Curing Common AV Headaches

Providing systems that will get used and make everyone happy

BUDGET CONSCIOUS  |  EASY TO USE  |  FUTURE PROOF  |  NEXT GENERATION  |  PROTECT YOUR REPUTATION
# Common AV Headaches

<table>
<thead>
<tr>
<th>Headache</th>
<th>Prescription</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodating odd room sizes</td>
<td>Adding displays and speaker placement</td>
</tr>
<tr>
<td>New AV technologies not supported by old AV cabling</td>
<td>HDBaseT extension on Category cable</td>
</tr>
<tr>
<td>Hard to share content/collaborate</td>
<td>Auto and manual input switchers</td>
</tr>
<tr>
<td>Video looks great, audio sounds terrible</td>
<td>Audio extraction, amps and speakers</td>
</tr>
<tr>
<td>Grounding and bonding of shielded cable</td>
<td>UTP cable with crosstalk prevention tech</td>
</tr>
</tbody>
</table>
Accommodating Odd Room Sizes

Adding displays
Display or projector placement and size
Accommodating Odd Room Sizes

• Every room presents a different challenge
• The audio element is just as important as the video element
• Consider the viewer experience but also consider the presenter
• Maintain the focal point and purpose
Accommodating Odd Room Sizes
Fixing the Bowling Alley

A. Flat screen displays (Qty 2 or 4)
B. HDMI splitters (Qty 1 or 2)
C. HDBaseT Extension (Qty 1 or 2)
D. HDMI cables (Qty 5 or 6)

Maintain the focus at the presenter | Provide detail for every participant
Fixing the Bowling Alley

1 X 4 Splitter
Leviton 41920-SP4

70m HDBT
Extender Set Tx&Rx
Leviton 41920-HT0

Display 1
Display 2
Display 3
Display 4
Projector

HDMI Cable
Category Cable
Accommodating Odd Room Sizes
Fixing the Training Room

A. Flat screen displays (Qty 2)
B. HDMI splitter (Qty 1)
C. HDMI cables (Qty 2 or 3)

Clear the view for all participants and provide sharp detail

Maintain focus on the presenter
Fixing the Training Room

Display/Projector 1

1 X 4 Splitter

Display/Projector 2

HDMI Cable
Choosing the Correct Screen Size

Where will the viewers sit?

• Maximum viewing distance
• Maximum viewing angle
  • Make sure the viewing angle of the viewer falls within the viewing angle of the display or projection screen

What will the viewers do?

• Critical – detailed engineering drawings or spreadsheets
• Reading – presentation slides
• General – training videos or movies
Screen Size and Aspect Ratio

• 4/6/8 Rule of Thumb
  • Critical: Min. Screen Height \times 4 = \text{Max. Viewing Distance}
  • Reading: Min. Screen Height \times 6 = \text{Max. Viewing Distance}
  • General: Min. Screen Height \times 8 = \text{Max. Viewing Distance}

• Aspect Ratio (AR) is the ratio of width (W) to height (H)
  • NTSC: \frac{4}{3} = 1.33
  • HDTV: \frac{16}{9} = 1.78
  • Cinemascope: \frac{2.35}{1} = 2.35

Find the missing screen size!
1. Solve for Screen Height
2. Calculate Width
3. Determine Diagonal Size
Solving for Display or Screen Size

1. We start with max distance  
   \[ 20' = 240” \]

2. Solve for required height using the  
   4/6/8 Rule of Thumb \( (H \times 4, 6, \text{ or } 8) = \text{Max Distance} \)  
   • \( H = \text{Max Distance} / (4, 6, \text{ or } 8) \)  
   \[ 240” \div 6 = 40” \]

3. Solve for the width using the aspect ratio \( (W / H = AR) \), in most cases HDTV \( (16 / 9 = 1.78) \)  
   • \( W = H \times AR \)  
   \[ 40” \times 1.78 = 71.2” \]

4. Use Pythagorean Theorem \( (H^2 + W^2 = D^2) \) to solve for the diagonal size \( (D) \)  
   • \( D = \sqrt{(H^2 + W^2)} \)  
   \[ \sqrt{(71.2)^2 + (40)^2} \approx 82” \]
Classroom Example

• Students in the back row are 24 feet from the screen

• They will be looking at slide presentations

• The client plans on an HDTV format display
Classroom Example

1. Use 6x Rule of Thumb for **Reading** to get recommended screen height (Max Distance / 6 = H)
   a) Find the Height  
   \[ \frac{24'}{6} = 4' \text{ H} \]
   b) Find the Width for HDTV  
   \[ 4' \times 1.78 \text{ AR} = 7.12' \text{ W} \]

2. Find the diagonal using the Pythagorean Theorem \( \sqrt{H^2 + W^2} \)
   a) \( \sqrt{4^2 + 7.12^2} = \sqrt{16 + 50.7} = \sqrt{66.7} = 8.17' \)
   b) Convert feet to inches by multiplying by 12  
   \[ 8.17' \times 12 = 98 \text{ inches} \]

We need a display or projector screen of at least 98” diagonal
Thank Goodness for the Internet

1. Max Viewing Distance = 24’
2. Min Screen Height
   • $24’ / 6 = 4’ (48”)$
3. Aspect Ratio = 1.78
4. Screen Width
   • $4’ \times 1.78 = 7.12’ (85.5”)$
5. Internet Search
   “Pythagorean Theorem calculator”

Min display size 98” diagonal
New AV Technologies Not Supported by Old AV Cabling

Moving on from VGA
Passive HDMI cables are not enough
HDMI extension – plug and play
Video Extension Options

• Why are HDMI Cords not enough?
  • Distance
  • Retrofit
• What solutions are available that require an AV staff to support?
  • Traditional distribution amplifiers and matrix switches
• What solutions are available that the IT team can support?
  • Video over Ethernet/IP
  • Wi-Fi
• What if there is no AV or IT staff to support?
  • Dependable plug-and-play solutions
Moving from a VGA to HDMI Projector

• 1/2” conduit in the wall
• VGA cable (field terminated)

• But, the HDMI cable connector is huge
• At least 7/8” diagonal

• Oh oh!
HDBaseT – More than Just Video and Audio

1. Full digital audio
2. HDMI uncompressed video
3. 100Mb Ethernet channel
4. Power over HDBaseT (PoH)
5. Control via RS-232 and IR

Simultaneous transmission of All 5 on a single category cable
Moving from VGA to HDMI Projector

• 1/2” conduit in the wall

• Not a problem for Cat 6A cable

• But remember the properties of HDBaseT
  • Like 10GBaseT
  • Alien crosstalk
Moving from VGA to HDMI Projector

70m HDBT Extender Set Tx & Rx
Leviton 41920-HT0
Moving from VGA to HDMI Projector

If you still have VGA devices — no problem — use an HDBaseT transmitter with built-in VGA to HDMI scaler.
The Distance Headache – HDMI Cables

• When the source is right next to display? All is good!

• When the source is remote from the display? Not so good!

Max recommended HDMI cable length for dependable performance is 15’ (5m) at 1080p
The Distance Headache — Cured!

- 100m HDBaseT Extender Solution – Leviton 41920-HTE
  - Single Cat 6A UTP cable
  - Powered from either end (PoH)
Hard to Share Content / Collaborate

Multiple input switching
Collaboration and Huddle Spaces

• Popularity of impromptu meeting spaces and remote collaboration

• Attempting to share wirelessly or connecting directly to the display

• Security concerns for both the network and guest devices
Automatic Sharing (Switching)

Just plug in and get the display!

3X1 Switcher

HDMI Extender Rx

Laptop

Tablet

Autoswitching Wallplate

HD Display

- HDMI Cable
- Category Cable
- VGA + Audio Cable
Controlled Sharing (Switching)

- 8-Button Control Panel
  Leviton 41920-CP8

- HDMI Extender Rx

- Learned and stored IR commands for display

- Laptop

- Tablet

- IR Emitter

- HD Display

- HD Display

- HDMI Cable
- Category Cable
- VGA Cable
- IR
Controlled Sharing (Switching)
Display Sharing - 4 Input Sources

Just plug in and get the display!

4X1 Switcher

Leviton 41920-SW4

HDMI Cable
Category Cable
Audio Cable
Video Looks Great!

(Audio Sounds Terrible)

Eliminating lip sync
Audio extraction
More speaker and amp options
Multiple levels of volume control
Speaker Layout
Eliminating the Lip Sync Headache

• Lip Sync: technical term for matching a speaking or singing person’s lip movement to the audio heard by the listener

• Can be video or audio delay – usually video delay due to signal processing at the display or projector

• Simplest and least expensive cure: Utilize the audio output from the video display device
Eliminating the Lip Sync Headache

Audio Amplifier

HDMI Cable

Audio Cable

Speaker Cable

Display / Projector

HDMI Cable

Audio Cable

Speaker Cable
Eliminating the Lip Sync Headache

When you don’t have a convenient audio output — insert an HDMI audio extractor!

Audio Amplifier

HDMI Audio Extractor Leviton 41920-HAE

Display / Projector

- HDMI Cable
- Audio Cable
- Speaker Cable
Adding More Speakers

Series: \[ Z_{\text{total}} = Z_1 + Z_2 \]
\[ = 4 + 4 \]
\[ = 8 \text{ ohms} \]

Parallel: \[ Z_{\text{total}} = \frac{1}{\frac{1}{Z_1} + \frac{1}{Z_2}} \]
\[ = \frac{1}{\frac{1}{8} + \frac{1}{8}} \]
\[ = 4 \text{ ohms} \]

Stereo Mixing Amplifier
Leviton 41920-A01

HDMI Cable
Audio Cable
Speaker Cable

Display / Projector
Even MORE Speakers!

- 70V amplifier supports many speakers up to 40 watts
- Mono output
- Simple daisy chain with 16/2 wire
- Select appropriate transformer tap to adjust level for various areas
Headache: Microphones

- Leviton audio amplifiers are mixing amplifiers
- Multiple inputs including mic
- Each input controllable for level and tone
- Mic input supports:
  - Dynamic mic
  - 48V phantom power for a condenser mic
  - Line level input
- Ducking function on 70v
Multiple Volume Controls

• Best to have 1 volume control
• But many sources have their own volume control
• Add a display or projector and amplifier – yet another headache!
Layered Volume Control

• If possible, take the remote out of the equation by using display settings to set a constant audio output level (line out)

• Set source to mid level

• Set amplifier to lowest setting and set display output level to maximum without distortion

• Adjust amplifier for appropriate listening level and if needed adjust display output level again for no distortion
Speaker Layout Example

• 26’ x 20’ Classroom size
• Students will be seated, but will sometimes move around in a technical lab atmosphere

• How many in-ceiling speakers do we need?
• What is the distance between in-ceiling speakers?
Speaker Layout

- Sitting or standing?
  - Sitting – 3’6” standard height
  - Standing – 5’6” standard height

- Identify speaker dispersion angle
  - Determine diameter of the conic section that intersects the standard height of the listener
Known:

Ceiling = 9’
Standing 5’6” = 3’6” from ceiling (42”)
Sitting 3’6” = 5’6” from ceiling (66”)
Assume dispersion angle is 120°

1. Calculate speaker coverage distance (conic section) at standing height, D
2. Divide dispersion angle by 2 to obtain a right triangle: 120° / 2 = 60°
3. Using the properties of a right triangle we determine ½ the coverage distance, d
   a) Tangent 60° = d / 42” and d = Tangent 60° x 42” = 72.75” = TAN(RADIANS(60)) * 42
   b) D = 2 x d = 72.75 x 2 = 145.5”
   c) D = 145.5” / 12” = 12.1’
4. Similarly the calculation for seated height (3’ 6”) yields a conic section = 19’
Speaker Layout

<table>
<thead>
<tr>
<th>No Overlap</th>
<th>Minimum Overlap</th>
<th>Maximum Overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="No Overlap Diagram" /></td>
<td><img src="image2" alt="Minimum Overlap Diagram" /></td>
<td><img src="image3" alt="Maximum Overlap Diagram" /></td>
</tr>
</tbody>
</table>

- **-4.4dB**
  SPL Variation throughout sound field
  Distance between speakers = Conic Section

- **-2.0dB**
  SPL Variation throughout sound field
  Distance between speakers = 75% of Conic Section

- **-1.4dB**
  SPL Variation throughout sound field
  Distance between speakers = 50% of Conic Section

*SPL = Sound Pressure Level*
Speaker Placement

- 26’ x 20’ classroom
- Seated Listeners = 3’6” high
- Conic section = 19’
- Distance between Speakers = 50% of Conic section (9’6”)

Provides maximum overlap for students who will be seated and move around the room in a technical lab atmosphere.
Grounding and Bonding of Shielded Cable

UTP cable with crosstalk prevention technology
Grounding and Bonding of Shielded Cable

- HDBaseT signals are similar to 10GBase-T
  - 300-500MHz clock
  - Alien crosstalk
  - Headaches when there are adjacent rooms or multiple links

- Which cable?
  - Shielded or UTP
  - If shielded you must ground and bond

- Where do you ground and bond?
  - Your option is the Telecommunications/Equipment Room
Grounding and Bonding of Shielded Cable

- In point-to-point applications, it is often impractical to get to the TR
  - More expensive cable and connectivity
  - More labor intensive than UTP cable
- Perils of not bonding and grounding
  - Safety
    - High voltage crossed onto the shield
  - Signal integrity
    - Drain wire becomes an antenna
Grounding and Bonding of Shielded Cable

• An alternative to shielded cable
  • XTP or intermittent shielded cable with alien crosstalk prevention technology

Berk-Tek Leviton Technologies Connectivity Systems for AV

AV6850
Cat 6A Premium 10G AV System
  • Recommended for high speed and low-latency AV applications over 10GBASE-T infrastructure

AV6400
Cat 6 Shielded 1G AV System
  • Recommended for shielded AV applications over 1GBaseT infrastructure
## AV6850 | Cat 6A Premium 10G AV System

<table>
<thead>
<tr>
<th>System Name</th>
<th>Patch Cord</th>
<th>Jack</th>
<th>Cable</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV6850</td>
<td>A)</td>
<td>B)</td>
<td>C)</td>
<td>10G AV support: Business, Universities, Hospitals, Industrial, Retail</td>
</tr>
<tr>
<td>Premium Cat 6A 10G AV System</td>
<td>SlimLine Boot 6AS10-xx*</td>
<td>Atlas-X1 6AUJK-Rx6</td>
<td>LANmark-XTP</td>
<td></td>
</tr>
</tbody>
</table>

### System Topology

NEAR END

- **A**
- **B**

90m

**C**

FAR END

- **A**
- **B**
AV6400 | Cat 6 Shielded 1G AV System

<table>
<thead>
<tr>
<th>System Name</th>
<th>Patch Cord</th>
<th>Jack</th>
<th>Cable</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV6400 Cat 6 Shielded 1G AV System</td>
<td>A) SlimLine Boot 6S560-xxx</td>
<td>B) Atlas-X1 61SJK-Rx6</td>
<td>C) LANmark-HD</td>
<td>1G AV support: Business, Universities, Hospitals, Industrial, Retail</td>
</tr>
</tbody>
</table>

System Topology

NEAR END

5m

Switch

Patch Panel

B

90m

C

FAR END

5m
## Common AV Headaches – Prevented

<table>
<thead>
<tr>
<th>Headache</th>
<th>Prescription</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accommodating odd room sizes</td>
<td>Adding displays and speaker placement</td>
</tr>
<tr>
<td>New AV technologies not supported by old AV cabling</td>
<td>HDBaseT extension on Category cable</td>
</tr>
<tr>
<td>Hard to share content/collaborate</td>
<td>Auto and manual input switchers</td>
</tr>
<tr>
<td>Video looks great, audio sounds terrible</td>
<td>Audio extraction, amps and speakers</td>
</tr>
<tr>
<td>Grounding and bonding of shielded cable</td>
<td>UTP cable with crosstalk prevention tech</td>
</tr>
</tbody>
</table>
Thank you

David Stoltz, Leviton Network Solutions

www.leviton.com/itav