Alphabet Soup

What we know about UHD interoperability from plugfests

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Role of Interop Working Group

The Interop Working Group facilitate interoperability work and plug-fests to test the usability and comprehensiveness of Ultra HD and related media standards including the Forum's Guidelines.

We also act to describe and promote the use of Ultra HD and related media services that meet the scope of the Ultra HD Forum in public forums.

Acronyms… acronyms…
Alphabet Soup

BT.2100 10 Bit HDMI2.0 ST.2094-40 8 Bit
ST.2084 HDMI2.0b HDR10 HDR10+
SDR PQ HLG SL-HDR1
HDMI2.0a ST.2094-10 BT.2020 HDMI2.1
BT.709 Advanced HDR Dolby Vision
ST.2086 ST.2094-20
ST.2094-30 DCI-P3 12 Bit
ARIB B67

Plugfests and Demonstrations

March 2016 – ATSC Meeting
Glass to Glass (Camera to Display) Test with PQ10 + SDR. HLG not generally supported on TVs

September 2016 – KPN/IBC
Display + STB / IPTV focused. SDR/PQ10/HLG10 formats. Issues with content preparation, full/narrow range, signalling over HDMI specifically for HLG (pre-standard ITU/ARIB). Display rendering issues and graphics colour shifts.

October 2016 – SMPTE
PQ/HLG/SDR Content verified for Forum usage. Initial introductions to SL-HDR1/Advanced HDR.

Plugfests and Demonstrations

December 2016 DTVP/DTG Plugfest 5
SDR/PQ10/HLG10 validation of decoding/rendering/signalling. Rendering and display issues with reference content reported from testing. HLG signalling support significantly improved from previous tests, but HDMI implementations mostly not implemented (pre-ITU standard/ARIB)

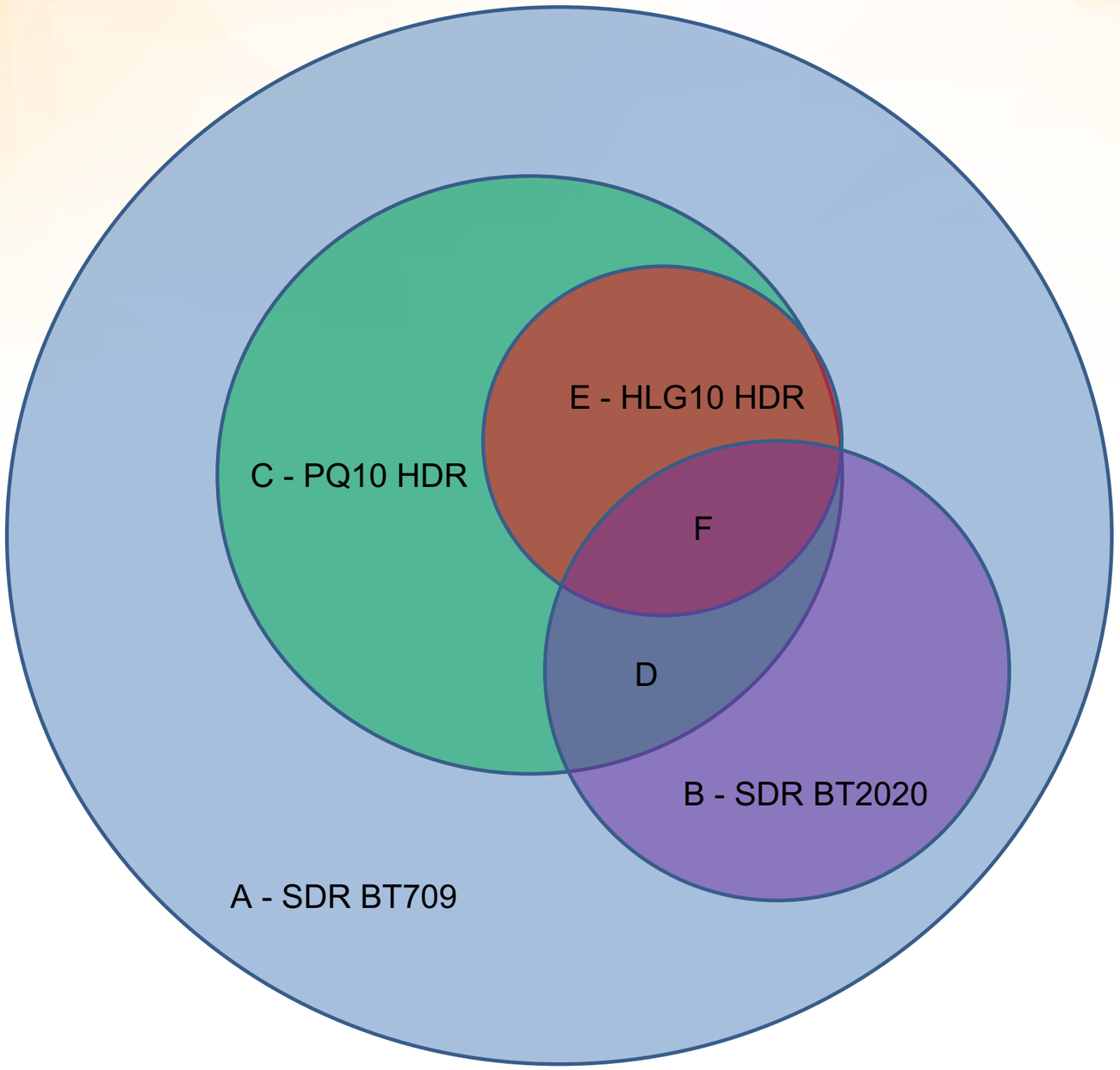
March/April 2017 Pre-NAB and NAB
SDR & HLG to PQ conversions on STB and Headend, SDR/HDR Receiver transition behaviours. HLG signalling behaviours over HDMI2.0b confirmed on limited range of TVs

Plugfests and Demonstrations

June 2017 6th DTG/DTVP Plugfest
SDR/PQ10/HLG10 display and rendering, HDMI2.0b signalling for BT.2100, Dynamics of Static Metadata, TV Behaviours with Metadata, SDR/HDR instream switching behaviour, Operator STBs generally SDR only.
Feed of Decode capabilities and Service Formats into Guidelines 1.4. Confirmed universal HLG10 for displays.

September 2017 Pre-IBC/IBC
Live HDR over IPTV (as PQ10), Receiver Adaptation, SDR/HDR conversions, and pre-Phase B HD HFR/HLG.

HDR Display Format Capabilities (Phase A)



A - SDR BT709

B - SDR BT2020, SDR BT709

C - PQ10 HDR, SDR BT709

D – PQ10 HDR, SDR BT.2020, SDR BT709

E - HLG10 HDR, PQ10 HDR, SDR BT709

F – HLG10 HDR, PQ10 HDR, SDR BT.2020, SDR BT709

Phase A - Decoder Capabilities

Type No.	Color Container	Resolution	Frame rate	Bit Depth	HDR	SDR BT2020	HDMI	HDCP	UHDF Phase A
1	BT.709	1080	P25/30	8	No	No	1.4	1.x	No
2	BT.709	1080	P50/60	8	No	No	1.4	1.x	No
3	BT.709	2160	P25/30	8	No	No	1.4	1.x	No
4	BT.709	2160	P50/60	8	No	No	2.0	2.2	No
5	BT.2020	1080	PP50/60	10	No	Yes	2.0	2.2	No
6	BT.2020	2160	P50/60	10	No	Yes	2.0	2.2	Yes
7	BT.2020	1080	P50/60	10	PQ10	Yes	2.0a	2.2	Yes
8	BT.2020*	1080	P50/60	10, 8	PQ10	No	2.0a	2.2	Yes
9	BT.2020	2160	P50/60	10	PQ10	Yes	2.0a	2.2	Yes
10	BT.2020*	2160	P50/60	10, 8	PQ10	No	2.0a	2.2	Yes
11	BT.2020	1080	P50/60	10	HLG10/PQ10	Yes	2.0b	2.2	Yes
12	BT.2020	2160	P50/60	10	HLG10/PQ10	Yes	2.0b	2.2	Yes
13	BT.2020*	1080	P50/60	10, 8	HLG10/PQ10	No	2.0b	2.2	Yes
14	BT.2020*	2160	P50/60	10, 8	HLG10/PQ10	No	2.0b	2.2	Yes

Phase A - Service Formats

Service Format Description	Attributes					Table 4 Decoders	UHDF Phase A
	Color Container	Resolution	Frame rate	Bit Depth	HDR		
HD SDR	BT.709	1080	P30	8	No	All	No
HDp60 SDR	BT.709	1080	P50/60	8	No	2 and above	No
UHD SDR	BT.709	2160	P30	8	No	3, 4, 6, 9, 10, 12 and 14	No
UHD SDR	BT.709	2160	P50/60	8	No	4 , 6, 9, 10, 12 and 14	No
HDp60 SDR2020	BT.2020	1080	P50/60	10	No	5, 6, 7, 9, 11, and 12	No
UHD SDR2020	BT.2020	2160	P50/60	10	No	6, 9, and 12	Yes
HDp60 PQ10	BT.2020	1080	P50/60	10	Yes	7 and above	Yes
HDp60 HLG10	BT.2020	1080	P50/60	10	Yes	11 and above	Yes
HDp60 HLG10*	BT.2020	1080	P50/60	10	Yes	11 and above (HDR), 5 and above (SDR)	Yes
UHD PQ10	BT.2020	2160	P50/60	10	Yes	9, 10, 12, and 14	Yes
UHD HLG10	BT.2020	2160	P50/60	10	Yes	12 and 14 (HDR)	Yes
UHD HLG10*	BT.2020	2160	P50/60	10	Yes	12 and 14 (HDR), 6, 9, and 10 (SDR)	Yes

Notes:
* Indicates the Service Format signals HLG10 using the SDR/BT.2020 backward compatible method.

ST.2086 Metadata Support

MaxFALL **MaxCLL**

Mastering Display Colour Volume

TV behaviours seen

- Static Metadata is actually Dynamic ... it can change and TVs that support ST.2086 and use the metadata in their rendering will respond dynamically, but note the standard is for one set of data for whole program officially, this is NOT Dynamic Metadata

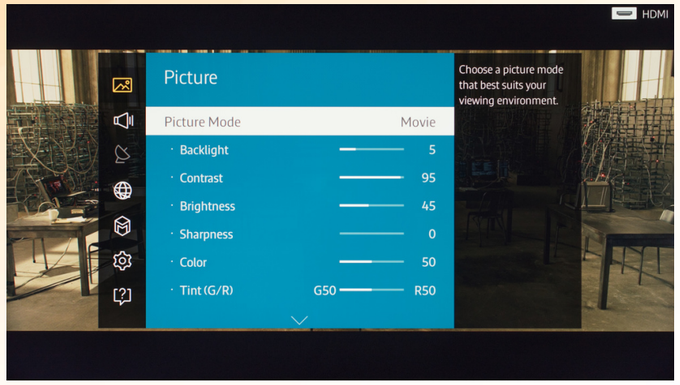
- Use of ST.2086 metadata for content rendering based on display capabilities is not standardised and dependent upon TV manufacturer decision / processing implementations… the range of approaches seen are…

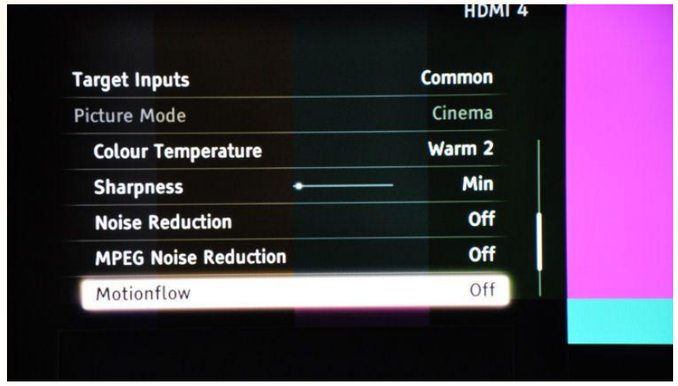
… Metadata Usage

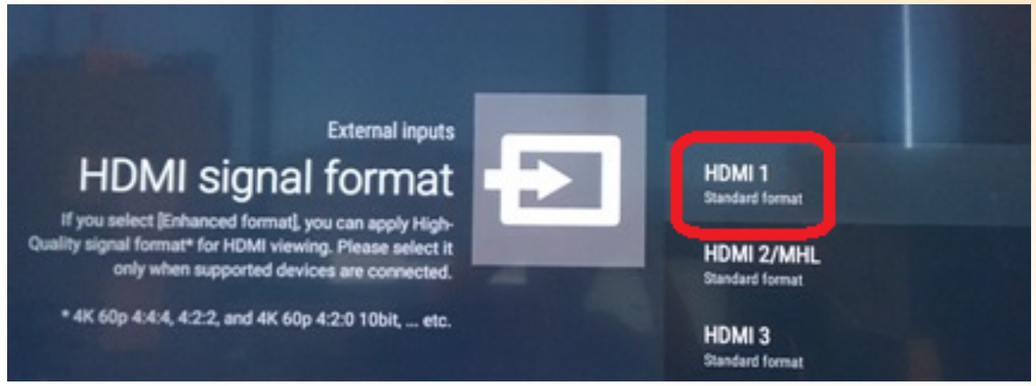
- Some TVs ignore metadata and don’t use it when present entirely (even when they state support for ST.2086)
- Some TVs ignore metadata when present and assume own values for MaxCLL/MaxFALL/Mastering Display Peak Luminance (i.e. 1000nits)
- Some TVs prioritise MaxCLL over Mastering Display Peak Luminance (i.e. ignore Mastering Display Peak value)
- Some TVs prioritise Mastering Display Peak Luminance (i.e. ignore MaxCLL)
- Some TVs use the higher of the two values of MaxCLL / Mastering Display Peak Luminance
- Some TVs use MaxCLL only if lower than Mastering Display Peak Luminance.
- Some TVs assume Metadata MUST be followed at all times and respond accordingly
- Some TVs undertake processing of video frames to determine own values for MaxCLL, MaxFALL on a continual basis
- Some TVs use combinations of above strategies

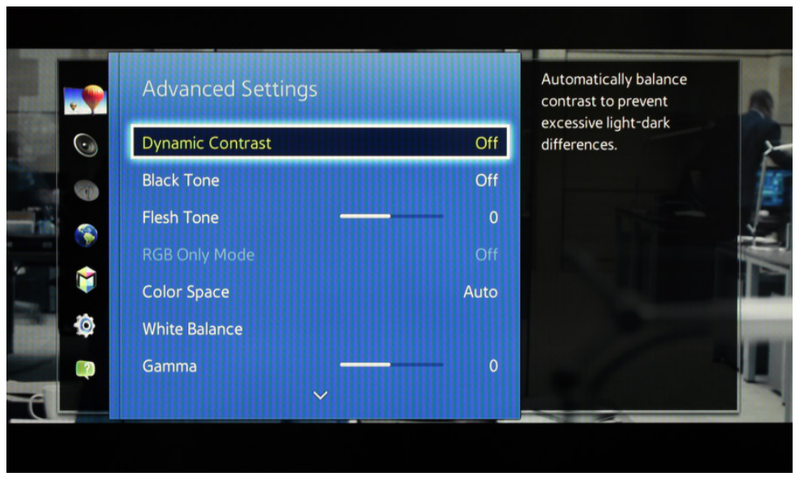
“Metadata MAY be used by the display
Then again it MAY NOT”

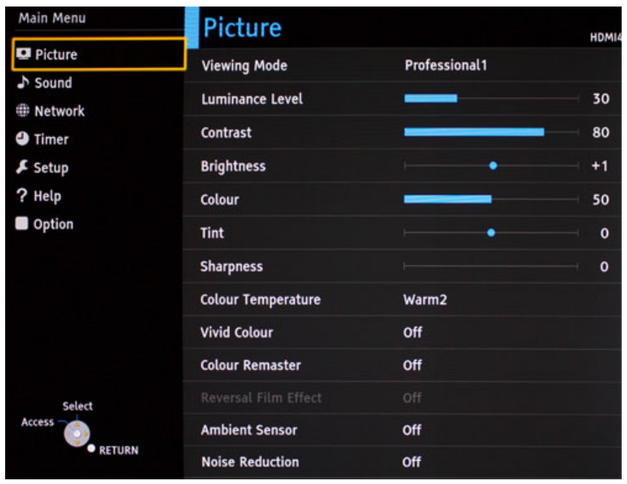
UI Complexity for Consumers

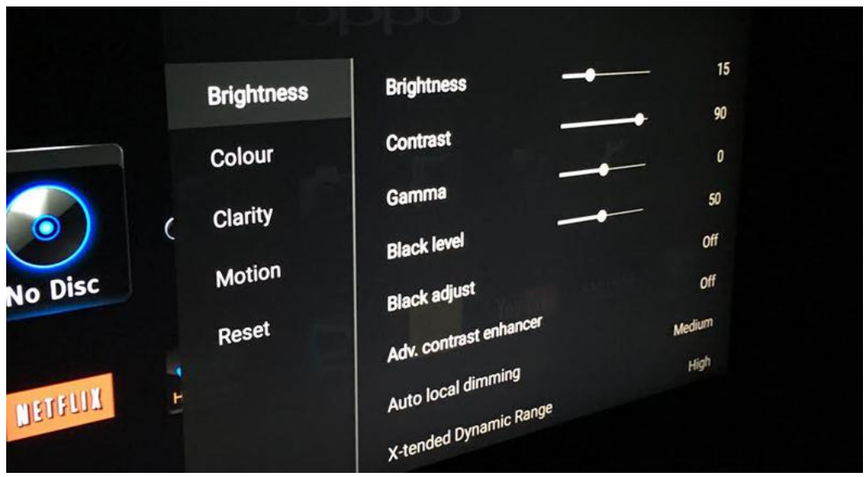












What we have learned - 1

- HLG10 moved from no support except via USB delivery (based on ARIB67) to near universal support on TVs 2016 or later

- Almost all TVs 2016 or later now support PQ10, HLG10, SDR709 and SDR2020 (HDMI2.0b) – patchy support 2015, almost no support 2014 for SDR2020 (required for HLG 'Backwards Compatibility')

- Video rendering went from poor color reproduction on many displays to very good on all (some remedial checks to be carried out still)

What we have learned - 2

- TV Processing can have detrimental effect on video experience more often than not (when settings are sub-optimal due to UI complexity)

- ST.2086 Metadata role/usage in video rendering is not standardised

- Obscure/invalid inter-relationships in settings (e.g. HDR only in Cinema mode) exist on some TVs

What we have learned - 3

- Instream Color Container and HDR format switching behaviour varies greatly with poor customer experience

- Standards interpretation issues (SDR BT.2020, HLG10 'Backwards Compatibility') still being resolved

- £800/$1000/€1000 Current price point UHD HDR TVs are all 8 bit + FRC + <500 Nits + 80-90% DCI-P3 as WCG – The average TV, but the wow is still there but a little subdued… (not every car is a Ferrari…)

Near Future Work

- Metadata use and display behaviours – informational for operators
- HDR Loudness
- Phase B – Including Additional CODECs, Dynamic Metadata, NGA and HFR

Demos – Come and See

Demo 1 – HDR in HLG with HFR at 100fps
Demo 2 – Receiver Display Adaptation
Demo 3 – SDR to HDR Conversion