HDR10+ Technology & Content Tools
SAMSUNG – July 2018
HDR systems deployed since 2015.

Studio masters delivered in “PQ” encoding. “Perceptual Quantizer”. PQ Enables content creators to exactly specify the image color and brightness as viewed on a reference monitor in the grading suite. – it’s up to displays to play this directly or adapt to the consumer’s viewing environment.

Premium Certification of HDR content, distribution and reproduction was announced by the Ultra-HD Alliance in December 2015.

HDR10+ metadata delivers scene specific image information enabling TVs to better handle HDR10 material on a wide range of displays and viewing conditions.
What are HDR10+ and ST 2094-40?

**HDR10** (for distribution)
- 10-bits
- (wide color) BT.2020
- (HDR) Static Metadata
  - SMPTE ST 2086
  - MaxFALL & MaxCLL

**HDR10+**
- LLC
  - (certified 2094-40 profile; see whitepaper)

**Dynamic Metadata**
- SMPTE ST 2094-40
  - Statistical Information
  - Basis OOTF for Guided Tone Mapping

**PQ**
- Perceptual Quantization
- SMPTE ST 2084
  - “HDR Essence” Same for all HDR

Open HDR format (2015)

Open Technology to extend reach of HDR into mid & lower tier televisions
Dynamic Tone Mapping

- Static Tone Mapping (HDR10): Tone mapping using **static metadata** (one set of metadata for entire content) such as Mastering display information (ST 2086), MaxCLL, MaxFALL

- Dynamic Tone Mapping (e.g. HDR10+): Tone mapping using **dynamic metadata (per scene)**

**Static Tone Mapping**

Scene Peak: from 100nit to 1,000nit

Tone mapped @ 500 nit

**Dynamic Tone Mapping**

Scene Peak: 100nit

Scene Peak: 1,000nit

By Pass

Tone mapping @ 500nits

Display peak: 500 nit

Use different curve per scene
Samsung and Amazon Prime Video First to Launch HDR10+ Content

Korea on December 13, 2017

Samsung Electronics and Amazon Prime Video today announced the entire Prime Video HDR library is now available in HDR10+, a new open standard that leverages dynamic metadata to produce enhanced contrast and colors on an expanded range of televisions. The Prime Video HDR10+ catalogue includes hundreds of hours of content such as Prime Originals *The Grand Tour*, *The Marvelous Mrs. Maisel*, *Jean-Claude Van Johnson*, *The Tick* and *The Man in the High Castle* plus hundreds of licensed titles. Prime Video is the first streaming service provider to deliver HDR10+ content to its users. HDR10+ is available on the entire Samsung 2017 UHD TV lineup – including the premium QLED TV models.

- Amazon status: HDR10+ on all HDR content.
Certification Program Opened June 20th 2018

HDR10+ Technologies, LLC, founded by 20th Century Fox, Panasonic and Samsung Make HDR10+ Technology Widely Available, Improving The Viewing Experience for Audiences

Los Angeles, CA – June 20, 2018 – HDR10+ Technologies, LLC today announced the start of the new licensing and logo certification program for HDR10+ technology. HDR10+ is the royalty-free, open standard dynamic metadata platform for High Dynamic Range (HDR), which optimizes picture quality for 4K Ultra HD displays and improves the viewing experience for all audiences.

The new HDR10+ technology optimizes picture quality for 4K Ultra HD displays by using dynamic tone mapping to reflect frame to frame or scene to scene variations in brightness, color saturation, and contrast. The resulting enhanced viewing experience can now be easily provided on a wide range of displays bringing the viewing experience much closer to the original creative intent for the content.

The HDR10+ license and logo certification is available to interested companies that meet HDR10+ technical and testing specifications. The HDR10+ certification program qualifies the compliance based on different device categories and their technical performance to ensure that HDR10+ compliant products meet high standards for picture quality.

Consumers will be able to look for the HDR10+ logo which signifies a product’s certification. The royalty-free adoption of HDR10+ for content production, distribution and consumption has already gained momentum with over 40 supporting companies.

“The new HDR10+ licensing and certification program represents a technological step forward for next generation displays,” said Danny Kayo, Executive Vice President of 20th Century Fox and Managing Director of the Fox Innovation Lab. “HDR10+ improves the viewing experience for all audiences by delivering higher picture quality to a wider range of affordable TVs and devices.”

- Technical Spec
- Test Spec
- Logo Usage
- Different adopter classes
  - Content
  - Source
  - Display
  - SoC
  - Tools
- Information: “HDR10PLUS.ORG”
HDR10+ LLC

HDR10+ LLC is a profile, logo and certification program formed by Samsung, Panasonic and 20th Century Fox Studios.

- HDR10+ LLC Profile follows 2094-40 supporting statistics and guided tone curves. Two statistical values are interpreted as new statistical image parameters.
- HDR10+ does not specify implementations

**Tools implementing spec used to create deliverable metadata**

**Adopt HDR10+ and incorporate the metadata in their HDR10 transmissions**

**Adopt HDR10+ and implement tone mapping with HDR10+ metadata.**
  - Utilize IPR outside of HDR10+ to process
  - Follow HDR10+ HDMI VSIF for v2.0a/b

HDR10+ LLC Specifies tests used to certify picture quality and awards logo to devices that pass
- Panel Performance (e.g. gamut, accuracy)
- Processed image quality
- ATC(s) perform the testing
Benefits of HDR10+ Ecosystem

- Solves problem of gap between TV performance and content mastering characteristics
  - Volume zone displays 300-500 nits
  - Premium zone displays ~1000 nits
- Provides better qualified metadata than simply SMPTE 2086
- Wide reach of HDR content across consumer UHD displays
- Quality bar based on technology and certification
- Adoption based on open technology
Metadata Steps

- **Image analysis:**
  - Identify scenes
  - Compute statistics across scene
  - Compute Bezier from statistics
  - Output JSON

- **JSON processing:**
  - Post Production workflows, clip management etc...
  - Offline encoder support
  - Represents metadata close to SEI format yet directly readable

- **‘SEI’ processing:**
  - Binary representation of metadata used by encoders

- **‘VSIF’ processing (optional)**
  - Binary representation used by HDMI
  - Derived from SEI

*(Image courtesy Joe Kane Productions)*
Post Production based Metadata Workflow

1.) Generate JSON from existing source asset (e.g. ProRes)

2.) (optional) Preview default performance at target deliverable (e.g. 400 nits)

3.) (optional) Adjust any scene if desired (e.g. combine/split)

(Image courtesy Amazon Studios & ColorFront)
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(Image courtesy Amazon Studios & ColorFront)
Live Workflow

HDR10+ + Live Workflow
Generation algorithm included in HEVC encoder
SEI directly produced (skips JSON step)
3C HDR10+ support: Demonstrated to studios

Main Themes:
• Metadata generation is easy.
• Metadata can be easily validated for HDR10 and HDR10+ at same time
• This is similar QC process

(Image courtesy Amazon Studios & ColorFront)
Launched HDR10+ support in Resolve 15

- **PR Quote:** *Support for native HDR10+™ controls in Da Vinci Resolve Studio*
HDR10+ support: Demonstrated Deluxe authored HDR10+ UHD Blu-ray disc playback across HDMI at NAB
Summary

- **HDR10+ Tools ready**
  - Mastering
  - Post Production
  - Encoding
  - Authoring

- **Upgrade path for HDR10 content**
- Scene based statistics
- Option for preview of result (professional uses)
- Samsung implementation provides for superior content to TV adaptation
- Our solution covers tone mapping and TV makers performs panel adaptation to finalize the processing.
MaxCLL is fine for use as a static “target”, but is too sensitive for dynamic use.

HDR10+ \textsuperscript{LLC} fixes to 7 percentiles:

\{1\%, 25\%, 50\%, 75\%, 90\%, 95\%, 99.98\%\}.

This solution is robust and tolerant of spurious pixels. (random extremely bright pixel/s)

Two new parameters are stored in the percentile vector to follow 2094-40 syntax:

\{1\%, llc, llc, 25\%, 50\%, 75\%, 90\%, 95\%, 99.98\%\}

Example 11\% 250 nits:

- Results in 90\%, 95\%, 99.98\% as “250”
The Bezier curve allows smooth, yet nuanced, mapping
- Critical tones can be preserved
- “In-between” areas can be compressed
- Provided in metadata (can be creatively controlled)
Beziers anchor points can be provided

- Calculated at same time as statistics
- Can be creatively controlled or created.
- Used in all Samsung TV implementations
- Available from Samsung royalty free to SoC and TV makers

Example 11% 250 nits:
- Results in straight line guide curve (aka “Bypass”)
Example: Bezier Curve
Why Bezier Basis Guided OOTF

- Continuity of slope: Bezier Curves

We can make the slopes continuous and preserve the creative intent in shadow area.
Transmit the basis curve and mix with product!
The Bezier curve allows avoidance of slope discontinuities
Slope discontinuities can cause sharp contour artifacts
Tone mapping in display should not be done using gamma as it is very coarse
Gamma based adaptation is difficult

This slope discontinuity can introduce banding artifacts after the tone mapping

No Creative Intent Preservation

Creative Intent Line

Knee Point

No performance maximization
Maximizes creative intent across various displays
- Enables content-specific mapping, avoids over aggressive static tone curves commonly found in displays
- Shadows fully preserved
- Ensures a low-APL baseline (e.g. will track PQ on low APL images)

Minimizes artifacts
- Hard slope changes can be avoided

Improves robustness of statistical measurements over static
- Tolerant of spurious pixels

Workflow compatible
- Manual or Automatic metadata generation for offline or live use cases

Deployment is being established across HDR ecosystem
- Tools, Software, SoC, and Display