

HDMI 2.0: What You Need to Know



The recent IFA Trade Show saw the introduction of HDMI 2.0, the newest version of the HDMI standard. Version 2.0 adds much better support for 3840×2160-resolution Ultra HD (UHD and also called 4K) sources going forward. I posed a number of in-depth technical questions concerning 2.0 to the HDMI group, but it refused to answer any of them. (The group so far has not released many details about HDMI 2.0 to the press.) Even so, I have gone ahead and made an effort to answer those questions on my own based on industry sources, published works, and some number-crunching.

HDMI 2.0 improvements

The most important change that HDMI 2.0 brings to the table is an increase in bandwidth from HDMI 1.4's 10.2 Gigabits per second (Gb/sec) rate to 18 Gb/sec. Higher bandwidth means higher resolutions and a higher frame rate capability. It also adds other features for future compatibility, including an increase to 32 audio channels over HDMI 1.4's eight channels, higher audio sample rates and 21:9 aspect ratio support. However, all of these features are less important than the impact on UHD-resolution content.

Bigger bandwidth

How does HDMI 2.0's extra bandwidth improve UHD support? Of that 18 Gb/sec bandwidth, only 14.4 Gb/sec is usable. The rest is overhead used for error correction and to make the signal more robust over long distances. (This 20% overhead exists in all HDMI versions.)

Sending a UHD image over HDMI 2.0 at 60 frames-per-second (fps) is easy. Using the same color depth as HDTV, we only need 6.05 Gb/sec of bandwidth to support that resolution and frame rate with audio. With its 14.4 Gb/sec limit, HDMI 2.0 can handle that quite easily. Concerts, sports, 3D films—any content shot with a 60 fps rate can now be sent over HDMI at full UHD resolution.

HDMI 2.0 and Rec. 2020

Rec. 2020 is a list of technical "recommendations" for UHD put forth by the International Telecommunications Union, an agency of the United Nations. As for broadcast or cable UHD TV, no standards exist yet. One key advantage that Rec. 2020 has over the current HDTV standard is that it allows for increased image bit-depths, which produces pictures with smoother gradients and less banding artifacts. Current HD video is 24 bits per-pixel, while Rec. 2020 allows for 30 bits or even 36 bits.

Does HDMI 2.0 fully support these higher bit-depths? From what our industry sources have told us, the answer is no. While our math shows that HDMI 2.0 has the bandwidth to support them, we've been told that they are not officially covered by the HDMI 2.0 specification. It's possible that some displays may work at the higher bit-depths, but they aren't required to.

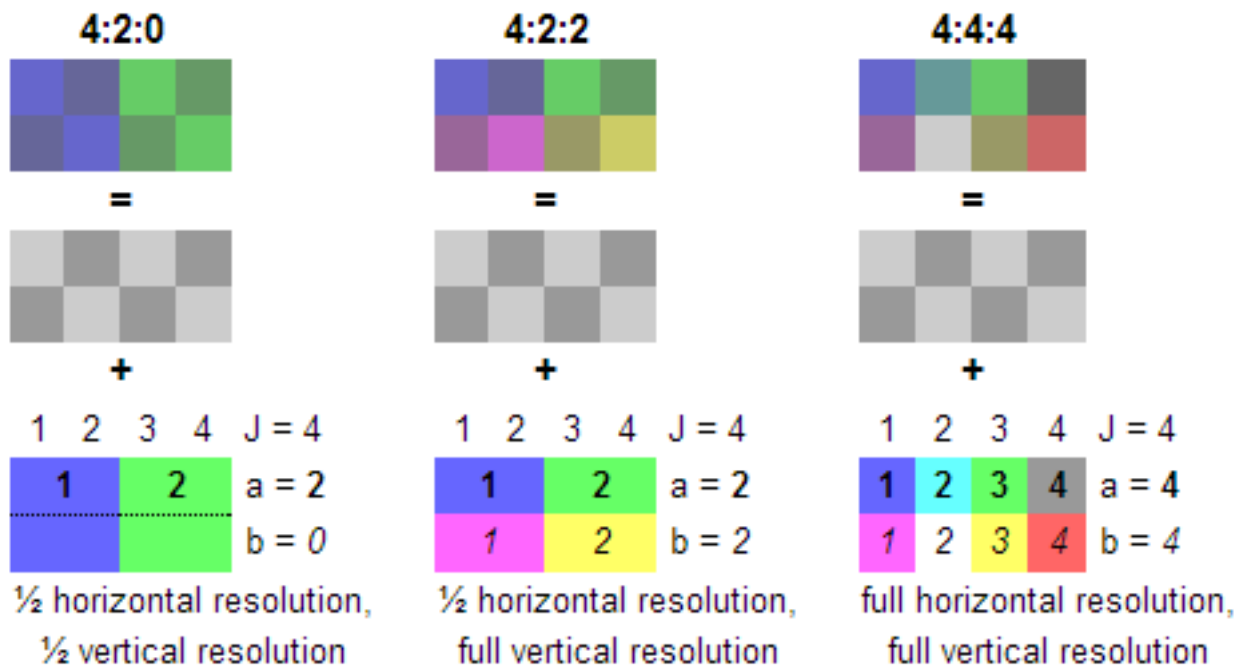
Sending more bits means more bandwidth. For example, sending a UHD image at 60 fps with full 36-bit color depth, 32 channels of audio and no compression requires 17.99 Gb/sec of bandwidth. This is more than HDMI 2.0 can handle. The key to making it fit is a color compression technique called chroma subsampling.

Color crunching

Here's how chroma subsampling works. The human eye is more sensitive to black and white detail than color detail. Chroma subsampling compression takes advantage of this fact by sending a full-resolution black and white (luma) information and only partial-resolution color (chroma) information. The result is a reduction of image data with no accompanying visual degradation.

There are three main types of chroma subsampling for video content: 4:4:4; 4:2:2; and 4:2:0. With 4:4:4 there is no subsampling. With 4:2:2, half of the color detail is thrown away. And with 4:2:0, 75% of color information is discarded. Blu-ray, HDTV, and DVD all use 4:2:0 subsampling. We don't notice the loss of color detail right now with those formats, and we aren't likely to notice it after the move to UHD.

Below is a visual diagram of chroma subsampling from [Wikipedia](https://en.wikipedia.org/wiki/Chroma_subsampling) that helps to explain how it works.



One unheralded change that HDMI 2.0 brings is an ability to send 4:2:0 content natively. Previous HDMI versions only used 4:2:2 or 4:4:4 subsampling, even though the Blu-ray format uses 4:2:0, so content first needed to be converted to 4:2:2 or 4:4:4. With UltraHD pushing the bandwidth limits of HDMI, Version 2.0's ability to send bandwidth-saving native 4:2:0 content, and to do so without degrading image quality, is a benefit.

By applying 4:2:2 subsampling to our prior high bit-depth content example—a UHD image at 60 fps with full 36-bit color depth and 32 audio channels—we now only need 12.02 Gb/sec of bandwidth. Using 4:2:0 drops that requirement to 9.03 Gb/sec. The signal can easily fit into HDMI 2.0 with bandwidth to spare.

Use of 4:2:0 subsampling also means that HDMI 2.0 offers enough bandwidth for an 8K-resolution (7680×4320) UHD image at 24 fps with 36-bit color and 32 audio channels. Hollywood films generally aren't shot at this resolution, and displays that can handle it don't yet exist, but the capability is there.

Here's a table showing possible UHD resolutions, bit-depths, chroma subsamplings and refresh rates. All listings include 32 channels of 24-bit, 96 kHz lossless audio except for Blu-ray, which is limited to 8 channels.

Resolution	Bit Depth	Chroma Subsampling	Refresh Rate	Bit Rate (Gb/sec)
1920x1080 (Blu-ray)	24-bit	4:2:0	24p	0.62
3840x2160	24-bit	4:4:4	24p	4.85
3840x2160	36-bit	4:4:4	24p	7.24
3840x2160	36-bit	4:2:2	60p	12.02
7680x4320	36-bit	4:2:0	24p	14.41

There are a couple of other Rec. 2020 features such as 120 fps content that HDMI 2.0 does not have the bandwidth for. Such content, and displays designed to handle it, might be a few years off, but it looks as if HDMI will need another revision at some point to accommodate 120 fps.

HDMI 2.0 and Current Hardware

Now that HDMI has fully caught up with UHD, are current UHD displays up to the task? Yes, but with an upgrade. There are two likely paths:

- 1) A firmware update
- 2) A hardware update

Sony has promised that the UHD displays it introduced in 55- and 65-inch sizes this year will receive a firmware update for HDMI 2.0. How is this possible? Since the HDMI 2.0 signal is electrically identical to HDMI 1.4, the change will be in how fast the HDMI chip operates. We speculate that Sony and others may have planned for HDMI 2.0 and used a faster chip in their UHD displays to prepare for it. This means the upgrade will be a simple firmware update that's likely downloaded from the Internet.

For devices like [Sony's VPL-VW1000ES](#) projector and [84-Inch](#) UHD TV that lack faster HDMI chips, a new 2.0 HDMI input board will be required. Whether this hardware update will come free is still unknown.

Samsung uses an outboard input box it calls OneConnect. It contains HDMI 1.4 inputs as well as others and the electronics for its Smart functions comes with 2013 UHD TVs. This external box sends all source signals to its UHD TVs via a single cable and unique connector. Samsung tells HD Guru its next generation Evolution Kit for its current UHD TVs will be an updated OneConnect box and it will include HDMI 2.0 inputs.

Some manufacturers might not provide an HDMI 2.0 upgrade path at all. Entry-level UHD TVs from companies like [Seiki](#) and [TCL](#) appear to be locked into HDMI 1.4 and have given no indication to date of an HDMI 2.0 upgrade path. Other UHD TV makers, including [Toshiba](#), [Sharp](#), and [LG](#), have not yet announced an upgrade path for their sets, if one even exists. Given the high prices that consumers have paid for first-generation UHD TVs, I imagine that these name brand 4K TV makers may try to offer some way to keep those sets up-to-date with HDMI 2.0.

HDMI 2.0 cables: No such thing

Finally, you don't need to upgrade your HDMI cables to work with HDMI 2.0 gear. In fact, there is no such thing as an HDMI 2.0 cable—any short length “High-Speed” cable should work just fine. An [AmazonBasics High-Speed HDMI Cable](#) (3 meters) sells for \$7.49 and we expect it to perform properly based on our use with HDTVs. Long Hi-Speed cables don't always perform properly with HDTV signals (so we expect problems with 4K signals too), check out our tests [here](#). When HDMI 2.0 displays and sources become available, HD Guru plans to perform a cable test to verify this claim.

Future Disc-ussion

Many of us have taken a wait-and-see attitude toward UHD displays, and HDMI 2.0 is part of the reason for it. But now that a transport mechanism exists to send full-resolution content with a higher refresh rate to an UHD display, we can expect a related update to the Blu-ray disc format.

If and when the HDMI organization releases more information on HDMI 2.0, I will update this article.

-Chris Heinonen

<http://hdguru.com/hdmi-2-0-what-you-need-to-know/ - more-11432>