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JCTVC-AA037: User Data Unregistered SEI for Backward Compatible HDR Coding

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Context : TR2 on HDR Coding

- TR2: Signalling, Backward Compatibility and Display Adaptation for HDR/WCG Video Coding
- Includes a method using Tone Mapping SEI
  - Based on JCTVC-Y0042
  - Two methods explained based on TMI SEI
    - Linear light
    - Nonlinear light

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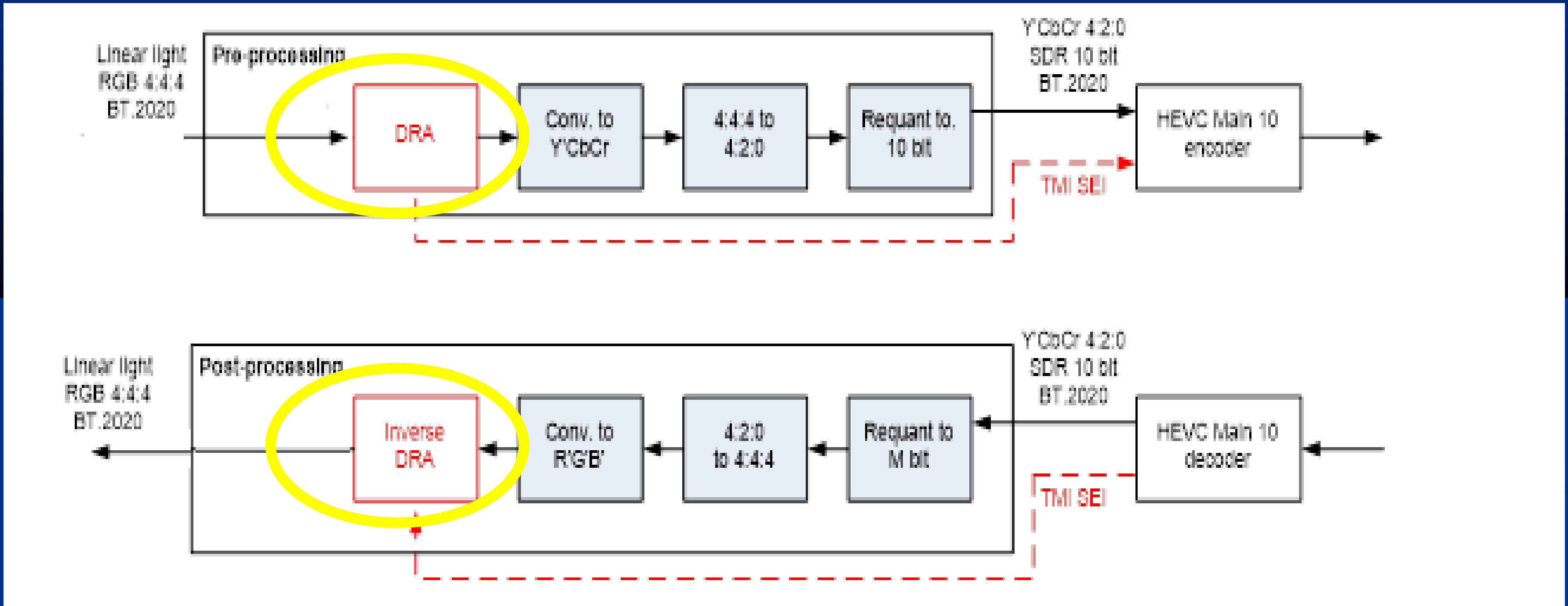
General Structure



- DRA / InvDRA are the tone mappings.
  - Could include standard PQ (nonlinear light)
  - Or replace PQ (linear light)

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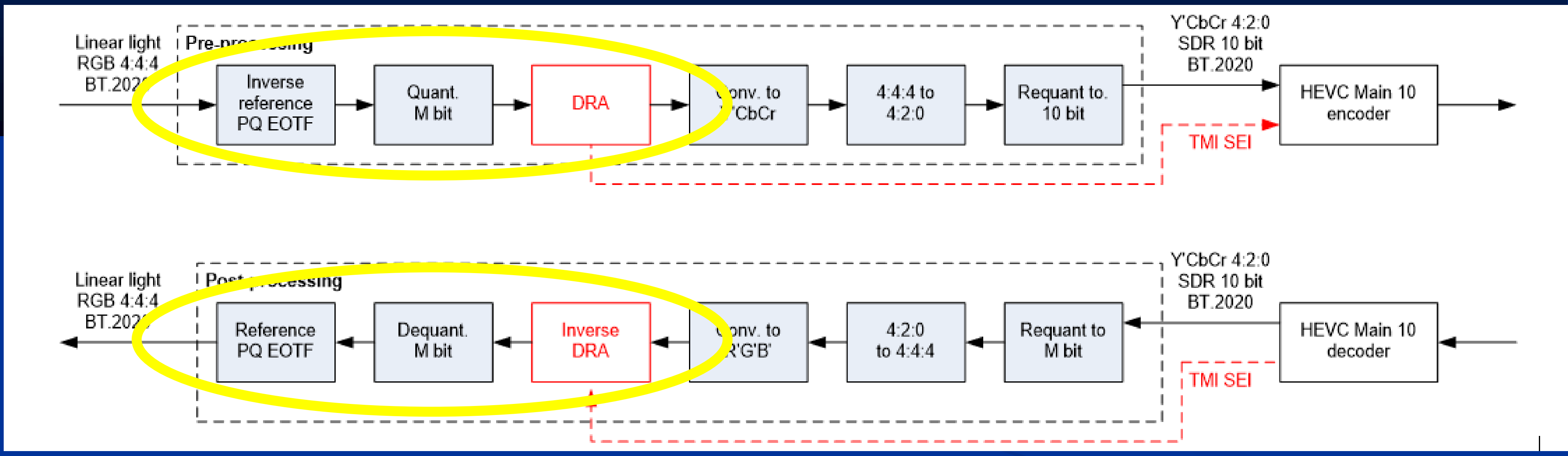
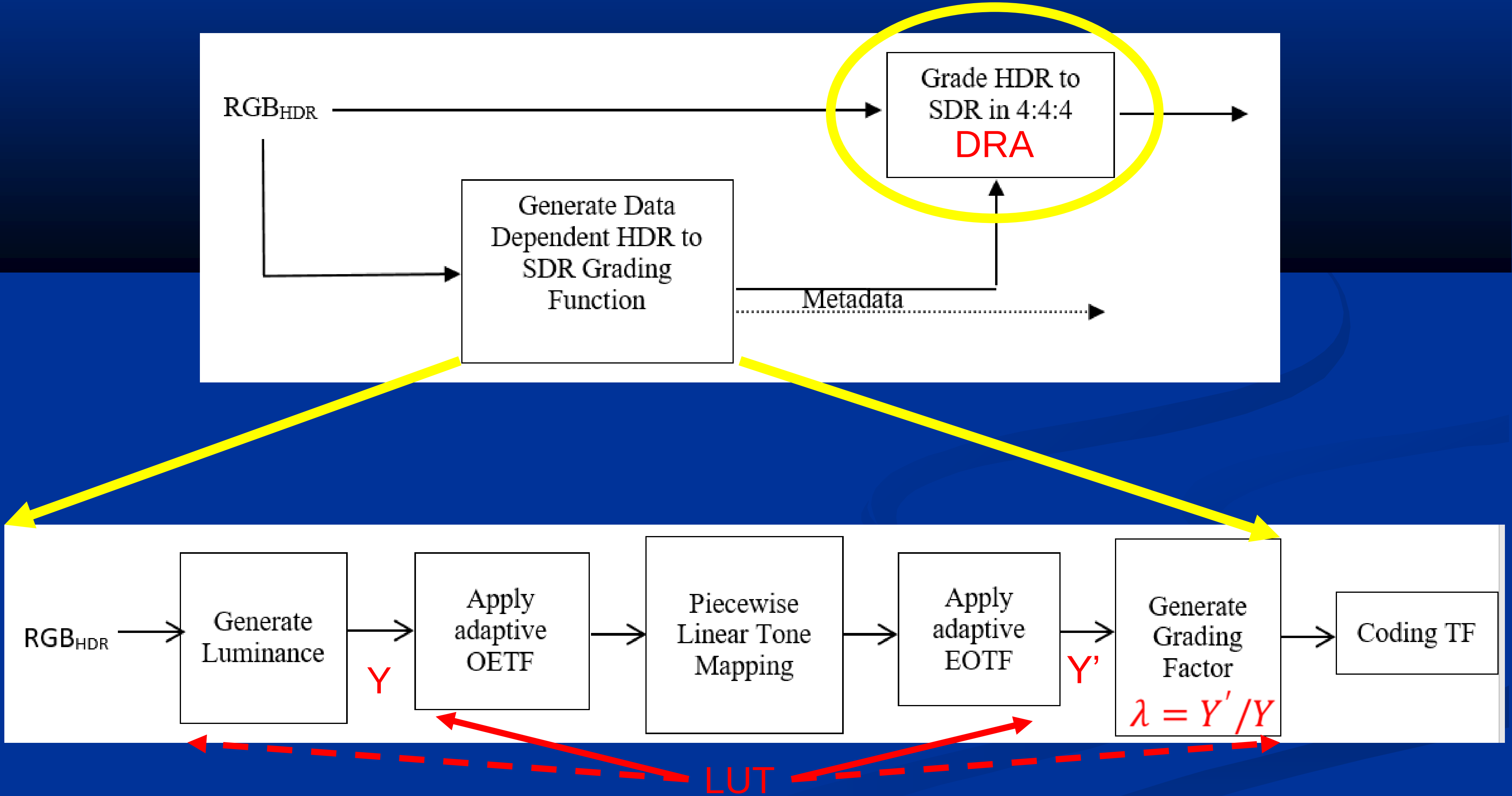
TMI on Nonlinear Light in TR2 (Fig.8-6)



Linear Light DRA (not in TR2)



Use Modified PQ (FVPQ)

$$V = iEOTF_{PQ}(\ L_o\ ) = \left(\frac{c_1 + c_2 * L_o^n}{1 + c_3 * L_o^n}\right)^m$$

where c_1, c_2, c_3, m, and n are constants defined as follows:

$$c_1 = c_3 - c_2 + 1 = 3424 \div 4096 = 0.835\,937\,5$$

$$c_2 = 2413 \div 128 = 18.851\,562\,5$$

$$c_3 = 299 \div 16 = 18.687\,5$$

$$m = 2523 \div 32 = 78.843\,75$$ → *(1+0.25*log(10000/PkInBr)

$$n = 1305 \div 8192 = 0.159\,301\,757\,812\,5$$

PkInBr is PeakInput Brightness

$$L_o = EOTF_{PQ}(\ V\ ) = \left(\frac{Max\left(\left(V^{1/m} - c_1\right), 0\right)}{c_2 - c_3 * V^{1/m}}\right)^{1/n}$$

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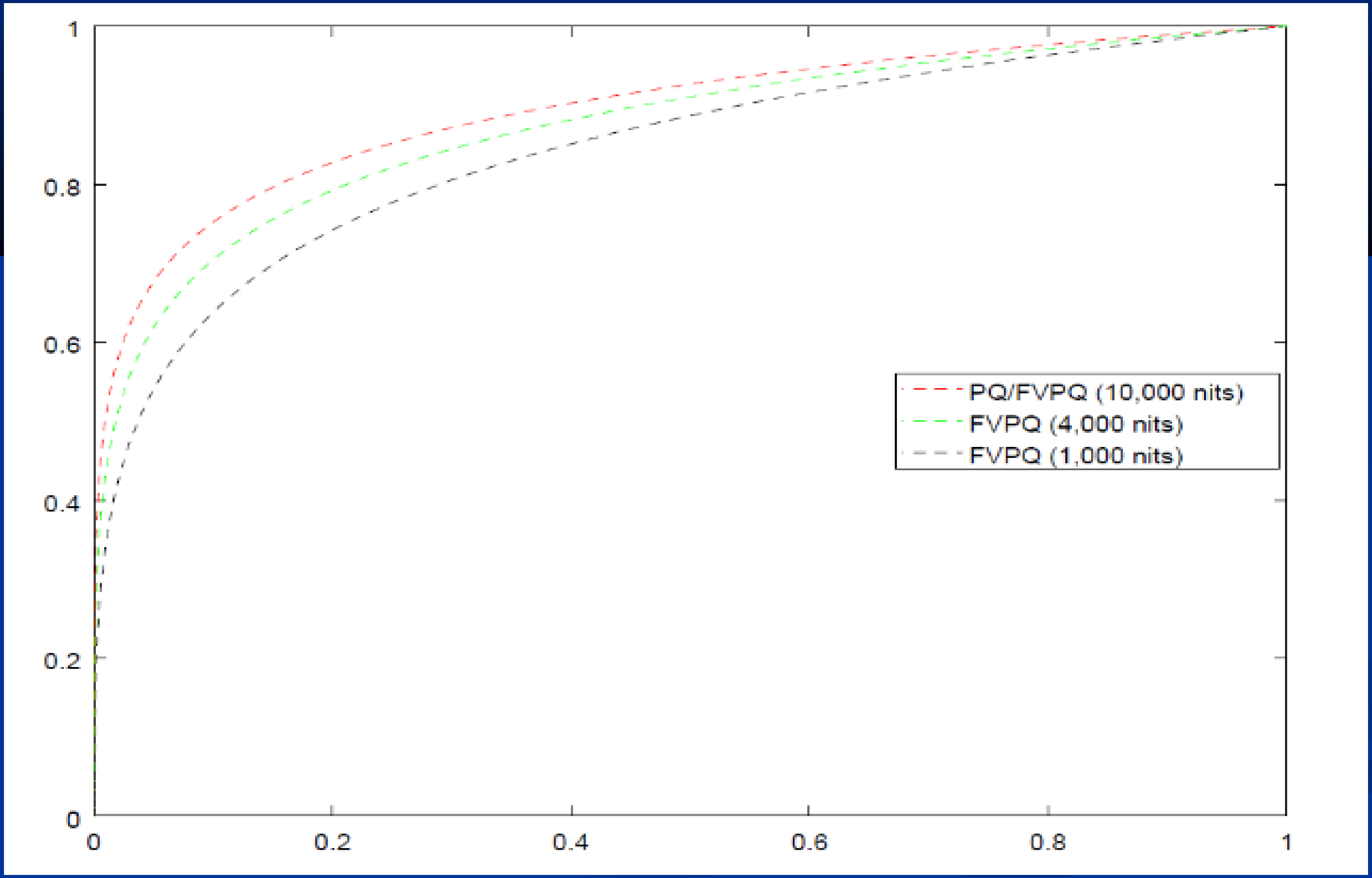
FVPQ = PQ at 10k Nits



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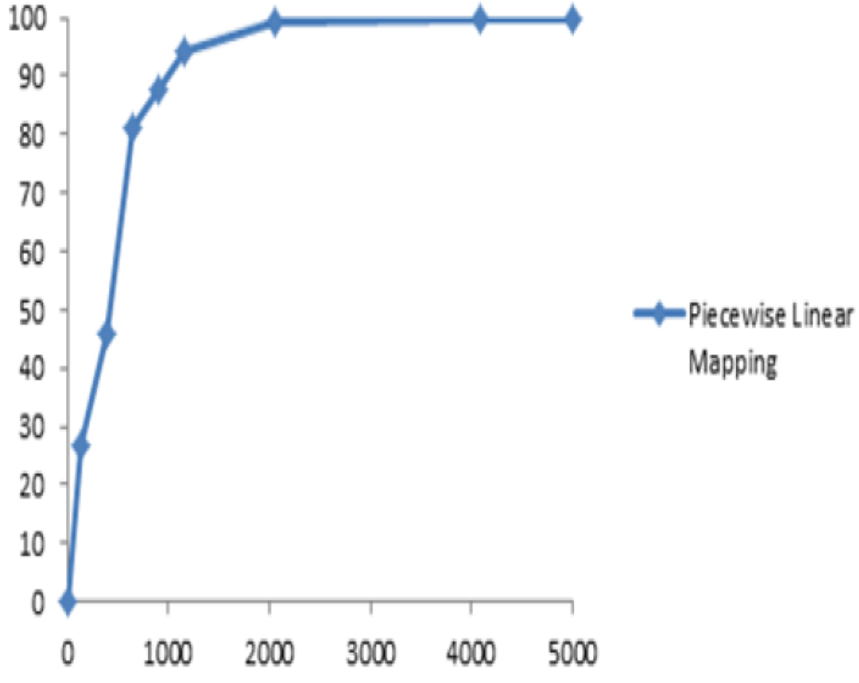
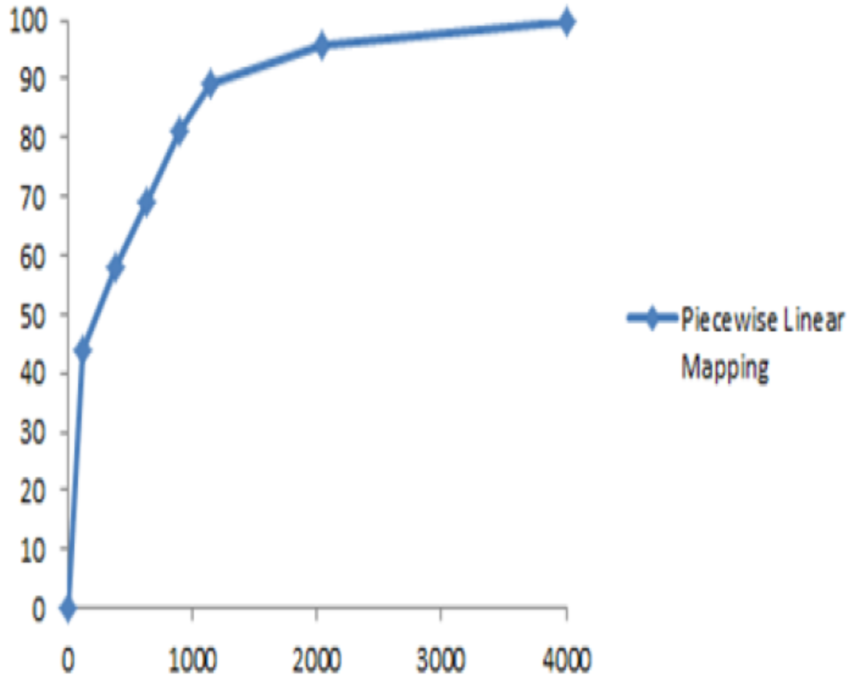
PieceWise Linear Map



Balloon Festival



Market

Other Blocks

- Generate grading factor
  - $\lambda = Y'/Y,$
    - Y = linear luminance; Y'=output(EOTF)
  - RGB_SDR' = RGB_HDR * λ
- Coding TF
  - BT.2020 gamma power law

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ETSI TS 103 433 v1.1.1 (2016-08)

5 HDR system architecture

The block diagram in Figure 2 depicts in more detail the HDR decomposition and reconstruction processes. The centre block included in dash-red box corresponds to the distribution encoding and decoding stages (e.g. based on HEVC or AVC video coding specifications). The two left and right grey-coloured boxes respectively enable format adaptation to the input video signal of the HDR system and to the targeted system (e.g. a STB, a connected TV, etc.) connected with the HDR system. The black solid line boxes show the HDR specific processing. The additional HDR dynamic metadata are transmitted on distribution networks typically by way of the SEI messaging mechanism. The present document relates to both the HDR signal reconstruction process and the HDR metadata format. The core component of the HDR decomposition stage is the HDR-to-SDR decomposition that generates an SDR video from the HDR signal. Optionally, a block of gamut mapping may be used when the input HDR and output SDR signals are represented with different colour gamut or colour spaces. The decoder side implements the inverse processes, in particular the SDR-to-HDR reconstruction step that goes back to HDR from the SDR video provided by the decoder.

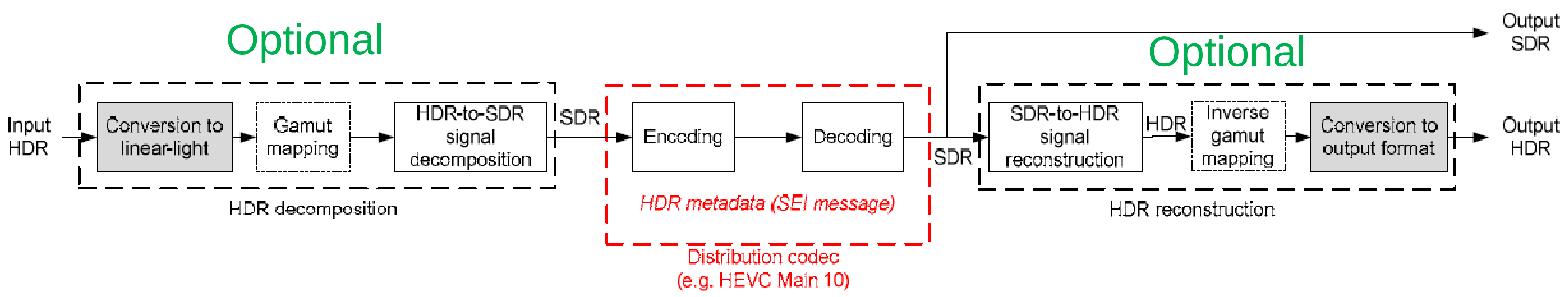

Figure 2: HDR system architecture overview

ETSI TS 103 433 v1.1.1 (2016-08)

7.2 Reconstruction process of the HDR stream

7.2.1 Introduction

This clause specifies the reconstruction process enabling the generation of an HDR picture from an SDR picture with associated dynamic metadata.

This process is defined for full range SDR picture signal (as defined in SMPTE RP 2077 [7]). For SDR picture defined as narrow-range signal, an (unspecified) conversion to full range process shall be applied first (e.g. as specified in SMPTE RP 2077 [7]). This process assumes that the SDR picture signal is represented with a bitdepth of 10-bit per component. For SDR picture represented with a different bitdepth, an (unspecified) conversion to 10-bit signal shall be applied first.

The process depicted in Figure 3 can be summarized as follows:

- From the input metadata conveyed in either **payloadMode** 0 or 1, a luma-related look-up table, *lutMapY*, is derived (see clause 7.2.3.1).
- Similarly, from the input metadata conveyed in either **payloadMode** 0 or 1, a colour correction look-up table, *lutCC*, is derived (see clause 7.2.3.2).
- The next step, described in clause 7.2.4, consists of applying the SDR-to-HDR reconstruction from the input SDR picture, the derived luma-related look-up table and colour correction look-up table. This process produces an output linear-light HDR picture.
- An optional inverse gamut mapping can be applied when the colour gamut and/or colour space of the SDR picture (as specified by the variable **sdrPicColourSpace**) and of the HDR picture (as specified by the variable **hdrPicColourSpace**) are different.

Tone Mapping Inf. SEI (1)

D.2.15 Tone mapping information SEI message syntax

tone_mapping_info(payloadSize) {	**Descriptor**
tone_map_id	ue(v)
tone_map_cancel_flag	u(1)
if(!tone_map_cancel_flag) {	
tone_map_persistence_flag	u(1)
coded_data_bit_depth	u(8)
target_bit_depth	u(8)
tone_map_model_id	ue(v)
if(tone_map_model_id = = 0) {	
min_value	u(32)
max_value	u(32)
} else if(tone_map_model_id = = 1) {	
sigmoid_midpoint	u(32)
sigmoid_width	u(32)
} else if(tone_map_model_id = = 2)	
for(i = 0; i < (1 << target_bit_depth); i++)	
start_of_coded_interval[i]	u(v)
else if(tone_map_model_id = = 3) {	
num_pivots	u(16)
for(i = 0; i < num_pivots; i++) {	
coded_pivot_value[i]	u(v)
target_pivot_value[i]	u(v)
}	

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Tone Mapping Inf. SEI (2)

D.3.15 Tone mapping information SEI message semantics

This SEI message provides information to enable remapping of the colour samples of the output decoded pictures for customization to particular display environments. The remapping process maps coded sample values in the RGB colour space (specified in Annex E) to target sample values. The mappings are expressed either in the luma or RGB colour space domain and should be applied to the luma component or to each RGB component produced by colour space conversion of the decoded image accordingly.

tone_map_id contains an identifying number that may be used to identify the purpose of the tone mapping model. The value of tone_map_id shall be in the range of 0 to $2^{32} - 2$, inclusive.

tone_map_model_id specifies the model utilized for mapping the coded data into the target_bit_depth range. Values greater than 4 are reserved for future use by ITU-T | ISO/IEC and shall not be present in bitstreams conforming to this version of this Specification. Decoders shall ignore all tone mapping SEI messages that contain a value of tone_map_model_id greater than 4 and bitstreams shall not contain such values.

NOTE 2 – A tone_map_model_id of 0 corresponds to a linear mapping with clipping; a tone_map_model_id of 1 corresponds to a sigmoidal mapping; a tone_map_model_id of 2 corresponds to a user-defined table mapping, and a tone_map_model_id of 3 corresponds to a piece-wise linear mapping, tone_map_model_id of 4 corresponds to luminance dynamic range information.

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User Data Unregistered

D.2.7 User data unregistered SEI message syntax

user_data_unregistered(payloadSize) {	**Descriptor**
uuid_iso_iec_11578	u(128)
for(i = 16; i < payloadSize; i++)	
user_data_payload_byte	b(8)
}	

D.3.7 User data unregistered SEI message semantics

This SEI message contains unregistered user data identified by a universal unique identifier (UUID), the contents of which are not specified in this Specification.

uuid_iso_iec_11578 shall have a value specified as a UUID according to the procedures of Annex A of ISO/IEC 11578:1996.

user_data_payload_byte shall be a byte containing data having syntax and semantics as specified by the UUID generator.

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User Data Example

User Data Unregistered (UDU) SEI

The UDU SEI syntax as described in H.265/HEVC Specification [4] contains unregistered user data identified by a universally unique identifier (UUID). The message consists of two fields as defined below:

- uuid_iso_iec_11578 is a unique 16 Byte field that shall be set to the value:
  Bytes 1-8: 0x46, 0x61, 0x73, 0x74, 0x56, 0x44, 0x4f, 0x55
  Bytes 9-16: 0x44, 0x55, 0x53, 0x65, 0x69, 0x4d, 0x65, 0x73

This represents the ASCII string: “FastVDOUDUSeiMes”

- user_data_payload_byte is a variable length field depending on the signalled data. In the current application, 20 bytes are used to represent the content mapping information.

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Metadata By Either TMI vs UDU

- Both methods can be used
  - TMI is preferred for interoperability
    - Appears nonstandard (ambiguous?)
    - Update TMI (JCTVC-AA0038)
  - UDU is always available

SEI Payload Data

Sequences	TMI SEI (bytes)	UUD SEI (bytes)
Balloon	134	36
Bike_Cut1	134	36
Bike_Cut2	134	36
FireEater	134	36
Garage	134	36
Hurdles	134	36
Magic_Cut1	134	36
Magic_Cut2	134	36
Magic_Cut3	134	36
Market	134	36
ShowGirl	268	72
Starting	134	36
Sunrise	134	36
Warm_Cut1	134	36
Warm_Cut2	134	36