CLEARING UP THE HDBASET TECHNICAL FUD

July 2010

HDBaseT™ is not an "HDMI killer" as many in the media would lead you to believe with their Fear, Uncertainty, and Doubt (FUD) coverage of the technology recently. In fact, its impact will be completely the opposite. The HDBaseT chips actually require an associated HDMI chip embedded within that same device to operate. This means HDBaseT ultimately may increase the proliferation of HDMI as a technology - if and when it takes off.

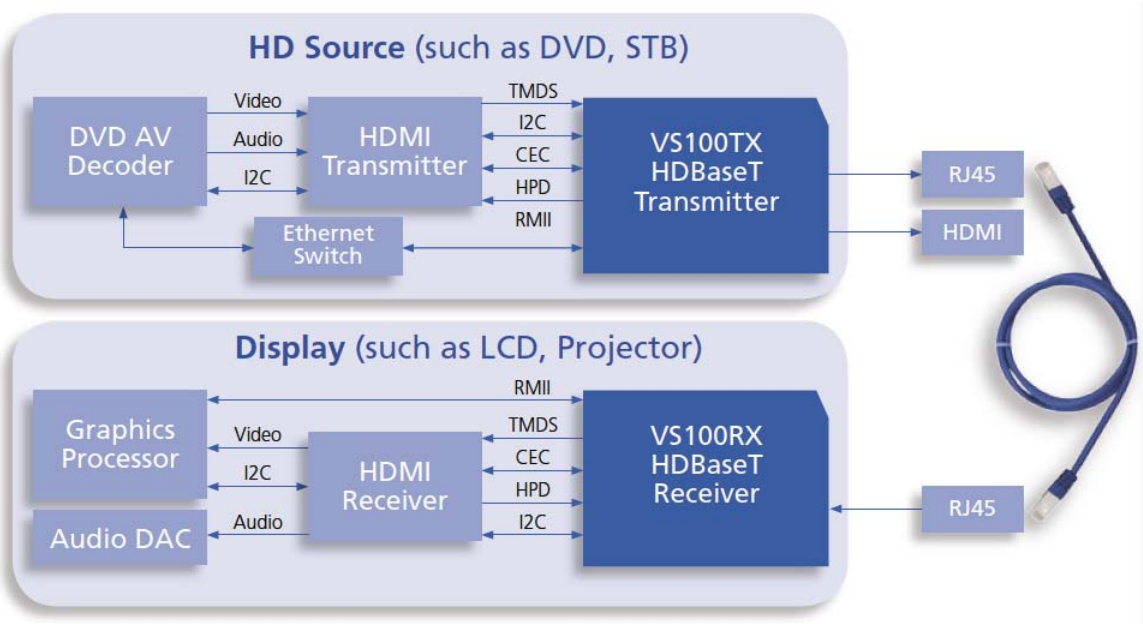


FIGURE A: The Valens VS100 System Functional Diagram

A more accurate view is that HDBaseT may end up supplanting the current HDMI cabling options, especially the wide variety of HDMI Extenders used for longer distances. It eventually also may eliminate the current use of HDMI Type A connectors now found on most A/V devices, but that is yet to be seen.

One of the problems that integrators wrestle with is whose products to use for extending HDMI over longer distances. Right now, each vendor's engineering designs, technologies, and implementations are proprietary with no "electrical interoperability" between them. That means that one has to use that vendor's products for all connection points within the HDMI chain. It also means that no one vendor's technology will be embraced and standardized on by the entire CE industry for inclusion into Blu-ray players, A/V receivers, HDMI Matrix Switchers, TV sets, or test tools. The HDBaseT Alliance wants to solve that problem.

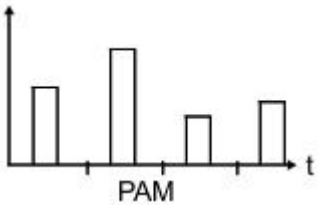
HDBaseT's biggest feature is that it uses standard CAT-5e or CAT-6 twisted pair cabling with RJ-45 connectors. This eliminates most of the problems people are experiencing when using standard HDMI cables and connectors. However, there currently are no fiber options, nor may there ever be.

HOW DOES IT WORK?

CLEARING UP THE HDBASET TECHNICAL FUD

Most of the current crop of good HDMI Extenders simply "extend" the HDMI signals across a pair of CAT-5 or CAT-6 twisted pair cables. This is especially true for the Transmission Minimized Differential Signaling (TMDS) lines that carry the video, audio multiplexed in with the video, and associated timing clock signals, which all occupy one of the twisted pair cables. These lines are susceptible to all of the electrical issues associated with trying to carry high frequency signals across long wire runs. The second cable usually carries all of the handshaking signals (with customized electronics for maintaining signal integrity) and the low current power for driving the HDMI receiver electronics. If a vendor has opted to use a single cable, they have devised some proprietary scheme for trying to deliver a comparable HDMI signal at the other end.

HDBaseT works differently. It is based upon the same technology used for coding Ethernet signals onto twisted pair cabling. It is called Pulse Amplitude Modulation (PAM). This is a means by which digital data is represented as a coding scheme using different levels of DC voltage at fairly high rates (in the order of 125 mega pulses per second or more for Ethernet).While Ethernet uses 5 Level PAM (PAM-5), HDBaseT uses a proprietary version that is slightly different. Some of the newer high speed Ethernet coding schemes, like 802.an (10GBaseT), use 16 Level PAM.



In case of HDBaseT, they use PAM as the way to "modulate" all of the HDMI and control signals onto each set of twisted pair wires. However, the intellectual property is in the proprietary coding scheme used to get all of that data onto the wire bundle. This gives them the advantage of being able to send the content across the a single CAT cable without the electrical characteristics of the wire affecting performance as much as the current HDMI signal "extender" approach that just shovels the bits across the wire at high speeds.

It is important thing to note that, while HDBaseT uses the same coding technology as Ethernet and does have an Ethernet channel, it is not Ethernet based. It is not packet based and does not use Internet Protocols (IP) either. It just happens to use the same type of twisted pair cable that most associate with Ethernet. We will cover more on this in just a bit.

HOW DOES HDMI "TRANSLATE" INTO HDBASET?

To really understand what HDBaseT is all about, it is useful to take a look at the chipsets themselves. Valens Semiconductor (http://www.valens-semi.com/), currently the only provider of the HDBaseT chips, unfortunately does not have much detail posted yet. They currently are supplying two chips – one is the transmitter (VS100TX) and the other is the receiver (VS100RX).

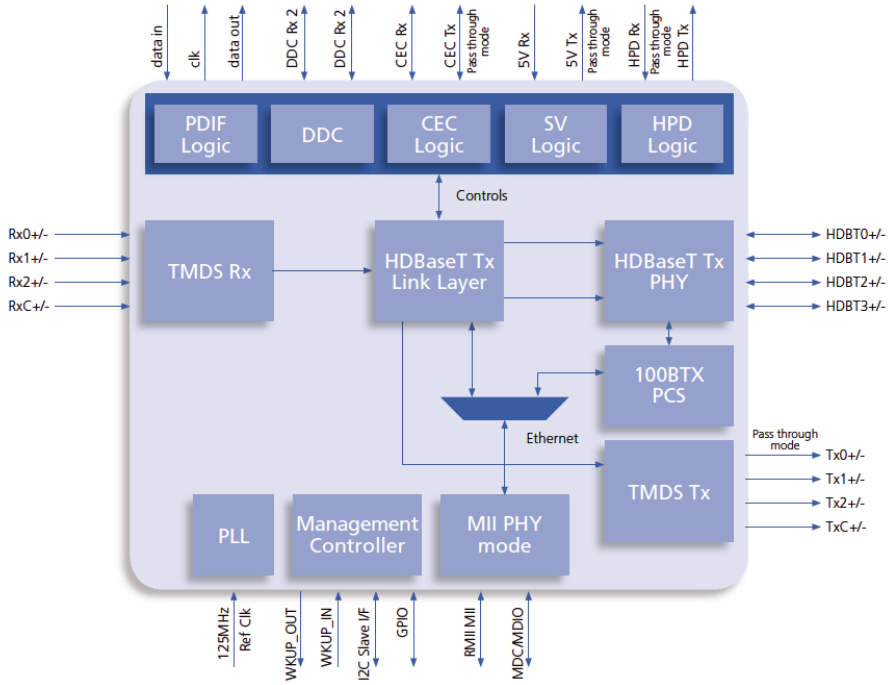


FIGURE B: Valens VS100TX High-Level Block Diagram

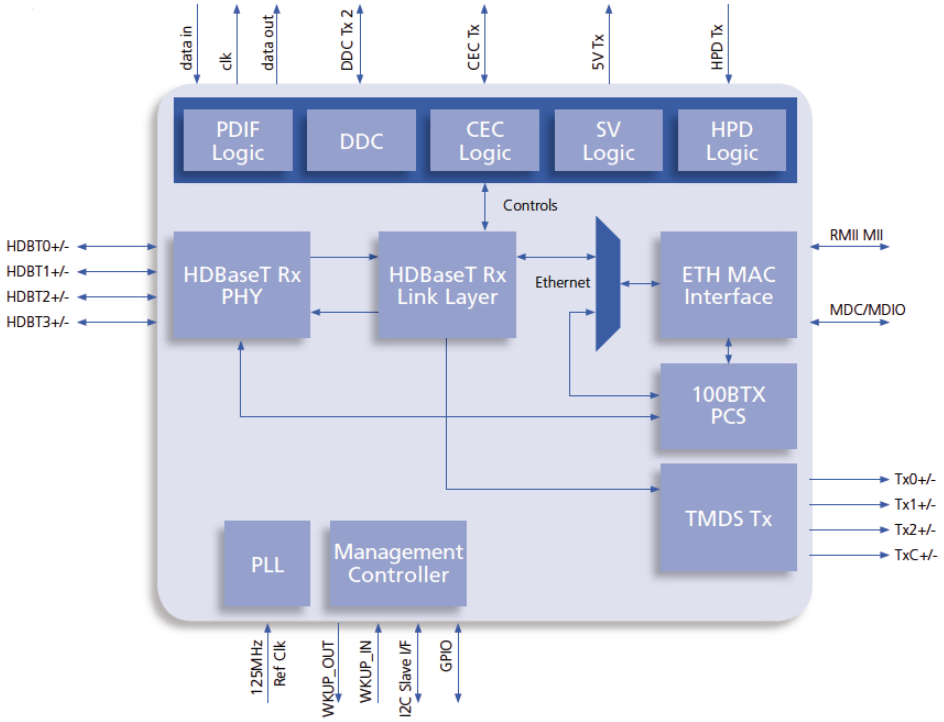


FIGURE C: Valens VS100RX High-Level Block Diagram

The pins of interest initially are the TMDS lines that interconnect directly with the TMDS lines on the associated HDMI transmitter or receiver chip. I will use the designators from the transmitter (VS100TX in FIGURE B) for this example, but the concepts are the same for the receiver as well. Rx0, Rx1, and Rx2 on the left-hand side correspond to the three red, blue, and green TMDS color channel outputs from the HDMI chip (note that they are viewed as receiving the HDMI TMDS data from the perspective of the HDBaseT chip).The +/- designates that that it is two "wires" that normally make up one of the differential twisted pairs within an HDMI cable. The RxC is the associated TMDS Clock line. These signals also carry the audio that is multiplexed over the video lines the in same way as an HDMI cable.

The important sets of pins are on the right-hand side of the diagram. The top set of pins corresponds to the four PHY-layer HDBaseT twisted pair wires to the RJ-45 jack (HDBT0 through 3). You notice that the HDBaseT chip simply acts as a pass-through for the HDMI TMDS signals that then get modulated using the HDBaseT coding scheme mentioned previously.

The other set of pins on the bottom right connect to a standard HDMI Type A connector. It will be up to the vendors to decide if they want to include that connector in their devices or to just use the RJ-45 instead. This is another reason why HDBaseT augments HDMI instead of replacing it as some speculate.

Some other pins of note are the additional lines normally run individually within an HDMI cable. These include the Consumer Electronics Control (CEC) line and the Display Data Channel (DDC) line. Since these also are "passed-through" from the associated HDMI chip, all of the functionality for CEC, HDCP, EDID discovery, Content Type Signaling, and things like the HDMI 3D_Structures embedded in the video stream work as they would if it were an HDMI cable.

While there is no dedicated wire in the HDBaseT cable for Hot Plug Detect (HPD) like there is with HDMI, there is logic built into the chips at both ends that raises a flag on the source side whenever a new device is plugged in. This logic is used for initiating the process for obtaining the EDID information from the new device and initiating the HDCP key exchange, just as it would with an HDMI cable.

Another thing to note is that the Link Layer Ethernet channel is independent of the HDMI 1.4 chipset interface. While this works for sending Ethernet across the HDBaseT cable, I wonder if it will have the capability to bridge to the Ethernet channel on newer HDMI 1.4 chipsets that offer HDMI Ethernet Channel (HEC) capabilities. I assume that integration will be a vendor-specific implementation. Similarly, there does not appear to be any capability to interface with the HDMI 1.4 Reverse Audio Channel feature. While this currently may not be a mass market requirement, it could impact how well this version of the technology integrates with these newer features of the HDMI 1.4 platform moving forward.

For the maximum video resolution, the length of a point to point wire run needs to remain under 100 meters. You can extend the overall source to sink length to 200 meters using an HDBaseT switch. Additionally, you potentially could daisy chain switches to increase that distance if required. This could be a big plus when using the technology for commercial installations or for digital signage applications.

However, there is a little known consideration when trying to play content over more than 100 meters. Once again, the powers that be in Hollywood want to be in control of any premium content being distributed throughout the home. They want to be able to limit the content distribution to a single household and see 100 meters as enough length to cover most homes. Therefore, HDBaseT has a built-

in capability to impose a "logical" limitation on the end-to-end length of an HDBaseT infrastructure to 100 Meters. HDBaseT has a built in mechanism for accurately detecting the maximum source to sink distance. Limiting the maximum distribution distance can be enabled by the content providers for certain types of material. My hope is that this never is enacted, but the capability to do it is there.

5PLAY

In addition to using a standardized RJ-45 connector and twisted pair cabling, HDBaseT includes several other features to enhance the HDMI standard. The entire bundle is marketed as 5Play™. It includes

1. Uncompressed high definition video
2. The same audio formats supported by HDMI
3. A variety of options for device control
4. 100BaseT Ethernet
5. Additional DC power over the same cable

VIDEO

It should be apparent by now that the video implementation is a simple pass-through from an HDMI chipset. All of the same resolutions incorporated into the HDMI 1.4 specifications appear to be supported. However, there currently is no public information available on how deep the bit depth will go for Deep Color nor is there any information on the support for the new Color Spaces introduced with 1.4. It does support 2K and 4K at the same frame rates in addition to the new mandatory 3-D formats. There currently is no integration with DisplayPort, but there is talk of being able to work with dual port versions (DisplayPort ++) via the HDMI interface.

Since the DDC line, which carries the HDCP encryption handshaking, is passed through, playback of premium content is consistent with HDMI. It actually may end up being more reliable since the HDBaseT coding scheme is not as susceptible to the resistive, capacitive, and crosstalk-related electrical problems that a normal HDMI cable may experience. Coding schemes tend to have less degradation over longer distances than strictly sending out high-speed binary ones and zeros.

AUDIO

Audio is passed through the same as video, so all formats are included. Once again, protected audio content will work as well. At some point, we may see HDBaseT used for audio-only distribution, but the costs may prohibit its wide use.

CONTROL

This is where the additional features of 5PLAY can really add value. We already talked a little about the integration with HDMI's CEC capabilities. HDBaseT participates in the same CEC topology tree as a "normal" HDMI interface.

HDBaseT also has the capability to support other low-speed control mediums like RS-232 and IR over the same cable. HDBaseT does not specify how these other control signals are implemented and vendors have the ability to engineer solutions to meet their specific requirements and value-added features. One of my fears is that, since the implementation of the additional control capabilities does not appear to be standardized, they potentially open the door for a level of incompatibility across different vendors' products. Since HDBaseT also has an Ethernet channel, IP control would be transparent, too.

Another interesting aspect from a control standpoint is the ability to run USB over HDBaseT. Icron Technologies Corporation (http://www.icron.com/), makers of several interesting long distance USB products including USB over Ethernet, has announced that they will be offering a product that uses HDBaseT for sending USB over twisted pair. Note, however, that while HDBaseT supports USB 1.1 and 2.0, it cannot handle the higher 480 Mb/s speed of USB 2.0.

ETHERNET

HDBaseT also support 100 Mb Ethernet over the same cable. There is talk about supporting gigabit Ethernet with some future release, but 100 Mb is in keeping with the new HDMI Ethernet Channel (although it still is not known if vendors will be able to bridge the two, as mentioned previously).

There is a great feature of HDBaseT that I have not seen discussed anywhere. HDBaseT has what I call an "Ethernet Fallback Mode (EFM). Remember we highlighted that HDBaseT uses a coding modulation similar to 100BaseT Ethernet. If you plug an HDBaseT device into an Ethernet-only infrastructure, the HDBaseT device is smart enough to realize it and only enables the Ethernet capabilities of the connection. This definitely will help eliminate any potential confusion around using a "standard" RJ-45 for both connection types and eliminates the need to have separate connectors for Ethernet and HDBaseT.

POWER

There appears to be a lot of confusion in the press about the power distribution features. At the wire level, HDBaseT conforms to the new IEEE 802.at-2009 Power over Ethernet Plus (PoE+) standard. The PoE+ devices can deliver up to about 25 watts of power over a single pair of wires. Remember that HDBaseT supports an Ethernet-only infrastructure for data. This also holds true for power by conforming to the PoE+ standard. This is DC power though. It is not AC.

The PoE+ standard delivers up to about 57 volts DC at about 400 mA. HDBaseT is claimed to have the additional ability to deliver 100 watts of DC power by sending power over the other pairs in the cable bundle. By keeping the voltage up and the current low, there is little heat rise in a single pair. However, it is not recommended to bundle several HDBaseT cables together when delivering high power to newer classes of higher power devices.

The higher-power 100 watt rating also is designed around the goal in the industry, especially for LED-based LCD TVs, of 1 watt per diagonal inch. When taking into consideration the voltage drop over 100 meters of cable, that means you should be able to drive a 40 inch display off of a single HDBaseT leg.

The HDBaseT reference designs on the Valens site show two power supplies for a single HDBaseT run. However, it is possible for a vendor to send power over the HDBaseT connection to the receiving device from the power source on the transmitter end. This eliminates the need to have yet another wall wart behind a TV. It is not clear if all vendors will support this configuration.

WHERE DO WE GO FROM HERE?

Version 1.0 of the HDBaseT specification and chipsets was just released to the HDBaseT Alliance members while the certification testing still is being worked out. But, as with most technologies, there always is the next generation on the horizon. The HDBaseT Alliance is focused on getting market traction with the current release and reference designs.

- One of the areas under consideration for improvement is in the way HDBaseT handles EDID and CEC when connecting a single source to multiple displays. There currently is not a defined way to perform EDID management like what we are seeing in some of the newer HDMI Matrix Switchers. This is becoming more of an issue as we move into mixed modes of 2-D and 3-D displays and is a consideration in your overall HDBaseT designs.
- There is work being done on making HDBaseT switches more intelligent in the way they discover and convey what devices are plugged into the ports.
- There also is an effort to standardize on running USB over an HDBaseT connection.

It will be interesting to see what other new features the HDBaseT Alliance conjures up as they move forward. Version 1.0 is a great start. Time will tell if the industry embraces it. While HDMI provided a means to deliver audio and video over a single cable, HDBaseT moves us into a single plate solution for everything.

About the Author

Derek R. Flickinger is Vice President of R & D for Interactive Homes, Inc. (www.InteractiveHomesInc.com). He provides consulting and implementation services for manufacturers and consumer electronics installation companies on new technologies, products, and strategies related to standards-based Distributed Audio, Video, Communications, and Control (DAVCC) systems for the home and consumer market spaces. He also hosts *The Custom Integrator Show* podcast and blog at http://custom.thedigitallifestyle.com. Derek's long-term goal is to be instrumental in the development and deployment of entertainment systems on space stations and space colonies.