

HDR10+ ADVANCED

Understanding the Evolving Ecosystem.



Presented by HDR10+ Technologies, LLC

Introduction

Launched in 2017, HDR10+ rapidly became a global standard, delivering the powerful benefits of High Dynamic Range with the support of over 170 companies and over 20,000 certified devices.

Since that time, premium televisions, projectors, and displays have realized ever larger screen sizes, higher peak brightness, greater color depth, and increased processing power. After years of experience with HDR10+, the major content distribution platforms have asked for greater versatility. In addition, entertainment enthusiasts have wanted to enjoy all the advantages of HDR viewing along with higher brightness.

All of this has brought the HDR10+ ecosystem to a further evolution that is specifically designed to empower the latest, most sophisticated televisions, satisfy the requirements of distribution platforms, and delight today's most demanding entertainment enthusiasts. This is HDR10+ ADVANCED.

The new standard introduces important new capabilities:

- **Enhanced Overall Brightness** – Extended statistical metadata is provided to produce better image tonality. Adopters can utilize this to achieve greater brightness that can be experienced on today's most advanced televisions.
- **Intelligent Motion Smoothing** – This metadata feature is used to address the effects of visible “judder” in a given scene, by allowing compatible displays to dynamically adjust the amount of motion “smoothing” that is applied.
- **Local Tone Mapping** – Allows creators to achieve greater brightness control in specific areas of the screen, adding more overall depth and detail.
- **Genre-based Optimization** – A new metadata tool enables content providers and encoders to create “customized” genres dynamically. The display can then optimize picture processing and tailor it to each type of content.
- **Advanced Color Control** – HDR10+ ADVANCED also enables encoders to dynamically calculate color gamut data, for more accurate color reproduction.
- **Cloud Gaming** – In addition to compatibility with HDR10+ GAMING picture mode, HDR10+ ADVANCED supports cloud-based games with real-time ambient light adaptation, creating a more engaging user experience.

HDR10+ ADVANCED also retains all the existing benefits of the HDR10+ ecosystem.

- HDR10+ ADVANCED content is backward compatible, in keeping with the capabilities of HDR10+ and HDR10 devices.
- HDR10+ ADVANCED devices are also backward compatible with HDR10+ and HDR10 content.

- HDR10+ ADVANCED is based on the growing popularity of the HDR10+ standard. (For more information on HDR10+, [download](#) the HDR10+ white paper.)
- Device manufacturers and distribution platforms can also implement the new HDR10+ ADVANCED standard without any royalty fees.
- Additionally, HDR10+ ADVANCED takes advantage of the robust certification infrastructure already in place for HDR10+, with testing centers around the world to ensure interoperability of content, televisions, and other devices.

In summary, HDR10+ ADVANCED delivers greater brightness, color, immersion, and overall enjoyment. With the development of HDR10+ ADVANCED dynamic metadata, content creators and entertainment enthusiasts can now realize the ultimate video experience.

Industry support

Several of the leading entertainment and technology companies have already announced strong support for HDR10+ ADVANCED.

According to BA Winston, VP of Technology at **Prime Video**, “HDR10+ ADVANCED marks a transformative leap in streaming picture quality, and we're thrilled to pioneer support for this new technology on Prime Video. We will offer HDR10+ ADVANCED on select titles from Prime Video's extensive catalog of award-winning programming, with plans to expand availability across our library in the future.”

Colorfront, a long time leading partner with Samsung on HDR10+, is thrilled about HDR10+ ADVANCED,” said Mark Jaszberenyi, CEO and Founder. “Its enhanced brightness, intelligent motion smoothing, local tone mapping, and advanced color control will empower creators to deliver truly immersive experiences and give viewers on premium displays the brighter, more detailed HDR they’ve been demanding.”

“As one of the major adopters for HDR10+, **MediaTek** is looking forward to supporting the latest HDR10+ Advanced technology, which brings a new level of visual excellence to home entertainment,” said Cody Huang, Senior Director at MediaTek. “By integrating HDR10+ Advanced into the Pentonic series, MediaTek continues to lead in supporting cutting-edge display standards that elevate the quality of digital media.”

“**Roku** has built its brand around making TV simple and delightful,” said Paul Nangeroni, Senior Director of Product Management. “For us, HDR10+ ADVANCED reinforces that promise with tools and technologies that enhance the TV experience while staying true to creator intent. We’re looking forward to deploying HDR10+ ADVANCED across our platform and working with our TV and content partners to bring the benefits to everyone.”

“Our goal at **Samsung** has always been to utilize the latest technology to make home entertainment more engaging, visually stunning and convenient,” said Inbeom Kim, Vice President of Visual Display (VD) Business at Samsung Electronics. “This is why we have included HDR10+ ADVANCED in our new line of televisions and look forward to working with our various OTT partners to implement this.”

The Power of HDR10+ ADVANCED

Enhanced Overall Brightness

The need

At the heart of HDR is improved color and grayscale/luminance, the range of tonal values from the darkest black to the brightest white. HDR enables improvements on both ends – darker darks and brighter brights. Grayscale is also critical for better rendition of the middle tones that help define the subtle shapes of on-screen objects. However, some entertainment enthusiasts have asked for brighter HDR viewing. In addition, some HDR modes didn't take full advantage of the brightness capabilities of today's premium televisions, which can exceed 4,000 cd/m² (4,000 "nits"), up to twenty times the brightness of prior-generation televisions. In response to this, the new function makes use of each television's full range of brightness.

The technology

Where conventional HDR can sometimes appear to be too dark, HDR10+ ADVANCED empowers content creators and display manufacturers with a range of viewing improvements.

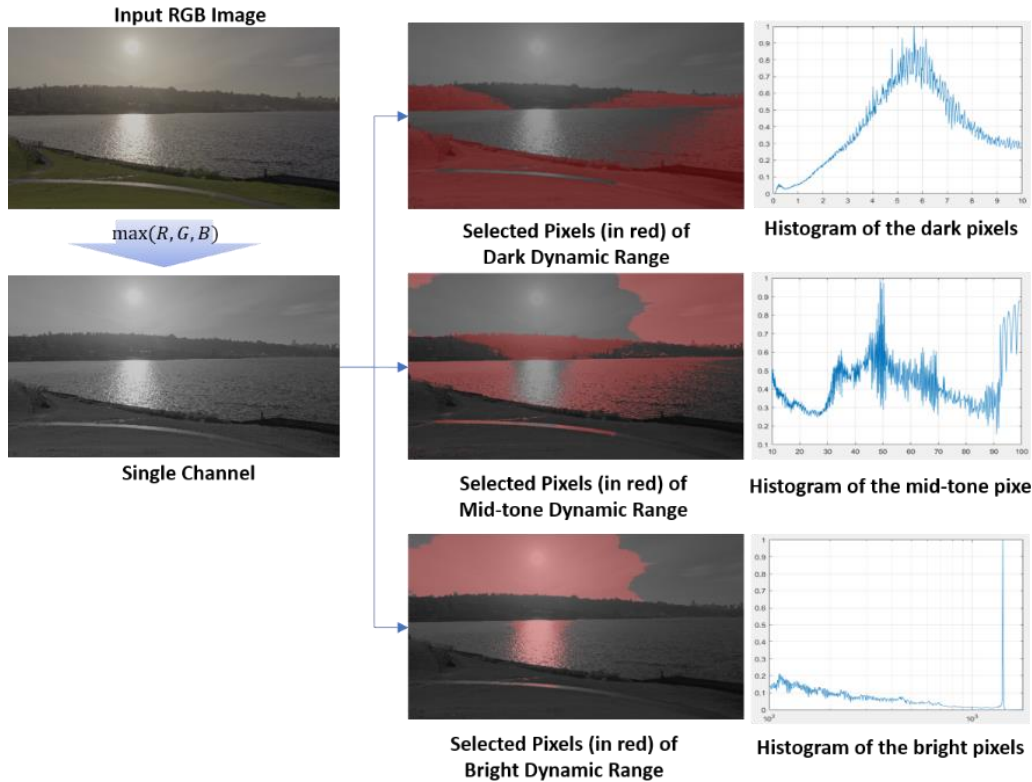
- **Tone Mapping Adjustments** enable brighter presentation to counteract darker tone mapping.
- **Dynamic Range Expansion** optimizes HDR content that is darker than the display's native luminance capabilities. This can provide a brighter picture tailored to the consumer's viewing environment.
- **Specific Viewing Preferences** deliver brighter and more vivid visuals for content such as sports where consumers expect heightened brightness.

Extended statistical metadata

Digital entertainment broadcasts, files, and streams include both audio/video content and "metadata" descriptors with technical details. Audio/video data is like the contents of a letter, while metadata is like the information on the letter's envelope. In all forms of HDR, the data for millions of pixels is accompanied by a small number of additional bits for metadata.

With HDR10+ ADVANCED, the production system analyzes the brightness level of each pixel in a frame and captures the metadata statistics more precisely. The system encodes the brightness at many more levels than HDR10+. These range from the 1st percentile (the very darkest areas) up to the 99.98th percentile (the very brightest). The display can then perform "guided tone mapping" that is exceptionally well-tailored to the

scene's content and the display's peak brightness. Moreover, this extended metadata enables television manufacturers to innovate, giving them the ability to develop more sophisticated tone mapping solutions.



During production, HDR10+ ADVANCED analyzes each frame and records the brightness level at many more levels than HDR10+, from 1% at the darkest to 99.98% at the brightest. Communicated as metadata, these statistics give today's brightest displays even more comprehensive guidance on how to render each scene.

The benefit

HDR10+ ADVANCED delivers more nuanced tone mapping on a scene-by-scene basis. It adjusts the tone mapping curve to take full advantage of the high-brightness capability of each individual display – including the latest premium televisions. The system also gives television manufacturers additional flexibility to provide increasingly sophisticated tone mapping. Enthusiasts who prefer higher brightness can enjoy all of this while also experiencing better rendering of subtle mid-tone grayscale that gives greater depth to onscreen shapes.

Intelligent Motion Smoothing

The need

Today's largest and brightest televisions have extraordinary and unprecedented capabilities. However, larger and brighter displays have an inherent tendency to make the "judder" of 24 frames-per-second (fps) filmed programs more apparent. While previous implementations of motion smoothing can suppress judder, this often imposed an unwanted "soap opera" look on certain movies and episodic TV programs. In HDR10+ ADVANCED, the motion smoothing levels appropriate for each type of content are pre-set by the creators, TV networks, and distribution platforms. This reduces objectionable judder while automatically providing motion smoothing consistent with their needs.

The technology

All moving pictures, whether movies, scripted television, sports, or games, depict motion as a sequence of still images at a particular frame rate. While movies have traditionally been captured and displayed at 24 fps, sports, concerts, and other entertainment programming usually have different requirements. For example, live television has been captured at 50 or 60 "interlaced" video fields per second. Additionally, the advent of High Definition introduced options for 50 or 60 "progressive" frames per second, while 4K enabled even higher frame rates.

Television frame rates and television brightness

The prospect of unwanted judder at 24 fps restricts how filmmakers can depict fast motion, limiting the speed of objects moving across the scene. To avoid judder, televisions can readily convert 24 fps content to 60 fps, 120 fps and even higher frame rates. However, too much motion smoothing can be readily visible even to untrained viewers.

In addition, the movie mastering process targets viewing in a darkened theater on a screen with 14 foot-Lamberts of illumination (equivalent to 48 nits). However, today's televisions far outstrip this 48-nit brightness standard. In fact, they can easily exceed 200 nits peak brightness, with high-end models surpassing 4,000 nits.

While sensitivity to judder varies from person to person, product reviewers frequently comment that 24 fps judder becomes more evident as display brightness increases. These motion artifacts, which had been subtle in movie theaters, can become distractions when viewing the same content at home.

To address this, instead of simple On/Off settings, the system supplies a metadata field for six discrete levels of motion smoothing from 0 (off) to 5 (maximum). To accommodate action during the course of a program, these levels can change from

scene to scene. This enables content creators and providers to identify the appropriate motion smoothing for each scene and communicate that setting directly to the television. For example, a broadcast network might select maximum smoothing for sports (level 5), while a movie studio might select moderate smoothing for a romantic comedy (level 1).

The benefit

HDR10+ ADVANCED Intelligent Motion Smoothing enables entertainment enthusiasts to have it all: the highest brightness, the largest displays, and motion smoothing that is automatically applied at the correct level for each type of content, whether movies, documentaries, sports, or games.

Genre-Based Optimization

The need

Television manufacturers know that “one size fits all” picture settings are not ideal for different entertainment genres. Movies and television dramas have different display requirements from news and sports. HDR10+ ADVANCED allows content creators to provide metadata for genre type, shot type, subject type and even the origination medium. This enables today’s advanced displays to apply specific image processing carefully tailored to the needs of specific content.

The technology

HDR10+ ADVANCED production and distribution supports particularly robust metadata to convey various content types. These can be applied and changed on a scene-by-scene or even frame-by-frame basis. Not only can the system identify the content categories listed below, but it also has room for future expansion.

- Genre Category
- Type of Sport
- Type of Object
- Object Brightness
- Type of Motion
- Lighting Environment
- Type of Setting
- Type of Shot
- Origination Medium

Scenario	Typical Metadata Tags
Soccer	Sports + Field Sports + Grass + Ball + Panning + Outdoor (Daylight)
Basketball	Sports + Court Sports + Clay/Brown background + Skin + Indoor (LED-lit) + Ball + Panning
Golf	Sports + Field Sports + Grass + Wide-angle View + Fixed/Static Camera + Ball
Racing Movie	Movie + Film Originated + Track & Racing (depending on the scene) + Fast Object Motion (depending on the scene)

The benefit

Instead of forcing the television’s video processor to “reverse engineer” the content type, encoders can send this information directly to the display. The television receives detailed, authoritative guidance for its internal processing, which helps to optimize the look of every scene. This enables HDR10+ ADVANCED to tailor the video metadata, so home viewers automatically receive a carefully curated presentation.

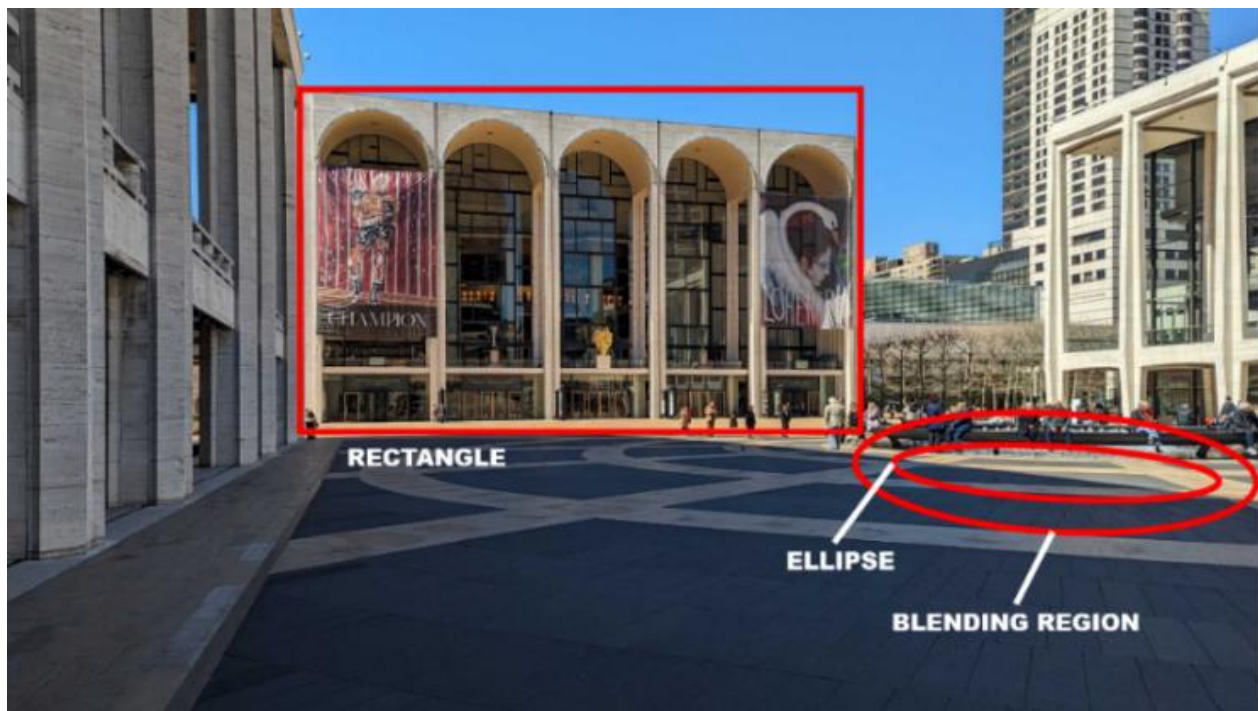
Local Tone Mapping

The need

When it comes to what cinematographers call dynamic range – the range of dark-to-light tones – not all areas of a scene are created equal. The brightest areas in a dark scene, or the darkest areas in a bright scene are unique. Local tone mapping is a powerful tool for compressing extremely high-dynamic-range content into the limited brightness range of display devices without losing details in bright highlights or dark shadows. Unlike global methods, local mapping adjusts contrast in specific areas of the scene based on surrounding pixels, preserving texture and preventing washed-out pictures. At their option, the creative team can also apply local tone mapping for other reasons, such as capturing a sunset, a special effect, or a person’s face. By doing so, content creators can define exactly how an image should appear on a given display.

The technology

HDR10+ provides dynamic metadata that identifies the brightest pixel in each individual scene or frame, for improved tone mapping. HDR10+ ADVANCED goes even further, enabling content creators to use Local Tone Mapping in up to three specific areas per frame. The size, shape and location of each are communicated to the television via metadata. Each area can be specified as a rectangle or ellipse and each ellipse can be accompanied by a surrounding “blending region” for a smoother transition to the tone mapping in the rest of the frame.



The benefit

Local Tone Mapping helps ensure that no details are lost in either highlights or shadows, providing a more natural visual experience. As a result, viewers get clearer, more beautifully rendered images.

Advanced Color Control

The need

Today's premium televisions achieve wider color "gamut," the range of reproducible colors. Display technologies such as Quantum Dots, OLED, and the various micro RGB backlights enable exceptionally pure color primaries, such as Blue uncompromised by traces of Red or Green. This establishes a greatly expanded range of reproducible colors, with visibly deeper, more intense hues. HDR10+ ADVANCED is designed to take full advantage of this.

The technology

Just as HDR10+ ADVANCED captures more metadata statistics on image brightness, Advanced Color Control captures detailed statistics on the color in each scene and transmits them as metadata. HDR10+ ADVANCED divides the color spectrum into twelve segments, and records maximum chroma value for each segment. Compatible televisions are then free to interpret the metadata in ways that best suit the specific display technology.

The benefit

HDR10+ ADVANCED enables today's most advanced displays to reproduce exceptionally accurate, lifelike, wide-gamut color.

Cloud Gaming

The need

For gamers, High Dynamic Range also confers an advantage, enabling them to see subtle onscreen objects that could make a dramatic difference in game play. And HDR10+ brought the benefits of sophisticated HDR to conventional gaming platforms. However, cloud gaming, which takes advantage of cloud processing to send an advanced video signal over the Internet, is rapidly growing in popularity. HDR10+ ADVANCED has been specifically designed to address this.

The technology

HDR10+ ADVANCED enables cloud game developers to utilize Source Side Tone Mapping, an enabling technology of HDR10+. Compatible displays will automatically enter into HDR10+ GAMING mode for more vivid reproduction. Moreover, there's no need to manually calibrate the display for HDR, and the display will automatically apply ambient light correction to optimize viewing.

The benefit

HDR10+ ADVANCED brings the look of cloud games up to the level of the most advanced conventional gaming platforms.

Conclusion

HDR10+ ADVANCED delivers the ultimate in picture quality with the broadest compatibility and a host of other benefits.

- *For content creators:* simple, cost effective implementation with powerful, new capabilities to make their work look its best.
- *For content providers:* state-of-the-art picture quality combined with access to the broadest range of compatible services and devices.
- *For device and display manufacturers:* royalty-free use, plus robust compatibility with products certified by HDR10+ Technologies, LLC.
- *For entertainment enthusiasts:* brighter, more engaging HDR images that they've been clamoring for.

In short, HDR10+ ADVANCED elevates the presentation of movies, episodic television, sports, and games, driving a dramatic new generation of entertainment.

Appendix: The HDR10+ Ecosystem

	HDR10	HDR10+	HDR10+ ADVANCED
Year introduced	2015	2017	2026
Established by the Consumer Electronics Association (now the Consumer Technology Association)	Yes	-	-
ITU standard Perceptual Quantization	Yes	Yes	Yes
Grayscale quantizing bits	10 bits	10 to 16 bits	10 to 16 bits
Maximum supported peak brightness	10,000 nits	10,000 nits	10,000 nits
Maximum resolution	Unlimited	Unlimited	Unlimited
Enhanced overall brightness to elicit the highest performance from the latest high-brightness displays	-	-	Yes & metadata driven
Motion Smoothing metadata from content creators	-	-	Yes
Content-specific metadata to optimize the most advanced display processing	-	-	Yes
HDR10+ ADAPTIVE to accommodate ambient light conditions	-	Yes	Yes
Tone Mapping metadata			
Static by program	Yes	Yes	Yes
Dynamic by scene and frame for “guided curve” tone mapping	-	Yes	Yes
Dynamic Local Tone Mapping for up to three areas of interest within a frame	-	-	Yes
Color Volume metadata			
Static by program	Yes	Yes	Yes
Dynamic by scene and frame	-	-	Yes
HDR10+ GAMING for source-side tone mapping			
For local game devices	-	Yes	Yes
For cloud games	-	-	Yes

NOTE: By design, HDR10, HDR10+, and HDR10+ ADVANCED content, services, and products are forward and backward compatible. All these televisions can accept HDR10+ ADVANCED content and display that content to the best of their capability.

For more information, visit hdr10plus.org



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