Installing AV in New Age Collaboration Spaces

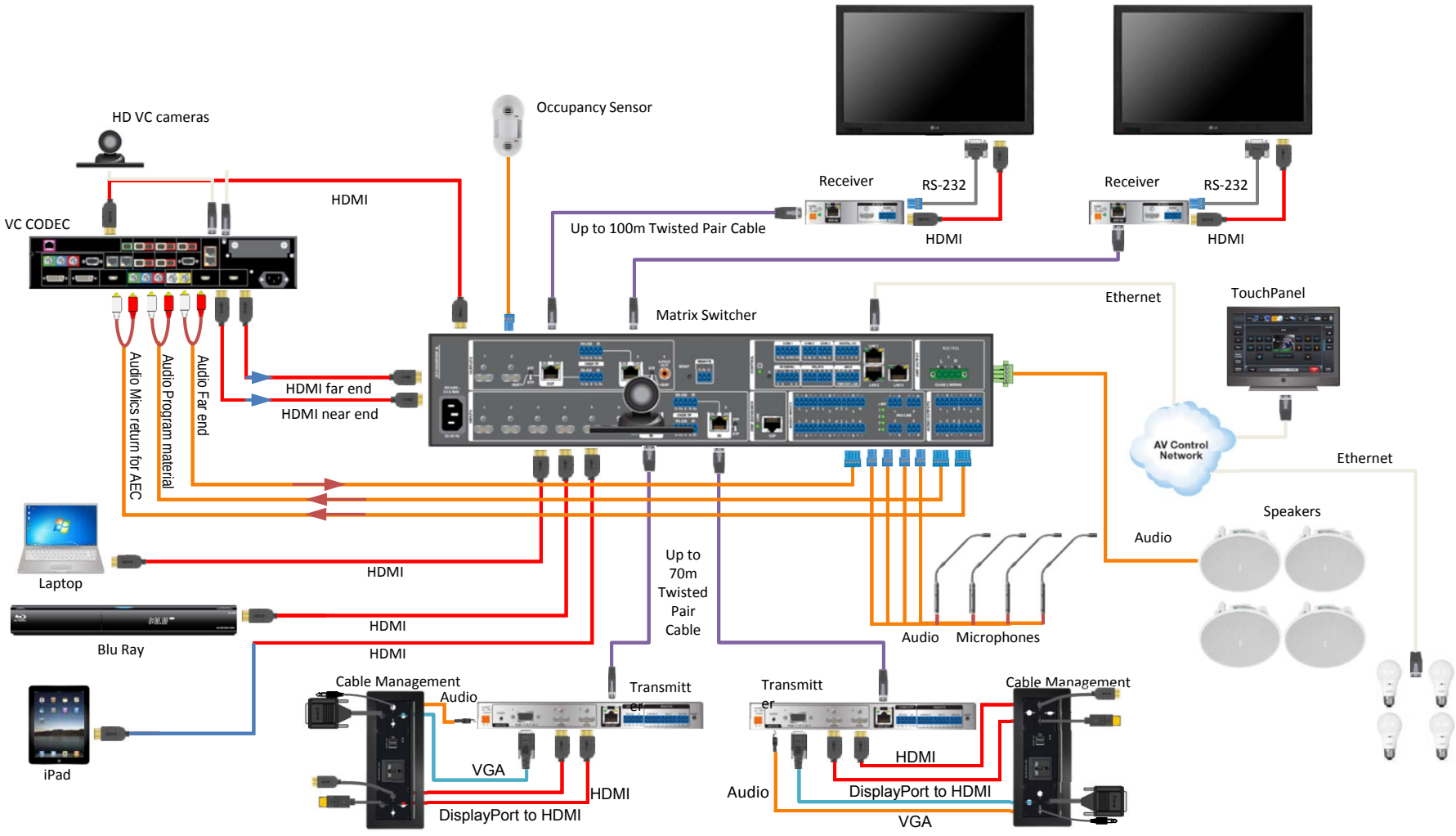
Karl Rosenberg

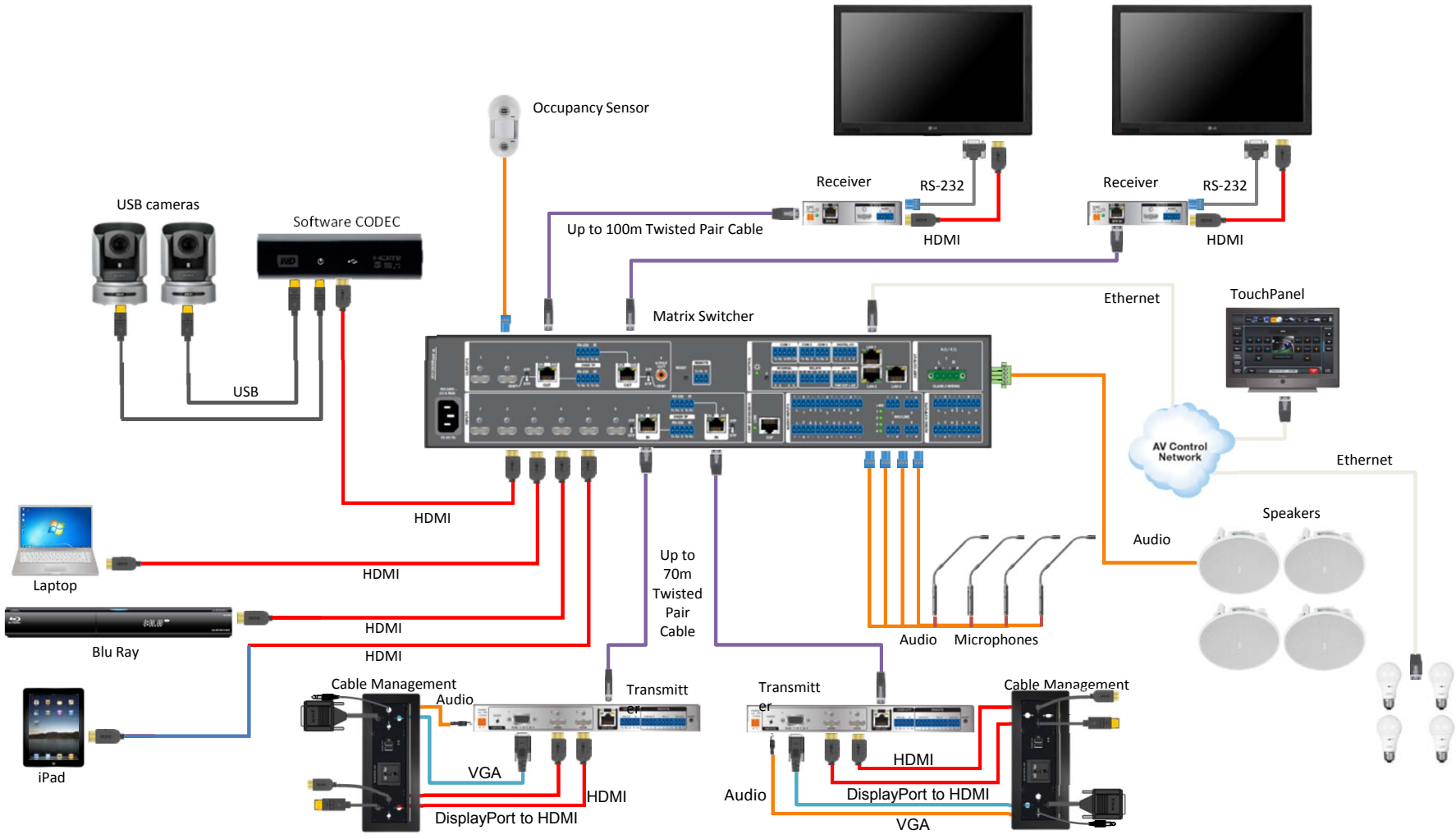
Extron

“How do I install a Collaboration Space”

Many Questions

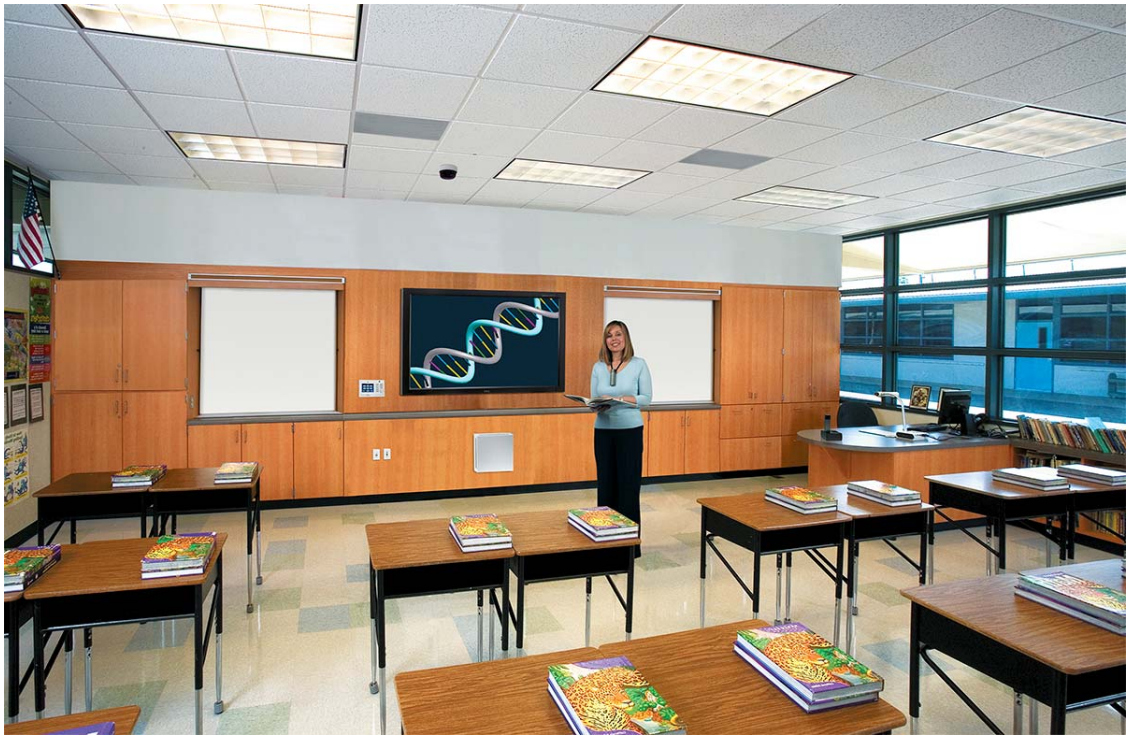
- What TV?
- HDMI or VGA?
- USB?
- Control?
- Cables?
- Wireless?
- Do we dig a trench?
- Furniture?
- Room scheduling
- Audio
- Microphones
- Speakers
- Amplifiers
- Motion sensors
- Lights
- Cable paths
- Mounting Hardware
- VTC?


HD VC cameras
Occupancy Sensor
HDMI
VC CODEC
Receiver
RS-232
HDMI
Up to 100m Twisted Pair Cable
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
Audio
Microphones
HDMI
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
Transmitter
Transmitter
Cable Management
iPad
VGA
HDMI
DisplayPort to HDMI
HDMI
Audio
DisplayPort to HDMI
VGA

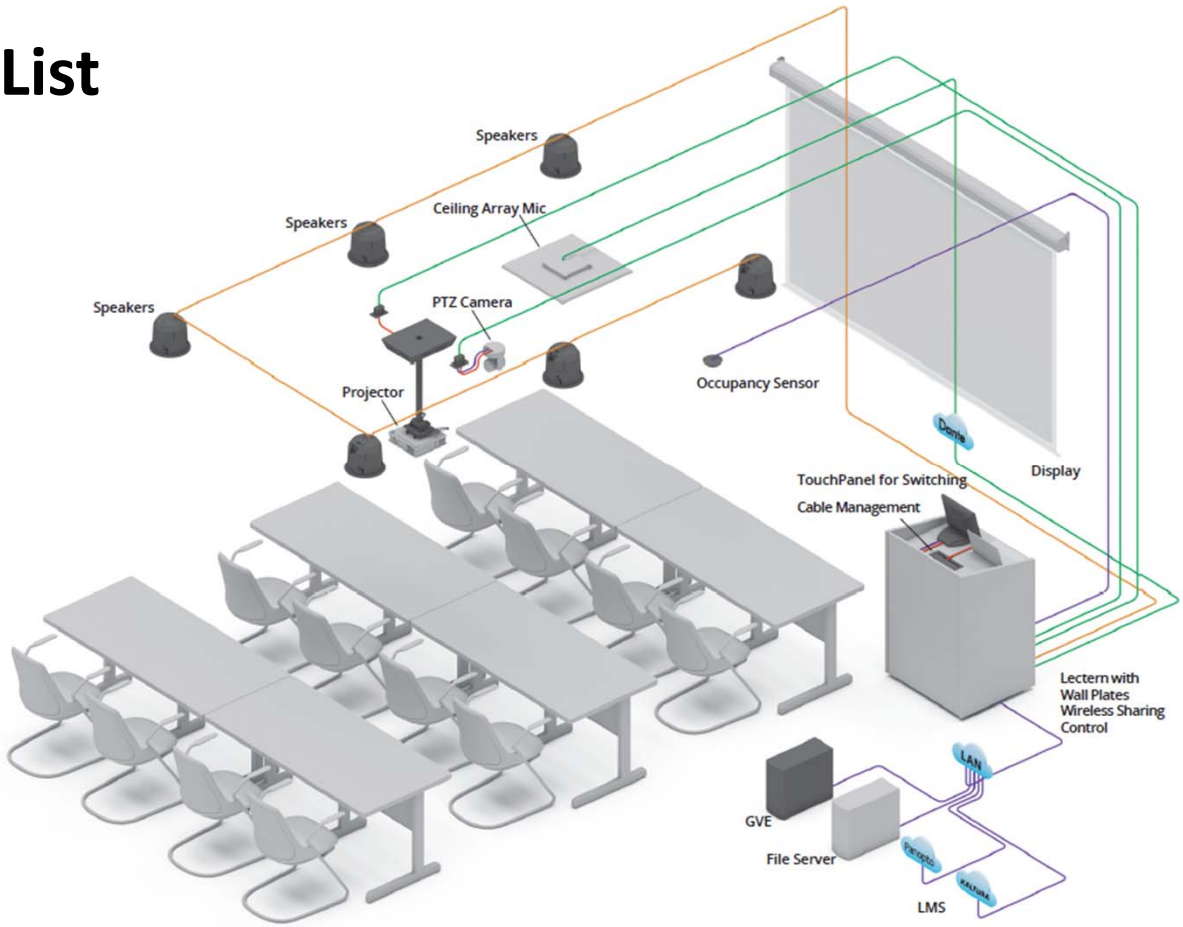
Classrooms are Changing

Classroom



Classroom Equipment List

- Projectors /Displays
- Switchers
- Cables/UTP
- Wall Plates
- Audio /MICS /Speakers
- Control
- Wireless

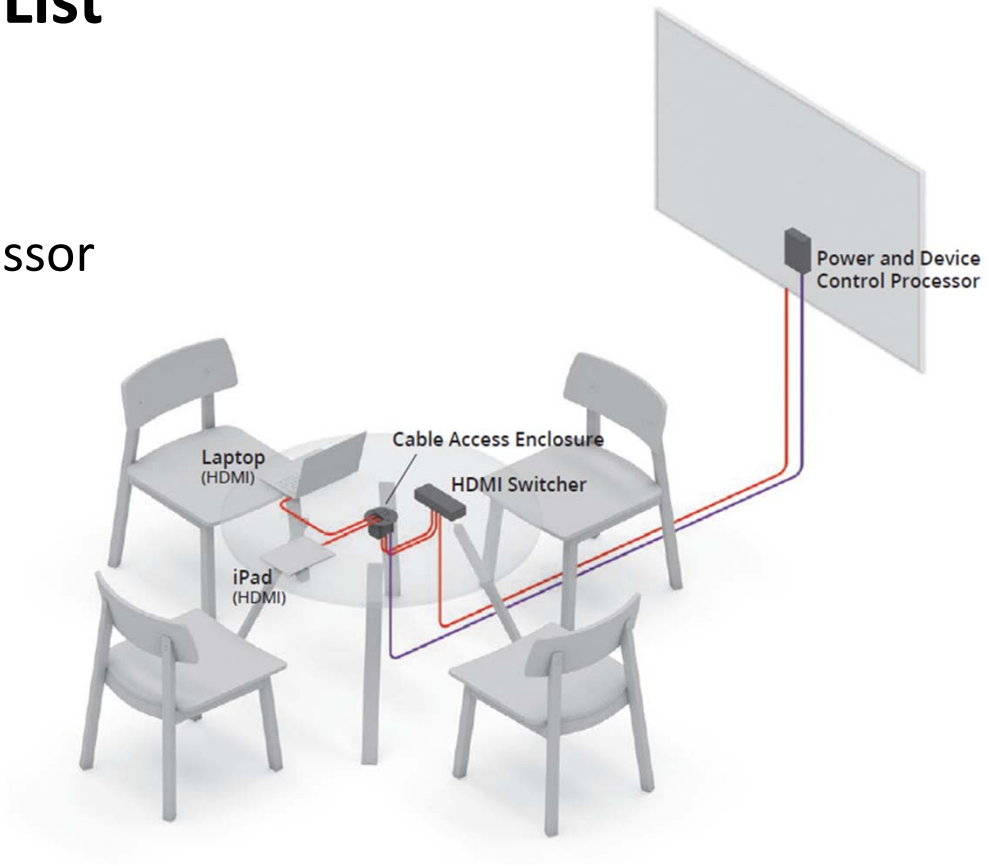


Boardrooms are Changing

Huddle Room

Huddle Room Equipment List

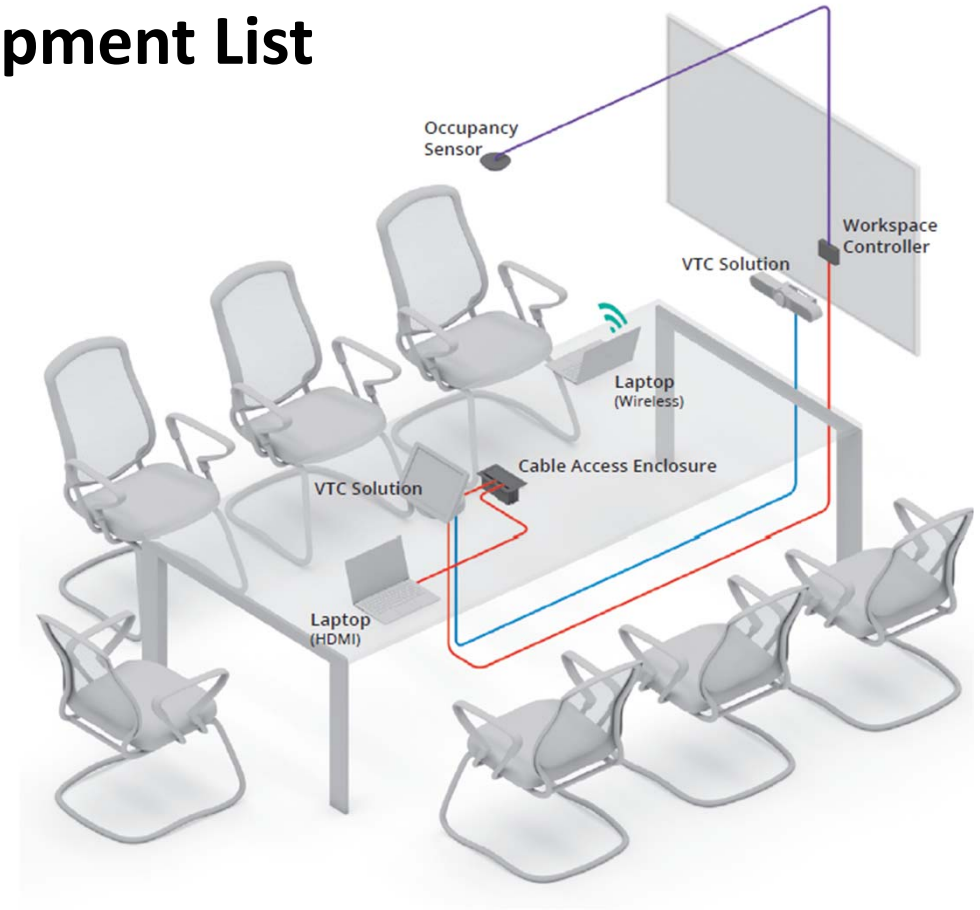
- Cable Access Enclosure
- Two input HDMI Switcher
- Power and Device Control Processor



Huddle Room with Soft VTC

Huddle Room with VTC Equipment List

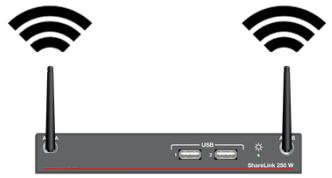
- Cable Access Enclosure
  - HDMI Male to Male
  - USB C Male to Male
  - Network Cable
- Workspace Controller
- Occupancy Sensor
- Video Conferencing Solutions



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



VoIP

zoom

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

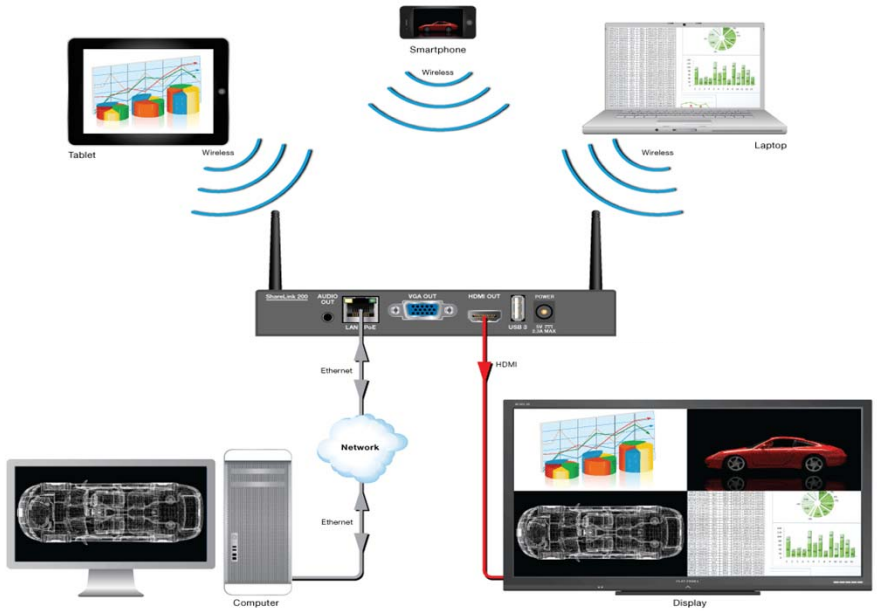
4 Types

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

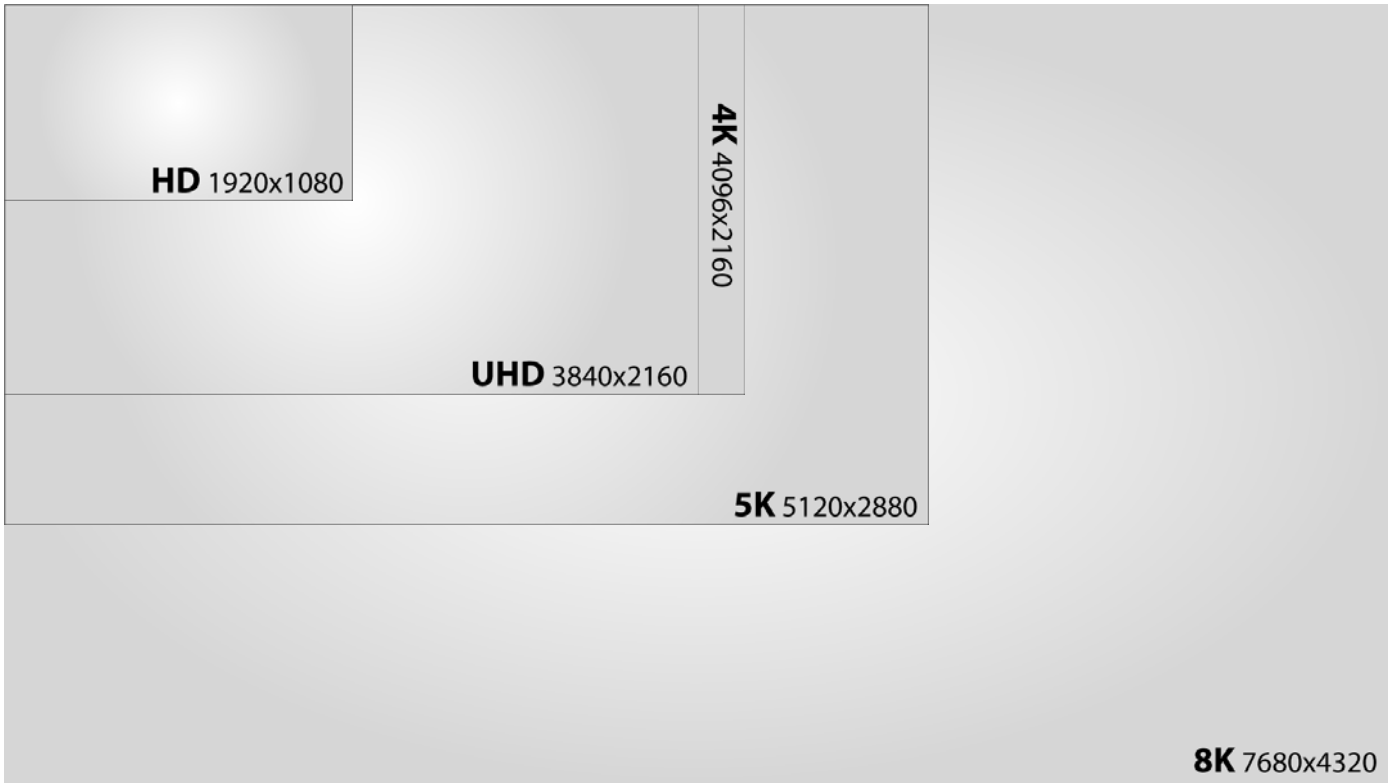
- Displays
- Mounting Hardware
- Connectivity
  - HDMI
  - USB
- Source to Display
  - EDID
  - HDCP
- Cables and Cabling Standards
- Wireless
- Cable Paths
- Furniture
- Audio
- Room Automation
- Conference Room Interfaces
- Control
- Room Scheduling
- Designs
- AV over IP

Displays

Resolutions

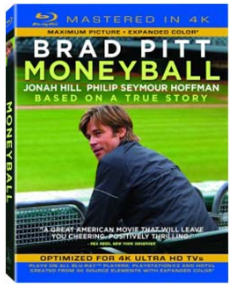
- Old Resolutions
- New standard 1080p
- Headed to 4K/UHD and 8K

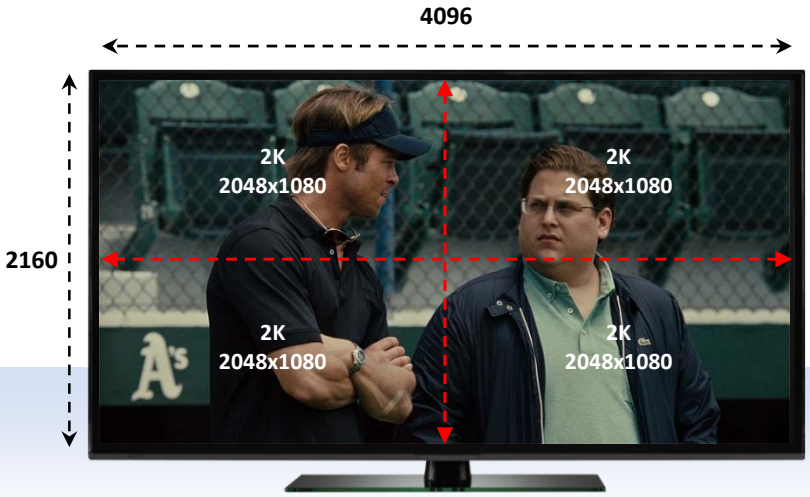
4K and Ultra HD Resolution Comparison



4K Signal Parameters

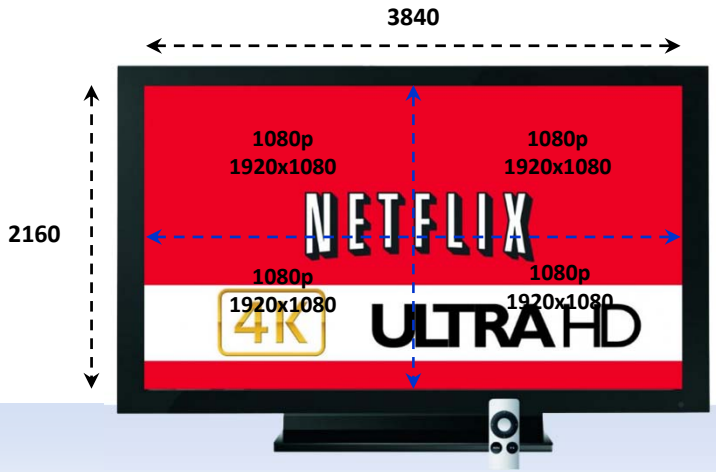
- 4K DCI is 4096x2160
  - Four times the resolution of 2K DCI
  - Targeted towards digital cinema
- 4K refresh rates
  - Varies – 24 Hz up to 60 Hz
- Color bit depth
  - 8-Bit, 10-bit, and 12-bit
- Aspect Ratio
  - 17:9 – same as 2K





Ultra HD Video Signal Parameters

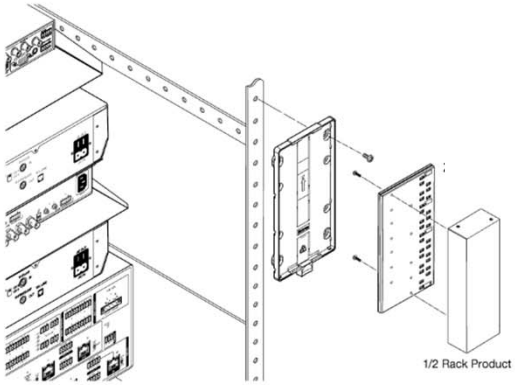
- Ultra HD is 3840x2160
  - Four times the resolution of 1080p
  - Targeted towards consumer and broadcast markets
- Ultra HD refresh rates
  - Varies – 24 Hz up to 60 Hz
- Color bit depth
  - 8-Bit, 10-bit, and 12-bit
- Aspect Ratio
  - 16:9 – same as 1080p

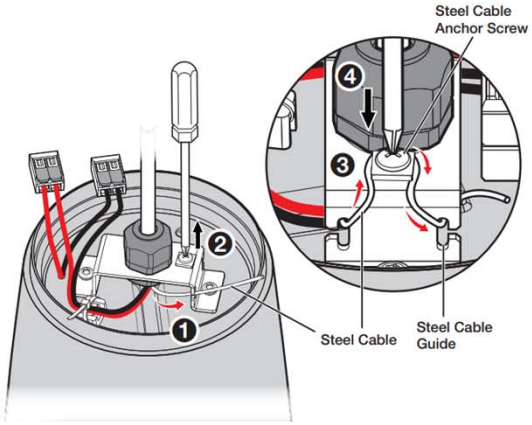


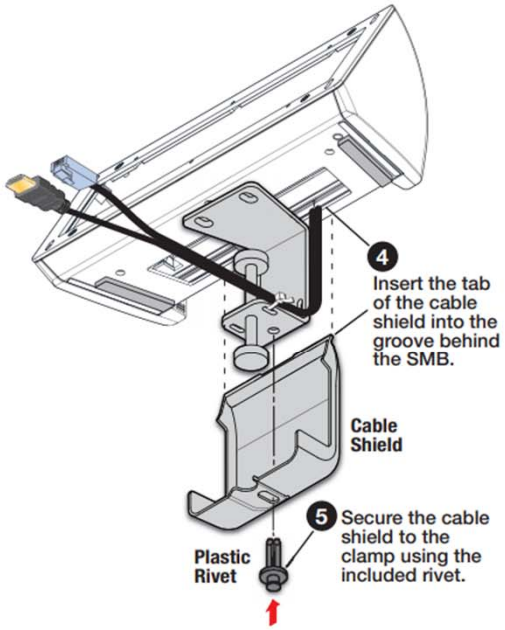
HDMI 2.0 and HDMI 2.1

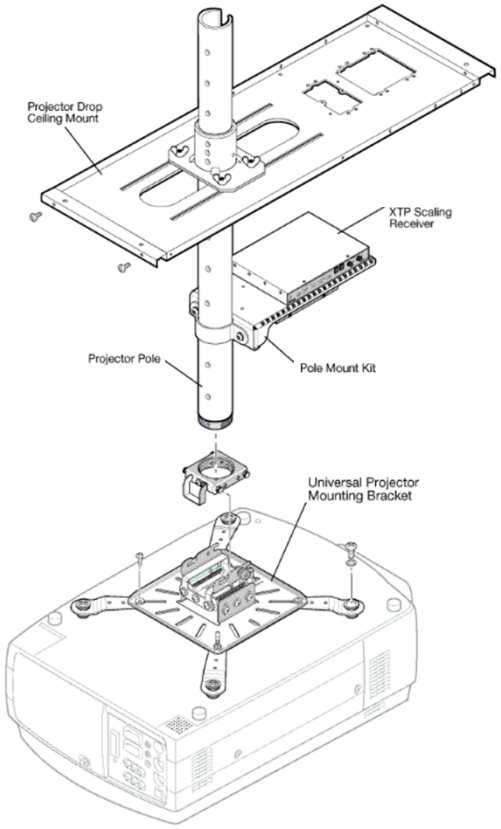
- New functionality includes
  - Enables transmission of HDR – High Dynamic Range video
  - Signaling speed to 18 Gbps
  - 4K@50Hz/60Hz, (2160p)
    - 4 times the clarity of 1080p/60 video resolution
  - Up to 32 audio channels with up to 1536 kHz audio sample frequency
    - 32 channels @ 48kHz each
  - Dual video streams on same screen, 4 audio streams
  - Support widescreen 21:9 format
  - Dynamic sync of audio/video
  - CEC extensions with expanded control via single point
- Backwards compatible

Mounting Hardware

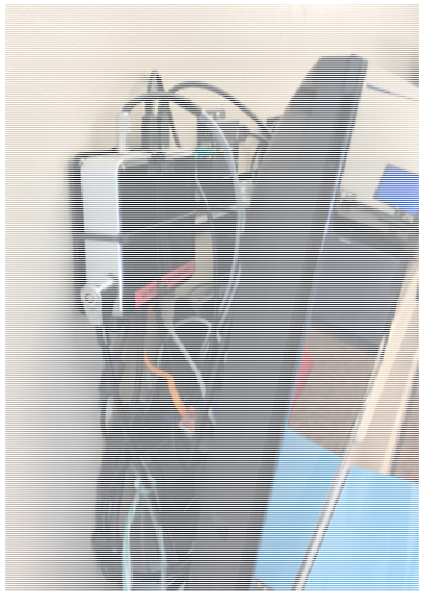

1/2 Rack Product


Steel Cable Anchor Screw
1
2
3
4
Steel Cable
Steel Cable Guide


4
Insert the tab of the cable shield into the groove behind the SMB.
Cable Shield
5
Secure the cable shield to the clamp using the included rivet.
Plastic Rivet


Projector Drop Ceiling Mount
XTP Scaling Receiver
Projector Pole
Pole Mount Kit
Universal Projector Mounting Bracket


REGAL



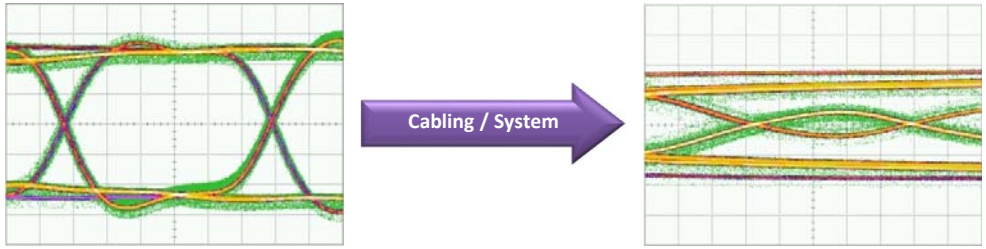
Connectivity

Connectivity

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

Digital Video Characteristics – Loss

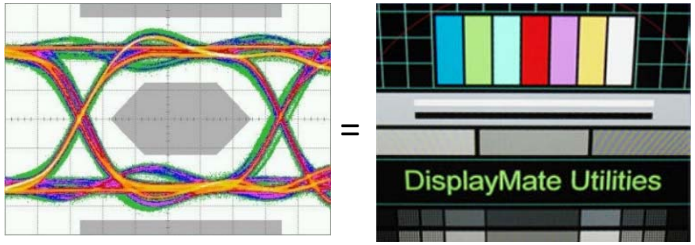
- Digital video signals consist of high speed transitions
- Very susceptible to degradation from:
  - Cable attenuation
    - Cable capacitance
    - Cable resistance
    - Impedance mismatch
  - Noise coupling
  - Crosstalk
  - Jitter



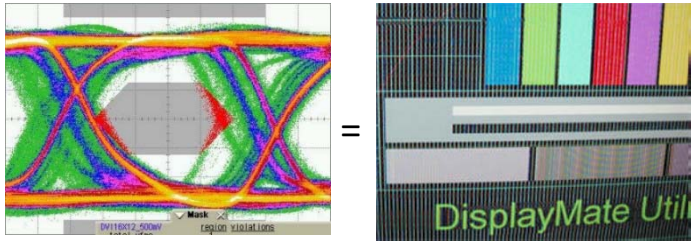
- All factors that Affect the receiver's ability to distinguish high and low transitions

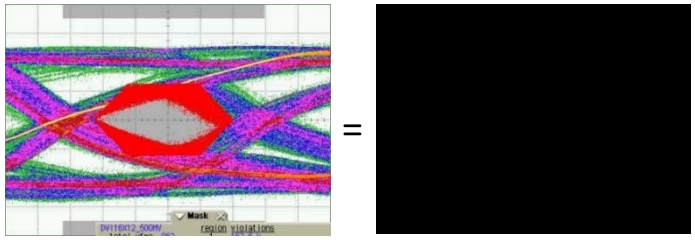
Digital Video Characteristics – Loss

- 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

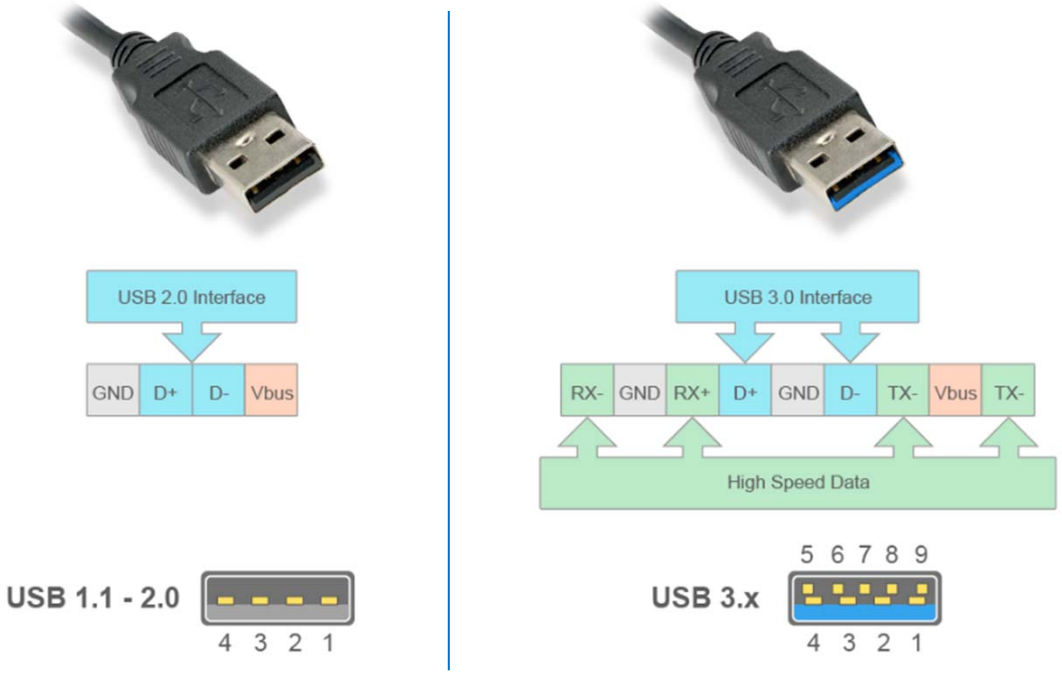
- A standard for communication protocols that includes cables and connectors
- Historically used for attaching peripheral devices to computers
- Maximum length of USB 2.0 cable: The 2.0 specification limits the length of a cable between USB 2.0 devices (Full Speed or Hi-Speed) to 5 meters (or about 16 feet and 5 inches).

USB Interface Connectors

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

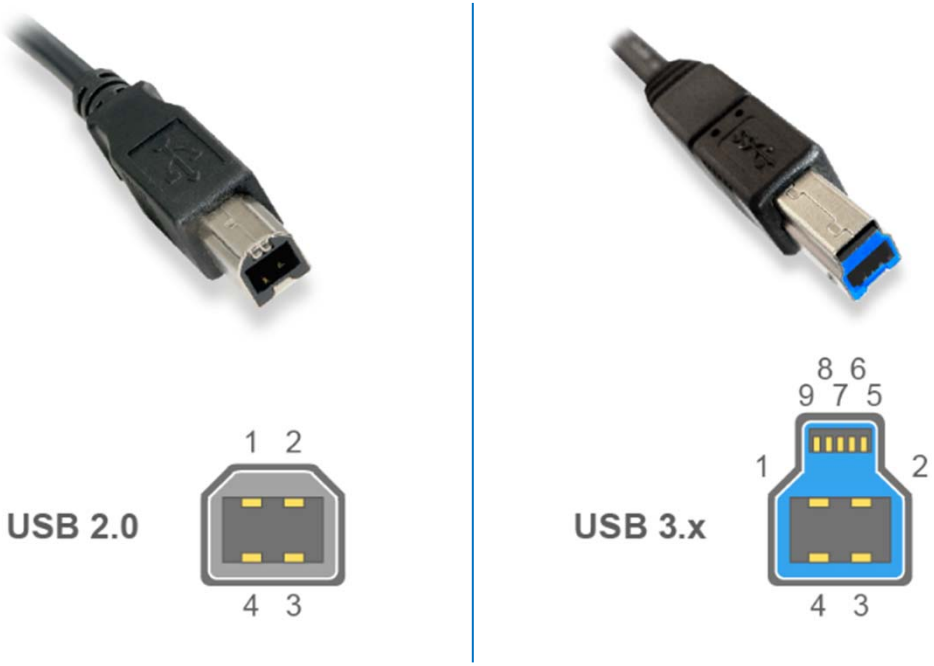
USB Type-A

- Standard connector found on most computer and USB devices



USB Type-B

- An upstream interface used to receive data or power
- Mostly used in printers and peripheral devices

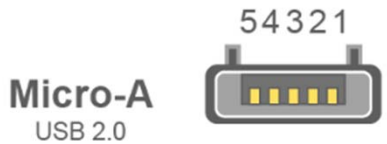


USB Mini

- Developed to provide data and power for smaller devices
- USB 2.0 capable and support USB OTG

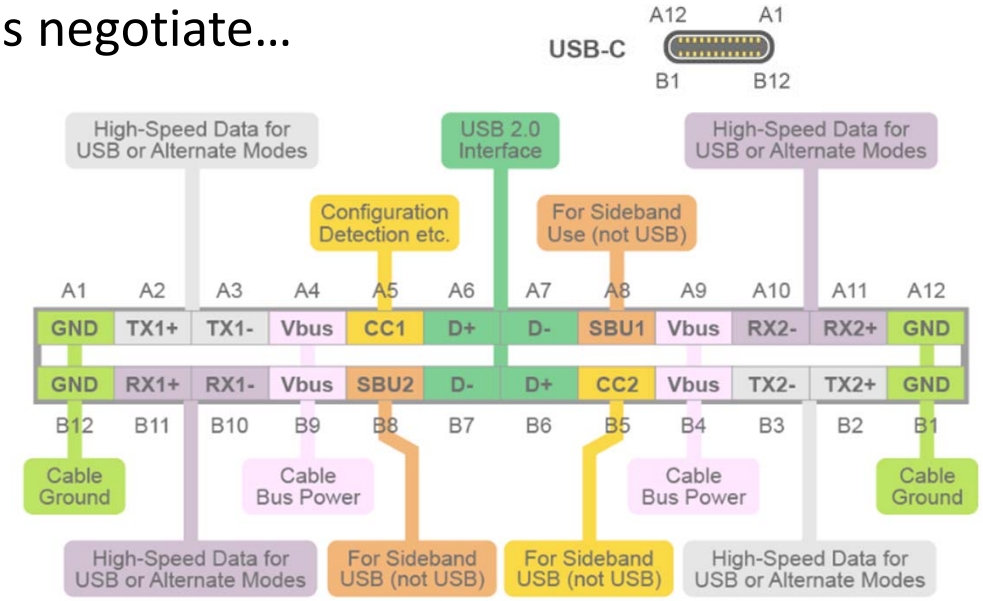
USB Micro

- USB 2.0 capable
- Slimmer interfaces that easily integrate into thinner devices



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

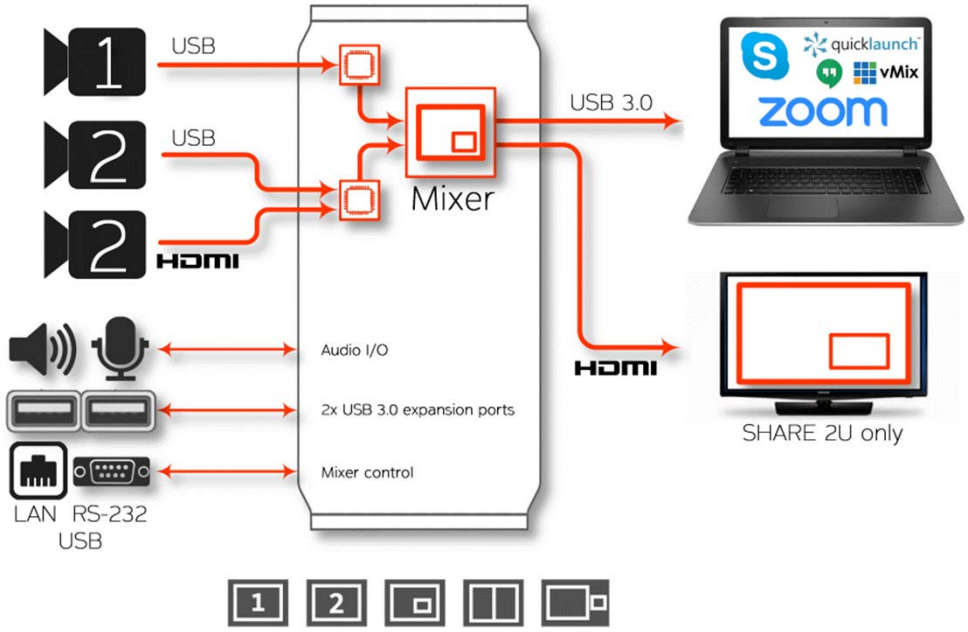


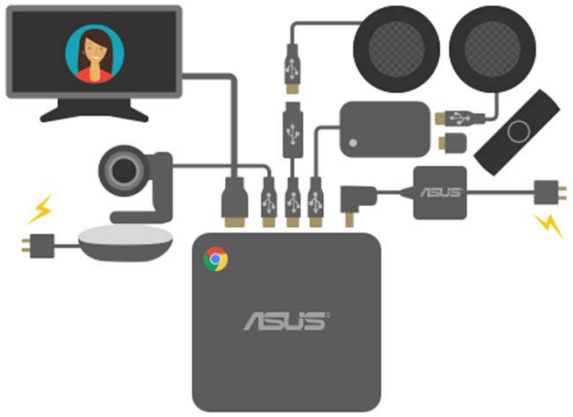
Digital Signals – USB

- 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

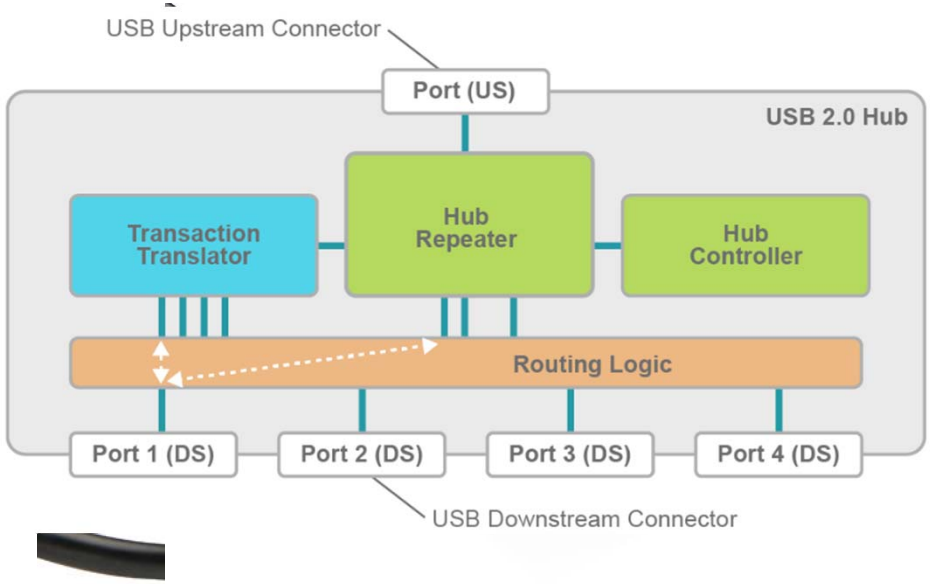
USB over distance?





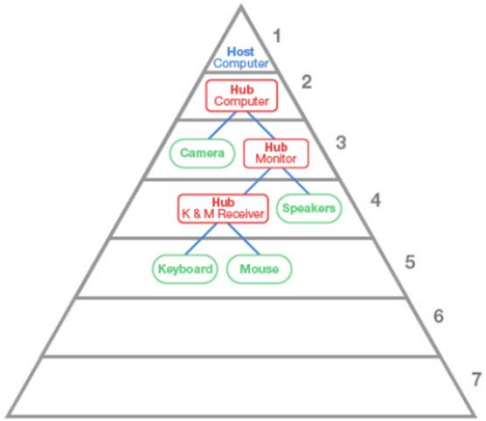
USB Hubs

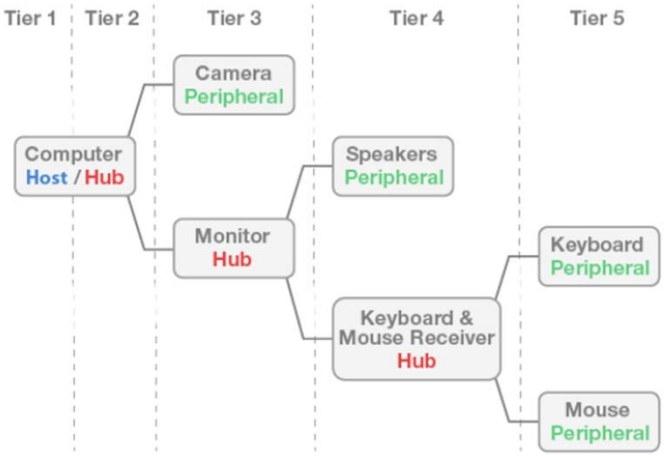
- Connects upstream port and multiple downstream ports
- Port sharing bandwidth among all connected devices
- Provides status and control information



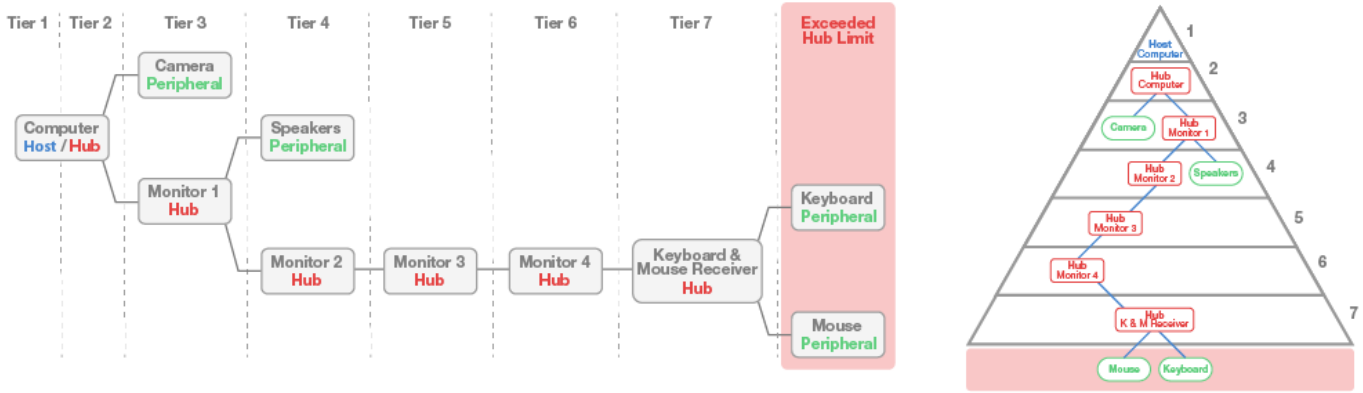
USB Tiered Star Topology

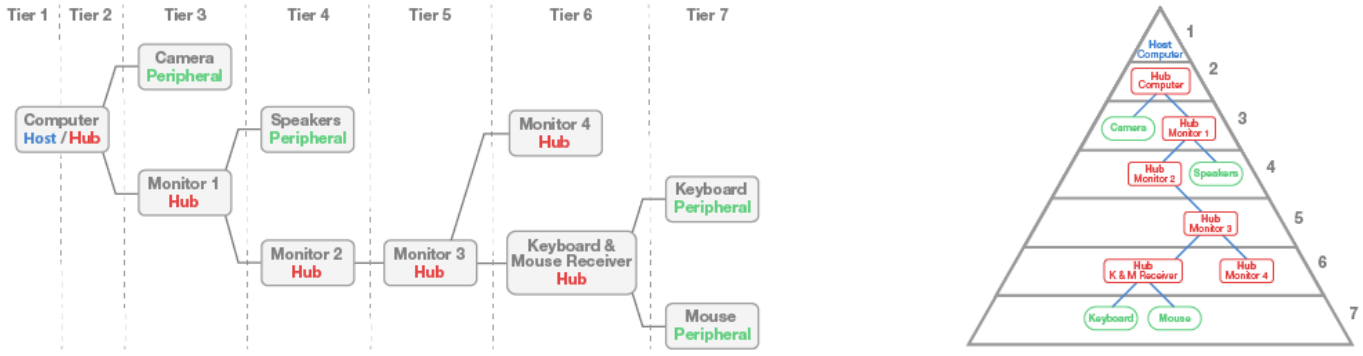
- Broken down into Tiers
- USB cable length is limited by the speed of electrical signals
- Tiered star topology has a max of seven tiers of communication
- Compound vs composite devices





USB Cascading Hub Limits





Source to Display

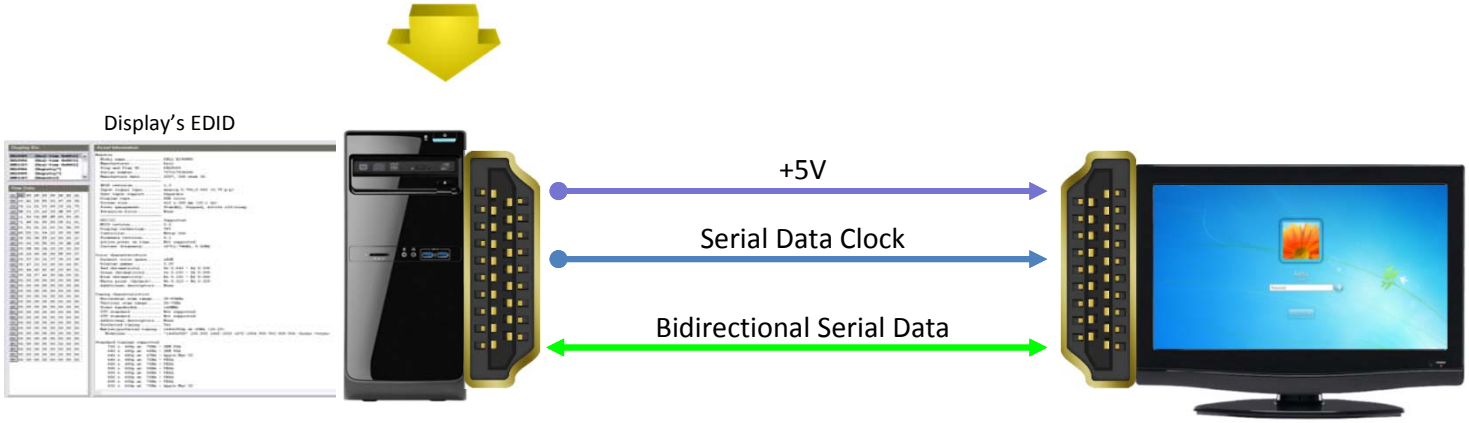
EDID and HDCP

EDID – Extended Display Identification Data

- EDID contains the following information:
  - Sink identity – device type, model number, etc.
  - Sink capability – video/audio
    - Video timing parameters, color space, audio formats, etc.

EDID – Sequence

- Power on PC or activate external graphics card
- Computer requests EDID data from display
- Display sends EDID data to computer
- Computer attempts to match display parameters



AV System Disparities

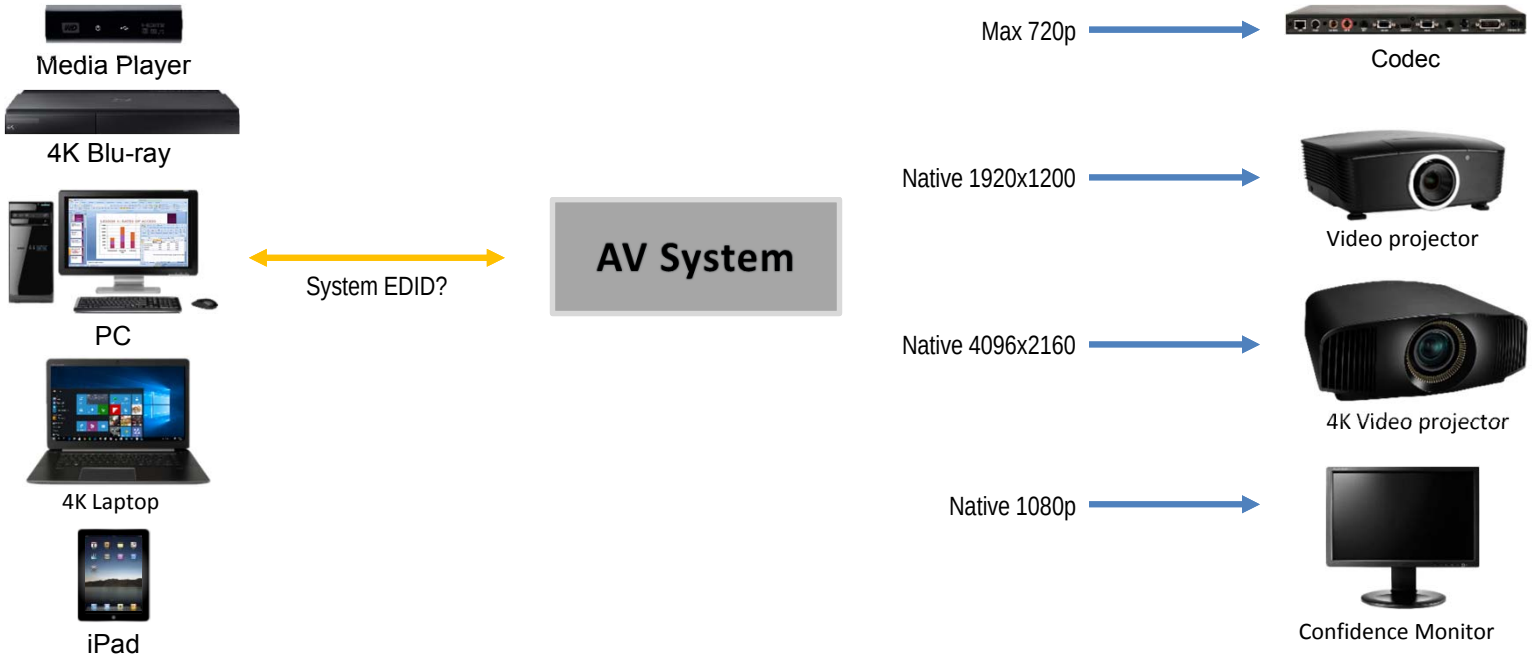
- BYOD equipment
  - How do they respond to EDID?

Portable devices:
- iPad may only output 1080p if audio is requested in EDID
- Other devices may not offer/support requested resolution

EDID set to:
- 1280x720@60
- RGB
- 2-ch audio

AV System Disparities

- Display's native resolution versus other equipment
  - How to choose?



HDCP – High-bandwidth Digital Content Protection

- HDCP protocol is a 3-phase process
  - Authentication
  - Content encryption
  - Renewability
- This can take a few moments depending on the number of downstream devices

DVD Player

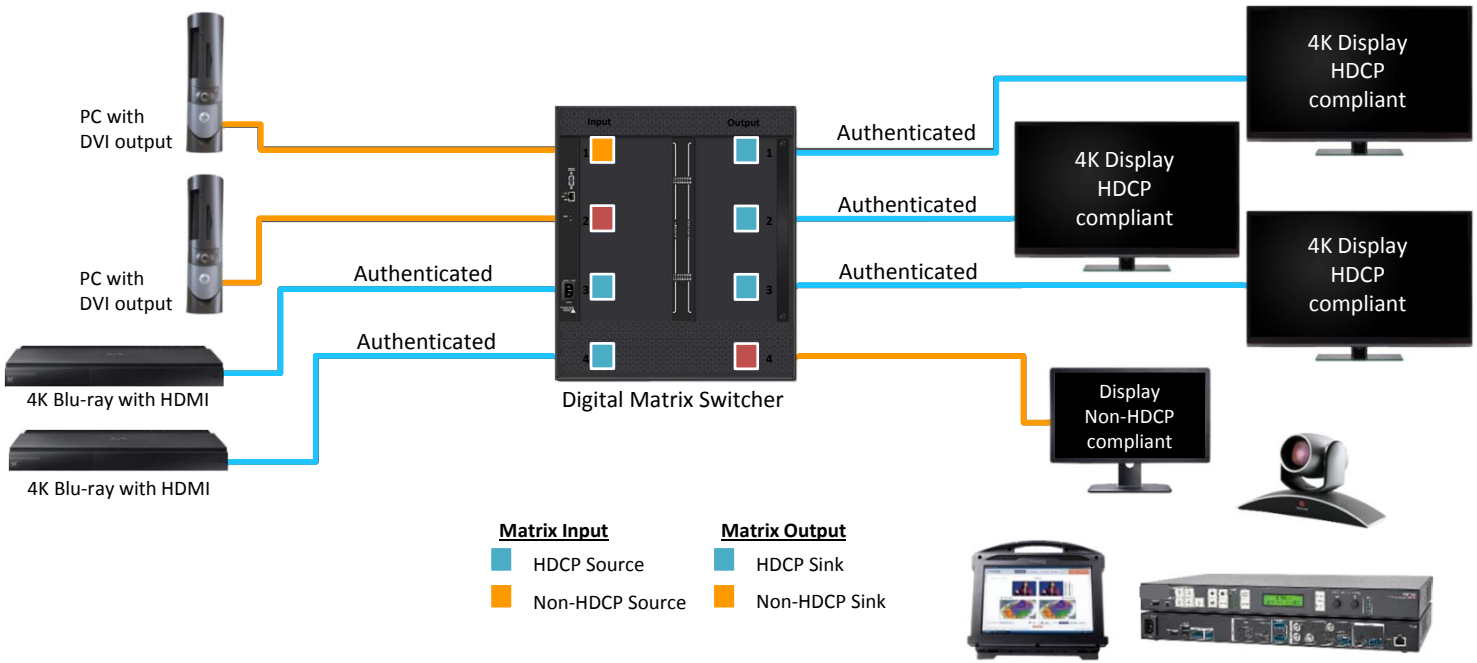
Blu-ray with HDMI

HDCP

- Most collaboration spaces don’t have Blu-Rays or Cable Tuners
- You will have to worry about Apple, Recording, and VTC products

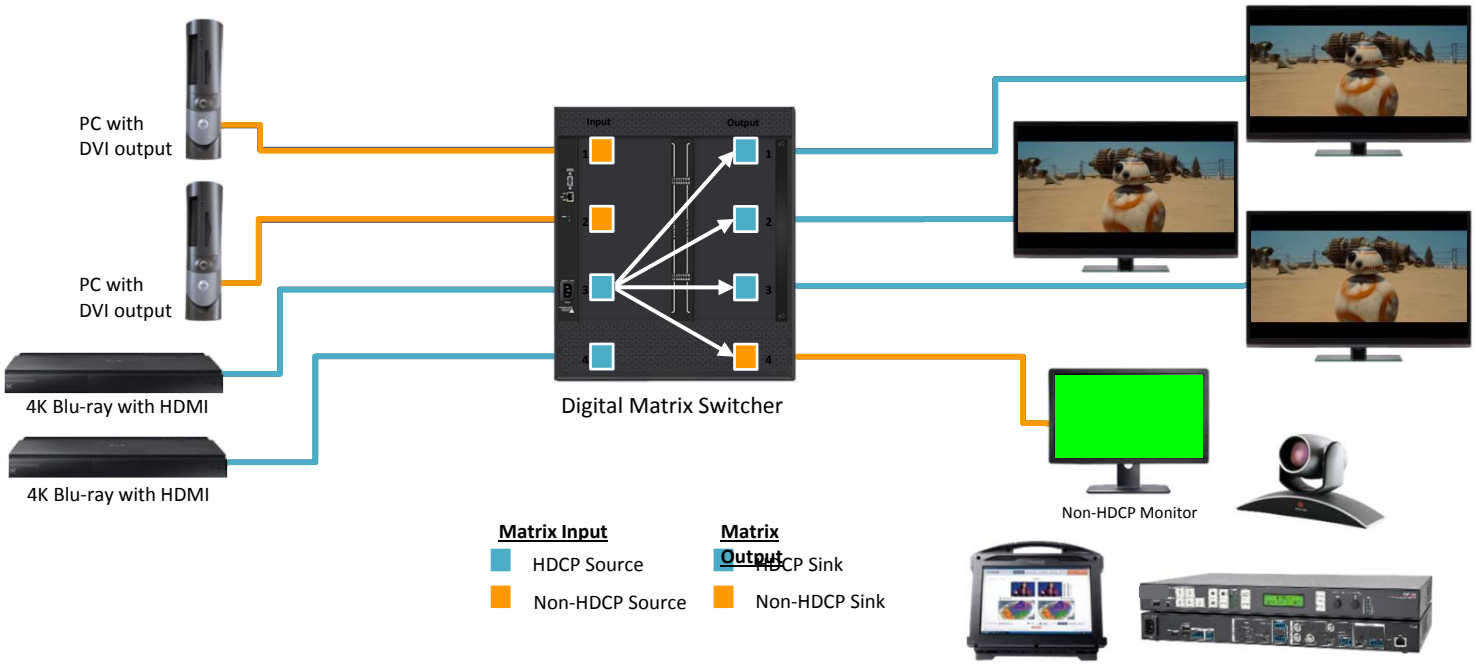
HDCP Handshakes

- I/O authentication



HDCP Handshakes – Not HDCP Compliant

- Visual confirmation



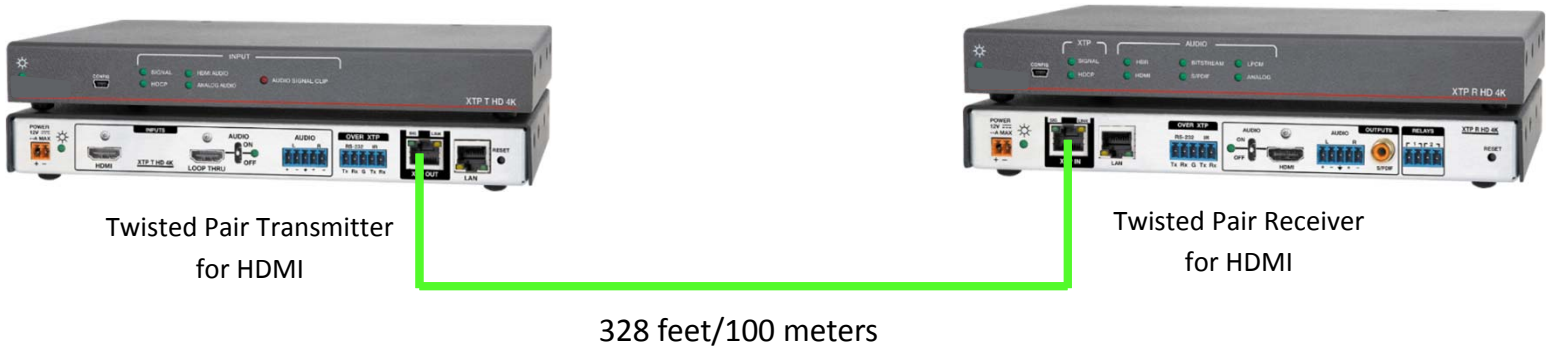
Cables and Cable Standards

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

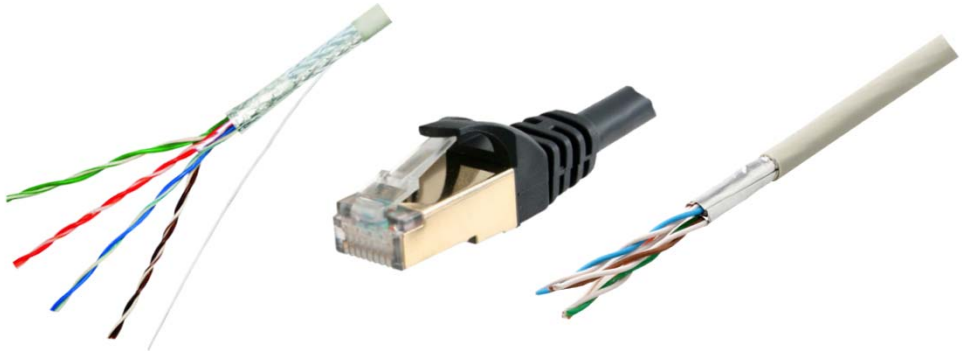


Why Use Twisted Pair?

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

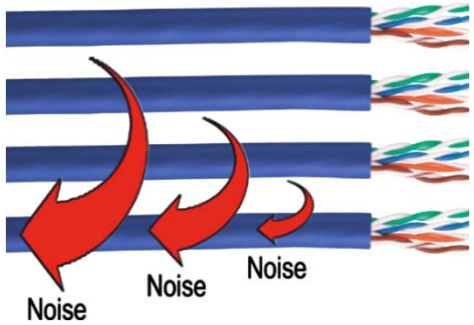
Twisted Pair Transmission

- 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

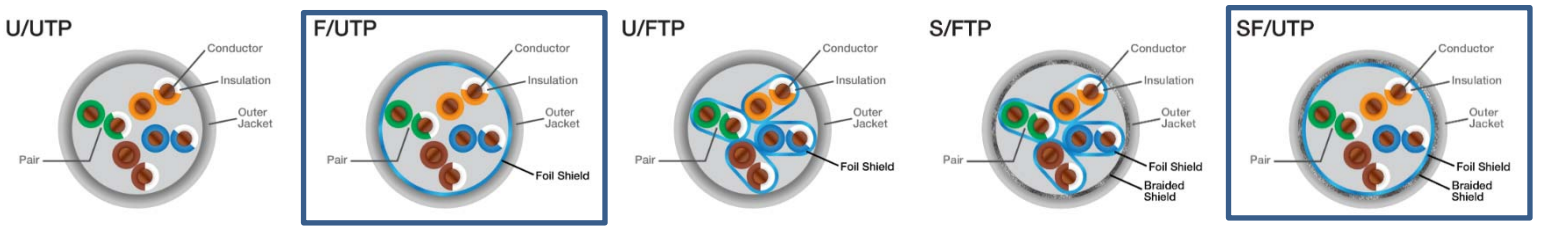


- Symptoms of noisy environments
  - Image drop-out or flashing
  - No image at all

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



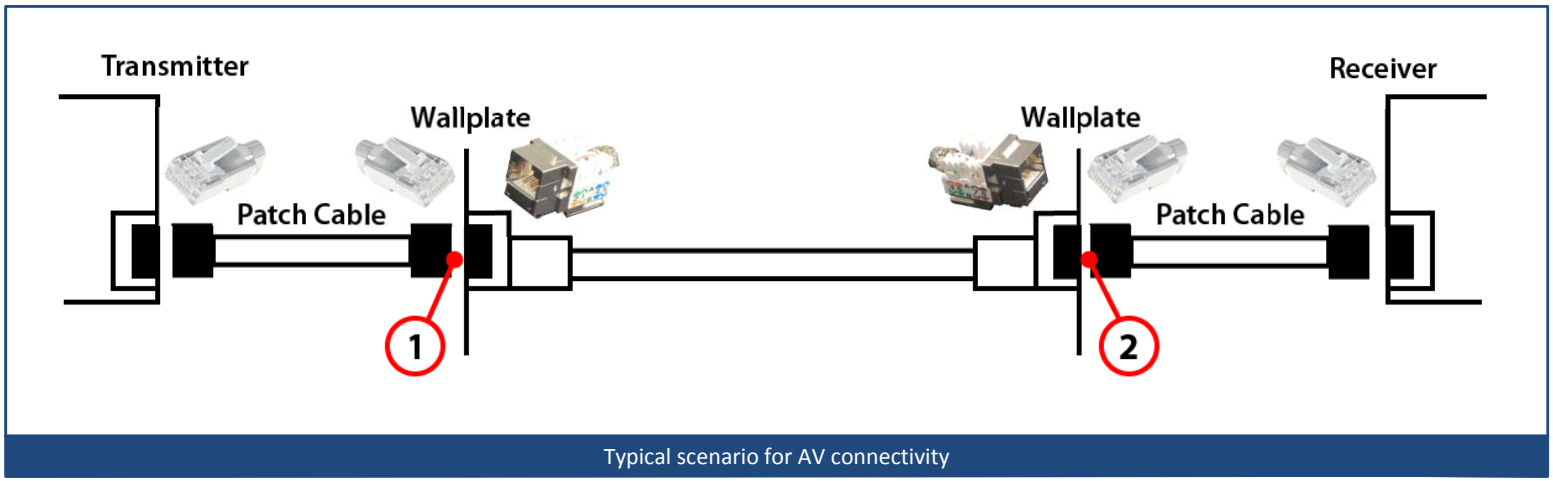
Twisted Pair Signal Transmission

- 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

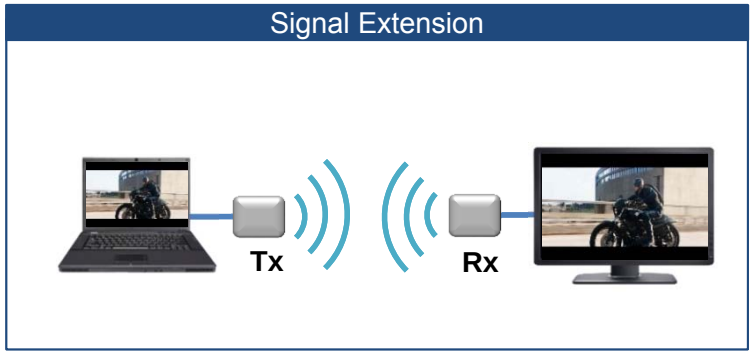
- Cable infrastructure and patch points
  - Up to 2 patch points recommended



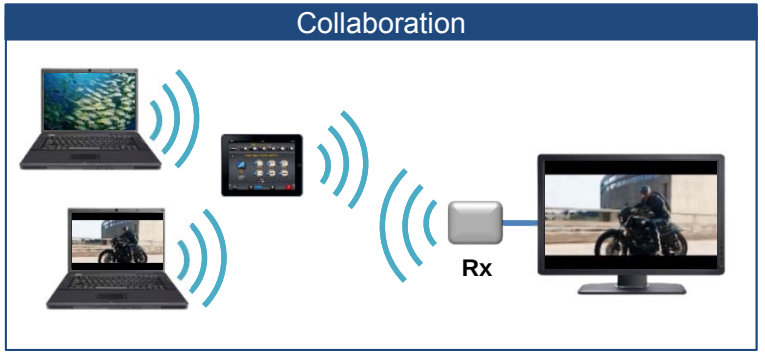
Typical scenario for AV connectivity

Wireless

Wireless Video Applications

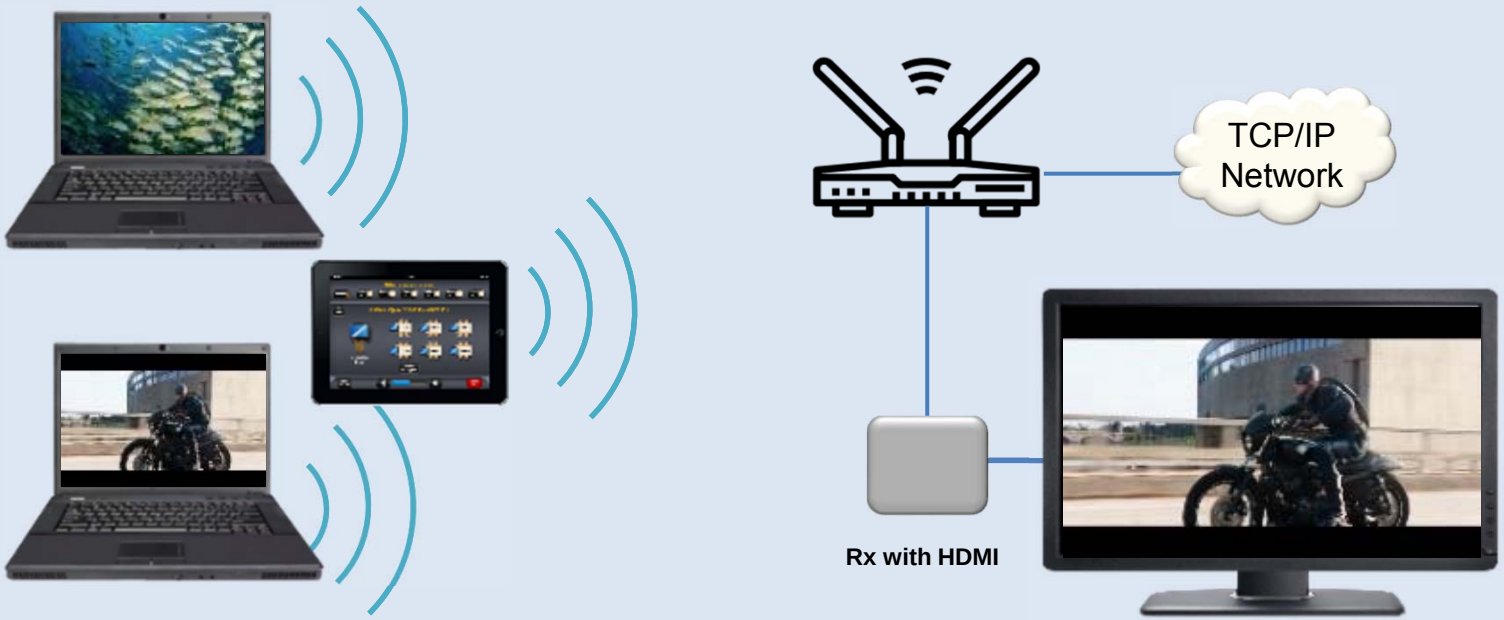


- Point-to-point applications where source video signal is converted to a modulated RF signal for wireless transmission to a receiver connected to a display



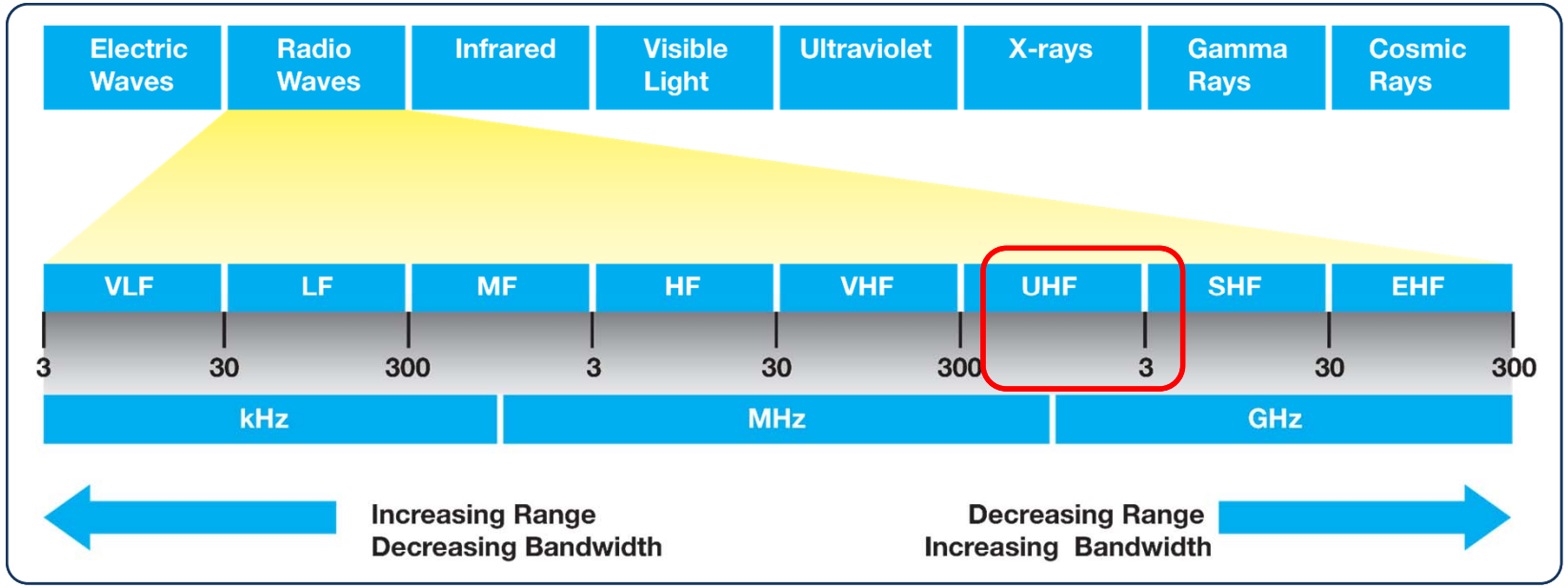
- BYOD applications where computing device encodes and transmits video content over a Wi-Fi network to a receiver connected to a display

Collaboration with their WAP



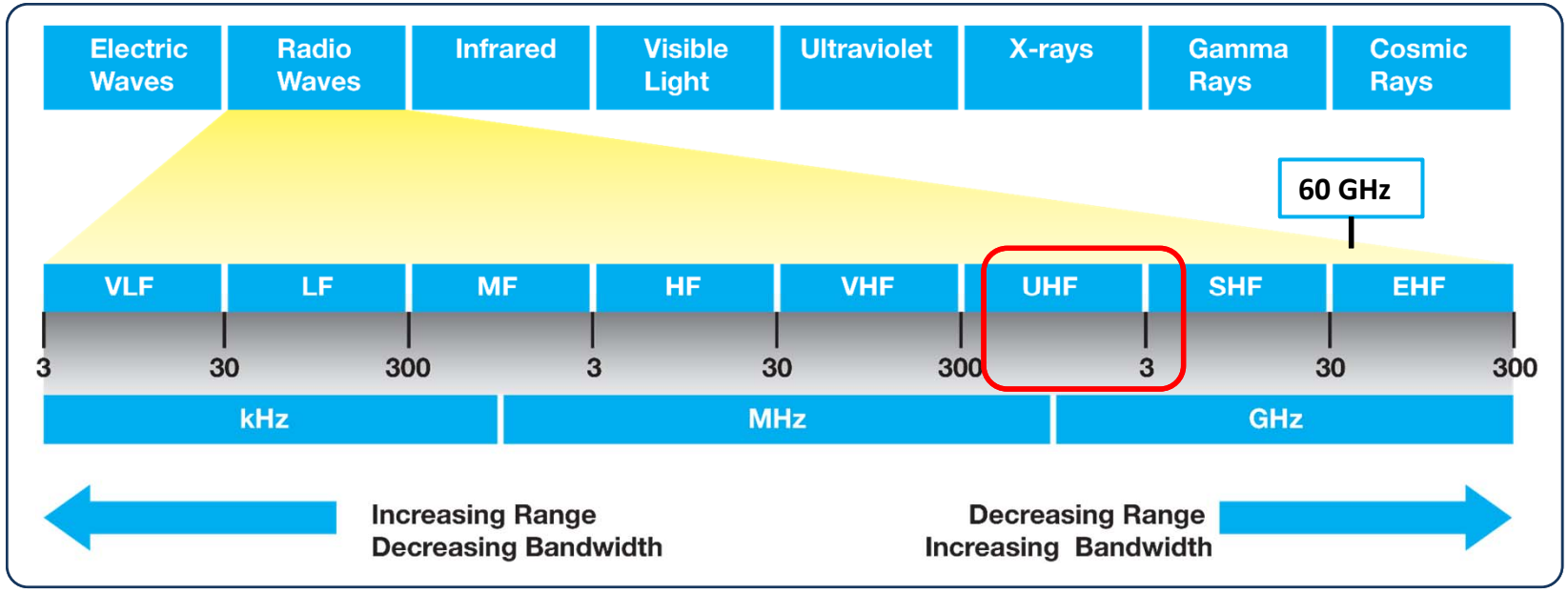
Radio Frequency Spectrum

- 500MHz to 5GHz balances capacity and range
- Transmits through common obstacles, such as walls, with low to moderate loss



Radio Frequency Spectrum

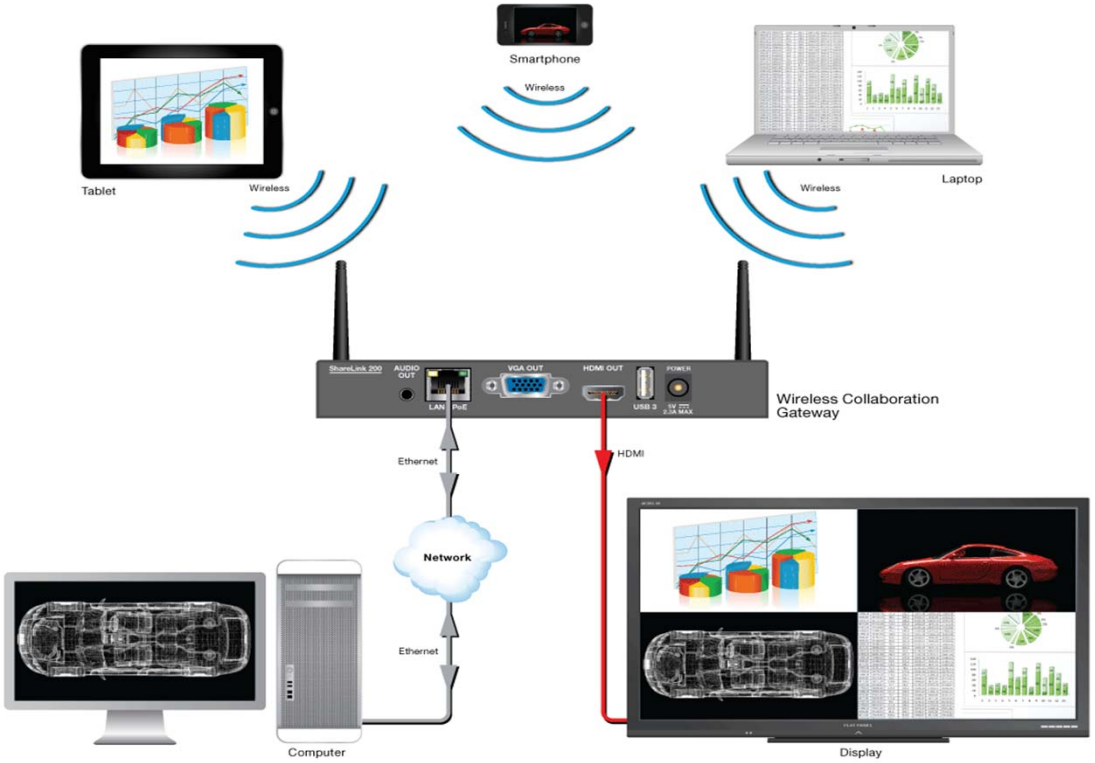
- 60 GHz used for higher data carrying capacity
  - Cannot penetrate solid objects
  - Short range



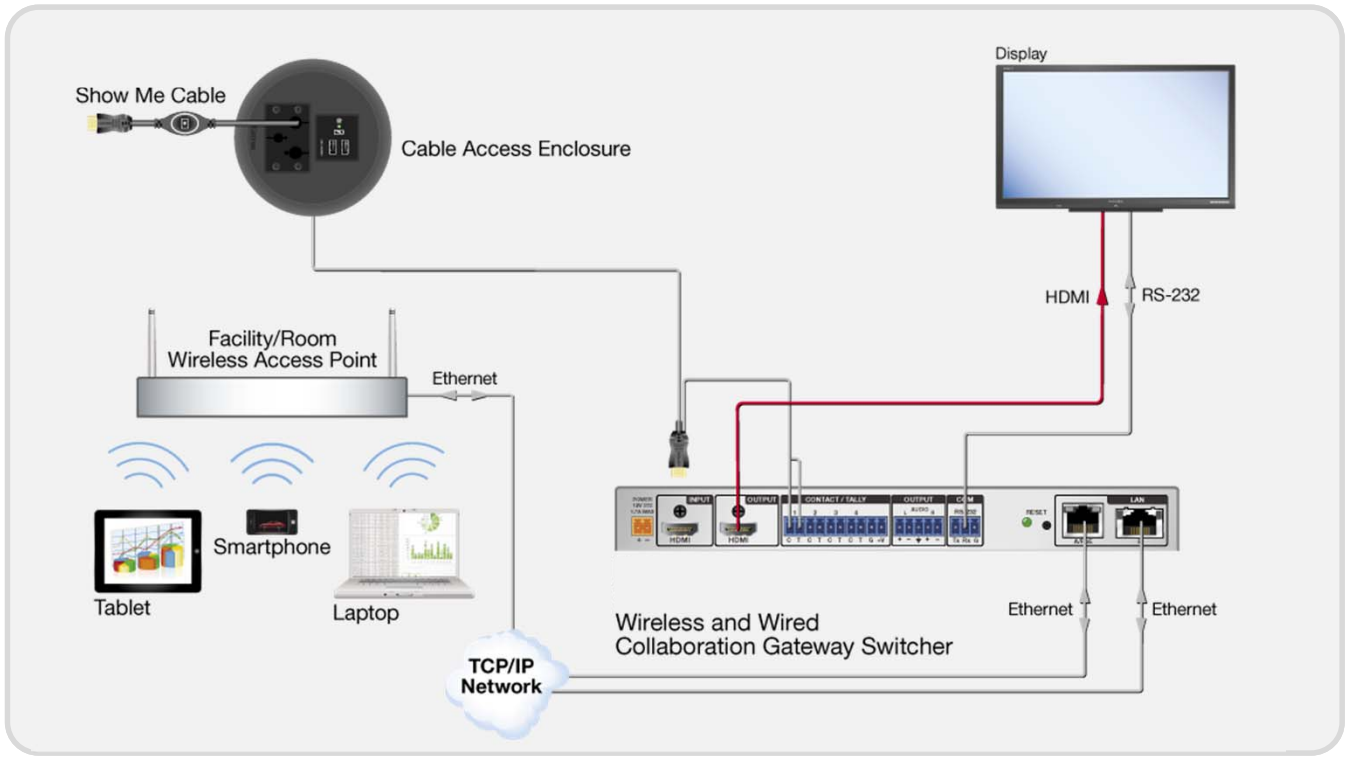
Proprietary Wireless Protocols

Wireless Interface	Frequency Band	Computing Hardware Required	Uncompressed Video
AirPlay	Wi-Fi	Apple Products	No
Chromecast	Wi-Fi	PC, tablet, smartphone	No
Miracast	Wi-Fi	PC, tablet, smartphone	No
WiDi	Wi-Fi	Intel Products	Yes
WiGig	Wi-Fi, 60 GHz	PC, tablet, smartphone	Yes
UWB	3.1 – 10.6 GHz	None	Yes
WHDI	5 GHz	None	Yes
WirelessHD	60 GHz	None	Yes

Using Your Own WAP

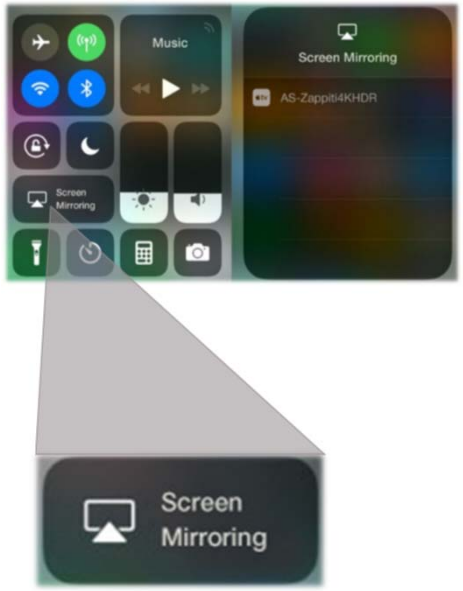


Using Their WAP



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

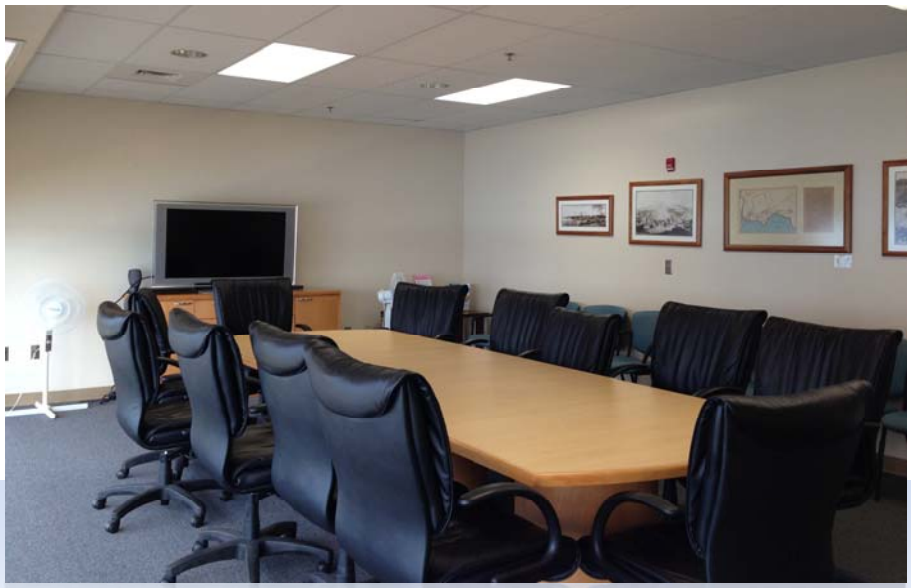
With Cable Runway

On Cement

Furniture

"Techniture, Learnature," and Power

Techniture vs Learnature



Cable Management

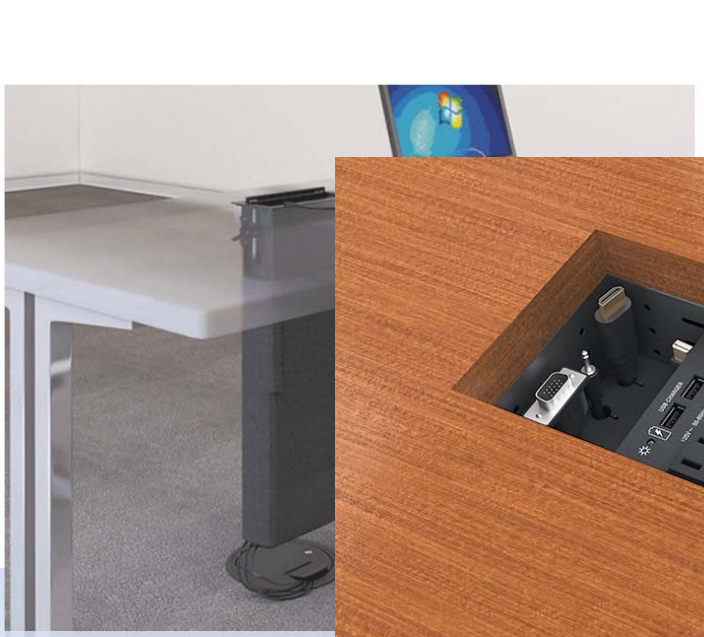


Table connectivity including Power and USB charging

Audio

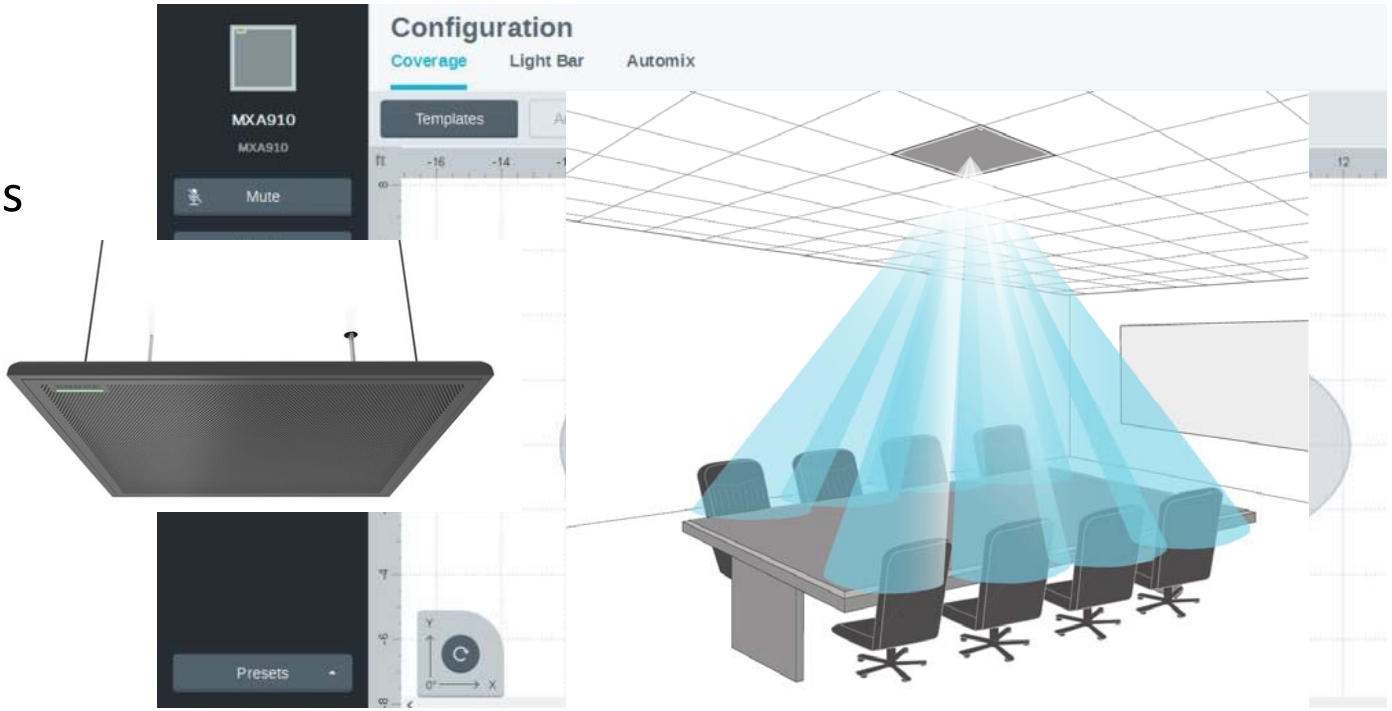
Microphones

- Boundary Mics

- Ceiling Mics

New Types of MICS

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

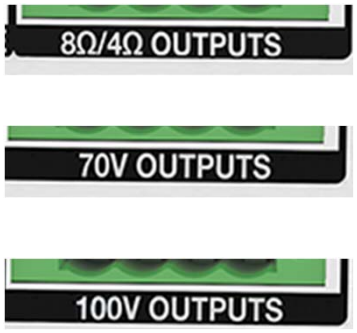


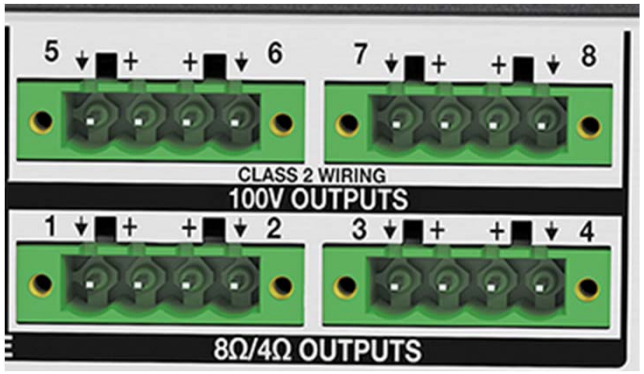
Speakers

- 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

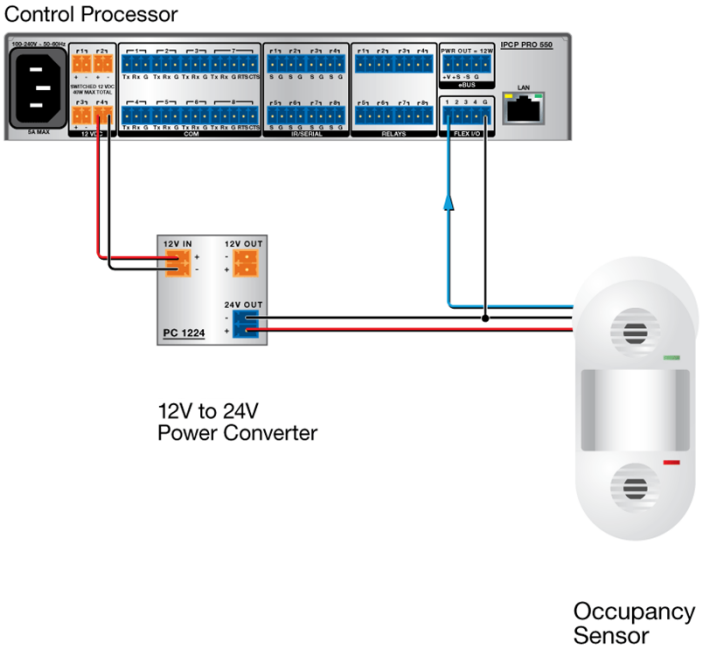




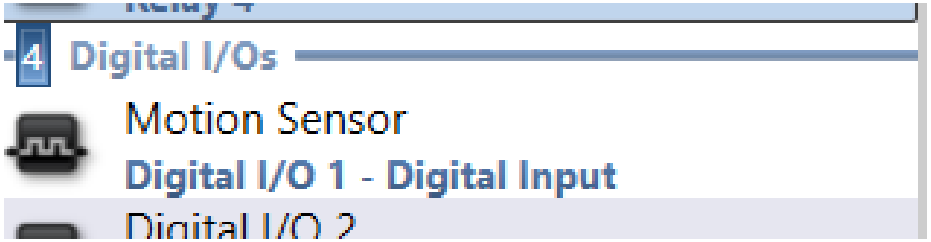
Room Automation

Simple Motion Sensor

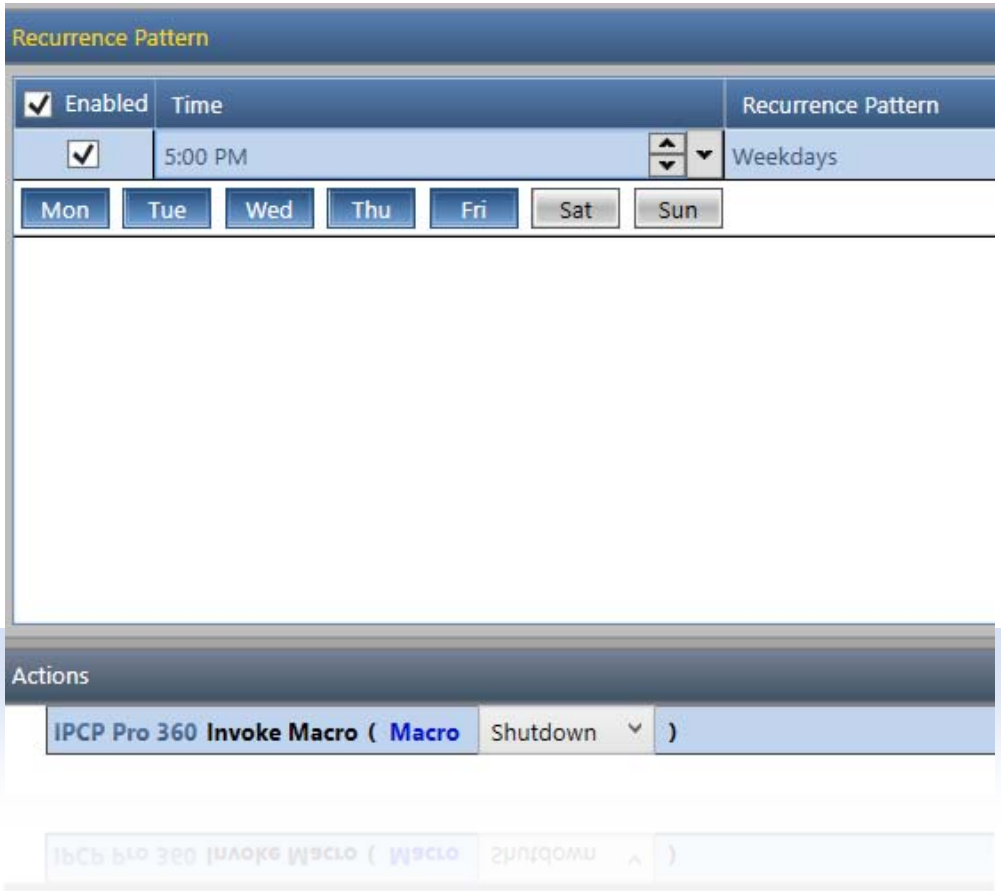
- Motion Sensor wiring



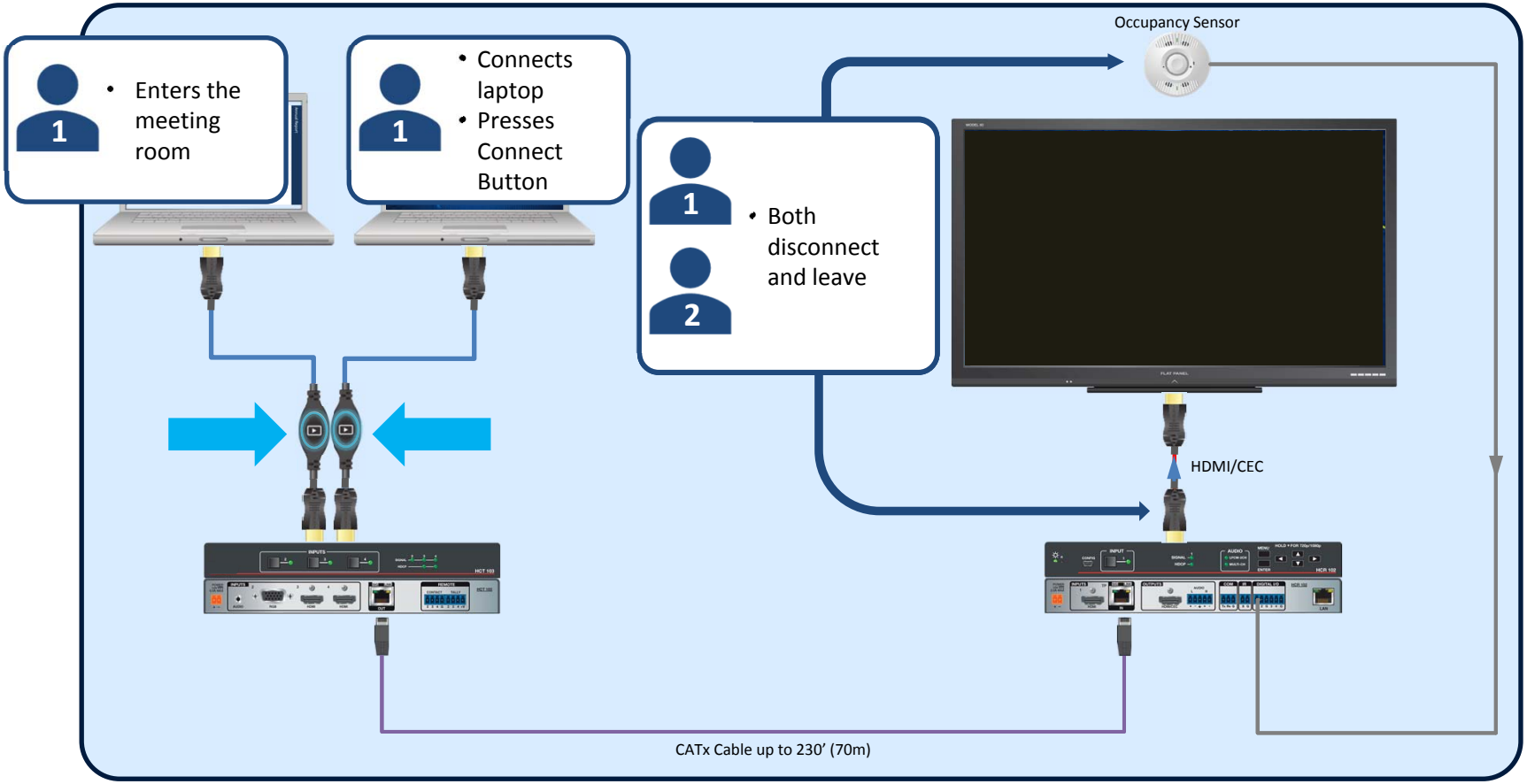
- Control system module for Motion Sensor configuration



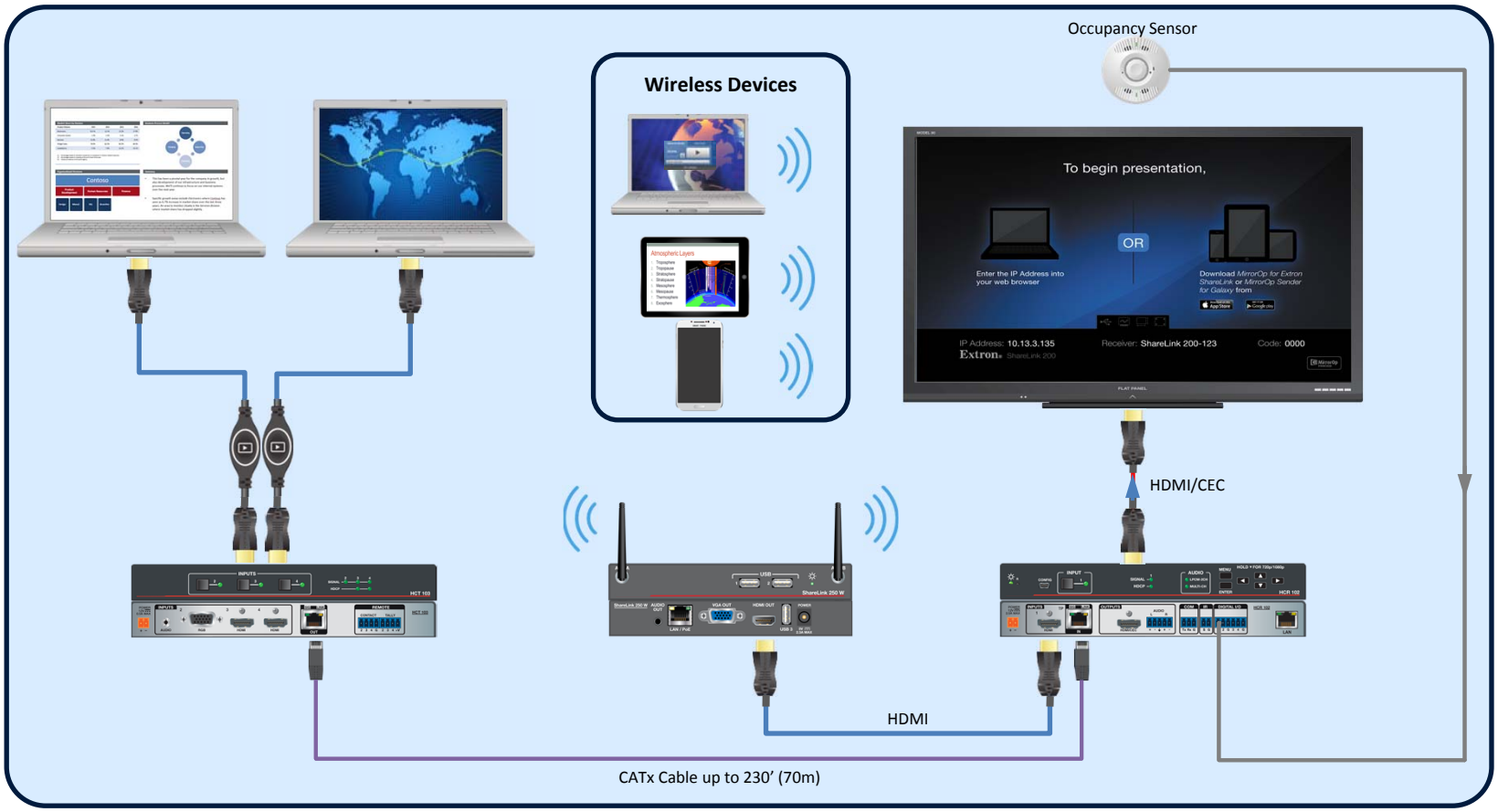
How a timer works



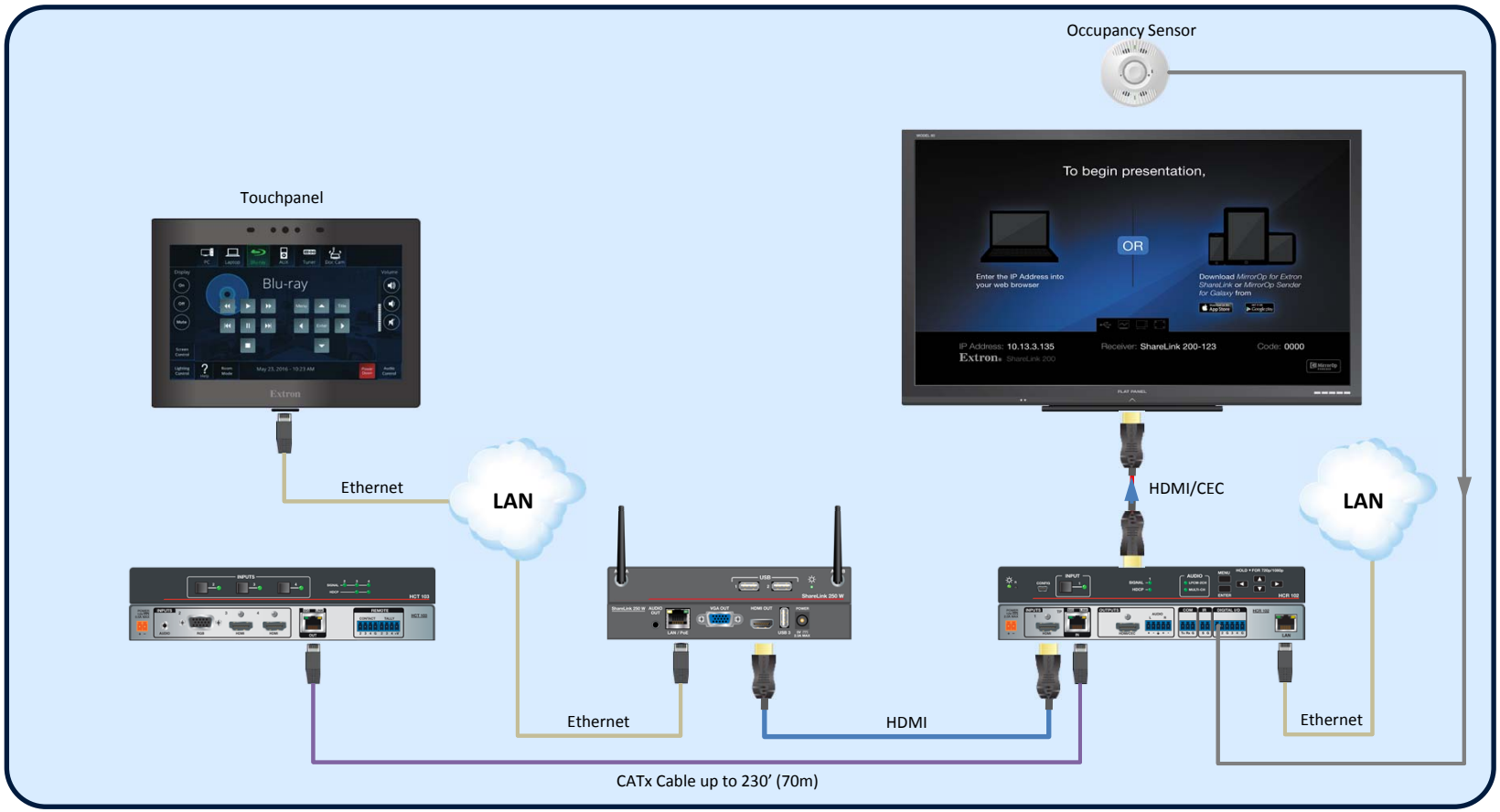
Occupancy Sensor and Collaboration Technology



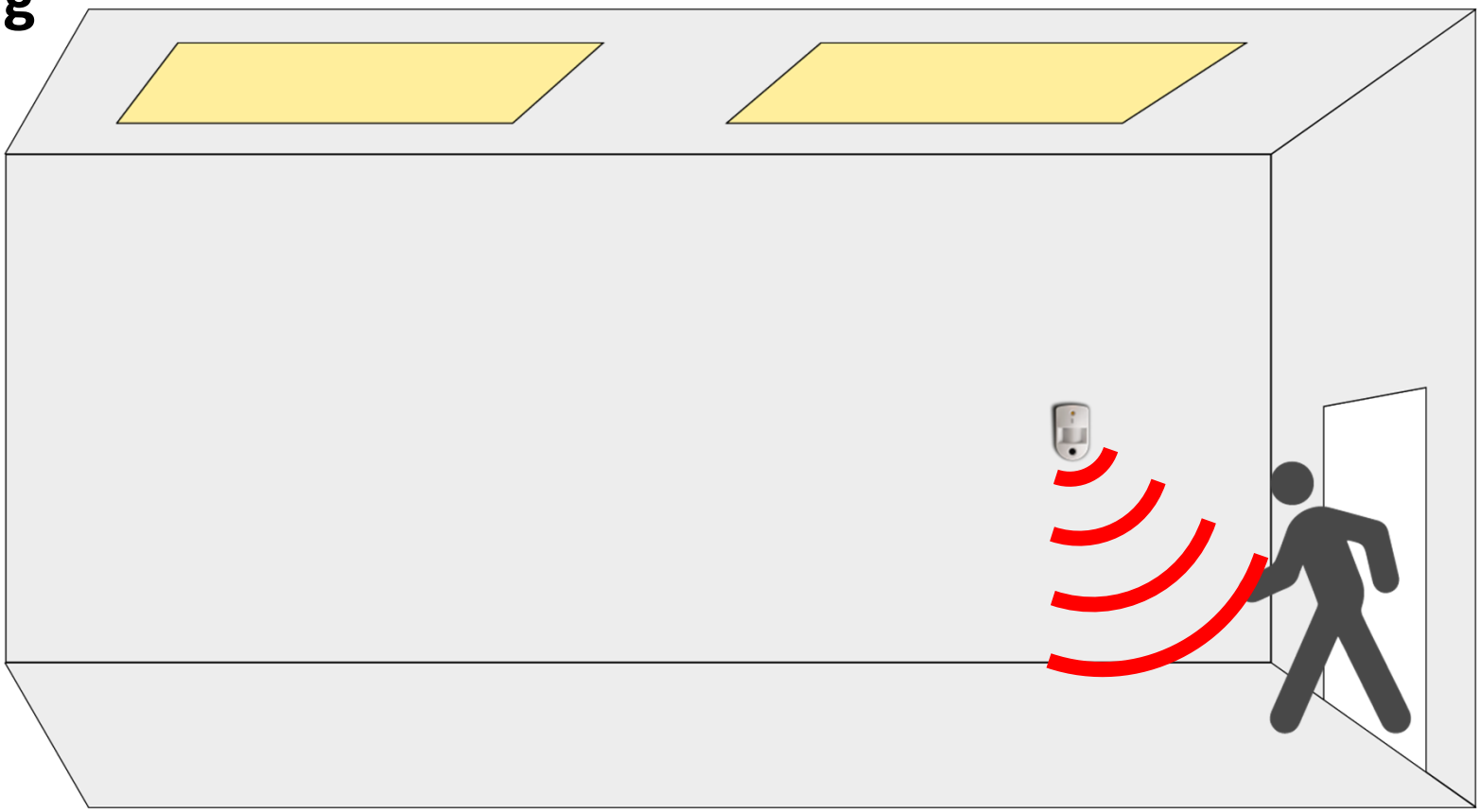
Upgrade Options – Wireless Connectivity



Upgrade Options – TouchPanel Control

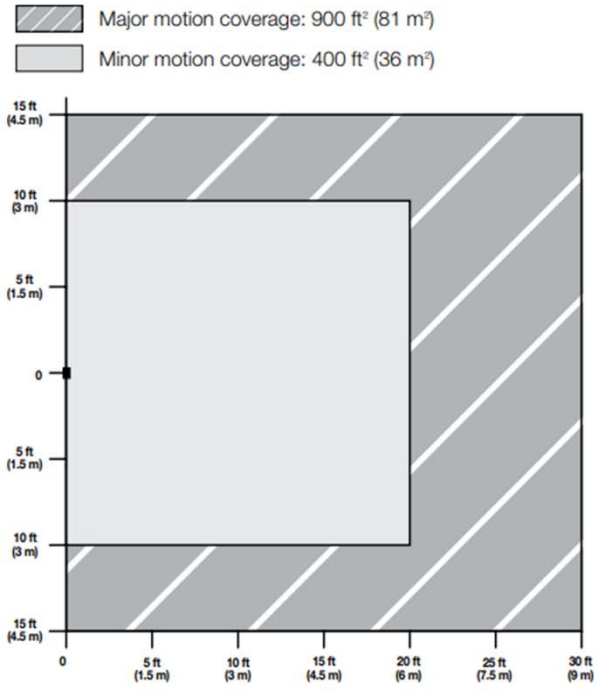


Lighting

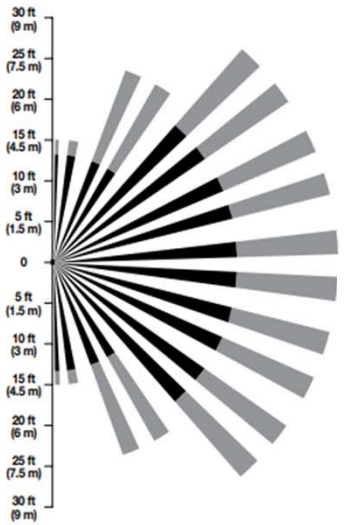


Sensor Dimmer Coverage Area

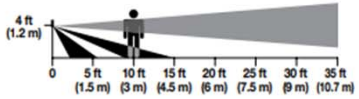
NEMA WD7 Test Grid Coverage (High Sensitivity Setting)



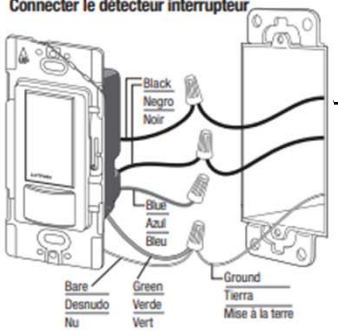
Horizontal Beam Diagram



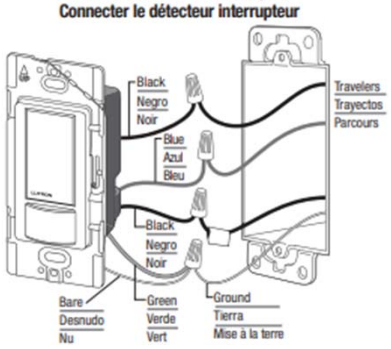
Vertical Beam Diagram



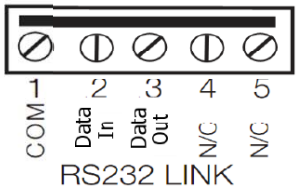
Connect sensing switch
Conecte el sensor con interruptor
Connecter le détecteur interrupteur



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



Signal
TxD
RxD
GND

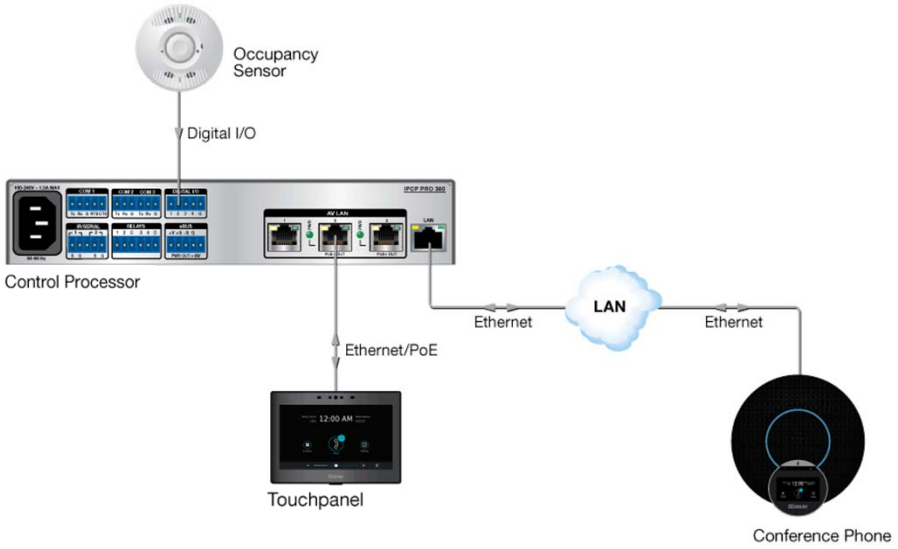


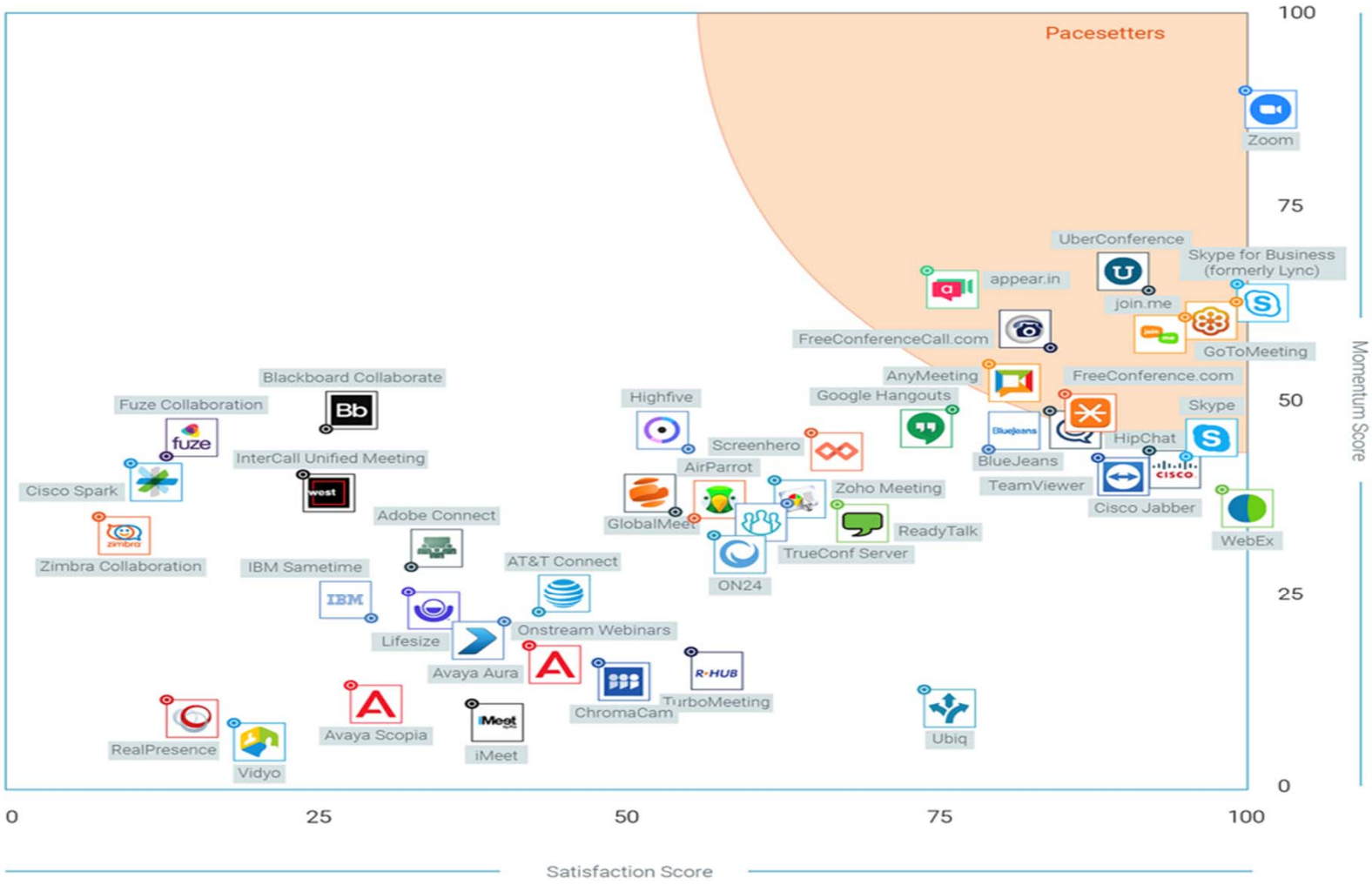
Conference Room Interfaces

Multiple Types of Devices

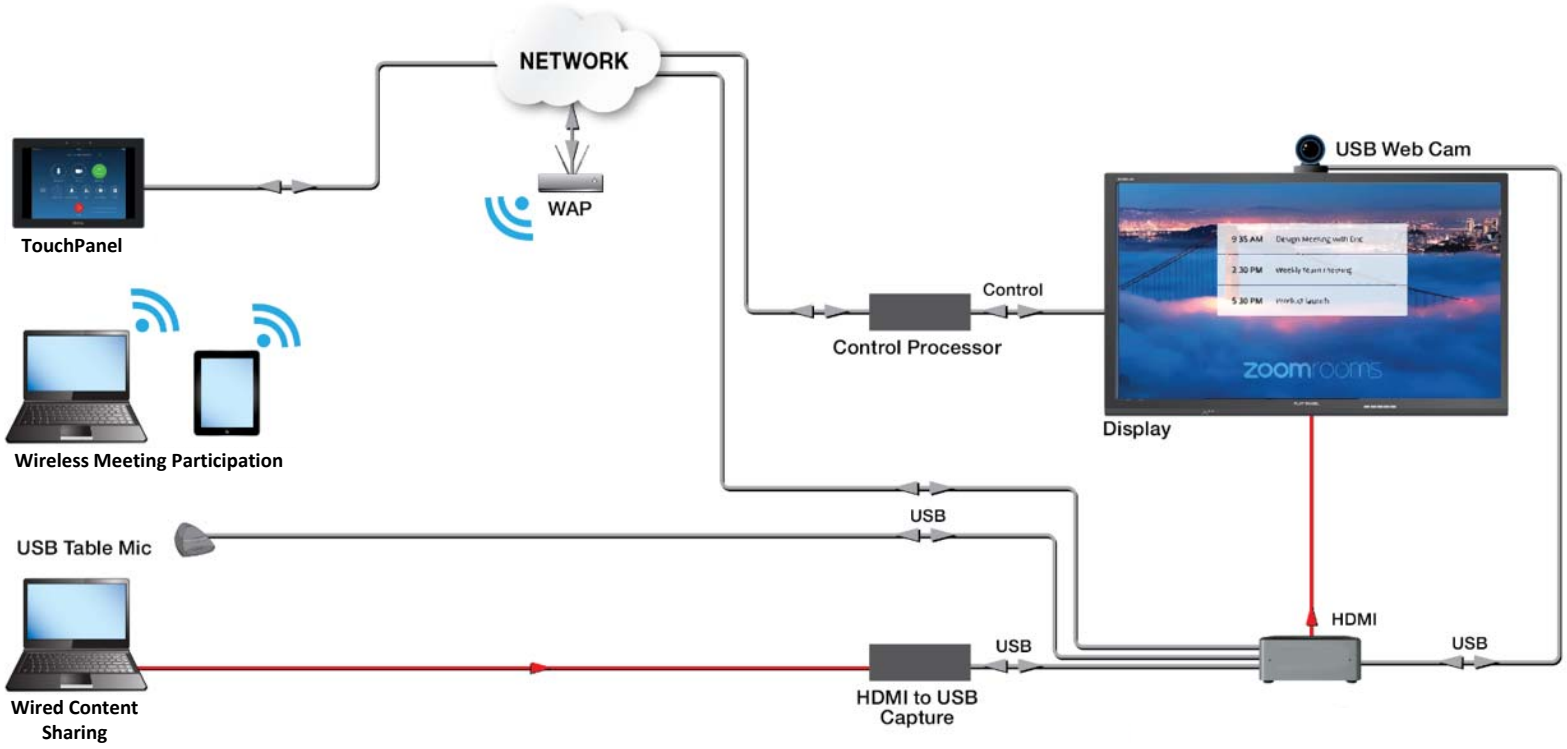
- Networks need to be capable of handling multiple types of devices and environments where BYOD is common

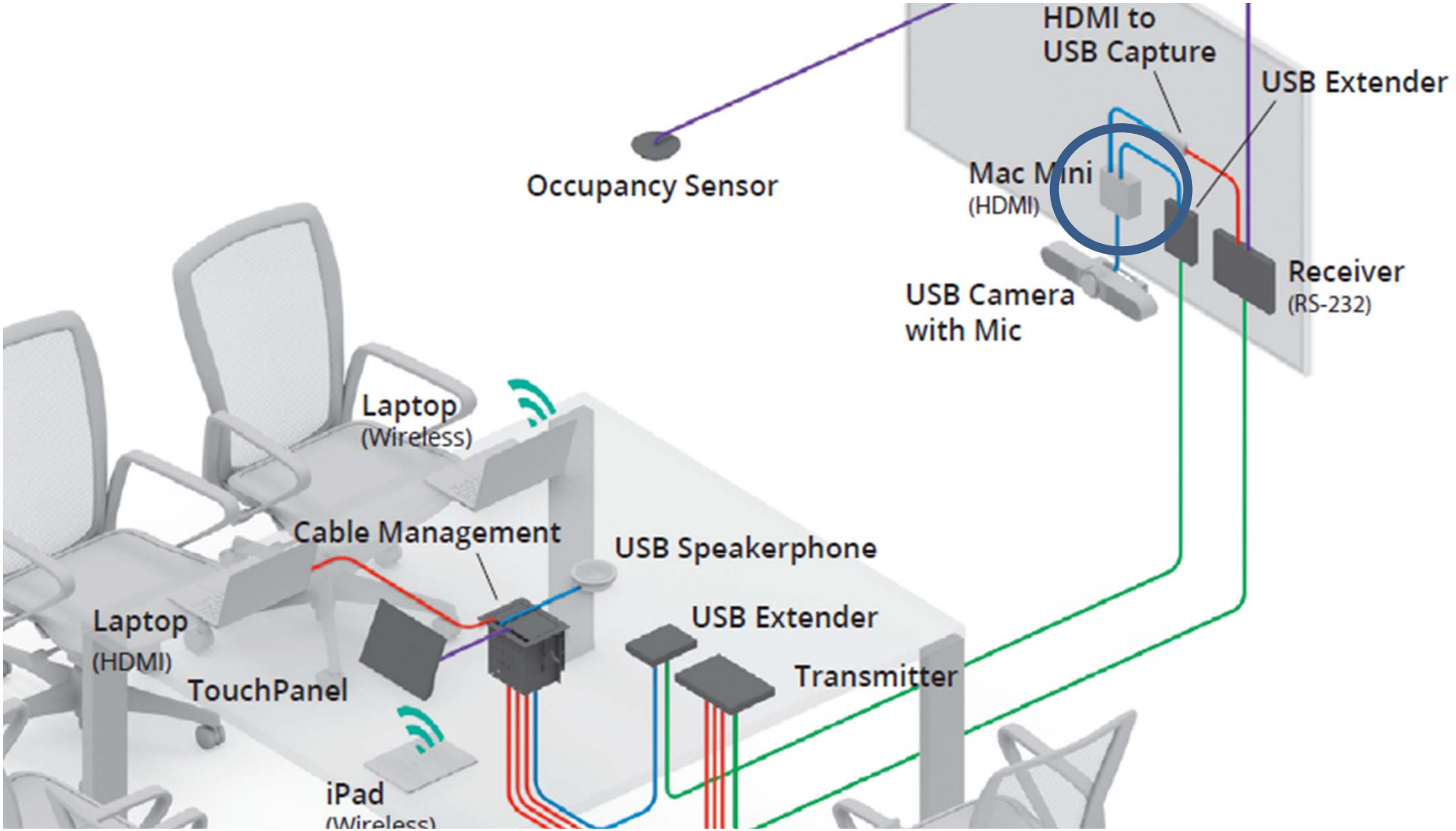
Seamless Conference Experiences




Pacesetters
Zoom
UberConference
Skype for Business (formerly Lync)
appear.in
join.me
GoToMeeting
FreeConferenceCall.com
AnyMeeting
FreeConference.com
Google Hangouts
Skype
Highfive
Screenhero
HipChat
BlueJeans
AirParrot
TeamViewer
Zoho Meeting
Cisco Jabber
WebEx
GlobalMeet
ReadyTalk
TrueConf Server
ON24
Blackboard Collaborate
Fuze Collaboration
InterCall Unified Meeting
Cisco Spark
Zimbra Collaboration
Adobe Connect
IBM Sametime
AT&T Connect
Onstream Webinars
Lifesize
Avaya Aura
TurboMeeting
ChromaCam
Avaya Scopia
iMeet
RealPresence
Vidyo
Ubiq
100
75
50
25
0
Momentum Score
0
25
50
75
100
Satisfaction Score

Control and Zoom Room




HDMI to
USB Capture
USB Extender
Occupancy Sensor
Mac Mini
(HDMI)
Receiver
(RS-232)
USB Camera
with Mic
Laptop
(Wireless)
Cable Management
USB Speakerphone
Laptop
(HDMI)
USB Extender
TouchPanel
Transmitter
iPad
(Wireless)

Control

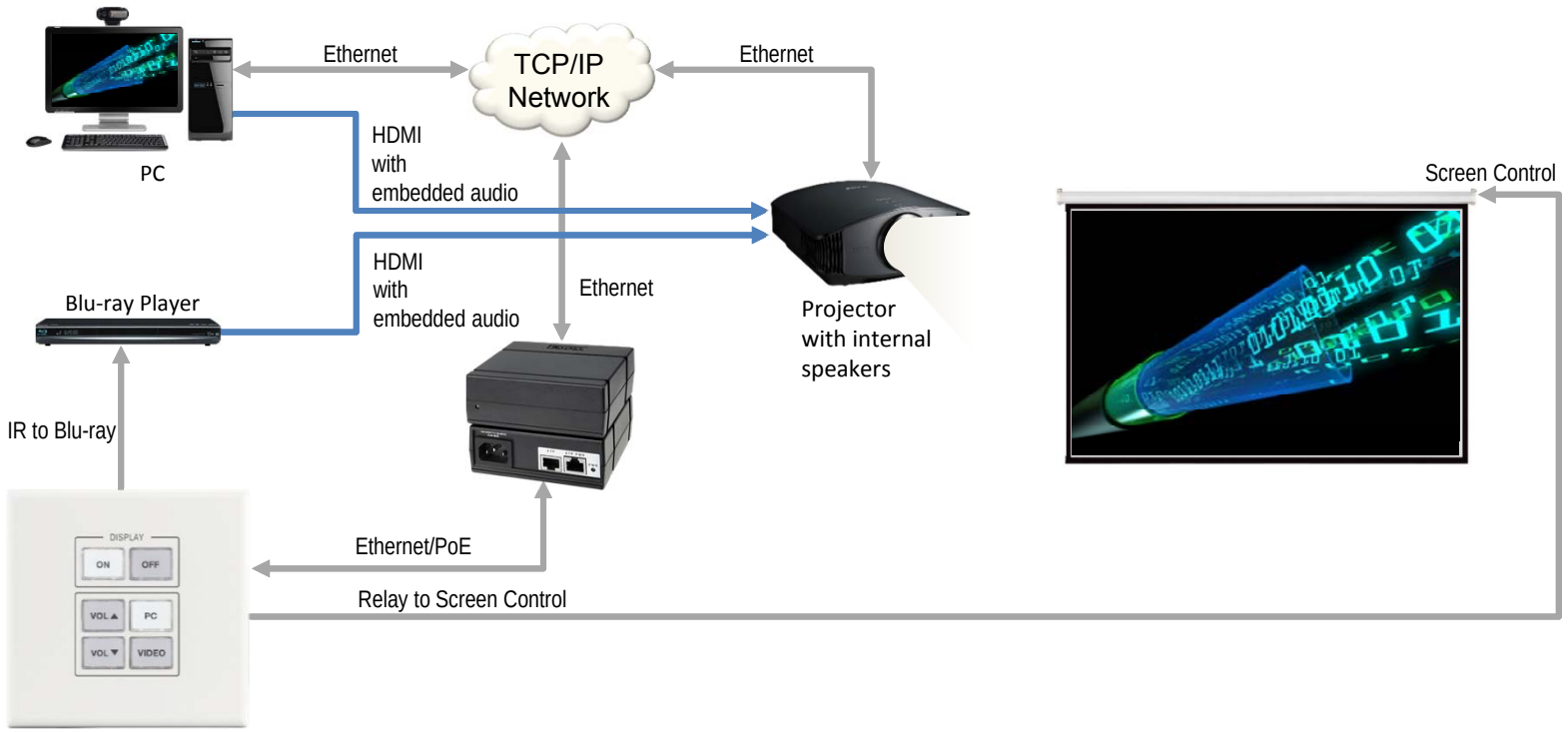
Push Button Controllers

These do NOT count!

Push Button Controllers

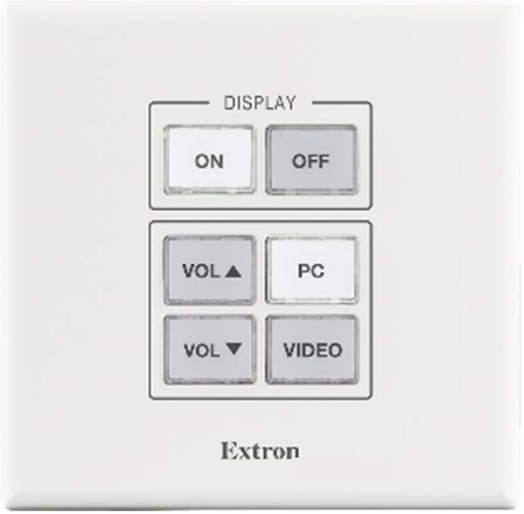
These do!

Single Display Application



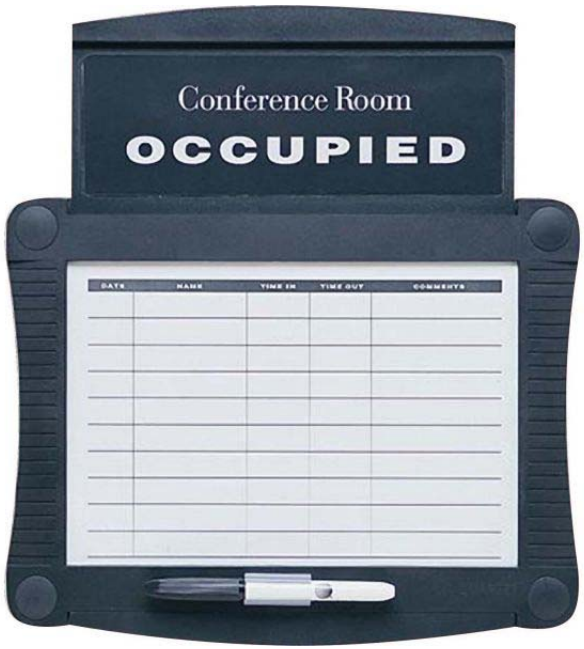
Features of PUSH – Button controllers

- 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

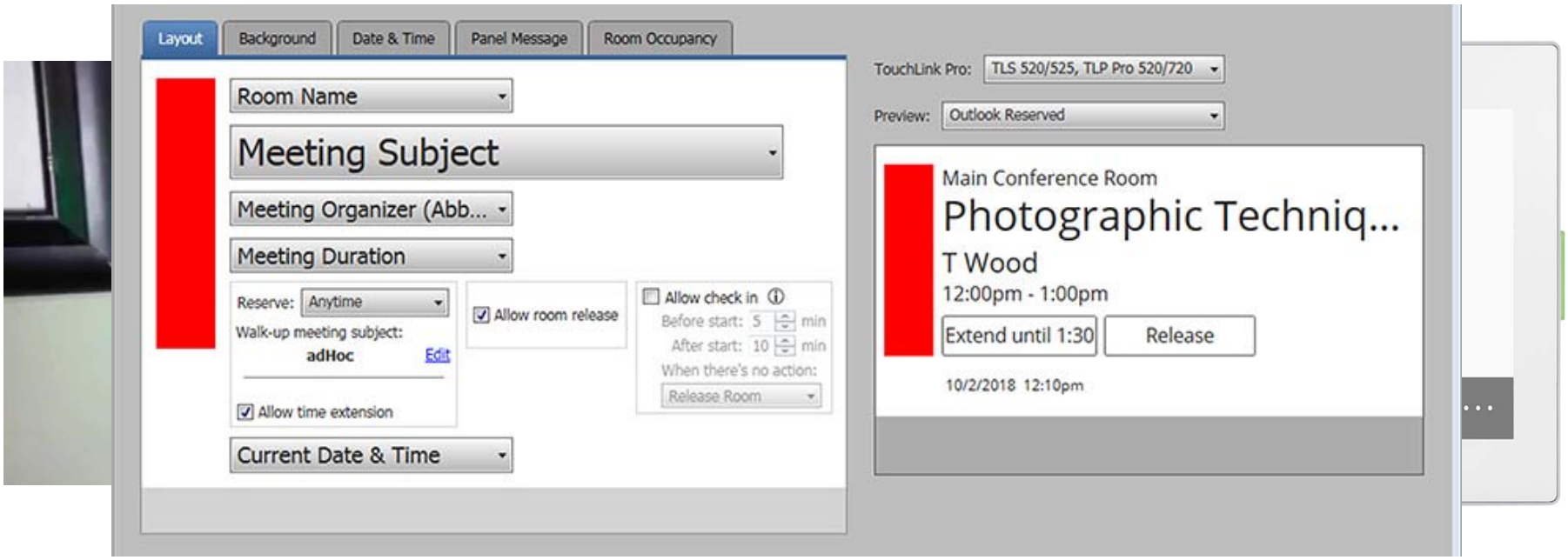


Room Scheduling

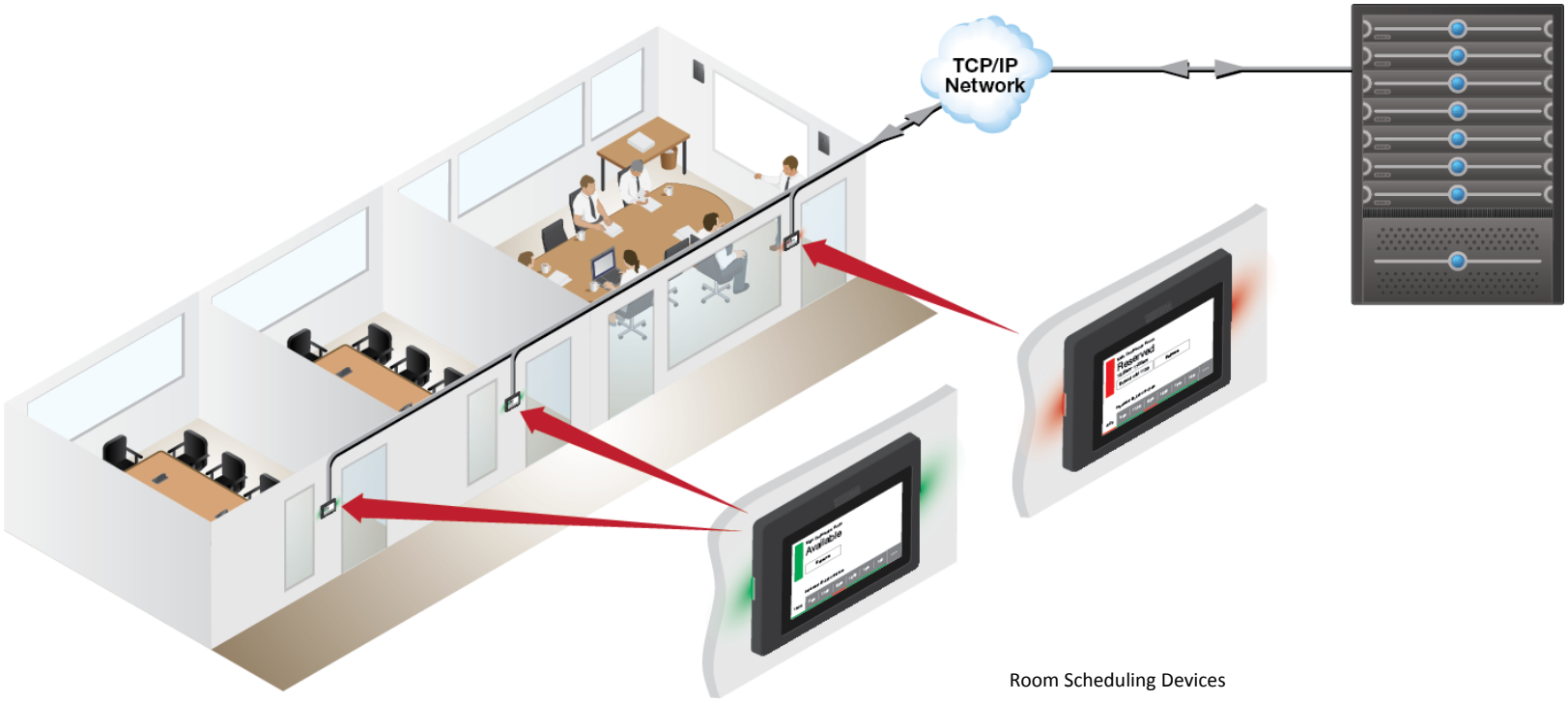
Scheduling – How it used to be



Room Scheduling Panels



Room Scheduling



Room Scheduling Devices

Designs


T07
C03
MAXIMUM 48
STORED CHAIRS
(stacks of 4 max)
S02,
TYP
T04,
TYP
122
MULTI-PURPOSE ROOM
D04
1'-7" TYP
1'-0" MIN
1'-0" MIN
CLASSROOM
Ideal for groups that do not have much discussion but have a need to take notes.
CONFERENCE
Ideal for groups under 20, with heavy discussion and a need to write or refer to materials.
U SHAPE
Ideal four groups under 30, with a designated speaker, heavy discussion, and a need to write or refer to materials.
HOLLOW SQUARE
Ideal for groups under 40, with heavy discussion and a need to write or refer to materials.
MEETING SQUARES
Ideal for any size group that needs to break into smaller groups.
THEATER
Ideal for any size group that does not have much discussion or does not need to refer to material.

Open Meeting Space – Capabilities

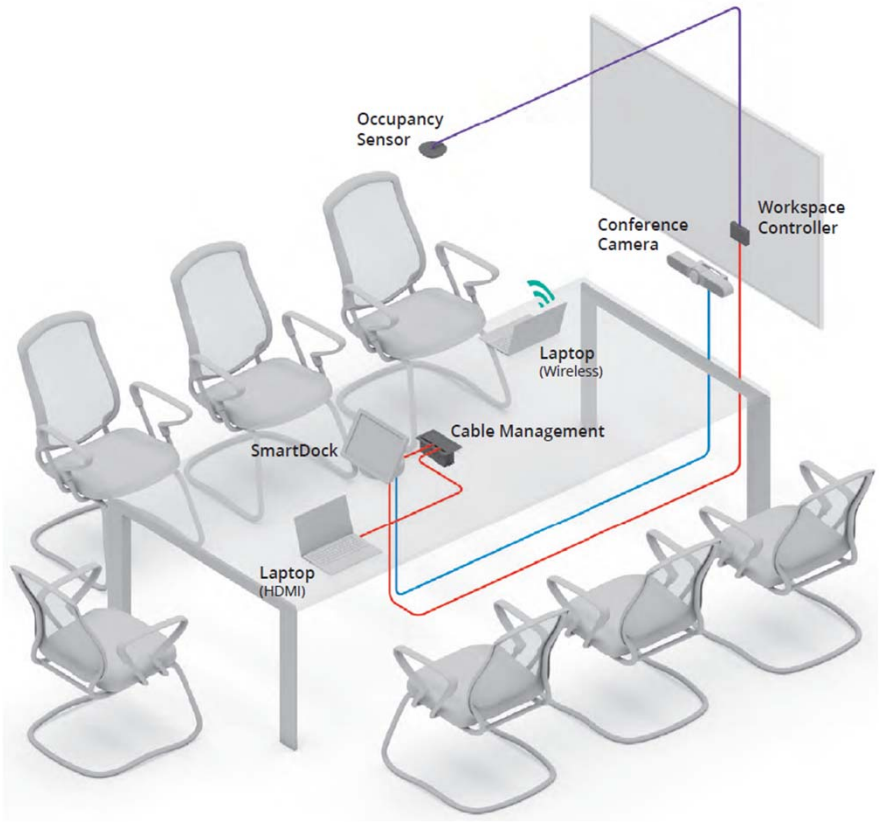
- Wirelessly share content from personal mobile devices
- Display content simultaneously from multiple different devices
- Play content from media player internal memory, USB/SD card, or network shares

Huddle Room with Video Conferencing – Capabilities

- Connect with team members using business collaboration software
- Access to cables and AC power
- Wirelessly share content from personal and mobile devices
- Occupancy sensor activity will start up room

Huddle Room with Video Conferencing – Capabilities

- Connect with team members using business collaboration software
- Access to cables and AC power
- Wirelessly share content from personal and mobile devices
- Occupancy sensor activity will start up room

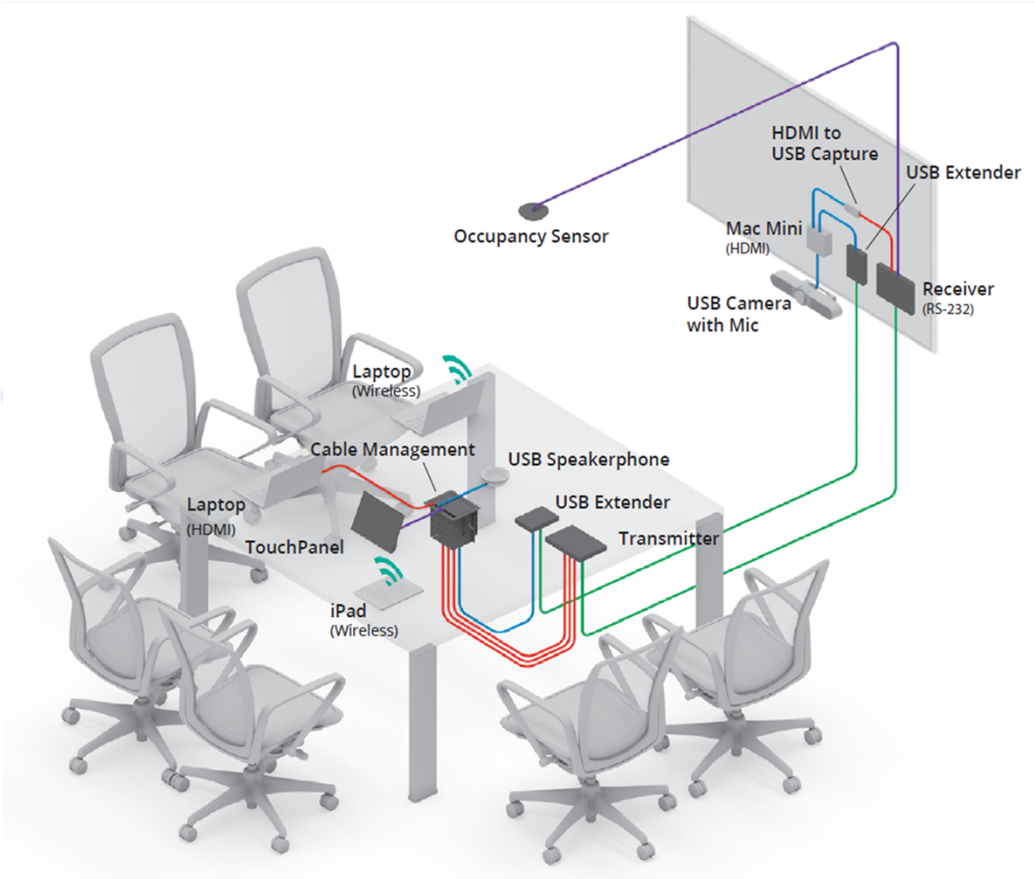


Equipment

zoom logitech cisco

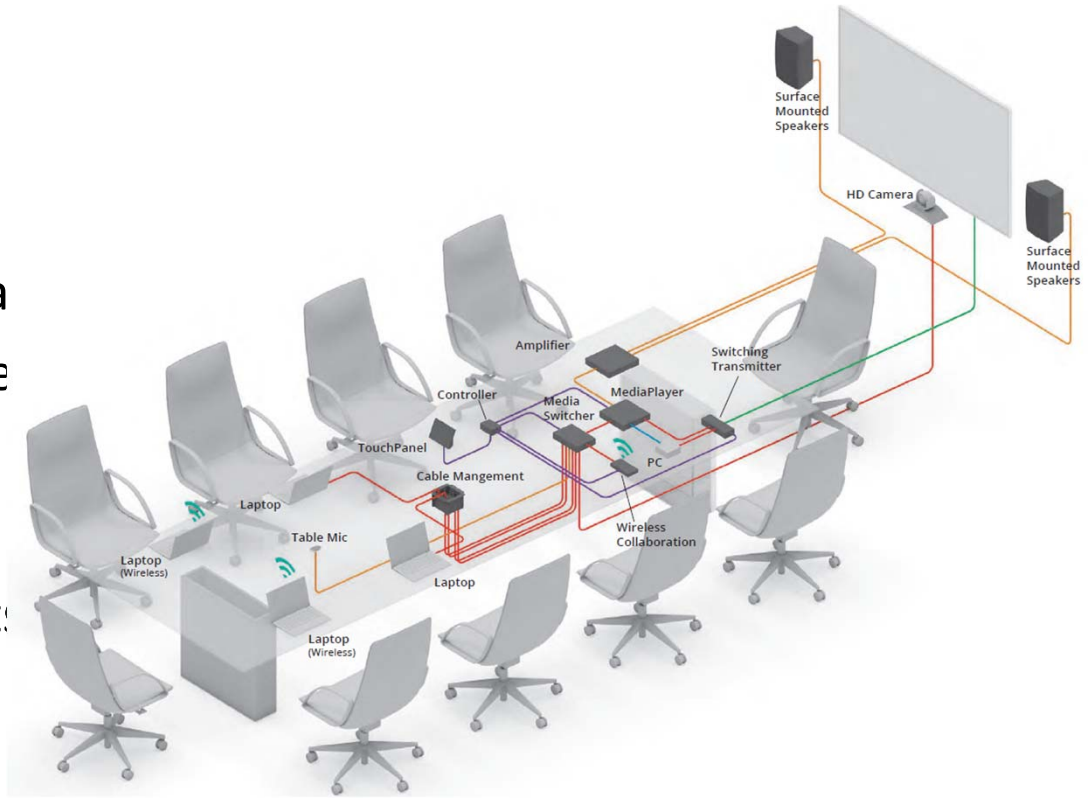
Google Microsoft DOLBY

StarLeaf Polycom lifesiz



Equipment

- Shielded CAT x cables
- HDMI switcher
- Four Input HDMI Switcher
- HDMI and Audio to USB Sca
- Wireless Collaboration Gate
- Tabletop Touch Panel
- Control Processor
- Stereo Amplifier - 100 Watt
- Speakers



AV over IP Considerations

New Technology

AV over IP – AES 67 Audio Distribution

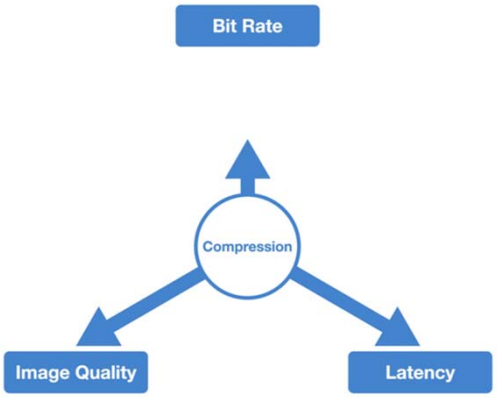
- AES 67 Standard allows audio transportation over IP based systems
- Interoperability between network audio over IP protocols
- Adds audio networking technology into a variety of applications
- Supports both multicasting and unicasting

+

= AES 67

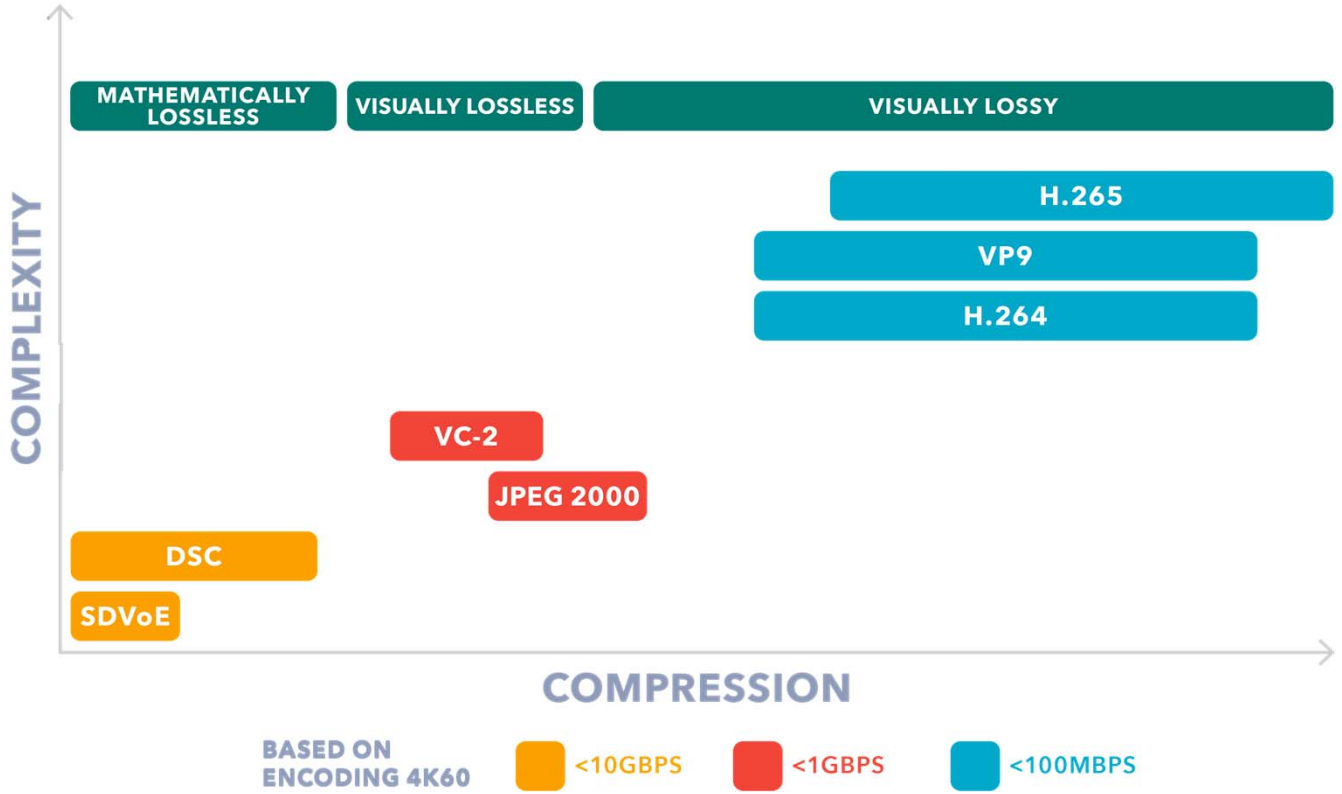
AV over IP – Compression

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



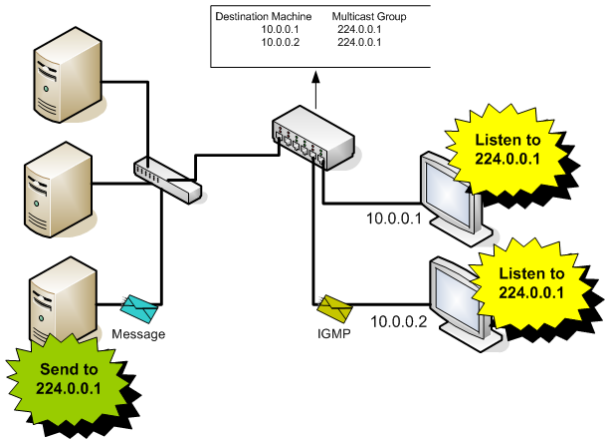
Video Rate	Uncompressed Bit Rate @ 24 bpp	1G Compression @ 880 Mbps	10G Compression @ 4 Gbps
480p60 (SD)	422	1:1	1:1
720p60 (HD)	1,330	2:1	1:1
1080p60 (HD)	2,990	3:1	1:1
2160p60 (UHD)	11,940	14:1	3:1
4096x2160 @ 30 (4K/30)	6,370	7:1	2:1
4096x2160 @ 60 (4K/60)	12,740	14:1	3:1

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