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W h i t e P a p e r

HDBaseT™ 101: IT/AV Designs for Schools
Stronger Networks for Smarter Students

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HDBaseT™ 101: IT/AV Designs for Schools

Stronger Networks for Smarter Students

AV technology expectations in today's K-12 and higher education classrooms are significant. Classrooms have graduated from chalkboards and overhead projectors to using connected tools like interactive whiteboards and document cameras. To ensure a quality learning experience throughout all types of environments, including lecture halls, libraries, and computer labs, teachers need to be able to easily extend HDMI®, VGA, and USB signals from their desks to the latest devices anywhere in the room. The challenge is to provide AV tools that maximize student engagement, are easy to use, and meet budgetary guidelines.



Technology Demands in the Classroom

An up-to-date audiovisual network is a crucial component for any classroom. Sound and video help capture the attention of students so they learn and retain more information. Plus, interaction with these audio and video devices helps to prepare students for the level of technology they can expect to see in later stages of life, such as in enterprise and commercial environments.

When it comes to choosing the right components to support an education AV network there are many factors to consider:

- Source signal type (HDMI vs VGA or composite video)
- Distance from source(s) to display(s)
- Use of passive cable vs active signal extension
- Ease of use
- Options for future technology upgrades

The options can be overwhelming and school budgets vary greatly.

IT/AV signal extension is a reliable solution for supporting large-format displays in hospitals, hotels, conference rooms, and other enterprise applications, but it is most ideal for deployment throughout school lecture halls, classrooms, and other learning environments. By installing a standards-based certified permanent link as part of an IT/AV network, schools and other learning institutions can save money and time during the initial construction while providing the capability for future technology upgrades.

Popular AV connector types prevalent in today's classroom:

RCA Stereo Audio

Analog audio with video capability commonly used for residential and commercial stereo speaker systems



Mini-Jack (3.5mm)

Analog audio with video capability, typically recognized as the headphone jack for a smartphone or laptop



VGA

Analog computer-to-display standard used with various computer monitors



Component and Composite

Analog video used for TV displays



DVI

Uncompressed digital video designed to replace VGA



DisplayPort

Digital video and audio VGA and DVI replacement that is replaced by Mini DisplayPort and Thunderbolt



USB

Capable of control, data, audio, and video, but only one type at a time



HDMI

Uncompressed digital video + digital audio that has become today's most popular consumer and commercial connector for HD up to 4K



Standards-Based Systems for AV Networks

Industry and association standards provide the peace of mind that systems are tested and installed to an agreed upon best practice. This supports interoperability between products and systems bought from different manufacturers at different times. Industry standards also offer a base of knowledge to rely on throughout the decision making process.

TIA Permanent Link

A permanent link is comprised of permanently installed fixtures (connectors, category-rated cable, etc.) in a data link. The link is standards based, testable, and certified to ensure a high level of performance and reliability, providing confidence in signal strength and dependability. It also serves as the basis by which contractors can offer system warranties on the network. The permanent link infrastructure, as part of an IT/AV system, can be used for the transmission of many AV signal types, including HDMI[®], VGA, and USB.

HDBaseT™ Certified Link

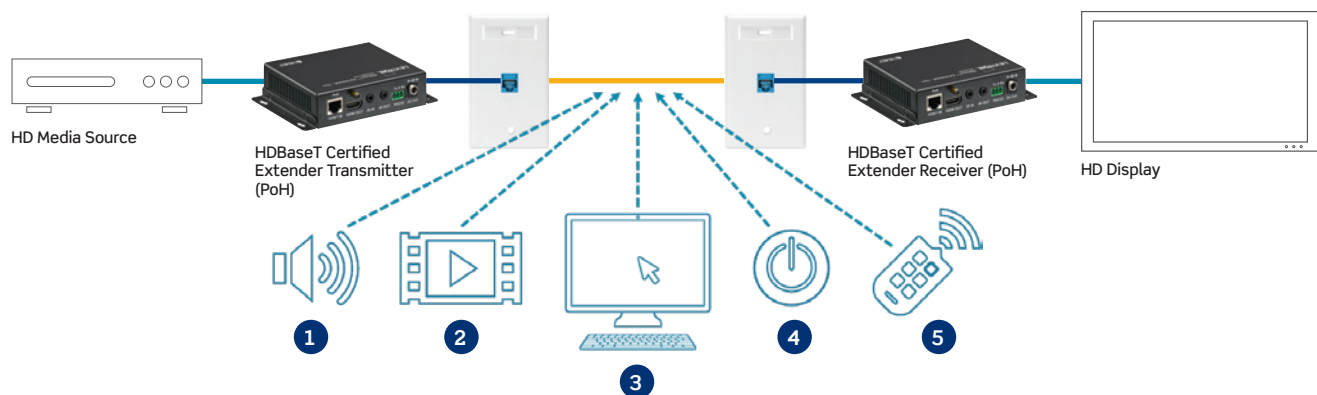
HDBaseT is an industry standard dedicated to providing high-definition AV solutions that run on category-rated cable. The HDBaseT certified link builds on the standards-based TIA permanent link. Adding HDBaseT certified signal extenders to the permanent link completes an end-to-end audiovisual channel for an IT/AV network, delivering a reliable, flexible, and high-quality signal transmission link with no programming required.

When to Use HDBaseT

With HDBaseT 5Play™ technology, schools can use a category-rated cable infrastructure to carry the high-bandwidth signals required for high-resolution displays across distances up to 100 meters (328 feet). This technology greatly exceeds the capability of passive HDMI cables, which are only appropriate for distances of approximately 35 feet or less.

HDBaseT 5Play delivers the simultaneous transmission of the following five signals over a single category cable:

1	2	3	4	5
Full Digital Audio	HDMI Uncompressed Video	100Mb Ethernet Channel	Power over HDBaseT (PoH)	RS-232 and IR Control
<ul style="list-style-type: none"> High-quality audio Lossless audio data of Dolby® TrueHD Full spectrum sound compatible with speaker systems ranging from mono or stereo to surround sound or theater sound systems 	<ul style="list-style-type: none"> HDCP compliant Comparable to Blu-ray Capable of supporting ultra high-definition 4K 	<ul style="list-style-type: none"> Great bandwidth for streaming web content Extends Internet from teacher's station to classroom display Provides an option for transmitting remote control signals 	<ul style="list-style-type: none"> Provides power over category-rated cable to extenders from either the source or display end Complies with IEEE802.3at-2009 (PoE+) Category 6A cable recommended 	<ul style="list-style-type: none"> Legacy serial command RS-232 for commercial equipment Reliable two-way wired control that is less susceptible to interference Wireless remote IR signal, common in consumer hardware



To get the benefit of all these signals in the past, three or four different cables were needed. With 5Play technology, building that network is far less cumbersome. However, to get the required performance, it's important to consider the capability of the type of cable supporting the system.

Supporting an IT/AV Network with Cat 6A

With the increasing demand for ultra high-definition video displays, it is important to install an optimal infrastructure now that will meet IT/AV network requirements and eliminate potential issues in the future. When planning to deploy category-rated cable for an IT/AV link, installing the most appropriately rated cable will increase overall network performance. The HDBaseT™ Alliance specification lists Cat 5e, Cat 6, and Cat 6A UTP cabling as supported media types. However, recent testing by Leviton shows Cat 6A UTP cabling is the most ideal solution to support an IT/AV link.

Leviton conducted a series of tests to verify the capability of different category channels, cable, and connector types for use with HDBaseT extenders. Testing concentrated on the effectiveness of the extenders at their maximum distance capability (shorter distances may have better performance), and was conducted using 1080p/60 video sources.

HDBaseT enables the transmission of AV signals at speeds of 10.2 Gbps and a frequency of 300 MHz. TIA UTP cable specifications define the frequency capability for Cat 5e at 100 MHz, Cat 6 at 250 MHz, and Cat 6A at 500 MHz. Prior to testing, Leviton experts hypothesized that Cat 5e would likely fail, as its capacity is well below the 300 MHz frequency requirement. Cat 6 signals would also likely struggle for the same reason.

Test results confirmed Cat 5e UTP cable is unable to provide the reliability desired for HD IT/AV signals over long distances, and in some cases it does not support the signal at all. Cat 6 UTP cable comes close to meeting signal requirements and delivers modest performance, but issues with alien crosstalk raise concerns regarding reliable signal integrity.

Alien crosstalk may not be an issue within individual classrooms, labs, lecture halls, or other rooms that benefit from single, point-to-point IT/AV links. However, applications and pathways where multiple cables are bundled together can generate enough alien crosstalk from 10GBASE-T or other HDBaseT signals to cause significant signal interference.

To avoid dropouts or link loss at high resolutions while mitigating issues caused by alien crosstalk, a Category 6A UTP channel with alien crosstalk prevention technology cable is highly recommended. No other UTP cable option reliably supports AV signal integrity over long distances while eliminating the installation headaches associated with FTP (shielded) cable, making it the best solution capable of meeting future IT/AV technology demands.

Throughout Leviton's testing, Cat 6A cable was the only category rating to consistently deliver reliable signal performance across the board, and it was Cat 6A cable with alien crosstalk prevention technology that provided top-tier performance throughout all phases of testing.

Select the Right Media and Components							
Cable Type	Cat 5e UTP		Cat 6 UTP		Cat 6A UTP	Cat 6A FTP	Cat 6A UTP
	ANSI/TIA Standard	Increased Margin Over ANSI/TIA Standard	ANSI/TIA Standard	ANSI/TIA Standard	ANSI/TIA Standard	ANSI/TIA Standard	Alien CrossTalk Prevention Technology
Recommended	No			Yes for Single Links	Yes	Yes	
Typical Outer Diameter	5.33 mm (Typical)	5.8 mm (Typical)	5.7 mm (Typical)	7.6 mm	7.1 mm	6.9 mm	
Typical Guaranteed PSANEXT Margin	Not Designed to Mitigate Alien Crosstalk			1dB	16dB	5dB	
Grounding or Bonding Required	No			No	Yes	No	

For more on HDBaseT and IT/AV cable testing, including Leviton's on-demand webinar, visit: leviton.com/ns/webinars.

Common Education IT/AV Scenarios

There are a number of ways in which IT/AV technologies can be deployed in real-world classroom applications.

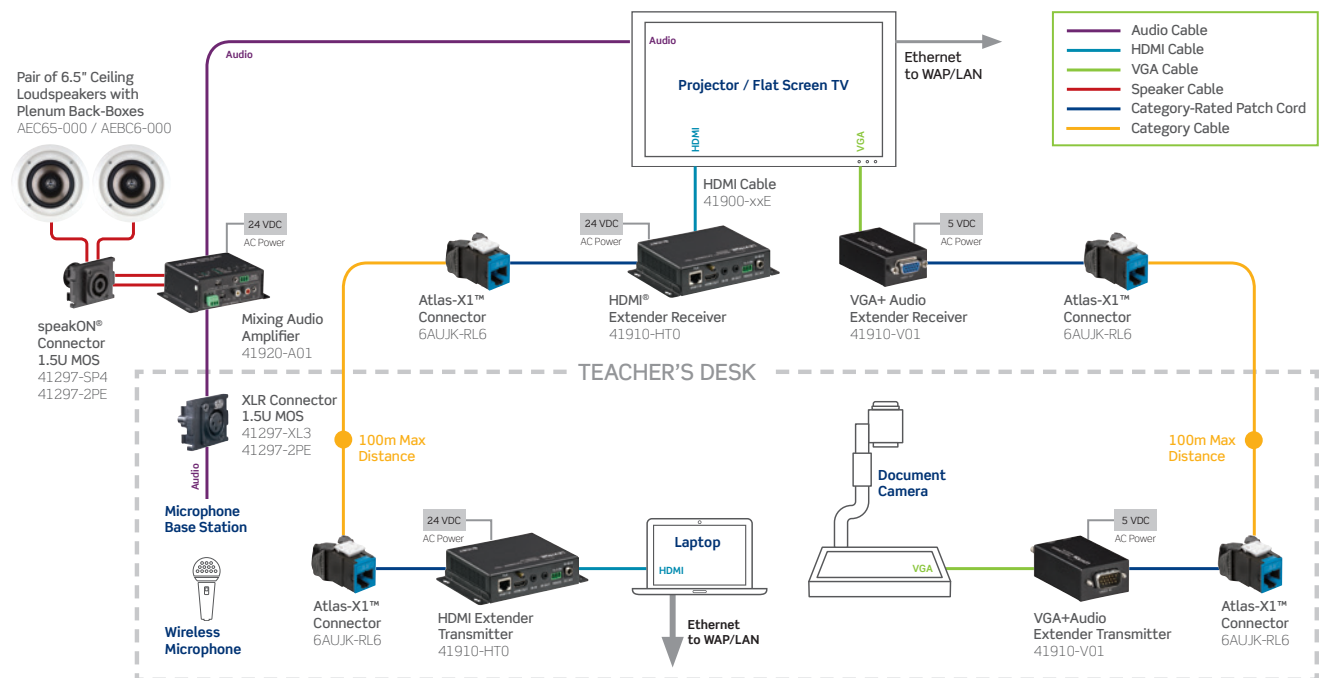
Three common scenarios include:

- Connecting multiple sources to a single display
- Connecting a PC to an interactive projector via VGA and USB connections
- Upgrading an interactive projector from VGA to HDMI[®] for greater bandwidth and higher resolution

Multiple Sources

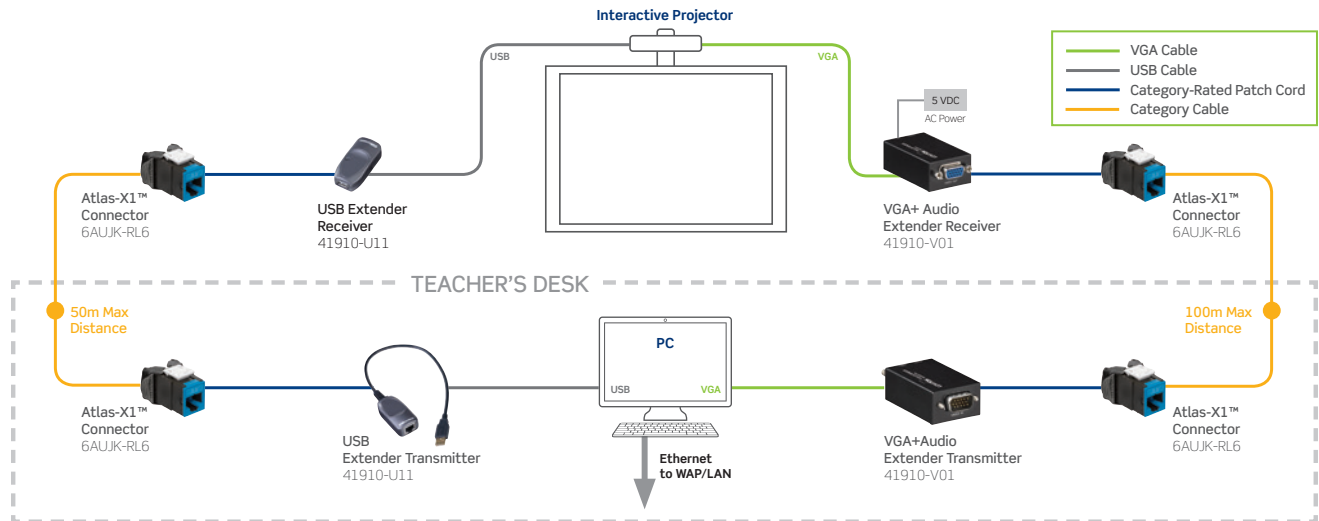
By running an IT/AV signal over category-rated cable, schools benefit from the reliability and performance associated with a tested, standards-based permanent link. Classrooms can use multiple sources, such as document cameras and laptops, to connect to projectors or large-format displays. These displays are already capable of managing video signals from multiple sources, eliminating the need for a dedicated switch and allowing schools to save additional resources by investing in less equipment.

In some cases, audio output is taken from the source. This can limit sound quality and distance. An audio amplifier connected to the display allows better synchronization of audio and video. Teachers will be able to use the remote control supplied with the display to adjust audio and video outputs, simplifying operation.



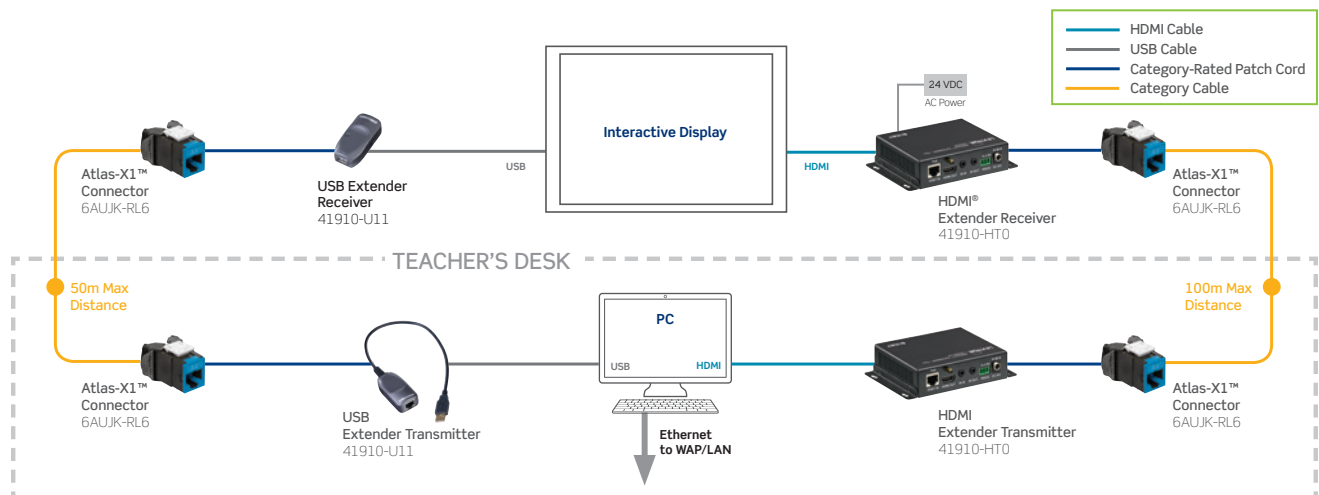
PC to Interactive Projector via USB and VGA Connections

In this scenario, a PC is connected to an interactive projector with a USB connection for control and a VGA connection for audio/video output. To allow an extended distance (up to 100 meters for VGA and up to 50 meters for USB) between the source computer and the projector, while protecting against signal degradation, a category-rated permanent link is necessary. In addition to signal extension capability, using a permanent link and category cabling prepares the system for easy upgrades to newer technologies, as shown in the following scenario.



Upgrading a PC to an Interactive Projector with an HDMI® Connection

In this scenario, the VGA connection can be upgraded to HDMI to handle greater bandwidth for supporting higher resolution displays and greater interactivity. HDBaseT™ technology upgrades are simple and easy, and replacing the existing IT/AV infrastructure is not required. The same reliable, standards-based permanent link is used; just swap out the VGA extenders for HDMI extenders. The USB connection remains unchanged. The link now provides a significant boost in audio/video quality and increased interactivity with no change to the cabling infrastructure. It is a simple plug-and-play solution that does not require any programming; a qualified datacom installer can easily perform the upgrade in a short period of time.



Extending the Lifecycle of Audiovisual Systems with IT/AV

An up-to-date audiovisual network helps students engage with classroom activities while familiarizing them with technologies they will see later in life. By using standards-based systems to create their AV network, schools and other learning institutions can rely on established best practices to provide performance assurance while balancing technology demands, budget concerns, and education benefits. Installation is simple, and technology upgrades only require swapping the extenders, with no change to the network infrastructure. And since these plug-and-play solutions do not require programming and can be added to an existing certified permanent link, a single datacom contractor can facilitate all datacom and audiovisual networking needs.

To learn more about **HDBaseT solutions** and how they enhance the student learning experience, visit: Leviton.com/ITAV.

THE SMART CHOICE FOR A BETTER NETWORK

High-performance connectivity backed by the industry's best service and support

We invent the industry's best technologies. We build them to last. And we stand behind every product and every installation – delivering industry-leading performance and unbeatable service and support – throughout the life of your structured cabling system. Add in the peace of mind that comes from working with a stable, century-old supplier and you get far and away the highest return on infrastructure investment in the industry.

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