



Commercial Requirements for Next Generation Video Codecs Phase 2

DVB Document C105

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DVB[®]

Intellectual Property Rights

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Foreword

DVB is an industry-led consortium of broadcasters, manufacturers, network operators, software developers, regulators and others from around the world committed to designing open, interoperable technical specifications for the global delivery of digital media and broadcast services. DVB specifications cover all aspects of digital television from transmission through interfacing, conditional access and interactivity for digital video, audio and data. DVB dominates the digital broadcasting environment with thousands of broadcast services around the world using DVB specifications. There are hundreds of manufacturers offering DVB-compliant equipment. To date, there are over 1 billion DVB receivers shipped worldwide.

Executive summary

The present document defines commercial requirements for next generation video codecs phase 2, which are focussing on delivering an enhanced service based on a base service that is already delivered in DVB markets with a potential solution that is more efficient than simulcast.

An Enhanced Service upgrades the Base Service to a significantly better experience (e. g. increased spatial resolution, increased temporal resolution, bit depth, enhanced dynamic range).

Benchmarks have been set as commercial requirements to select the appropriate solutions.

The solution shall be available 12 months latest after approval of the commercial requirements.

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1. Introduction

Between 2018 and 2020 several new video codec solutions have emerged: AV1, EVC, VVC, AVS3 and LCEVC. Some of them have already been deployed commercially.

DVB launched a survey in spring 2020 to consider the potential interest of DVB members, the need for DVB standardization activities in relation to these new codecs, the potential applications and the potential timeline.

As a result, 95 % of respondents indicated that new codecs should be added to the toolbox with volume shipments expected in 2021 -2023. The most suggested applications of new codecs appear to be 4k efficient delivery and 8K delivery.

1.1. Scope

The present document defines commercial requirements for next generation video codecs phase 2, which are focussing on delivering an enhanced service based on base service that is already delivered in DVB markets with a potential solution that is more efficient than simulcast.

2. References

[1]	ETSI TS 101 154 V2.7.1	Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcast and Broadband Applications
[2]	ITU-R Recommendation BT.2100-1 (06/2017)	Image parameter values for high dynamic range television for use in production and international programme exchange
[3]	DVB CM-AVC0413r3	CM-AVC Study Mission Report; “HDR Enhancements to DVB UHD- 1 Phase 2”
[4]	DVB CM-AVC0035	DVB AV Codec Criteria
[5]	ETSI TS 103 285	Digital Video Broadcasting (DVB); MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks
[6]	DVB TM AVC 1168	Communication from EBU Video Systems (VS) to DVB TM-AVC on HFR compatible issues

3. Definitions and conventions

3.1. Terms

For the purposes of the present document, the following terms apply:

Term	Meaning
Base service	A service that for the purpose of this document remains unmodified in quality and remains compatible with existing

	IRDs in the field (i. e. decodable without impairment). Uses one of the conformance points defined for HD or SD in TS 101 154.
Enhanced service	An Enhanced Service upgrades the Base Service to a significantly better experience (e. g. increased spatial resolution, increased temporal resolution, bit depth, enhanced dynamic range).

3.2. Abbreviations

For the purposes of the present document, the following abbreviations apply:

Term and abbreviation	Meaning
Commercial Requirement (CR)	Normative text clauses in the present document that are provided in order to guide the specification work on next generation video codecs in the Technical Module.
HDR	High Dynamic Range
BT.2020	ITU-R Recommendation BT.2020
BT.709	ITU-R Recommendation BT.709
DVB delivery systems	DVB defined systems for the delivery of AV content (i.e. Terrestrial, Cable, Satellite and IP)

3.3. Conventions

Commercial Requirement tagging scheme:

Req x. [y].z.	Name	Status	Priority	Use case
<p>Numeric requirement ref.</p> <p>x = section y = subsection(s) z = sequence number</p> <p>This is a unique id within the document that could be used to refer to a requirement within a specific version of this document.</p> <p>Note that this id. is not strictly coupled to the particular requirement, could vary across different</p>		<p>This status field can have the following states:</p> <p>Draft = work in progress</p> <p>Complete = completed and agreed in task force</p> <p>Agreed = agreed within CM-XYZ</p> <p>Accepted = accepted by CM</p>	<p>This field is the associated priority set by the CM to the requirement.</p> <p>1→ Must have</p> <p>2→ Recommended to have</p> <p>3→ Nice to have</p>	<p>Identifies the use cases that relate to this commercial requirement, if applicable.</p> <p>[UC]</p>

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For the purpose of this document, the following normative conventions are used in the Commercial Requirements text:

Convention	Meaning
shall enable	The functionality shall be specified but its support is optional.
shall support	The functionality shall be specified and its support is mandatory.
should enable	The functionality is recommended to be specified and its support is optional.
should support	The functionality is recommended to be specified and supported.
may enable	The functionality may be specified and if it is then its support is optional, and it shall not have any weight in the selection or exclusion of any particular solution.
may support	The functionality may be specified and if it is then its support is recommended but it shall not have any weight in the selection or exclusion of any particular solution.
shall not preclude	The functionality shall not be prevented.
should not preclude	It is recommended not to prevent the functionality.

4. Commercial requirements

4.1. General Requirements

Req 4.1-1	Bitstream Delivery	Draft	1	UC1
The specifications shall be defined in a way that the base service and enhanced service can be delivered both as one single bit stream or/and as two separate bitstreams.				

Req 4.1-1b	Backward Compatibility	Draft	1	UC1
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The specification shall be defined in a way that the enhanced service is fully transparent to a legacy receiver which is only capable of processing the base layer.

Req 4.1-2	Required Architecture Changes			
<p>The technology shall be able to be implemented on common, mid-range TV SoCs without requiring significant architectural changes to those SOCs.</p> <p>NOTES:</p> <ul style="list-style-type: none"> - Adding an additional video codec is not considered as a significant architectural change. - Ultimately the implementation is left to the manufacturer. 				

Req 4.1-3	Security			
<p>The technology shall be implementable in a secure video pipeline in an IRD SoC.</p>				

Req 4.1-3b	Security			
<p>The solution shall support a use case whereby the base layer is FTA and the enhanced layer is protected.</p> <p>NOTE:</p> <p>The intent is to ensure the interoperability with one use case to the extent possible. If this CR cannot be met or verified; TM or its relevant subgroups shall report to CM-AVC and seek advice</p>				

Req 4.1-4	Security	Draft	1	UC1
<p>The technology shall be able to operate with current forensic watermarking in IRDs.</p> <p>NOTE:</p> <ul style="list-style-type: none"> - A suitable way forward is the analysis at architecture level for one content protection technology and its principles carried out by CM-SEG 				

Req 4.1-5	Picture Processing	Draft	1	UC1
<p>The technology shall be capable of being implemented on a modern TV SoC without interference with an individual TV manufacturers' proprietary video scaling and picture processing technologies or resultant picture quality.</p>				

Req 4.1-6	Targeted Advertising			
<p>The Solution shall be able to operate with DVB TA Phase 2 without requiring modification to the existing specifications.</p> <p>NOTE:</p> <ul style="list-style-type: none"> - The intent is to ensure the interoperability with TA to the extent possible. If this CR cannot be met or verified; TM or its relevant subgroups shall report to CM-AVC and seek advice. 				

Req 4.1-7	Picture Quality of enhanced service	Draft	1	UC1
<p>The solution, shall enable a common mid-range TV to present the enhanced service at the same level of quality as native UHD signal when viewed using a range of content and viewed at ‘UHD screen distances’ as described by BT.500</p> <p>NOTES:</p> <ol style="list-style-type: none"> 1 The expectation is that the enhanced service provides a significant improvement over an upscaled HD signal, even when processed by a mid-range TV. 2 Such assessment will also inform whether that the solution can provide this level of quality, with significantly lower bit rate than UHD so that there is a clear benefit over not transmitting an enhanced service and only delivering the base service." 3 it is understood that “same level” means that the difference falls within the tolerance margin for such assessment as defined in BT.500 				

4.2. Backward Compatible Commercial Requirements

Req 4.2-1	“Backward compatible” Base and Enhanced Services	Draft	1	UC1
<p>The specifications shall enable the provisioning of a Base Service and an Enhanced Service in the same multiplex over MPEG-2 TS delivered to compatible devices (see section 3.1) .</p> <p>Examples:</p> <ul style="list-style-type: none"> • for a SD Base Service as defined in ETSI TS 101 154, the Enhanced Service would be an HD service comparable to the HD profiles as defined in ETSI TS 101 154. • for a HD Base Service as defined in ETSI TS 101 154, the Enhanced Service would be an UHD service comparable to the UHD profiles as defined in ETSI TS 101 154. <p>NOTE:</p> <ul style="list-style-type: none"> - when enhancing HD to UHD service upgrade, additional features other than resolution, such as color space and high dynamic range enhancement may be considered. 				

Req 4.2-3	Efficient Delivery of Enhanced Service	Draft	1	UC1
<p>The solution shall enable concurrent delivery of Base Service and Enhanced Service in a more efficient manner than simulcasting with an equivalent perceived picture quality as an equivalent simulcast.</p>				

The additional bit rate required for the concurrent delivery shall be at least 30% lower than the total additional bit rate required to simulcast an equivalent quality Enhanced Service using VVC. ^[1]

Both Base Service and Enhanced Service shall be at least at “good” level of video quality.

NOTE:

- ITU-R BT.500 may be a suitable reference to define and quantify the level of video quality.

Req 4.2-4	Sequences for Performance evaluation	Draft	1	UC1
The sequences used for the evaluation in 4.2.3 shall include at least some sequences where full-resolution quality is significantly better (e.g., at least one MOS point according to ITU-R BT.500 formal MOS scale) when compared to an upsampled version of the same sequence.				

Req 4.2-5	Delivery systems	Draft	1	UC1
The Base Services and Enhanced Services shall be delivered over the same delivery system, i.e., either both over OTA (e.g., MPEG-2 TS) or both over OTT (e.g., DVB-DASH).				

Req 4.2-6	Minimum set of conformance points	Draft	1	UC1
At minimum, the following conformance point combinations shall be considered for support by the solution:				
SDAVC bitstream as defined in 5.6 ETSI TS 101 154		HD as defined in 5.14.4 ETSI TS 101 154 (HEVC UHD bitstream using PQ10 or HEVC UHD bitstream using HLG10 constrained to 1920x1080 spatial luminance resolution)		
HD AVC bitstream as defined in 5.6 ETSI TS 101 154		UHD. as defined in 5.14.4 in ETSI TS 101 154 5.14.4 (HEVC UHD bitstream using PQ10 or HEVC UHD bitstream using HLG10)		
HD HEVC (HEVC UHD bitstream using PQ10 or HEVC UHD bitstream using HLG10 constrained to 1920x1080 spatial luminance resolution)		UHD. as defined in 5.14.4 in ETSI TS 101 154 5.14.4 (HEVC UHD bitstream using PQ10 or HEVC UHD bitstream using HLG10)		

^[1] Namely, $\text{bitrate}(\text{Base Service} + \text{Enhanced Service}) + \text{bitrate}(\text{overhead}) \leq \text{bitrate}(\text{Base Service}) + 0.7 * \text{bitrate}(\text{Enhanced Service using VVC}) + 2 * \text{bitrate}(\text{overhead})$.

It is assumed that the same audio is used for base service and enhanced services in both cases.

Req 4.2-7	Minimum set of conformance points	Draft	1	UC1										
<p>The specifications shall enable the provisioning of a Base Service and an Enhanced Service as DVB DASH ETSI TS 103 285 delivered to compatible devices (see section 3.1)</p> <p>Examples:</p> <table border="1"> <thead> <tr> <th>Base Service</th> <th>Enhanced Service</th> </tr> </thead> <tbody> <tr> <td>H.264/AVC or H265/HEVC Bitstream at 360p as specified in Table 25 of TS 103 285</td> <td>Bitstream at 720p as specified in Table 25 of TS 103 285</td> </tr> <tr> <td>H.264/AVC or H265/HEVC Bitstream at 540p as specified in Table 35 of TS 103 285</td> <td>HD Bitstream at 1080p as specified in Table 25 of TS 103 285</td> </tr> <tr> <td>H.264/AVC or H265/HEVC Bitstream at 720p as specified in Table 35 of TS 103 285</td> <td>UHD Bitstream at 1440p as specified in Table 25 of TS 103 285</td> </tr> <tr> <td>H.264/AVC or H265/HEVC Bitstream at 1080p as specified in Table 35 of TS 103 285</td> <td>UHD Bitstream at 2160p as specified in Table 25 of TS 103 285</td> </tr> </tbody> </table>					Base Service	Enhanced Service	H.264/AVC or H265/HEVC Bitstream at 360p as specified in Table 25 of TS 103 285	Bitstream at 720p as specified in Table 25 of TS 103 285	H.264/AVC or H265/HEVC Bitstream at 540p as specified in Table 35 of TS 103 285	HD Bitstream at 1080p as specified in Table 25 of TS 103 285	H.264/AVC or H265/HEVC Bitstream at 720p as specified in Table 35 of TS 103 285	UHD Bitstream at 1440p as specified in Table 25 of TS 103 285	H.264/AVC or H265/HEVC Bitstream at 1080p as specified in Table 35 of TS 103 285	UHD Bitstream at 2160p as specified in Table 25 of TS 103 285
Base Service	Enhanced Service													
H.264/AVC or H265/HEVC Bitstream at 360p as specified in Table 25 of TS 103 285	Bitstream at 720p as specified in Table 25 of TS 103 285													
H.264/AVC or H265/HEVC Bitstream at 540p as specified in Table 35 of TS 103 285	HD Bitstream at 1080p as specified in Table 25 of TS 103 285													
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H.264/AVC or H265/HEVC Bitstream at 1080p as specified in Table 35 of TS 103 285	UHD Bitstream at 2160p as specified in Table 25 of TS 103 285													

Req 4.2.8	Re-multiplexing on another multiplex	Draft	2	UC1
<p>The solution should be interoperable with existing head-end equipment (e.g., re-multiplexing equipment) across DVB broadcast networks.</p> <p>NOTE: Upgrading existing head-end equipment across broadcast networks for enhancement services may be challenging and therefore the impact of the selected solution on signaling and transport should be minimized</p>				

4.3. Timeline requirements

Req 4.3-1	Availability of specifications	Agreed	2	UC2
<p>The specifications for the solution shall be available at latest 12 months after CR approval.</p> <p>TM-AVC to liaise with CM-AVC if any impact is anticipated on ongoing work.</p>				

4.4. V&V requirements

[will be delivered later]				

5. Expected technical work

5.1. Impact on existing specifications or need for new ones

If a new solution is required, then the relevant DVB specifications will be updated (e. g. ETSI TS 101 154, ETSI TS 103 285, ETSI EN 300 468, ETSI TS 103 770).

6. Annex: Use cases (informative)

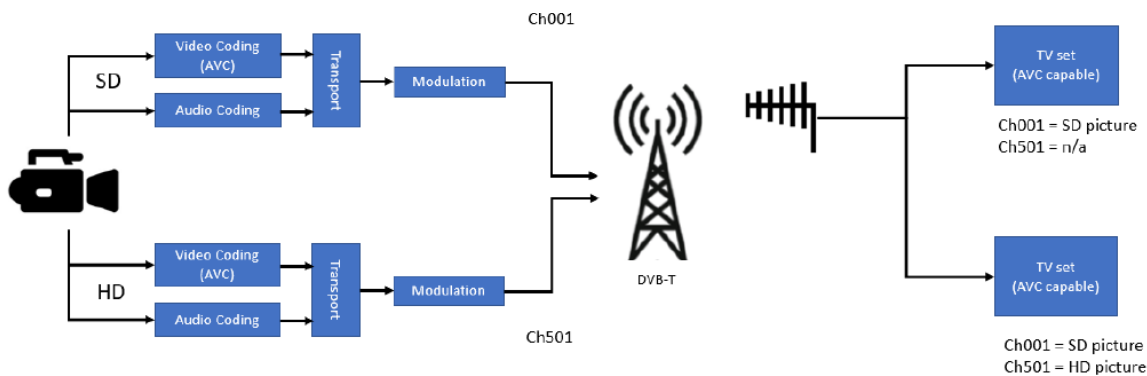
6.1. Use case 1: broadcast (e.g., DVB-T), enhancing AVC

A relevant number of receiver devices is still unable to receive HEVC. The need to transmit with AVC, combined with bandwidth costs, forces broadcasters to transmit the majority of their services at low resolutions.

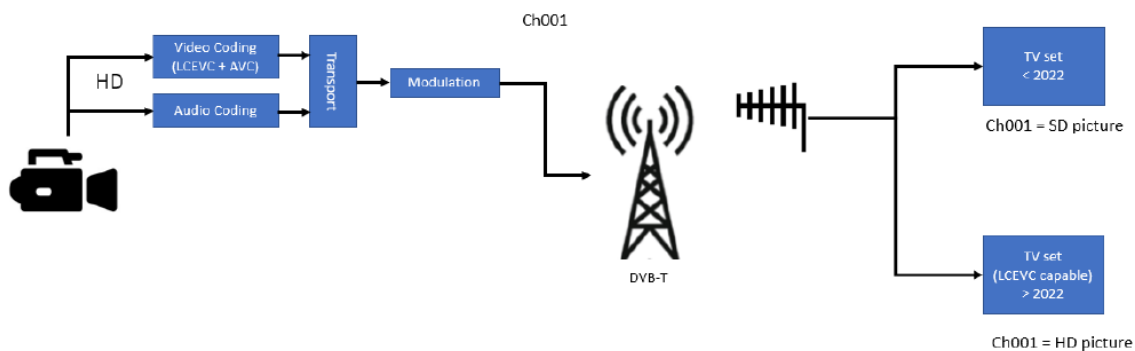
In this scenario, the enhanced service would provide an HD resolution – with HDR optional – starting from an SD service encoded with AVC, with modest bandwidth increase.

With this option, most if not all channels can be migrated to higher quality without losing the ability to serve the entire audience. End users with the newest receiver devices (or equipped with suitable means to achieve LCEVC compatibility, such as inexpensive adapters) will be able to receive content at higher quality.

The alternative would be to simulcast both SD and HD using AVC (duplicating both video data and all of the non-video data associated with a service, as well as multiplying transcoding costs and energy). Without LCEVC, because of the scarce bandwidth availability, only a subset of services would be transmitted at high quality.



Simulcasting with AVC



LCEVC enhancing AVC

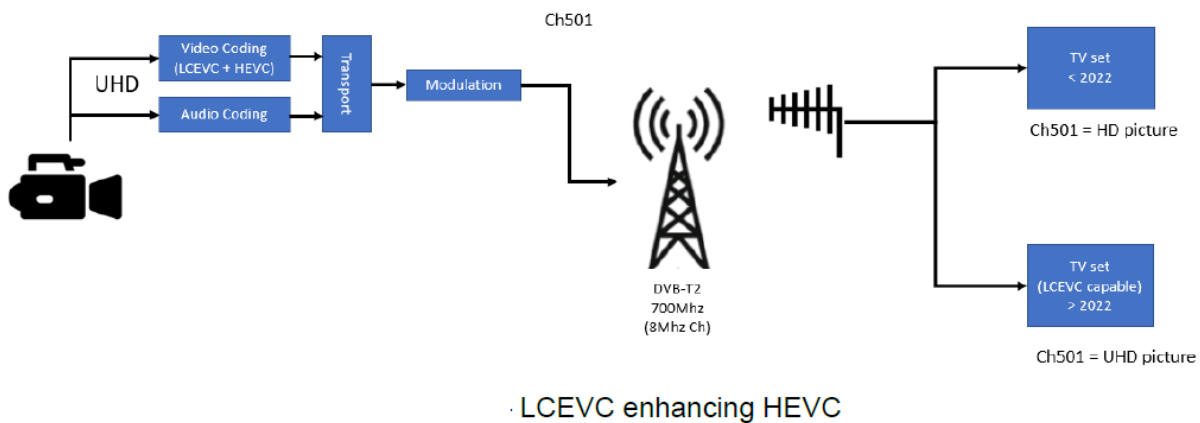
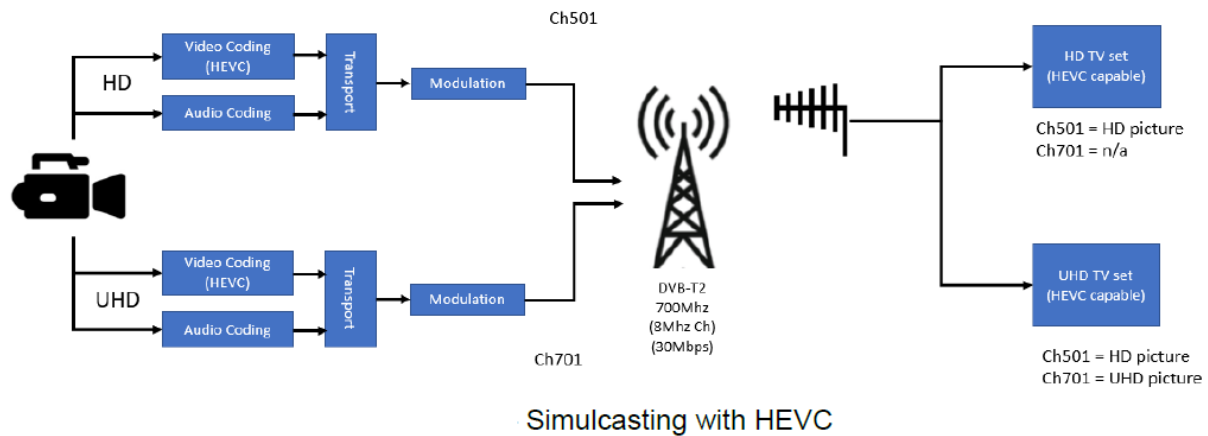
6.2. Use case 2: broadcast (e.g., DVB-T2), enhancing HEVC

In this scenario, the enhanced service would provide a UHD resolution – with HDR optional – starting from an HD service encoded with HEVC, with modest bandwidth increase.

With this option, most if not all channels can be migrated to UHD without losing the ability to serve the HEVC-capable devices unable to receive UHD. End users with the newest receiver devices (or equipped with suitable means to achieve LCEVC compatibility, such as inexpensive adapters) will be able to receive content at higher quality.

The alternative would be to simulcast both HD and UHD using HEVC (duplicating both video data and all of the non-video data associated with a service, as well as multiplying transcoding costs and energy), or to transmit only UHD using HEVC and lose a portion of the audience. Without LCEVC, because of the scarce bandwidth availability and the installed base of HD-only HEVC receivers, only a small subset of services (if any) would be transmitted at UHD quality.

When enhancing HEVC, LCEVC performs like other next-generation video codecs, satisfying all the Phase 1 CRs. The additional benefit for LCEVC is that it can already be used by “catch-all” video workflows even when only a modest portion of the installed base is capable of decoding LCEVC. Without LCEVC, next generation services will be used only when 100% of the target installed base has been replaced, or for the low percentage of content that is sufficiently valuable to justify the costs of simulcasting.



6.3. Use case 3: broadband (DVB-I), enhancing AVC

Especially for secondary-screen devices, AVC is expected to remain the minimum-common-denominator video codec for the foreseeable future.

In this scenario, the enhanced video stream(s) within a DVB-I service would provide a higher resolution – with HDR optional – starting from lower resolution video encoded with AVC.

With this option, most mobile devices, PCs, new LCEVC-compatible devices and other receiver devices capable of decoding LCEVC will receive higher quality services, while LCEVC-unaware legacy receiver devices will receive the base layer video.

7. History

Ref	Month Year	Milestone
C105	April 2023	BlueBook publication (Internal document CM2135r3)