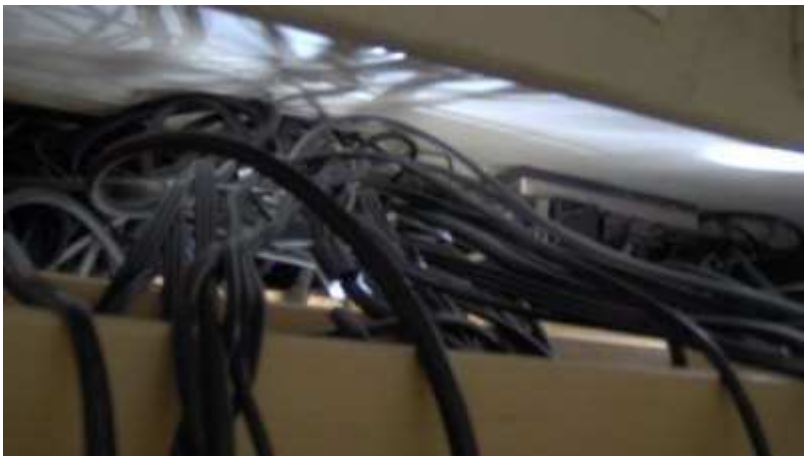
Commentary by Joshua Zyber

Once upon a time, connecting our home video equipment was pretty straightforward. We had a TV, we had a VCR, and we had a simple RF coaxial cable (the type with the pointy spike on the end like cable TV comes in on). You screwed one end of the cable to the VCR and the other to the TV, and voila! That was all there was to it. The "home theater" was ready to go. OK, sure, the quality wasn't very good, but this was a long time ago and we really didn't know any better. So long as we got picture and sound, who could complain?

Eventually, savvy consumers learned the benefit of separating the video from the audio, and so we went from a single RF coaxial to three RCA-type cables: yellow for the video, and red & white for the audio. These delivered a marginally cleaner picture and stereo sound. If you were really on the cutting edge, you might have owned an S-VHS deck or a laserdisc player with a super-fancy (for the time) S-video cable. S-video took the concept of separation one step further by splitting (though still in one cable) the video signal into individual brightness and color portions which would be recombined inside the television. Laserdisc also gave us the first digital audio connections, in the form of the now-familiar digital coaxial or Toslink optical cables.

DVD brought us to the end of the line for home video analog signal transmission with Component Video, which splits the picture into three distinct streams: one for luma (the colorless base of the image, carried on the green or 'Y' cable) and two for color (the blue 'Pb' and red 'Pr'). By dividing the signal this way, Component Video provides a greater amount of bandwidth to carry more information in each section, allowing for a sharper picture with purer colors, and helps to prevent unwanted noise from intruding into the final image we see on screen. The obvious downside to all this signal separation, of course, is the clutter of cables most home theater owners find behind their TVs.

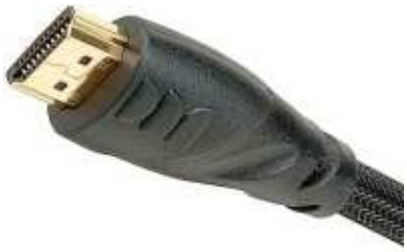


A scary view from behind my own equipment rack.

As we move further into the digital age, although Component Video is still supported even in the High Definition realm, there's been a push to move us all to purely-digital connection types. DVD started this with the availability of DVI and then HDMI video cables, the latter of which is now standard on all Blu-ray and HD DVD players. There's even been talk of eventually phasing out support for Component Video (which can't carry the HDCP security encryption that the studios want to enforce) in favor of strictly HDMI (which can), although fortunately that's still a ways off.

Ironically, the shift to HDMI has brought us full-circle back to cramming all of our picture and sound together onto a single cable. However, advances in digital compression and transmission permit much more information, including both High Definition video and high-resolution audio, into such a small space without loss of quality. This is, we've been told, a best case scenario for everyone. The end viewer gets the highest standard in signal quality with the least amount of cable clutter, and the content producers get the copy protection they want. Everybody wins, right? Oh, if only it were that easy.

The problem is that HDMI is an evolving standard that was essentially rushed to market before all of its critical features could be finalized.



As a result, in the short few years since the first HDMI products were released, we've already been through several revisions of the protocol. We started with HDMI 1.0, which laid out the basic specifications for how picture and sound would be transmitted. Later, HDMI 1.1 added support for the DVD-Audio music format, an oversight someone missed the first time around. This was then followed by HDMI 1.2 and 1.2a, enhancing some capabilities useful for specific PC applications. Realistically, for the purposes of High Definition movie watching on the HD DVD or Blu-ray formats, any of these first four HDMI types is as good as any other, and up to this point consumers have not had to worry too much about buying equipment with the "right" HDMI format. They can all transmit HD video just fine, and all carry high-resolution audio once it's been decoded to multi-channel PCM by the source player (more on this below).

Unfortunately, any sense of security or stability we may have felt thus far has undergone a major shakeup with the arrival of HDMI 1.3 (and its follow-ups 1.3a and soon-to-be 1.3b), the first significant revisions to the cable format's spec. HDMI 1.3 adds support for several new features that *may* theoretically prove useful or enhance the movie watching experience. Because of that, electronics and cable manufacturers have inundated the press with a wave of publicity hype talking up the benefits of the product, insisting that any new piece of A/V equipment *must have* HDMI 1.3 to be current. Anything less, we're told, is already obsolete. This has prompted many consumers to hold off their purchase of Blu-ray or HD DVD equipment until they can be sure that everything will be fully HDMI 1.3 compliant. And many who've already purchased existing products are left wondering whether they'll need to upgrade so soon (at present, only a small handful of players on either format are 1.3-capable). Just about everyone is confused or downright misinformed about what HDMI 1.3 really does or what it offers to HD DVD and Blu-ray viewers.

Before we go any further, I want to emphasize something I said above. HDMI 1.3 adds **support for** several new features. HDMI 1.3 itself does not automatically bring those features. In fact, it doesn't bring any features at all. HDMI is just a connection type linking one piece of equipment to another. An HDMI cable is simply a conduit that allows the transmission of data from a source to a receptor, and nothing more. If it helps, visualize it similar to an oil pipeline leading from a well to a refinery. The pipe itself doesn't create the oil or refine it into gas; it just carries it from one end to the other. HDMI 1.3, therefore, is a bigger pipe than previous HDMI versions. In order to benefit from the new features that HDMI 1.3 supports, those features must be active in the source and active in the receiving piece of equipment, both of which must have HDMI 1.3 transmission circuitry (as must any intermediary device in between, such as switchers, splitters, or video processors).

And right there, my friends, is the rub.

So let's take a look at these new features that HDMI 1.3 supports, at least the ones that are potentially relevant to HD DVD or Blu-ray consumers. The following bullet points that I'll break out and address individually have been quoted directly from the official HDMI web site:

> - **Higher speed:** Although all previous versions of HDMI have had more than enough bandwidth to support all current HDTV formats, HDMI 1.3 increases its single-link bandwidth to 340 MHz (10.2 Gbps) to support the demands of future HD display devices, such as higher resolutions, Deep Color and high frame rates. In addition, built into the HDMI 1.3 specification is the technical foundation that will let future versions of HDMI reach significantly higher speeds.

Certainly, a higher speed of data transmission may prove useful for computer applications, but has little benefit for Blu-ray or HD DVD. All previous versions of HDMI have more than sufficient bandwidth to carry 1080p High Definition video along with uncompressed multi-channel PCM audio without issue. For home theater purposes, there's no gain here.

> - **Deep Color:** HDMI 1.3 supports 10-bit, 12-bit and 16-bit (RGB or YCbCr) color depths, up from the 8-bit depths in previous versions of the HDMI specification, for stunning rendering of over one billion colors in unprecedented detail.
> - **Broader color space:** HDMI 1.3 adds support for "x.v.Color™" (which is the consumer name describing the IEC 61966-2-4 xvYCC color standard), which removes current color space limitations and enables the display of any color viewable by the human eye.

Now here's something that sure sounds impressive. Who wouldn't want a greater color range in their HD video, especially when it's marketed with a sexy name like "Deep Color" that boasts of delivering billions of new color shades "beyond the capability of the human eye to perceive them"? Wow, that must be great! Of course, it begs the question of what use many of those colors are if it's impossible for human beings to ever see them, but hey let's not get bogged down in semantics.

Yes, as terrific of a High Definition picture as we're getting now, the occasional color banding artifact will still intrude into a Blu-ray or HD DVD picture. This is something that Deep Color or the less flashily-named xvYCC standards might improve by smoothing the gradients between color shades with a greater range of intermediary colors. That's a worthy upgrade, but here's the problem: Neither HD DVD nor Blu-ray support xvYCC or Deep Color, and never will. Those features are beyond the spec of either format.

Really muddying the waters on this issue is the fact that both the HD DVD and Blu-ray camps have been advertising Deep Color in their higher-end hardware, such as the recent press release from Toshiba declaring that the upcoming "top-of-the-line HD-A35 also adds support for Deep Color via HDMI, allowing compatible display devices to deliver outstanding video quality - displaying millions of possible colors to billions of possible colors."

Doesn't that announcement flat-out state that the HD-A35 player will offer Deep Color? It sure seems to, but the wording is misleading. While the player itself may "support" Deep Color, in order for Deep Color to work it must be enabled in the player (possible), enabled in the television (possible), **and** the disc must be authored to include all of those billions of extra colors. That last one's the problem. The video encoded on HD DVD discs (and Blu-rays too) is limited to 8-bit color. So are the studio archive masters, for that matter. If some studio were to start authoring new discs with 16-bit Deep Color, those discs would be completely incompatible with the majority of existing

players, rendering them unplayable. Such a disc would have to be labeled and marketed as an all-new Deep Color HD DVD or Deep Color Blu-ray format, and distinguished from the regular HD DVD or Blu-ray formats, discs for which would have to be released separately. Imagine the marketing nightmare! And for what gain? At its best, you'd get a barely-perceptible improvement in color fidelity. Yes, from a videophile perspective, even small improvements are welcome. I'd personally love to see it implemented. Ideally, both formats should have been designed with Deep Color from the start, but that isn't the way it worked out, and it's too late to change either format to incorporate it now. To do so would make no business sense whatsoever. Sorry, that's just not going to happen.

Long story short, even if you have a brand new HDTV that can actually render all of those billions of new colors (most can't), and even if you have HDMI 1.3 connections on both ends and every piece of equipment in-between, you'll simply never get those colors from a Blu-ray or HD DVD source. Maybe in some other type of product (like an HD camcorder or video game) or some future movie format, but not from HD DVD or Blu-ray. If you're in the market to buy a new HDTV, it might be a good idea to future-proof it by ensuring that it supports HDMI 1.3 and Deep Color, but in the here-and-now they aren't necessary.

- **Lip Sync:** Because consumer electronics devices are using increasingly complex digital signal processing to enhance the clarity and detail of the content, synchronization of video and audio in user devices has become a greater challenge and could potentially require complex end-user adjustments. HDMI 1.3 incorporates automatic audio synching capabilities that allows devices to perform this synchronization automatically with total accuracy.

Better lip sync correction is a feature I would very much like to see, because this is a problem that I still run into from time to time. Once again, however, the function must be present in both the source player and in the receptor (either the television or an A/V receiver). To my knowledge, it hasn't been enabled in any consumer products thus far. Will it be useful in the future? I hope so. Is it worth holding off on the purchase of a Blu-ray or HD DVD player for a year or more before we do see this feature? I would guess not, especially since you'd be forced to buy a new TV or audio receiver at that time to make use of it, and I'd imagine that's not something a lot of people will be eager to do.

- **New HD lossless audio formats:** In addition to HDMI's current ability to support high-bandwidth uncompressed digital audio and all currently-available compressed formats (such as Dolby Digital and DTS), HDMI 1.3 adds additional support for new lossless compressed digital audio formats Dolby TrueHD and DTS-HD Master Audio.

Perhaps the single most confusing aspect of HDMI 1.3 is its support for high-resolution audio formats such as Dolby Digital Plus, Dolby TrueHD, and DTS-HD, all of which require more bandwidth (and copy protection) than can be transmitted over the old digital coaxial or Toslink optical audio connections that were sufficient for Standard-Def DVD. If using one of those cable types, the HD DVD or Blu-ray player will downconvert the DD+, TrueHD, or DTS-HD signal to standard Dolby Digital or DTS quality. In order to benefit from the full high-resolution quality of these formats, the player must be connected by either HDMI or multi-channel analog. For the purposes of this article, we're obviously going to focus on the HDMI transmission method.

As I sat down to write out a detailed explanation of how the audio formats are handled on both Blu-ray and HD DVD, I realized that I would probably never be able to summarize the situation

nearly as concisely or eloquently as this description from AVSForum member Sanjay Durani, which is reprinted here with permission:

> *First let's clarify some nomenclature. Dolby and DTS have both introduced new audio codecs. The lossy ones are DD+ (Dolby Digital Plus) and DTS-HD (High Definition). The lossless codecs are Dolby TrueHD and DTS-HD MA (Master Audio).*
>
> *Think of Dolby TrueHD and DTS-HD MA as zipping a computer file to save space. None of the data is discarded, just packed more efficiently to take up less storage space. When you unzip the file, 100% of the data is still there, and you get a bit-for-bit copy of the original.*
>
> *If you had a zipped document that you wanted to send me on disc, you would have two choices. You could unzip it on your computer before putting it on the disc. Or you could send it to me as a zipped file (would take up less space on the disc) and I could unzip it on my computer. Either way, I end up with the exact same document, down to the last letter.*
>
> *Likewise, decoding (unpacking) a soundtrack in the player or in the receiver will yield the exact same results. It's not like high end receivers have a special secret version of TrueHD decoding reserved for them that cheap players aren't allowed to have. It's just format decoding. If certain audio data is flagged for the left front channel, then decoding in the worlds most expensive receiver won't place that data somehow "more" into the left front channel than decoding in the world's cheapest player.*
>
> *Going back to the zipped document analogy. If you wanted to change anything in the document, from simple correction of spelling mistakes to complex re-formatting for a better look, you would first need to unzip that document. You wouldn't be able to manipulate it while it was still zipped.*
>
> *Similarly, everything a receiver does to the soundtrack, up to and including D/A conversion, requires the soundtrack to be in uncompressed PCM form. In fact, when you send your receiver a DD or DTS bitstream, the first thing it does is decompress the soundtrack to linear PCM. Only then can it apply things like bass*

management, time alignment, etc.

Soundtracks on HD DVD (and eventually on Blu-ray, when it goes interactive) operate very differently than they do on DVD. With current DVDs, you need entirely separate soundtracks for things like foreign languages and filmmaker's commentary. This is actually a pretty wasteful approach.

With HD DVD, soundtracks can be authored in the 'Advanced' mode, which allows multiple content streams to be live-mixed (mixed in real time). You don't need another soundtrack for foreign languages. Just swap out the English centre channel stream with one of the foreign centre channel streams. You don't need another soundtrack for commentary. Just reduce the level of the main soundtrack and mix in the commentary stream. Same with button sounds and other interactive features, like picture-in-picture.

Just like editing the document requires unzipping the file first, doing any of this live-mixing to the soundtrack requires decoding it to linear PCM first. This is why it has to be done in the player. They're not going to transmit every option to your receiver, just one soundtrack. You choose what you want to hear, it is mixed in the player (i.e. the soundtrack you want to hear is literally built in real time inside the player) and transmitted as a final mix to your receiver.

Current HDMI allows 8 channels of 96/24 PCM to be transmitted (more than enough resolution for any soundtrack), but not the new codecs in their native form. When HDMI 1.3 arrives, it will allow the new codecs mentioned above to be transmitted in their native bitstream, but only if they were authored in 'Basic' mode (no interactivity). If the soundtrack was authored in Advanced mode, then it cannot be transmitted in undecoded form; decoding in the player is mandatory because of live mixing.

So far, all HD DVD soundtracks have been authored in Advanced mode. Which means nothing will change when new receivers arrive on the market. Despite having HDMI 1.3 transmission and decoders built into the receiver, decoding will still have to take place in the player.

Currently, Blu-ray discs are authored in Basic mode, since they haven't gotten interactivity yet. As soon as BD Java is up and working, they'll all be authored in Advanced mode too. At that point, what are the decoders in the receivers going to do? Decode the relatively few BD titles that were released before interactivity? Most of those titles will be re-issued anyway.

Personally, I'm glad that decoding is shifting to the player. I wish it had always been that way. Since receivers need the data in PCM form anyway, that's what every player should be outputting (irrespective of what format is used to store the data on the disc). As mentioned before, when new audio codecs and formats arrive, you'll have to buy a new player. But as long as the players keep outputting the audio in PCM form, current receivers will always remain compatible with anything that shows up in the future. How elegant is that!

Once again, marketing material from the hardware manufacturers is misleading. Onkyo outright claims that their upcoming DV-HD805 HD DVD player offers "streaming of the new lossless surround sound formats, Dolby TrueHD and DTS-HD Master Audio, as well as two 'lossy' formats, Dolby Digital Plus and DTS®-HD High Resolution Audio." Sure, the player will be able to transmit the bitstreams of those formats, but only if the disc is authored in Basic mode, which no HD DVDs are, a fact they conveniently neglect to mention.

So, after all that, what does HDMI 1.3 truly gain the HD DVD or Blu-ray consumer that couldn't be gotten from any of the previous existing versions of HDMI? Frankly, not a lot. 1.3 offers the ability to transmit extended color ranges that don't even exist in the source, and makes available the delivery of raw audio bitstreams that are better off decoded inside the player first anyway, after which they can be (and currently are with great success) transmitted as uncompressed PCM by any version of HDMI. Honestly, the only real innovation that HDMI 1.3 allows for is the enhanced lip sync correction feature, and there's no indication of when or how that might be implemented.

If you were buying a new HDTV or A/V receiver right now and wanted to feel thoroughly future-proofed, it certainly couldn't hurt to make sure that they're HDMI 1.3 compliant, but there's no reason to feel nervous or cheated if they aren't. At the present time, for all practical applications, any version of HDMI is perfectly capable of transmitting the best that Blu-ray or HD DVD offers just as well as any other. Unfortunately, HDMI 1.3 is more hype than substance.

Does this clear up the confusion about HDMI 1.3? Please join us in the forums to discuss the topic further.

Got a question you'd like to see Joshua Zyber answer in a future column? Send it to us via our Feedback form.

Earlier on High-Def Digest:

High-Def FAQ: Why Don't the Black Bars Go Away? (Jul 13, 2007)