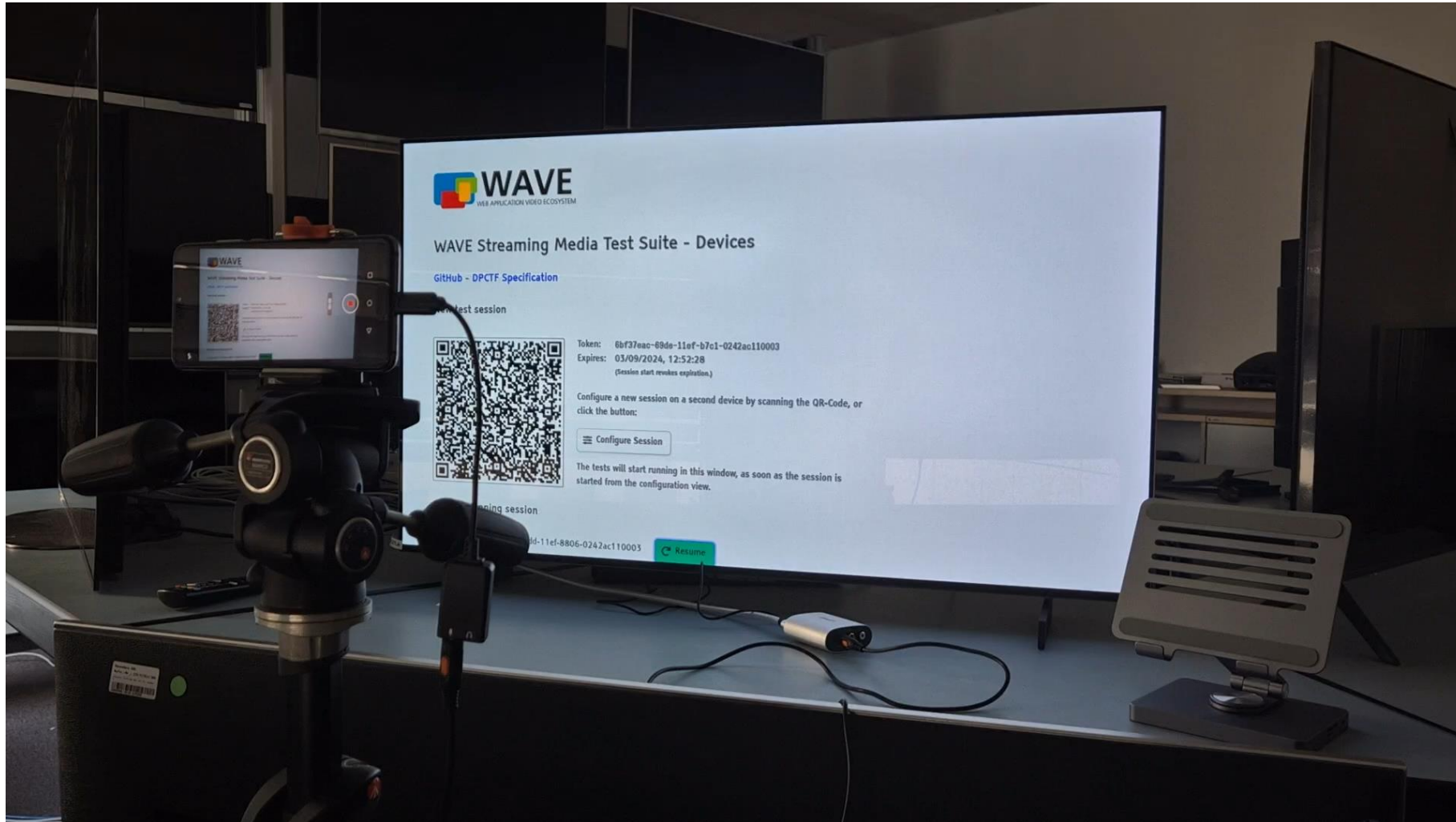
Where to start?

- Visit the CTA WAVE Landing Page of the Test Suite and read the description: [LINK](#)
- View and read the Test Suite Explainer carefully
- Visit the Test Suite main GitHub Repo: [dpctf-deploy](#) and follow the instructions in the README



Source: <https://www.cta.tech/Resources/Standards/WAVE-Project/WAVE-Streaming-Media-Test-Suite-Devices>

Demo at Fraunhofer FOKUS TV Lab



Technical Requirements

- OS:
 - Unix-like systems: **Linux**, Mac, Windows with WSL2 (without Docker Desktop)
 - Windows with Docker Desktop
 - Linux is the preferred system due to docker native support
- Docker
- TLS server certificates (Important for encrypted tests using EME)
- Camera: Recording & analysing 50/60Hz video playback needs camera recording at 120Hz
 - Validation done with top of the range mobile phone, e.g. Samsung S23+ or equivalent

Example of Failing Observations

cfhd_12.5_25_50-local: All Results

Test files: 1; Total subtests: 6

Test Files

1. /cfhd_12.5_25_50-local/low-latency-playback-over-gaps__t2.html

Test	Show/Hide Messages	Xx01
/cfhd_12.5_25_50-local/low-latency-playback-over-gaps__t2.html		
Test workflow		PASS
[OF] Every video frame S[k,s] shall be rendered and the video frames shall be rendered in increasing presentation time order.		FAIL
Xx01: First frame found is 8, expected to start from 1. First frame number tolerance is 0. Last frame found is 251, expected to end at 750. Last frame number tolerance is 0. Mid frame number tolerance is 10. Total of missing frame count is 506. Last frame detected before gap 115 exceeded 'stall_tolerance_margin'=7.5 frames of expected frame 125.		
[OF] Video: The playback duration shall match the duration of the CMAF Track		FAIL
Xx01: Playback duration 10089.88ms does not match expected duration 9760.0ms +/- tolerance of 50ms. Detected duration is different by 329.88ms. Allowed tolerance is 50ms and duration frame tolerance is 0. Starting missing frame number is 7. Ending missing frame number is 499.		
[OF] Video: The presented sample shall match the one reported by the currentTime value within the tolerance.		PASS
Xx01: Total failure count is 0. Tolerances: +/- (1 frame(s) + 150ms.)		
video ended event fired		PASS
video remains in waiting state until skipping over the gap		PASS

Validation at HbbTV Plugfests / Testing Events

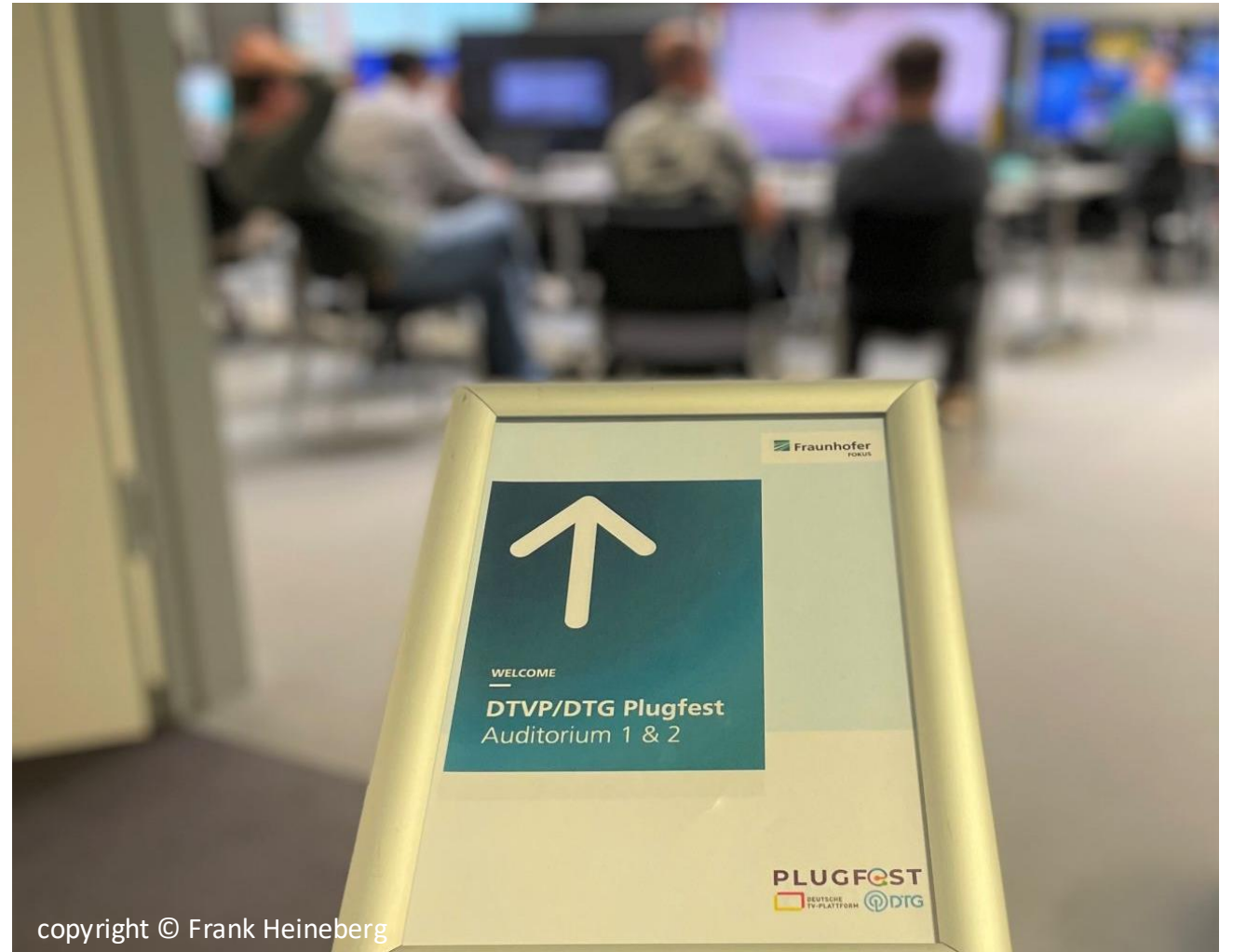
- Previous HbbTV Plugfests/Testing Events
 - Feb. 2023 DTG/London
 - Jun. 2023 Fraunhofer/Berlin
 - Oct. 2023 Kineton/Naples
 - Feb. 2024 DTG/London
 - Jun. 2024 Kineton/Milan
- Next HbbTV Plugfests/Testing Events
 - Oct. 2024 Fraunhofer/Berlin



2024 DTVP / DTG Plugfest + HbbTV Testing Event, October 07-11
Hosted by Fraunhofer FOKUS

Monday 07.10.	DTVP / DTG Plugfest* HbbTV, UHD, DVB-E, NGA Start time: 10:00	
Tuesday 08.10.	DTVP / DTG Plugfest* HbbTV, UHD, DVB-E, NGA	
Wednesday 09.10.	DTVP / DTG Plugfest* ½ Day	HbbTV Testing Event** (in-person and remote) ½ Day
Thursday 10.10.	HbbTV Testing Event** (in-person and remote)	
	HbbTV Testing Group Meeting***	
Friday 11.10.	HbbTV Testing Event** (in-person and remote) End time: 16:00	

* DTVP/DTG/HbbTV members: free
** DTVP/DTG/HbbTV members: free
*** HbbTV testing group meeting only

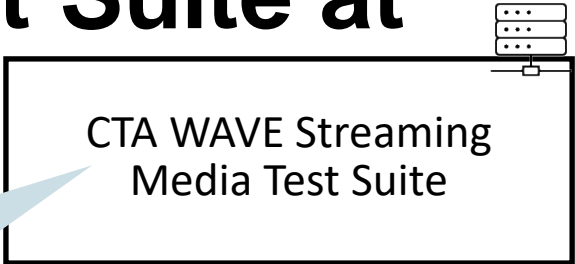


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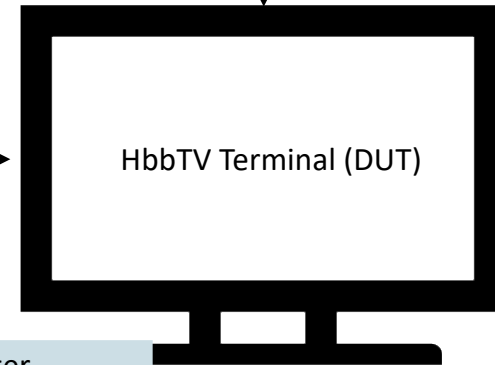
CTA WAVE Streaming Media Test Suite at HbbTV Berlin Plugfest



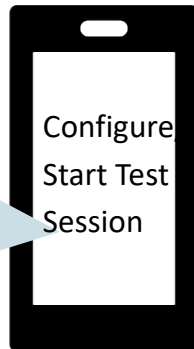
Ubuntu VM at Fraunhofer FOKUS Data Centre



2 Launch Test Runner Landing Page

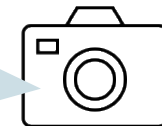


Any Smartphone to scan QR code of Session configure, Start and monitor session



3

Recording for Later observation. We used a Smartphone with 120FPS (Disabled some features like auto-focus,...)



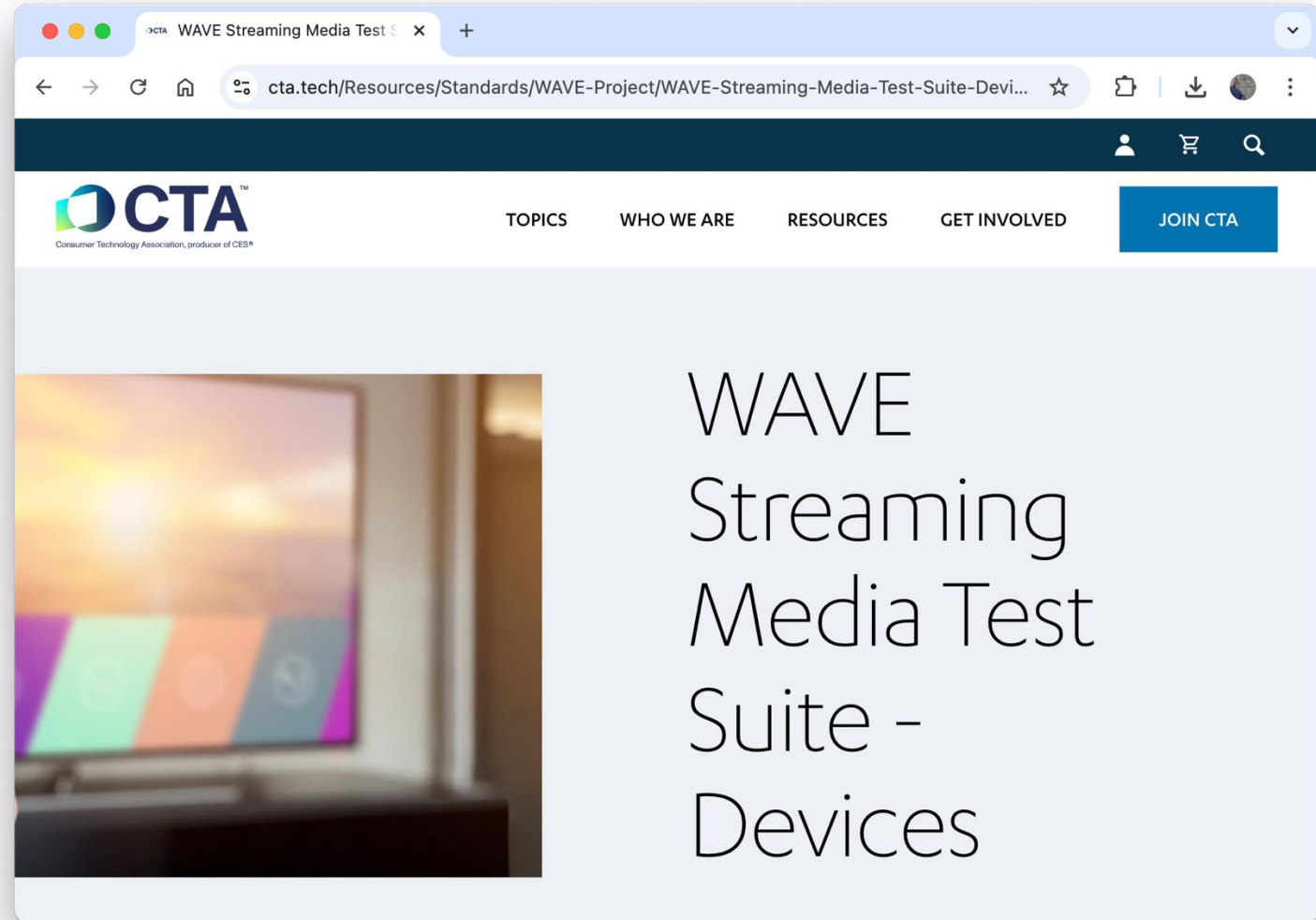
4

Recording

Plugfest Results Summary

#	Status	Start	End	Duration	Test F	HbbTV Version	PASS	FAIL	TIMEOUT	NOT RUN
1	completed	26/06/2023,	26/06/202	00:22:38	26/26	HbbTV/1.6.1	42	1	4	0
2	completed	26/06/2023,	26/06/202	00:22:39	26/26	HbbTV/1.6.1	44	1	3	0
3	completed	26/06/2023,	26/06/202	00:18:27	26/26	HbbTV/1.6.1	50	1	0	0
4	completed	26/06/2023,	26/06/202	00:20:27	26/26	HbbTV/1.5.1	50	1	0	0
5	completed	26/06/2023,	26/06/202	00:19:08	26/26	HbbTV/1.6.1	50	1	0	0
6	completed	27/06/2023,	27/06/202	00:21:19	26/26	HbbTV/1.5.1	48	1	1	0
7	crashed	27/06/2023,	14:42:09		20/26	HbbTV/1.6.1	24	0	8	0
8	completed	27/06/2023,	27/06/202	00:18:50	26/26	HbbTV/1.6.1	50	1	0	0
9	completed	28/06/2023,	28/06/202	00:19:08	26/26	HbbTV/1.6.1	50	1	0	0
10	completed	28/06/2023,	28/06/202	00:18:32	26/26	HbbTV/1.6.1	50	1	0	0
11	completed	28/06/2023,	28/06/202	00:19:30	26/26	HbbTV/1.6.1	50	1	0	0
12	completed	7/14/2023,	7/14/2023	00:21:54	26/26	HbbTV/1.6.1	52	0	0	0
13	completed	7/14/2023,	7/14/2023	00:20:05	26/26	HbbTV/1.6.1	52	0	0	0

Thank You!



Source: <https://www.cta.tech/Resources/Standards/WAVE-Project/WAVE-Streaming-Media-Test-Suite-Devices>