

Title: HDMI cabling for 3D TV
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Author: David Meyer, Founder & Product Development Director
CEDIA Certified Instructor (SME) for HDMI, Licensed HDMI Adopter

Introduction

3D TV is the big new thing of 2010, exploding onto cinema screens virtually out of nowhere. Last November we weren't talking about 3D at all, in December we were 'wowed' with Avatar, and suddenly in January most of the major CE brand vendors showed their upcoming 3D TV offerings at CES, Las Vegas! *Talk about breakneck speed!* The media is all over this new technology, but little is being said about the intricacies of what's needed to make it all work at home... *and work well at that!*

My aim here is to provide you with the most important information pertaining to 3D TV, to enable you to better predict and prepare for 3D installations. We'll take a look at the HDMI 1.4 specification and suggest what you need to know about cabling for 3D to secure the most reliable results. But before I get stuck into such details, it helps to understand *why* and how 3D has come about..

3D Evolution

Short sighted cynics suggest that the success of 3D will be limited by the lack of content available, but in all fairness we have to start somewhere. All it takes is the vision and leadership of a few, and hey, if there's a buck in it, they will do it. James Cameron is one such leader. I won't go into the technicalities of *how* he created the 3D experience for Avatar, suffice to say that its unprecedented success was the catalyst for the timing of the collective CE brands' decision to release 3D products NOW.

I expect that for the first year or so 3D will remain a premium niche format, before going main stream in due course. That's what happened with color TV in the 60s, VHS in the 80s, DVD in the 90s and Blu-ray more recently. None of them were overnight successes, but as time and technology progressed, the uptake of new formats and standards became a whole lot faster.

I first personally saw really good stereoscopic 3D (the type on offer this year) being demonstrated while I was working on the **HDMI Techzone** booth at CES 2008 (Kordz was an invited participant on the booth that year). Yep, that's right – **two full years ago**. The R&D for displaying decent 3D in the home was actually done ages ago - this is how the CE brands were able to implement it so quickly following 3D's commercial success at the cinemas, and since then they've been falling over each other to be first to market.

What does HDMI have to do with 3D?

There are three main organisations that have been instrumental in creating 3D standards for the home. In no particular order, they are;

1. The 3D@Home Consortium
www.3dathome.org
2. The Blu-ray Disc Association
www.blu-raydisc.com
3. HDMI Licensing, LLC
www.hdmi.org



The 3D@Home Consortium takes a great and necessary leadership role in the development of 3D for the home, but their role does not extend to creating and enforcing industry-wide standards. They are a very cluey collaboration of companies and individuals, for development and reference purposes - a “think tank” of sorts. The Blu-ray Disc Association is also a body that cannot dictate standards to the whole industry, restricted only to the Blu-ray format as a 3D source. They are certainly influential, but not definitive.

The reason HDMI have instead taken the primary leadership mantle is simple – without HDMI, 3D doesn’t work. HDMI is the current standard for domestic digital HD connectivity, and it will be the one common element in all 3D systems at home, regardless of brand, source, display type, etc. HDMI connects all 3D devices together.

HDMI version 1.4

When the new HDMI 1.4 specification was released in November 2009, it really only included in-principle support for 3D TV. Since then the updated 1.4a specification, released early March 2010, properly defines a number of mandatory 3D formats for source, repeater and display devices. But what about the HDMI cables? Well, there are only two changes to HDMI cables as part of the 1.4 spec;

- i. Addition of optional HDMI **Ethernet Channel** (HEC) – the only physical change, and
- ii. Changes to **labelling** on cable products, packaging and marketing to allay confusion
Eg; “High Speed”, “High Speed with Ethernet” are compliant labels, “HDMI 1.4 Cable” is NOT

Neither of these new cable features will affect nor influence the operation of 3D in any way - 3D TV is a function of hardware, not cables. So does that mean that existing HDMI cables will support 3D? Absolutely, at least with the currently defined 3D formats (more on this later). It’s purely a question of bandwidth, and to better understand this it’s a good idea to take a better look at the 3D formats themselves.

3D formats

There are three categorized types of 3D sources; Packaged media (eg; disc), over the air broadcast TV (including satellite), and cable into the home (copper or fiber). Each has a different set of performance criteria and legacy limitations, so each may use slightly different 3D formats to maximize available technology. HDMI 1.4a defines the following;

Broadcast & Cable 3D formats – Mandatory support for **720p/50-60** and **1080i/50-60** (note HD only), same as existing broadcast HD. However 3D-TV broadcast will combine each left and right eye image into a single frame, in either “Top & Bottom” (sometimes called “Over and Under”) or “Side by Side” formats. Here’s a simplified example of how they look;

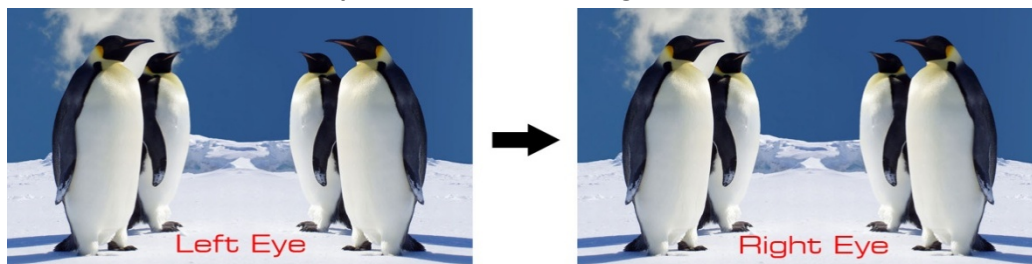


The display will then take each incoming combined frame and process it to separate out the left and right eye images, displaying each in turn as full screen alternating frames. As you can imagine, the effective resolution on screen will be compromised, with each eye exhibiting effectively half of the horizontal or vertical resolution of the comparable 2D image. The reason they do this is to maintain the same bandwidth requirement for 3D as for they do for current 2D HD-TV broadcast.

Packaged media 3D formats – This includes primarily Blu-ray, for which the Blu-ray disc Association (BDA) already defined its standards for 3D storage and output before HDMI 1.4a even came along. HDMI has endorsed the BDA’s specs, but went a step further to mandate support for the same with both repeaters and displays, not just Blu-ray sources. Mandatory 3D formats are as follows;

1080p/24fps per eye	effectively 1080p/48 (24x2), or around 3.56Gbps*
720p/50, 59.94 or 60Hz per eye	up to 720p/120 (60x2 max), or around 4.46Gbps*

Sequential frames – left/right in turn



In reference to 3D signals, the biggest difference between broadcast and packaged media is that the latter maintains full resolution per eye, with complete left/right frames alternating from source. Now there are two main applications for these formats – movies and games (whether from Blu-ray or something else). Movies will be optimized in 3D with 1080p/24 per eye, whereas gaming mandates support for 720p resolution in order to maintain the higher frame rate of at least 50Hz. It’s a balancing act between resolution and frame rate to maintain a similar overall bandwidth.

Here’s a handy reference chart depicting data rates at different resolutions;

Res	2D	3D
720p/60*	1.98 Gbps	1.98 Gbps “Top & Bottom”
		1.98 Gbps “Side by Side”
		3.96 Gbps Seq. (Blu-ray & Game)
1080i/60*	2.23 Gbps	2.23 Gbps “Top & Bottom”
		2.23 Gbps “Side by Side”
1080p/24*	1.78 Gbps	3.56 Gbps Seq. (Blu-ray movie)
1080p/60*	4.46 Gbps	8.92 Gbps not included in 1.4a Potential future game

*assuming 8 bit color per channel (24 bit total)



HDMI cable compatibility

To date the real world application benchmark in choosing a HDMI cable has been for it to support 1080p/60, the predominant premier 2D format. At normal color depth, 1080p/60 in 2D produces a data rate of approximately 4.46Gbps. Compare that to the figures on the previous page for the mandated 3D formats – 720p/60-3D (3.96Gbps) is getting up towards 1080p/60-2D (4.45Gbps), and 1080p/24-3D is actually lower than both at only 3.56Gbps! These are only rough calculations, but you get the idea.

I've also seen some cable vendors promoting farcical ideas about very high refresh rates –240Hz etc - as something that the HDMI cable needs to support. This is misleading scare tactics, as such features exist in the displays, not the source. Blu-ray for example will output a maximum of 60Hz for 2D, and 120Hz for 3D, then the display will do its thing –240Hz, 600Hz, sub-field processing, smooth motion filtering etc, *blah, blah...* Always keep in mind that the cable is only required to carry whatever the output from source – don't be baffled by the numbers emanating from the TV's brochure.

So which HDMI cable do you need for 3D? Simple, nothing changes...yet. A **Standard** (Speed) HDMI cable will support both mandatory broadcast 3D formats, and any HDMI cable that already reliably passes 1080p/60 in 2D will also pass the currently mandated sequential 3D formats. **However** I predict that gamers will not be entirely satisfied with 720p resolution, yearning instead for the benchmark 1080p, but of course they'll still want frame rates up to 60Hz per eye. Currently, HDMI transmitters in most devices are generally limited to 2.25Gbps/channel, but to reach 1080/120 (60x2), they will need to rise to match the maximum specification of HDMI, being 3.4Gbps/channel. To reliably connect this, only genuine certified High Speed cables (10.2Gbps) can be used. So if you want to cover yourself for this eventuality (I would), **get High Speed now**. CAUTION – A cable that supports 1080p is not necessarily High Speed, in fact most over 5m are not. Reference to version numbers is also not indicative. The cable needs to simply be labelled "High Speed".

Conclusion

I've always said that the cable should be the easy part in the home cinema system installation – the bit you don't see when it's all finished, the bit that doesn't give you grief. With the advent of 3D, this mantra does not change. Many misunderstand it, and some vendors may see marketing opportunities in it, but from a HDMI cabling point of view 3D does not immediately change things at all. It's all numbers - stick with the arithmetic and you can't go wrong.

"Standard" HDMI will support broadcast 3D formats, many examples of which also support 1080p/60 by application, and so will also be fine for all pilot 3D formats. But for the best and most reliable long term results, go for "High Speed". Many of the upcoming 3D TVs will also offer web connectivity, so "High Speed with Ethernet" is the ultimate choice.

For more details, contact Kordz, or go to <http://www.kordz.com/>.

David Meyer
Managing Director
Kordz Pty Ltd

