Installing AV in New Age Collaboration Spaces

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Extron
“How do I install a Collaboration Space?”
Many Questions

- What TV?
- HDMI or VGA?
- USB?
- Control?
- Cables?
- Wireless?
- Do we dig a trench?
- Furniture?
- Room scheduling

- Audio
- Microphones
- Speakers
- Amplifiers
- Motion sensors
- Lights
- Cable paths
- Mounting Hardware
- VTC?
Classrooms are Changing
Classroom
Boardrooms are Changing
Huddle Room
Huddle Room with Soft VTC
Collaboration Space Considerations
Keys to Success in this Collaboration Arena (three C’s)

○ Connectivity
  – Cable Access
  – CATx, AV, Wireless, and USB

○ Conferencing Interface
  – Zoom..Skype...your laptops or phones
  – Phone interface
  – VOIP

○ Control
  – Simple
  – Push button
  – Motion sensor
  – Touchpanel with Interface
Basics of Installing

- Signal Integrity
  - Using Shielded CATx cable
  - HDMI and USB
- Table Power
- Conferencing Interface
  - ZOOM / Skype
- Wireless Video
- Audio
  - Usually using Speakers on Display
- Control
  - “people forget this all the time”
- Room Scheduling
AV Technology Deployment

4 Types
Hard Wired AV Infrastructure Using CATx

- Wired AV connections offer benefits related to reliability
Wireless AV

- Wireless AV offers flexibility, mobility, and benefits for installations that have architectural challenges
AV Streaming

- Multiple platforms available for greater exposure
  - YouTube
  - Panopto
  - LMS
- Highly scalable with most AV and control signals existing on the same cable
AV over IP

○ Audio
  – AES67

○ Video
  – Codec
  – Compression

○ Network
  – Layer 3 Protocols
  – Security
Agenda

• Displays
• Mounting Hardware
• Connectivity
  – HDMI
  – USB
• Cables and Cabling Standards
• Wireless

• Cable Paths
• Audio
• Room Automation
• Control
• Room Scheduling
• Designs
• AV over IP
Displays
Resolutions

- Old Resolutions
- New standard 1080p
- Headed to 4K/UHD and 8K
4K and Ultra HD Resolution Comparison

- **HD**: 1920x1080
- **UHD**: 3840x2160
- **5K**: 5120x2880
- **8K**: 7680x4320
Ultra HD Video Signal Parameters

○ Ultra HD is 3840x2160
  – Four times the resolution of 1080p
  – Targeted towards consumer and broadcast markets

○ Ultra HD refresh rates
  – Varies – 24 Hz up to 60 Hz

○ Color bit depth
  – 8-Bit, 10-bit, and 12-bit

○ Aspect Ratio
  – 16:9 – same as 1080p
Connectivity
Connectivity

- Digital Video Characteristics
- HDMI
- Fiber Optic HDMI
- HDMI to USB
- USB
Digital Video Characteristics – Loss

- Digital video signals consist of high-speed transitions
- Very susceptible to degradation from:
  - Cable attenuation
    - Cable capacitance
    - Cable resistance
    - Impedance mismatch
  - Noise coupling
  - Crosstalk
  - Jitter
- All factors that Affect the receiver’s ability to distinguish high and low transitions
Digital Video Characteristics – Loss

- Difficult to anticipate
  - Image quality does not degrade like analog

- Cliff effect
  - Occurs when the receiver can no longer distinguish high and low values
    - Too many bit errors have occurred
Digital Video Characteristics – Variables

○ Cables can vary widely in performance
  – Adapters are useful but may affect signal quality

Damage caused by faulty HDMI connector
Digital Signals – HDMI

- HDMI is an uncompressed digital video signal
  - Designed for the consumer market

<table>
<thead>
<tr>
<th>Standard</th>
<th>Data Rate</th>
<th>Chroma Sampling</th>
<th>4K/UHD @ 30 Hz</th>
<th>4K/UHD @ 60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDMI 1.4a</td>
<td>10.2 Gbps</td>
<td>4:4:4</td>
<td>1 cable, 8-bit</td>
<td>2 cables, 8-bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 cables, 16-bit</td>
</tr>
<tr>
<td>HDMI 2.0/a/b</td>
<td>18.0 Gbps</td>
<td>4:4:4</td>
<td>1 cable, 16-bit</td>
<td>1 cable, 8-bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 cables, 16-bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4:2:0</td>
<td>n/a</td>
<td>1 cable, 16-bit</td>
</tr>
<tr>
<td>HDMI 2.1</td>
<td>48.0 Gbps</td>
<td>4:4:4</td>
<td>1 cable, 16-bit</td>
<td>1 cable, 16-bit</td>
</tr>
</tbody>
</table>
Fiber Optic HDMI

- Hardwired

- Adapters
**HDMI to USB**

- Supports all HDMI 1.4
- Video resolutions up to Ultra HD @ 30 Hz
Digital Signals – USB

○ A standard for communication protocols that includes cables and connectors

○ Historically used for attaching peripheral devices to computers

○ Maximum length of USB 2.0 cable: The 2.0 specification limits the length of a cable between USB 2.0 devices (Full Speed or Hi-Speed) to **5 meters** (or **about 16 feet** and 5 inches).
USB Interface Connectors

- Type-A
- Type-B
- USB Mini
- USB Micro
- USB-C
USB Type-C

- Send Data, Video, Audio, and Power
- Latest, high speed, reversible USB
- Deliver up to 100 watts! Devices negotiate...
- Supports “alternate modes”... like DisplayPort and HDMI
Digital Signals – USB

- Over the year’s speeds have increased, providing additional options for transporting video and audio.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Data Rate</th>
<th>Maximum Output Power</th>
<th>Power Direction</th>
<th>Cable Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB 1.1</td>
<td>12 Mbps Full Speed</td>
<td>2.5V, 500mA</td>
<td>Host to peripheral</td>
<td>Type-A to Type-B</td>
</tr>
<tr>
<td>USB 2.0</td>
<td>480 Mbps High Speed</td>
<td>2.5V, 1.8A</td>
<td>Host to peripheral</td>
<td>Type-A to Type-B</td>
</tr>
<tr>
<td>USB 3.0</td>
<td>SuperSpeed USB (5 Gbps)</td>
<td>5V, 1.8A</td>
<td>Host to peripheral</td>
<td>Type-A to Type-B</td>
</tr>
<tr>
<td>USB 3.1</td>
<td>SuperSpeed USB 10 Gbps</td>
<td>20V, 5A</td>
<td>Bi-directional</td>
<td>Type A or Type B to Type-C, Type-C both ends</td>
</tr>
<tr>
<td>USB 3.2</td>
<td>SuperSpeed USB 20 Gbps</td>
<td>20V, 5A</td>
<td>Bi-directional</td>
<td>Type-C both ends</td>
</tr>
<tr>
<td>USB 4</td>
<td>SuperSpeed USB 40 Gbps</td>
<td>20V, 5A</td>
<td>Bi-directional</td>
<td>Type-C both ends</td>
</tr>
</tbody>
</table>
Cables and Cable Standards
HDBaseT

- HDBaseT Alliance, is a consumer electronic (CE) and commercial connectivity standard for transmission of uncompressed high-definition video (HD), audio, power, home networking.
Twisted Pair Transmission

○ Distance
  – 328 feet (100 meters) between endpoints
Why Use Twisted Pair?

- One twisted pair cable can carry multiple signals
  - Video
  - Audio
  - Bidirectional RS-232 control and IR
  - Ethernet
  - Remote Power
Twisted Pair Transmission

- Cable
  - Supports CATx cable
  - Solid conductor, shielded twisted pair cable with shielded connectors should always be used
  - Skew-free cable should not be used with XTP Systems
Twisted Pair Signal Transmission

- Shielded cable protects against outside interference from:
  - Air conditioning units
  - Power from adjacent cabling
  - Crosstalk from other cables or within the same cable
  - Radio interference from walkie-talkies

- Symptoms of noisy environments
  - Image drop-out or flashing
  - No image at all
Twisted Pair Shielding

- Different types of twisted pair shielding

<table>
<thead>
<tr>
<th>Cable Name</th>
<th>Outer Shielding</th>
<th>Individual Pair Shielding</th>
</tr>
</thead>
<tbody>
<tr>
<td>U/UTP</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>F/UTP</td>
<td>Foil</td>
<td>None</td>
</tr>
<tr>
<td>U/FTP</td>
<td>None</td>
<td>Foil</td>
</tr>
<tr>
<td>S/FTP</td>
<td>Braided</td>
<td>Foil</td>
</tr>
<tr>
<td>SF/UTP</td>
<td>Braided &amp; Foil</td>
<td>None</td>
</tr>
</tbody>
</table>
## Twisted Pair Signal Transmission

- **Types of Category cable**

<table>
<thead>
<tr>
<th>Cable</th>
<th>Gauge</th>
<th>Conductor</th>
<th>Outer Shield</th>
<th>Pair Shielding</th>
<th>Required Bandwidth</th>
<th>Crosstalk Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT 5e (U/UTP)</td>
<td>24</td>
<td>Solid</td>
<td>None</td>
<td>None</td>
<td>100 MHz</td>
<td>~27dB</td>
</tr>
<tr>
<td>CAT 5e (F/UTP)</td>
<td>24</td>
<td>Solid</td>
<td>Foil</td>
<td>None</td>
<td>100 MHz</td>
<td>~27dB</td>
</tr>
<tr>
<td>CAT 6 (U/UTP)</td>
<td>24-23</td>
<td>Solid</td>
<td>None</td>
<td>None</td>
<td>250 MHz</td>
<td>~37dB</td>
</tr>
<tr>
<td>CAT 6 (STP)</td>
<td>24-23</td>
<td>Solid</td>
<td>Foil</td>
<td>None</td>
<td>250 MHz</td>
<td>~37dB</td>
</tr>
<tr>
<td>CAT 6a (U/UTP)</td>
<td>24-23</td>
<td>Solid</td>
<td>None</td>
<td>None</td>
<td>500 MHz</td>
<td>~37dB</td>
</tr>
<tr>
<td>CAT 6a (F/UTP)</td>
<td>24-23</td>
<td>Solid</td>
<td>Foil</td>
<td>None</td>
<td>500 MHz</td>
<td>~37dB</td>
</tr>
<tr>
<td>CAT 6a (U/FTP)</td>
<td>24-23</td>
<td>Solid</td>
<td>None</td>
<td>Foil</td>
<td>500 MHz</td>
<td>~37dB</td>
</tr>
<tr>
<td>CAT 6a (SF/UTP)</td>
<td>24</td>
<td>Solid</td>
<td>Braid and Foil</td>
<td>None</td>
<td>500 MHz</td>
<td>~37dB</td>
</tr>
<tr>
<td>CAT 7 (S/FTP)</td>
<td>24</td>
<td>Solid</td>
<td>Braid and Foil</td>
<td>Foil</td>
<td>600 MHz</td>
<td>~60dB</td>
</tr>
<tr>
<td>CAT 7a (S/FTP)</td>
<td>24</td>
<td>Solid</td>
<td>Braid and Foil</td>
<td>Foil</td>
<td>1 GHz</td>
<td>~60dB</td>
</tr>
</tbody>
</table>
Twisted Pair Installation

○ Cable infrastructure and patch points
  – Up to 2 patch points recommended
Wireless
Wireless Video Applications

- **Point-to-point applications** where source video signal is converted to a modulated RF signal for wireless transmission to a receiver connected to a display.

- **BYOD applications** where computing device encodes and transmits video content over a Wi-Fi network to a receiver connected to a display.
Collaboration with their WAP

TCP/IP Network

Rx with HDMI
Using Your Own WAP
Using Their WAP
Key Features to have in a Wireless Video Platform

○ Easy Wireless and Wired Collaboration
  – Wireless connections via OS mirroring or app
  – Wired connections via HDMI Input
  – Contact/Tally I/O ports
    › Add Motion Sensor
    › Add Button control

○ Multi-Platform Support
  – Mac / Windows runtime or installed app
  – Android / iOS app
  – Apple & Android mirroring
Cable Paths
The Wrong Way
With Core Drilling
With Cable Runway
On Cement
Audio
Microphones

- Boundary Mics
- Ceiling Mics
New Types of MICS

- Ceiling Arrays
- CATx Cable
- POE and POE+
- Steerable Lobes
Speakers

- In Ceiling
- Wall Mounted
- Pendant
- Blends into Environment
Amplifiers

- Impedance – 4Ω/8Ω, 70V, 100V
- Channel Number – 1, 2, 3, 4, 8
- Power Output per channel – < 100 watts, 100-200 watts, > 200 watts
- Networked Audio – Dante, AES67
Room Automation
Simple Motion Sensor

- Motion Sensor wiring

- Control system module for Motion Sensor configuration
How a Timer Works
Occupancy Sensor and Collaboration Technology

- Enters the meeting room
- Connects laptop
- Presses Connect Button

After a configured period of inactivity the system automatically shuts down

CATx Cable up to 230' (70m)
Upgrade Options – Wireless Connectivity

CATx Cable up to 230’ (70m)
Upgrade Options – TouchPanel Control

- Touchpanel
- Ethernet
- LAN
- HDMI/CRC
- CATx Cable up to 230' (70m)
- Occupancy Sensor

Network Connections:
- Touchpanel to Touchpanel
- Touchpanel to Monitor
- Monitor to WordPress
- Raspberry Pi to WordPress
Lighting
Sensor Dimmer Coverage Area

NEMA WD7 Test Grid Coverage (High Sensitivity Setting)

- Major motion coverage: 900 ft² (81 m²)
- Minor motion coverage: 400 ft² (36 m²)

Horizontal Beam Diagram

Vertical Beam Diagram

Signal
- TxD
- RxD
- GND

Connect sensing switch
Conecte el sensor con interruptor
Connecter le détecteur interrupteur

RS232 LINK

BICSI FALL
Conference & Exhibition
Control
Push Button Controllers

These do NOT count!
Push Button Controllers

These do NOT count!
Single Display Application

1. PC connected via Ethernet to TCP/IP Network.
2. Blu-ray Player connected to network via Ethernet.
3. HDMI with embedded audio from Blu-ray Player to PC.
4. Projector with internal speakers connected via Ethernet to TCP/IP Network.
5. Screen Control connected to Relay via Ethernet/PoE.
Features of PUSH – Button Controllers

- Manage, monitor, and control AV devices using a standard Ethernet network
- Fully configurable ...NO Programming
- Two bidirectional RS-232 ports
- Two relays for controlling room functions
- One IR port for connecting up to two emitters
- Remote volume control port for external third-party AMPS
Room Scheduling
Scheduling – How It Used To Be
Room Scheduling Panels
Room Scheduling

TCP/IP Network

Room Scheduling Devices
AV over IP Considerations

New Technology
AV over IP – AES 67 Audio Distribution

- AES 67 Standard allows audio transportation over IP based systems
- Interoperability between network audio over IP protocols
- Adds audio networking technology into a variety of applications
- Supports both multicasting and unicasting
AV over IP – Compression

Compression – Three factors

- Bit Rate
- Image Quality
- Latency

<table>
<thead>
<tr>
<th>Video Rate</th>
<th>Uncompressed Bit Rate @ 24 bpp</th>
<th>1G Compression @ 880 Mbps</th>
<th>10G Compression @ 4 Gbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>480p60 (SD)</td>
<td>422</td>
<td>1:1</td>
<td>1:1</td>
</tr>
<tr>
<td>720p60 (HD)</td>
<td>1,330</td>
<td>2:1</td>
<td>1:1</td>
</tr>
<tr>
<td>1080p60 (HD)</td>
<td>2,990</td>
<td>3:1</td>
<td>1:1</td>
</tr>
<tr>
<td>2160p60 (UHD)</td>
<td>11,940</td>
<td>14:1</td>
<td>3:1</td>
</tr>
<tr>
<td>4096x2160 @ 30 (4K/30)</td>
<td>6,370</td>
<td>7:1</td>
<td>2:1</td>
</tr>
<tr>
<td>4096x2160 @ 60 (4K/60)</td>
<td>12,740</td>
<td>14:1</td>
<td>3:1</td>
</tr>
</tbody>
</table>
AV over IP – Compression Ratios

- **MATHEMATICALLY LOSSLESS**
  - H.265
  - VP9
  - H.264

- **VISUALLY LOSSLESS**
  - VC-2
  - JPEG 2000

- **VISUALLY LOSSY**
  - DSC
  - SDVoE

The diagram categorizes compression methods based on their complexity and compression ratio, with options ranging from *<10GBPS* to *<100MBPS*.
AV over IP – Network

- Layer 3 Protocols
  - Multicasting
  - IGMP Snooping
- Client Network?
- Private Network?
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