

Color explosion on the
screen – HDMI 2.0a
transmits HDR video



To create an even more intense home movie experience, various technical developments have taken place in recent years. High dynamic range (HDR) is the latest and probably the most spectacular innovation in terms of picture quality. A new module for the R&S®VTC/VTE/VTS video tester family is the appropriate T&M solution.

To improve the video quality, three main points are taken into consideration: resolution, frame rate and pixel quality. The introduction of the first UHD TV sets several years ago quadrupled the number of pixels in comparison to FullHD – especially to do justice to bigger and bigger displays. Newer UHD standards also define a higher frame rate (HFR), so that the picture remains clear even during fast movements. The pixel quality can be improved by an extension of the color space and a higher dynamic range (HDR) for luminance. These extensions aim to approximate the picture image to the perception of the human eye as closely as possible. For this to succeed, the dynamic range must be increased to achieve the necessary color saturation, which significantly impacts the color quality, even in very bright and very dark picture areas. This is where HDR comes into play.

High dynamic range

The dynamic range within a picture is defined as the difference in brightness between the darkest and brightest areas. The physical quantity to capture brightness is called luminance, which is measured in cd/m^2 or nits. Fig. 1 shows the luminance spectrum measurable on the earth and the part of it that the human eye masters. Up to now, television technologies with standard dynamic range (SDR) have a very limited minimum and maximum brightness. As a result, picture information is lost especially in dark and light areas. That is a thing of the past with HDR video.

Future HDR television displays, in contrast to the SDR devices with a value in the order of magnitude of 100 nits, will reach a maximum luminance of several thousand nits and will be able to show this value together with rich black. But how does it look on the content side?

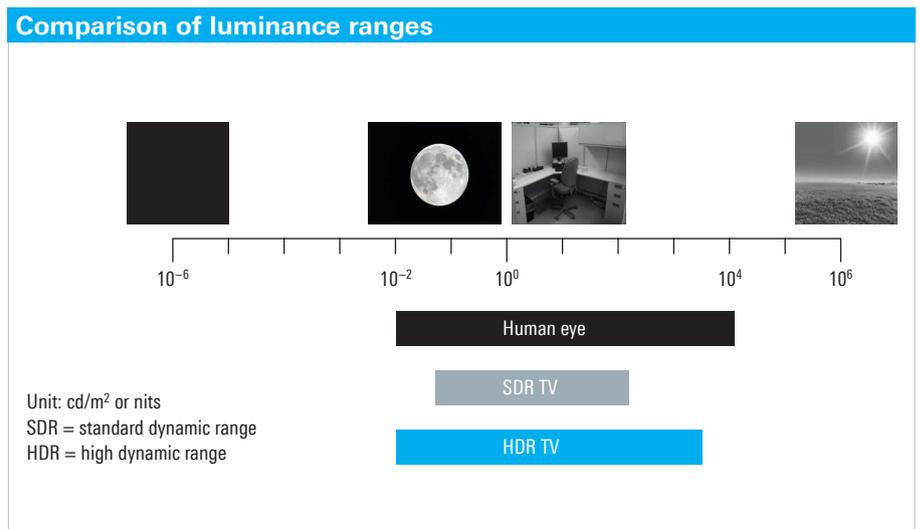


Fig. 1: Comparison of luminance range of the human eye with that of HDR and SDR TV sets.

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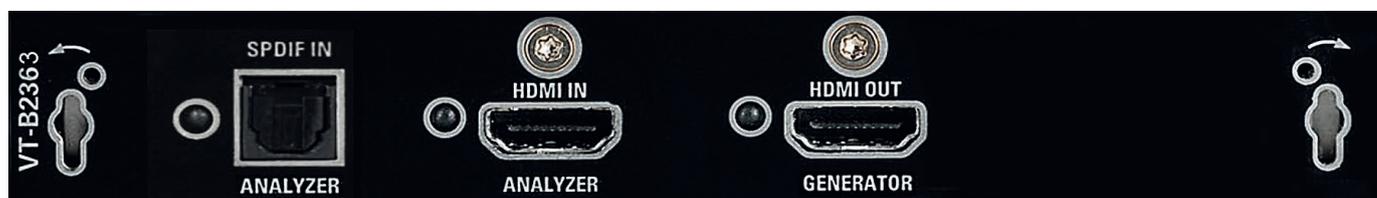


Fig. 2: The R&S®VT-B2363 HDMI RX/TX 600 MHz module offers generator and analyzer functions for HDMI 2.0a including support for HDCP 2.2.

HDR can bring added value to consumers' screens only if there is suitable program material available. Currently, this is still very limited, at least for the end user. The UHD Blu-ray Disc™ to be launched shortly and large web TV providers will support the feature. HDR streams are already available through Amazon and Netflix. Classic broadcast sites will also not be able to avoid HDR in the long run. Test transmissions have already taken place (e.g. through Sky in the summer of 2015, when parts of a German soccer league match were aired in UHD/HDR via satellite using the R&S®AVHE100 headend solution). Standardization bodies have the topic on their agenda, e.g. for ATSC 3.0. The film industry has also long been on the way to HDR. For a long time now, new movies and series have been produced in high video color depth, keeping future playback capabilities in mind.

Since HDR does not depend on the resolution, this characteristic would not necessarily be limited to UHD content, but could also enhance HD videos. Whether it comes into practice is still uncertain, but conceivable. In any case, in the studio, or rather in post production, there is already footage that allows HDR playouts. For example, with 10 bits per color channel, as has been specified for the UHD Blu-ray Disc™. In the mastering process, a reference monitor is used to create the artistic interpretation, i.e. the final color scheme of the video material, for the output channels, whether it is broadcast, Blu-ray™ or Internet / video-on-demand. In order to obtain the desired picture quality as pure as possible on each HDR dis-

play, metadata is transmitted along with the picture contents. This metadata includes characteristics of the reference monitor (EOTF, color space, primary colors, etc.), which can be interpreted and implemented by HDR-capable receivers. The transfer of HDR content between consumer electronics is performed via HDMI connections in line with the new 2.0a specification.

HDMI extensions related to HDR

Above all, HDMI 2.0a brings support for HDR based on the CTA-861.3 HDR Static Metadata Extension standard. The standard revision includes a signaling function for HDMI sinks and a transmission system for HDR metadata (for sources).

Based on a newly introduced static HDR metadata block as part of the enhanced extended display identification data (E-EDID), HDMI sinks now signal their support for HDR. Non-HDR-capable sources ignore this block. With positive signaling, the source sends HDR content, including the necessary metadata. The metadata is transmitted in the data island periods (where the transmission of audio data and additional data occurs with HDMI) as a Dynamic Range and Mastering InfoFrame. An InfoFrame is sent every two pictures.

Metadata is static, which means that only a fixed metadata set is used for a specific content (broadcast, film). Dynamic metadata, i.e. data that changes depending on the scenario, is currently not part of the HDMI specification.

R&S®VTx video tester family fit for HDMI 2.0a

Fig. 2 shows the new R&S®VT-B2363 HDMI RX/TX 600 MHz module for the R&S®VTS compact video tester, R&S®VTE video tester and R&S®VTC video test center. This module allows users to conduct interoperability test for latest-generation HDMI sinks and sources at different stages in the value chain process.

In contrast to the previous R&S®VT-B360 / -2360 / -2361 modules, it supports HDMI 2.0a with data rates up to 18 Gbit/s including related innovations such as scrambling. It is backward compatible with previous HDMI versions and fully replaces the predecessors. In addition to HDCP 1.4, it also supports HDCP 2.2 and enables not only encoding and decoding, but also a status display of the HDCP connection for debugging purposes.

The analyzer and generator functions are activated independently of each other via software keycode. In addition to realtime analyzing and generating, the respective compliance test mode can be selected optionally for sources and sinks. The extent of supported compliance testing is referred to in the data sheet. Tests certified by the HDMI Forum are available as MOI documents from the HDMI LLC or HDMI Forum servers.

As for HDR, the generator function offers free editing of the Dynamic Range and Mastering InfoFrame (Fig. 3) and allows the display of the controlled sink's E-EDID including the HDR

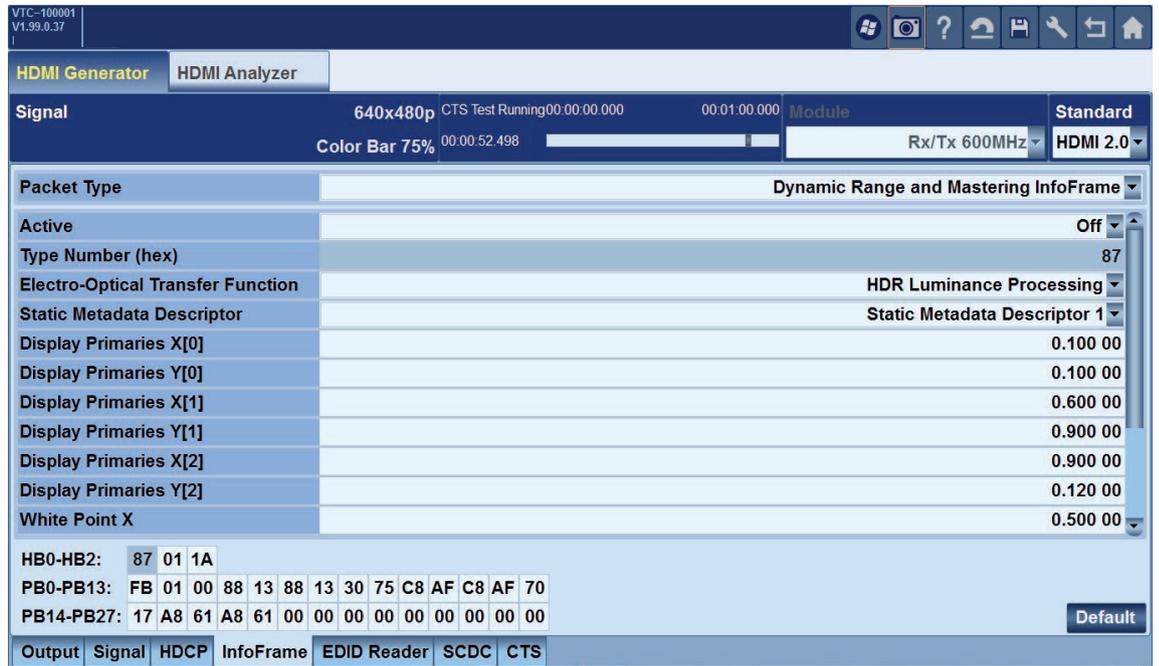


Fig. 3: The generator application makes it possible to configure the Dynamic Range and Mastering InfoFrame.

metadata block. Conversely, a suitable E-EDID is provided at the analyzer end and the Dynamic Range and Mastering InfoFrame is displayed. A specific HDR test in line with the compliance test specification (CTS) is available for both the generator and the analyzer.

The module can be used as usual together with the other analysis functions of the R&S®VTx product family to view the received A/V signal more in detail.

Summary

HDR enables an even more realistic TV experience. To ensure HDR-capable devices work together within the home, they must support the HDMI 2.0a standard. With its R&S®VTx video tester family, Rohde&Schwarz now offers a test option that enables users to test the new HDMI features in development, quality assurance and production.

Harald Gsödl

Additional information

Webcast: 4K, HDR and HDMI 2.0a

More information about the contents of this article are available in the form of a webcast. The multimedia presentation gives a brief insight into the technologies mentioned and shows T&M solutions for HDMI 2.0a for consumer electronics.



<https://www.rohde-schwarz.com/news214/01>

Application note: UHD with high dynamic range (HDR)

The document focuses on the use of HDR in broadcasting and its implementation within the transmission chain with the R&S®AVHE100 headend solution for encoding and multiplexing.

<https://www.rohde-schwarz.com/news214/02>