ATSC Standard: A/336:2023-08 Amendment No. 1, “Improved Timeline Recovery”

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15 February 2024

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Revision History

Version	Date
Amendment approved	15 February 2024

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1. OVERVIEW

1.1 Definition

An Amendment is generated to document an enhancement, an addition or a deletion of functionality to previously agreed technical provisions in an existing ATSC document. Amendments shall be published as attachments to the original ATSC document. Distribution by ATSC of existing documents shall include any approved Amendments.

1.2 Scope

This document provides a performance improvement of the video watermark-based media time recovery capability specified in A/336.

1.3 Rationale for Changes

ATSC has specified audio watermarking (A/334) and video watermarking (A/335) technologies and associated protocols (A/336) that enable ATSC 3 receivers to provide ATSC 3 features including execution of A/344 Broadcaster Applications for ATSC 3 services received via redistribution delivery paths, including HDMI.

Because redistribution delivery paths include latency and time-shifting, one important function of the watermarking protocols is to enable the receiver to recover and track the media presentation timeline; i.e. the current playback position (or "media time") in the service. Among other things, media time recovery enables an A/344 Broadcaster Application to closely synchronize the presentation of broadband-delivered content to the content presented in the service received via redistribution, permitting a variety of Broadcaster Application-driven use cases to be offered such as dynamic ad replacement, audio replacement, and captioning. These use cases require that receiver be able to recover the media time with high reliability, because even small amounts of media time error or recovery latency can result in a perceptually degraded user experience.

In addition to fulfilling ATSC 3 market requirements, these specifications have also been adopted by other SDOs (e.g. DVB Blue Book A178-1r1 and ETSI TS 103 464) with similar requirements.

Extensive broadcast field trials of the technologies were recently conducted in the German market[1] and while they were found to perform extremely well across a wide range of commercial environments, a need was identified for improving the reliability of precise media time recovery from the video watermark in certain reduced-quality video environments, e.g. when significant reduction in resolution or encoding bit-rates are applied to the service during redistribution.

While this testing was performed in a DVB market, its results are believed to apply equally to the technology's use in commercially relevant use cases within ATSC 3 markets (e.g., delivery of diginet and "nightlight" services).

This amendment revised ATSC A/336:2023-08 for the purpose of improving the reliability of media time recovery from the video watermark in reduced-quality redistribution environments.

[1] See "ADB2 Test Result" in Deutsche TV Platform: ADB2 White Paper, November 2022 (https://tv-plattform.de/wp-content/uploads/2022/11/DTVP_White_Paper_ADB2_V1.pdf).

1.4 Compatibility Considerations

The changes described in this document are backward-compatible with the version of the standard to which this Amendment pertains.

2. LIST OF CHANGES

Change instructions are given below in *italics*. Unless otherwise noted, inserted text, tables, and drawings are shown in blue; deletions of existing text are shown in ~~red strikeout~~. The text "[ref]" indicates that a cross reference to a cited referenced document should be inserted.

2.1 Normative References

No changes.

2.2 Informative References

No changes.

2.3 Acronyms and Abbreviations

No changes.

2.4 Terms

Add the following definition, retaining alphabetic ordering of the definitions of terms:

Hamming distance – The number of bits in two sequences at which their corresponding values are different.

2.5 Change Instructions

In Section 5.1.7.2, make the following changes:

5.1.7.2 extended_vp1_message()

The bit stream syntax of the extended_vp1_message() shall be as shown in Table 5.12.

Table 5.1 Bit Stream Syntax for the extended_vp1_message()

Syntax	No. of Bits	Format
extended_vp1_message() {		
if (header == 0xAE0AB9E4)		
zero_pad	2	'0'
time_offset	~~8~~6	uimsbf
header	32	0xAE0AB9E4~~bslbf~~
else {		
time_offset_parity_msb	2	bslbf
time_offset	6	uimsbf
time_offset_parity_lsb	32	bslbf
}		
alternate_packet()	127	bslbf
zero_pad	1	'0'
}		

time_offset – This ~~8~~6-bit field shall convey the time offset of the video frame in which this extended_vp1_message() is carried relative to the first frame in its VP1 Message Group, in units of 1/30 of a second. It shall convey a value in the range 0 through 44, inclusive.

header – This 32-bit field shall consist of a header element with value 0xAE0AB9E4 as specified in ATSC A/334 Audio Watermark Emission [4].

time_offset_parity_msb – This 2-bit field shall convey the 2 most-significant bits of the Time Offset Parity Sequence associated with the value of the time_offset field, as specified in Table 5.13 below.

time_offset_parity_lsb – This 32-bit field shall convey the 32 least-significant bits of the Time Offset Parity Sequence associated with the value of the time_offset field, as specified in Table 5.13 below.

alternate_packet() – This 127-bit field shall be as given by Table 5.22 and the parameter descriptions that follow; however, the alternate_parity_whitening_sequence and alternate_payload_whitening_sequence given in Table 5.~~13~~14 shall be employed in place of the parity_whitening_sequence and payload_whitening_sequence given in Table 5.23.

zero_pad – This ~~one-bit~~ field shall be set to value '0'.

Table 5.13 Time Offset Parity Sequences (hexadecimal)

time_offset (6 bits)	time_offset_parity_msb (2 bits)	time_offset_parity_lsb (32 bits)
00	0	7FF7FF52
01	2	E4ABD3A9
02	0	D2138A5F
03	2	494FA6A4
04	2	243F1548
05	0	BF6339B3
06	2	89DB6045
07	0	12874CBE
08	2	533A079D
09	0	C8662B66
0A	2	FEDE7290
0B	0	65825E6B
0C	0	08F2ED87
0D	2	93AEC17C
0E	0	A516988A
0F	2	3E4AB471
10	2	BD302237
11	0	266C0ECC
12	2	10D4573A
13	0	8B887BC1
14	0	E6F8C82D
15	2	7DA4E4D6
16	0	4B1CBD20
17	2	D04091DB
18	0	91FDDAF8
19	2	0AA1F603
1A	0	3C19AFF5

1B	2	A745830E
1C	2	CA3530E2
1D	0	51691C19
1E	2	67D145EF
1F	0	FC8D6914
20	3	61246963
21	1	FA784598
22	3	CCC01C6E
23	1	579C3095
24	1	3AEC8379
25	3	A1B0AF82
26	1	9708F674
27	3	0C54DA8F
28	1	4DE991AC
29	3	D6B5BD57
2A	1	E00DE4A1
2B	3	7B51C85A
2C	3	16217BB6

Table 5.~~13~~14 Alternate Whitening Sequences (binary)

alternate_parity_whitening_sequence	alternate_payload_whitening_sequence
00111001110010100111100011110000011100101001100100011011110100100010011111000	1100100111010001110101110001001001100111 0101101100

When present, the extended_vp1_message() shall be the first (i.e., left-most) wm_message() present in a video frame.

A Time Offset Parity Sequence, when present, enables receivers to error-correct the time_offset field. The parity sequences are selected to maximize the Hamming distance among valid emission sequences in the 40 most-significant bits of an extended_vp1_message(). The minimum Hamming distance among the Time Offset Parity Sequences is 15. Inclusion of Time Offset Parity bits in any extended_vp1_message() is optional. Receivers can determine whether an extended_vp1_message() instance includes a Time Offset Parity Sequence by comparing the values in its 9th through 40th most-significant bits to the fixed **header** sequence and the **time_offset_parity_lsb** sequences. The minimum Hamming distance between the **header** sequence and any **time_offset_parity_lsb** sequence is 13.

Within a VP1 Message Group, an extended_vp1_message() shall be conveyed in at least those video frames whose sampling instant is within a right half-open time interval starting at a time that is an integer multiple of 0.3 seconds following the initial frame of the VP1 Message Group and ending 1/30 of a second later, for integers 0 through 4, unless a vp1_message() is also present in the VP1 Message Group, in which case for integers 1 through 4. When both vp1_message() and extended_vp1_message() are included in a VP1 Message Group, both message types shall be used in every VP1 Message Group of the VP1 Video Watermark Segment.

Increment the table numbers of Tables 5.14-5.32 to become Tables 5.15-5.33 due to the newly inserted Table 5.13.

Update all references to the renumbered Tables 5.14-5.33 throughout the remainder of the document.

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