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**H.264/AVC as Mandatory-to-Implement Video Codec for RTCweb
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Abstract

This memo proposes that H.264/AVC be selected as the mandatory-to-implement (MTI) video codec for RTCweb due to its Adoption Advantage, Quality-Power-Bandwidth advantage, Hardware Acceleration Advantage and Well-established IPR Status.

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1. Introduction

This memo offers a proposal that H.264/AVC be selected as the mandatory-to-implement (MTI) video codec for RTCweb. This document asserts that the constrained baseline profile is the likely best choice and uses it to make certain points. However, the author(s) are open to assertions that other H.264/AVC profile(s) should be additionally mandated or recommended.

This document is not intended for publication as an RFC.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119](#)>.

3. H.264/AVC Adoption Advantage

H.264/AVC is widely used for enterprise videoconferencing equipment and services. High-definition (HD), web videoconferencing commonly uses H.264/AVC as well, including Skype.

H.264/AVC is becoming the de-facto standard for the Mobile web and 3GPP has recommended the H.264/AVC [[AVC01](#)] codec along with the mandatory H.263. Apple's iOS, Google's Android, RIM's Blackberry and Ericsson's mobile device platforms all support H.264/AVC.

Web (entertainment) video is dominated by H.264/AVC, and increasingly "multi-screen/BYOD" video services from cable companies and telco's are using H.264/AVC over their private web video networks

Thus, HTML5 browsers will likely need to have the H.264/AVC codec regardless to remain popular. Internet Explorer and Safari appear to be including H.264/AVC in the set of codecs they ship regardless of the RTCweb video codec MTI decision. And Google's Chrome continues shipping with H.264/AVC today.

We assert that the lack of clearly indicating that H.264/AVC was the mandatory video codec for HTML5's video tag has created uncertainty and increased costs for those deploying sites or developing applications trying to cover multiple possible codecs instead.

Mandating the H.264/AVC codec for RTCweb is in the best interest of rapid adoption given it is already pervasive deployed and used in real-time communications and web video applications.

4. H.264/AVC has the Quality-Power-Bandwidth advantage

First, we believe that mobile devices will be important to the success of RTCweb going forward. They generally have slower CPUs than desktop computers and maximizing battery life is extremely important.

Second, we assert that the three (3) most important factors to analyze in that context are a) the user experience or perceptual quality of the resultant video images, b) the amount of compute or CPU power applied to do the compression - this correlates with electrical power consumption, and c) the amount of bandwidth available or consumed. All three factors must be considered together as they are interrelated.

For a given bitrate, a codec can improve the quality by doing more computation, but that will drain power quicker. While 4G/LTE brings more bandwidth to the equation, error properties of the medium and/or mobile data transmission costs will still put pressure on implementers to minimize bandwidth utilized by RTCweb streams. Throwing bandwidth at the problem is not a good assumption to improve quality while keeping CPU power constant.

We quickly captured examples of leading H.264/AVC and VP8 products on popular mobile and desktop platforms and came to the conclusion that H.264 looks better than VP8 when both are run on same platform at the same bitrates.

It is very hard in making tests to try and decide what parameters to use for codecs in a way that does not bias tests. So instead, we choose the "best in class" products that we could find to demonstrate performance comparisons.

Captures of Mobile Tests;

FaceTime using H.264 on an iPhone to linphone on a fast desktop PC.
<http://dl.dropbox.com/u/17089001/video-samples/facetime.mov>

Bria using VP8 on iPhone to linphone on a fast desktop PC. <http://dl.dropbox.com/u/17089001/video-samples/iphone-vp8-vs-iphone-264.mov>

Bria using VP8 on Galaxy Nexus to linphone on a fast desktop PC.
<http://dl.dropbox.com/u/17089001/video-samples/galaxy-nexus.mov>

Shown side-by-side, Bria using VP8 on iPhone (left) and FaceTime with H.264/AVC on iPhone (right), going to linphone and FaceTime. <http://dl.dropbox.com/u/17089001/video-samples/iphone-vp8-vs-iphone-264.mov>

Captures of Desktop-only Tests;

FaceTime H.264/AVC from a fast notebook computer to fast desktop. <http://dl.dropbox.com/u/17089001/video-samples/facetime-264-desktop.mov>

-or- <http://dl.dropbox.com/u/17089001/video-samples/facetime-264-desktop.webm>

Chrome with VP8 from same fast notebook computer to same fast desktop.

<http://dl.dropbox.com/u/17089001/video-samples/chrome-vp8-desktop.mov>

-or- <http://dl.dropbox.com/u/17089001/video-samples/chrome-vp8-desktop.webm>

Two fast notebook computers - one running Chrome and the other running Fictive - both sending to the same desktop computer shown side by side. http://dl.dropbox.com/u/17089001/video-samples/chrome_and_factime_desktop.mov>

-or- http://dl.dropbox.com/u/17089001/video-samples/chrome_and_factime_desktop.webm

The tests and resultant captures were done on a fast wireless network with no other traffic on the wireless network, with the exception of the side by side demo. For the sides by side demo above, both devices were on the same WiFi network but did not seem to be having any losses or coming close to filling the network. The results in the side by side seemed to be the same as when there were run independently so we do not believe that having them both on the same network impacted results.

Of course, these results do not preclude implementations improving in the future, but this gives some idea of the current state of the art.

Our conclusion is that H.264/AVC is best at delivering on the Quality-Power-Bandwidth optimization.

5. Hardware Acceleration Advantage

H.264/AVC has a several year head start on hardware/DSP optimization and is already deployed pervasively. For handheld mobile phones, hardware acceleration is a must to maximize Quality-Power-Bandwidth.

H.264/AVC hardware is already incredibly inexpensive. Some of the low end consumer cameras will record H.264/AVC video, such as this sub-100 US dollar (<\$100) Powershot A810 from Cannon. [[AVC07](#)]

6. Well-Established IPR Status for H.264/AVC

6.1. Disclosed and Publicly Available Lists of Patents

As typical with many standards bodies, the joint work of ITU/MPEG that produced H.264/AVC has a common patent policy requiring disclosure by participants and third parties of any known patents or patent applications that may be essential to implement specifications in development. These can be downloaded in spreadsheet format [[AVC02](#)]. The policy goes on to ask contributors to pre-agree to either RAND (reasonable & non-discriminatory, but may not be free) or royalty-free licensing of their own company's patents, with or without reciprocal requirements. There is some anecdotal evidence to suggest US courts consider such disclosure requirements [[AVC03](#)] in patent lawsuit decisions.

While all that alone doesn't guarantee 100% visibility of all possible essential patent claims, H.264/AVC was finished in late 2003 and has been commercially shipping at scale for 6-7 years or more which should have brought to light any other patent holders interested in enforcing or collecting on their essential patents.

Over 300 patents (more if counting multiple jurisdictions) covering mechanisms spanning several of AVC's profiles are licensed via the MPEG LA H.264/AVC licensing program and are publicly listed [[AVC04](#)].

The risk of an unknown, essential patent appearing at this point should be comparatively low, which would be a benefit to selecting a H.264/AVC profile as the mandatory codec.

6.2. Royalty Free for Innovation, Low-volume shipments

To paraphrase, the MPEG LA license [[AVC05](#)] does allow up to 100K units per year, per legal entity/company (type "a" sublicensees in MPEG LA's definition), to be shipped for zero (\$0) royalty cost. This should be adequate for many RTCweb innovators or start-ups to try out new implementations on a large set of users before incurring any patent royalty costs, a benefit to selecting a H.264/AVC profile as the mandatory codec.

6.3. Higher H.264/AVC Profile Tools Bundled

It should be noted that when one licenses the MPEG LA H.264/AVC pool [[AVC04](#)], patents for higher profile tools - such as CABAC, 8x8 - are bundled in with those required for the constrained baseline profile. Thus, these could optionally be used by RTCweb implementers to achieve even greater performance or efficiencies than using H.264 constrained baseline alone, a benefit to selecting H.264/AVC and

RTCweb could also go as far as recommending those higher profiles.

6.4. Future IPR Status Consideration

For additional informative purposes, the MPEG/IEC/ISO made a call for a royalty-free video coding solution for the Internet. As of its 98th meeting, two tracks forward are being pursued; one of which is based on the H.264/AVC constrained baseline profile [[AVC06](#)]. MPEG is presently collecting patent licensing declarations that would include patent holder's royalty expectations unbundled from other higher profile mechanisms. Should this effort result in a royalty-free constrained baseline profile, this would benefit RTCweb in the future if H.264/AVC is selected as mandatory today.

7. Questions about IPR Status of VP8

For the purposes of further illustrating the benefits of the well-known IPR status of H.264/AVC, what follows are some comparisons to the unknowns that surround VP8 as of the writing of this contribution. Information that resolves the open questions below is welcomed.

First, Google should be commended for offering their essential patents on VP8 royalty-free. However, other patent holders -- including ones not licensees of VP8/WebM -- may exist as suggested by all the respondents to MPEG LA's call for a VP8 essential patent pool. Also, VP8 was not developed openly in a standards body and thus subjected to the prescribed essential patent disclosures, etc.

Second, others have previously advocated that the lack of lawsuits against shipping VP8 implementations to date means all is ok. VP8 has been shipping a shorter time compared to H.264/AVC and the finite number of companies that have shipped it to date may have, for example, sufficiently large patent portfolios themselves to have discouraged others from starting such a VP8 lawsuit against them. Bottom line is that it isn't a good argument that no prior lawsuits are an implicit indication of low risk to future patent lawsuit for VP8.

Attribute	AVC	VP8
Developed Openly in Standards Body	Yes	No
-		
Required Patent Disclosures and/or predeclared RAND or similar licensing promise	Yes	No
-		
Open Source implementation	Yes	Yes
-		
Patent Royalties	Yes for >100KU per yr	None Known (*)

Table 1: Comparison of H.264/AVC & VP8 IPR Status Impacting Features

(*) A dozen or so companies responded to MPEG LA's call for essential patents on VP8, but a license for that has not been published and fees that may be asked for in the future is unknown.

As suggested by Table 1, sufficient time and open, industry development along with the prescribed patent disclosures is beneficial to be more certain of the risks with shipping the chosen mandatory codec.

Not having the benefit of a longer deployment duration and open, industry development for VP8, the following questions result;

(a) Like MPEG/IEC/ISO, can Google list the present patents covered in its VP8 license (of course it is noted that any future Google owned essential patents are supposed to be included too)?

(b) Does Google, or anyone else involved in any patent analysis, know of any third-parties with viable essential patent claims on VP8? c) If any in (b), are they not a concern? Why?

(c) If any in (b), are they not a concern? Why?

(d) If Google is certain there is no concern regarding (b) & (c), can Google provide some assurance (such as indemnification) to the VP8 licensees and thus indirectly assuring the RTCweb working group?

8. Security Considerations

TBD.

9. IANA Considerations

None.

10. References

10.1. Normative References

10.2. Informative References

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