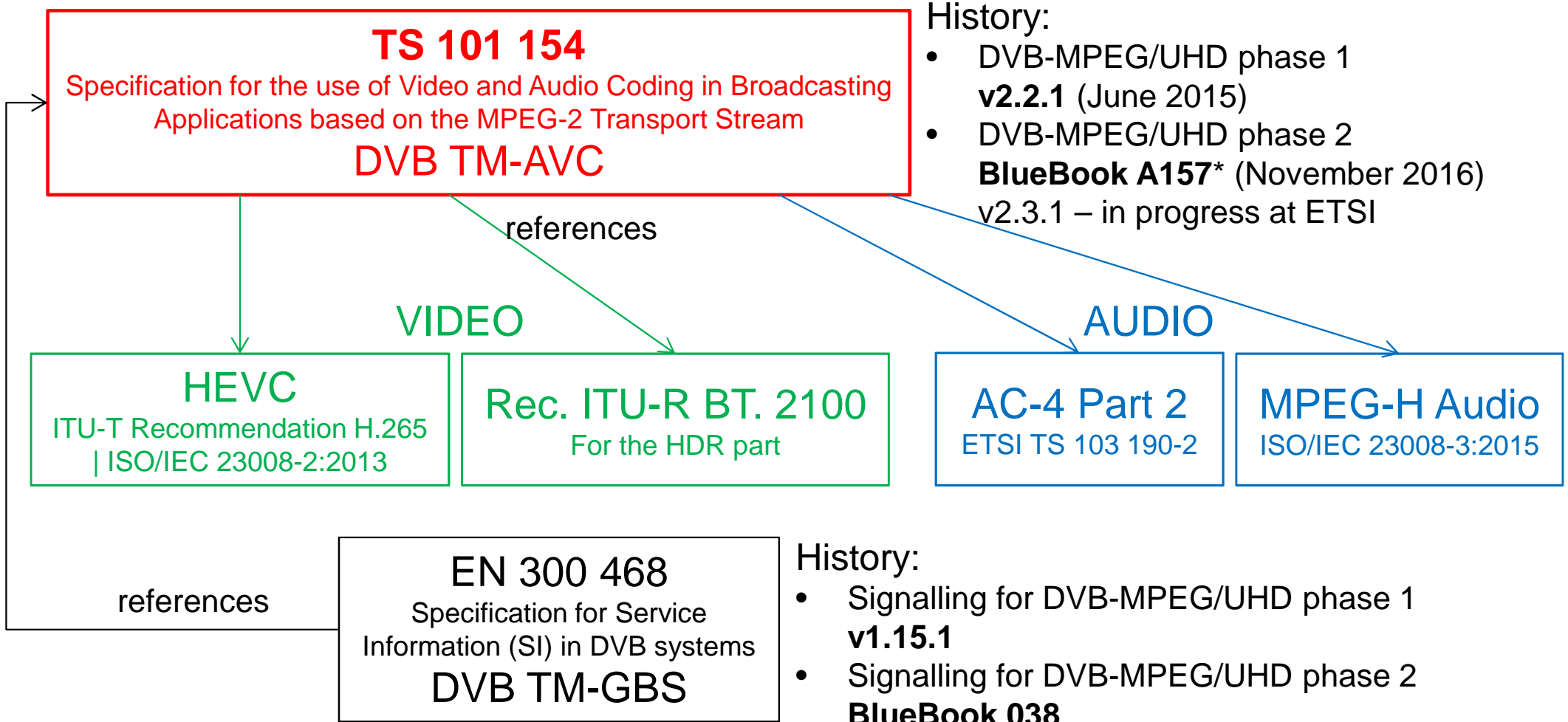


DVB-UHD in TS 101 154

Virginie Dugeon on behalf of
DVB TM-AVC

January 18th 2017, 15:00 CET

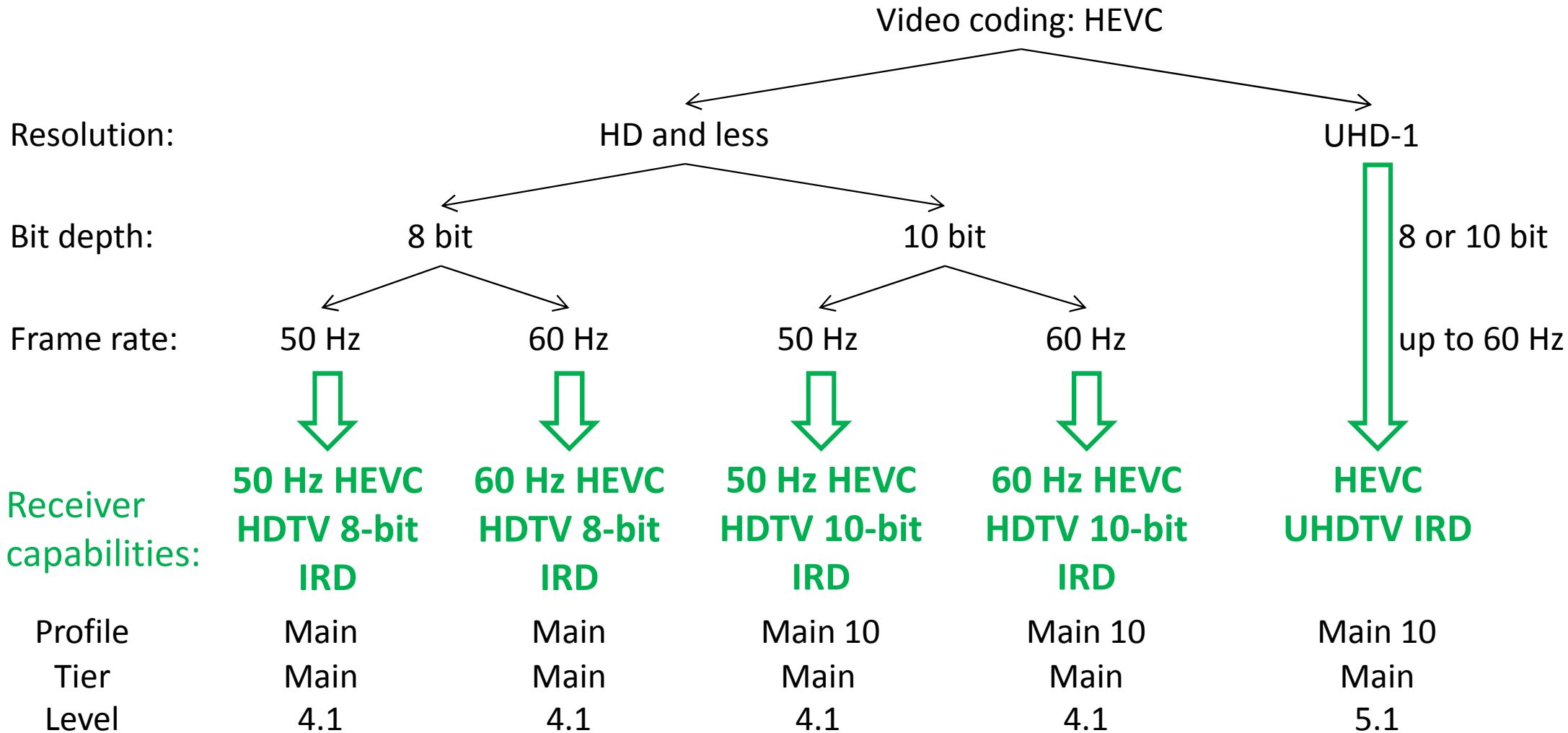
Standards



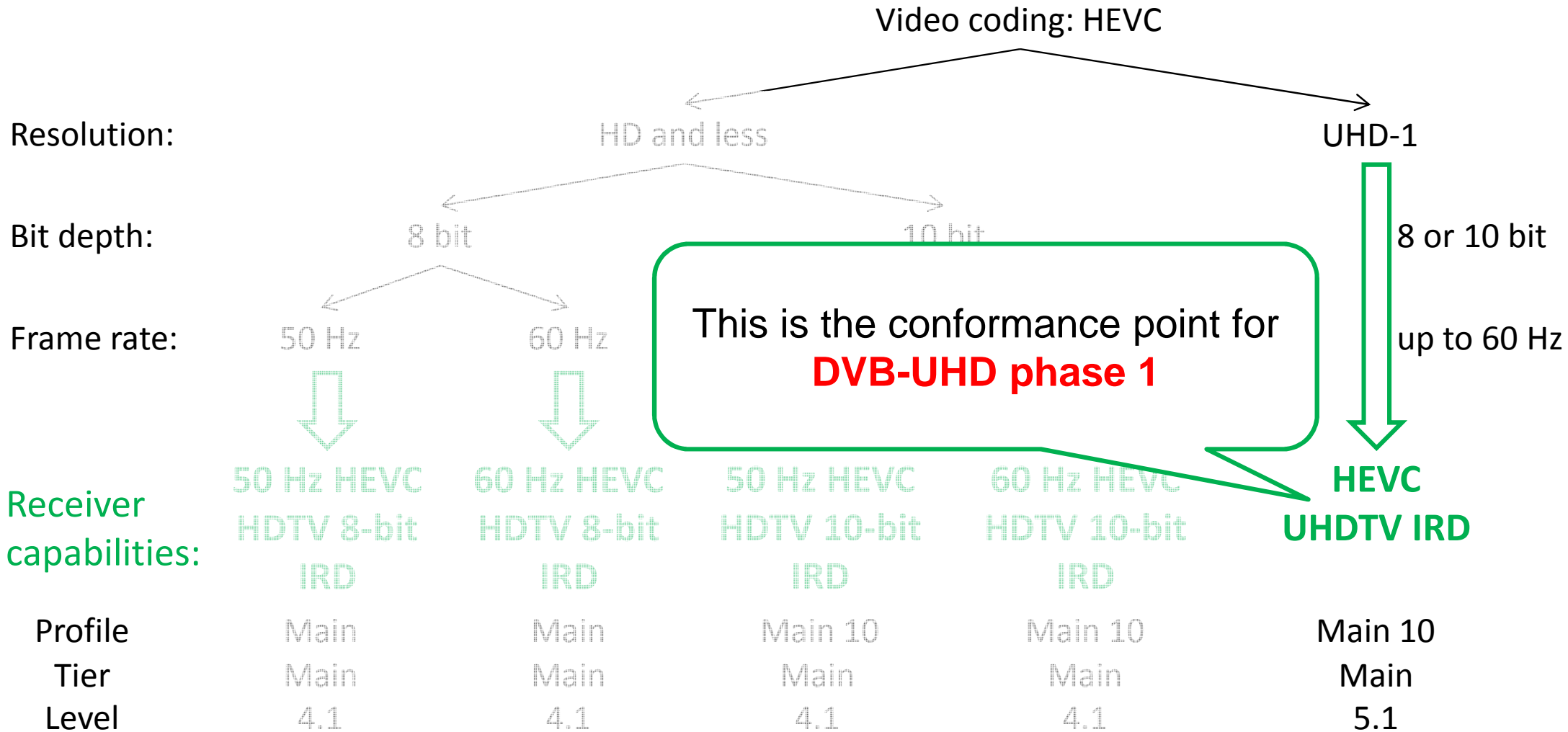
*https://www.dvb.org/resources/public/standards/a157_dvb_mpeg2_uhd-1_phase_2.pdf

- **DVB-MPEG/UHD phases 1 and 2:**
 - Video coding technology
 - Spatial resolutions
 - Colour primaries
 - High Dynamic Range
 - High Frame Rate
 - DVB-UHD phase 2 conformance points
 - DVB-SI signalling
- Next Generation Audio
- Relevant clauses in TS 101 154 v2.3.1

DVB-UHD phase 1: HEVC HD and UHD conformance points



DVB-UHD phase 1: HEVC HD and UHD conformance points



DVB-UHD phase 2: differences to phase 1

Video coding: HEVC

Resolution:

Bit depth:

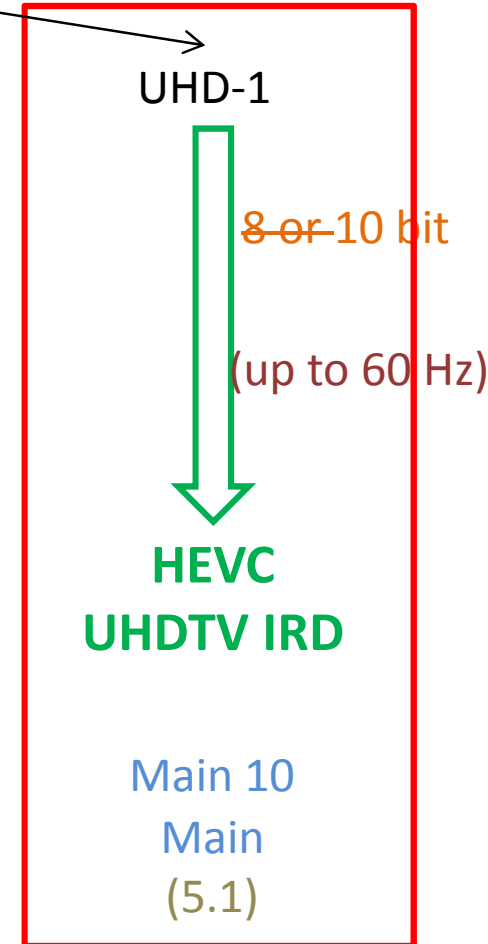
Frame rate:

Receiver capabilities:

Profile
Tier
Level

UHD phase 2 is an extension to UHD phase 1:

- Based on HEVC Main 10 Profile Main Tier
 - Only 10 bits are supported
- HDR bitstreams can have a frame rate equal to or lower than 60Hz
- HFR bitstreams (with or without HDR) have a frame rate higher than 60Hz
 - The Level is 5.1 for bitstreams with a frame rate up to 60Hz
 - The Level is 5.2 for HFR bitstreams



DVB-UHD phase 1: spatial resolutions

Vertical size	Horizontal size	Display aspect ratio	Frame rate (see note)	Progressive or Interlaced
2 160	3 840, 2 880	16:9	25, 50	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60	P
1 800	3 200	16:9	25, 50	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60	P
1 440	2 560	16:9	25, 50	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60	P
1 080	1 920, 1 440	16:9	24 000/1 001, 24	P
			25	I
			50	P
			30 000/1 001, 30	I
			60 000/1 001, 60	P
900	1 600	16:9	25, 50	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60	P
720	1 280, 960	16:9	25, 50	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60	P
540	960	16:9	25, 50	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60	P

All listed formats are supported by the **HEVC UHDTV IRD**

DVB-UHD phase 2: spatial resolutions

Vertical size	Horizontal size	Display aspect ratio	Frame rate (see note)	Progressive or Interlaced
2 160	3 840, 2 880 ¹	16:9	25, 50, (100) ²	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60, (120 000/1 001, 120) ²	P
1 800	3 200	16:9	25, 50, (100) ²	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60, (120 000/1 001, 120) ²	P
1 440	2 560	16:9	25, 50, (100) ²	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60, (120 000/1 001, 120) ²	P
1 080	1 920, 1 440 ¹	16:9	24 000/1 001, 24	P
			25	↓ ¹
			50, (100) ²	P
			30 000/1 001, 30	↓ ¹
			60 000/1 001, 60, (120 000/1 001, 120) ²	P
900	1 600	16:9	25, 50, (100) ²	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60, (120 000/1 001, 120) ²	P
720	1 280, 960 ¹	16:9	25, 50, (100) ²	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60, (120 000/1 001, 120) ²	P
540	960	16:9	25, 50, (100) ²	P
			24 000/1 001, 24, 30 000/1 001, 30, 60 000/1 001, 60, (120 000/1 001, 120) ²	P

¹ Support for interlaced scan and non-square pixel resolutions was dropped

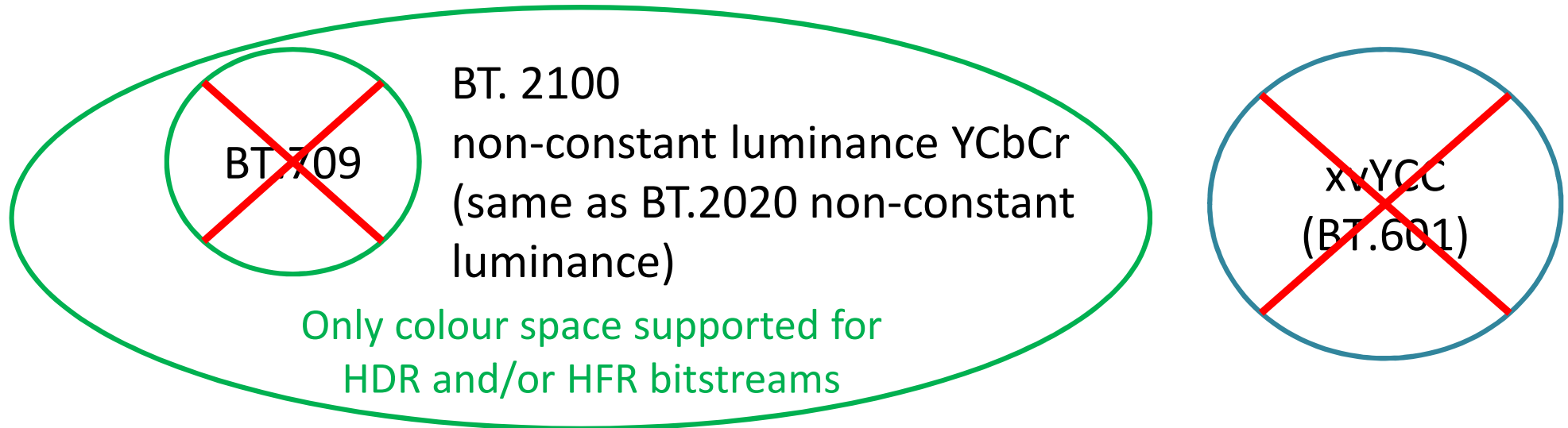
² 100, 120 000/1 001 and 120 Hz are only supported by HFR capable receivers

DVB-UHD phase 1: colorimetry



- BT. 2020 non-constant luminance colour primaries and matrix coefficients:
 - Only signalling is supported
 - Mapping to the colour capabilities of the display is NOT defined (outside the scope of TS 101 154)
- Support for SDTV is not mandatory (since BT. 601 colorimetry is optional): only „sub-HD“ resolutions are supported, rather than real SDTV
- No full range video
- 4:2:0 chroma sampling only (Main and Main 10 Profiles only support 4:2:0)
- Transfer characteristics is the one from BT. 709 and BT. 2020 (SDR)

DVB-UHD phase 2: colour primaries and matrix coefficients



- Only signalling of colour space and matrix coefficients has to be supported
- Actual colour capabilities of the display are NOT specified (outside of TS 101 154 scope)
- Only „sub-UHD“ resolutions are supported, rather than real HD formats (since BT.709 colorimetry is not supported)
- No full range video (only narrow range BT.2100 is supported)

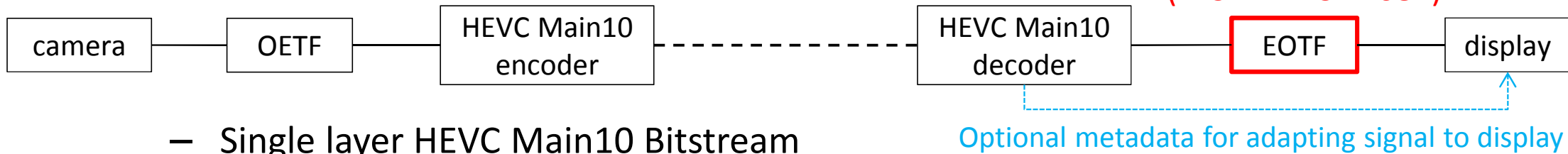
Questions?

Please submit your questions using the webex chat.

DVB-UHD phase 2 High Dynamic Range: two solutions

- PQ10 (+ optional metadata)

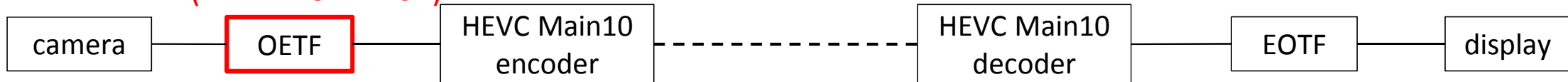
ITU-R BT.2100 PQ system
(= SMPTE ST 2084)



- Single layer HEVC Main10 Bitstream
- Bitstream is not backwards compatible to DVB-UHD phase 1 receivers

- HLG10

ITU-R BT.2100 HLG system
(= ARIB STD-B67)



- Single layer HEVC Main10 Bitstream
- Bitstream decodable by DVB-UHD phase 1 receivers as Standard Dynamic Range

DVB-UHD phase 2: Optional metadata for PQ10 solution

- Optional for both bitstreams and receivers
- Two SEI messages specified by HEVC are mentioned in TS 101 154:

Mastering display colour volume SEI message

mastering_display_colour_volume(payloadSize) {
for(c = 0; c < 3; c++) {
display primaries_x [c]
display primaries_y [c]
}
white_point_x
white_point_y
max_display_mastering_luminance
min_display_mastering_luminance
}

May help improving colour reproduction of mastered content when shown on other displays than the mastering display

Content Light Level Information SEI message

content_light_level_info(payloadSize) {
max_content_light_level
max_pic_average_light_level
}

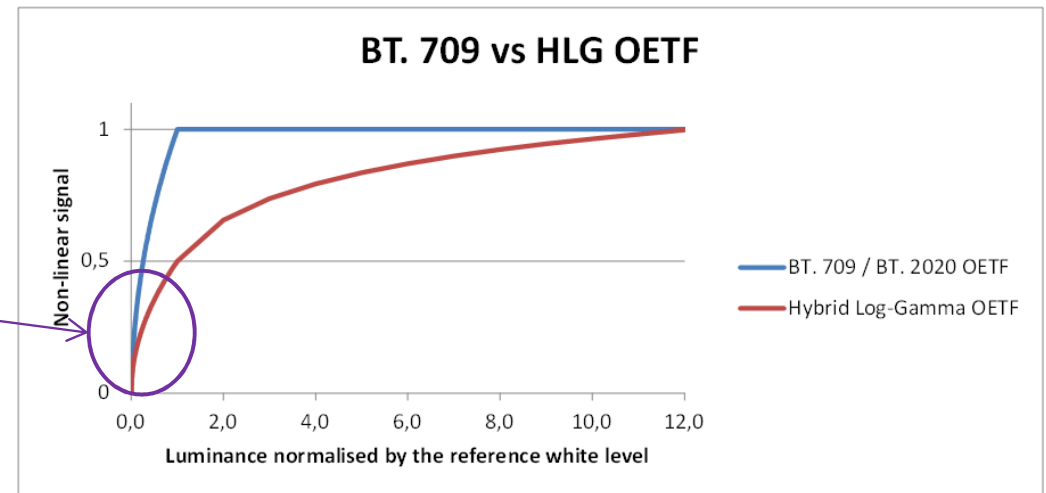
Identifies upper bounds for the nominal target brightness light level of the video content

DVB-UHD phase 2: HDR Backwards Compatible solution HLG10

- Backwards compatibility in the sense of DVB = capability for a new UHD Phase 2 Bitstream to be decodable by already standardized DVB UHD Phase 1 receivers
- Solution adopted in TS 101 154 v2.3.1: **Hybrid Log-Gamma OETF**
 - Native backwards compatibility of the transfer function

This part of the Transfer Function is similar to the BT.709 / BT.2020 transfer function for Standard Dynamic Range

$$E' = \begin{cases} r\sqrt{E} & 0 \leq E \leq 1 \\ a \cdot \ln(E - b) + c & 1 < E \end{cases}$$



- No change to HEVC coding necessary, only new signalling needed

DVB-UHD phase 2 HDR Signalling

PQ10: transfer_characteristics in the VUI

Video Usability Information

Sequence Parameter Set

```
seq_parameter_set_rbsp() {  
  ...  
  vui_parameters_present_flag  
  if( vui_parameters_present_flag )  
    vui_parameters( )  
  ...  
}
```

```
vui_parameters( ) {  
  ...  
  video_signal_type_present_flag  
  if( video_signal_type_present_flag ) {  
    ...  
  }  
  colour_description_present_flag  
  if( colour_description_present_flag ) {  
    colour_primaries  
    transfer_characteristics  
    matrix_coeffs  
  }  
  ...  
}
```

Value 16 for SMPTE ST2084

HLG10: alternative transfer characteristics SEI

Transfer_characteristics in the VUI still signals the BT.2020 transfer function (value 14)

The alternative transfer characteristics SEI message has to be present at every Random Access Point (to be used in combination with the information in the VUI)

```
alternative_transfer_characteristics ( payloadSize ) {  
  preferred_transfer_characteristics  
}
```

Value 18 for ARIB STD-B67

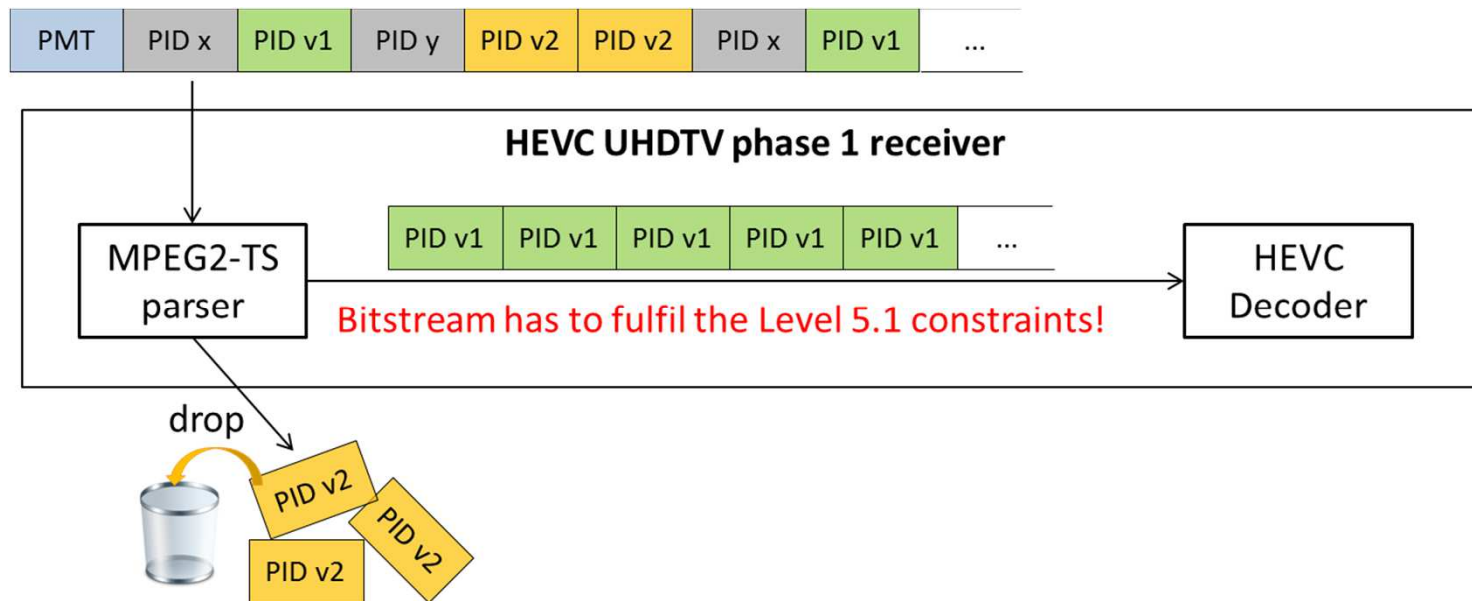
- Signalling for dynamic switching between HLG10 and SDR, and between PQ10 and SDR is also covered
- Dynamic switching should be seamless for decoding, but not for display (display can go black)

Questions?

Please submit your questions using the webex chat.

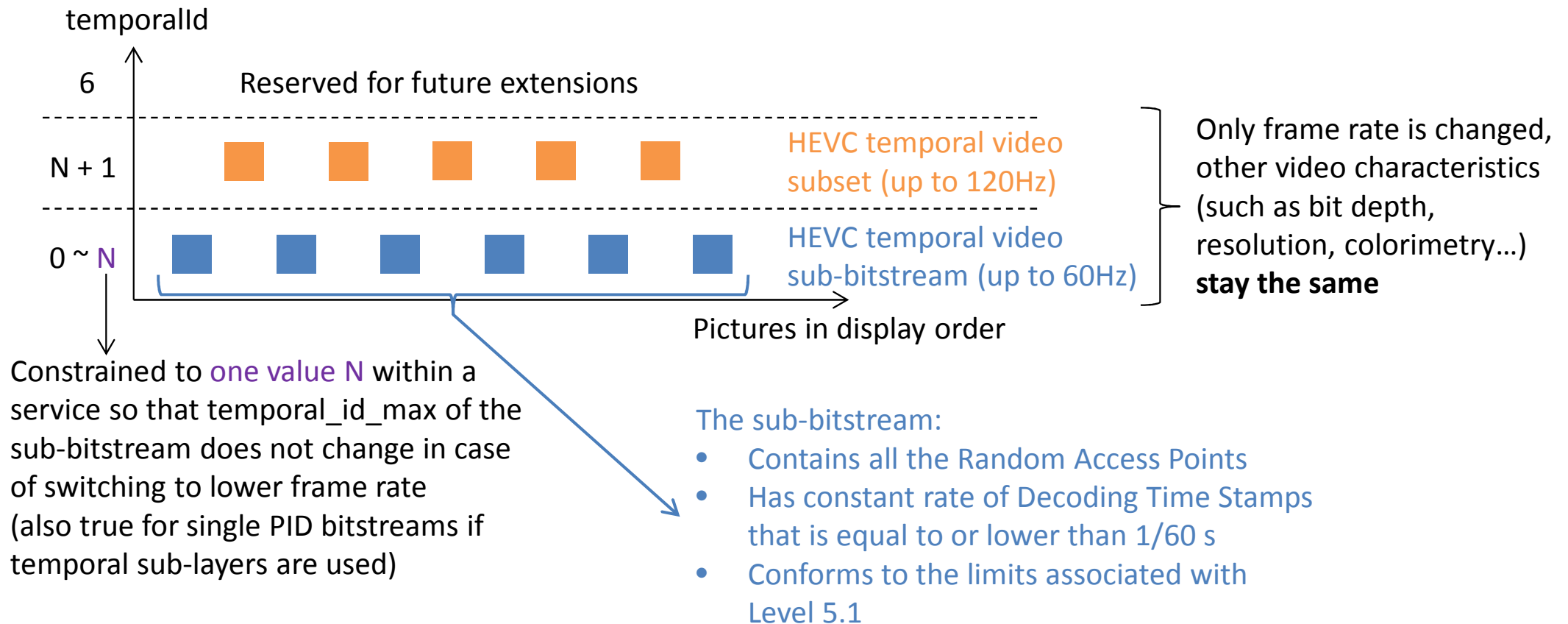
DVB-UHD phase 2: High Frame Rates

- Support for frame rates 100, 120 000/1 001 and 120 Hz
 - Dynamic changes within a service only allowed for doubling or halving of frame rate
- Single PID HFR bitstream when backwards compatibility to UHD phase 1 receivers is not necessary
- Dual PID and temporal scalability when the bitstream is intended to be decodable by UHD phase 1 receivers at half frame rate:



DVB-UHD phase 2: HFR backwards compatible solution

- Use of HEVC temporal sub-layers with signalling based on temporalId



Questions?

Please submit your questions using the webex chat.

DVB-UHD phase 2 receiver conformance points

HEVC HDR HFR UHDTV IRD using PQ10

100 fps with 50 fps sub-bitstream
 120000 / 1001 fps with
 60000 / 1001 fps sub-bitstream
 120 fps with 60 fps sub-bitstream
 100 fps
 120000 / 1001 fps
 120 fps

HEVC HDR UHDTV IRD using PQ10

BT.2100 PQ system
 (SMPTE ST 2084, 10-bit, 4:2:0, BT.2020,
 NCL Y'CbCr)

HEVC UHDTV IRD		PHASE 1 IRD	
10 bit and 8 bit	3840x2160	50 Hz HEVC HDTV 10-bit IRD	60 Hz HEVC HDTV 10-bit IRD
23.98p	2880x2160	25p/1	23.98p
24p	3200x1800	50p	24p
25p	2560x1440	1920x1080	29.97p/1
29.97p		1440x1080	30p
30p		1800x900	59.94p
59.94p		1280x720	60p
60p		960x720	960x540
		960x540	

HEVC HDR HFR UHDTV IRD using HLG10

100 fps with 50 fps sub-bitstream
 120000 / 1001 fps with
 60000 / 1001 fps sub-bitstream
 120 fps with 60 fps sub-bitstream
 100 fps
 120000 / 1001 fps
 120 fps

HEVC HDR UHDTV IRD using HLG10

BT.2100 HLG system
 (ARIB STD-B67, 10-bit, 4:2:0, BT.2020,
 NCL Y'CbCr)

HEVC UHDTV IRD		PHASE 1 IRD	
10 bit and 8 bit	3840x2160	50 Hz HEVC HDTV 10-bit IRD	60 Hz HEVC HDTV 10-bit IRD
23.98p	2880x2160	25p/1	23.98p
24p	3200x1800	50p	24p
25p	2560x1440	1920x1080	29.97p/1
29.97p		1440x1080	30p
30p		1800x900	59.94p
59.94p		1280x720	60p
60p		960x720	960x540
		960x540	

DVB-UHD phase 2 bitstream conformance points

HFR bitstreams

HEVC UHDTV Bitstream
(UHD-1 Phase 1)

Dual PID and
temporal scalability

(Decodable by phase 1
receivers at half frame rate)

Single PID

HLG10

(Decodable by phase 1
receivers as SDR)

HDR HLG10
HFR Dual PID and
temporal scalability

(Decodable by phase 1 receivers
as SDR and at half frame rate)

HDR HLG10
HFR Single PID

PQ10

HDR PQ10
HFR Dual PID and
temporal scalability

HDR PQ10
HFR Single PID

HDR bitstreams

DVB-SI signalling for DVB-UHD

- Goal is to signal the bitstream conformance points identified in TS 101 154

service_type in the service descriptor

service_type	Description
...	
0x1F	HEVC digital television service (see note 4)
0x20	HEVC UHD digital television service with HDR and/or a frame rate of 100 Hz, 120 000/1 001 Hz, or 120 Hz, or a any combination of HDR and these frame rates (see note 5)
...	

Existing values for HEVC HD and UHD phase 1 bitstreams (and bitstreams decodable by UHD phase 1 receivers)

New values for HEVC UHD phase 2 non-backwards compatible bitstreams

(stream_content/stream_content_ext/component_type) in the component descriptor

stream_content	stream_content_ext	component_type	Description
0x9	0x0	0x00	HEVC Main Profile high definition video, 50 Hz (notes 2 and 9)
		0x01	HEVC Main 10 Profile high definition video, 50 Hz (notes 2 and 9)
		0x02	HEVC Main Profile high definition video, 60 Hz (notes 2, 4 and 9)
		0x03	HEVC Main 10 Profile high definition video, 60 Hz (notes 2, 4 and 9)
		0x04	HEVC ultra high definition video
		0x05	HEVC ultra high definition video with PQ10 HDR with a frame rate lower than or equal to 60 Hz
		0x06	HEVC ultra high definition video, frame rate of 100 Hz, 120 000/1 001 Hz, or 120 Hz without a half frame rate HEVC temporal video sub-bit-stream
		0x07	HEVC ultra high definition video with PQ10 HDR, frame rate of 100 Hz, 120 000/1 001 Hz, or 120 Hz without a half frame rate HEVC temporal video sub-bit-stream
0xB	0xF	0x04	HLG10 HDR (see notes 7, 11, and 12)
		0x05	HEVC temporal video subset for a frame rate of 100 Hz, 120 000/1 001 Hz, or 120 Hz (see notes 11, and 12)

New informative values for signalling additional information about HEVC UHD phase 2 bitstreams

DVB-SI signalling of DVB-UHD bitstream conformance points

HEVC UHD TV Bitstream
(UHD-1 Phase 1)

Service_type: 0x1F

Mandatory component desc. (0x9/0x0/0x04)

HLG10

Service_type: 0x1F

Mandatory component desc. (0x9/0x0/0x04)

Optional component desc. (0xB/0xF/0x04)

PQ10

Service_type: 0x20

Mandatory component desc. (0x9/0x0/0x05)

Dual PID and
temporal scalability

Service_type: 0x1F

Mandatory component desc. (0x9/0x0/0x04)

Optional component desc. (0xB/0xF/0x05)

HDR HLG10
HFR Dual PID and
temporal scalability

Service_type: 0x1F

Mandatory component desc. (0x9/0x0/0x04)

Optional component desc. (0xB/0xF/0x04)

Optional component desc. (0xB/0xF/0x05)

HDR PQ10
HFR Dual PID and
temporal scalability

Service_type: 0x20

Mandatory component desc. (0x9/0x0/0x05)

Optional component desc. (0xB/0xF/0x05)

Single PID

Service_type: 0x20

Mandatory component desc. (0x9/0x0/0x06)

HDR HLG10
HFR Single PID

Service_type: 0x20

Mandatory component desc. (0x9/0x0/0x06)

Optional component desc. (0xB/0xF/0x04)

HDR PQ10
HFR Single PID

Service_type: 0x20

Mandatory component desc. (0x9/0x0/0x07)

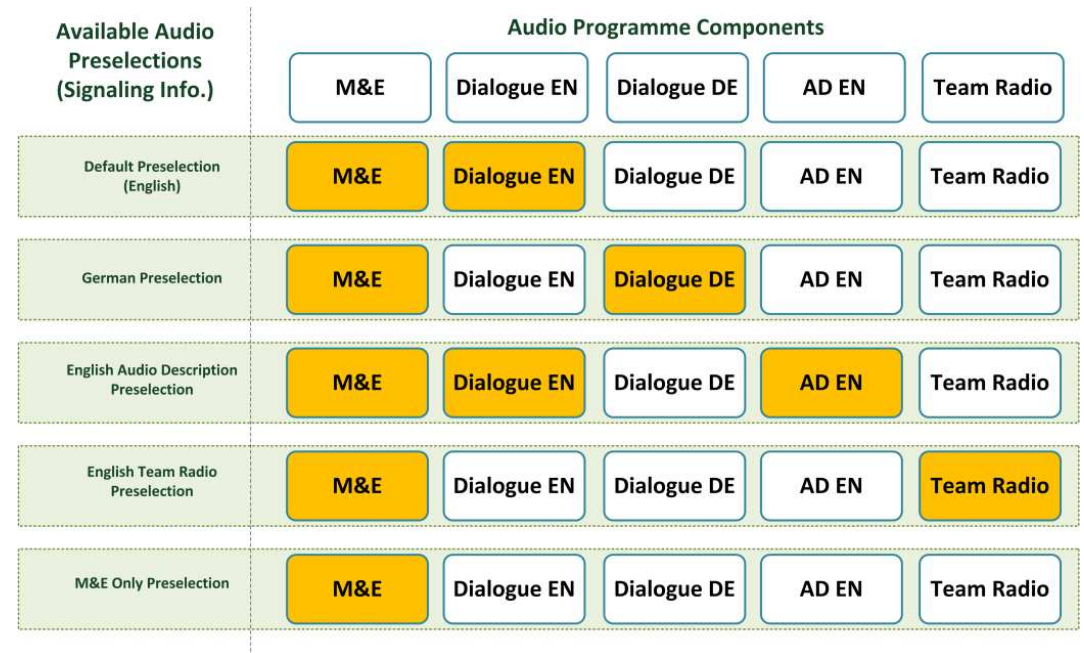
Questions?

Please submit your questions using the webex chat.

- DVB-MPEG/UHD phases 1 and 2:
 - Video coding technology
 - Spatial resolutions
 - Colour primaries
 - High Dynamic Range
 - High Frame Rate
 - DVB-UHD phase 2 conformance points
 - DVB-SI signalling
- **Next Generation Audio**
- Relevant clauses in TS 101 154 v2.3.1

Next Generation Audio overview

- Flexibility to create and deliver content with new concepts and techniques:
 - Immersive audio with the addition of height elements
 - Metadata can describe properties of audio tracks
 - Personalization options
 - Concept of audio preselections
 - Audio objects to facilitate immersive and personalized audio



NGA definitions in TS 101 154

Complete collection of all Audio Programme Components
and a set of accompanying Audio Preselections

Audio Programme

Audio Programme Component 0

...

Audio Programme Component N

+ metadata:

Audio Preselection* 0

...

Audio Preselection M

One **Default Audio
Preselection**

NGA definitions in TS 101 154

Complete collection of all Audio Programme Components and a set of accompanying Audio Preselections

Smallest addressable unit of an Audio Programme

Audio Programme

Audio Programme Component 0

...

Audio Programme Component N

+ metadata:

Audio Preselection* 0

...

Audio Preselection M

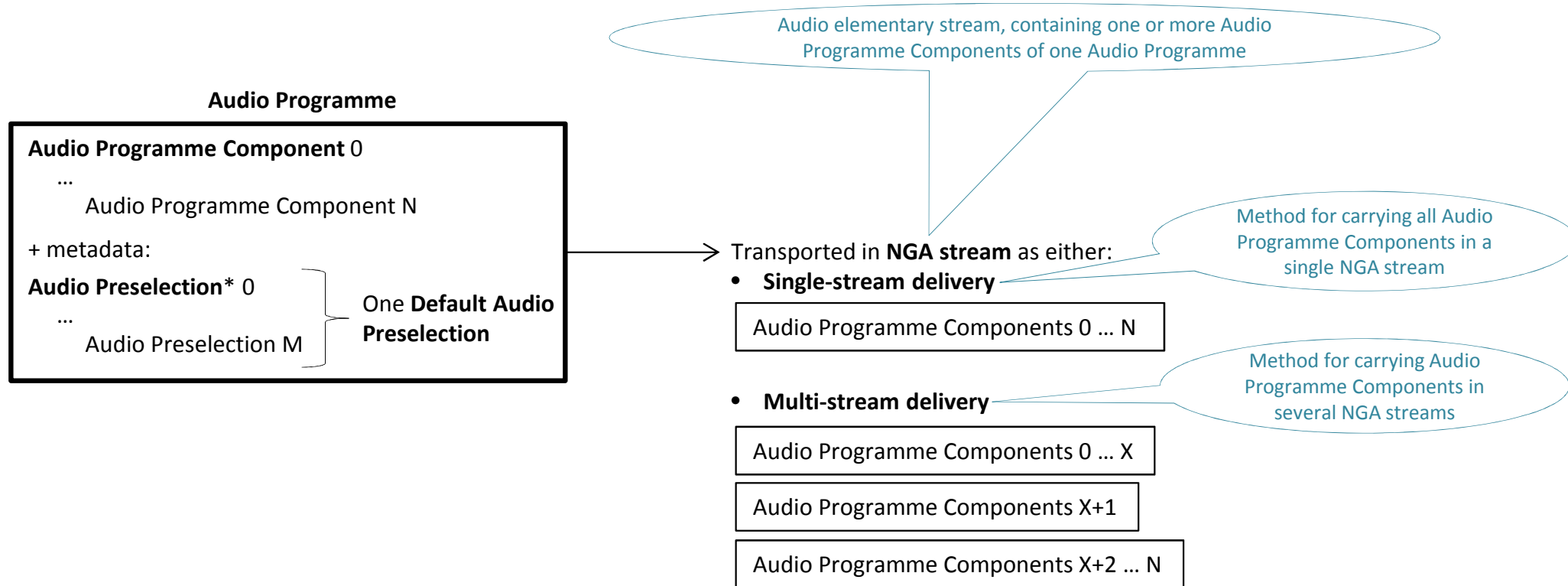
One Default Audio Preselection

Set of Audio Programme Components representing a version of the Audio Programme that may be selected by a user for simultaneous decoding

Audio Preselection including all Audio Programme Components to be decoded when IRD cannot make a selection amongst several preselections

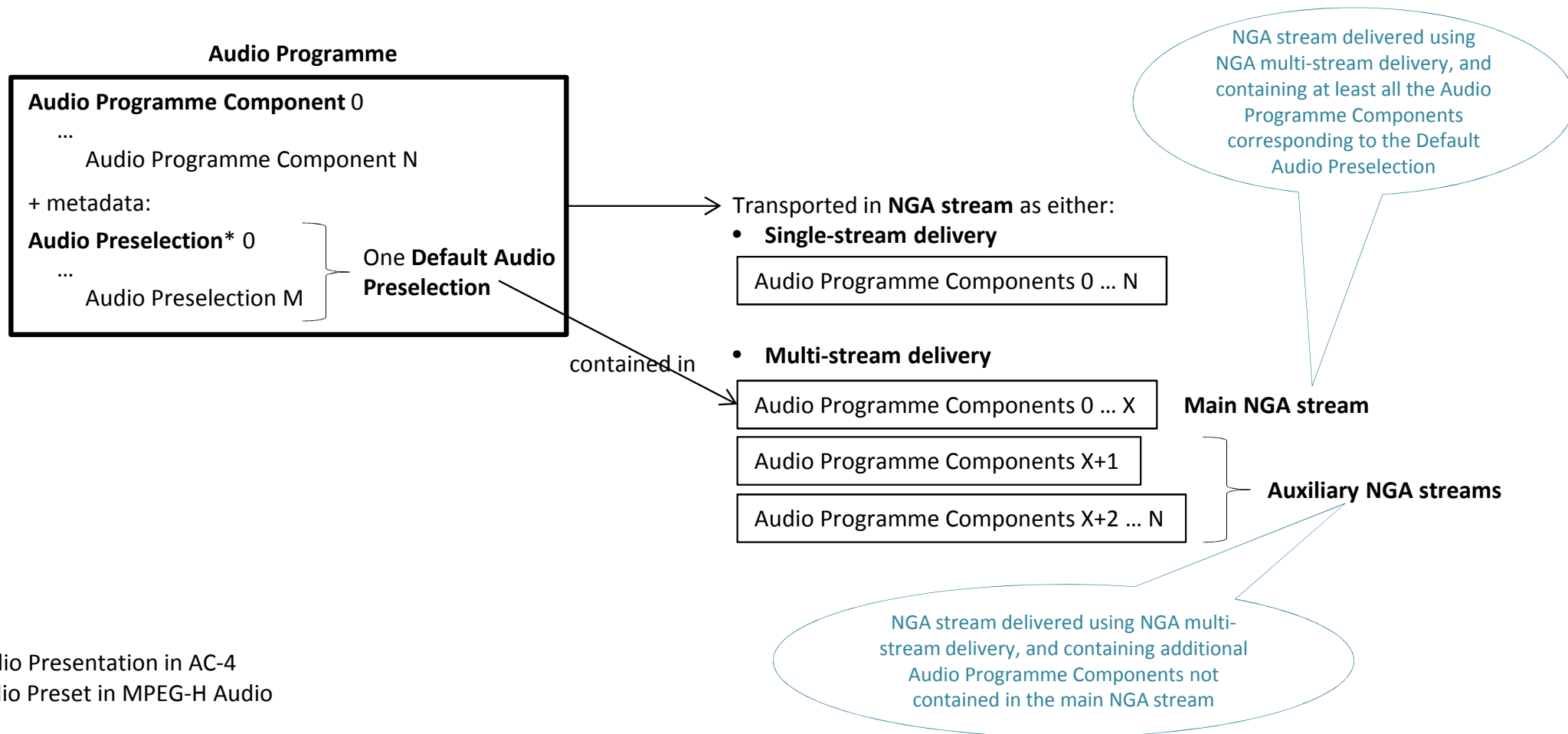
* Audio Presentation in AC-4
Audio Preset in MPEG-H Audio

NGA definitions in TS 101 154



* Audio Presentation in AC-4
Audio Preset in MPEG-H Audio

NGA definitions in TS 101 154



* Audio Presentation in AC-4
 Audio Preset in MPEG-H Audio

Two Codecs for Next Generation Audio

AC-4 Part 2

Extension to AC-4 Part 1 (supported in TS 101 154 v2.2.1 clause 6.6)

MPEG-H Audio

Low Complexity Profile Level 1, Level 2 or Level 3

Both codecs support:

- Single-stream and multi-stream delivery of Audio Programme Components
 - Dynamic Range and Loudness control metadata
- **Similar wording about renderer:** “A reference renderer provides a broadcaster a tool to verify the rendering performance of the generated NGA delivery signal. Defining a reference renderer does not imply that the signal will be rendered with the reference renderer nor does it enforce implementation requirements on the IRD. It is recommended that the IRD implements either the reference renderer or a renderer that performs at least as well as the reference renderer given the capabilities of the IRD.”

Offers Audio/Video frame rate matching

Deviations from the MPEG specification:

- MPEG specified object and HOA renderer is not mandatory (see above)
- User interaction interface, generic loudspeaker rendering/format conversion, immersive rendering, binaural rendering are optional

DVB-SI signalling for NGA

- (stream_content/stream_content_ext/component_type) in the component descriptor

stream_content	stream_content_ext	component_type	Description
0x9	0x1	0x0E	AC-4 Part-2
		0x0F	MPEG-H Audio LC Profile
0xB	0xE	0x00 to 0xFF	NGA component type feature flags according to table 27

New component type values for the two NGA codecs

component_type bits		Description
b ₇ (MSB)		reserved zero for future use
b ₆		content is pre-rendered for consumption with headphones
b ₅		content enables interactivity
b ₄		content enables dialogue enhancement (see note)
b ₃		content contains spoken subtitles
b ₂		content contains audio description
b ₁	b ₀	preferred reproduction channel layout:
0	0	no preference
0	1	stereo
1	0	two-dimensional
1	1	three-dimensional
NOTE: Content enabling dialogue enhancement also offers support for clean audio for the hearing impaired.		

Table 27: Next generation audio component_type value assignments

Specific NGA features are indicated by different values in the component_type byte

- **PMT signalling of NGA codecs and features using:**
 - **Codec Specific Descriptors for signalling basic audio codec information**
 - MPEG-H 3D Audio Descriptor
 - AC-4 Descriptor
 - **Audio Preselection Descriptor for signalling:**
 - Accessibility information
 - Languages
 - Text labels (via Message Descriptor, linked by the message_id field)
 - Indications about enabled interactivity and 2D/3D rendering information
 - The available Audio Preselections that enables offering different versions from the same Audio Programme
 - The auxiliary NGA streams within one TS carrying additional Audio Program Components (linked via the component_tag field)
 - **Stream Identifier Descriptor for identifying:**
 - The auxiliary NGA streams within one TS carrying additional Audio Program Components

Questions?

Please submit your questions using the webex chat.

- DVB-MPEG/UHD phases 1 and 2:
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 - DVB-SI signalling
- Next Generation Audio
- Relevant clauses in TS 101 154 v2.3.1

HEVC (UHD phase 1 and 2)

5.14 HEVC IRDs and Bitstreams

5.14.1 Specifications common to all HEVC IRDs and Bitstreams

5.14.2 HEVC HDTV IRDs and Bitstreams

5.14.3 HEVC UHD TV IRDs and Bitstreams

Clause describing
DVB-UHD phase 1

New 5.14.4 HEVC HDR UHD TV IRDs and Bitstreams

5.14.5 HEVC HDR HFR UHD TV IRDs and Bitstreams

Clauses describing
DVB-UHD phase 2

NGA

New 6.7 AC-4 for channel-based, immersive and personalized audio

6.8 MPEG-H Audio

Annex K Next-Generation Audio Overview

Questions?

If you have more questions, please send an email to:

virginie.drugeon@eu.panasonic.com

kolff@dvb.org

siebert@dvb.org