

ATSC Standard: A/332:2017 Amendment No. 1, Capability Codes

Doc. A/332:2017-Amend-No-1
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Revision History

Version	Date
Amendment approved	26 March 2021

ATSC Standard: A/332:2017 Amendment No. 1, Capability Codes

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 updates and extends the “capability codes” defined in Section 5. These capability codes are used in several ATSC standards to express one of:

- Required decoder features in order to decode a Service(s)
- Required decoder features in order to run a Broadcaster Application
- Decoder features

The uses within ATSC standards are:

- 1) A/331:2020
 - a) SLT.SLTCapabilities (all services – Section 6.3)
 - b) SLT.Service.SVCCapabilities (this service – Section 6.3)
 - c) HELD@requiredCapabilities (this Broadcaster Application – Section 7.1.8)
 - d) MMT DCIT
 - e) HTTP User-Agent Header Field (this device – Section 7.1.2.4)
- 2) A/332:2017 (Dec)
 - f) ...oma:Content.PrivateExt.sa:Capabilities (this content – Section 5.2.2.3.3)
- 3) A/344:2020
 - g) deviceInfoProperties.deviceCapabilities (this device – Section 9.13)

1.3 Rationale for Changes

The codes are incomplete with respect to current ATSC features. Also, with the addition of the A/344 device query for capabilities, more device feature signaling is desired.

1.4 Compatibility Considerations

This amends and augments the list of codes by way of additions, clarifications, deletions, and deprecation to reserved status.

- Codes clarified are believed to have not been in use with respect to aspects that are changed.
- Codes deleted, or changed to reserved, are considered to have been unusable as defined.
- Newly specified domains of applicability, indicated for each code, are believed to be consistent with use to date.

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.

Modify the Normative References as follows:

2.1 Normative References

- [1] ~~ATSC: “ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable,” Doc. A/65:2013, Advanced Television Systems Committee, Washington, D.C., 7 August 2013.~~
- [2] ATSC: “ATSC-Mobile DTV Standard, Part 4 – Announcement,” Doc. A/153 Part 4:2009, Advanced Television Systems Committee, Washington, D.C., 15 October 2009.
- [3] ATSC: “ATSC Standard: Signaling, Delivery, Synchronization, and Error Protection (A/331),” Doc. A/331:201721, Advanced Television Systems Committee, Washington, D.C., ~~6 December 2017~~19 January 2021.
- [4] ~~IANA: “Hypertext Transfer Protocol (HTTP) Parameters,” <http://www.iana.org/assignments/http-parameters>.~~
- [5] ~~IANA: “MIME Media Types,” <http://www.iana.org/assignments/media-types>.~~
- [6] ~~IANA: “Reliable Multicast Transport (RMT) FEC Encoding IDs and FEC Instance IDs,” <http://www.iana.org/assignments/rmt-fec-parameters>.~~
- ...
- [13] ATSC: “ATSC Standard: Video—HEVC—(A/341), with Amendment No. 1,” Doc. A/341:20172019, Advanced Television Systems Committee, Washington, D.C., ~~19 May 2017~~14 February 2019, Amendment No. 1 approved 2 March 2021.
- [14] ATSC: “ATSC Standard: AC-4 System—(A/342—Part 2),” Doc. A/342-2:2017021, Advanced Television Systems Committee, Washington, D.C., ~~23 February 2017~~10 March 2021.
- [15] ATSC: “ATSC Standard: MPEG-H System—(A/342—Part 3),” Doc. A/342—Part—3:2021, Advanced Television Systems Committee, Washington, D.C., ~~3 March 2017~~11 March 2021.
- [16] ATSC: “ATSC Standard: Non-Real-Time Content Delivery,” Doc. A/103:2014, Advanced Television Systems Committee, Washington, D.C., 25 July 2014.
- [17] ~~IETF: “RaptorQ Forward Error Correction Scheme for Object Delivery,” RFC 6330, Internet Engineering Task Force, August 2011.~~
- [18] ATSC: “ATSC Standard: Captions and Subtitles, with Amendment No. 1,” Doc. A/343:20168, Advanced Television Systems Committee, Washington, D.C., ~~21 December 2016~~10 October 2018, Amendment No. 1 approved 8 February 2021.
- ...
- [X] ATSC: “ATSC Standard: Companion Device,” Doc. A/338:2021, Advanced Television Systems Committee, Washington, D.C., 19 February 2021.
- [Y] ATSC: “ATSC 3.0 Interactive Content,” Doc. A/344:2021, Advanced Television Systems Committee, Washington, D.C., 19 February 2021.
- [Z] ITU-R: “Recommendation Parameter values for the HDTV standards for production and international programme exchange,” Doc. BT.709-6, International Telecommunications Union, Geneva Switzerland, June 2015.
- [A] ITU-R: “Use of large screen digital imagery Recommendations in video information systems applications,” Doc. BT.2000-0, International Telecommunications Union, Geneva Switzerland, January 2012.

[B] ITU-R: “Image parameter values for high dynamic range television for use in production and international programme exchange,” Doc. BT.2100-2, International Telecommunications Union, Geneva Switzerland, July 2018.

[C] ATSC: “Audio Common Elements,” Doc. A/342-1:2021, Advanced Television Systems Committee, Washington, D.C., 9 March 2021.

Add to Section 3.3 Acronyms ad Abbreviations

AAC – Advanced Audio Coding

AMP – Application Media Player

AVC – Advanced Video Coding

DNF – Disjunctive Normal Form

DRM – Digital Rights Management

HDR – High Dynamic Range

HEVC – High Efficiency Video Coding

HTTP – HyperText Transport Protocol

IMSC1 – Internet Media Subtitles and Captions 1

MPEG – Moving Picture Experts Group

PVR – Personal Video Recorder

RMP – Receiver Media Player

SDR – Standard Dynamic Range

SEI – Supplemental Enhancement Information

SHVC – Scalable High Efficiency Video Coding

SL-HDR – Single Layer High Dynamic Range

Modify Section 5 as follows:

5. SERVICE ANNOUNCEMENT: SERVICE GUIDE

5.2 ATSC SG Data Model

5.2.2.3.3 Device Capabilities

5.2.2.3.3.1 Device Capabilities Related Content-Level Private Extensions

Elements from the ATSC3-0 namespace may be used within the OMA `PrivateExt` element, to indicate an ATSC 3.0 device capabilities related element, as given in Table 5.10.

The `sa:Capabilities` XML element specifies the capabilities and capability groups¹ required in the receiver to be able to create a meaningful presentation of the content. Using this element, it is possible to express multiple alternate sets of required capabilities and capability groups, the support for any one of the multiple alternate sets is sufficient to create a meaningful presentation. This is done by using a logical or expression in the `sa:Capabilities` element. It is also possible to express decoder features to HTTP servers and A/344 [Y] applications (see Table 5.11 Note 1)

¹ A capability group is a set of capabilities

using the syntax described in this section (see also A/331 Section 7.1.2.4 [3], A/344 Section 9.13 [Y]).

The `sa:Features` XML element specifies capabilities and capability groups, whether essential or optional, usable to create meaningful presentations of this Content, if supported by a receiver. This element can be used to provide content properties in the Service Guide or to filter content in accordance with user preferences. The `sa:Features` element is a logical expression of the form specified in Section 5.2.2.3.3.2 and is not constrained to use capability codes designated therein as “Required”. When not already provided in disjunctive normal form² (DNF), this logical expression can be expanded into DNF, wherein each term indicates a set of capabilities usable in one or more meaningful presentations of this Content. A receiver can evaluate the entire `sa:Features` element to discern whether it can meaningfully present this Content, thereby duplicating the functionality of `sa:Capabilities`, but can analyze and evaluate each term of the DNF to discern whether any capabilities that are preferred or of interest are available for meaningful presentations of this Content.

Table 5.10 Device Capabilities Related Content-Level Private Extensions

Name	Type	Category	Cardinality	Description	Data Type
Content	E		.	'Content' fragment ...	
...					
PrivateExt	E1	NO/ TO	0..1	An element serving as a container for proprietary or application-specific extensions.	
<code>sa:Capabilities</code>	E3	NO/TM	0..1	Capabilities and capability groups required for decoding and presenting the content signaled using capability codes, capability strings and Boolean operators (and/or). This string shall conform to the normative syntax defined for <code>capabilities</code> described in Section 5.2.2.3.3.2	string
<code>sa:Features</code>	E3	NO/TM	0..1	Capabilities and capability groups usable when decoding and presenting the content signaled using capability codes, capability strings and Boolean operators (and/or). This string shall conform to the normative syntax defined for <code>capabilities</code> described in Section 5.2.2.3.3.2.	string

5.2.2.3.3.2 Device Capabilities Syntax and Semantics

This section defines the syntax for the required device capabilities and capability groups indicated by `capabilities`. The syntax is described using the Augmented Backus-Naur Form (ABNF) grammar defined in RFC 5234 [9], and UTF-8 as defined in RFC 3629 [10] (Section 4). Rules are separated from definitions by an equal "=", indentation is used to continue a rule definition over more than one line, literals are quoted with "", parentheses "(" and ")" are used to group elements, optional elements are enclosed in "[" and "]" brackets, and elements may be preceded with `<n>*` to designate n or more repetitions of the following element; n defaults to 0.

Syntax of `capabilities` shall be as specified below:

² DNF is a canonical normal form of a logical formula consisting of a disjunction of conjunctions, wherein each conjunction is a “term”. Compared to an expression in DNF, an equivalent expression that is not in DNF can be more compact.

```

ccode                = 1*4HEXDIG
capability_string_code = ubyte "=" 1*utf8
ubyte                = 1*3DIGIT
utf8                  = *( UTF8-char )
boperator             = and / or
and                   = "&"
or                    = "|"
expr                  = ccode
                      / capability_string_code
                      / expr WSP expr WSP boperator
capabilities          = expr

```

The semantics of `capabilities` shall be as specified below.

`ccode` – This terminal symbol represents a certain capability or capability group. This symbol evaluates as “true” if and only if the device has the capability or capability group identified. Values of `ccode` shall be a code point from Table 5.11.

`capability_string_code` – The first operand `ubyte` represents the ~~registry identified by the~~ capability category code. Values of `ubyte` shall be from Table 5.12 `capability_category_code` column. The second operand specifies the ~~value of the~~ capability ~~or capability group within that registry, and shall be as specified in that registry~~. This symbol evaluates as “true” if and only if the device has the capability ~~or capability group~~ identified. Characters chosen from UTF8-char shall not include Whitespace (WSP).

`boperator` – This nonterminal symbol represents a Boolean operator.

`and` – This nonterminal symbol represents the logical-and symbol.

`or` – This nonterminal symbol represents the logical-or symbol.

`expr` – This recursive nonterminal symbol represents a sequence of `ccode` symbols, `capability_string_code` symbols, and postfix logical operations. In an `expr`, when the `boperator` is “and”, this symbol evaluates as “true” if and only if both the first and second operands evaluate as “true”; and when the `boperator` is “or”, this symbol evaluates as true if and only if one or both of the first and second operands evaluate as “true.”

`capabilities` – This nonterminal represents capabilities and capability groups required for decoding and presenting the content signaled. If this nonterminal evaluates as “true”, capabilities and capability groups required to be able to create a meaningful presentation of the content are present. Using this nonterminal it is possible to express multiple alternate sets of capabilities and capability groups, the support for any one set of which is sufficient to create a meaningful presentation.

Table 5.11 Capability Codes

capability_code Meaning		Reference	Required (See Note 1)	Supported (See Note 2)
0x0000	Forbidden		n/a	n/a
Capability Category: Download Protocols				
0x0100-0x01FF	Reserved for future ATSC use.			
Capability Category: FEC Algorithms				
0x0200	RFC-6330 AL FEC Repair-only	Section 5.3.8	X	X

capability_code	Meaning	Reference	Required (See Note 1)	Supported (See Note 2)
0x0201	STAGGERCAST	A/331 Sections 7.1.5.1 & 7.2.3.3 [3]		X
0x0201-0x02FF	Reserved for future ATSC use.			
Capability Category: Wrapper/Archive Formats				
0x0300-0x03FF	Reserved for future ATSC use.			
Capability Category: Compression Algorithms				
0x0400-0x04FF	Reserved for future ATSC use.			
Capability Category: Media Types (RMP – See Note 3)				
0x0500	[Reserved for AVC standard definition video]	Section 5.3.1A.2.8 [16]		
0x0501	[Reserved for AVC high definition video]	Section 5.3.1A.2.9 [16]		
0x0502	AC-3 audio	A/103 Section A.2.10 [16]		
0x0503	E-AC-3 audio	A/103 Section A.2.11 [16]		
0x0504	DTS-HD audio	A/103 Section A.2.18 [16]		
0x0505	HE AAC v2 with MPEG Surround	A/103 Section A.2.21 [16]		
0x0506	HE AAC v2 Level 6 audio	A/103 Section A.2.22 [16]		
0x0507	Frame-compatible 3D video (Side-by-Side)	A/103 Section A.2.23 [16]		
0x0508	Frame-compatible 3D video (Top-and-Bottom)	A/103 Section A.2.24 [16]		
0x0509	ATSC 3.0 S H HEVC Video	Section 5.3.3 5.3.4	X	X
0x050A	ATSC 3.0 HDR Video	Section 5.3.4	X	X
0x050B	Dolby® AC4 Audio	A/342 Part 2 [14]	X	X
0x050C	MPEG-H Audio	A/342 Part 3 [15]	X	X
0x050D	IMSC1 Text Profile	A/343 [18]	X	X
0x050E	IMSC1 Image Profile	A/343 [18]	X	X
0x050F	4K Resolution	A/341 [13]		X
0x0510	ATSC 3.0 HDR with ST 2094-10	Section 5.3.6		X
0x0511	ATSC 3.0 SDR with SL-HDR1 SEI	Section 5.3.7		X
0x0512	ATSC 3.0 SHVC Video	Section 0		X
0x0513	HFR with one temporal sub-layer	Section 5.3.10		X
0x0514	HFR with unfiltered temporal sub-layers	Section 5.3.11		X
0x0515	HFR with filtered temporal sub-layers	Section 5.3.12		X
0x0516	ATSC 3.0 Fixed/Mobile 3D HEVC	Section 5.3.13		X
0x0517	ATSC 3.0 Fixed/Mobile 3D SHVC	Section 5.3.14		X
0x0518	ATSC 3.0 Wide Color Gamut	Section 5.3.15		X
0x0519	ATSC 3.0 HD Progressive Video	Section 5.3.16		X
0x051A	ATSC 3.0 Personalization Selection	Section 5.3.17		X
0x051B	ATSC 3.0 Dialog Enhancement	Section 5.3.18		X
0x051C	ATSC 3.0 Video Descriptive Services	Section 5.3.19		X
0x051D	ATSC 3.0 SD Progressive Video	Section 5.3.20		X
0x051E	ATSC 3.0 Legacy SD Video	A/341 Section 6.2.1 [13]		X

capability_code	Meaning	Reference	Required (See Note 1)	Supported (See Note 2)
0x051F	ATSC 3.0 Interlaced HD Video	A/341 Section 6.2.2 [13]		X
0x0520-0x057F	Reserved for future ATSC use.			
Capability Category: Media Types (AMP – See Note 4)				
0x0580	[Reserved for AVC standard definition video]	Section 5.3.1		
0x0581	[Reserved for AVC high definition video]	Section 5.3.1		
0x0582	AC-3 audio	A/103 Section A.2.10 [16]		
0x0583	E-AC-3 audio	A/103 Section A.2.11 [16]		
0x0584	DTS-HD audio	A/103 Section A.2.18 [16]		
0x0585	HE AAC v2 with MPEG Surround	A/103 Section A.2.21 [16]		
0x0586	HE AAC v2 Level 6 audio	A/103 Section A.2.22 [16]		
0x0587	Frame-compatible 3D video (Side-by-Side)	A/103 Section A.2.23 [16]		
0x0588	Frame-compatible 3D video (Top-and-Bottom)	A/103 Section A.2.24 [16]		
0x0589	ATSC 3.0 HEVC Video	Section 5.3.3	X	X
0x058A	ATSC 3.0 HDR Video	Section 5.3.4	X	X
0x058B	Dolby® AC4 Audio	A/342 Part 2 [14]	X	X
0x058C	MPEG-H Audio	A/342 Part 3 [15]	X	X
0x058D	IMSC1 Text Profile	A/343 [18]	X	X
0x058E	IMSC1 Image Profile	A/343 [18]	X	X
0x058F	4K Resolution	A/341 [13]		X
0x0590	ATSC 3.0 HDR with ST 2094-10	Section 5.3.6		X
0x0591	ATSC 3.0 SDR with SL-HDR1 SEI	Section 5.3.7		X
0x0592	ATSC 3.0 SHVC Video	Section 0		X
0x0593	HFR with one temporal sub-layer	Section 5.3.10		X
0x0594	HFR with unfiltered temporal sub-layers	Section 5.3.11		X
0x0595	HFR with filtered temporal sub-layers	Section 5.3.12		X
0x0596	ATSC 3.0 Fixed/Mobile 3D HEVC	Section 5.3.13		X
0x0597	ATSC 3.0 Fixed/Mobile 3D SHVC	Section 5.3.14		X
0x0598	ATSC 3.0 Wide Color Gamut	Section 5.3.15		X
0x0599	ATSC 3.0 HD Progressive Video	Section 5.3.16		X
0x059A	ATSC 3.0 Personalization Selection	Section 5.3.17		X
0x059B	ATSC 3.0 Dialog Enhancement	Section 5.3.18		X
0x059C	ATSC 3.0 Video Descriptive Services	Section 5.3.19		X
0x059D	ATSC 3.0 SD Progressive Video	Section 5.3.20		X
0x059E	ATSC 3.0 Legacy SD Video	A/341 Section 6.2.1 [13]		X
0x059F	ATSC 3.0 Interlaced HD Video	A/341 Section 6.2.2 [13]		X
0x05A0-0x05FF	Reserved for future ATSC use.			
Capability Category: Internet Link				

capability_code Meaning		Reference	Required (See Note 1)	Supported (See Note 2)
0x0600	Internet link, downward rate 56,000 bps or better	A/103 Section A.2.25 [16]		
0x0601	Internet link, downward rate 512,000 bps or better	A/103 Section A.2.26 [16]		
0x0602	Internet link, downward rate 2,000,000 bps or better	A/103 Section A.2.27 [16]		
0x0603	Internet link, downward rate 10,000,000 bps or better	A/103 Section A.2.28 [16]		
0x0604-0x06FF	Reserved for future ATSC use.			
Capability Category: Interactive				
0x0700	Interactive Content Environment	A/344 [Y] (all)	X	X
0x0701	WSPath/atscVid	A/344 [Y] 8.2.1	X	X
0x0702	WSPath/atscAud	A/344 [Y] 8.2.1	X	X
0x0703	WSPath/atscCap	A/344 [Y] 8.2.1	X	X
0x0704	WSPath/atscCD	A/344 [Y] 8.2.1	X	X
0x0705-0x07FF	Reserved for future ATSC use.			
Capability Category: Other				
0x0800	DRM	Section 5.3.21.1	X	X
0x0801	Companion Device	Section 5.3.21.2	X	X
0x0802-0x08FF	Reserved for future ATSC use.			
ATSC Reserved				
0x001-0x00FF, 0x0900- 0xFFFF	Reserved for future ATSC use.			
<p>Note 1 - Codes marked with an "X" in this column are those codes that have use when signaling "capabilities and capability groups required in the receiver to be able to create a meaningful presentation of the content" (as described in Section 5.2.2.3.3.1 above).</p> <p>Note 2 - Codes marked with an "X" in this column are those codes that have use when signaling the capabilities of receivers to HTTP servers (A/331 [3] Section 7.1.2.4) and A/344 Applications (A/344 [Y] Section 9.13).</p> <p>Note 3 – Required or supported without using an interactive environment; e.g., the real RMP only.</p> <p>Note 4 – Required or supported using the interactive environment; e.g., the real RMP, HTML5 media stack, etc.</p>				

Table 5.12 Capability Categories and Registries

capability_category_code (ubyte)	Capability Category	Registry Reference
0x00	Minimum HTTP Cache Size	Section 5.3.22.1
0x01	Minimum Broadcast Cache Size	Section 5.3.23
0x00	reserved	
0x01	Download Protocol	No registry—use widely used industry name
0x02	FEC Algorithm	IANA registry of FEC encoding IDs and instance IDs [6]
0x03	Wrapper/Archive Format	IANA registry of media types and subtypes [5]
0x04	Compression Algorithm	IANA registry of HTTP Content Coding values [4]
0x05	Media Type	IANA registry of media types and subtypes [5]
0x06	Internet Link	No registry
0x07	Interactive	No registry
0x08	Other	No registry

0x029-0xFF	Reserved for future ATSC use.	
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5.3 Description of Code Points

The terms “RMP” and “AMP” as used in Table 5.11 and this section are not as commonly used in A/344 [Y]. These refer to two separate environments within the receiver. The RMP is the native receiver environment. It is expected to support at least the essential capabilities to create useful presentations. The AMP is in the interactive environment intended to support broadcaster applications. As such, it can include additional functionality, which include support for a different set of capabilities. These different environments and their capabilities are separated into two similar sets of capability codes in the table above to cover the use cases where decoder capabilities exist in only one of the environments.

Other Code Points in Table 5.11 shall follow the description specified in the section referred in the column “Reference”.

Note: User private data, including capability codes, can be added with user-defined-namespace elements or attributes.

5.3.1 Capability Codes 0x0500, 0x0501, 0x580, 0x581: AVC Video

The capability codes 0x0500, 0x0501, 0x0580, and 0x0581 are allocated to represent AVC standard definition video and AVC high definition video, respectively. These codes should not be used but might be usable if a future version of the ATSC 3.0 standard defines full specifications for the use of AVC.

5.3.2 Capability Codes 0x0507, 0x0508, 0x0587, and 0x0588: 3D Video

The capability codes 0x0507, 0x0508, 0x0587, and 0x0588 are allocated to represent various 3D video configurations. These codes should not be used but might be usable if a future version of the ATSC 3.0 standard defines full specifications for their use.

5.3.3 Capability Codes 0x0509 and 0x0589: ATSC 3.0 ~~S~~HEVC Video

The capability_code values 0x0509 and 0x0589 shall represent the receiver ability (using the RMP or AMP respectively) to ~~support~~ decode and display or output video (including at least the base layer of ~~HEVC or~~ HEVC scalable video) encoded using HEVC in conformance with the ATSC specification A/341 [13] but not requiring ability to support the constraints related to HDR in A/341 [13].

5.3.4 Capability Codes 0x050A and 0x058A: ATSC 3.0 HDR Video

The capability_code values 0x050A and 0x058A shall represent the receiver ability (using the RMP or AMP respectively) to ~~support~~ decode and display or output video encoded using HEVC ~~video encoded~~ in conformance with the ATSC specification A/341 [13] including the aspects of A/341 describing HDR. That is, ~~In this case~~ the receiver’s ability to decode and display or output ~~shall support~~ HEVC video encoded in conformance with all constraints including constraints regarding HDR in A/341 [13].

5.3.5 Capability Codes 0x050F and 0x058F: 4K Resolution

The capability_code values 0x050F and/or 0x058F shall represent the receiver ability (using RMP or AMP respectively) to decode and display or output video with spatial resolution greater than or equal to 3840×2160 (nominal), which is encoded per A/341 [13] with spatial resolution greater than or equal to 3840×2160. Note that this represents the ability to display or output at 3840×2160, not merely the ability to decode video encoded at 3840×2160 and create a meaningful output.

5.3.6 Capability Codes 0x0510 and 0x0590: ATSC 3.0 HDR Video with ST2094-10 SEI

The capability_code values 0x0510 and/or 0x0590 shall represent the receiver (using the RMP or AMP respectively) ability to decode HEVC video encoded in conformance with the ATSC specification A/341 [13] and specifically to utilize ST 2094-10 metadata. Note that this represents the ability to utilize the ST 2094-10 metadata in the decoding process, as described by the ST 2094-10 SEI messages as codified in A/341 Section 6.3.2.2.1 [13].

5.3.7 Capability Codes 0x0511 and 0x0591: ATSC 3.0 SDR Video with SL-HDR1 SEI

The capability_code values 0x0511 and/or 0x0591 shall represent the receiver (using the RMP or AMP respectively) ability to decode HEVC video encoded in conformance with the ATSC specification A/341 [13] and specifically to utilize SL-HDR1 metadata. Note that this represents the ability to utilize SL-HDR1 metadata carried in the SL-HDR Information SEI messages as codified in A/341 Sections 6.3.2.1.1 and 6.3.2.1.2 [13].

5.3.8 Capability Code 0x0200: AL-FEC ~~as defined by RFC 6330~~

The capability_code value 0x0200 shall represent the receiver ability to ~~utilize support the~~ AL-FEC data to perform error correction ~~protocol~~ in conformance to ~~RFC 6330 [17]~~ the ATSC specification A/331 [3]. ~~The receiver must support this capability code in order to acquire the service contents delivered on the repair flow/ protocol as specified in Annex of A/331 [3].~~

5.3.9 Capability Codes 0x0512 and 0x0592: ATSC 3.0 SHVC Video

The capability_code values 0x0512 and 0x0592 shall represent the receiver ability, in the RMP or AMP respectively, to decode and display or output video enhanced by an SHVC enhancement layer in conformance with the ATSC specification A/341 Sections 6.3.1, 6.3.2.1, 6.3.3.3, and 6.3.4 [13] as applied to the context determined by the other conjoined capability codes.

5.3.10 Capability Codes 0x0513 and 0x0593: HFR with One Temporal Sub-Layer

The capability_code values 0x0513 and/or 0x0593 shall represent the receiver ability (using RMP or AMP respectively) to decode and display or output high frame rate (i.e., a picture rate of 100, 120/1.001, 120) video encoded using HEVC with exactly one temporal sub-layer in conformance with the ATSC specification A/341 Section 6.3.4 [13]. A code from this section shall not appear in a conjunction with any code from Section 5.3.11 or Section 5.3.12.

5.3.11 Capability Codes 0x0514 and 0x0594: HFR with Unfiltered Temporal Sub-Layers

The capability_code values 0x0514 and 0x0594 shall represent the receiver ability, in the RMP or AMP respectively, to decode and display or output high frame rate (i.e., a picture rate of 100, 120/1.001, 120) video using HEVC encoded with exactly two temporal sub-layers in conformance with the ATSC specification A/341 Section 6.3.4 [13] without the temporal filtering described in A/341 Section 6.3.4.1 [13]. A code from this section shall not appear in a conjunction with any code from Section 5.3.10 or Section 5.3.12.

5.3.12 Capability Codes 0x0515 and 0x0595: HFR, Temporal Filtering

The capability_code values 0x0515 and 0x0595 shall represent the receiver ability, in the RMP or AMP respectively, to decode and display or output high frame rate (i.e., a picture rate of 100, 120/1.001, 120) video using HEVC encoded with exactly two temporal sub-layers and in conformance with the ATSC specification A/341 Section 6.3.4 [13] and with temporal filtering in conformance with A/341 Section 6.3.4.1 [13]. A code from this section shall not appear in a conjunction with any code from Section 5.3.10 or Section 5.3.11.

5.3.13 Capability Codes 0x0516 and 0x0596: ATSC 3.0 Fixed/Mobile 3D HEVC

The `capability_code` values 0x0516 and 0x0596 shall represent the receiver ability, in the RMP or AMP respectively, to decode and display or output stereoscopic video using HEVC with independently encoded left and right views, subject to the constraints of ATSC specification A/341 Sections 6.2.3 and 6.3.3 [13] as described in Annex C [13].

5.3.14 Capability Codes 0x0517 and 0x0597: ATSC 3.0 Fixed/Mobile 3D SHVC

The `capability_code` values 0x0517 and 0x0597 shall represent the receiver ability, in the RMP or AMP respectively, to decode and display or output stereoscopic video using HEVC having left and right views further encoded using SHVC, subject to the constraints of ATSC specification A/341 Sections 6.2.3, 6.3.1, and 6.3.3 [13] as described in Annex C [13].

5.3.15 Capability Codes 0x0518 and 0x0598: ATSC 3.0 Wide Color Gamut

The `capability_code` values 0x0518 and 0x0598 shall represent the receiver ability, in the RMP or AMP respectively, to decode and display or output video having colors outside the ITU-R BT.709 [Z] gamut when encoded using HEVC with primaries and matrix coefficients (i.e., system colorimetry) of ITU-R BT.2020 [A] and ITU-R BT.2100 [B], subject to the constraints of ATSC specification A/341 Section 6.3.2.

5.3.16 Capability Codes 0x0519 and 0x0599: ATSC 3.0 HD Progressive Video

The `capability_code` values 0x0519 and 0x0599 shall represent the receiver ability, in the RMP or AMP respectively, to decode and display or output progressive video formats between 720 and 1440 lines, as constrained in Section 6.2.3 of ATSC specification A/341 [13] in the context of the other conjoined capability codes.

5.3.17 Capability Codes 0x051A and 0x059A: Personalization Selection

The `capability_code` values 0x051A and 0x059A shall represent the receiver ability, in the RMP or AMP respectively, to decode and reproduce or output audio subject to a personalization selection by the user, as specified in ATSC specification A/342 Part 1 [C], in the context of the other conjoined capability codes.

5.3.18 Capability Codes 0x051B and 0x059B: Dialog Enhancement

The `capability_code` values 0x051B and 0x059B, shall represent the receiver ability, in the RMP or AMP respectively, to decode and reproduce or output audio subject to a personalization control by the user to set a relative level of dialog, as specified in ATSC specification A/342 Part 1 [C], in the context of the other conjoined capability codes.

5.3.19 Capability Codes 0x051C and 0x059C: Video Descriptive Service

The `capability_code` values 0x051C and 0x059C shall represent the receiver ability, in the RMP or AMP respectively, to decode and reproduce or output video descriptive services subject to a personalization control by a user, as specified in ATSC specification A/342 Part 1 [C], in the context of the other conjoined capability codes.

5.3.20 Capability Codes 0x051D and 0x059D: ATSC 3.0 SD Progressive Video

The `capability_code` values 0x051D and 0x059D shall represent the receiver ability, in the RMP or AMP respectively, to decode and display or output progressive video formats having fewer than 720 lines, as constrained in Section 6.2.3. of ATSC specification A/341 [13] in the context of the other conjoined capability codes.

5.3.21 Capability Category “Other” (0x08xx)

5.3.21.1 Capability Code 0x0800: DRM

The `capability_code` value 0x0800 shall represent that the Receiver supports Digital Rights Management, or that the service is encrypted and requires one. Note that this does not indicate a specific DRM system.

5.3.21.2 Capability Code 0x0801: Companion Device

The `capability_code` value 0x0801 shall represent that the Receiver supports a Companion Device as defined in A/338 [X], or that the service requires one.

5.3.22 Capability Category String Codes (ubyte)

This section identifies string “token” codes that can be used with the `capability_string_code` ubyte value and defines the syntax of the “value” (utf8) of that token.

5.3.22.1 ubyte 0x00: Minimum HTTP Cache Size

The ubyte value 0x00 shall represent that the service or content requires, or the Receiver has, an HTTP cache size in bytes of at least the value of the token, utf8. The syntax of utf8 shall be a decimal integer that represents a minimum cache size in multiples of 100,000 bytes; e.g., “00=5” signals that 500,000 bytes in HTTP cache is needed or supported. This cache is available for any Broadcaster Application signaled in the HELD. See A/331 [3]. The cache content includes HTTP content requested by the Broadcaster Application while executing. Broadcast content is not included in this number. See Section 5.3.10.2.

5.3.23 ubyte 0x01: Minimum Broadcast Cache Size

The ubyte value 0x01 shall represent that the service or content requires, or the Receiver has, a broadcast cache size in bytes of at least the value of the token, utf8. The syntax of utf8 shall be a decimal integer that represents a minimum cache size in multiples of 100,000 bytes; e.g., “01=2” signals that 200,000 bytes in broadcast is needed or supported. This cache is available for any Broadcaster Application signaled in the HELD. See A/331 [3]. All other cache content associated with non-executing `appContextId`'s can be flushed by the Receiver as needed to make up the signaled amount available to the currently executing Broadcaster Application. The cache content includes: the HELD `HTMLEntryPackage`, NRT content with the same `appContextId`, and storage of Broadcaster Application originated data.

Modify Annex A as follows (next page):

Annex A Schema

This Annex contains the normative XML Schema for elements and attributes defined in this specification.

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:sa="tag:atsc.org,2016:XMLSchemas/ATSC3/SA/1.0/"
  xmlns:rrt="tag:atsc.org,2016:XMLSchemas/ATSC3/RRT/1.0/"
  targetNamespace="tag:atsc.org,2016:XMLSchemas/ATSC3/SA/1.0/"
  elementFormDefault="qualified">
  <xs:import namespace="http://www.w3.org/XML/1998/namespace"
    schemaLocation="W3C/xml.xsd"/>
  <xs:import namespace="tag:atsc.org,2016:XMLSchemas/ATSC3/RRT/1.0/"
    schemaLocation="RRT-1.0-2016113020210128.xsd"/>
  <xs:element name="Capabilities" type="sa:CapabilitiesType" />
  <xs:element name="Features" type="sa:CapabilitiesType" />
  <xs:simpleType name="CapabilitiesType"><xs:restriction base="xs:string"/>
</xs:simpleType>
```

...

The definition of this schema can also be found in an XML schema file, SA-1.0-20210312~~170921~~.xsd at the ATSC website. The XML schema file RRT-1.0-20210128~~170209~~.xsd can also be found at the ATSC website.

...

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