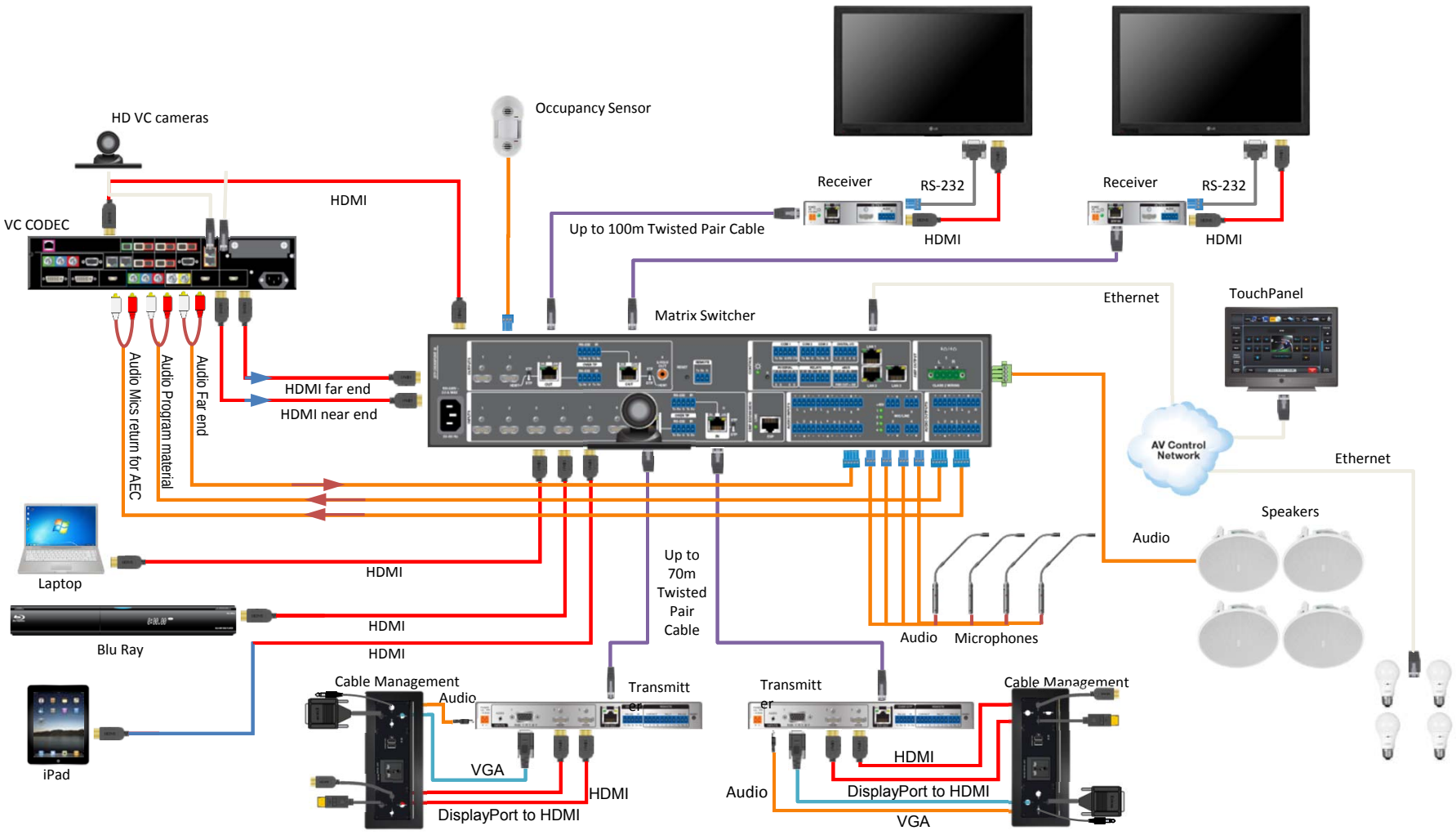
Installing AV in New Age Collaboration Spaces

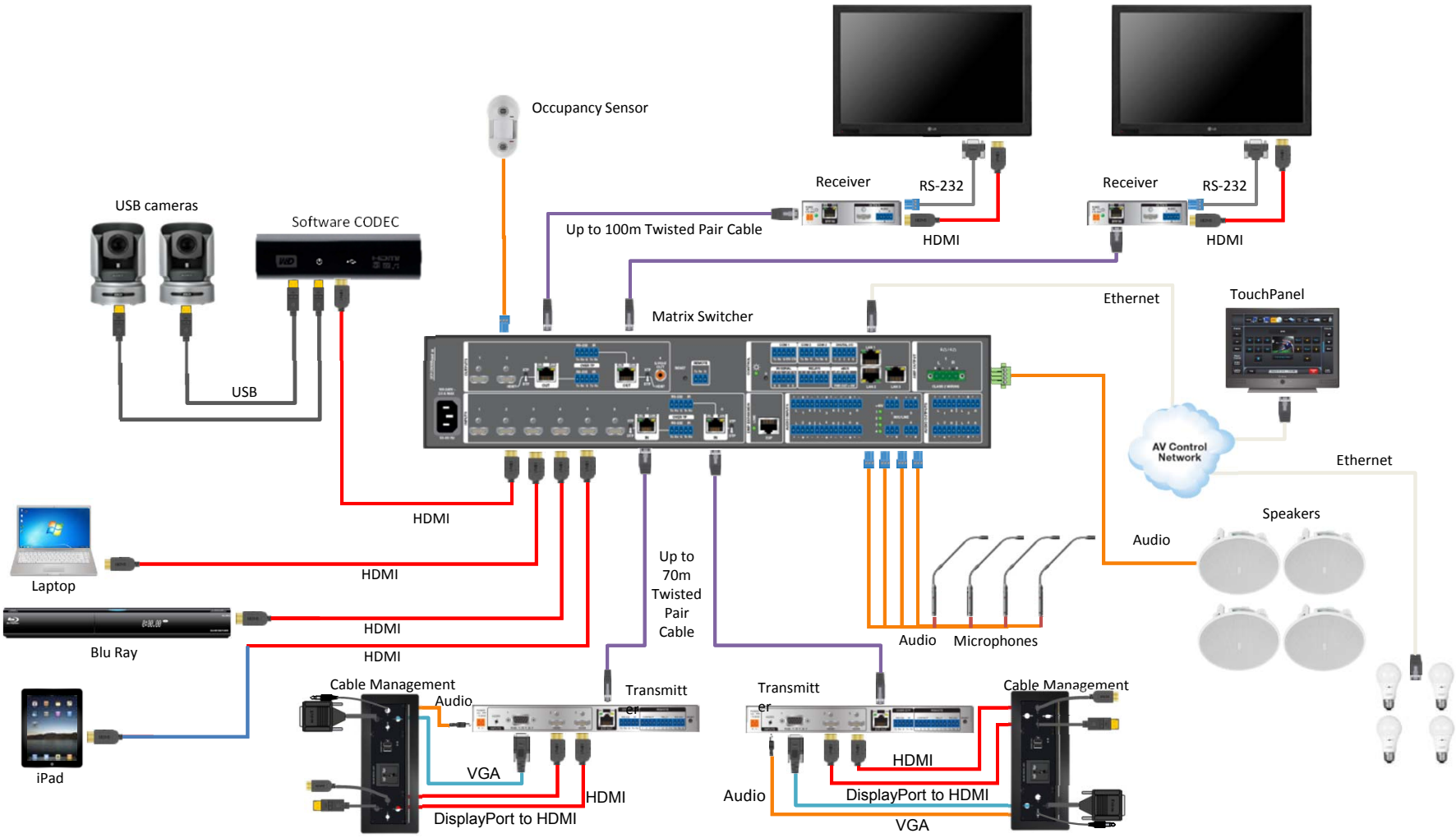
Karl Rosenberg
Extron

“How do I install a Collaboration Space?”

Many Questions

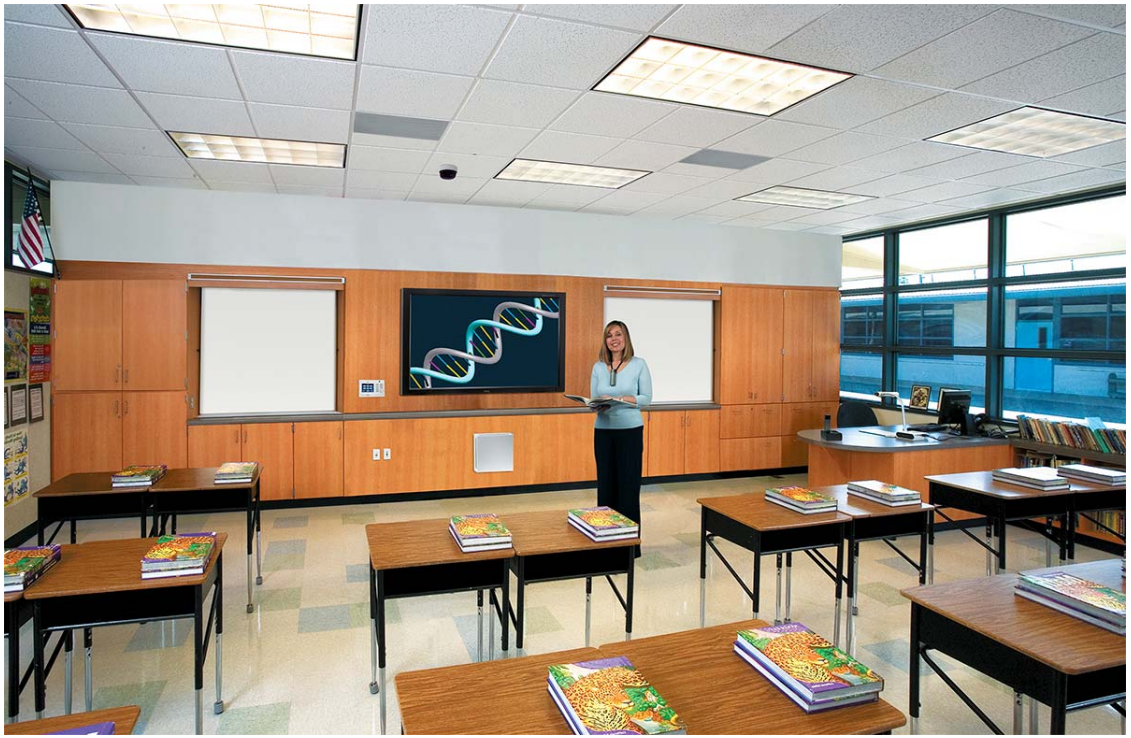
- What TV?
- HDMI or VGA?
- USB?
- Control?
- Cables?
- Wireless?
- Do we dig a trench?
- Furniture?
- Room scheduling
- Audio
- Microphones
- Speakers
- Amplifiers
- Motion sensors
- Lights
- Cable paths
- Mounting Hardware
- VTC?


HD VC cameras
Occupancy Sensor
HDMI
VC CODEC
Up to 100m Twisted Pair Cable
Receiver
RS-232
HDMI
Receiver
RS-232
HDMI
Matrix Switcher
Ethernet
TouchPanel
Audio Mics return for AEC
Audio Program material
Audio Far end
HDMI far end
HDMI near end
AV Control Network
Ethernet
Speakers
Audio
Laptop
HDMI
Up to 70m Twisted Pair Cable
Blu Ray
HDMI
HDMI
Audio
Microphones
Cable Management
Audio
Transmitter
Transmitter
Cable Management
iPad
VGA
HDMI
DisplayPort to HDMI
HDMI
Audio
DisplayPort to HDMI
VGA


Occupancy Sensor
Receiver
RS-232
HDMI
Receiver
RS-232
HDMI
USB cameras
Software CODEC
Up to 100m Twisted Pair Cable
Matrix Switcher
Ethernet
TouchPanel
USB
AV Control Network
Ethernet
HDMI
Speakers
Audio
Laptop
HDMI
Up to 70m Twisted Pair Cable
Blu Ray
HDMI
Audio
Microphones
HDMI
Cable Management
Audio
Transmitt er
Transmitt er
Cable Management
iPad
VGA
HDMI
HDMI
DisplayPort to HDMI
Audio
DisplayPort to HDMI
VGA

Classrooms are Changing

Classroom



Boardrooms are Changing

Huddle Room

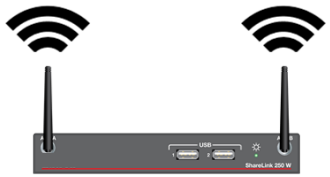
Huddle Room with Soft VTC

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

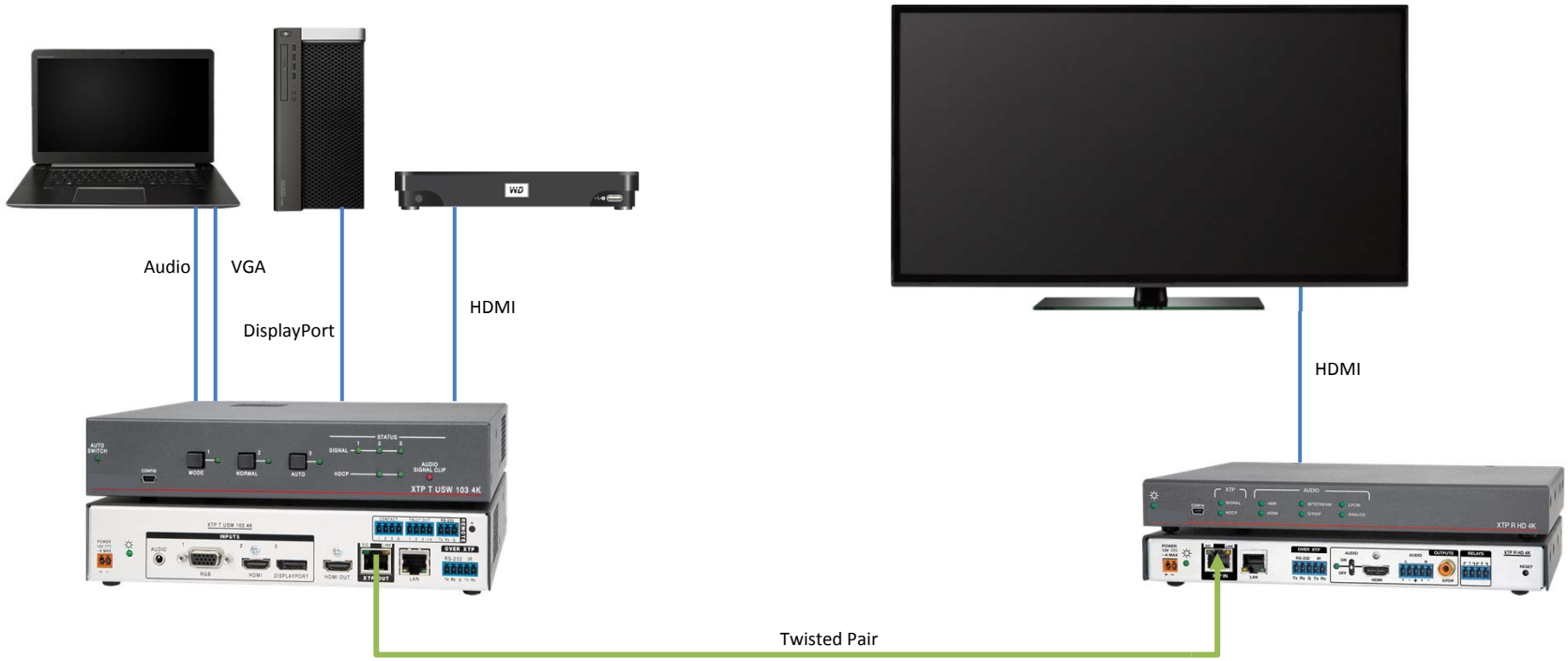
- Signal Integrity
  - Using Shielded CATx cable
  - HDMI and USB
- Table Power
- Conferencing Interface
  - ZOOM / Skype
- Wireless Video
- Audio
  - Usually using Speakers on Display
- Control
  - “people forget this all the time”
- Room Scheduling

AV Technology Deployment

4 Types

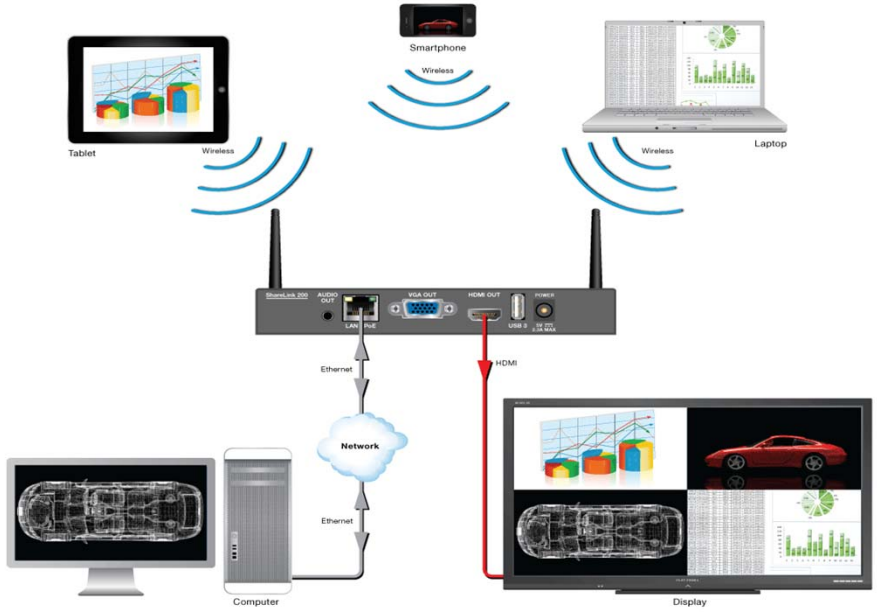
Hard Wired AV Infrastructure Using CATx

- 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

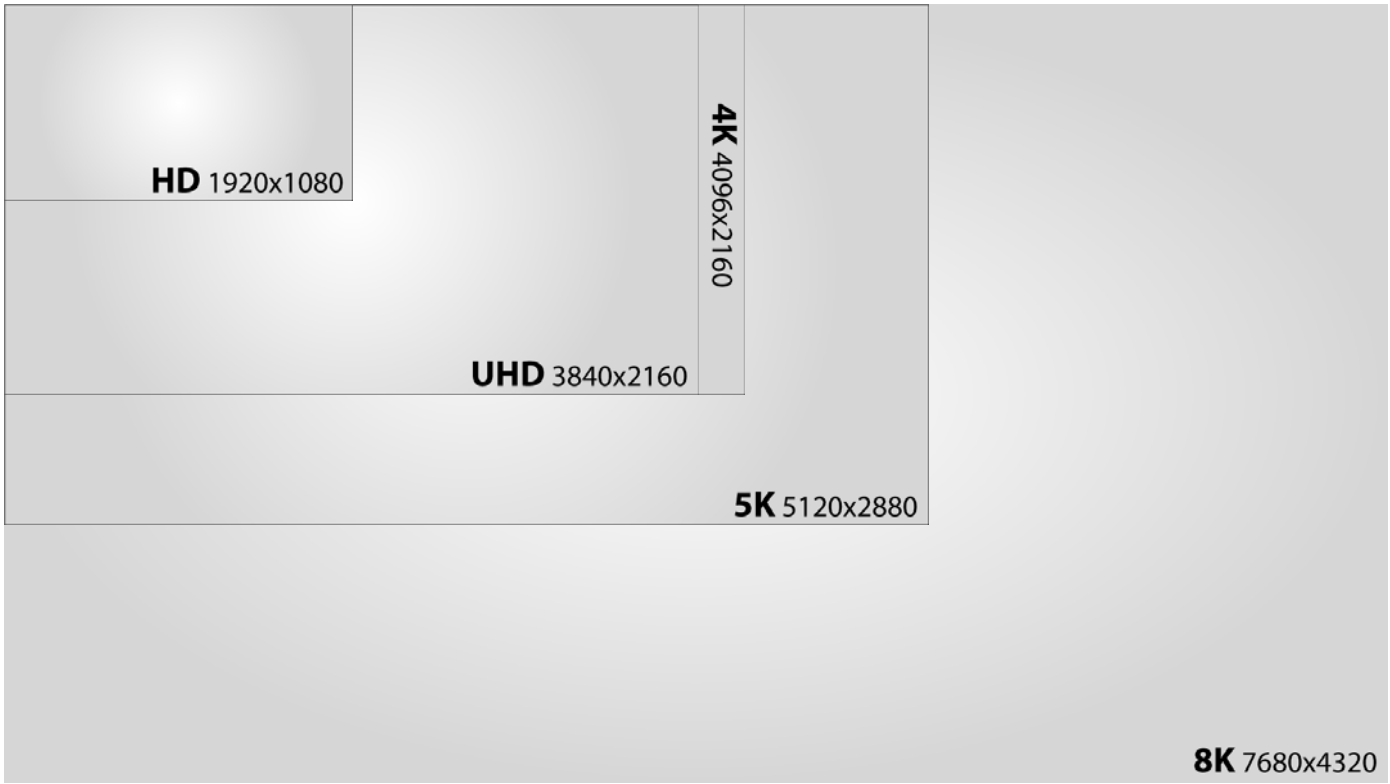
- Displays
- Mounting Hardware
- Connectivity
  - HDMI
  - USB
- Cables and Cabling Standards
- Wireless
- Cable Paths
- Audio
- Room Automation
- Control
- Room Scheduling
- Designs
- AV over IP

Displays

Resolutions

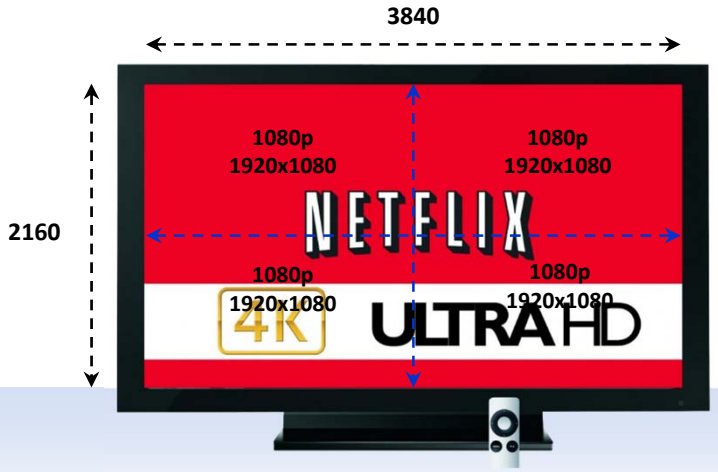
- Old Resolutions
- New standard 1080p
- Headed to 4K/UHD and 8K

4K and Ultra HD Resolution Comparison



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



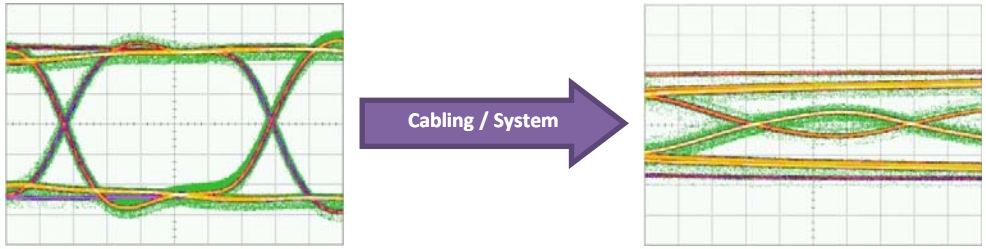
Connectivity

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

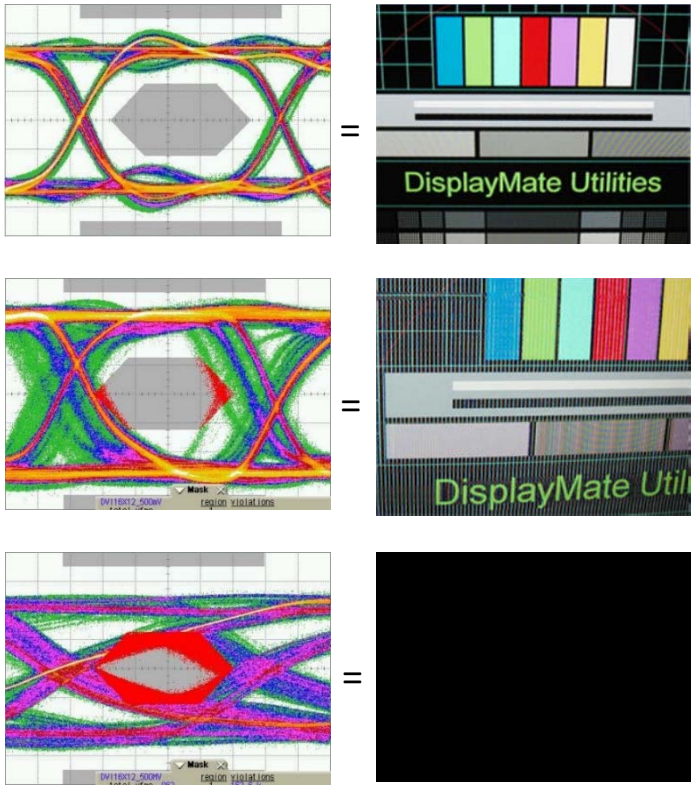


- All factors that Affect the receiver's ability to distinguish high and low transitions

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

Data Rate Capabilities of HDMI				
Standard	**Data Rate**	**Chroma Sampling**	**4K/UHD @ 30 Hz**	**4K/UHD @ 60 Hz**
HDMI 1.4a	10.2 Gbps	4:4:4	1 cable, 8-bit	2 cables, 8-bit
				4 cables, 16-bit
HDMI 2.0/a/b	18.0 Gbps	4:4:4	1 cable, 16-bit	1 cable, 8-bit
				2 cables, 16-bit
		4:2:0	n/a	1 cable, 16-bit
HDMI 2.1	48.0 Gbps	4:4:4	1 cable, 16-bit	1 cable, 16-bit

Fiber Optic HDMI

- Hardwired

- Adapters

HDMI to USB

- Supports all HDMI 1.4
- Video resolutions up to Ultra HD @ 30 Hz

Digital Signals – USB

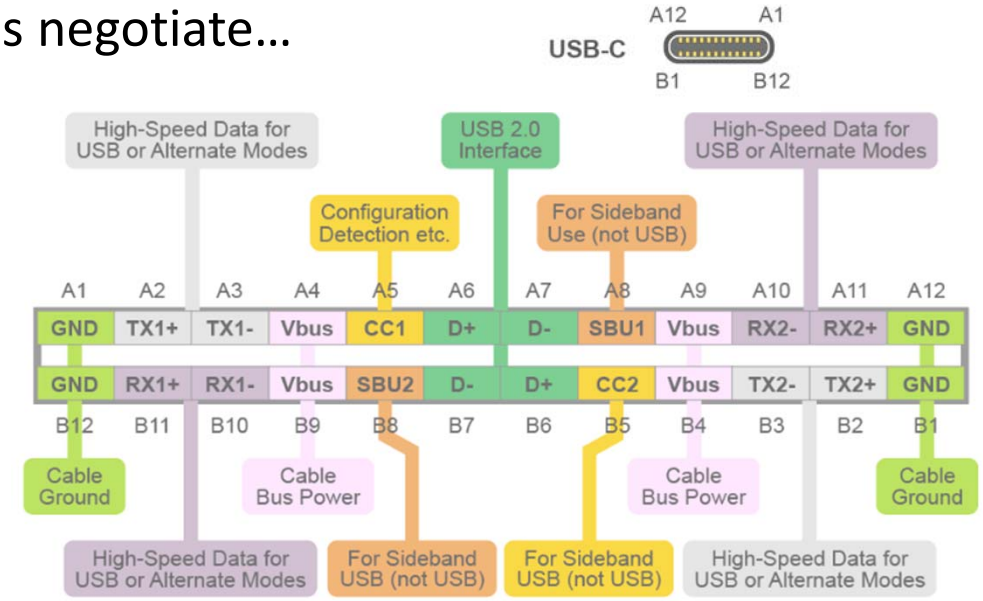
- A standard for communication protocols that includes cables and connectors
- Historically used for attaching peripheral devices to computers
- Maximum length of USB 2.0 cable: The 2.0 specification limits the length of a cable between USB 2.0 devices (Full Speed or Hi-Speed) to **5 meters** (or **about 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

Data Rate Capabilities of USB				
Standard	**Data Rate**	**Maximum Output Power**	**Power Direction**	**Cable Configuration**
USB 1.1	12 Mbps Full Speed	2.5V, 500mA	Host to peripheral	Type-A to Type-B
USB 2.0	480 Mbps High Speed	2.5V, 1.8A	Host to peripheral	Type-A to Type-B
USB 3.0	SuperSpeed USB (5 Gbps)	5Vm 1.8A	Host to peripheral	Type-A to Type-B
USB 3.1	SuperSpeed USB 10 Gbps	20V, 5A	Bi-directional	Type A or Type B to Type-C, Type-C both ends
USB 3.2	SuperSpeed USB 20 Gbps	20V, 5A	Bi-directional	Type-C both ends
USB 4	SuperSpeed USB 40 Gbps	20V, 5A	Bi-directional	Type-C both ends

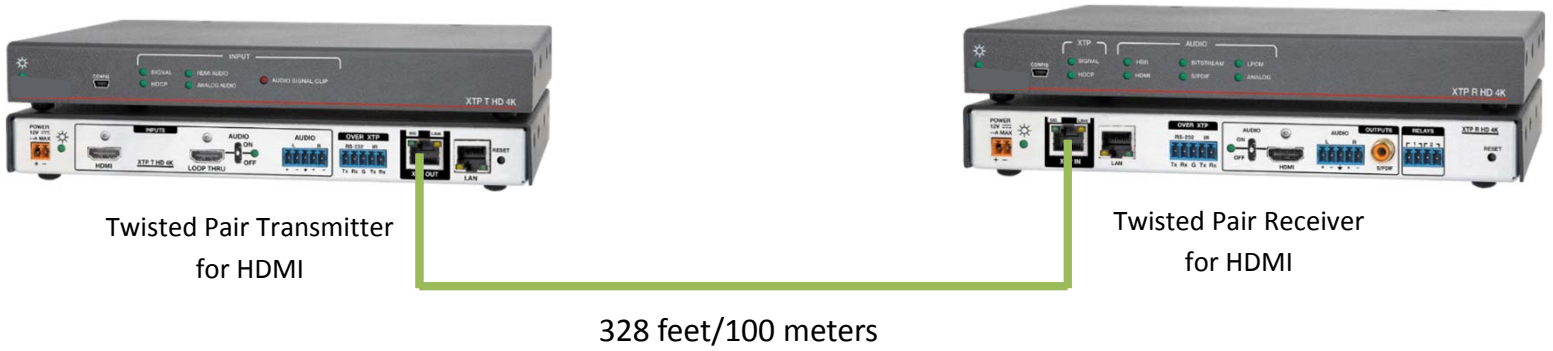
Cables and Cable Standards

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

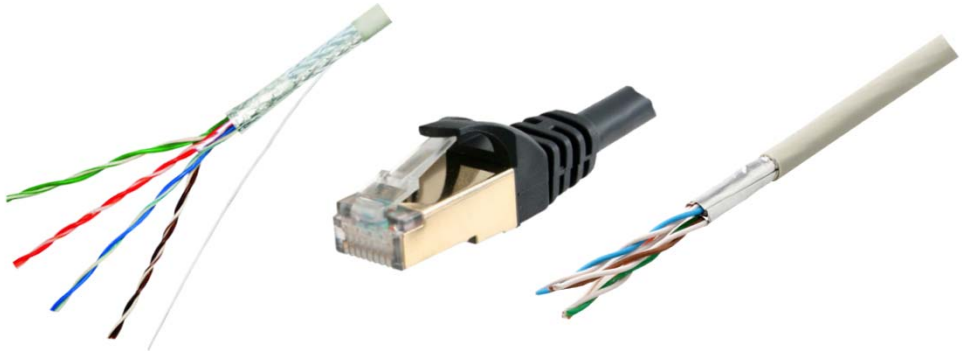


Why Use Twisted Pair?

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

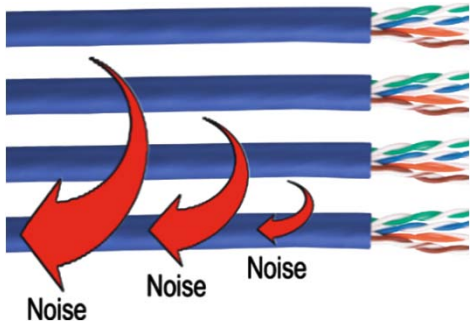
Twisted Pair Transmission

- 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

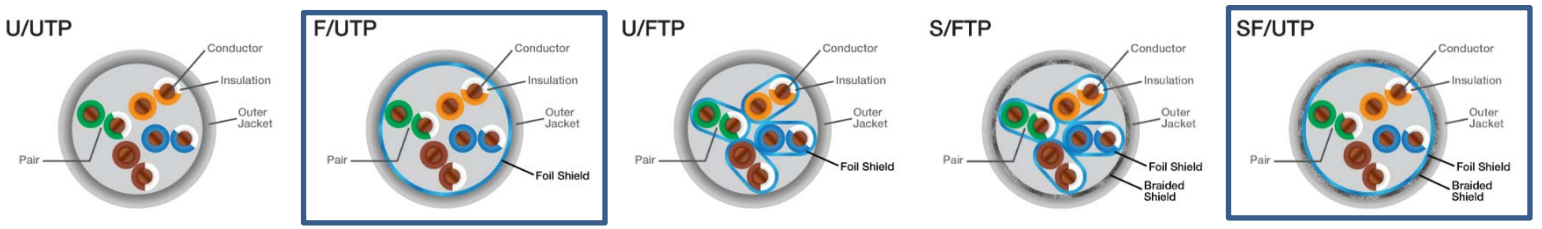


- Symptoms of noisy environments
  - Image drop-out or flashing
  - No image at all

Twisted Pair Shielding

- Different types of twisted pair shielding

Cable Name	Outer Shielding	Individual Pair Shielding
U/UTP	None	None
F/UTP	Foil	None
U/FTP	None	Foil
S/FTP	Braided	Foil
SF/UTP	Braided & Foil	None



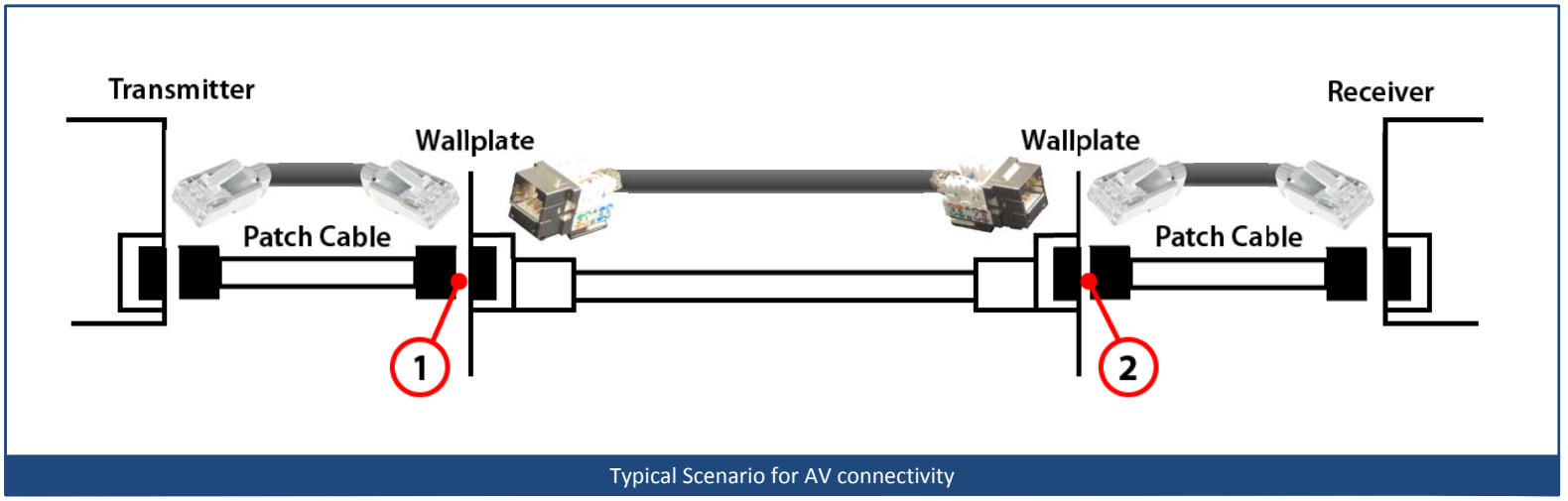
Twisted Pair Signal Transmission

- Types of Category cable

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

Twisted Pair Installation

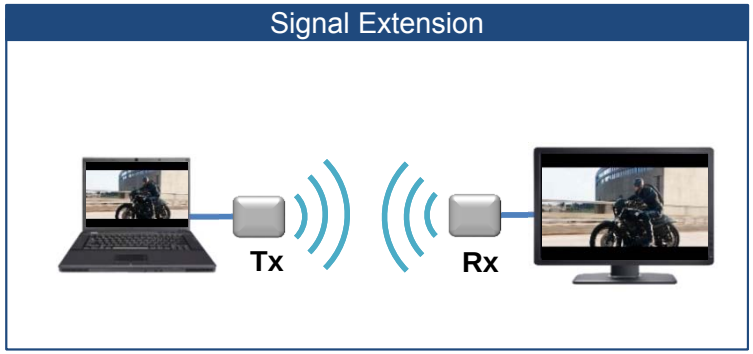
- Cable infrastructure and patch points
  - Up to 2 patch points recommended



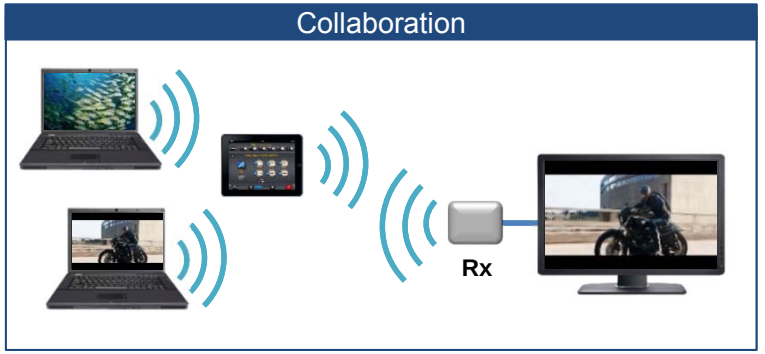
Typical Scenario for AV connectivity

Wireless

Wireless Video Applications

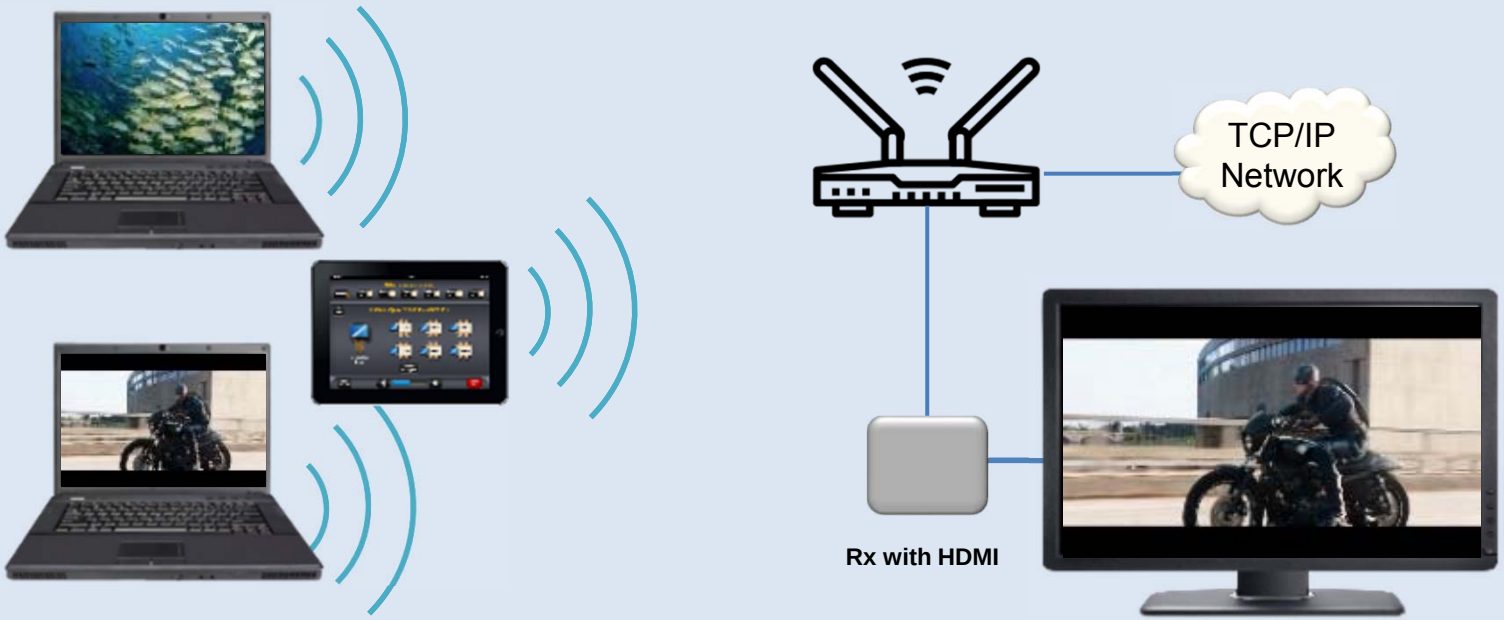


- Point-to-point applications where source video signal is converted to a modulated RF signal for wireless transmission to a receiver connected to a display

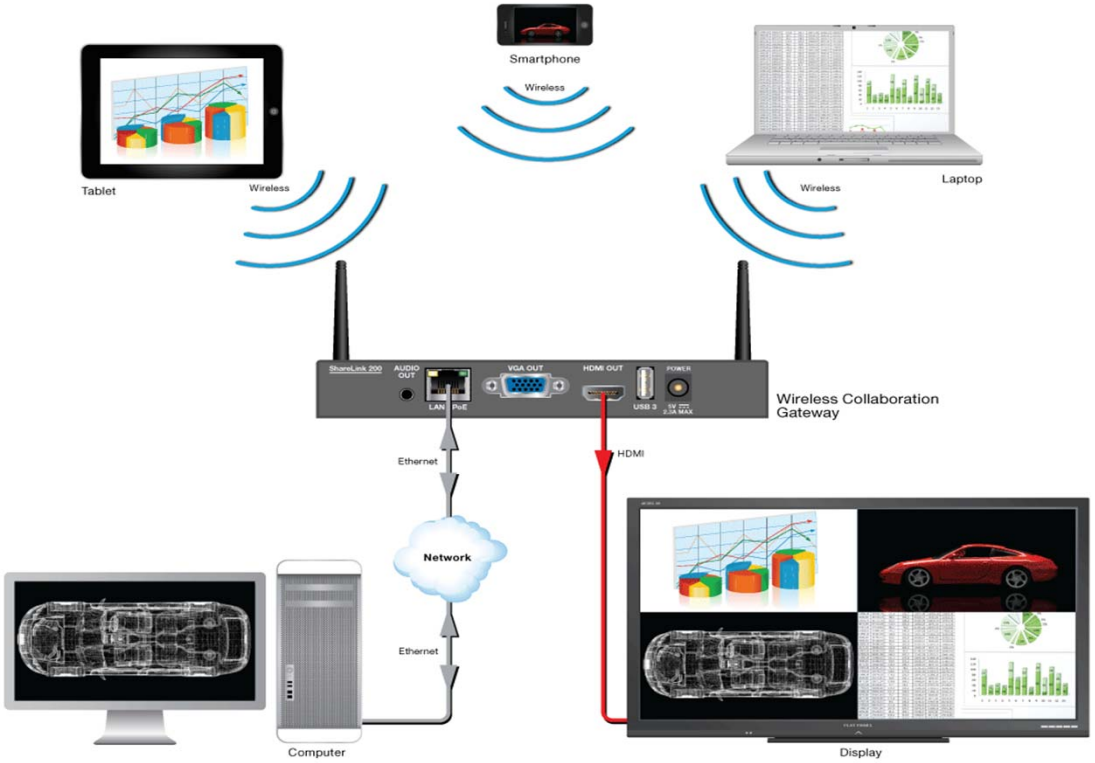


- BYOD applications where computing device encodes and transmits video content over a Wi-Fi network to a receiver connected to a display

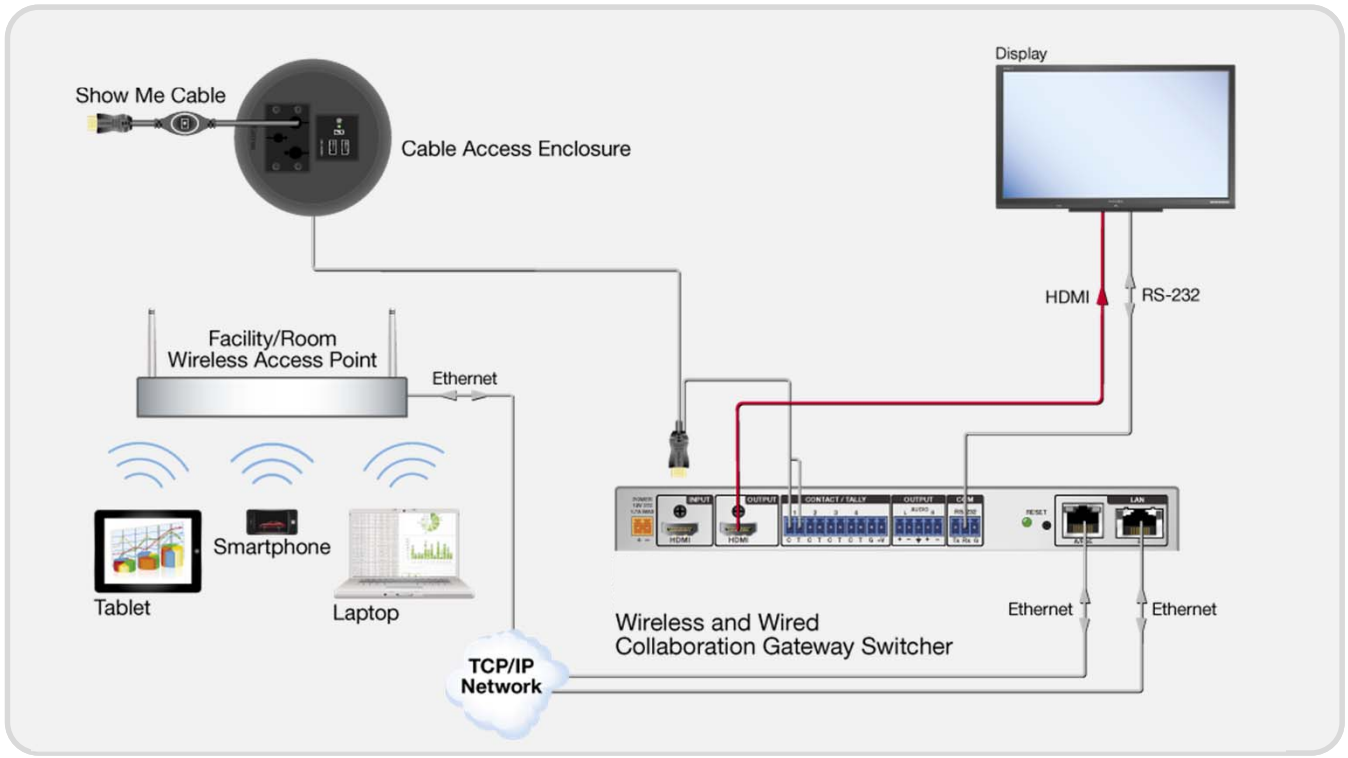
Collaboration with their WAP



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

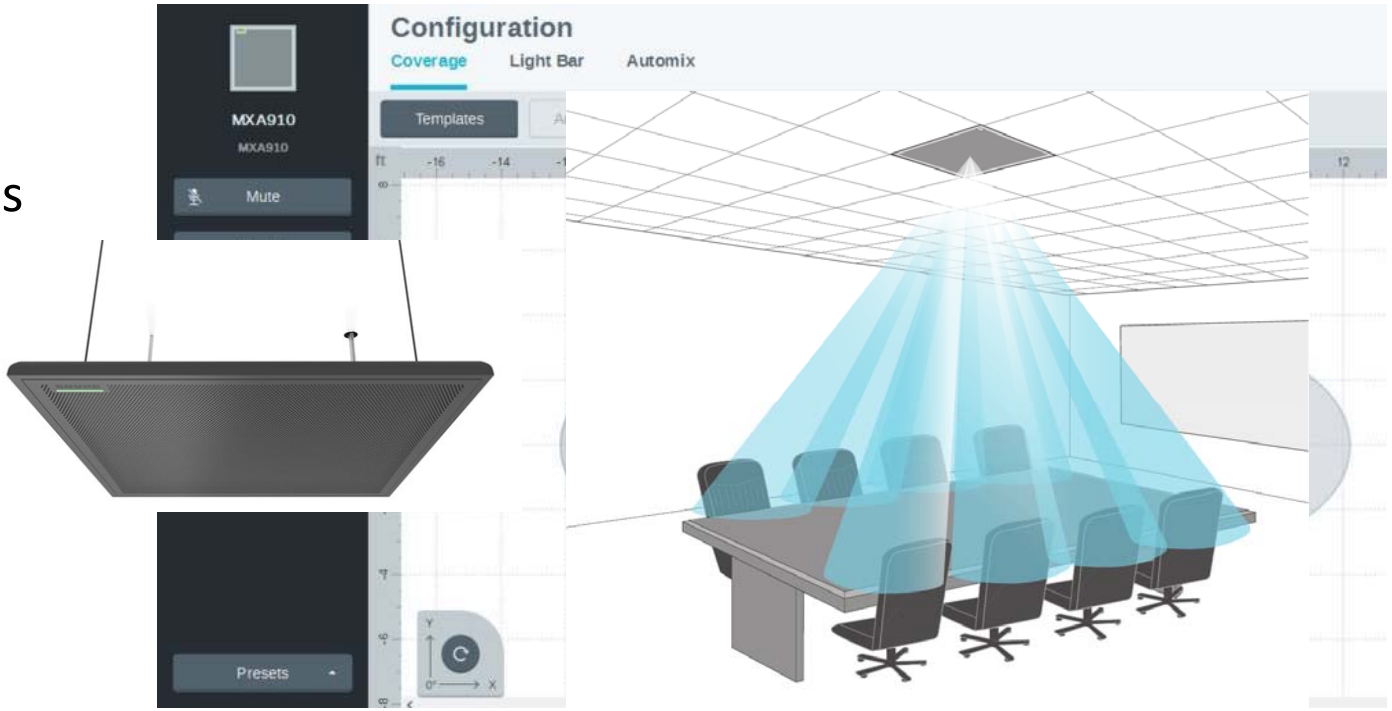
Microphones

- Boundary Mics

- Ceiling Mics

New Types of MICS

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

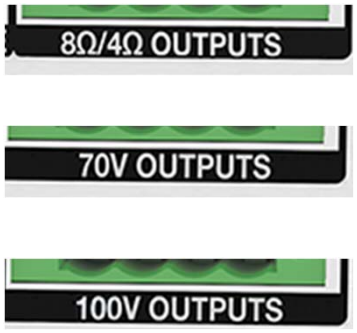


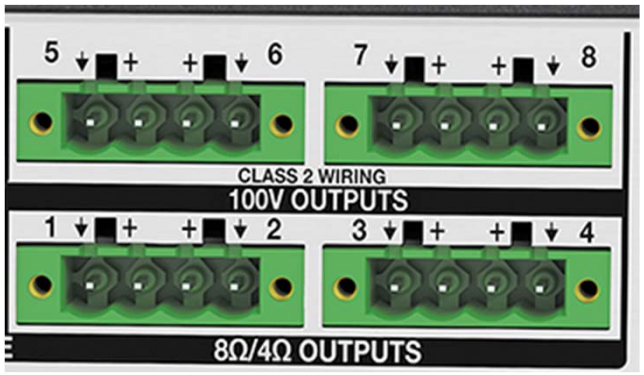
Speakers

- 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

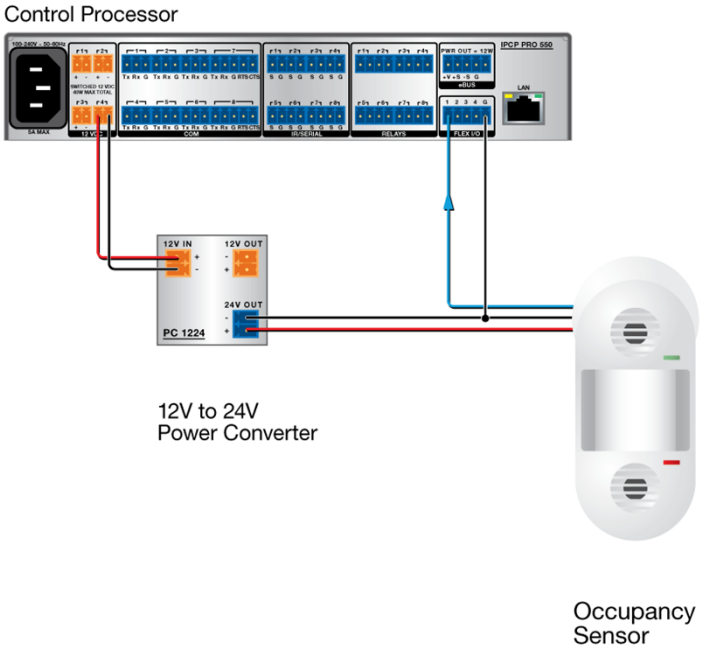




Room Automation

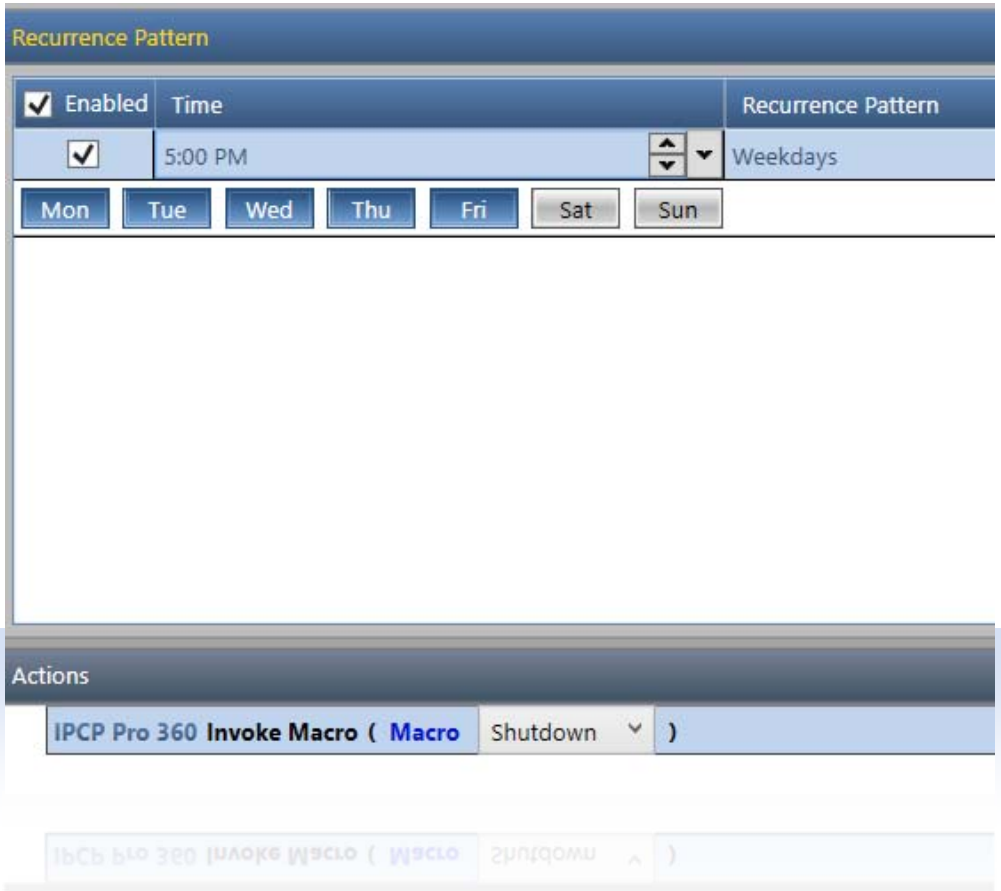
Simple Motion Sensor

- Motion Sensor wiring

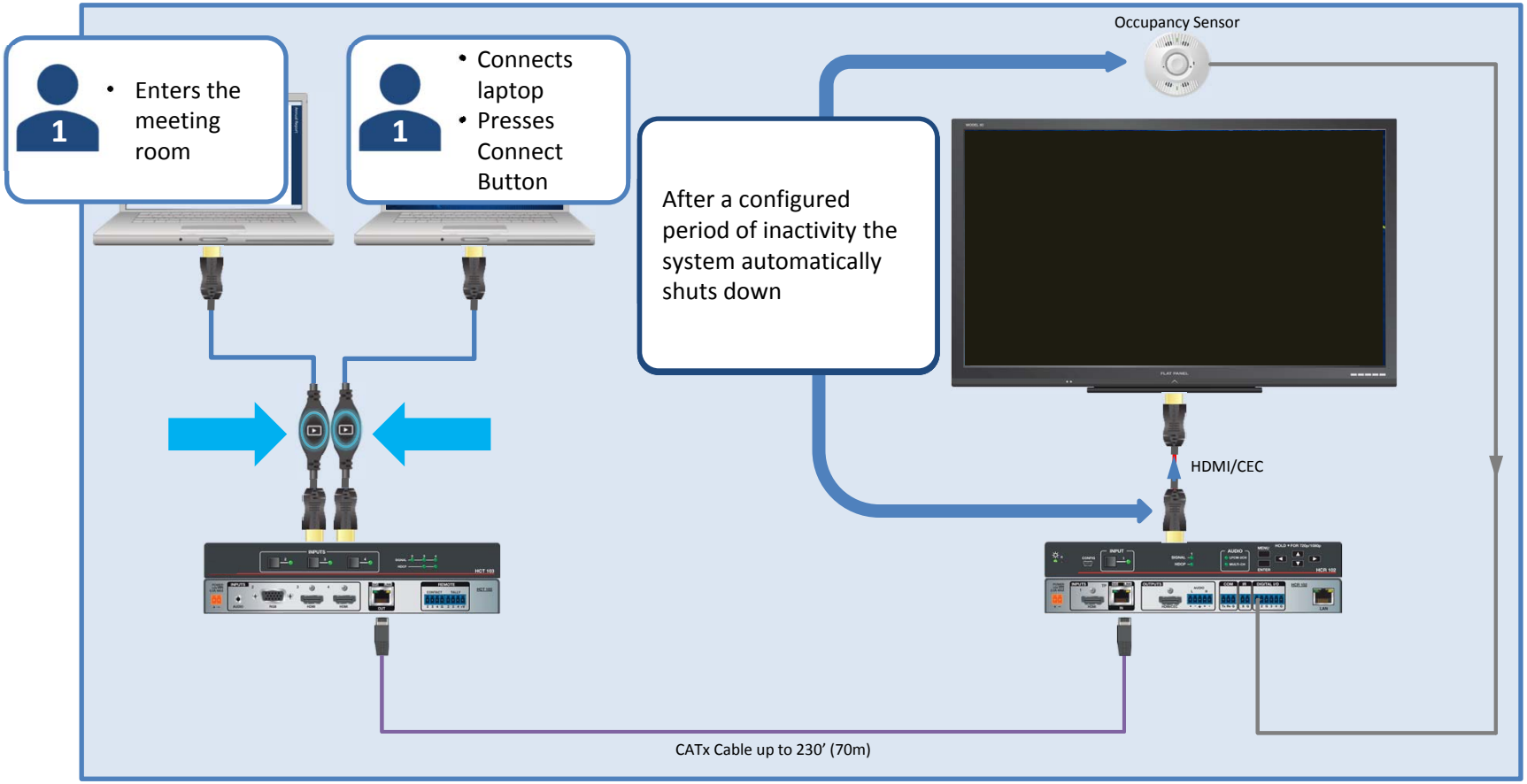


- Control system module for Motion Sensor configuration

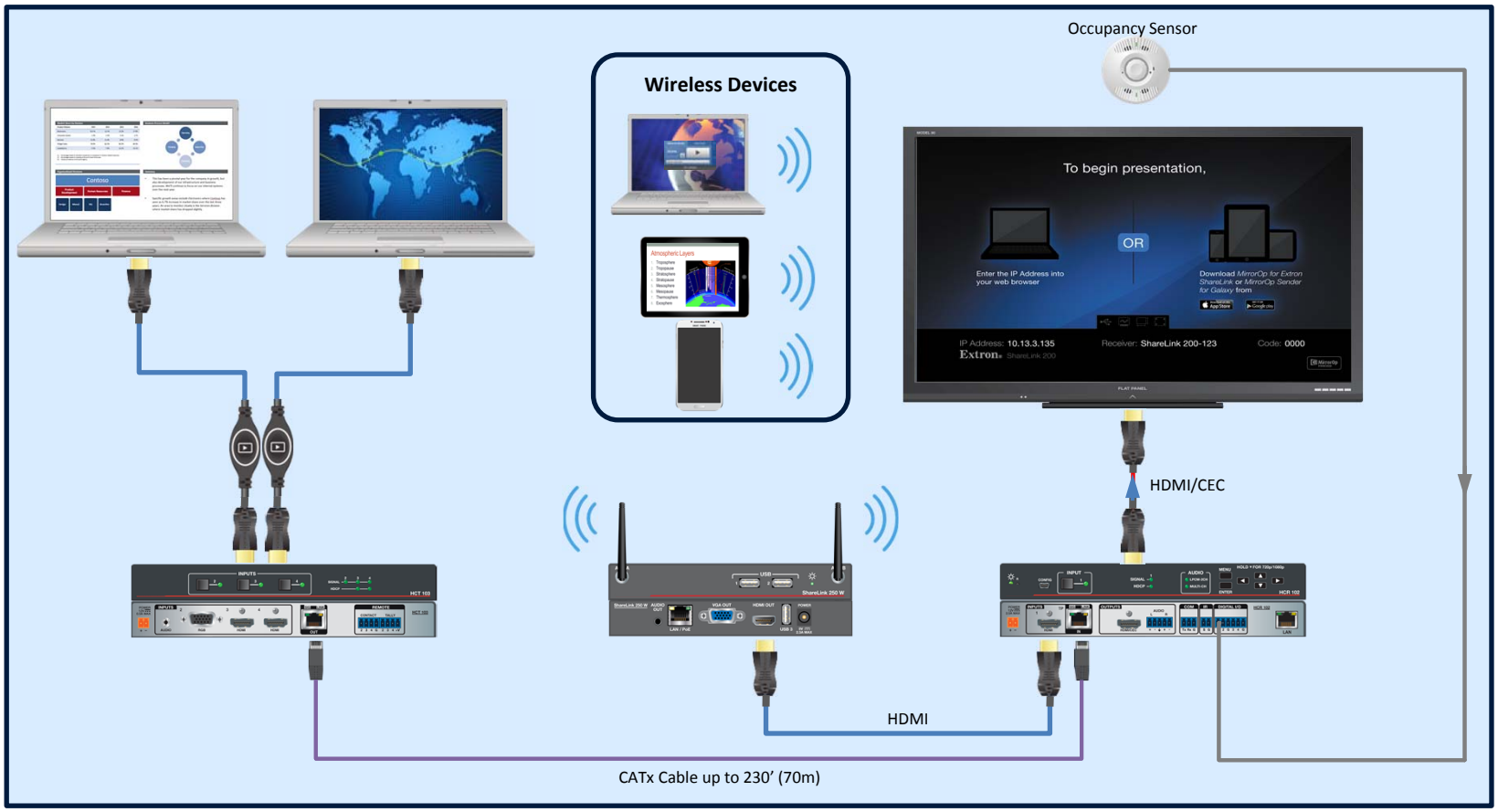
How a Timer Works



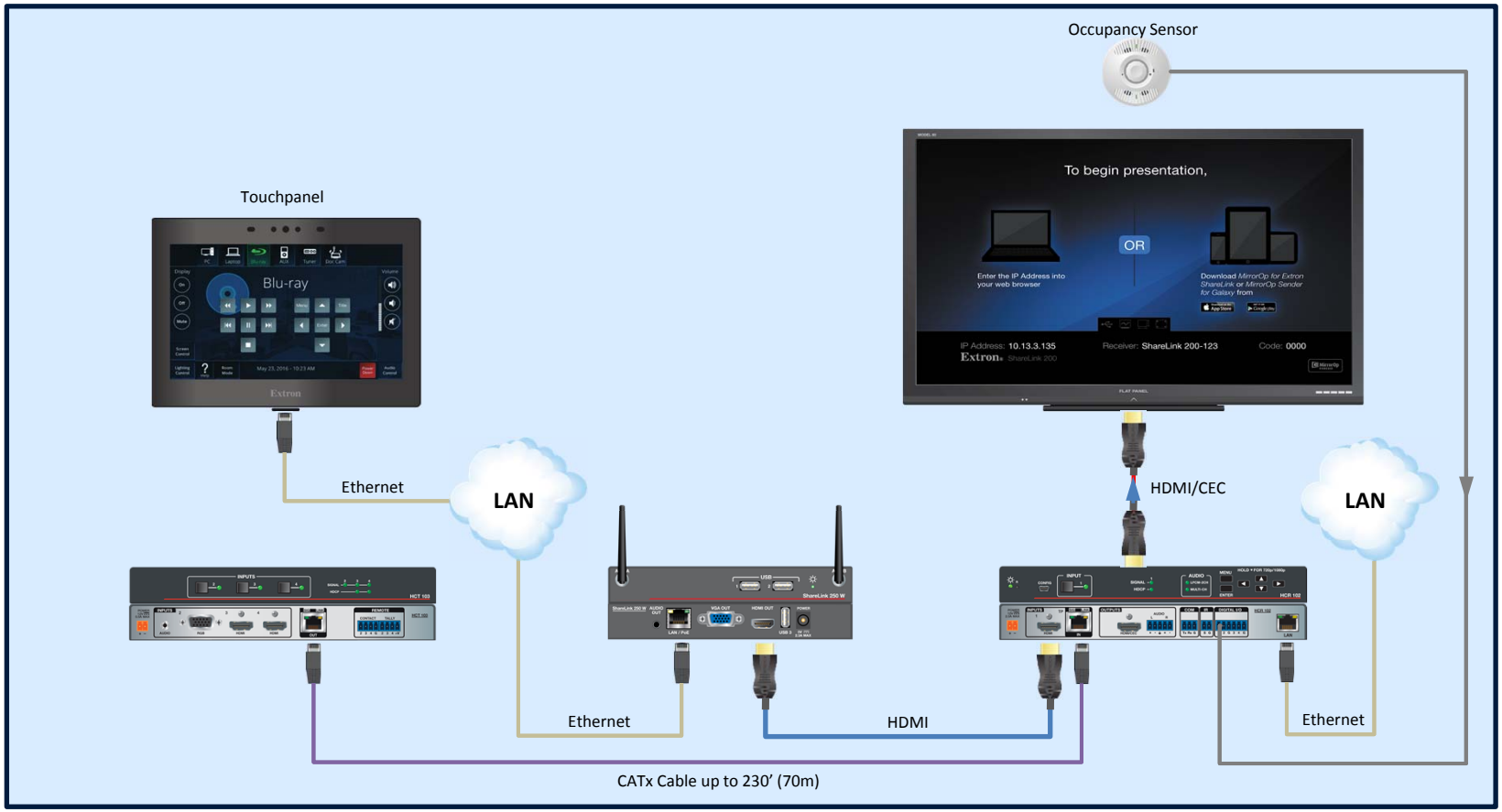
Occupancy Sensor and Collaboration Technology



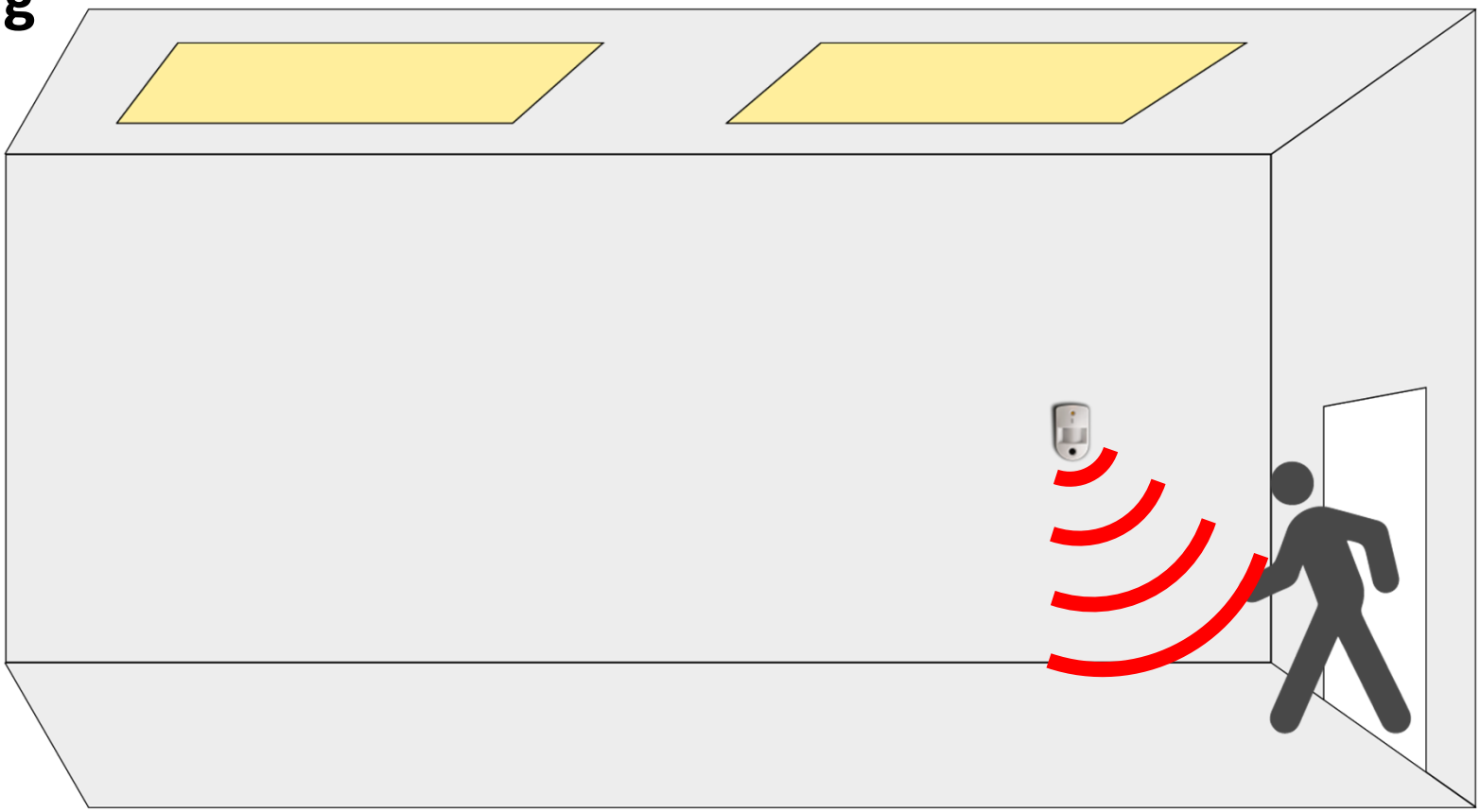
Upgrade Options – Wireless Connectivity



Upgrade Options – TouchPanel Control

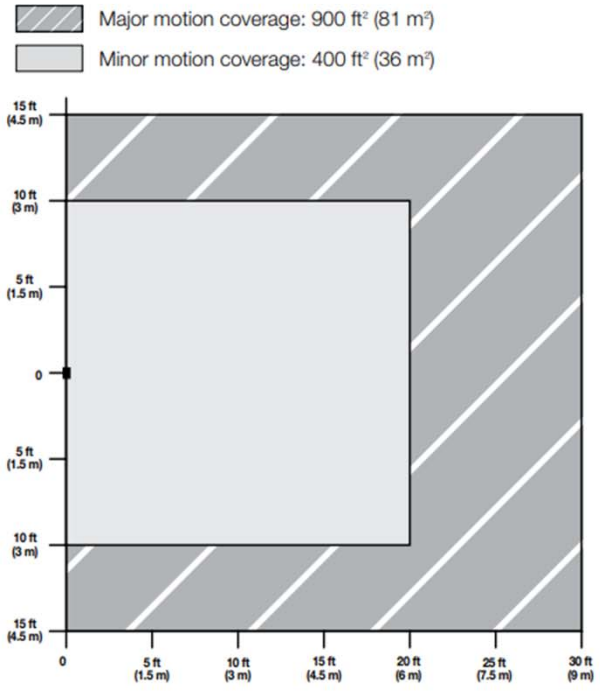


Lighting

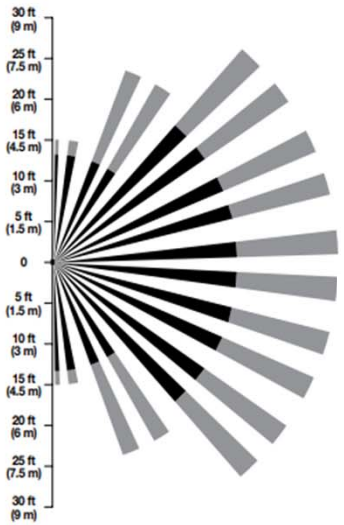


Sensor Dimmer Coverage Area

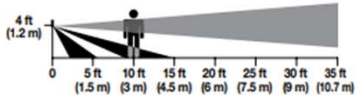
NEMA WD7 Test Grid Coverage (High Sensitivity Setting)



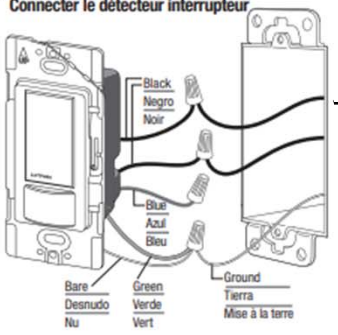
Horizontal Beam Diagram



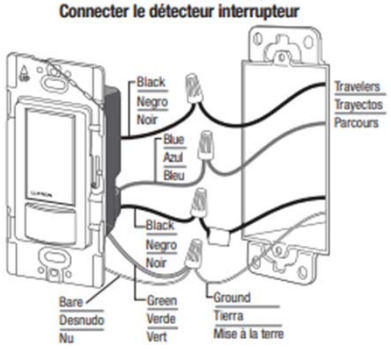
Vertical Beam Diagram



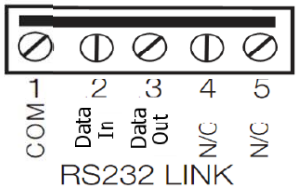
Connect sensing switch
Conecte el sensor con interruptor
Connecter le détecteur interrupteur



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



Signal
TxD
RxD
GND



Control

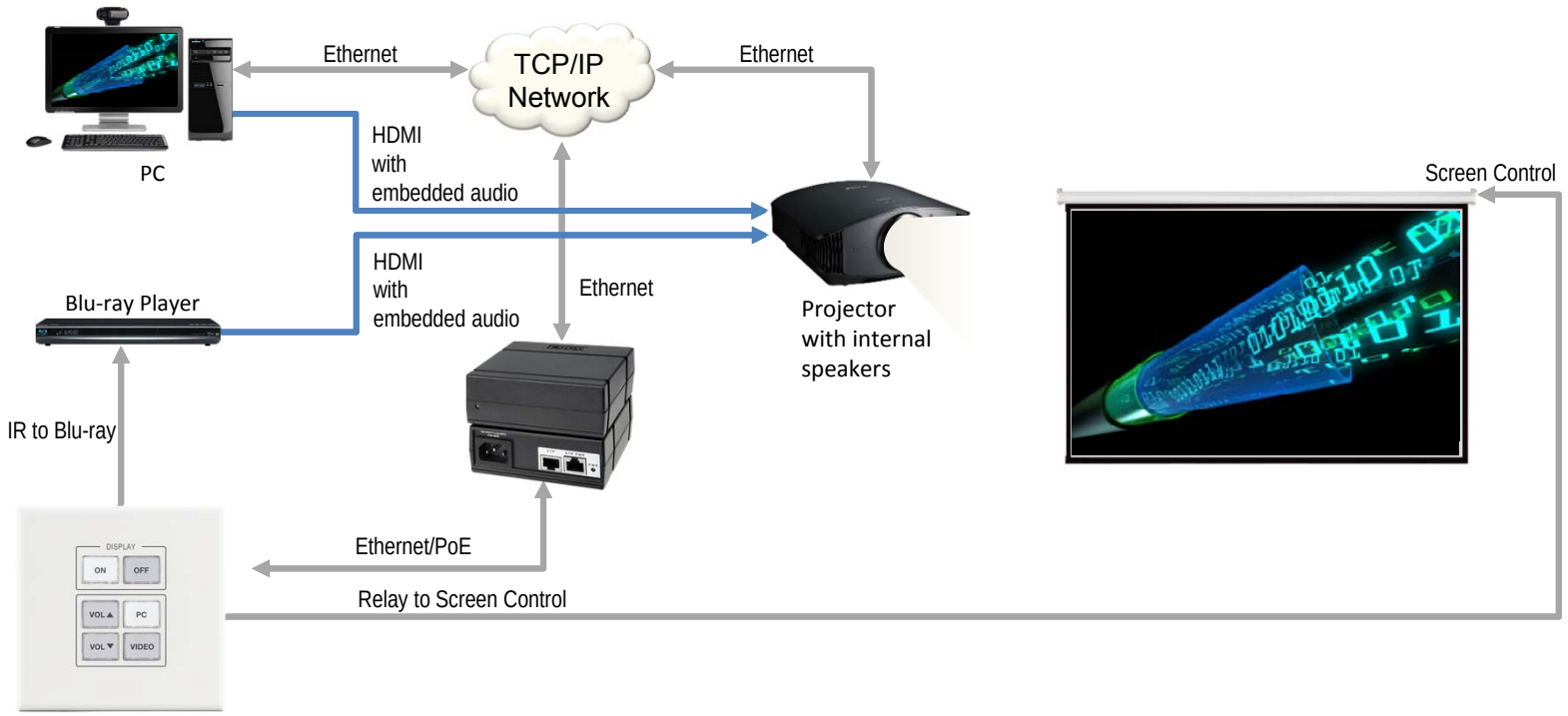
Push Button Controllers

These do NOT count!

Push Button Controllers

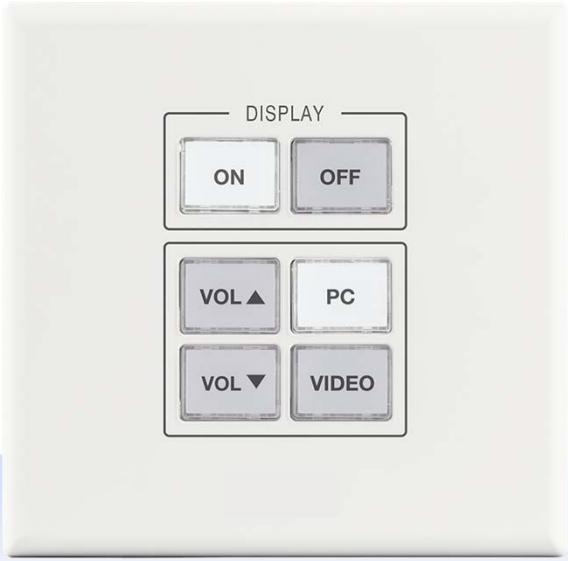
These do NOT count!

Single Display Application



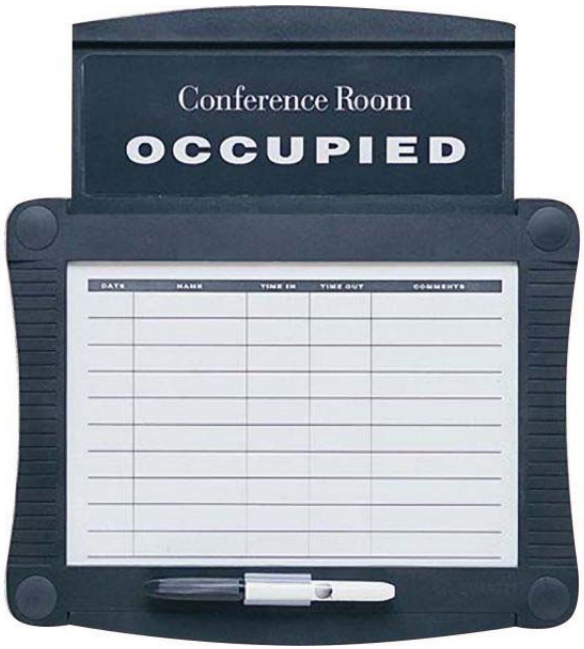
Features of PUSH – Button Controllers

- 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

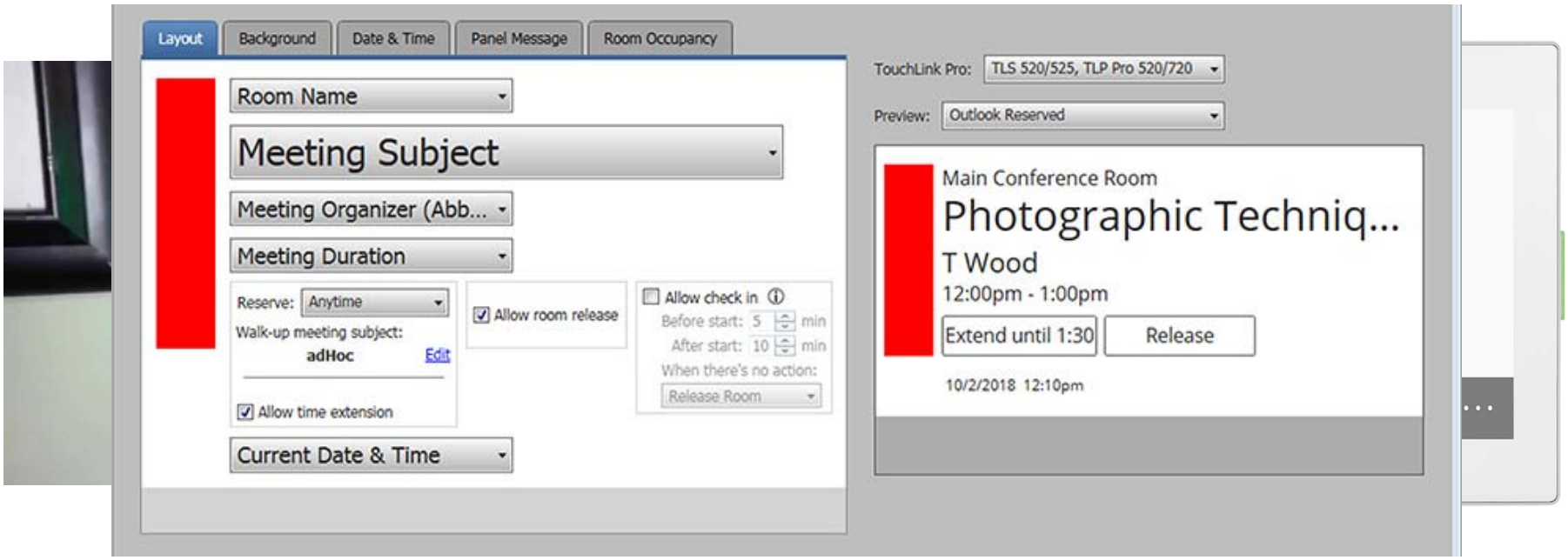


Room Scheduling

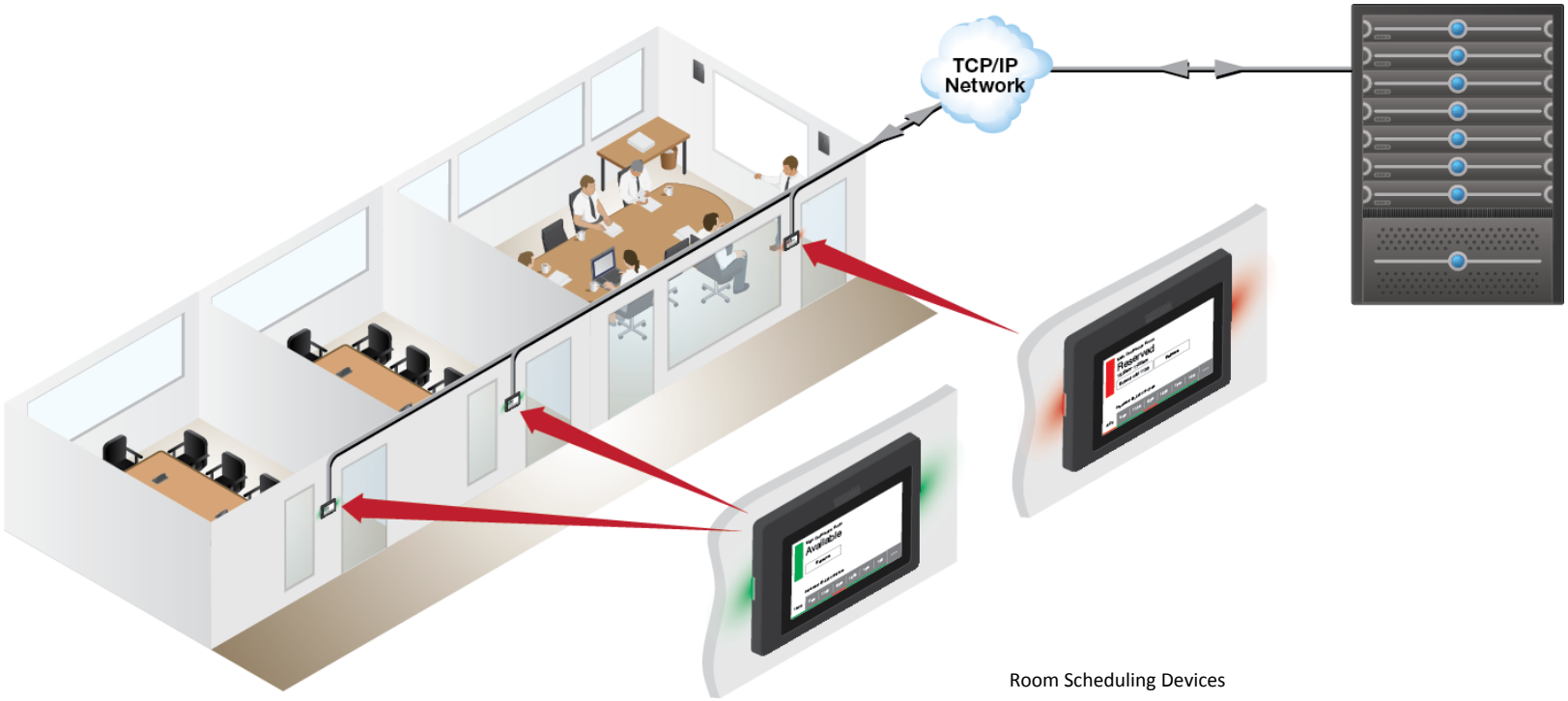
Scheduling – How It Used To Be



Room Scheduling Panels



Room Scheduling



Room Scheduling Devices

AV over IP Considerations

New Technology

AV over IP – AES 67 Audio Distribution

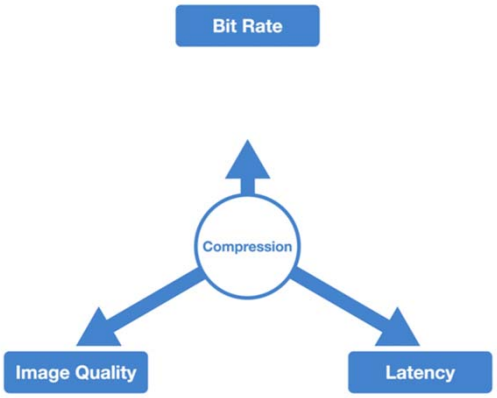
- AES 67 Standard allows audio transportation over IP based systems
- Interoperability between network audio over IP protocols
- Adds audio networking technology into a variety of applications
- Supports both multicasting and unicasting

+

= AES 67

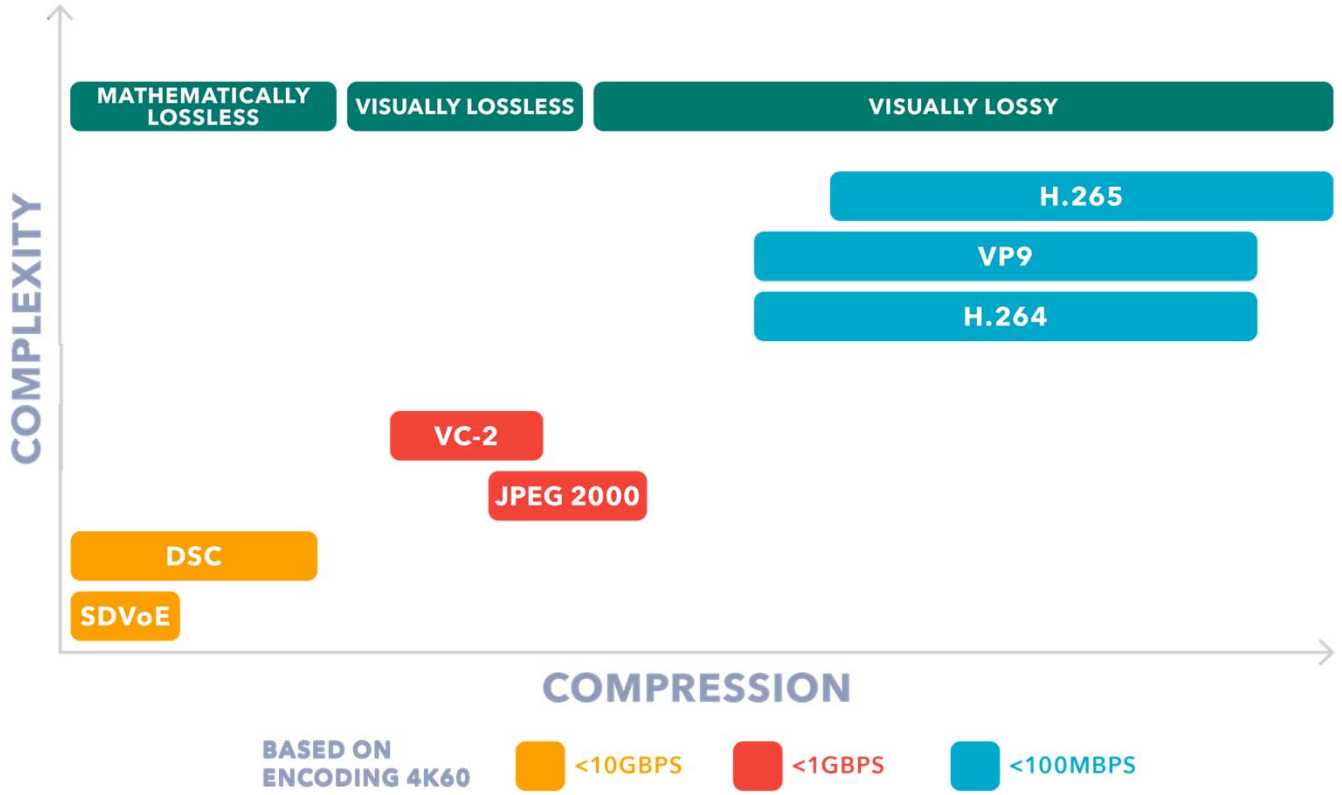
AV over IP – Compression

- Compression – Three factors
  - Bit Rate
  - Image Quality
  - Latency



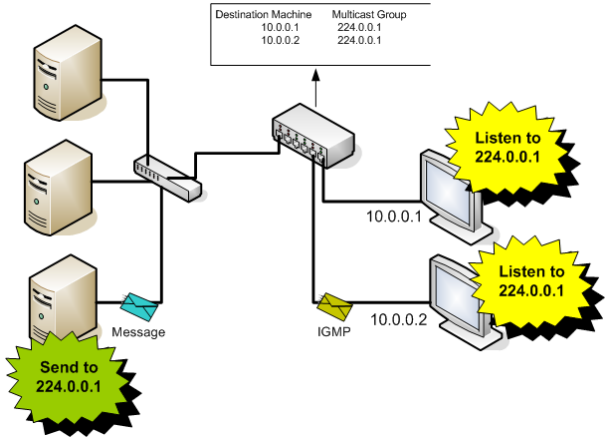
Video Rate	Uncompressed Bit Rate @ 24 bpp	1G Compression @ 880 Mbps	10G Compression @ 4 Gbps
480p60 (SD)	422	1:1	1:1
720p60 (HD)	1,330	2:1	1:1
1080p60 (HD)	2,990	3:1	1:1
2160p60 (UHD)	11,940	14:1	3:1
4096x2160 @ 30 (4K/30)	6,370	7:1	2:1
4096x2160 @ 60 (4K/60)	12,740	14:1	3:1

AV over IP – Compression Ratios



AV over IP – Network

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



Installing AV in New Age Collaboration Spaces

Karl Rosenberg
Extron