D6.2: Standardisation plan and report

Editor: Daoust François (W3C)

This deliverable captures actions planned by the consortium to standardise, help finalize emerging standards, and contribute features that the project needs to relevant standardisation groups. This deliverable also reports on Initial contributions to standards.
Basic Information

<table>
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<tr>
<th>Work package</th>
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              Leo Andrews (Radioplayer) |

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EXECUTIVE SUMMARY

This is the first version of the standardisation plan and report for the HRADIO project. It captures the standardisation areas relevant for the project along with actions planned by the consortium to standardise, help finalize emerging standards, and contribute features that the project needs to relevant standardisation groups. Initial contributions to standards include the specification of the Open Mobile Radio Interface (OMRI) [1] at WorldDAB and its submission to ETSI.

A final version of this deliverable will be published in M30 to report on all project partners contributions to standards and actions planned after the end of the project.
# TABLE OF CONTENTS

1. **INTRODUCTION** .................................................................................................................. 8  
   1.1. Background ......................................................................................................................... 8  
   1.2. Objectives ......................................................................................................................... 8  
   1.3. Structure of this document ............................................................................................... 8  
2. **STANDARDISATION PLAN** ................................................................................................. 10  
   2.1. Relevant standardisation organisations .............................................................................. 10  
   2.1.1. RadioDNS / ETSI ........................................................................................................... 10  
   2.1.2. WorldDAB / ETSI ......................................................................................................... 11  
   2.1.3. W3C .............................................................................................................................. 11  
   2.2. Candidate standardisation areas ....................................................................................... 12  
   2.2.1. Radio tuner support in native apps ................................................................................. 13  
   2.2.2. Radio tuner support on the Web .................................................................................... 14  
   2.2.3. Live content support on the Web ................................................................................. 15  
   2.2.4. DAB decoding in a Web app ......................................................................................... 16  
   2.2.5. Distribution and synchronization of Web content with media ........................................ 17  
   2.2.6. Fragmentation reduction ............................................................................................... 17  
   2.2.7. Improve image handling for station logos ...................................................................... 18  
   2.2.8. Phonetic spelling of station names ................................................................................ 19  
   2.2.9. Convergence of metadata vocabularies ........................................................................ 19  
   2.3. Action plan ....................................................................................................................... 19  
3. **CONTRIBUTIONS TO STANDARDISATION ACTIVITIES** ........................................... 23  
   3.1. Open Mobile Radio Interface (OMRI) .............................................................................. 23  
   3.2. TV Control API .................................................................................................................. 23  
   3.3. Media Source Extensions ................................................................................................. 24  
   3.4. WebRTC to distribute media content .............................................................................. 25  
   3.5. Media Timed Events ......................................................................................................... 26  
   3.6. Web Media API ................................................................................................................. 27  
4. **CONCLUSIONS** .................................................................................................................. 28
LIST OF TABLES

TABLE 1 – STANDARDISATION ACTION PLAN .................................................................................. 22
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>ATSC</td>
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<td>Content Distribution Network</td>
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<td>Consumer Electronics</td>
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<td>Dynamic Adaptive Streaming over HTTP</td>
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<td>EPG</td>
<td>Electronic Program Guide</td>
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<td>European Standardisation Organization</td>
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<td>FQDN</td>
<td>Fully Qualified Domain Name</td>
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<td>Hybrid broadcast broadband TV</td>
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<tr>
<td>HTML</td>
<td>HyperText Markup Language</td>
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<td>HTTP Live Streaming</td>
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<tr>
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<td>Internet Protocol</td>
</tr>
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<td>Moving Picture Experts Group</td>
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<td>Media Source Extensions</td>
</tr>
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<td>Quick UDP Internet Connections</td>
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<td>W3C</td>
<td>World Wide Web Consortium</td>
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<tr>
<td>WAVE</td>
<td>Web Application Video Ecosystem</td>
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1. INTRODUCTION

This deliverable reports on the standardisation activities of the HRADIO project during the first 15 months of the project.

1.1. BACKGROUND

The HRADIO project focuses on radio service innovations enabled by the convergence between cost-effective broadcast distribution and the flexibility and interactivity of internet-based mechanisms, notably to personalise radio services, provide, intuitive functionalities like time-shifting and, eventually, to foster and exploit user engagement.

While such features are frequent on TV, through interactive TV standards such as HbbTV in Europe, radios have just started to embrace hybrid technologies. HRADIO will pave the way to bring these features not only to broadcasters’ native mobile applications, but also to Web sites, connected radios and into the car, publishing its developments as ready-to-use Android and HTML client implementations of well documented APIs fostering new service developments for the radio sector.

1.2. OBJECTIVES

The main objectives of HRADIO’s standardisation activities are:

- To specify the APIs at the heart of the HRADIO platform, and have them adopted as standards and implemented on devices.

- To make sure that the web is a suitable platform for HRADIO, so that HRADIO applications may target a wide range of devices.

Standardisation of a given technology can only be achieved when relevant stakeholders, both within the project and outside of the project, agree to it. The project supports partner efforts needed to drive discussions in standardisation organisations and/or finalize on-going standardisation activities.

1.3. STRUCTURE OF THIS DOCUMENT

Section 2 outlines the standardisation plan created during the first year of the HRADIO project, highlights standardisation topics that have been identified as directly relevant to the project. It also describes the standardisation action plan.
discussed by project partners. This plan will be completed and adjusted, based on progress and on needs that arise from pilot activities within HRADIO.

Section 3 details the contributions towards standardisation activities that project partners made during the first 15 months of the project in relation with the HRADIO project. This section will be completed in the final version of the deliverable.
2. STANDARDISATION PLAN

2.1. RELEVANT STANDARDISATION ORGANISATIONS

2.1.1. RadioDNS / ETSI

RadioDNS is an organisation which develops hybrid radio specifications. RadioDNS provides the link between content that is broadcast over FM, DAB, HD Radio and content provided over an Internet connection. Specifications published by RadioDNS are standardized at ETSI, one of the official European Standards Organizations (ESO).

RadioDNS published three standards that are directly relevant to the HRADIO project:

- **TS 103 270 v1.2.1 – RadioDNS Hybrid Radio; Hybrid lookup for radio services** [2]: The standard defines a methodology for discovering an Authoritative FQDN for a radio service, including discovery using DNS queries to radiodns.org, a root domain server operated by RadioDNS.

- **TS 101 499 v3.1.1 – Slideshow** [3]: The standard describes an application that can be delivered using broadcast, IP, or a combination of the two, and that provides a visual and clickable accompaniment to a radio service. Note this standard is now maintained in WorldDAB.

- **TS 102 818 v3.1.1 – Service and Programme Information** Error! Reference source not found.: The standard describes the metadata about a radio station (including logos) and its individual programmes and schedule, as well as an index of on-demand/podcast material, using an XML schema data model. Note this standard is now maintained in WorldDAB

RadioDNS is working on several other specifications, including:

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1 https://radiodns.org/
2 https://www.etsi.org/
2.1.2. WorldDAB / ETSI

WorldDAB is the global industry forum for digital radio, facilitating the adoption and implementation of broadcast digital radio based on Digital Audio Broadcasting (DAB/DAB+). WorldDAB develops and promotes DAB specifications, standardized at ETSI, and develops the Open Mobile Radio Interface (OMRI) [1], a technical interface for communication between applications and radio chipsets present on the device, which is at the core of HRADIO’s system architecture.

DAB standards also define features that allow broadcasters to send metadata along the audio signal that the HRADIO project builds on to create new functionalities. These features include:

- **RadioWEB**, a specification that combines HTML, CSS, JavaScript and other web-technologies with radio technologies to add new functionalities for radio broadcasters.

- **RadioTAG**, a bookmarking protocol for discovery and communication between client radio devices and a broadcaster-provided web service to record the time and radio service being listened to.

2.1.3. W3C

The World Wide Web Consortium (W3C) develops royalty free Web standards such as HTML, CSS, and various JavaScript APIs that compose the Web platform, implemented in Web browsers on a wide range of devices. Standards published by W3C:

- [RadioWEB](https://www.worlddab.org/)
- [RadioTAG](https://www.w3.org/)
- [RadioWEB](https://www.worlddab.org/), a specification that combines HTML, CSS, JavaScript and other web-technologies with radio technologies to add new functionalities for radio broadcasters.
- [RadioTAG](https://www.w3.org/), a bookmarking protocol for discovery and communication between client radio devices and a broadcaster-provided web service to record the time and radio service being listened to.

- **Dynamic Labels (DL)**, short text messages transmitted in the DAB/DAB+ signal which can be tagged
- **Slideshows** [3] and **Service and Programme Information** [4] in collaboration with RadioDNS, now fully handled in WorldDAB.
- **Mapping between Transport Protocol Experts Group (TPEG) and DAB transport** to deliver Traffic and Travel Information (TTI) to end-users.
W3C are also at the core of interactive layers in most hybrid radio (and TV) specifications.

W3C is organized in three main types of groups:

- **Working groups** develop technical standards
- **Community groups** conduct pre-standardisation work, incubating technical solutions that may lead to standardisation work
- **Interest groups** identify use cases & requirements to steer standardisation priorities.

Main groups identified by the HRADIO project:

- The **Media & Entertainment Interest Group**\(^5\), formerly known as the Web and TV Interest Group, steers the standardisation of media-related features on the Web. This group discusses the future of the TV Control API specification (following closure of the TV Control Working Group which drafted the specification), media timed events, new features for Media Source Extensions to improve streaming support on the Web (following closure of the HTML Media Extensions Working Group which developed the standard).

- The **schema.org Community Group**\(^6\) discusses changes, additions and extensions to schema.org, a set of schemas to annotate Web pages with structured data that search engines may ingest.

### 2.2. CANDIDATE STANDARDISATION AREAS

Hybrid radio builds on the convergence between broadcast and IP technologies. The term **hybrid** covers different dimensions:

\(^5\) [https://www.w3.org/2011/webtv/](https://www.w3.org/2011/webtv/)

\(^6\) [https://www.w3.org/community/schemaorg/](https://www.w3.org/community/schemaorg/)
The HRADIO project has explored these dimensions to identify candidate areas where lack of standards impedes or slows down the realisation of hybrid radio scenarios. These candidate areas are described below along with their status when the HRADIO project starts, and main questions considered by the project.

2.2.1. Radio tuner support in native apps

To provide the presentation and interactive layers envisioned in most hybrid scenarios, radio devices need to adopt operating systems originally developed for other embedded devices such as Android. Such systems do not have native or standardized interfaces to expose broadcast signals to applications running on them.

Similarly, to be able to target a wide range of devices, hybrid radio applications need to run on smartphones and other devices, regardless of the underlying operating system (Android, iOS, Windows). Such smartphones may have dedicated radio tuner hardware, or may be coupled with radio tuners, e.g. through USB, but operating systems do not provide radio tuner interfaces.

The existence of a standard interface that can be implemented at the operating system level across devices to access and control the broadcast signal is a key enabler to the creation of native hybrid radio experiences that may leverage signals receiver over broadcast.

- Hybrid distribution, whereby the radio content is distributed over broadcast and/or IP to a wide range of devices, including radio sets, smartphones, and laptops.

- Hybrid content, whereby additional data is sent along with the audio signal (metadata, slideshows, traffic information, EPG, applications). In the broadcast world, the enabler for augmenting the signal in such ways is the switch from analogue to digital, for instance the use of DAB/DAB+ technologies for radio. In the IP world, additional data may either be provided in-band, e.g. as events tracks in the media transport stream, or out-of-band, e.g. as a separate resource that the application can fetch over the network using HTTP.

- Hybrid experience, whereby the content and interface rendered to the user combines both content from the broadcast signal and content delivered over IP, allowing to customize the user’s interface in real time and provide interaction mechanisms, while still leveraging the efficiency of broadcasting in terms of content delivery.
This standard interface would need be implementable on top of content received over IP too, so that hybrid radio applications may reuse the same code regardless of whether the signal comes from broadcast or IP.

When the HRADIO project started in 2017, preliminary discussions for the creation of a common API took place in WorldDAB, leading to the creation of a Technical Committee in February 2017 to develop the specification. Can this API be finalized, standardized and implemented across devices?

2.2.2. Radio tuner support on the Web

The Web platform provides a natural fit for the creation of interactive experiences that can run on a wide range of devices. The Web platform provides critical technologies to enable media applications: HTML5 [5] introduced the `<audio>` and `<video>` tags, Media Source Extensions (MSE) [6] gave full control to application over adaptive streaming, and Encrypted Media Extensions (EME) [7] provided APIs to control playback of encrypted content. Taken together, these technologies marked the end of the era of plug-ins for media playback on the Web and led to the explosion of media streaming on the Web in the past few years.

However, while Web applications can easily fetch network resources over HTTP, there is no standard way to access broadcast signals from within Web applications. W3C started work on a TV Control API [8] in 2014, under the scrutiny of AT&T, BBC, Espial, Fraunhofer FOKUS, IRT, LG, Mozilla and Sony. Standardisation efforts stopped in 2017, before the HRADIO project started, due to a combination of factors:
ATSC\(^7\) was considering referencing the TV Control API in ATSC 3.0\(^8\) provided the API could be standardized in time for inclusion. They eventually decided to create a custom API to expose the tuner to Web applications as a local network service.

AT&T’s acquisition of DirecTV changed their priorities in that space as well.

Mozilla shelved the development of Firefox OS for TV, which was the main driver for them to participate in this work.

Other browser vendors did not view tuner control as a priority and had security concerns, e.g. on ways to associate a broadcast signal with an origin, more so if that signal embeds additional data, including applications.

When the HRADIO project started, there was no ongoing standardisation activity to expose radio tuners to Web applications, and the future of the TV Control API had moved into the hands of the Media & Entertainment Interest Group at W3C.

2.2.3. Live content support on the Web

Media-related Web technologies mentioned in 2.2.2 Radio tuner support on the Web were driven by on-demand use cases. They allowed the creation of smooth media playback experiences for file-based media on the Web. However, live streaming, common in radio, introduces specific requirements that go beyond what these technologies were trying to provide.

**Latency of distribution**

The main one is the latency of distribution. Hybrid distribution requires the ability to use different distribution mechanisms at once, broadcast and broadband. One user may be listening to radio through the broadcast signal, while another may be listening to radio through broadband. Furthermore, where practical, it should be possible to seamlessly switch from one distribution mechanism to the other. This

\(^7\) https://www.atsc.org/
\(^8\) https://www.atsc.org/standards/atsc-3-0-standards/
requires the latency of distribution to be equivalent regardless of the distribution mechanism.

Typical latency of distribution for broadcast from capture to delivery is a few seconds. When the project starts, the typical latency of distribution for broadband using MSE and adaptive streaming technologies such as MPEG DASH [9] is several dozens of seconds. This latency is due to a combination of factors, and includes the creation of media segments before distribution, caching into CDNs, internal buffering in Web browsers and playback latency. Can the latency of distribution of media content on the Web get reduced to a few seconds, to ease cases where multiple distribution mechanisms are used at once?

**Companion data sources**

Other requirements arise from companion data sources. Broadcasting takes an in-band approach, whereby the media streams are combined with additional data sources (events, metadata, images) in the same transport stream. The Web approach is more out-of-band, whereby applications are responsible to fetch additional data as separate resources to complete the media resources being played. Web browsers may support in-band captioning tracks, but practical support is limited and, as of end of 2017, HTML does not have a generic cue mechanism to expose in-band metadata tracks to Web applications. Furthermore, even if it did, the use of timed events to trigger cues may remain problematic if, in order to render a cue, an application first needs to fetch external resources (such as images). HTML does not give a way for applications to learn about new cues before they are triggered.

**Customized continuous media stream**

To produce a continuous media stream or to customize the media stream for the user, broadcasters also need to mix content from different sources. These sources may use different codecs. For instance, ads may be encoded differently from music or content captured in the studio. MSE does not let Web applications splice heterogeneous media streams, forcing broadcasters to either transcode all content to the same codec, or to work around this limitation by switching between multiple media elements, with the risk of creating “air gap”. Could this situation be improved?

**2.2.4. DAB decoding in a Web app**

One approach that the HRADIO project is prototyping is the possibility to deliver the DAB signal over HTTP and let Web applications decode, process and render the
content, so that broadcasters do not have to use different tools and processes to distribute content over broadcast and broadband.

Can DAB decoding be done efficiently in Web applications? Efficient binary stream processing is usually done using programming languages that provide facilities for low-level memory manipulation, such as C++. WebAssembly\(^9\), under standardisation at W3C, creates a binary instruction format supported across browsers, designed as a portable target for compilation of high-level languages like C++. Is it enough to cover all needs on that front?

### 2.2.5. Distribution and synchronization of Web content with media

The combination of media content with other types of content to create richer experiences poses several challenges. The lack of a generic data cue mechanism in HTML, and possible timing issues when cues reference external content but are seen too late by the application have been pointed out in 2.2.3 Live content support on the Web. Similarly, security issues that arise when a broadcast signal include interactive content have been raised in section 2.2.2 Radio tuner support on the Web: security on the Web platform relies on the same origin policy, how can an application delivered over broadcast be securely associated with an origin?

Additional content may be distributed out-of-band. One question that arises in such cases is: How can out-of-band content be synchronized with media playback? There are no strong guarantees on the Web that media playback follows any particular clock, no explicit mechanism that allows an application to detect the exact position on the media timeline at a specific time, and no mechanism to trigger an action at a precise position on the media timeline. Is the available (lack of) precision enough to implement hybrid radio scenarios on the Web?

### 2.2.6. Fragmentation reduction

CE devices dedicated to media playback remain constrained devices that follow specific production processes. The convergence between devices in terms of capabilities and software is ongoing, but media devices have not turned into all-purpose computers yet. One notable remaining difference between most media devices and laptops or recent smartphones is that the firmware and operating

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\(^9\) [https://webassembly.org/](https://webassembly.org/)
system installed on media devices is very rarely updated once the device has shipped (typically because no one pays for these updates).

At the other end of the spectrum, Web technologies and Web browsers are updated almost daily.

As media devices embrace Web technologies to provide the interactive layer, one question that arises is: What is the Web platform? In other words, what are the Web technologies that media devices need to support so that they can run media Web applications?

This is one the main goals of the CTA WAVE Project, started in 2016, and run in collaboration with W3C: to define a common baseline of Web technologies, updated annually to keep pace with the evolving Web platform, that should be supported by manufacturers of media devices. That baseline is based on technologies supported across the main browser codebases used to browse the Web on all-purpose devices. Can this baseline be used for hybrid radio devices as well? Does it need to be adjusted?

### 2.2.7. Improve image handling for station logos

The RadioDNS specification provides five logo sizes by way of a standard. These sizes were determined some time ago, when devices did not have high pixel density screens. Although the specification does not preclude the use of other sizes, these five mandatory sizes are felt by automotive manufacturers to be of adequate resolution.

One approach would be to define an update to the standard to include the addition of a high-resolution square (1400 square is the minimum size Apple accepts for podcast cover art) and a high resolution 16:9 image such as a full HD 1920x1080 image.

Adequate station logos are vital for hybrid interfaces which are often competing with other visually rich audio services (Spotify, Pandora) and so the requirement is to make these two images mandatory alongside the existing ‘Project Logo’ sizes.

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2.2.8. Phonetic spelling of station names

As voice control is introduced into hybrid radio, there is a need to ensure voice control systems are able to both correctly recognise station names and correctly pronounce them. For example, a radio station called Hot Sounds Liverpool FM may also be known by locals as Hot Radio or Hot Liverpool or Hot FM. In other words, the public uses a local synonym for a station and not the ‘official’ station name. A voice control system needs to know these synonyms.

Likewise, when announcing the name of a radio station, a voice system must pronounce this correctly. For example, BBC Radio Five Live. The word “live” can be pronounced in two ways. When the word is used as a verb – to live – the I vowel is a short vowel. However, in this context, the word “live” is used as an adjective where the pronunciation is more like “lyve”. The mispronunciation can sound peculiar to the user.

To avoid this, phonetics can be provided for station names, as part of the metadata schema. There are a number of approaches which can be adopted as standards already exist. The main standards are: International Phonetic Alphabet, or a phonetic respelling system such as those established by the BBC, Wikimedia, and the major dictionary publishers – or pidgin English. Further, there is also a standard phonetic markup language – Speech Synthesis Markup Language (SSML) [1] which adequately caters for the above.

2.2.9. Convergence of metadata vocabularies

The HRADIO platform provides a way to discover radio programmes. Traditional radios will follow vocabularies described in the RadioDNS SPI standard [4] to describe their programmes, so that they can be indexed by radio content platforms. Pure Web radios will rather target usual search engines and follow vocabularies that these search engines understand, notably schema.org vocabularies.

A few years ago, BBC and EBU worked with the schema.org community to extend support for TV and radio programs in schema.org. These extensions are now part of the core schema.org vocabulary. Can SPI content be mapped to schema.org metadata automatically? Can schema.org metadata that describes a radio programme be mapped to SPI content automatically? Does either of these vocabularies need to be completed?

2.3. ACTION PLAN

Table 1 below describes the standardisation plan that project partners discussed and started to enact. The plan will be adjusted based on outcomes of ongoing
project pilot activities. Sufficiently advanced and closed actions are summarized in section 3 Contributions to standardisation activities.
<table>
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<th>Goal</th>
<th>Action</th>
<th>Who</th>
<th>Status</th>
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<tbody>
<tr>
<td>Radio tuner in native apps</td>
<td>Draft initial OMRI spec</td>
<td>IRT</td>
<td>Closed</td>
</tr>
<tr>
<td></td>
<td>Finalize OMRI spec and standardise at ETSI</td>
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<td>Assess support for resuming work on W3C TV Control API in Media &amp; Entertainment Interest Group</td>
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<td>Draft TV Control spec</td>
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<td>Live content on the Web</td>
<td>Evaluate requirements on MSE</td>
<td>W3C</td>
<td>Ongoing</td>
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<td></td>
<td>Contribute to MSE v2 incubation</td>
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<td>Explore usage and possible extensions of WebRTC technologies to reduce the distribution latency</td>
<td>W3C</td>
<td>Ongoing</td>
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<td>DAB decoding in a Web app</td>
<td>Identify possible technical gaps (WebUSB, WebAssembly)</td>
<td>IRT</td>
<td>Ongoing</td>
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<td>Distribution and synchronization of Web content with media</td>
<td>Gather inputs from HRADIO, organize W3C discussions on the topic</td>
<td>W3C</td>
<td>Ongoing</td>
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<td>Fragmentation reduction</td>
<td>Help transition the Web Media API Community Group to a W3C Working Group</td>
<td>W3C</td>
<td>Closed</td>
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<td>Improve image handling for station logos</td>
<td>Research solutions that help downstream systems and standards (e.g. RadioDNS) benefit</td>
<td>RP</td>
<td>Ongoing</td>
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<tr>
<td>Phonetic spelling of station names</td>
<td>Research solutions</td>
<td>RP</td>
<td>Ongoing</td>
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<tr>
<td>Convergence of metadata vocabularies</td>
<td>Explore mapping between SPI (used in RadioDNS) and schema.org (used by pure Web radios)</td>
<td>W3C</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Link SPI and on-demand downloadable content for timeshifting use cases</td>
<td>Review SPI and design complementary information if needed</td>
<td>IRT</td>
<td>Not started</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Authenticity verification</td>
<td>Integrate authenticity verification to RadioWEB (as done in DVB for HbbTV)</td>
<td>IRT</td>
<td>Not started</td>
</tr>
</tbody>
</table>

Table 1 – Standardisation action plan
3. CONTRIBUTIONS TO STANDARDISATION ACTIVITIES

This section summarizes contributions to standardisation activities made by the project during the first 15 months of the project to address the candidate standardisation topics identified in section 2.2. This section will be completed in the final standardisation report at the end of the project.

3.1. OPEN MOBILE RADIO INTERFACE (OMRI)

Linked to 2.2.1 Radio tuner support in native apps.

As reported in 2.2.1, preliminary discussions for the creation of a common API to access and control radio tuners from native applications had taken place in WorldDAB when the HRADIO project started. These discussions led to the creation of a Technical Committee in February 2017 to develop the Open Mobile Radio Interface (OMRI).

Through the HRADIO project, IRT developed the OMRI specification in WorldDAB, and submitted it to ETSI for standardisation. The OMRI specification was published by ETSI in October 2018 under the name **TS 103 632 – Digital Audio Broadcasting (DAB); Open Mobile Radio Interface (OMRI); Application Programming Interface (API)** [1].

IRT has also been working on an implementation for Android within WP3 to validate the design of the API and promote its adoption. Work on other implementations for iOS and Web applications are planned.

3.2. TV CONTROL API

Linked to 2.2.2 Radio tuner support on the Web.

The TV Control API [8], developed at W3C, aims to enable web applications to present audio and video media from broadcast TV and radio, using the media elements defined in HTML. The API provides access to programme and service information. The API had initially been identified as key for the project. However, work on the API was discontinued in 2017 (as explained in 2.2.2).

W3C conducted a series of discussions with stakeholders involved in the development of the API to better understand needs and assess interest for resuming the work. AT&T, BBC, Comcast, Espial, Google, LG, Sony and others indicated interest for such an API in theory, but the outcome of both private and public
discussions within the Media & Entertainment Interest Group\textsuperscript{11} so far is that there is not enough traction to resume the work. Most media companies are heavily investing on adaptive streaming over HTTP, and while broadcast is certainly here to stay, adding support for broadcast signals on the Web is not seen as a priority compared to improvements to IP-based streaming, especially because not all devices embed tuners.

The currently favoured approach in hybrid standards such as ATSC 3.0 is rather to expose tuners to Web applications as a local network service that Web application can discover and interact with. In other words, in ATSC 3.0, Web applications are rendered on top of a video overlay that they can control through commands sent to a local WebSocket server. ATSC 3.0 defines the discovery API and application protocol. This approach is consistent with the approach taken in HbbTV, where a specific API is used to control a custom object element that renders the broadcast signal.

The HRADIO project acknowledges the lack of support for standardizing the TV Control API for the time being. The project will periodically re-assess the situation. In the meantime, the project plans to develop an implementation of the OMRI API directly in JavaScript, or in WebAssembly for performance reasons, to give developers a consistent interface to leverage the radio signal across devices. By definition, this implementation can only give Web applications access to resources that follow usual protocols on the Web, in other words HTTP, WebSocket or WebRTC. It will not give Web applications any direct access to the broadcast signal. An intermediary local service (e.g. a WebSocket server) may be considered in some cases to expose the broadcast signal to Web applications indirectly.

3.3. MEDIA SOURCE EXTENSIONS

Linked to 2.2.3 Live content support on the Web.

Different approaches can be envisioned to lower the latency of distribution of media content on the Web. One approach is to improve the efficiency of adaptive streaming mechanisms. This is ongoing e.g. with the progressive adoption of

\textsuperscript{11} https://www.w3.org/2017/09/07-webtv-minutes.html
chunked encoding in MPEG DASH and HLS\(^\text{12}\), whereby media segments are subdivided into a series of smaller chunks that can be passed through the chain immediately as they become available. This approach is promising and could bring the latency of distribution on the Web on par with the broadcasting world. The HRADIO project is monitoring progress but does not plan to contribute to these activities.

Another approach to reducing the latency of distribution is to look at the latency introduced on the client device during media playback. MSE was developed for on-demand scenarios and does not specify any requirements in terms of playback latency and does not contain any hook that a Web application could use to control the amount of buffering that a Web browser uses before it starts rendering frames. W3C is discussing the standardisation of a new version of MSE, and pondering whether main browser vendors are willing to implement a low-latency mode for MSE\(^\text{13}\).

Similarly, the first version of MSE did not support the ability to switch between media chunks encoded using different codecs. Here, browser vendors already agreed to investigate a codec switching feature to MSE and started incubation of a technical solution\(^\text{14}\).

### 3.4. WEBRTC TO DISTRIBUTE MEDIA CONTENT

*Linked to 2.2.3 Live content support on the Web.*

Another interesting approach to reduce the latency of distribution of media content on the Web is to look at whether other distribution mechanisms could be used, borrowing from real-time technologies used in WebRTC to enable real-time communications between peers. W3C raised the use of WebRTC for media content distribution as an issue\(^\text{15}\) in the Media & Entertainment Interest Group and reached


\(^{13}\) https://github.com/w3c/media-and-entertainment/issues/6


\(^{15}\) https://github.com/w3c/media-and-entertainment/issues/1
out to media companies in that field to organize a discussion call within that group. Google presented shorter-term and longer-term options to the group\textsuperscript{16}, notably using QUIC for transport.

The possibility to use WebRTC technologies to distribute content on the Web would allow broadcasters to get down to lower than one second distribution latency. For radio, this could ease or enable real-time interactions with radio listeners.

### 3.5. MEDIA TIMED EVENTS

*Linked to 2.2.5 Distribution and synchronization of Web content with media.*

Through the project, W3C organized and contributed to a series of discussions on the combination of media content with other types of content. Contributions include:

- **Review of the “Carriage of Web Resource in ISOBMFF” proposal developed at MPEG, and organization of relevant discussions with the Technical Architecture Group (TAG) at W3C.** The proposal describes a mechanism to store and deliver Web data in ISOBMFF containers to enable enriching audio/video content, as well as audio-only content with synchronized, animated, interactive Web data, including overlays. The review identified several issues with the proposal, summarized in a letter sent to MPEG on behalf of the Media & Entertainment Interest Group.

- **Participation in the Media Timed Events Task Force within the Media & Entertainment Interest Group to specify use cases and requirements for a generic cue mechanism for the Web\textsuperscript{10}, that could e.g. be used to expose MPEG DASH emsg box events.**

- **Discussions on synchronization needs within the Media & Entertainment Interest Group, including scenarios that require frame accuracy precision\textsuperscript{17}, and on mechanisms best suited to meet these needs.**

\textsuperscript{16} https://www.w3.org/2018/10/02-me-minutes.html
\textsuperscript{17} https://github.com/w3c/media-and-entertainment/issues/4
These efforts are ongoing. They may lead to updates in media algorithms in HTML and a concrete proposal for a generic cue mechanism.

3.6. WEB MEDIA API

Linked to 2.2.6 Fragmentation reduction.

The CTA WAVE Project started an effort in 2017 to define a common baseline of Web technologies that should be supported by all media devices. The Web Media API specification is the result of these discussions. It is targeted at device manufacturers so that they can have a reference document at their disposal when they integrate support for Web technologies in their devices. It is also targeted at content providers and developers in general so that they know what technologies they can rely on being supported across devices.

This baseline is relevant for hybrid radio devices. The Web Media API is developed in a Community Group. W3C investigated the possibility to standardise the specification within a Working Group. The standardisation process is not entirely adapted to the effort at hand, though: standardisation efforts at W3C are often loosely bounded in time, and the goal of this effort is to produce annual specifications that follow the evolution of the Web platform. CTA WAVE participants decided against transitioning to a Working Group for now, and in favour of pursuing the work in the Web Media API Community Group.

One interesting aspect of this effort is testing, needed to certify devices. The CTA WAVE project invested time and resources (through Fraunhofer FOKUS) into producing a test suite to assess conformance to the Web Media API specification. Tests are extracted from tests in the Web Platform Tests project, a community-based project that contains official test suites for Web standards. W3C reviewed the testing tools produced as part of this effort, and is working with Comcast, CTA and Fraunhofer FOKUS to integrate the test runner that Fraunhofer FOKUS developed for use on constrained CE devices back into the Web Platform Tests project.

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18 https://www.w3.org/community/webmediaapi/
19 https://github.com/web-platform-tests/wpt
4. CONCLUSIONS

The HRADIO project identified several candidate areas where lack of standards impedes or slows down the realization of hybrid radio scenarios, starting with the lack of a common interface to access and control radio tuners from applications, and including possible areas of convergence between traditional radio and the Web platform on a common set of technologies and vocabularies.

Project partners started to investigate candidate areas and contributions they could make to progress relevant standardisation efforts. Main contribution is the development of the Open Mobile Radio Interface (OMRI) at WorldDAB and its standardisation at ETSI. The project has also made several contributions to Web platform standardisation discussions, e.g. to clarify the status of the TV Control API, raise requirements for media timed events support, and discuss low-latency distribution mechanisms for media content on the Web.

Project partners maintain an action plan that will guide standardisation activities for the remainder of the project. A final version of this deliverable will be published at the end of the project to describe further contributions to standards and actions planned after the end of the project.
REFERENCES

[1] ETSI TS 103 632 v1.1.1, *Digital Audio Broadcasting (DAB); Open Mobile Radio Interface (OMRI); Application Programming Interface (API)*, October 2018, URL: https://www.etsi.org/deliver/etsi_ts/103600_103699/103632/01.01.01_60/ts_103632v010101p.pdf


