HDBaseT™
Do's & Don'ts
and Best Practices

White Paper

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Max has 27 years in the unified communications and collaboration industry and is founder of one of the industry's top firms for AV/IT training and consulting. He carries some of the top certifications in networking and audiovisual technologies. He is the author of the new book – Da Vinci Sales and has conducted several Da Vinci Sales seminars worldwide. Max has been the keynote speaker for several industry events and was awarded InfoComm's Educator of the Year Award in 2010. Max has achieved a great deal of success in network security, technology channel sales and channel/market development. He has been a senior academy faculty member for InfoComm University for over a decade. Max has developed and executed comprehensive global training programs for industry associations, channel partners and for technology manufacturers. His experience in Unified Communications includes videoconference and collaborative environment design for global enterprises, development, training and implementation. Max served in the U.S. Army for 10 years where he gained his initial experience in computer/electronics technology and worked with complex computer networks, advanced radar systems and specialized electronics and thermal and night vision imaging devices.

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Introduction

Like any good technology salesperson, a good technologist needs to communicate well. A technology salesperson uses three major categories to position their products and solutions: good, better and best. A technologist doesn't have the luxury of always having this positive spin. In light of this reality, this whitepaper is broken down into three more realistic categories for the technologist to communicate the HDBaseT Do's and Don'ts; DO, DON'T and BEST PRACTICES.

Using this three-fold approach, while maintaining the technologist's emphasis on realistic and meaningful field information, this whitepaper is divided into the following three major categories:

- DO – These Are Good and Acceptable Practices – These practices will work. However, there are times that these would be pushing the limits of manufacturers' specifications that are often set and measured in laboratories where little–to-no environmental factors are introduced. These practices should be used when the environment is known to be a good environment that will not introduce harsh conditions or troublesome electromagnetic interference and/or electrostatic discharges that can negatively impact the system's performance. These practices can also be used when there are limitations on cost, time and scope where the best practices cannot feasibly be used.

- DON'T – The Practices In This Section Will Not Work. If, in some instances, the installer, designer or project manager finds he or she can somehow make these practices work, it is VERY likely it will not work the next time they try it or it will stop working over a period of time. The practices outlined here include items that have been reported back from the field that have resulted in many lost hours of troubleshooting or rewiring of systems. The recommendation remains to stay away from the practices listed in this section even if there is evidence it may have worked as an exception in one instance or another.

- BEST PRACTICE – These Are Recommended and Preferred Practices – These are preferred methods for design, installs, quality control and quality assurance for optimal performance in extremely adverse conditions for the lifecycle of the system. These recommendations are given regardless of individual manufacturer specifications based on known characteristics about the technologies being used and the effects of the harsher environments. Some of these best practices may appear to be overkill and excessive; it is the job of the installer, designer, and/or project manager to balance the cost, scope and schedule of the project and determine when these best practices are in the best interest of the overall project. These are stated as recommendations when conditions dictate or when the limits of specifications are being pushed. These are not required to get standard performance.

Background and Overview

Before I get into the Do's, Don'ts and Best Practices, I believe some background information is in order. What is HDBaseT? HDBaseT is the de facto standard for Ultra-HD video distribution in commercial and residential applications. It brings a full feature set called 5Play™, increased distance and better performance than other solutions. The 5Play feature set offers uncompressed, ultra-HD video and audio, Ethernet, up to 100W of power, control and USB, all through standard category cable. The audio-video signal most commonly fed to an HDBaseT system is HDMI, however converters on the front end of an HDBaseT transmitter lend it to be used in almost any professional or residential AV application. One of the main things to know is that the core of the technology is the ability to extend the signals and to "multiplex" using 5Play. This takes this technology far beyond the standard extender or balun.

An important statement that I made above is that HDBaseT is the "de facto standard". That is a pretty bold statement for a consultant to make, but I can do so with a pretty safe level of confidence. You see, HDBaseT is not only a technology

that has considerable technical capabilities with 5Play and long distance through standard category cable, it also has the backing of the industries' biggest and brightest through the HDBaseT Alliance. With founding members like Sony Pictures, LG, Samsung and Valens and over a hundred members who contribute to the knowledge base and seek certification for their products, HDBaseT is one of the most widely adopted and supported technologies in Pro-AV. The HDBaseT Alliance is one of the most collaborative and technically proficient groups in our industry. I recommend that any technologist reading this to use the resources available to them to grow and learn from the wealth of knowledge available at www.HDBaseT.org – particularly in the Installer Zone, a collaborative portal targeting installers and integrators and focusing on the technology.

So, what is specific to this whitepaper? What is the major challenge for HDBaseT? The biggest challenge for HDBaseT came along long before HDBaseT was developed. When HDMI and DVI were originally developed they were designed for one-to-one connections over very short distances (i.e. PC to monitor). HDMI and DVI are inherently problematic in multiple in and multiple out or long haul applications (the TMDS technology is not a long signal run technology). Recent developments in switching and routing technologies have overcome many of the HDMI and DVI issues that are related to long haul and routing problems, however they still come up from time to time and for technologists the phrase "from time to time" translates as "difficult to identify and troubleshoot." Many of these problems have to do with copy protection and handshakes (where the display has identification capabilities that are sent to the source in order to configure format parameters and confirm that it can legally receive encrypted content). The issues are caused when multiple displays try to send their information to a source, which is limited in the amount of information (HDCP keys) it can accept from these displays. In cases like this the source is not designed to connect to multiple displays. (An example of this would be set top boxes, which usually can only accept HDCP sink handshakes from a maximum of four devices – if you have more than four displays in your system, you will have problems.) In professional environments, whether consumer electronics (home theater) or commercial electronics, switching and video processing equipment can now process the copy protection and handshake information (HDCP and EDID) for the source, but the technologist needs to know if they are dealing with professional equipment or not.

Now that HDMI and DVI are more mature and widely used in professional video systems (both consumer and commercial applications), manufacturers have done well at addressing the HDCP and EDID issues. At the moment, most systems that implement HDBaseT are primarily used to extend HDMI or DVI, and as such must first be clear of all HDCP and EDID problems. This leads us to our first "DO" in this whitepaper.

HDBaseT Do's

DO – Check Your HDMI Versions
Until HDMI 1.3, the HDMI standard did not support "clock stretching" for the i2c bus protocol, an issue when transmitting above 70 KHZ. (HDMI 1.3 and above does support it.) Because HDBaseT follows these standards, it can become an issue and prevent an image to be transmitted, if you have an older set-top box or DVD player in your installation. Clock stretching relates to the EDID and HDCP information, and allows the slave devices to hold the serial clock line LOW after reception and acknowledgement of a byte to force the master into a wait state, until the slave is ready for the next transfer.

In those cases where there is an old HDMI version (HDMI 1.2 or below), you have two options: either switch for a newer version or different brand, or install an HDMI splitter for EDID termination and HDCP repeater.

DO – Draw Out and Test Your EDID and HDCP Flow Ahead of Time
Knowing that HDBaseT is at its core, an extender (with the added 5Play "multiplex" capability) helps us to address one of the biggest challenges. Because most of the time we are plugging these HDBaseT products into HDMI (or DVI) sources and displays, the challenges we have with HDCP, EDID, Hot Plug Detect and CEC are all still very much an issue. To address many of the HDBaseT issues, we find ourselves correcting more HDMI/DVI issues than extender or 5Play issues. To rectify this, make sure that you have drawn out your schematics or line drawings to include HDCP,

EDID, HPD, and CEC. The HDBaseT devices you put in the system may include matrix switching and/or scaling that may also have HDMI /DVI (EDID and HDCP) management features that will impact the overall signal flow. You will need to know what roles all the devices in the chain play in respect to sink, source or repeater and draw these out in your system flow.

DO – Adhere to the MFG Specs

There are times when we can push the envelope and get a lot more out of products than what the manufacturer states. However, we recommend you stick to what the manufacturer's specifications state when designing and installing a system. It is always best to have a goal of staying completely within the specifications and making exceptions only when absolutely necessary. The larger issue becomes when the exception starts to become the rule. In most cases, the specification from a manufacturer is established in a test environment that is far less harsh than the environments most integrators find themselves in when they are in the field. When an integrator stretches the specification, even just a little, they are risking a lot of additional man-hours. The question then comes to mind how much time is saved doing something quickly and when you are pushing the limits of a product only for it to be re-done correctly later? Our recommendation is to do it right the first time and follow the manufacturer's guidelines from the start. As a best practice there is prudence in leaving headroom from the manufacturer's specification to account for harsh install environments and miscalculated distances on site surveys and such. Ultimately this saves time and money on installation and service and maintenance costs.

DO – Use Proper Cable Runs, Patches and Blocks, Terminations and Bend Radius

The best way to turn a category 5 cable into a category 3 cable is to roll it up the same way you do an extension cord from your garage (the "hand to elbow, hand to elbow - and so on" roll). Category cable is susceptible to misuse and rough conditions, particularly during the installation process. Even during the cable pulling process, category cable gets quite abused. This abuse changes the characteristics of the cable and can, in turn, affect its performance. In this section the recommendation is to treat the cables and connections as if the signal integrity depends on it, because it does. You should use pre-made patch cables and these should be kept short (<5m). Blocks should be used minimally and the quality of the tools to punch these down need to be high quality and well maintained. Follow proper cable run standards and adhere to proper bend radius guidelines. Check your terminations and test your cable path using quality and proper test equipment. If you must cross the path with another signal type, the cables should cross at a 90 degree angle to each other (perpendicular).

DO – Have Proper Test Equipment and Stage Installs

As with other technologies and subsystems within any AV/IT installation in commercial or residential settings, it is recommended that the HDBaseT equipment in the system or subsystems be staged and connected together using the same cabling that will be used at the installation site. It is good practice to prove the system will work in a controlled environment prior to introducing the system to the harsh install environment. This is especially important if this is the first time the components of the system or subsystem have been integrated together. Integration factors such as control and HDCP/EDID should be tested and proven in a controlled environment when integrating devices for the first time.

DO – Identify and Document the 5Play Features in the System

HDBaseT leverages a packetizing technology (not Ethernet, but somewhat like it) to prepare the information for transport and then it uses a unique modulation technology to actually transport information in the signal. The use of these combined technologies allows HDBaseT to send a lot more information than the typical local area network can over the same infrastructure. This enables HDBaseT to provide the 5Play feature set, which consists of ultra-HD audio and video, Ethernet, controls, USB, and 100W of power. However, it's important to understand that not all products support the full 5Play set. It is important that you document which of the features of 5Play are being implemented in your system, and verify that the products being used support those particular features and are interoperable with each other. The HDBaseT Certification does not guarantee that all five of the 5Play features are enabled on the certified device. Once a product has been certified, it transmits audio & video according to the HDBaseT specs. Any of the other features are certified separately. Make sure to check the HDBaseT Alliance's Certified Product List, on their website, to understand which features are supported by each certified product, and therefore which products may be interoperable with what. Also, sometimes vendors add proprietary features that

may make products non-interoperable with other brands, which at this point is not related to HDBaseT. So it's important to also check the manufacturers' datasheets and product notes to make sure all bases are covered.

HDBaseT Don'ts

DON'T – Connect Different MFGs Unless Verified on the Certified Product List and the MFGs

HDBaseT is a de facto standard, however there may be products that use the technology but have yet to be certified by the HDBaseT Alliance The HDBaseT Alliance has established all of the criteria to measure the performance of the products based on strict guidelines to ensure consistency in quality. Products that are not HDBaseT certified and that are not on the Certified Product List may not interoperate, while products that are on the list have been tested to meet the requirements for the AV features of 5Play. The next step in the process is to verify with the manufacturer to what extent the products are interoperable.

DON'T - Use Cheap or Substandard Cabling

The weakest link in any chain sets the strength for the entire chain. This is true for the signal path for HDBaseT. HDBaseT is designed to work on Cat5e; the specification will carry 5Play up to 100m/328 ft. The specification is based on the premise that the chosen Cat5e cable meets the TIA standard and will pass testing from a network cable analyzer. There are cheap cables on the market that tout Cat5e specification yet do not pass these tests and may not suffice for 5Play applications. There is no absolute requirement for Cat6 shielded cable (it is a best practice when using some of the products that implement the HDBaseT technology in such a way that yield more than 100m, higher resolutions or work in harsher environments). This DON'T is "when using Cat5e don't go cheap." Remember that the cable is likely to outlive every other element in your system.

DON'T – Overdrive or Under-Specify the System

The system may work when you complete the install. Part of why specifications are the way they are is that they anticipate a slight degradation of electronics over time. If a manufacturer provides a warranty of five years they calculate the slight degradation of the electronics they use into that warranty. If you push or exceed the specification it may work out of the box, but over time (as the electronics age) the system will stop working or performance will degrade considerably, and your company will be on the hook for the repairs and related labor because the specifications were not adhered to. The specifications take a lot more into account than "will it work" or "good enough".

DON'T – Underestimate the Environmental Factors – or Forget Seasonal Factors

The environmental factors play a much bigger role than a lot of people give them credit for. Electromagnetic Interference (EMI) and Electrostatic Discharge (ESD) are two of the biggest signal disrupters in long-haul video distribution and the biggest culprit in messing this distribution up is the physical environment. These environmental factors include other cables, lights, copiers, HVAC or any number of electrical devices. Some of these devices are only used during certain seasons and make it hard to detect, troubleshoot or even foresee. (For example, when installing a system at a school during the summer, you should assume that there will much more activity once the school year starts…) Do not overlook or underestimate the impact these have on your signal path and signal integrity. And don't forget to include these environmental factors in your site surveys and needs assessments (including out-of-season environmental impact).

DON'T – Commission or Sign-Off Without Fully Testing (DDC and Hot Plug Detect Voltage)

It can be easy to send a signal from point A to point B and consider a job done. However, it is important to know that the more complex the system and signals, the more thorough the testing should be. Don't sign-off on a system

without testing to make sure (at a minimum) that the DDC path has continuity and that the Hot Plug Detect pins have voltage (if applicable – depending on source type to be connected). This will prevent a lot of heartache later when different sources are connected to the system, and will define the end-user experience. Your source (laptop or test patter generator) may not act the same way the sources that the user will bring in. Don't assume that because your source works, theirs will as well.

HDBaseT Best Pratices

BEST PRACTICE – When In Doubt, Use Shielded Cat6 With Shielded Plugs

We stated earlier that there is no requirement to use Cat6. Some manufacturers strongly recommend this and some even do require it with their products when sending higher resolutions or when the environment is particularly prone

to noise and interference. It is a best practice to use Cat6 when there is any doubt about the environmental factors or what resolution will be transmitted. Cat6 shielded cable will give you the extra confidence and will allow you to deploy in less than optimal physical environments. This also allows for a level of future proofing and an upgrade path toward higher resolutions or other technical specifications that may require a more robust infrastructure cabling system.

BEST PRACTICE – Use Proper Grounding

It is a best practice to ground all of the system components. Since we already recommended that you use shielded twisted pair (Cat6) with shielded plugs, it should make perfect sense that you should also ground all of the system components. My basic electronics instructor had the saying: "ground is ground the world around" – by that, he meant ground everything everywhere. Grounding all of the devices ensures that every stray voltage and all forms of electronic interference have a path to ground instead of a path to and through your main signals. Ensuring proper ground will maintain your signal integrity for the lifecycle of the system.

BEST PRACTICE – Isolate HDBaseT Cat Cables from Other Signal Types

Cable bundling is one of the biggest challenges to digital signal distribution. You will find a few whitepapers about cable bundling and such challenges. You will find resources from vendors on the HDBaseT Alliance website as well, and in the Installer Zone. This is not a problem that is limited to HDBaseT. However, if you are considering designing a system in a harsh environment with a lot of structured cabling and you have the ability to separate out the HDBaseT cable from the other signal types, then it is recommended to do so.

BEST PRACTICE – Have the MFGs Verify Interoperability Throughout a System or Subsystem

The first step in verifying HDBaseT interoperability is to use the HDBaseT Alliance's Certified Product List. When products receive the certification for interoperability from the HDBaseT Alliance they are placed on the Certified Product List on the HDBaseT.org website. However, it is a best practice to verify the interoperability of the individual features that you intend on using in your application with the manufacturer (literature, collateral, manuals, website and/or technical personnel) as well to ensure that you are using the most up-to-date information.

Conclusion

In an HDBaseT system deployment, the technologist is where "the rubber meets the road" and the technologist can make or break the success of the whole system deployment. By simply following a few dos, avoiding the don'ts and knowing when best practices can get you out of a bind, you, the technologist, can save the day. Below is a checklist that can help you implement an HDBaseT system and know what to do, what not to do and what best practices you need to use when the time calls for it:

HDBaseT Technologist Checklist

Pre-Installation
Check Sources for HDMI 1.3 or Higher
Draw and Trace EDID and HDCP Paths
Draw and Trace HDBaseT 5Play Feature Set Paths
Check HDBaseT Certification Product List for Interoperability
Check With Manufacturers to Verify Interoperability
Verify Cable Quality

Pre-Installation
Stage and Test Sub-Systems
Adhere to Cable Installation Guidelines and Requirements
Bends, Separation, Cross Paths, Patches and Punch Downs

Pre-Installation
Visually Inspect Cable Installations and Terminations
Use Signal Generator and Test Equipment to Verify System Functionality

Verify in Field

- Distance
- Resolution
- Audio Format
- Control Type
- Environmental Impact

Best Practice

- Ground All Equipment
- Use CAT6
- Isolate HDBaseT

Celebrate

- A Job Well Done
- An HDBaseT Success
- One of Many