1 = Blue 2 = Red
3 = Green 4 = Orange

AV Like Paint by Numbers

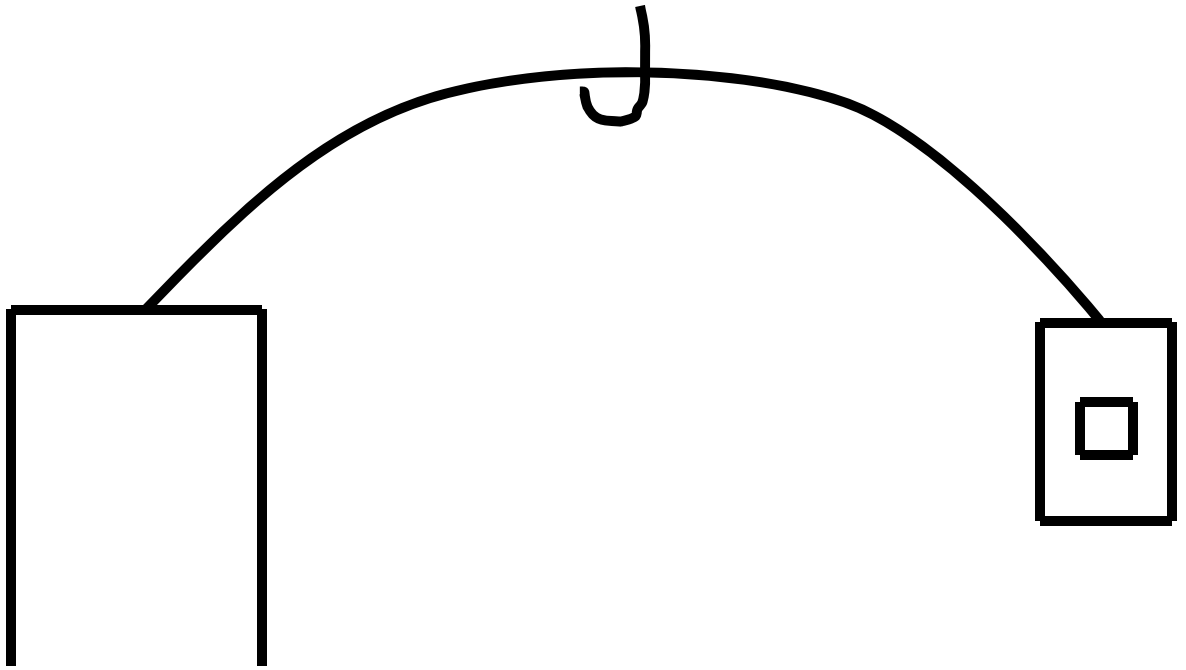
Presented By: Eric J. Marshall

1 = Blue 2 = Red
3 = Green 4 = Orange

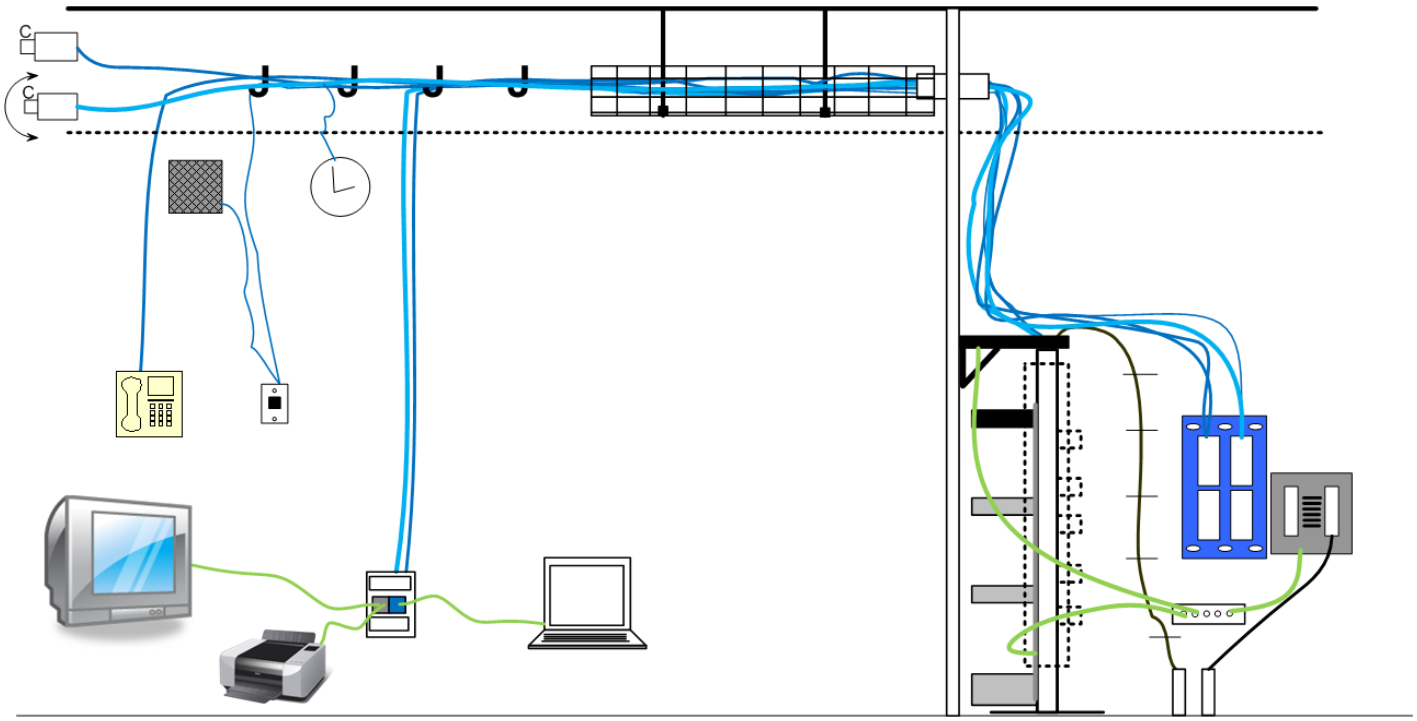
AV Like Paint by Numbers

Presented By: Eric J. Marshall

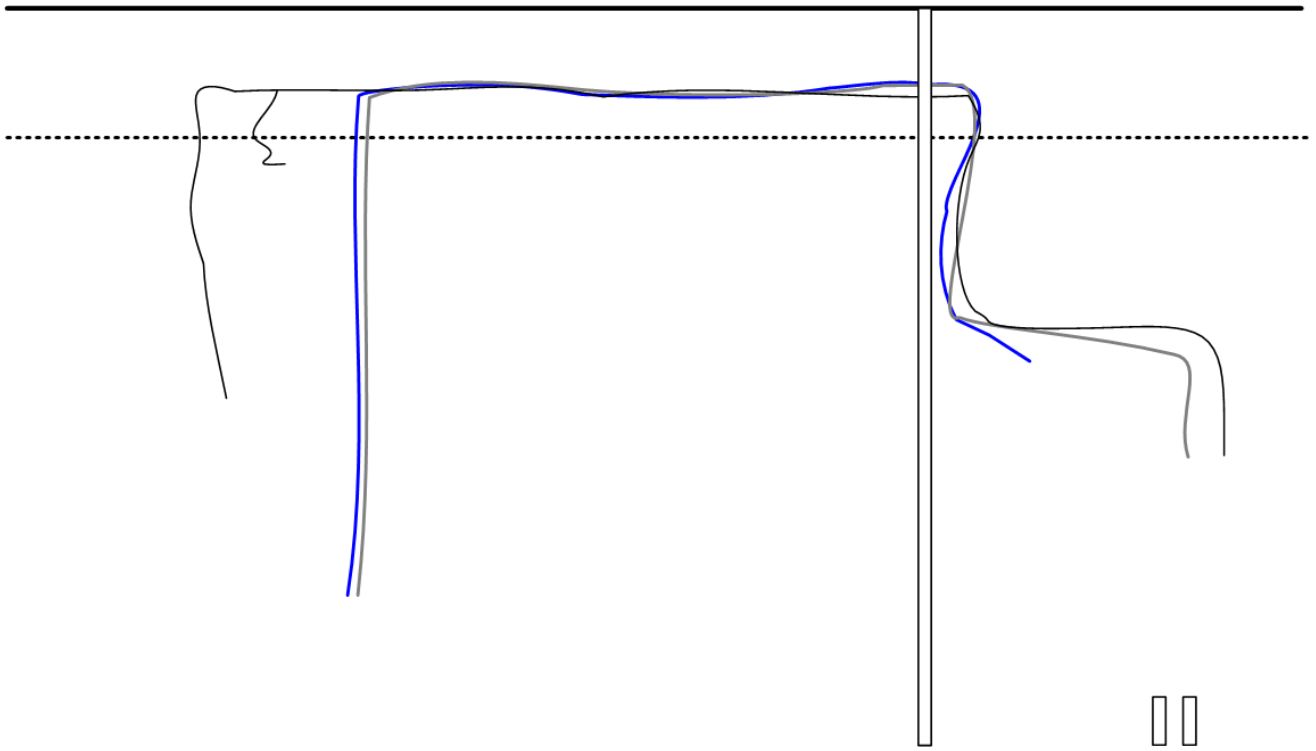
When I started in the industry, my boss drew me a picture of what WE DID.



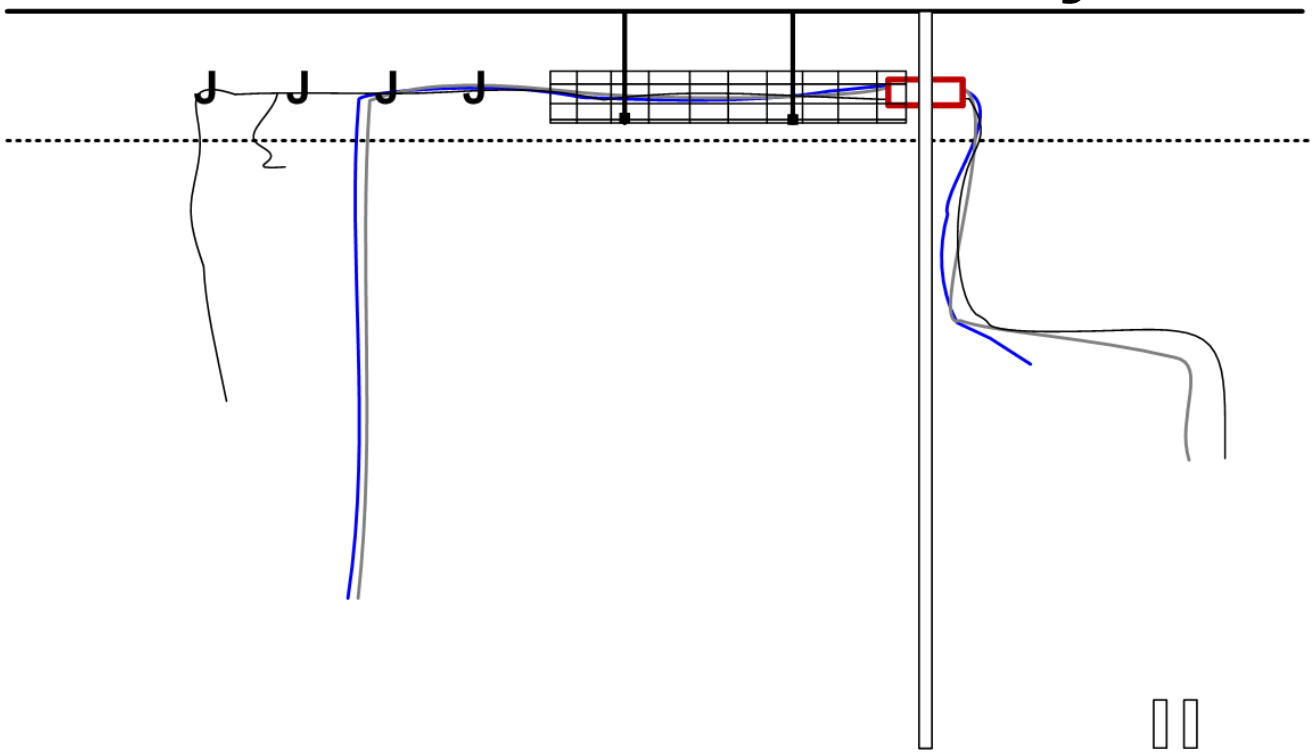
I Upgraded the Drawing



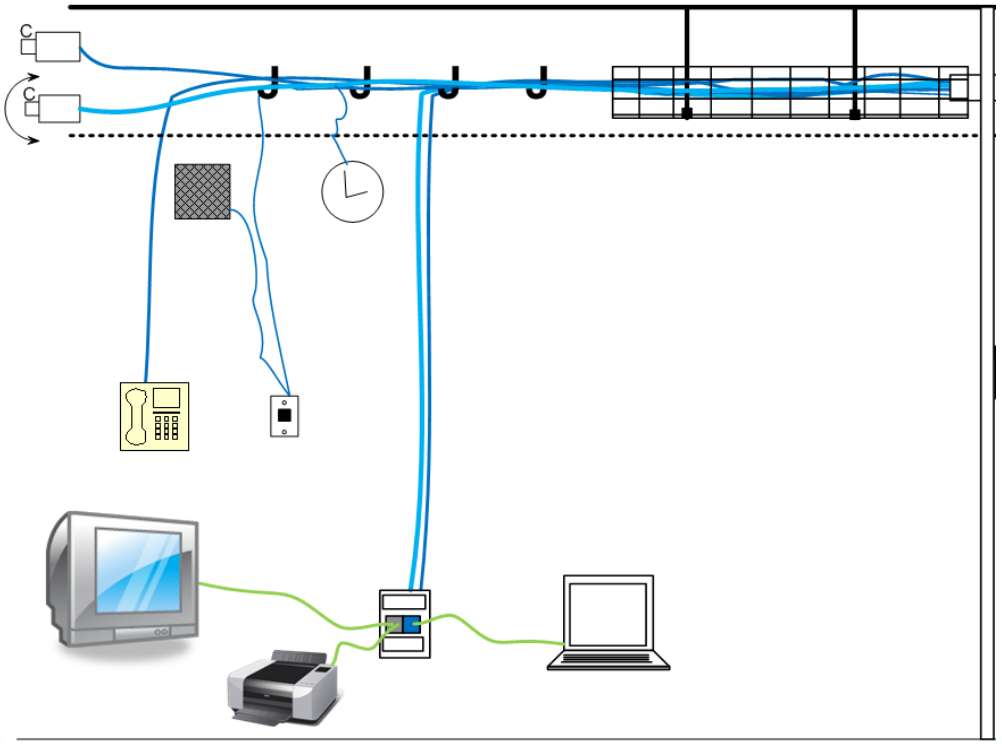
1. Address Cable



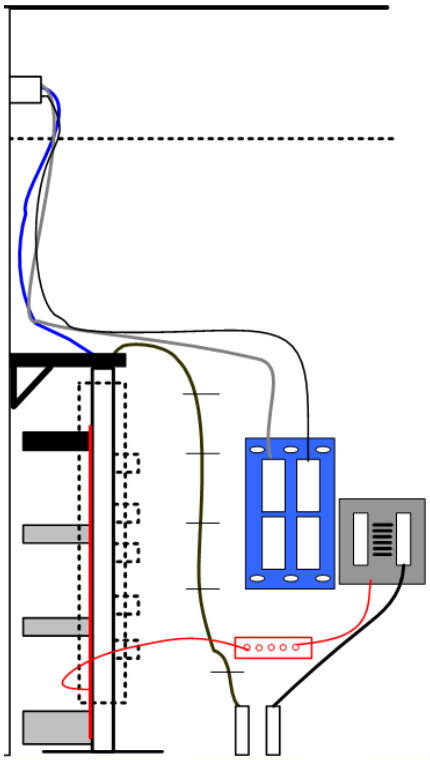
2. Address Pathway



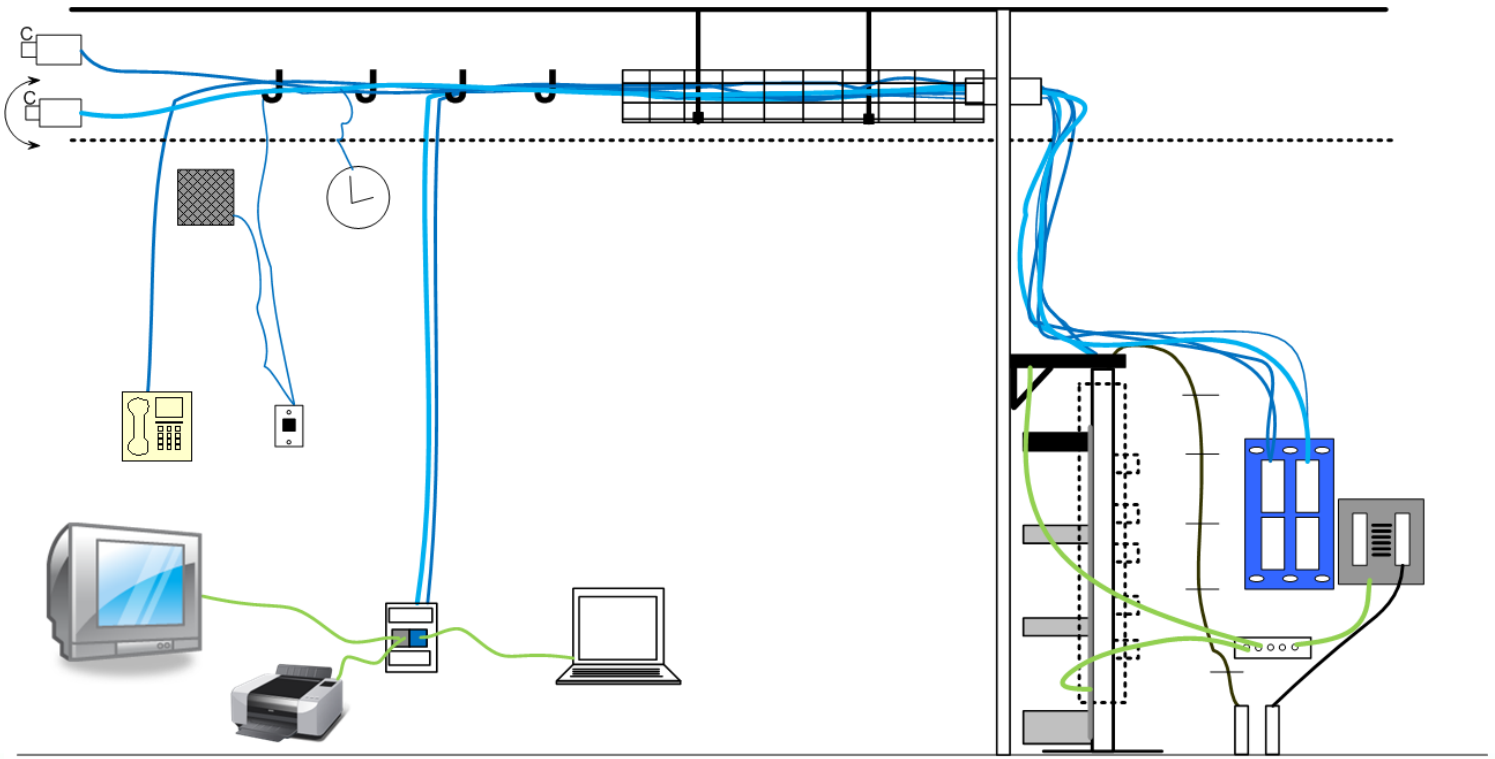
3. Address the Stations



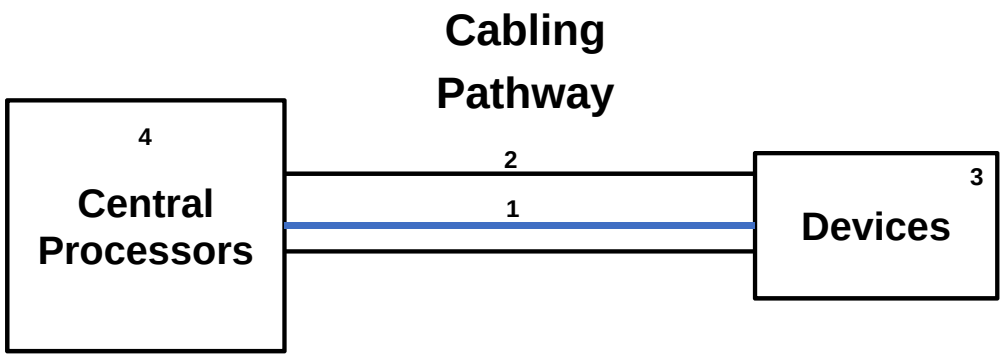
4. Address the Head End



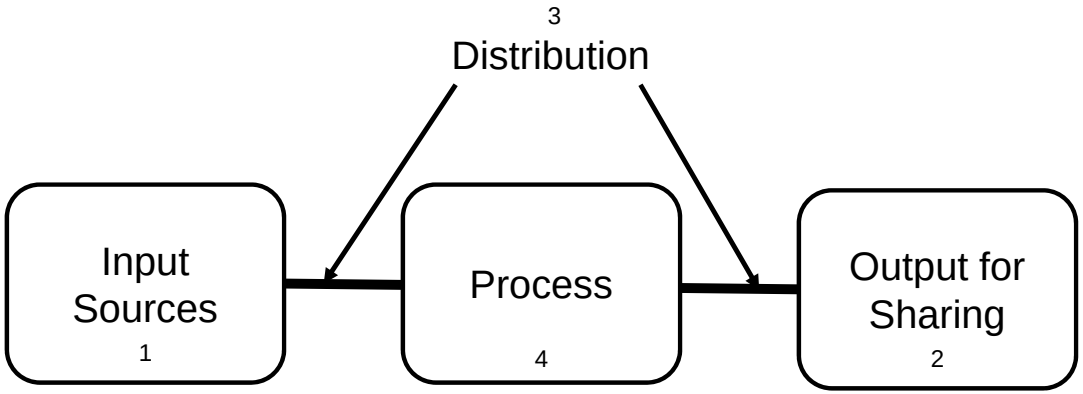
Completed Picture



What Do We Do TODAY?



Audio Video


3
Distribution
Input Sources
1
Process
4
Output for Sharing
2

Can we do AV?

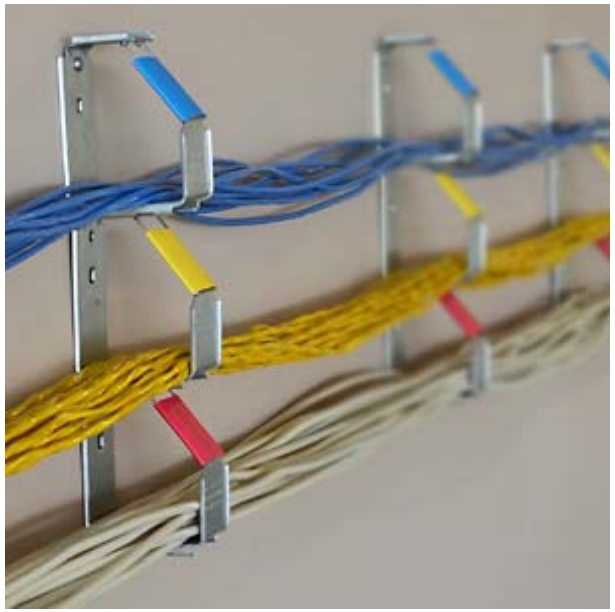
I was hired to start doing AV at a structured cabling company

Do you know how to install cable?

Do you know how to mount things on walls and ceilings?

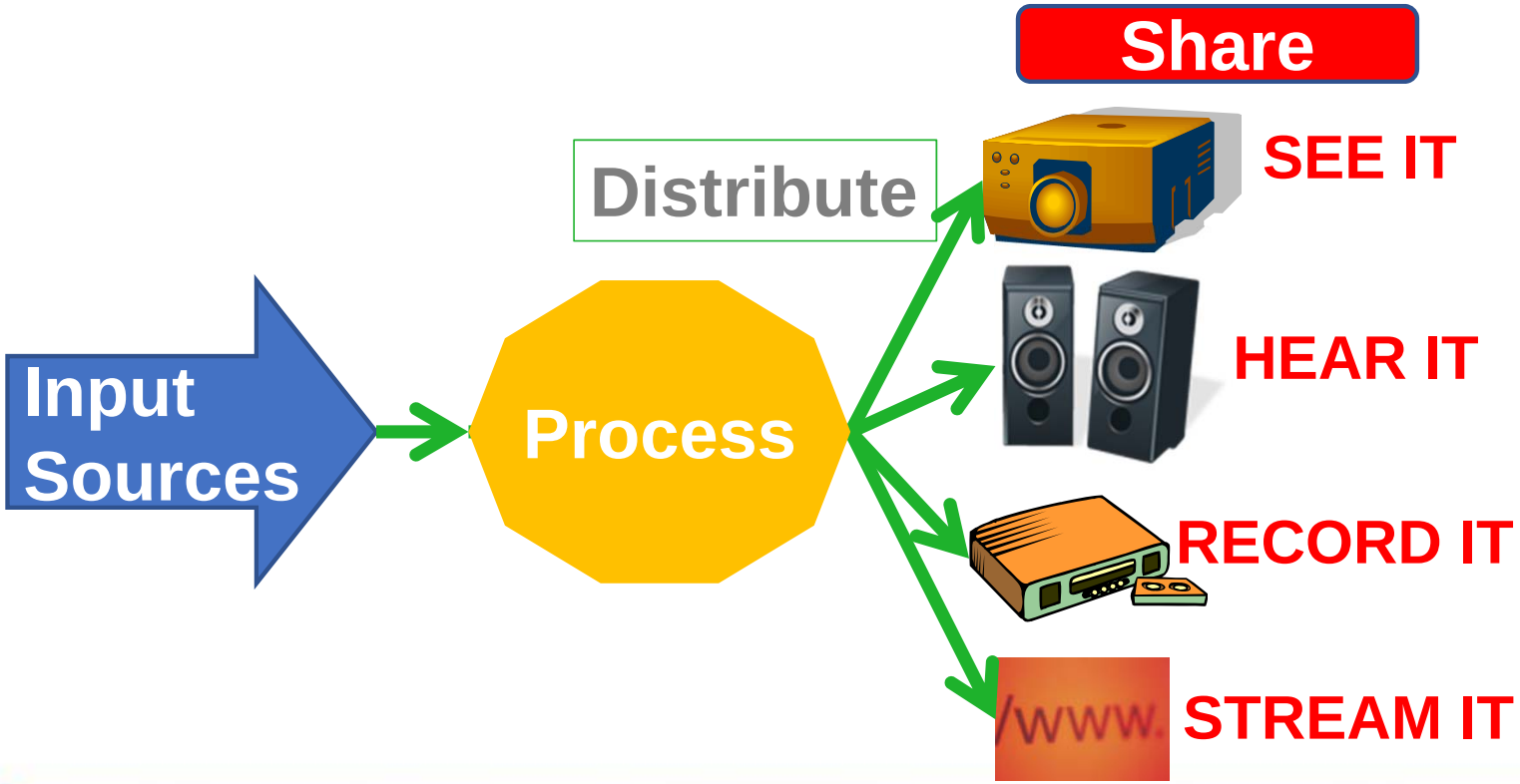
Let me pull your cable!
We are both going to the same place!

TDMM:
Save 30-40%

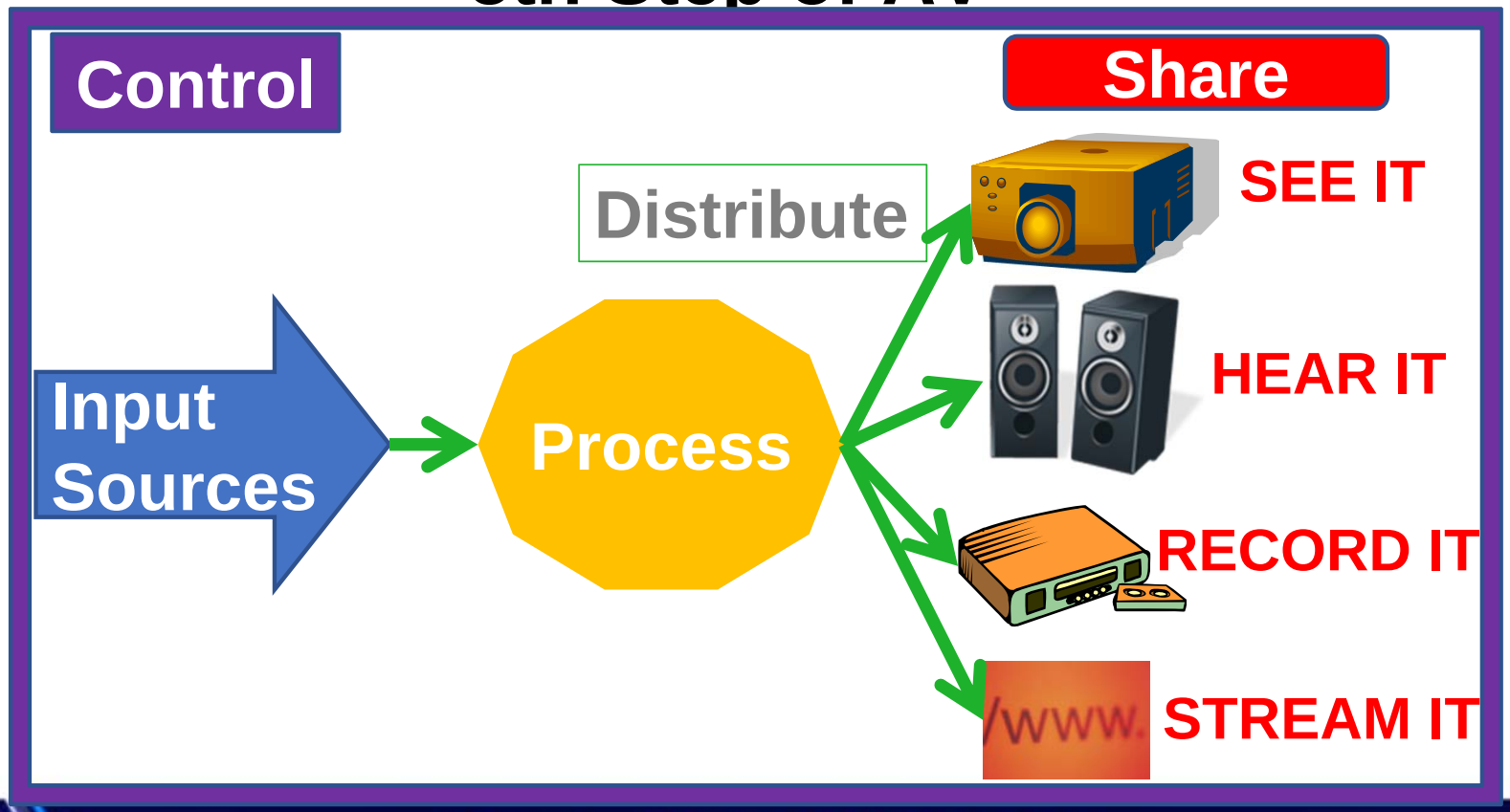


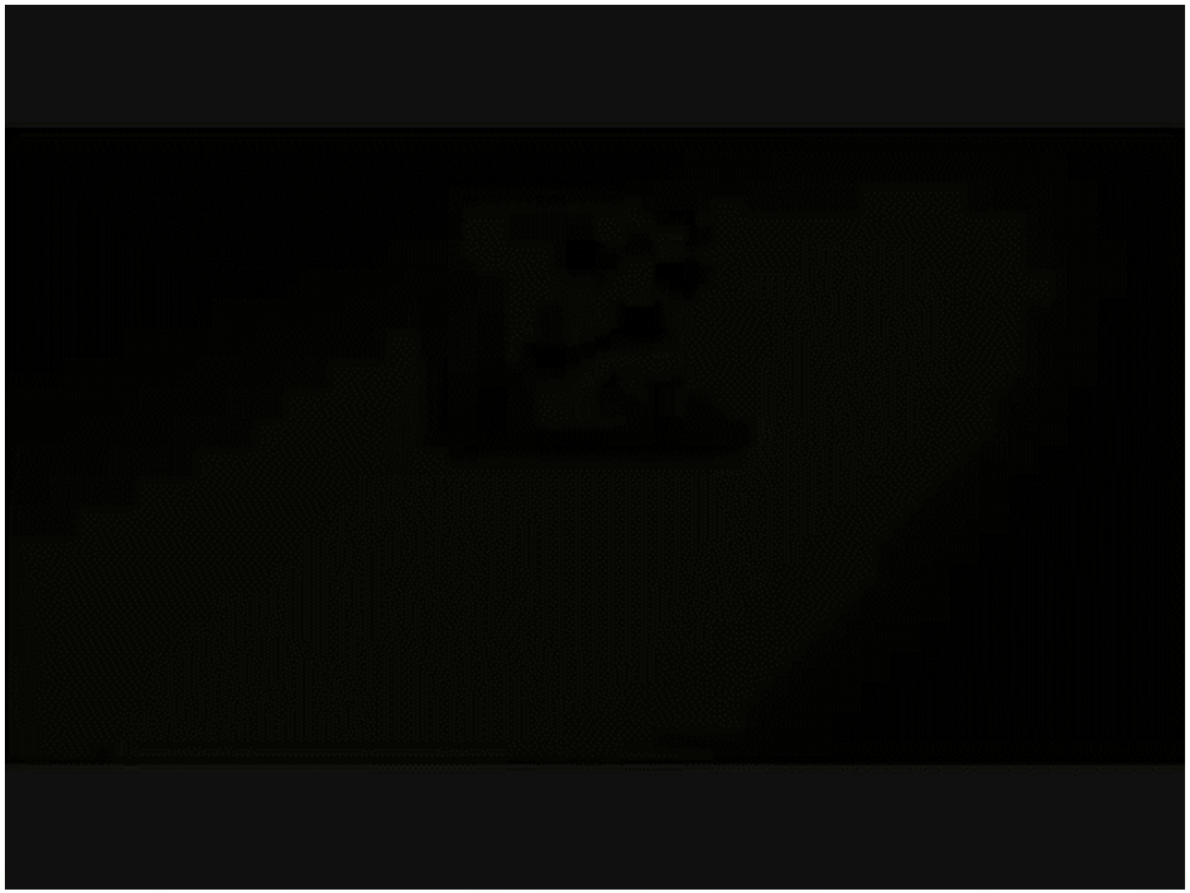
Sold 2.4 million
In 2 months!

4 Steps of AV



5th Step of AV





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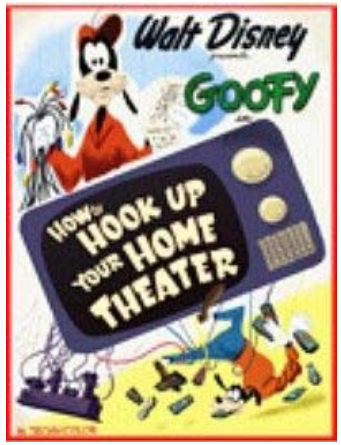
Low Voltage Services

Step 1 – Input Sources



What are input sources?

Anything that generates Audio or Video

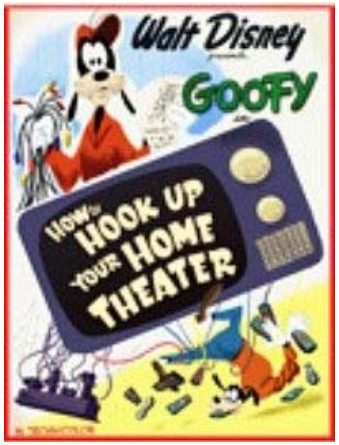
Audio Source Examples

- CD Player / Recorder
- SACD and DVD-A
- MP3 Player
- Streaming Internet / Audio Server
- AM/FM Tuner
- Satellite Radio
- Cassette Tape Player / Recorder
- Phonograph / Record Player / Turntable
- Microphone
- Instrument
- Background Music

Video Source Examples

- BluRay Player / Recorder
- TV Tuner or TV antenna
- Cable TV / Satellite TV
- VCR
- PVR / Video Server
- I-Pod Video
- Camcorder
- Computer / Internet
- Video CDs
- Document Camera
- Game Console

You don’t have to worry about all the sources



INPUT
Sources

Devices have connectors

CONNECTORS CONNECT

BUT

THE REAL CONNECTION IS THE **SIGNAL**

Devices have connectors

CONNECTORS CONNECT

BUT

THE REAL CONNECTION IS THE **SIGNAL**

Devices have connectors

CONNECTORS CONNECT

BUT

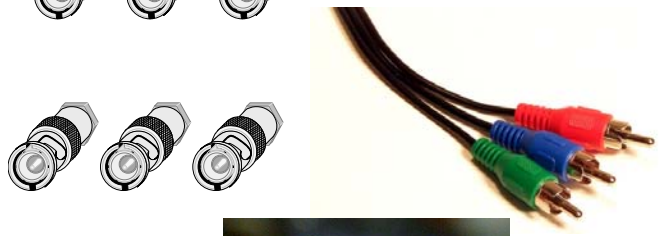
THE REAL CONNECTION IS THE **SIGNAL**

High Resolution

- RGBHV = 5 Wire
- RGBS = 4 Wire
- RGsB/RsGsBs = 3 Wire

Can be either

- Component = 3 Wire



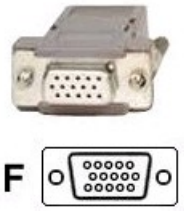
Low Resolution

- S-video (Y/C) = 2 Wire
- Composite = 1 Wire
- Radio Frequency (RF)

BNC Connector

- Used with coaxial cable.
- It is a round metal connector that is pressed and twisted to lock into place.
- BNC stands for “Bayonet Neill Concelman” (the names of the two developers – Paul Neill and Carl Concelman).
- Used for professional AV applications.

DB / HD Connectors



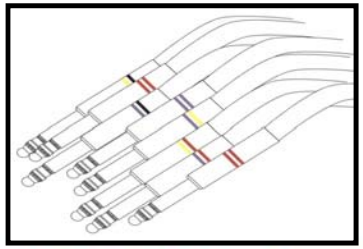
HD15 VGA Plug

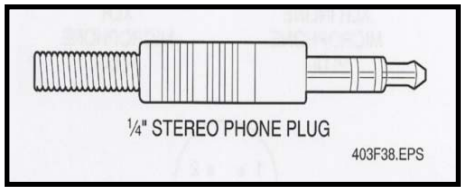
- Common connector for computers.
- If it has 2 rows of pins it is called a “D-sub” or “DB” connector.
- If it has 3 rows of pins it is called an “HD” connector.
- The connector type is usually followed by a number telling the number of pins it can hold.
- (ex. DB9, DB25)
- HD15 is what is used by most computers!

DB9 Serial Plug

Audio plug

- Plugs are used for many audio applications
- Typical sizes are 3.5mm, 2.5mm, ¼”, and 3/16”
- 3.5mm is what is used on most computers and portable audio devices!





Audio Connectors

Female XLR Connector

Pin	Signal
1	Shield
2	Signal +
3	Signal -

Male XLR Connector

RCA Plug

¼” Plug TRS (Tip Ring Sleeve)

1/8” 3.5mm mini-plug TRS

Speakon for Speakers

Euroblock, Captive Screw or Phoenix Connector

Toslink

Digital Connectors

HDMI

DVI

FireWire

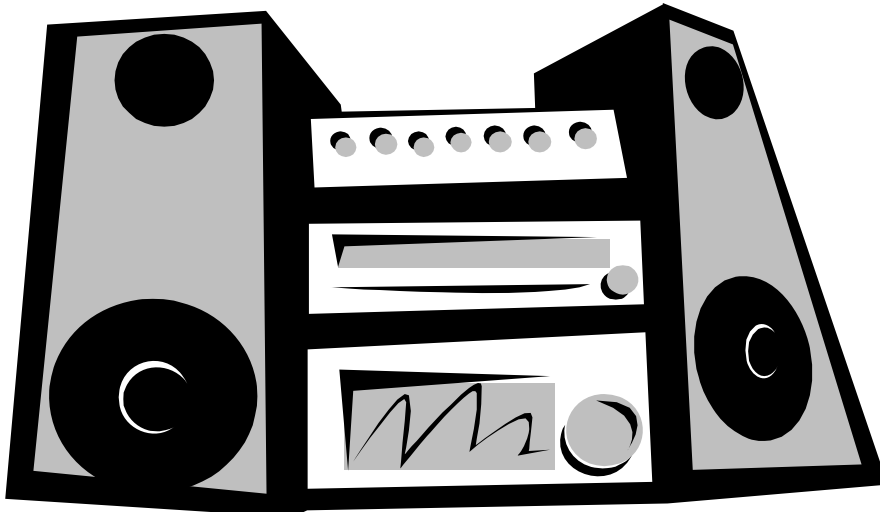
Thunderbolt

Display Port

SDI

USB

What Does Digital Add to Signal?



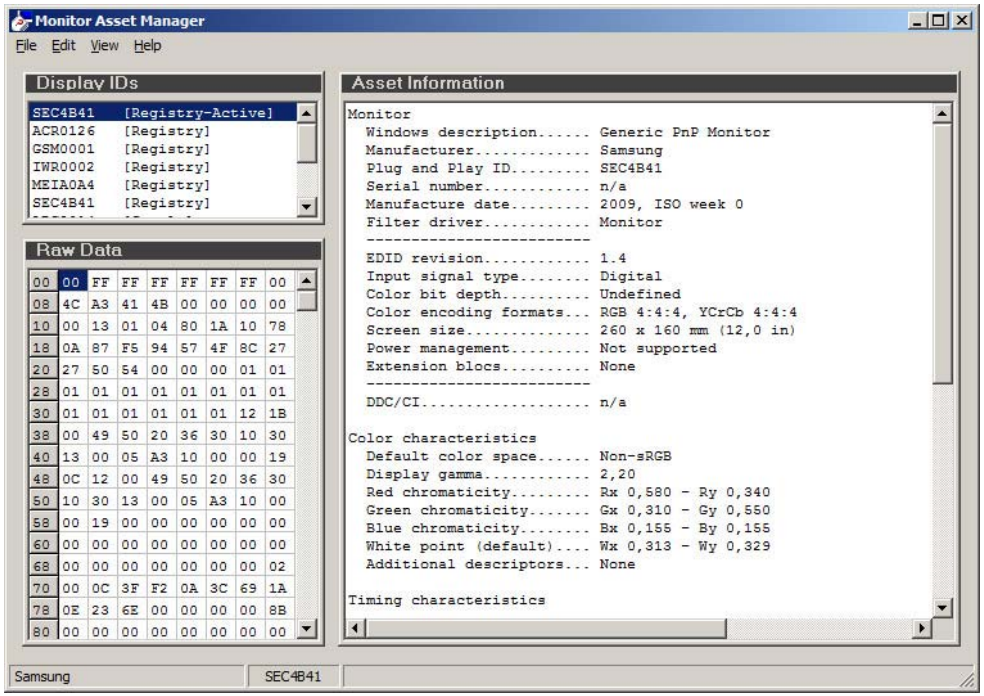
AUDIO

What Does Digital Add to Signal?

EDID

(Extended Display Identification Data)

- Hot Sync
- AV properties
  - HDCP



What Does Digital Add to Signal?

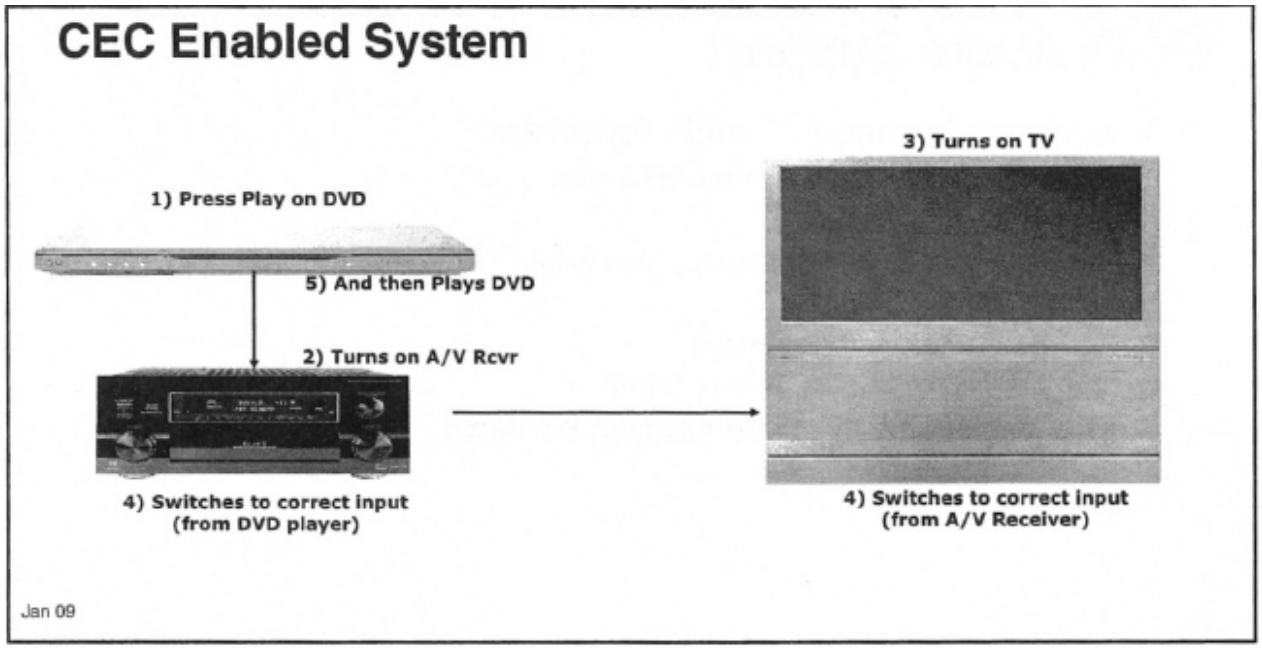
HDCP™

HIGH-BANDWIDTH DIGITAL CONTENT PROTECTION

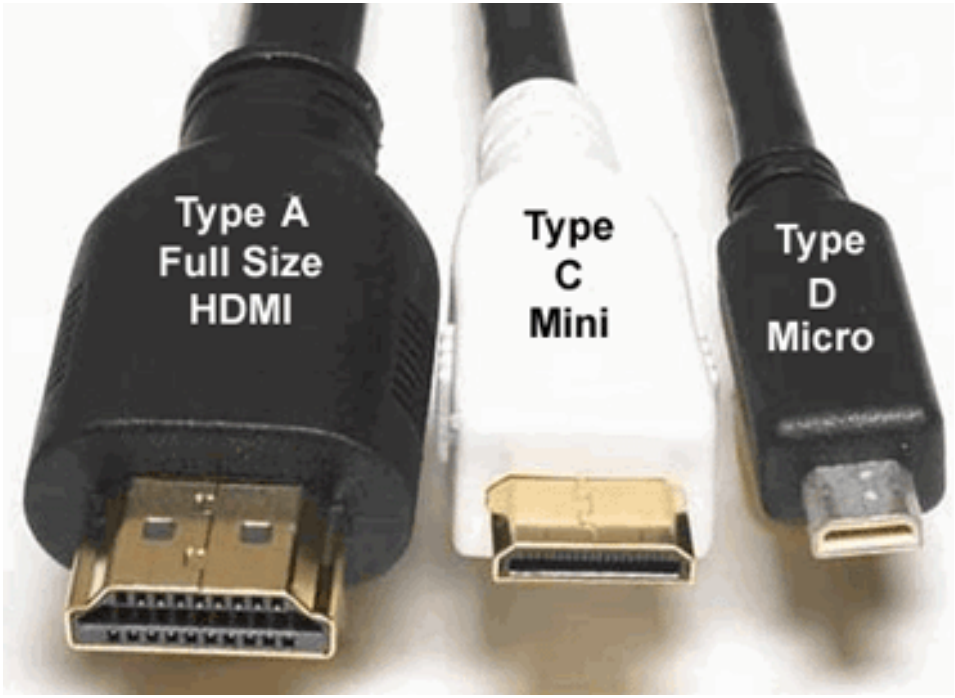
Prevent Non-licensed devices from receiving content

Block eavesdropping – “Man in the Middle” attacks

What Does Digital Add to Signal?



Different HDMI Examples



Different Display Port Examples

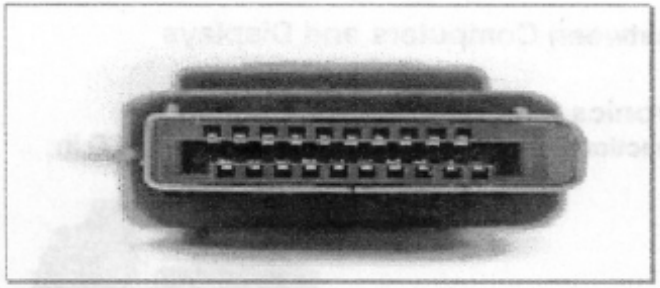
Display Port

Display Port Mini

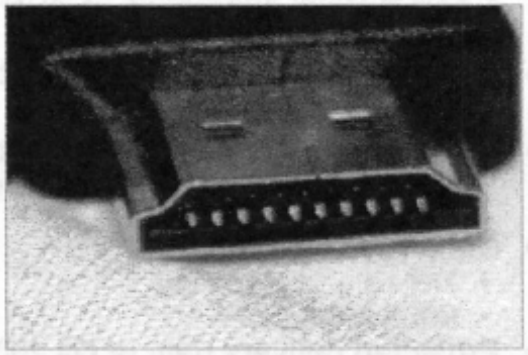
Display Port / HDMI Comparison

DVI

Display Port vs. HDMI



Display Port

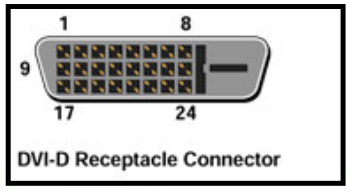


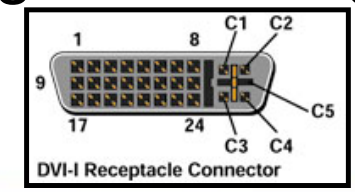
HDMI

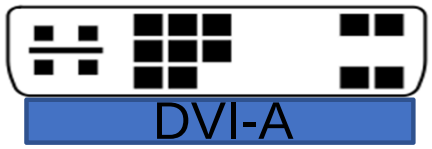
Jan 09

DVI Connector

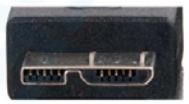
- LFH (low force helix) connector
- DVI-D = 24 pins and a single larger, offset ground bar; carry a digital signal ONLY.
- DVI-I = have 4 extra pins that surround the offset ground bar; carry both digital and analog signals.
- Used for Digital and High Definition Video







Different USB Examples

Connector Type	USB 2.0 Image	USB 3.0 Image
A		
B		
Micro-B		
Mini-B 5 Pin		–
Mini-B 4 Pin		–
C		

Don’t get confused by the connectors!

COMPUTERS

- D-sub (DB)
- HD
- DIN
- BNC
- DVI
- HDMI

VIDEO

- F-type
- HD
- RCA
- BNC
- DIN
- DVI
- HDMI

AUDIO

- RCA
- Plugs
- DIN
- Captive Screw
- Binding Post
- XLR
- HDMI
- F-Type
- Toslink

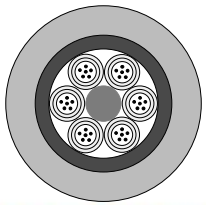
CONNECTORS CONNECT

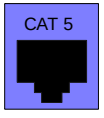
BUT

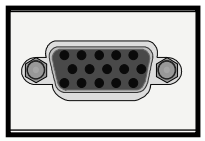
THE REAL CONNECTION IS THE **SIGNAL**

The Physical Connection

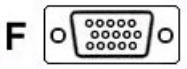
- Consists of two major components:
  - Conductors= pieces of wire that carry signals between devices. **$$$$$$**
  - Connectors= mechanical junctions between the conductors and pieces of equipment.
- To properly understand how to connect devices to the AV system you need to understand *CONNECTORS **and** SIGNALS.*







What's the difference on the connector?

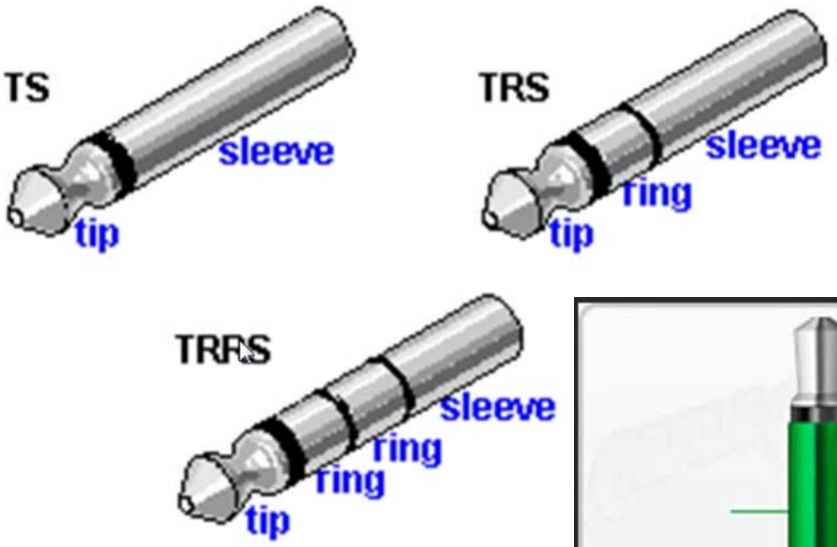


HD15 VGA Plug

DB9 Serial Plug

- The Pin Out – the way the conductors are placed in the connectors on each end. The pin out is the "Road Map" for the signal!

What's the difference on the connector?



What are the Pin-outs?

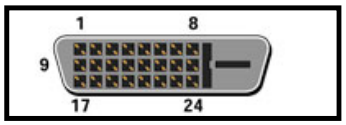
- Computer = HD 15
- S-video = 4 pin din
- Consumer Audio plug = 3.5mm
- Instrument/Professional Audio plug = ¼”
- RCA Color codes
  - Yellow, Green & Blue & Red = video
  - White, Red, Black, Orange= audio
- What version digital cable?

Male vs Female Connectors

What else makes the difference?

- Cables are a channel for the signal – WHAT GOES IN COMES OUT!!!!!
- **Cables/Adapters can not change the signal – electronics or special circuitry within a cable can.**

- Examples:
  - DVI signal from a computer is different from DVI signal from a TV.
  - VGA (computer) and component video are different signals.



Gender Changers & Adapters

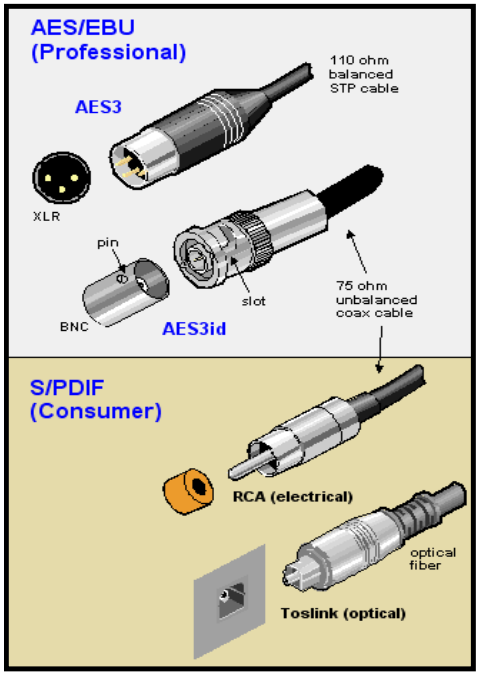
Make sure signal is same!
Make sure pin out is same!

Use one at other end?
Useful for coupling

Gender Changers & Adapters

Make sure signal is same!

AES/EBU vs. S/PDIF



CONNECTORS CONNECT

BUT

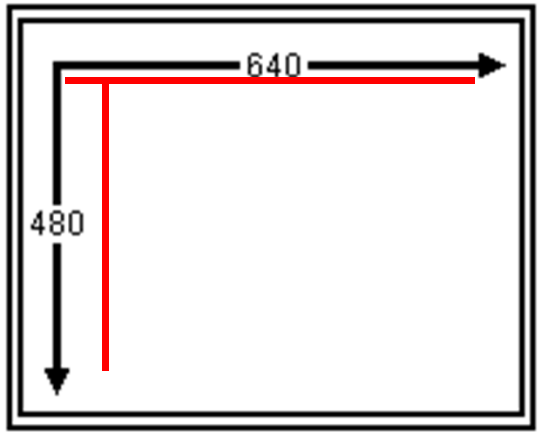
THE REAL CONNECTION IS THE **SIGNAL**

What is in the signal?
VIDEO

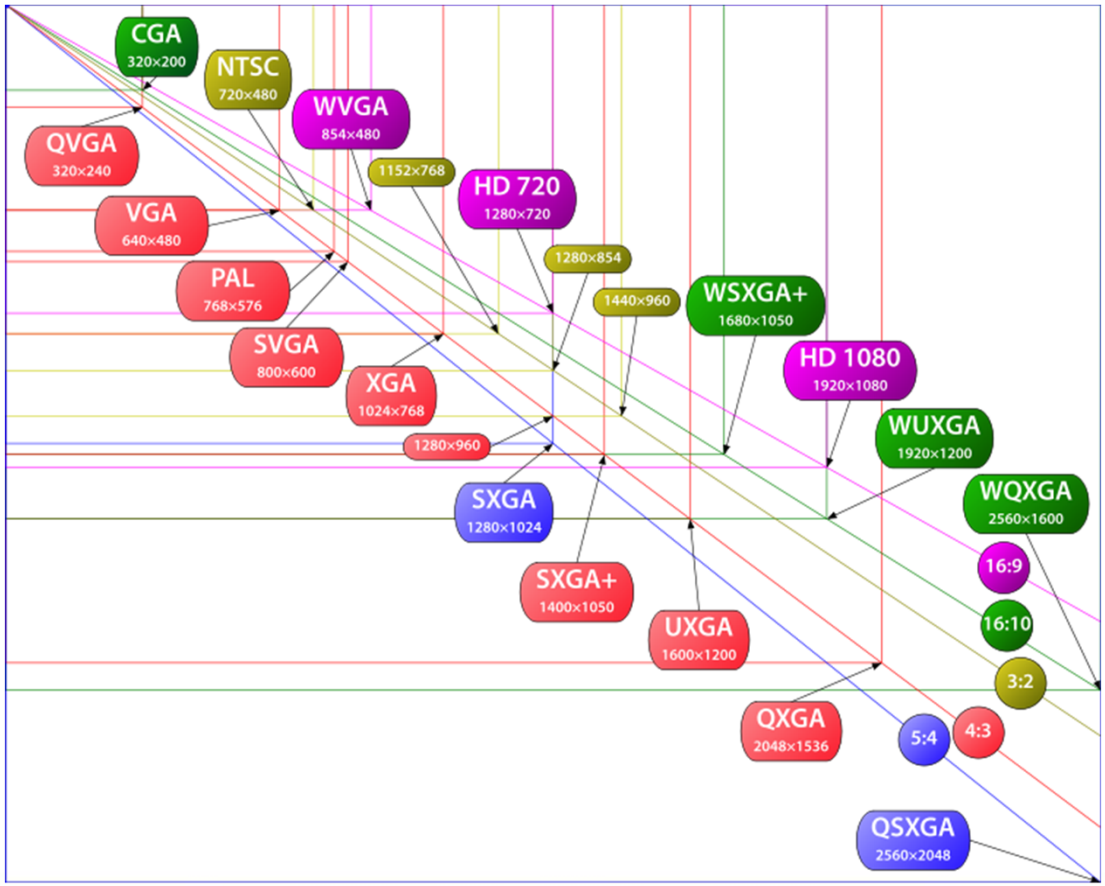
- Resolution
- Signal Type – RGB, Component…
- Digital Add Ons

What is Resolution?

- Resolution = a measure of a video device's capability to make small dots and lines on a screen.
- Horizontal resolution = number of dots that can fill one line
- Vertical resolution = Number of lines.
- NTSC standard = 480 lines
- HDTV = 720 and 1080 lines
- UHD = 2K, 4K, 8K

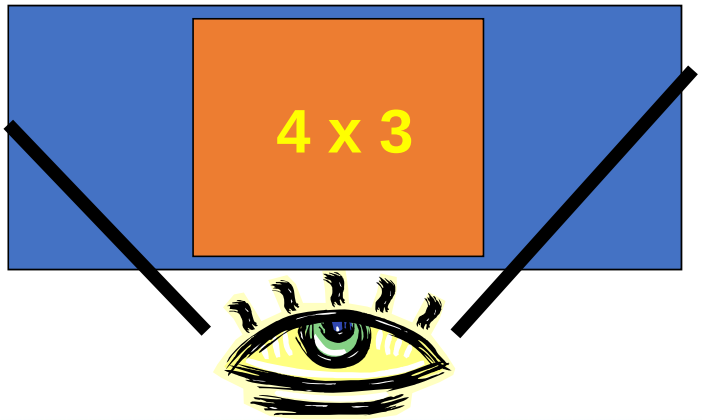


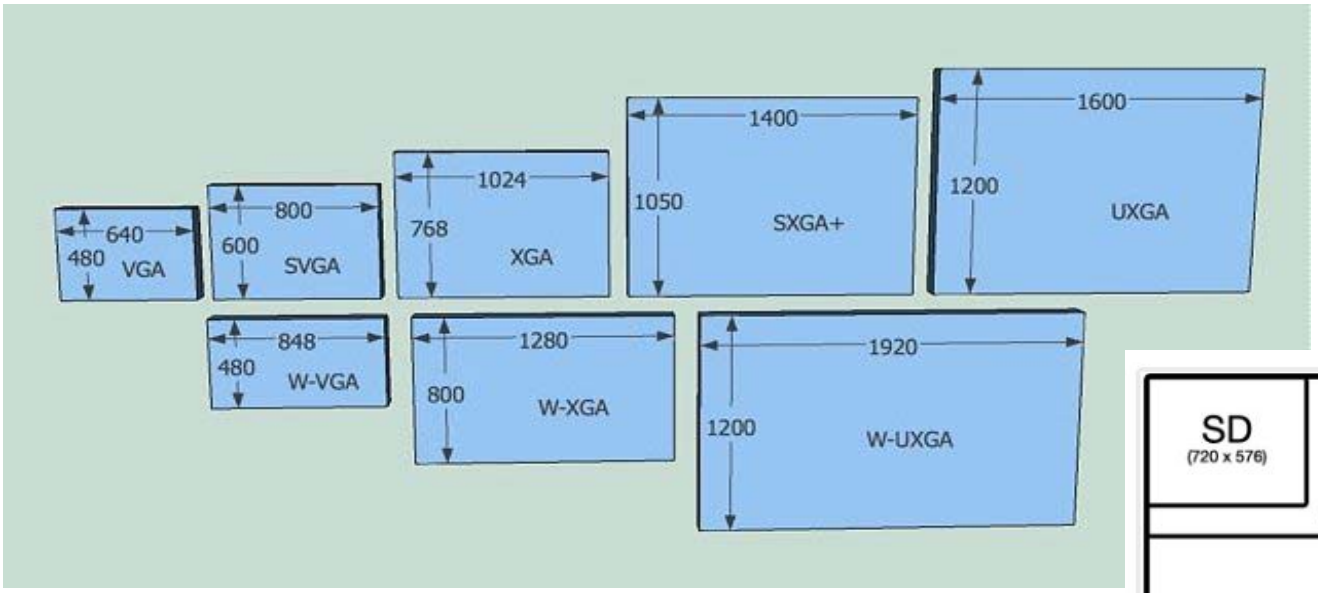
Example Resolutions
640 x 480 VGA
800 x 600 SVGA
1024 x 768 XGA
1600x 1200 UXGA
1920x1080 Full HD

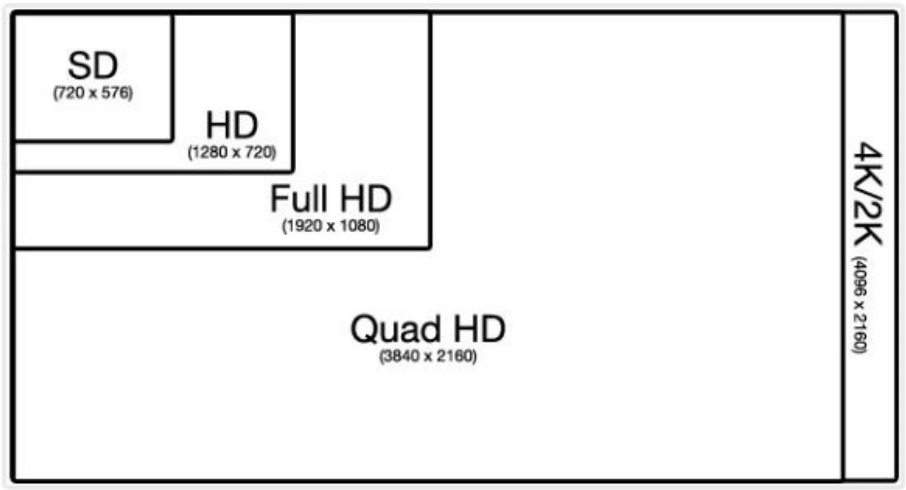


What is High Definition?

- High Definition is wider and fills more of the eyes viewing area.
- High Definition has more pixels.
- High Definition can be both digital and analog.








33.177.600 pixels
8K
7680x4320
8.294.400 pixels
4K
3840x2160
3.686.400 pixels
2K
2560x1440
2.073.600 pixels
HD (Blu-ray)
1920x1080
921.600 pixels
HDready
1280x720
Pal (DVD)
720x576
414.720 pixels


FullHD
1920x1080
4K
3840x2160
8K UHDTV
7680x4320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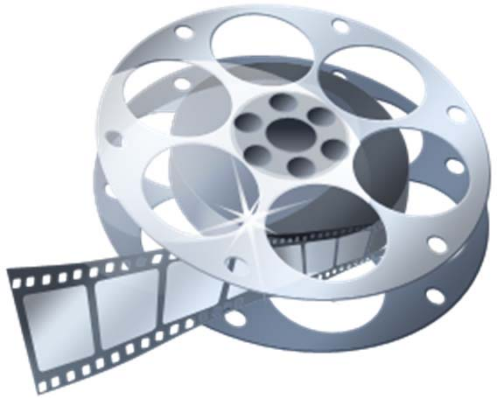
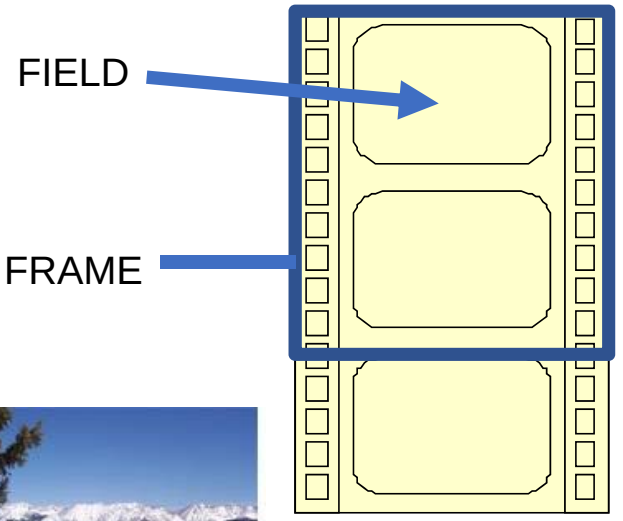
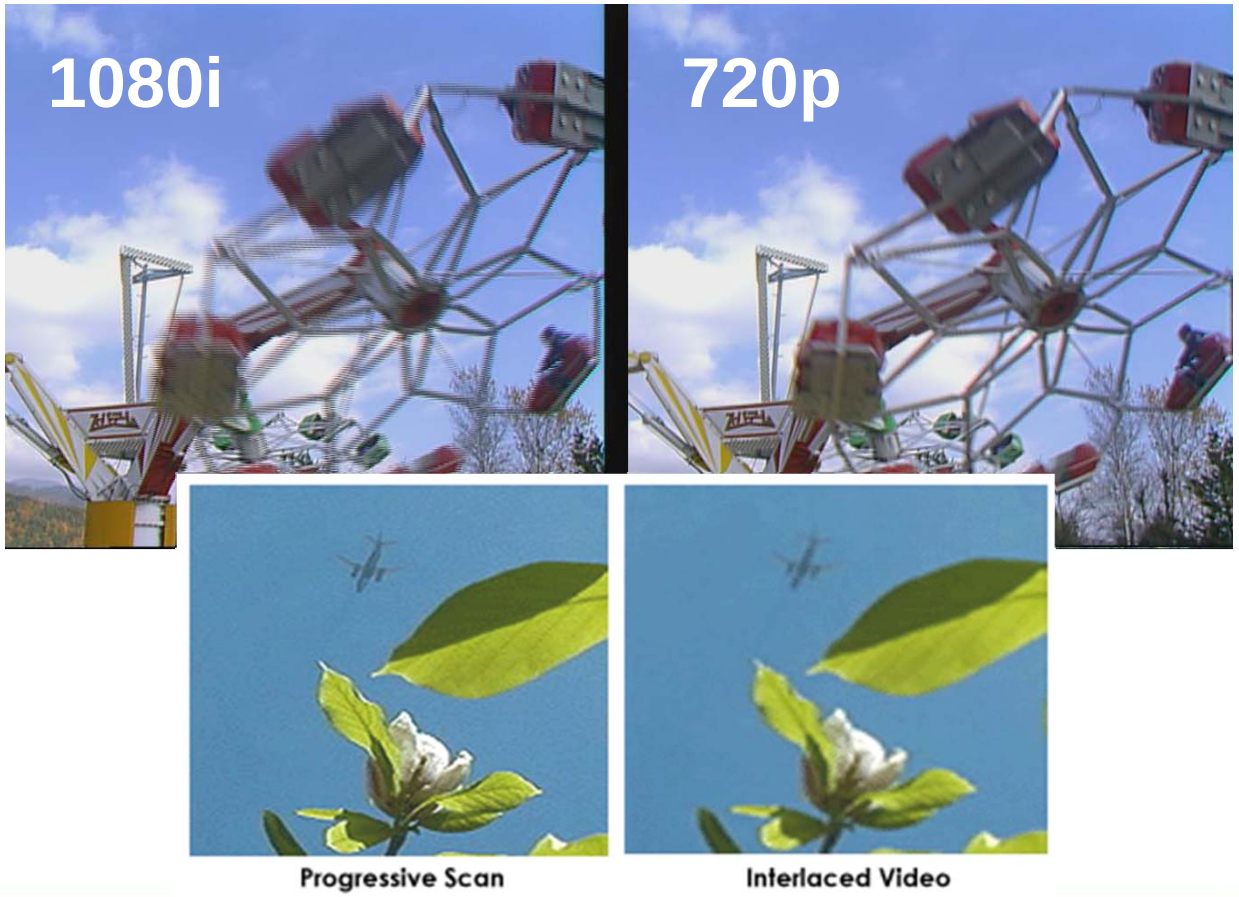
Low Voltage Services

What is with the “i” and “p”?

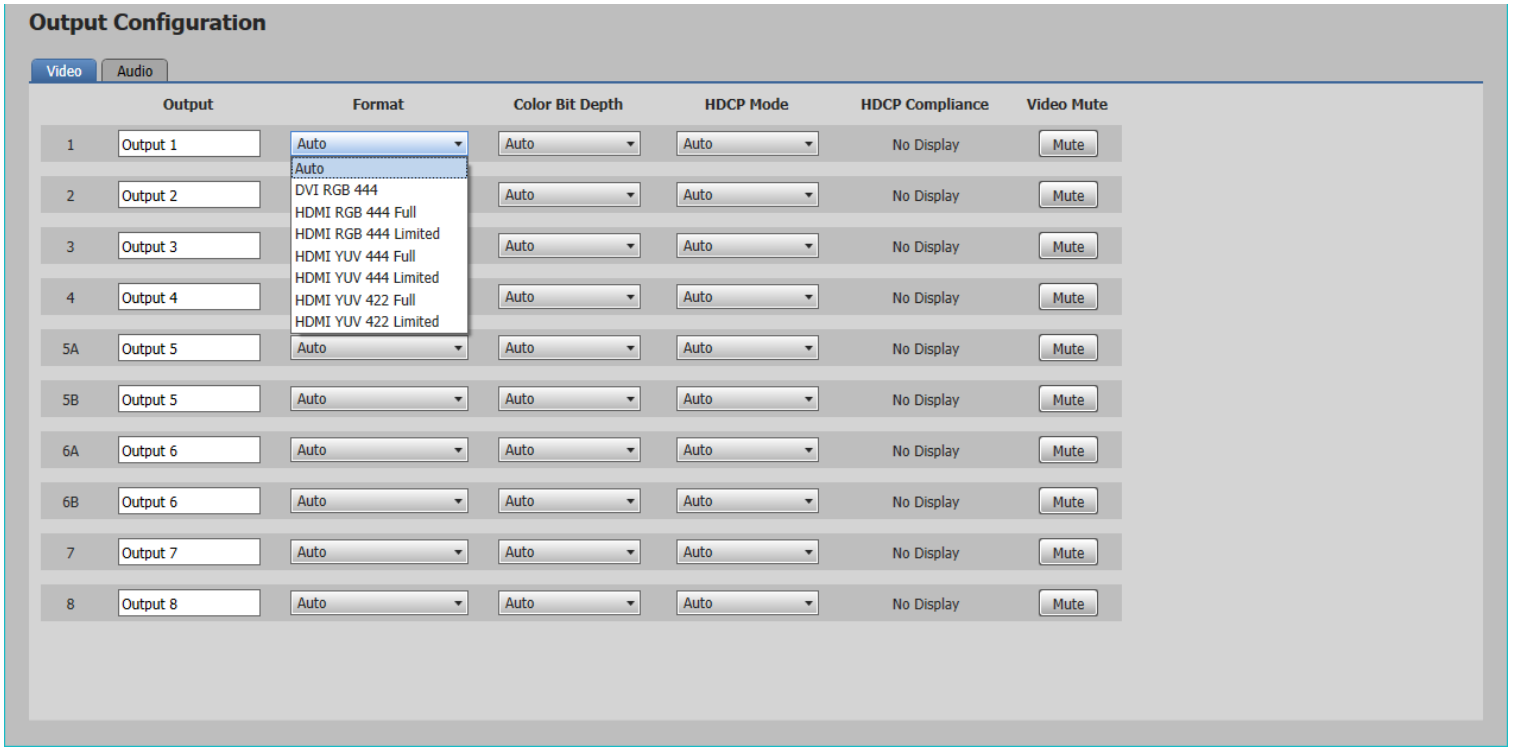




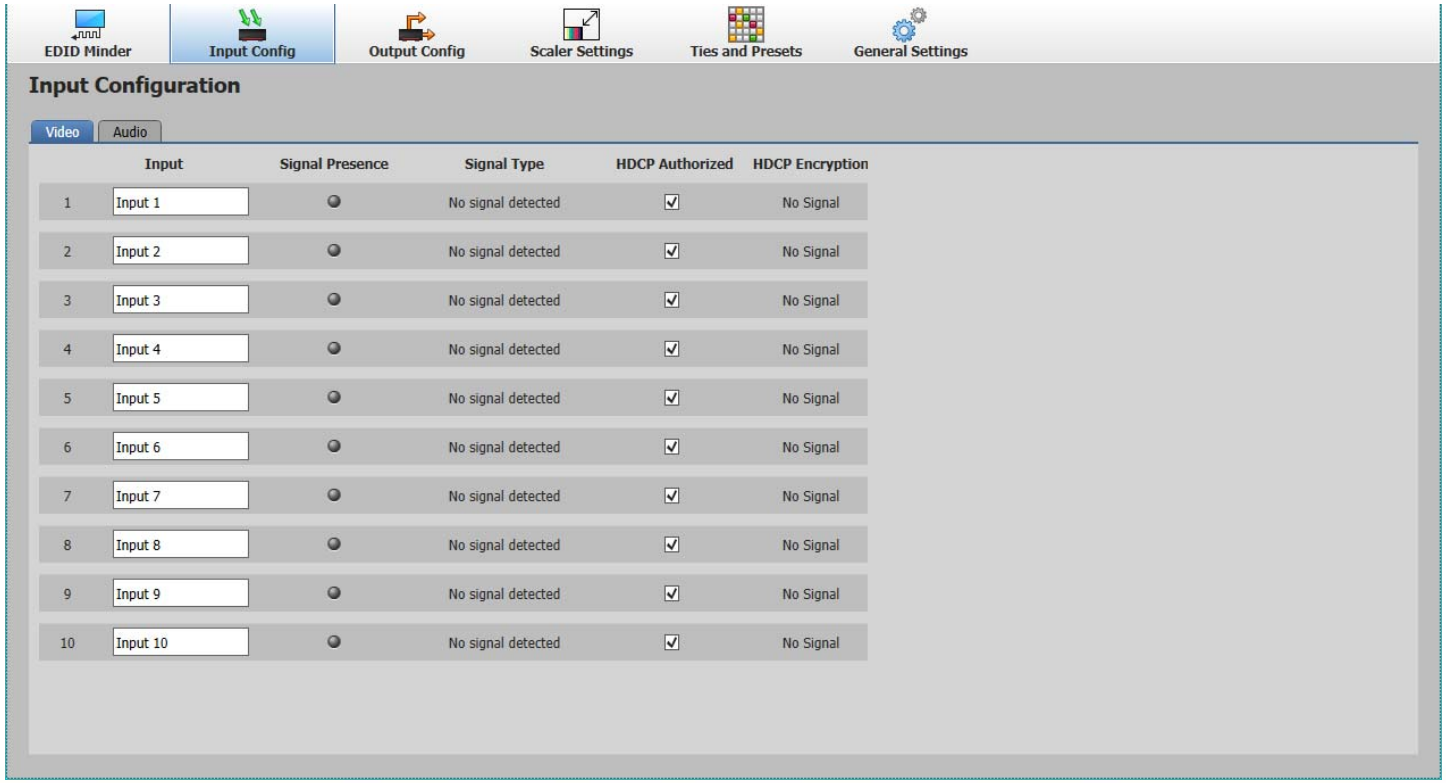
1/60th of a second field + 1/60th of a second field = 1/30th of a second frame


1080i
720p
Progressive Scan
Interlaced Video

What is Signal Type?



Digital Add Ons?



What About Audio?

Pro Audio cables and connectors - an overview: https://youtu.be/AnU27N3Clsw
Measuring 100V line audio systems: https://youtu.be/2RG2i4FtA2M
How to Choose the Best Speaker Cables: Gauge, Resistance and More: https://youtu.be/r7DdcZCbABo
How To Wire Subwoofers - Parallel vs Series - Single Voice Coil and Dual Voice Coil: https://youtu.be/jryFmICR4qA
How To Test Your Speaker System: https://youtu.be/TCdUL5ZvMHc
THE BEST Multimeter tutorial (HD): https://youtu.be/bF3OyQ3HwfU
Audio Impedance Meter- Testing 70/ 100 volt Speakers: https://youtu.be/NKCN_aK9wgQ
Amplifier to Speaker Matching Tutorial | UniqueSquared.com: https://youtu.be/pUou_noD1Gc
Understanding Sound Reinforcement - Power Amplifiers (Part 1): https://youtu.be/xFRH_1WQw4Y
Understanding Sound Reinforcement - Power Amplifiers (Part 2): https://youtu.be/QS2JXG6QWmQ
Troubleshoot and Eliminate AC Hum on Sound System: https://youtu.be/l4famaQmWnA
Biamp Audio 101 - Wiring & Interconnects: Balanced vs. Unbalanced: https://youtu.be/2uHaQ5OY9ew
Biamp Audio 101 - Gain Structure: Steps for Proper Gain Structure: https://youtu.be/rNbbz9swKto
Biamp Audio 101 - Measurements & the dB: Audio Meters: https://youtu.be/S6cUqud7JiY
SynAudCon: Gain Structure: https://youtu.be/lel8FZ4wLf8
What does bridge on an amplifier mean: https://youtu.be/cwXGd4bI-f0

What About Audio?

Pre-Process

–Mic = -60 dBV (0.001 volt) to -40 dBV (0.010 volt)

–Instrument = -20dBu

–Pro Line = +4dBu (1.25V)

–Consumer Line “Aux” = -10 dBV (0.300 volt)

After Process

–Speaker = 25v or 70v or 4/8ohm

Electrical dB reference chart:

Reference Symbol:	Reference type:	Reference level:	Comments:
dBm	power	0 dBm = 1.0 mW	Original electrical dB reference
dBV	pressure	0 dBV = 1.0 V RMS = +2.2 dBu	Rarely used in pro audio
dBv	pressure	0 dBv = 0.7746 V RMS	Older version of dBu, rarely used
dBu	pressure	0 dBu = 0.775 V RMS	Frequently used in pro audio
dB VU	pressure	0 dB VU ~ +4 dBu	Pseudo-reference for VU meters & LED bar graphs

Meters

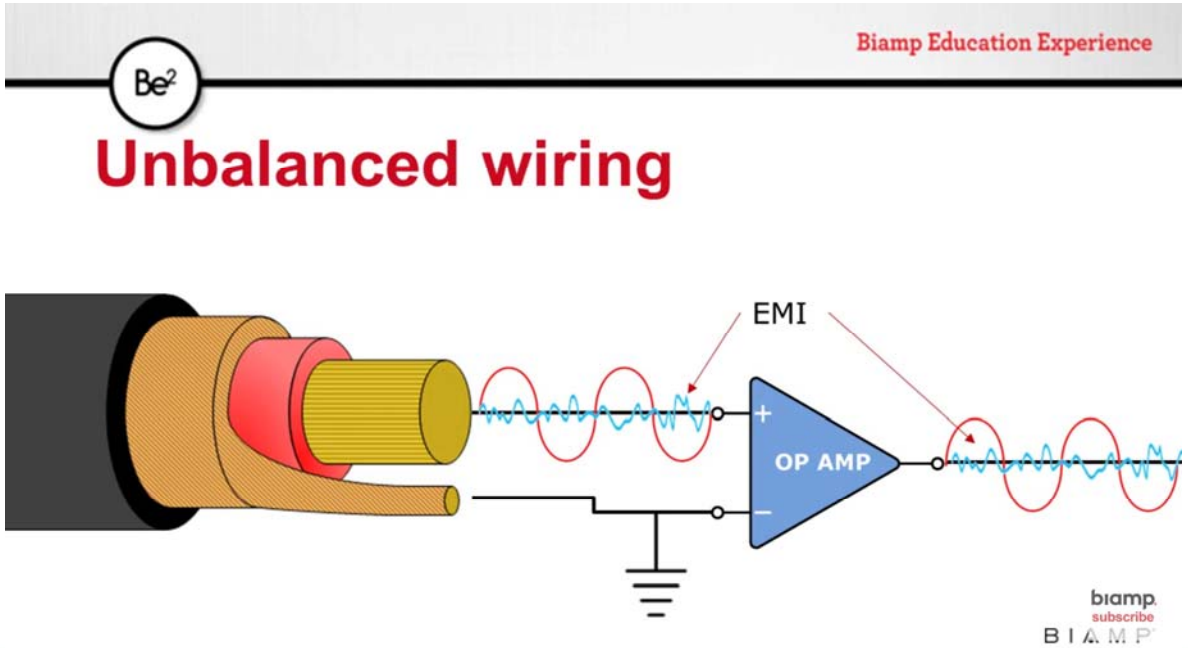
Scales compared

Volts	dBu	VU	dBfs (SMPTE RP155)
12.283V	24dBu		0dBfs
9.757V	22dBu		-2dBfs
7.750V	20dBu		-4dBfs
6.156V	18dBu		-6dBfs
4.890V	16dBu		-8dBfs
3.884V	14dBu		-10dBfs
3.085V	12dBu		-12dBfs
2.451V	10dBu		-14dBfs
1.947V	8dBu		-16dBfs
1.546V	6dBu	+2	-18dBfs
1.228V	4dBu	0	-20dBfs
0.976V	2dBu	-2	-22dBfs
0.775V	0dBu	-4	-24dBfs
0.616V	-2dBu	-6	-26dBfs
0.489V	-4dBu	-8	-28dBfs
0.388V	-6dBu	-10	-30dBfs
0.309V	-8dBu	-12	-32dBfs
0.245V	-10dBu	-14	-34dBfs
0.195V	-12dBu	-16	-36dBfs
0.155V	-14dBu	-18	-38dBfs
0.123V	-16dBu	-20	-40dBfs
97.6mV	-18dBu		-42dBfs
77.5mV	-20dBu		-44dBfs
61.6mV	-22dBu		-46dBfs
48.9mV	-24dBu		-48dBfs

biamp. subscribe BIAMP

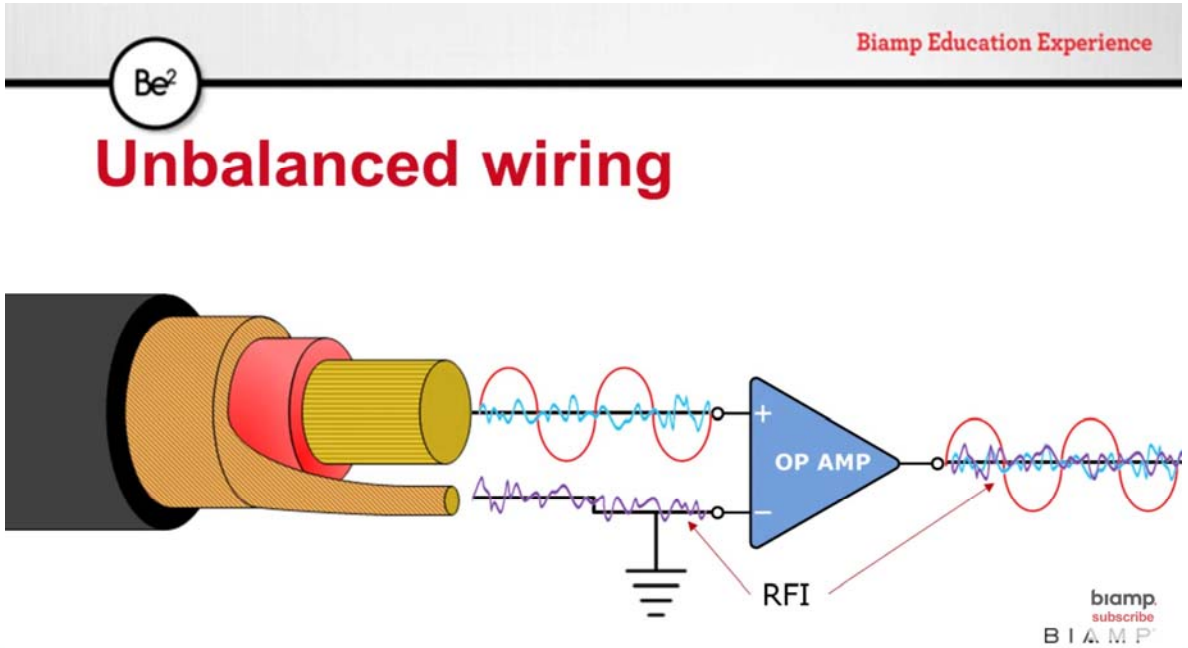
What About Audio?

Balanced vs Unbalanced



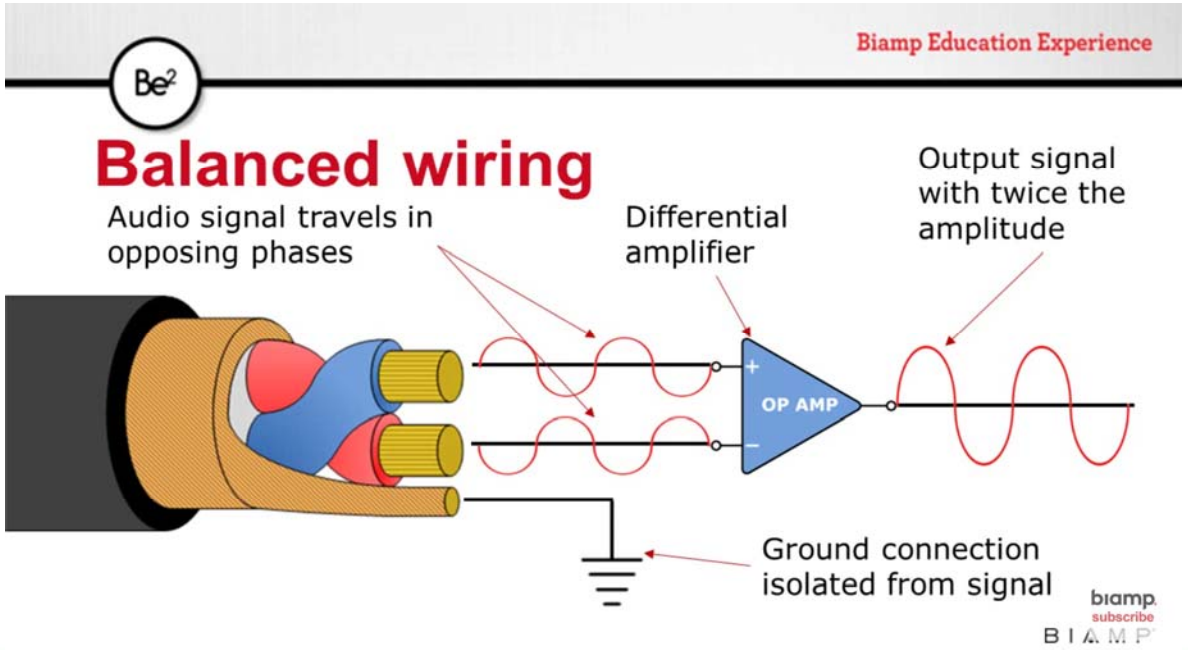
What About Audio?

Balanced vs Unbalanced



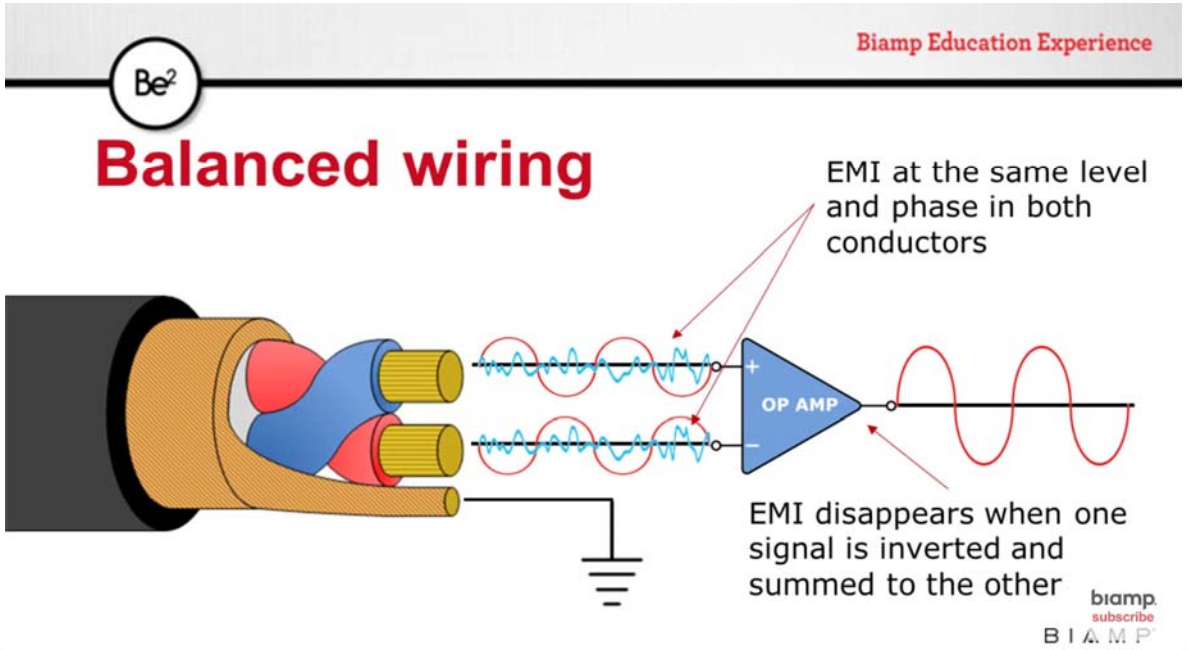
What About Audio?

Balanced vs Unbalanced



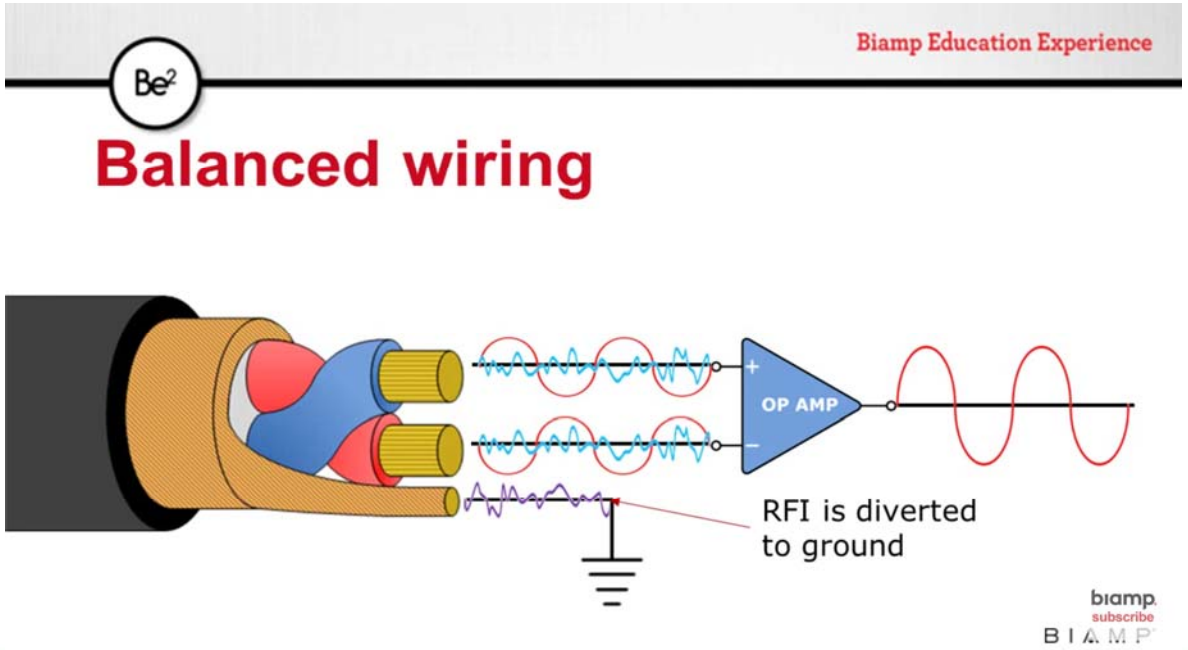
What About Audio?

Balanced vs Unbalanced



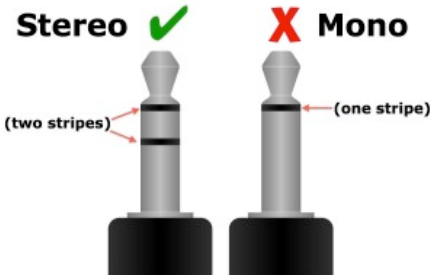
What About Audio?

Balanced vs Unbalanced



What About Audio?

Mono vs Stereo



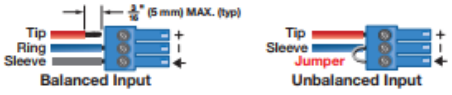


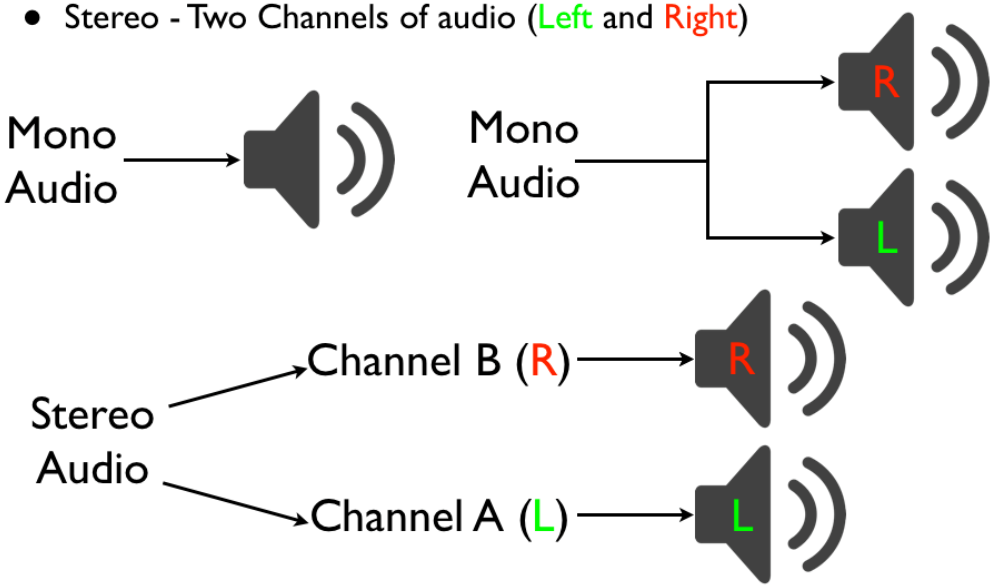
Figure 4. 3-pole Audio Input Wiring

Figure 5. 6-pole Audio Input Wiring

Figure 6. 3-pole Audio Output Wiring

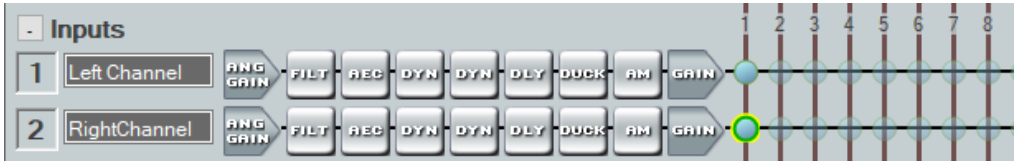
Figure 7. 6-pole Audio Output Wiring

- Mono - One single Chanel of Audio
- Stereo - Two Channels of audio (Left and Right)



What About Audio?

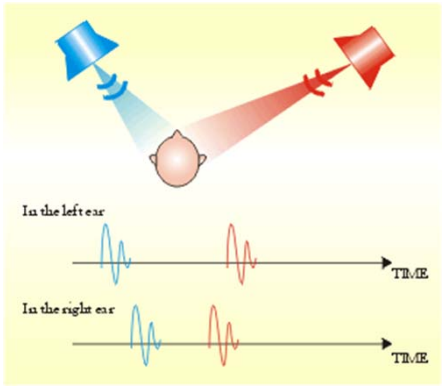
Mono vs Stereo



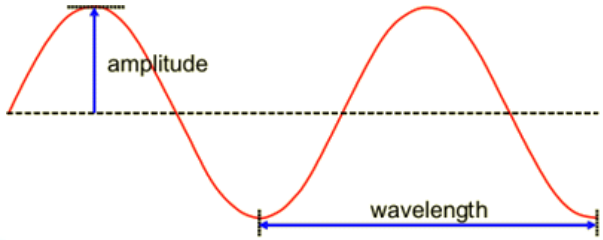
When mixing stereo to mono, attenuate both channels by -6dB to the output bus and the sum will be at the same 0 dB as both input channels

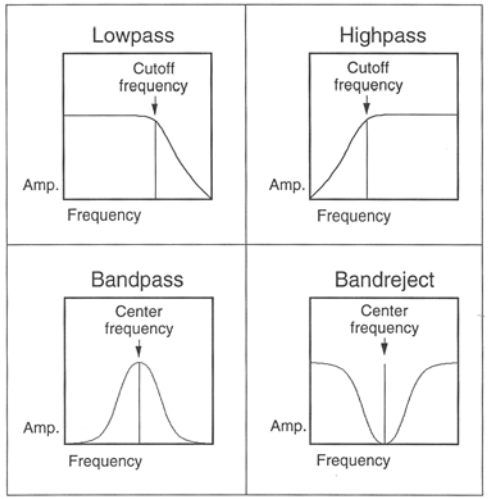
What About Audio?

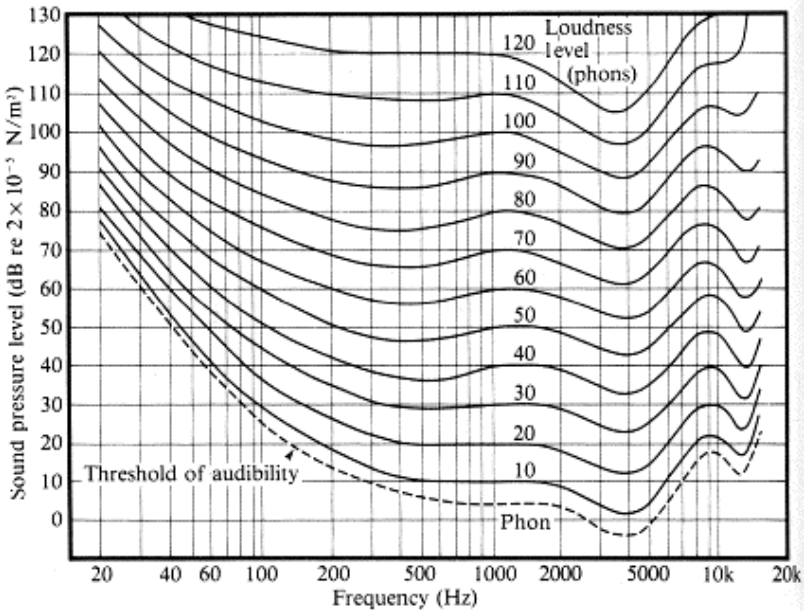
Frequency, Loudness, and Timing



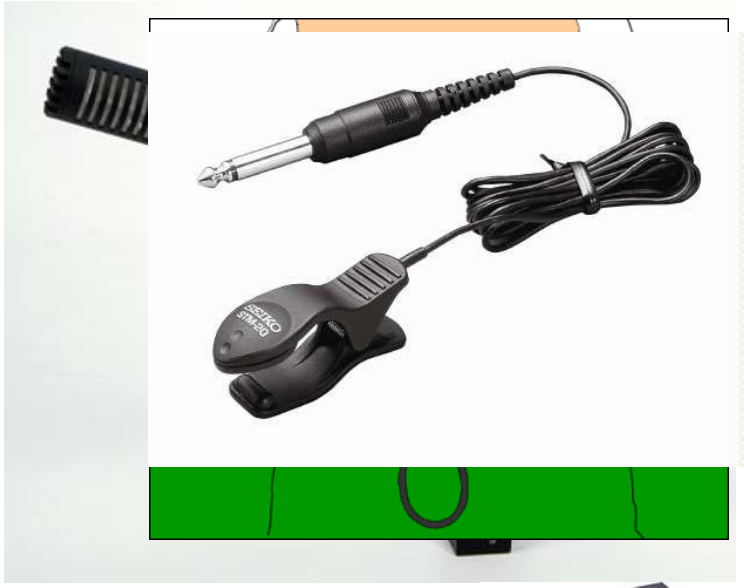
1-35 ms







Microphones for Applications



- Handheld
- Shotgun - Theatre
- Parabolic – Sporting events
- Lavalier – Attach to clothing
- Contact pickup – Musical instruments
- Pressure response – Lay on flat surface

XLR
Connector

Handheld
Microphone

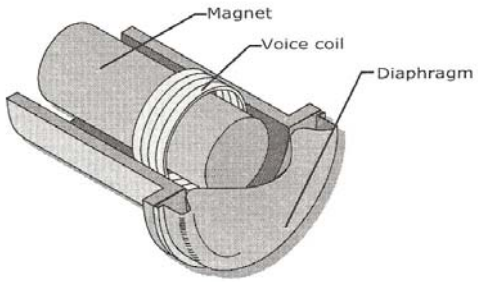
XLR
Connector

Gooseneck Microphone

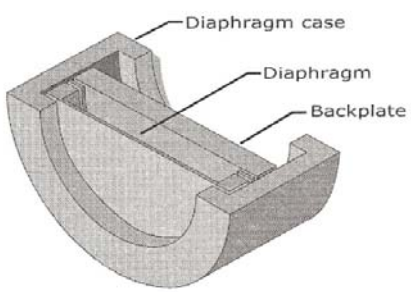
XLR
Connector

Boundary Microphone

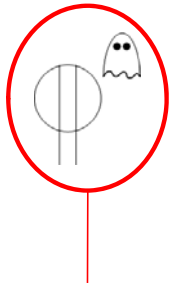
- Two common types of microphones are…
  - Dynamic Microphones



  - Condenser Microphones

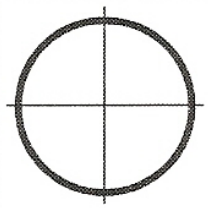
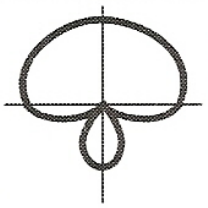
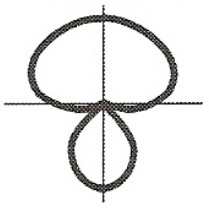
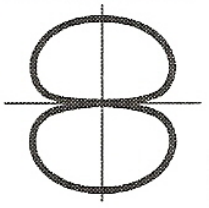


(Requires phantom power)

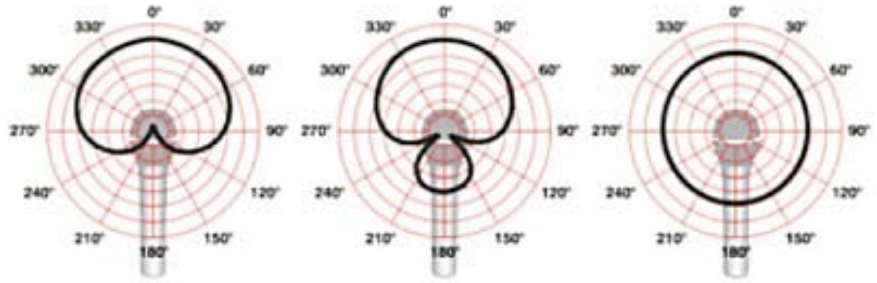


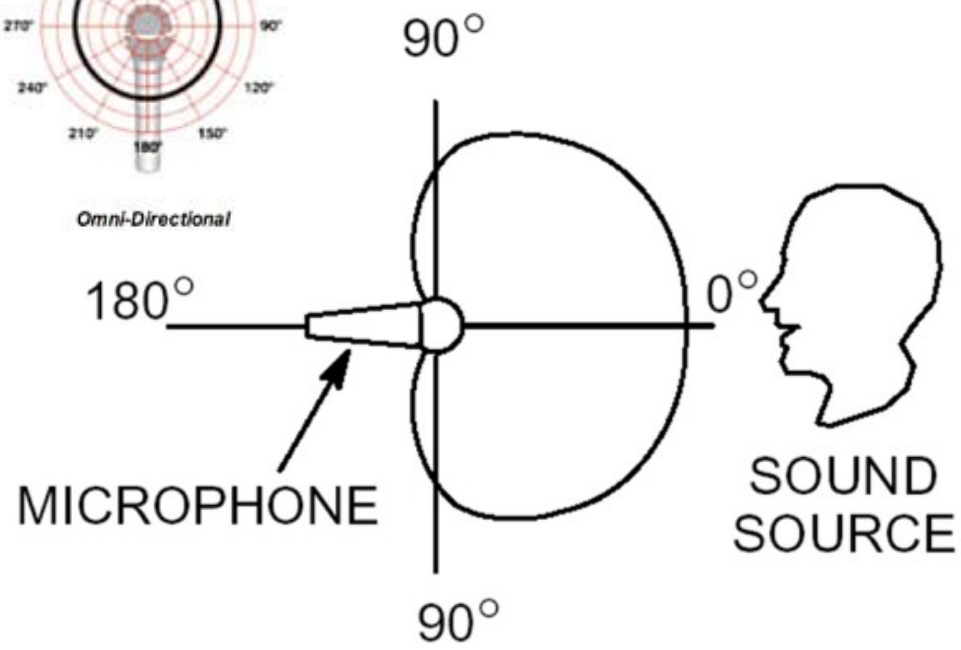
Phantom Power

Microphone Pick Up Patterns

Characteristic	Omni - directional	Cardioid	Super - cardioid	Hyper - cardioid	Bi - directional
Polar response pattern					
Coverage angle	360°	131°	115°	105°	90°
Angle of maximum rejection (null angle)	–	180°	126°	110°	90°

Microphone Pick Up Patterns





Handheld Microphone and Transmitter

Beltpack Transmitter

Wireless Receiver

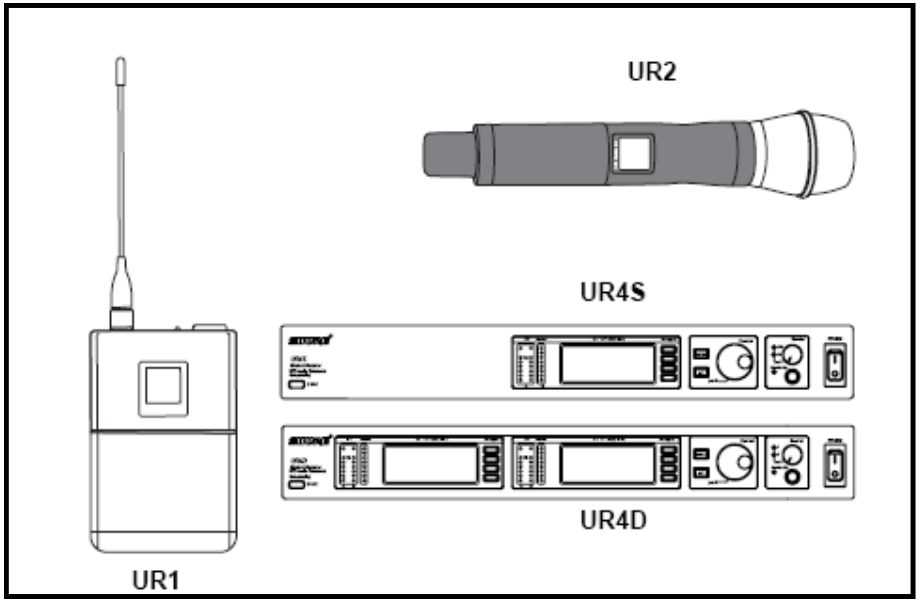
Lavalier Microphone

Antenna Distribution Amplifier

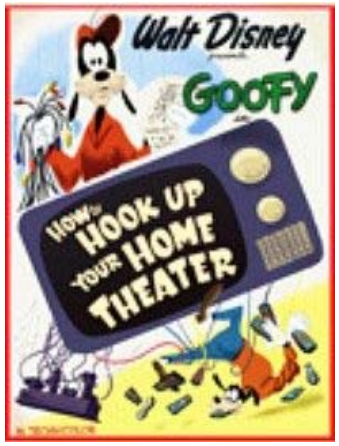
Depends on Frequency!
More money is typically better (features)

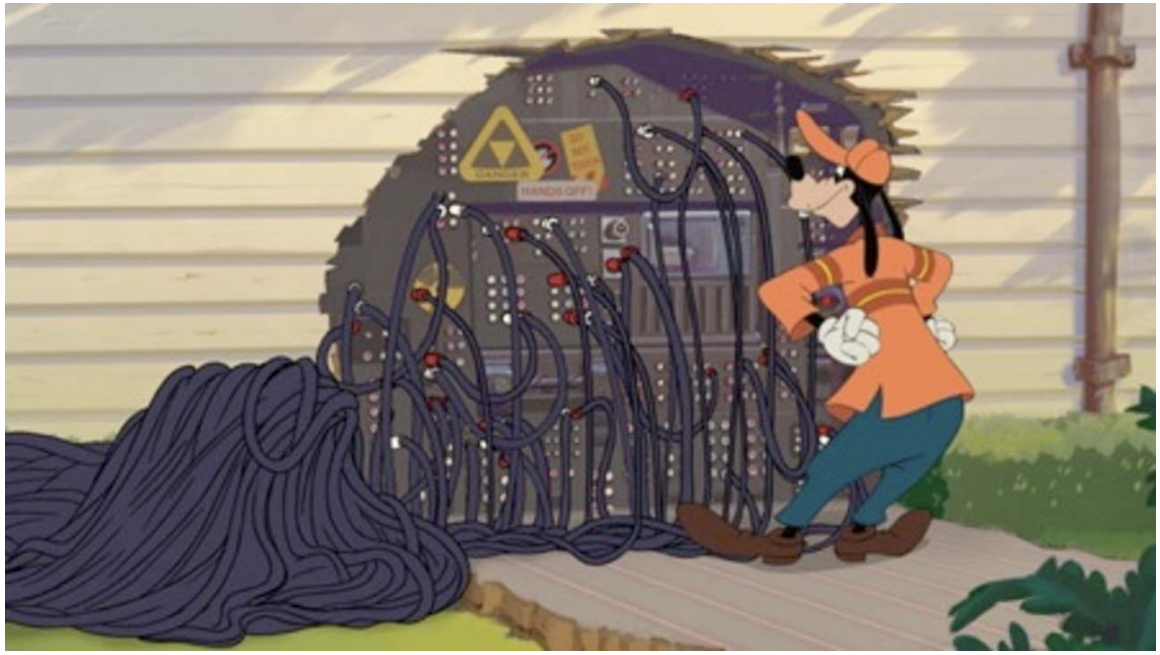
- VHF
- UHF
- UWB

Ultra Wide Band



Input





- Traditional
  - Skill Required
- Plug and Play
  - Not Hard Lid
  - Limited Futureability
- Twisted Pair
  - Solid conductor plugs
  - 2 cables = 1 UTP/1 STP
  - Pay attention to A vs. B
  - Cat5E better for analog (Skew Free/Low Skew)

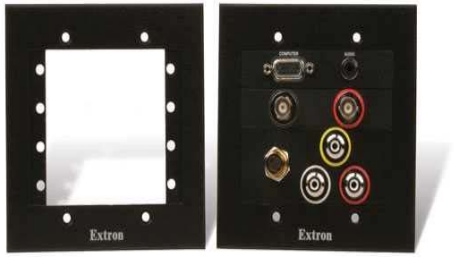
Pre-made and Custom Plates

Cable Cubbie

Decora Inputs

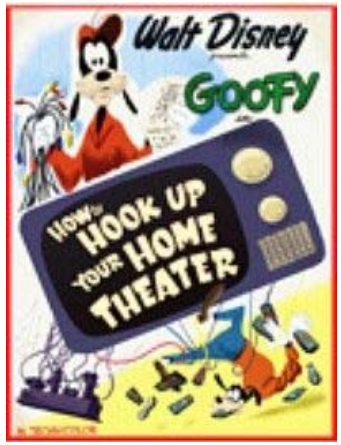
AV3ATCBK

Floor Box Inputs

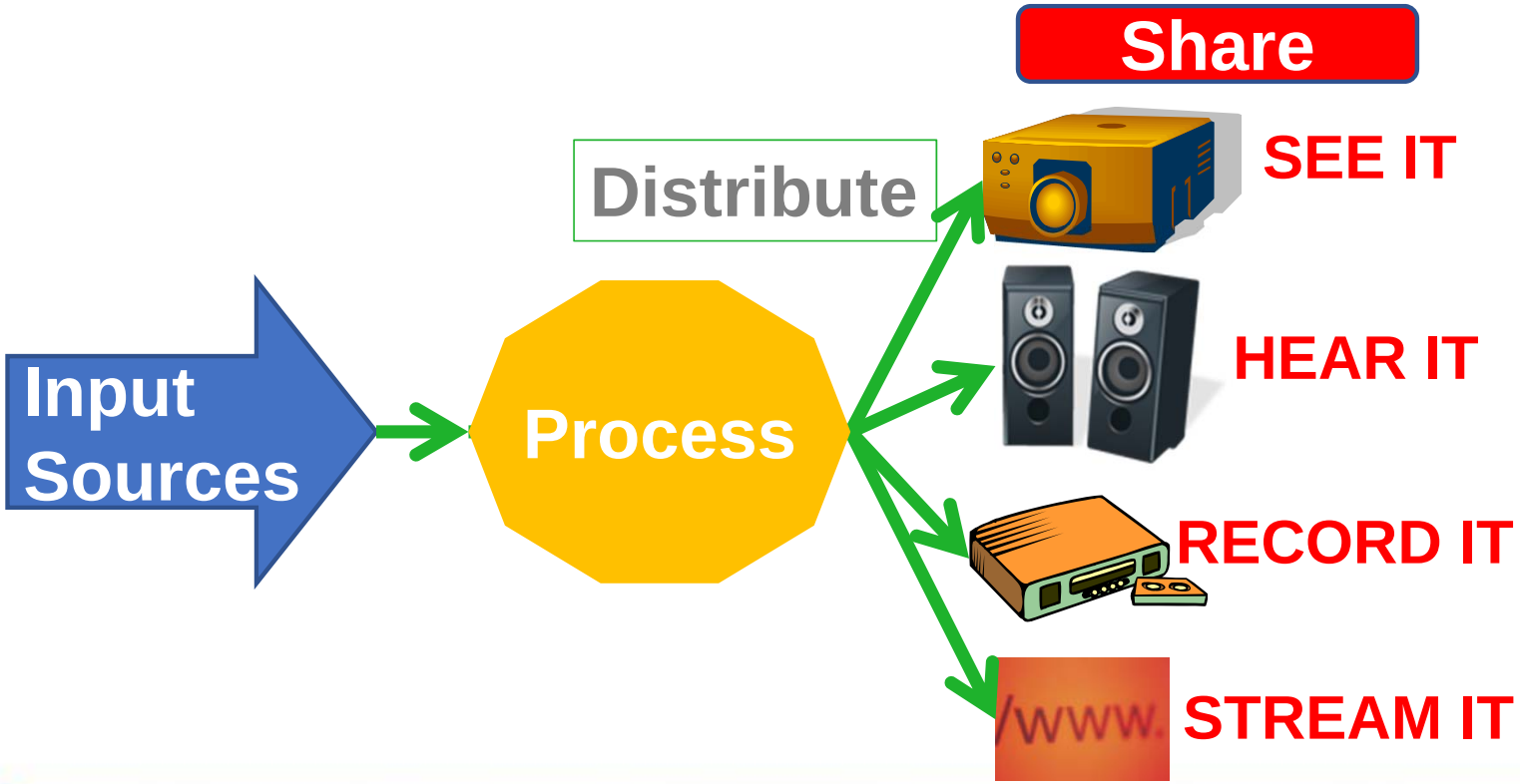


AAP Plates

Step 2 – Share



4 Steps of AV



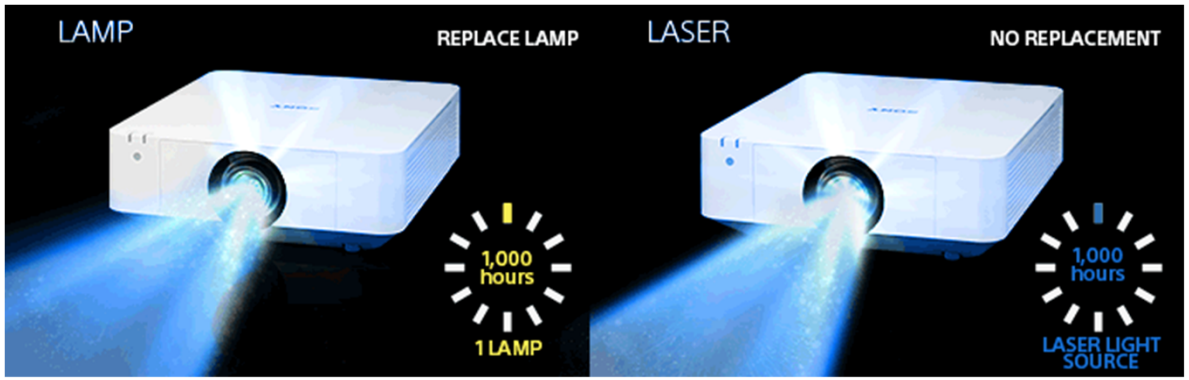
Projector Types

- ✓Pico
- ✓Portable
- ✓Multi-purpose
- ✓Professional \ Large Venue
- ✓Interactive

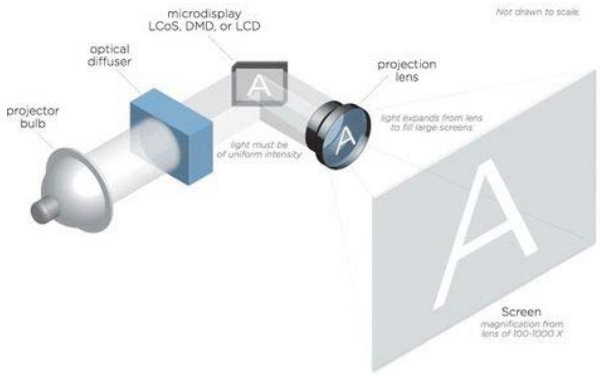
Projector Types

- ✓Standard Throw
- ✓Short Throw
- ✓Ultra Short Throw
- ✓Ultra WIDE Throw

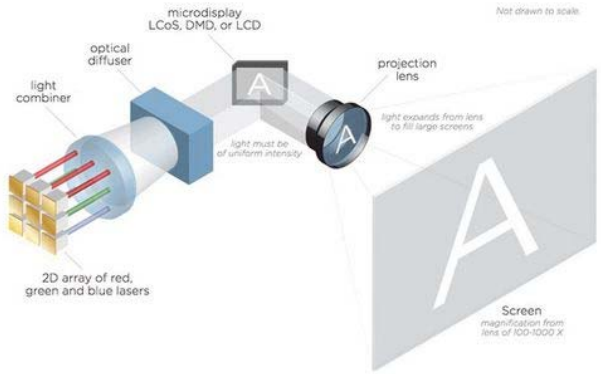
Laser vs Bulb



Bulb Projector



RGB Laser Projector



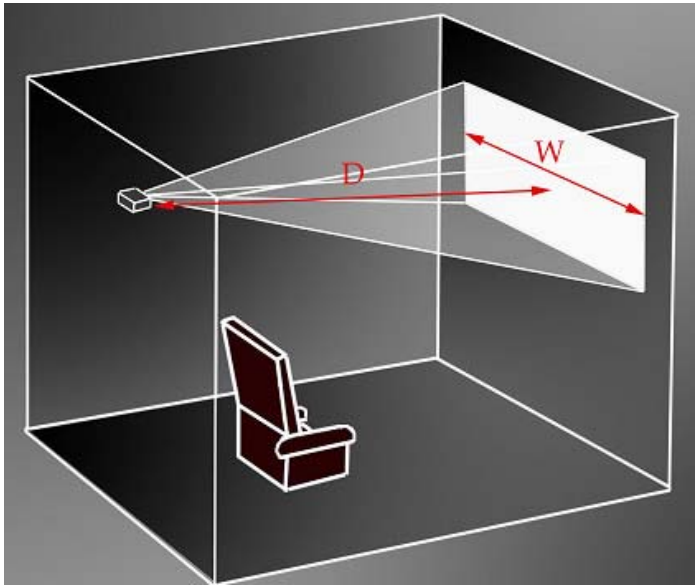
Projector Specs

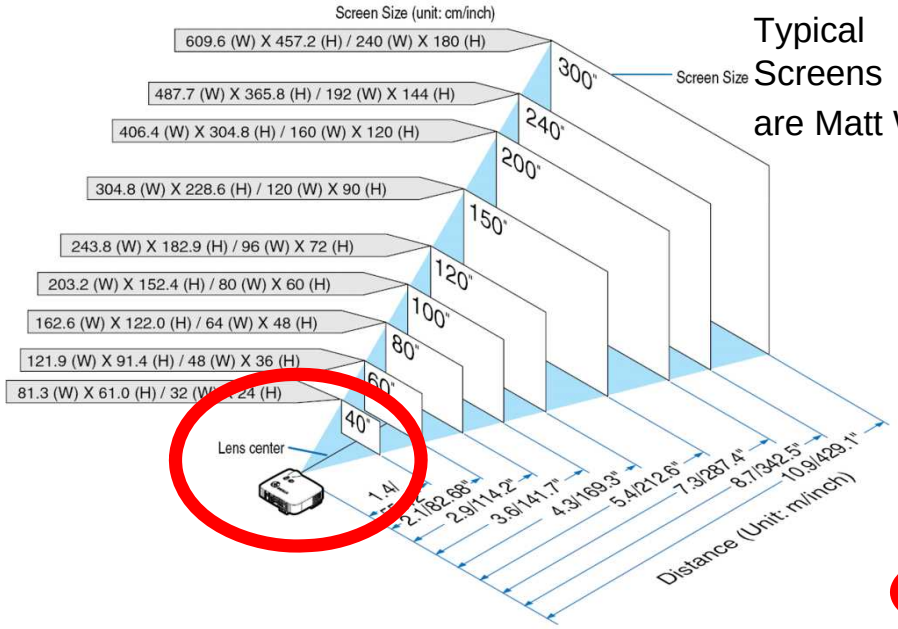
- **Lumens**
  - Minimum 3000
  - Double is noticeable
    - fade over time
  - Keystone can half
  - Color Brightness
- **Contrast Ratio**
  - Light cancels

CAUTION: Use specs MOSTLY to compare models by same manufacturer

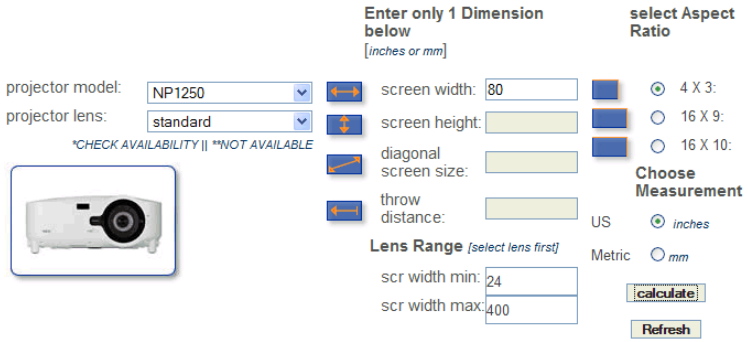
Projector Specs

- Throw Ratio
  - Multiply by width
- Native Resolution
  - Rescales to within
- Warranty
- Inputs





Typical Screens are Matt White

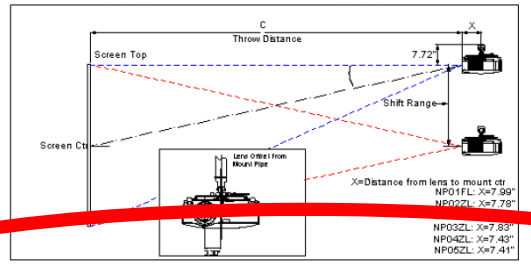


Note: Distances may vary +/-5%

	Scr Diagonal	Scr Width(H)	Scr Height(V)	Scr Drop(B)	Dimension (D)	Throw Distance(C) [max]
TELE	100	80	60	variable	0	162.4
	Scr Diagonal	**Scr Width(H)**	**Scr Height(V)**	**Scr Drop(B)**		**Throw Distance(C) [min]**
WIDE	100	80	60	variable		121.6

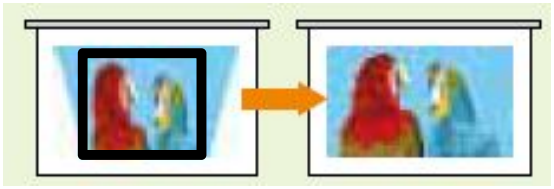
13.5’

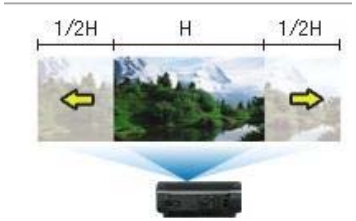
10’



Distance from bottom of screen to floor should be 3-4 feet.

- PC-free presentations
- Wireless
- AUTO keystone
- Wireless mouse control
- Lens Shift
- Network Capable
  - Control and Monitor
  - Content





- Use furthest distance to determine HEIGHT
- IF showing…
  - Video ÷ 8
  - Data ÷ 6
  - Graphics ÷ 4
- WIDTH is determined by ratio…
  - 4:3 = 1.33
  - 16:9 = 1.78
  - 16:10 (8:5) = 1.6

4:3 NTSC Video	16:9 HDTV	16:10	5:4 Data Graphics
H = D x .6	H = D x .49	H = D x .5299	H = D x .625
W= D x .8	W = D x .87146	W = D x .848	W = D x .781
D= H x 1.667	D = H x 2.04	D = H x 1.8868	D = H x 1.601
D = W x 1.25	D = W x 1.1475	D = W x 1.1793	D = W x 1.281

1.85:1 WideScreen(Letterbox)	2.35:1 CinemaScope	15:9
H = D x .4762	H = D x .3915	H = D x .5146
W = D x .881	W = D x .92	W = D x .8576
D = H x 2.1	D = H x 2.554	D = H x 1.9433
D = W x 1.135	D = W x 1.0868	D = W x 1.166

QLED TV

QLED (Samsung Q7F)

QLED PROS AND CONS

Pros:
Brilliant whites
Ultra-bright (1,500nits)
Variety of screen sizes between 49-88-inch

Cons:
Not as slim (25.4mm)
Overly bright
Less convincing blacks
Slower refresh rate

OLED TV

OLED (LG B6)

OLED PROS AND CONS

Pros:
Lighter and thinner (2.57mm)
Self-lighting pixels
More convincing blacks
Faster refresh rate (0.001ms)
Judder and blur-free

Cons:
Only found in three screen sizes: 55, 65 & 77-inch
Muted brightness (1,000nits)
Expensive

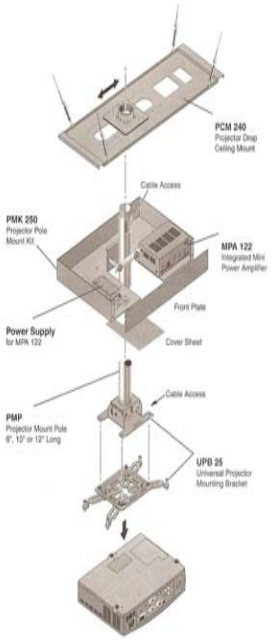
LED TV

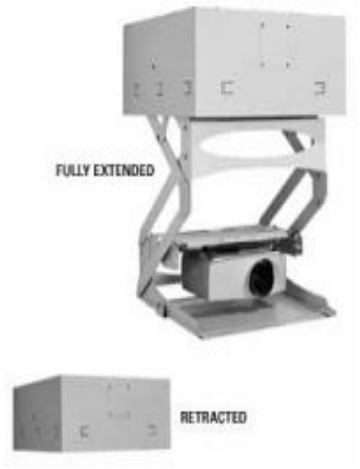
LED (Samsung KS8000)

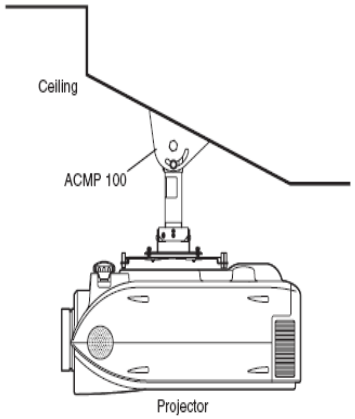
	QLED	OLED	LED
Black Level	Good	Perfect	Good
Motion Blur	Great	Perfect	Good
Viewing Angle	Poor	Great	Poor
Color volume	Great	Good	Good
Gray Uniformity	Average	Good	Average
Luminosity	Good	Good	Great
Image Retention	Great	Poor	Great
Price and Availability	Poor	Average	Great

https://www.rtings.com/tv/reviews/by-type/qled-vs-oled-vs-led

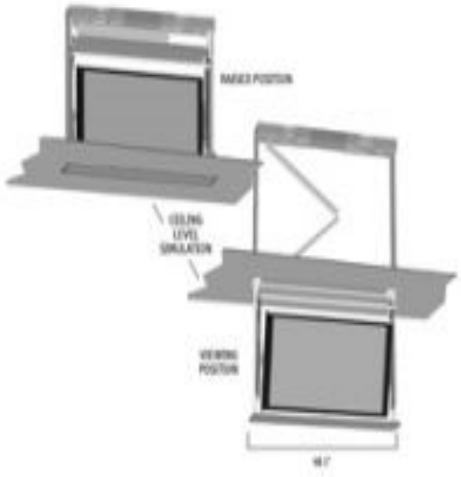
Projector Mounting Examples



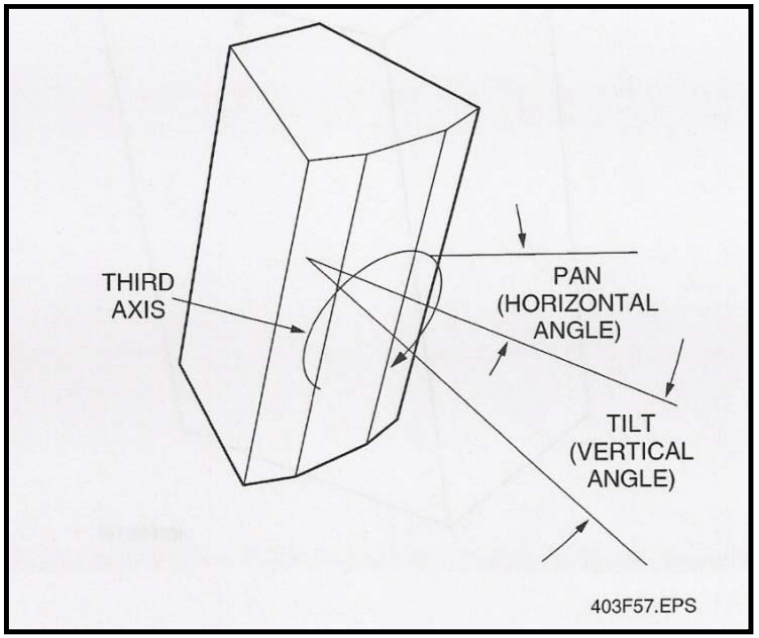


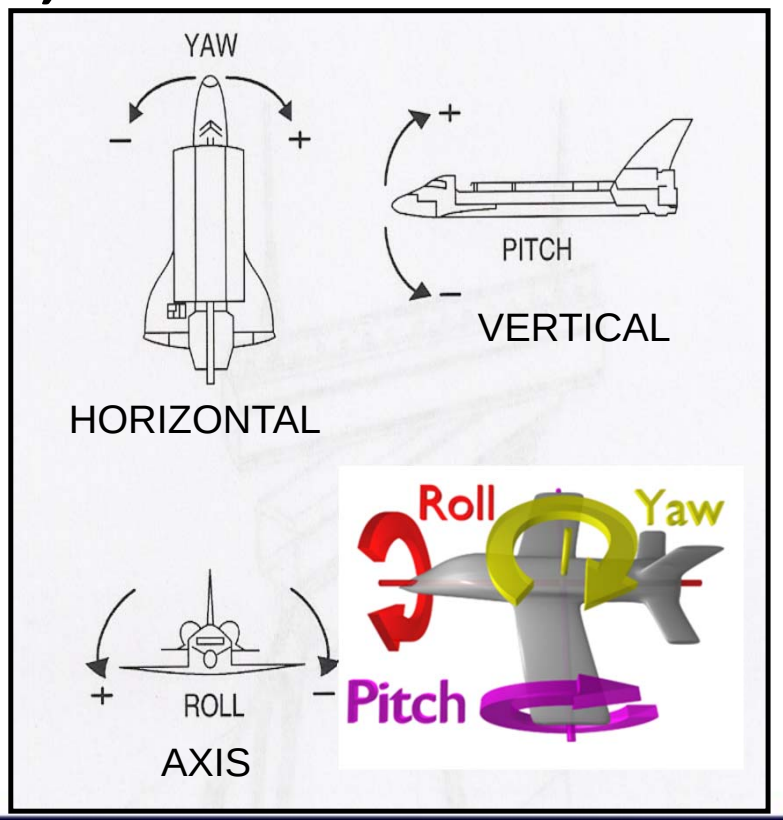


Monitor Display Mounting Examples



Pitch, Roll, & Yaw





A Word About Digital Signage

2018 BICSI WINTER
CONFERENCE & EXHIBITION
Orlando, FL | February 4-8

E.R.I.C.
Low Voltage Services

A Word About Video Walls

Ceiling (Flush Mount) Speakers

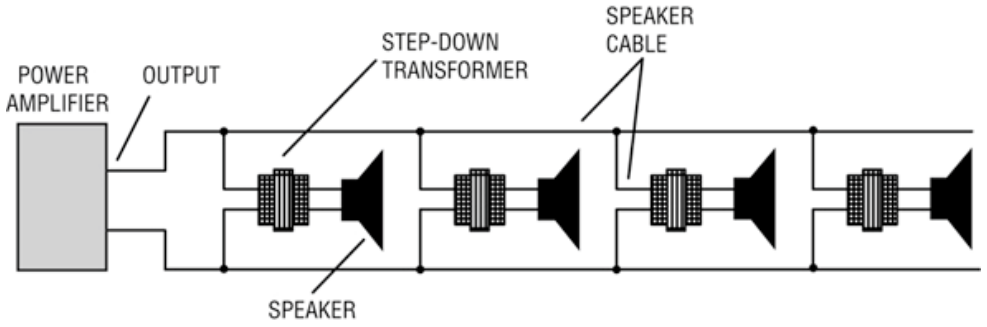
Wall (Surface Mount) Speakers

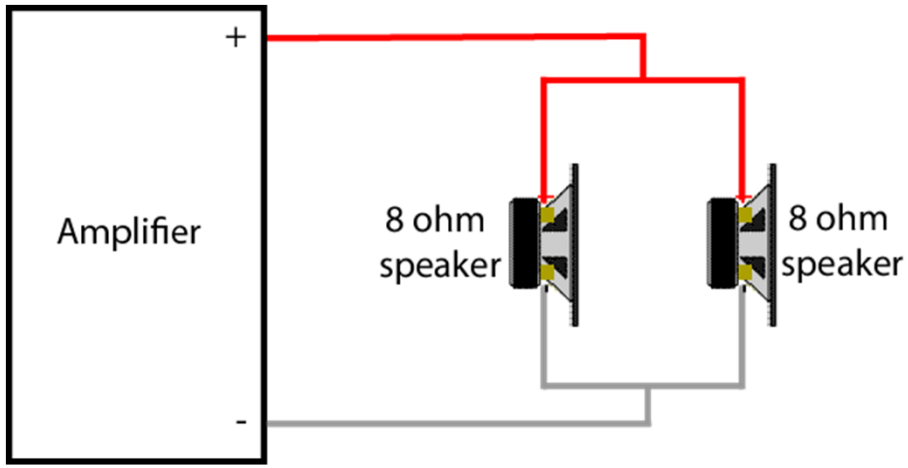
Wall (Flush Mount) In-Wall Speakers

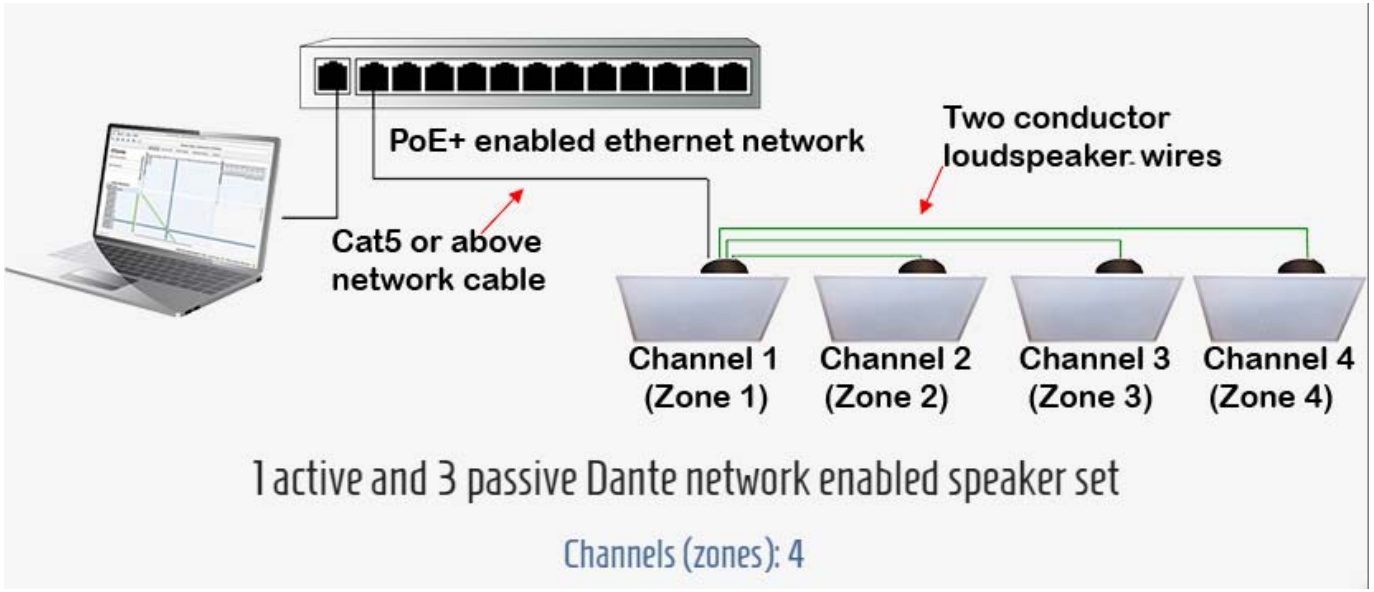
Pendant Speakers

Hidden Speakers

Constant Voltage vs 4/8 ohm direct



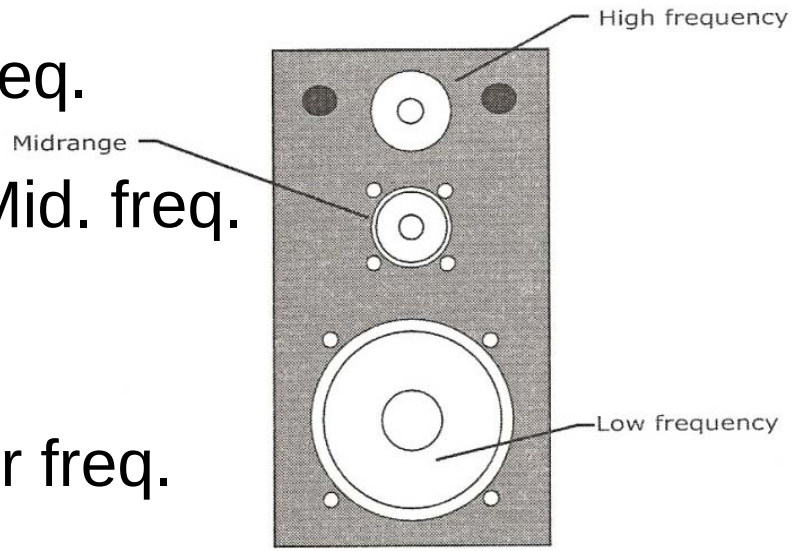




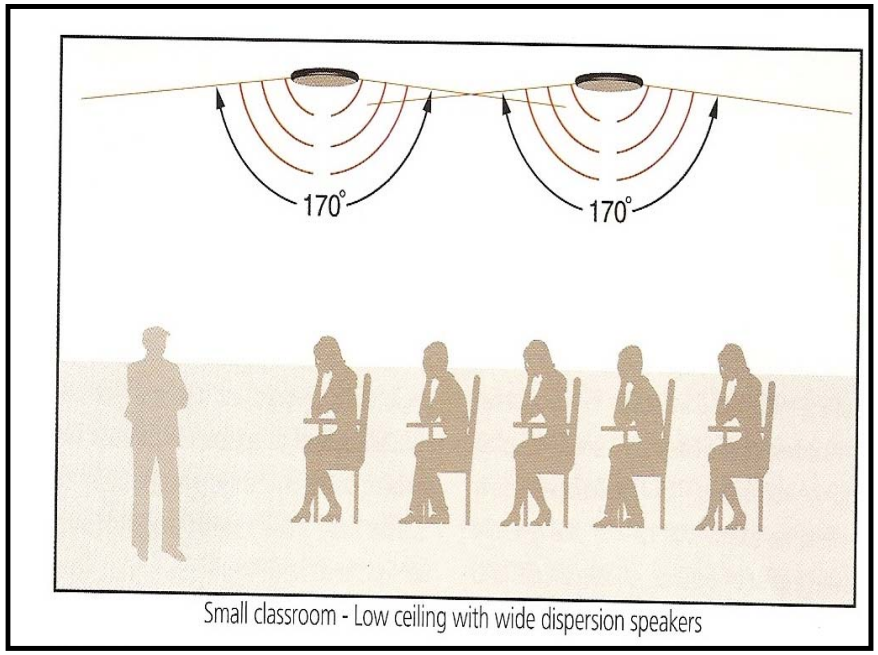
Dante Speakers

Powered Speakers

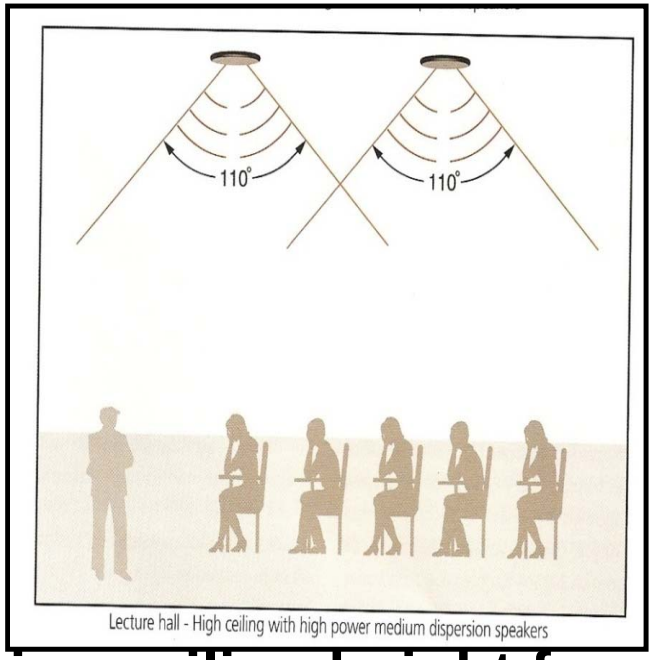
- Speakers frequency ranges…
  - **Tweeters**-High freq.
    (2,000-20,000 Hz)
  - **Horns**-Mid.-High freq.
    (300-8,000 Hz)
  - **Midrange cones**-Mid. freq.
    (200-8,000 Hz)
  - **Woofers**-Low freq.
    (40-600 Hz)
  - **Subwoofers**-Lower freq.
    (20-200 Hz)



Speaker dispersion



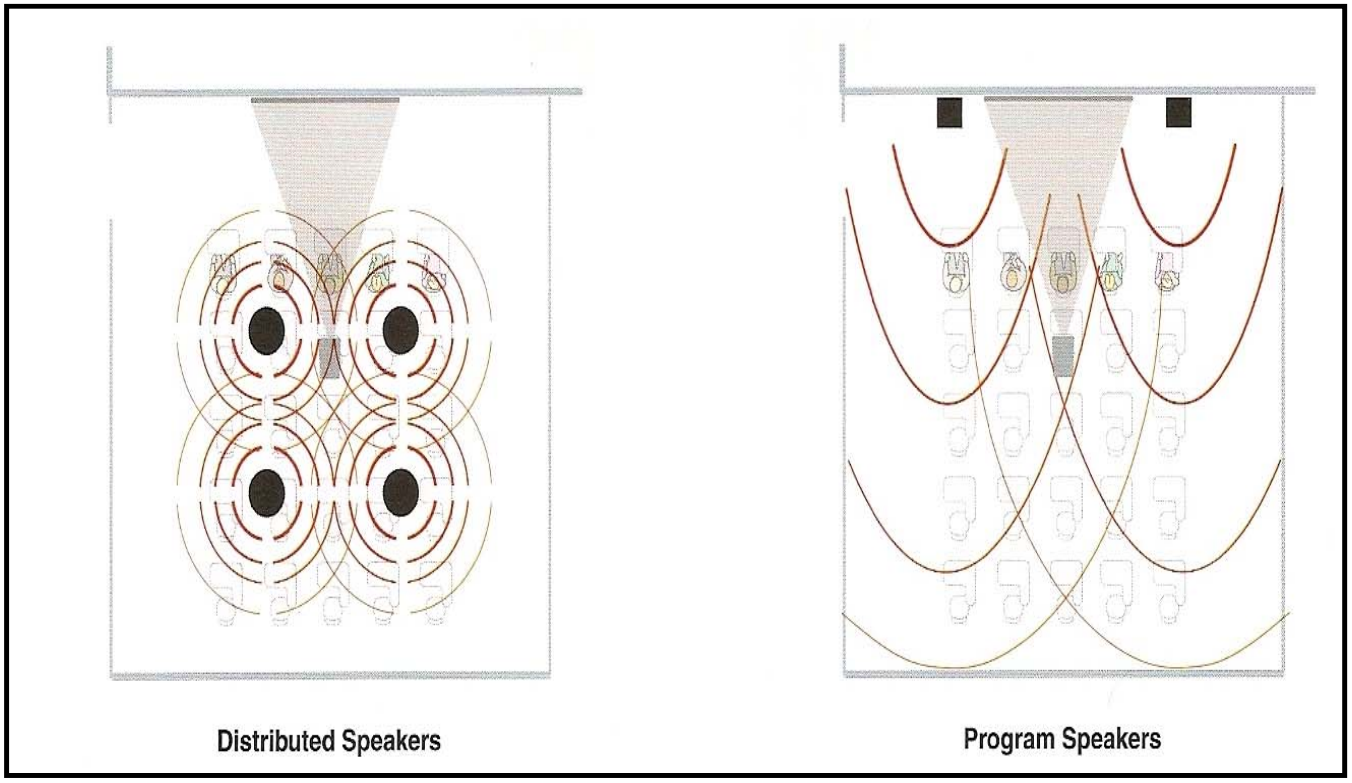
Small classroom - Low ceiling with wide dispersion speakers



Lecture hall - High ceiling with high power medium dispersion speakers

Work with architect to determine ceiling height for speakers and adequate screen height!

Speaker dispersion



Speaker Placement

- ***Turning volume up does not increase coverage area only loudness***
- Ceiling Speakers
  - Determine # of speakers using ceiling height X2 rule
- Wall Baffles
  - Determine # based on height from floor to speaker
    - 8’ high = space 20’ apart
    - 16’ high = space 30’ apart
    - Stagger on opposing walls

2018 BICSI WINTER CONFERENCE & EXHIBITION

Orlando, FL | February 4-8

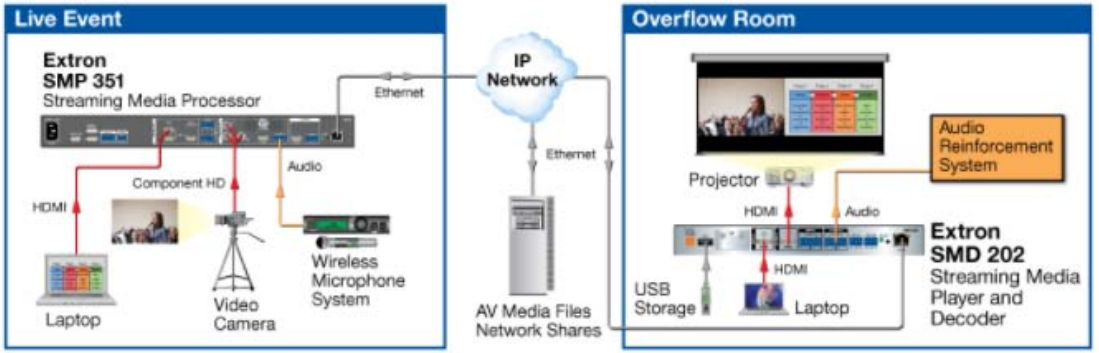
E.R.I.C.
Low Voltage Services

Recording

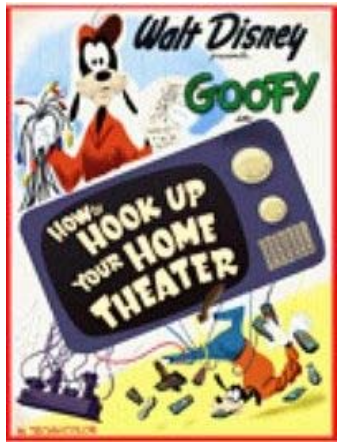
Streaming

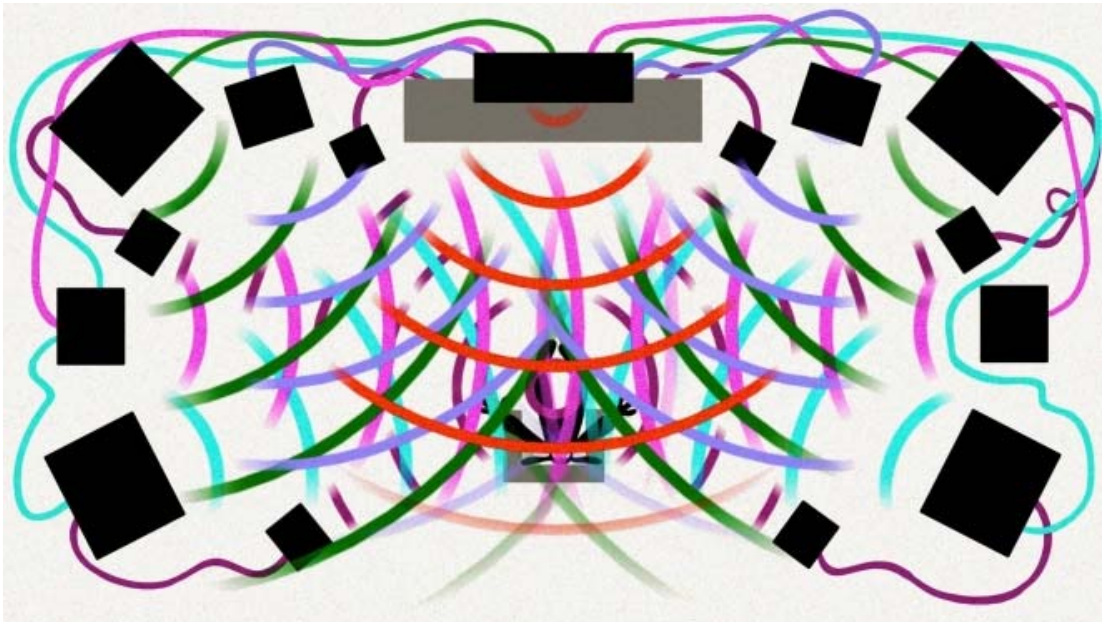
INput

OUTput



Step 3 – Process

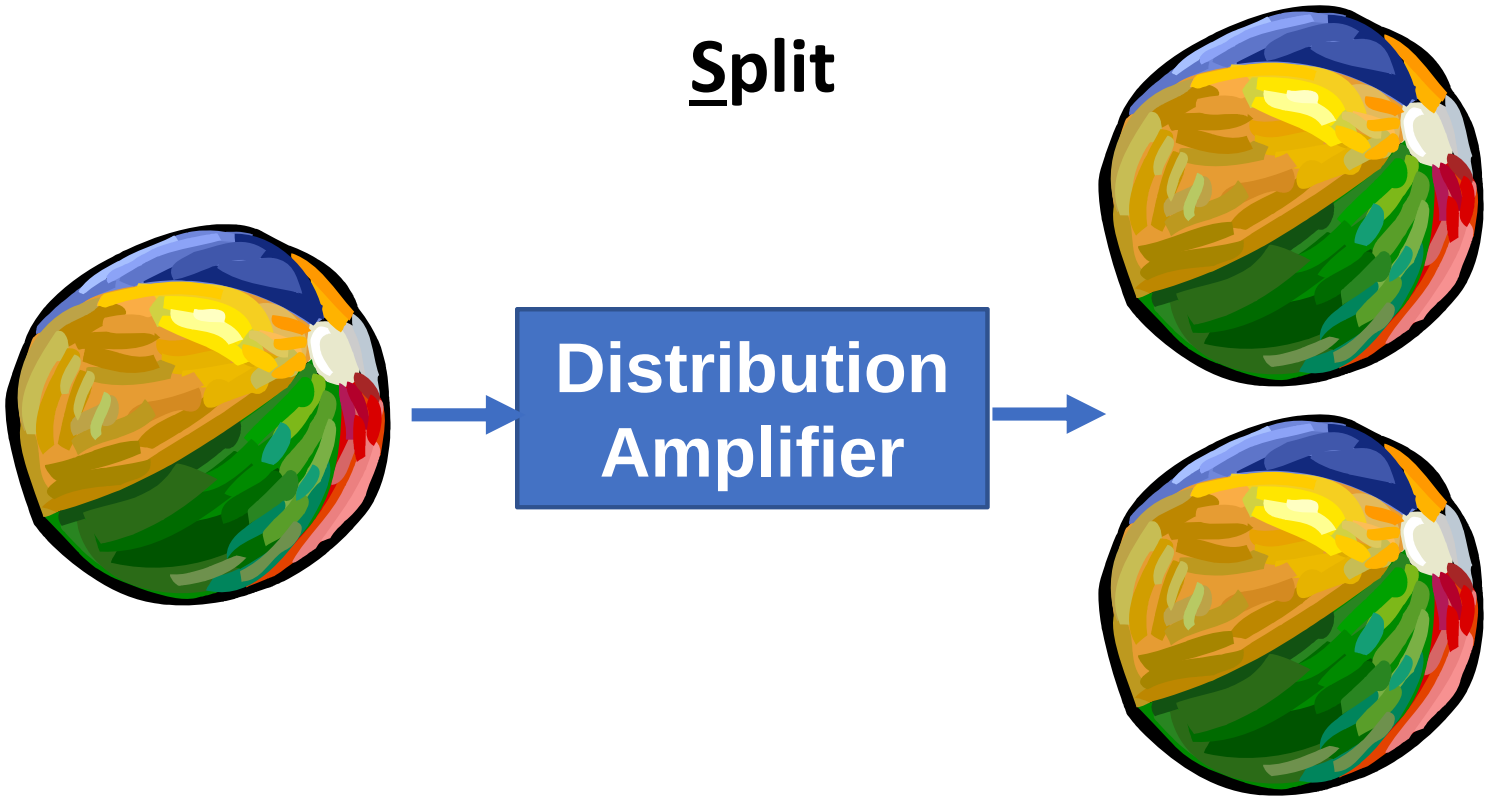




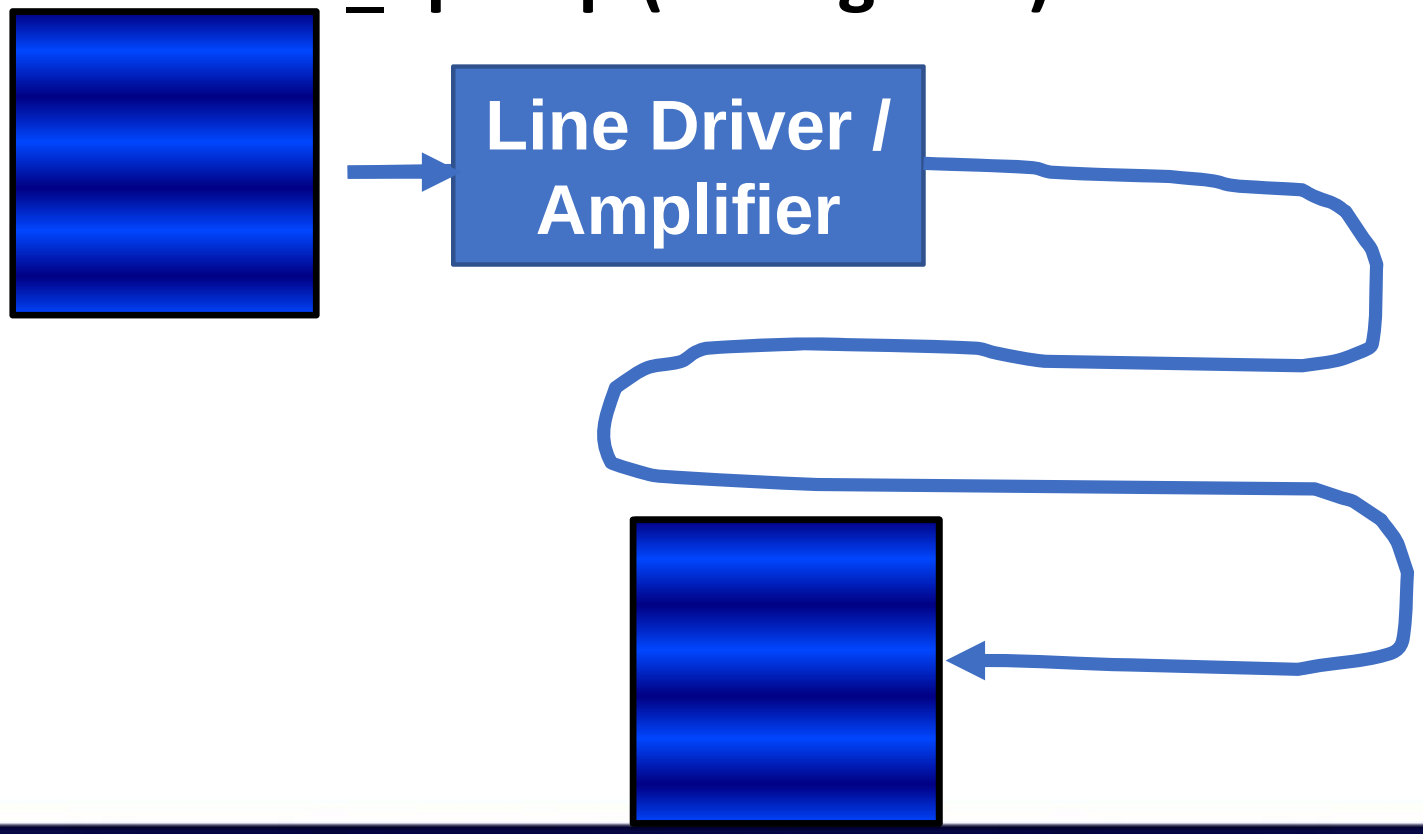
STEP 3 - Process

- Can be separate pieces of equipment or built into equipment used in step 2
  - Best to use separate
- Can be separate pieces of equipment for each option or one box can do several processing options
  - Save money and space with a box that does many features

Split



Supe Up (Strengthen)

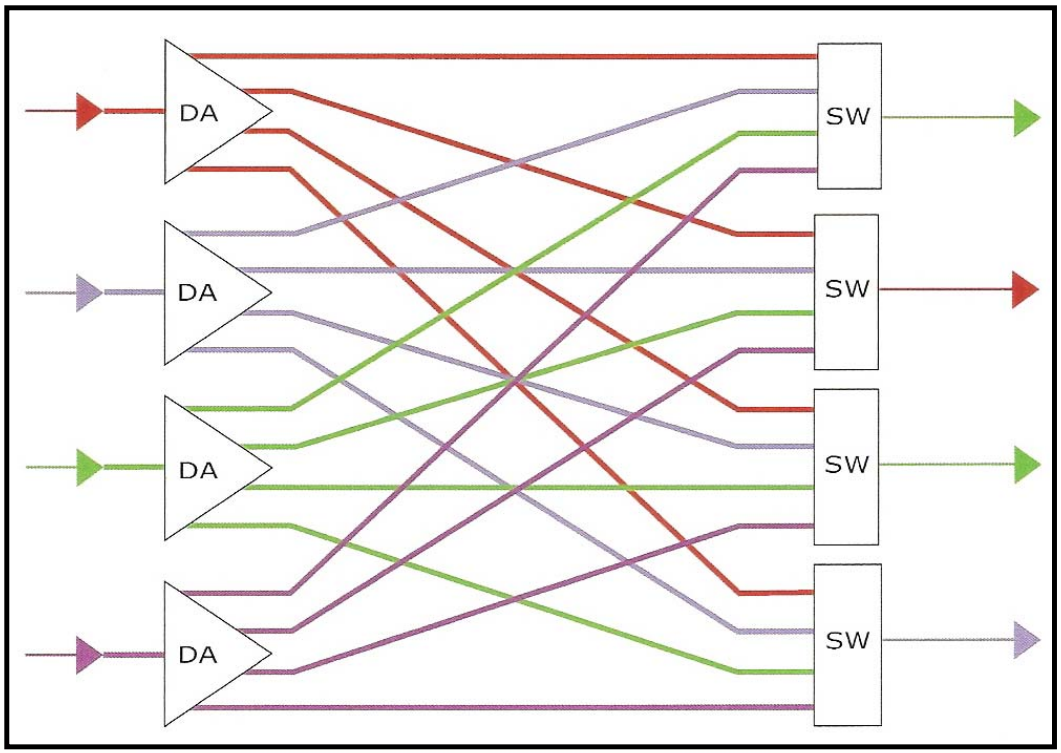


Switch

Switcher

Mixer for Audio

Matrix Switcher



re-Size

Superimpose

Title Generator / Graphic Processor

Mixer for Audio

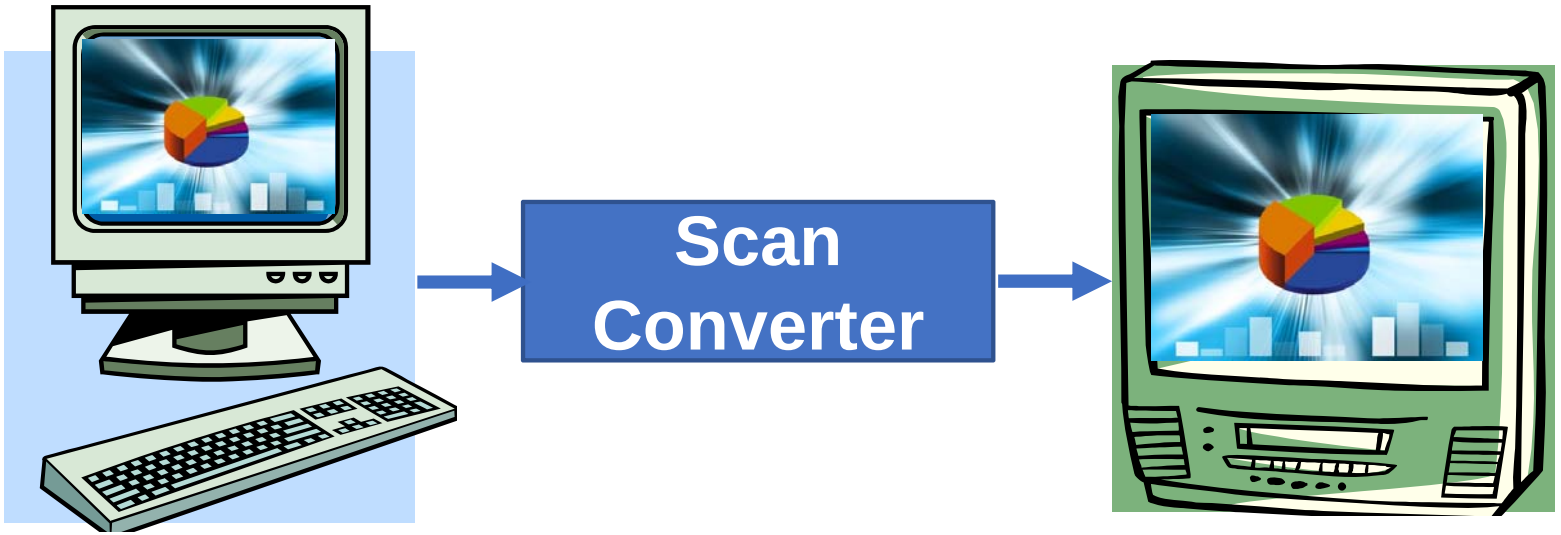
Side by Side

PIP Processor

PIP = Picture in Picture

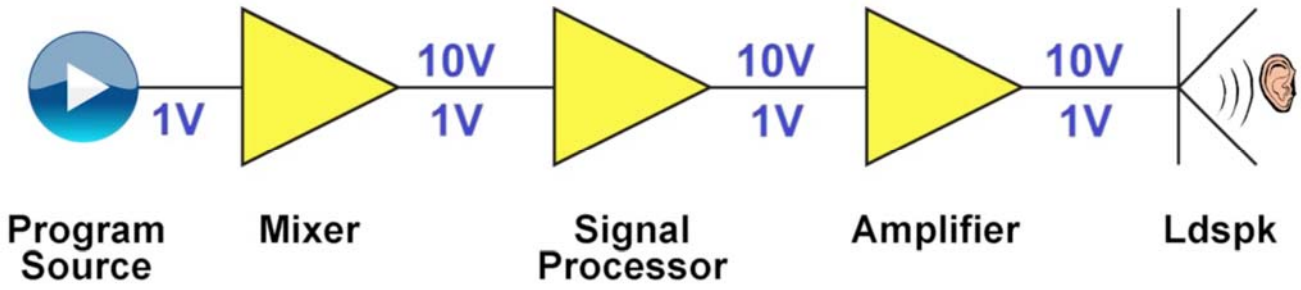
Window Wall Processor

Swap



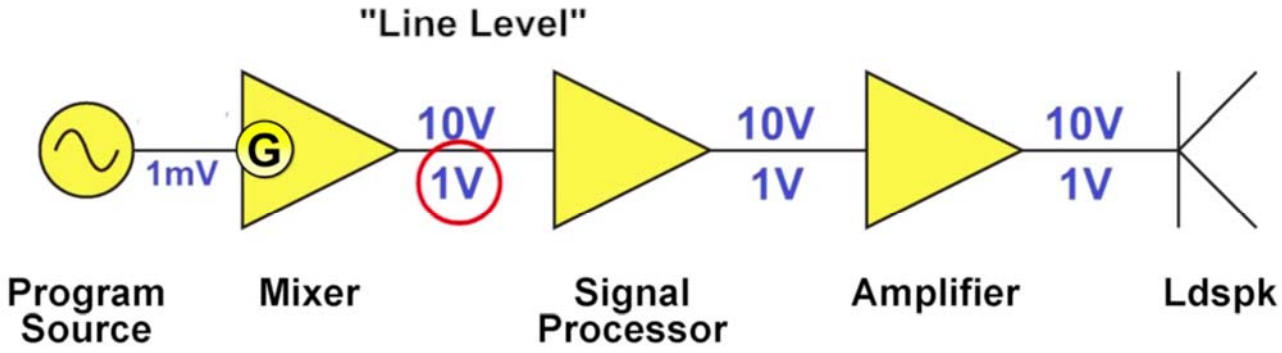
Audio Processing

A Simple, Ideal Case



Audio Processing

A Real-World System

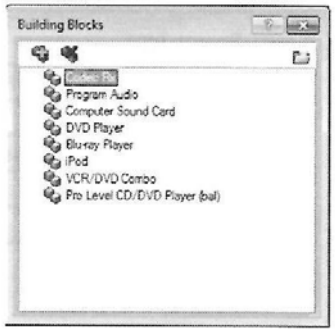


Audio Processing

Line Input Building Blocks – Gain Levels

- Individual gain is added based on operating level of the source (gain compensation)
- Target level -17dBFS (allow enough headroom)

Input Type	Operating Level	Gain Compensation	Target Level
Codec Rx	+4 dBu	0 dB	-17dBFS (+4dBu)
Program Audio	+4 dBu	0 dB	-17dBFS (+4dBu)
Computer Sound Card (analog)	0 dBv	+1.8 dB	-17dBFS (+4dBu)
DVD Player	-10 dBv	+11.8 dB	-17dBFS (+4dBu)
Blu-ray Player	-10 dBv	+11.8 dB	-17dBFS (+4dBu)
iPod (analog)	0 dBv	+1.8 dB	-17dBFS (+4dBu)
VCR/DVD Combo	-10 dBv	+11.8 dB	-17dBFS (+4dBu)
Pro Level CD/DVD Player (balanced)	+4 dBu	0 dB	-17dBFS (+4dBu)



EDSP – Building Blocks

Wireless Microphone Building Blocks

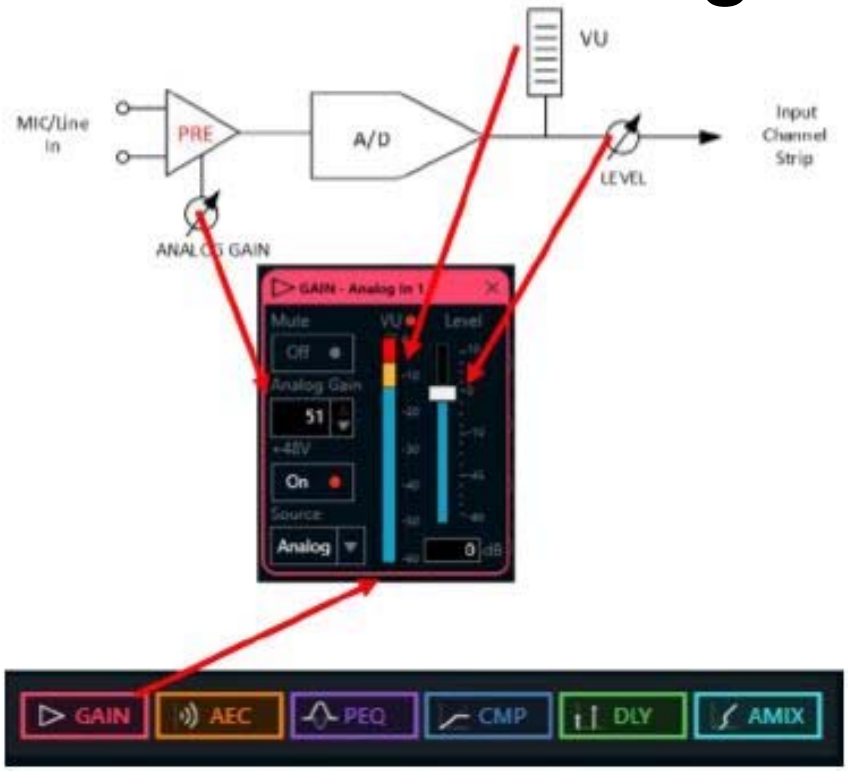
Microphone Type	Operating Level	Gain Compensation	Target Level
Wireless Mics (+4 dBu)	+4 dBu	0 dB	-17 dBFS (+4dBu)
Wireless Mics (-10 dBv)	-10 dBv	+11.8 dB	-17 dBFS (+4dBu)
Wireless Mics (-30 dBu)	-30 dBu	+34 dB	-17 dBFS (+4dBu)

EDSP – Building Blocks

Audio Processing

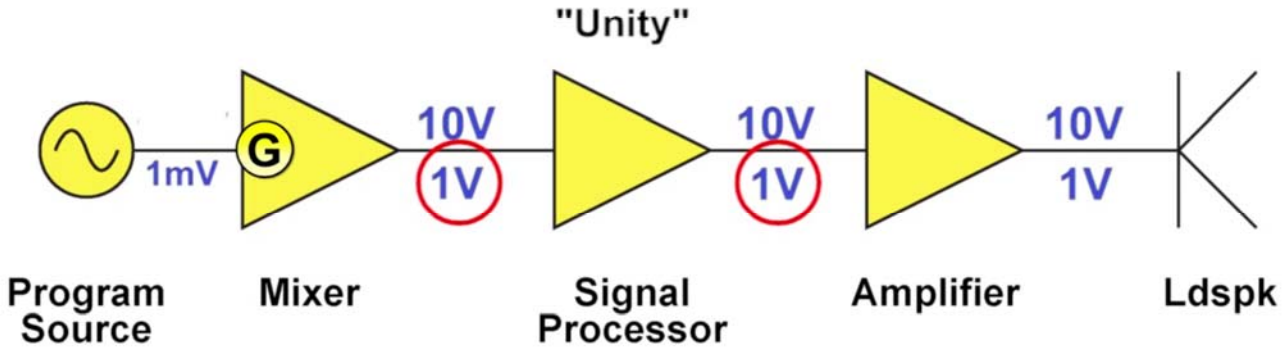
Audio Processing

Audio Processing

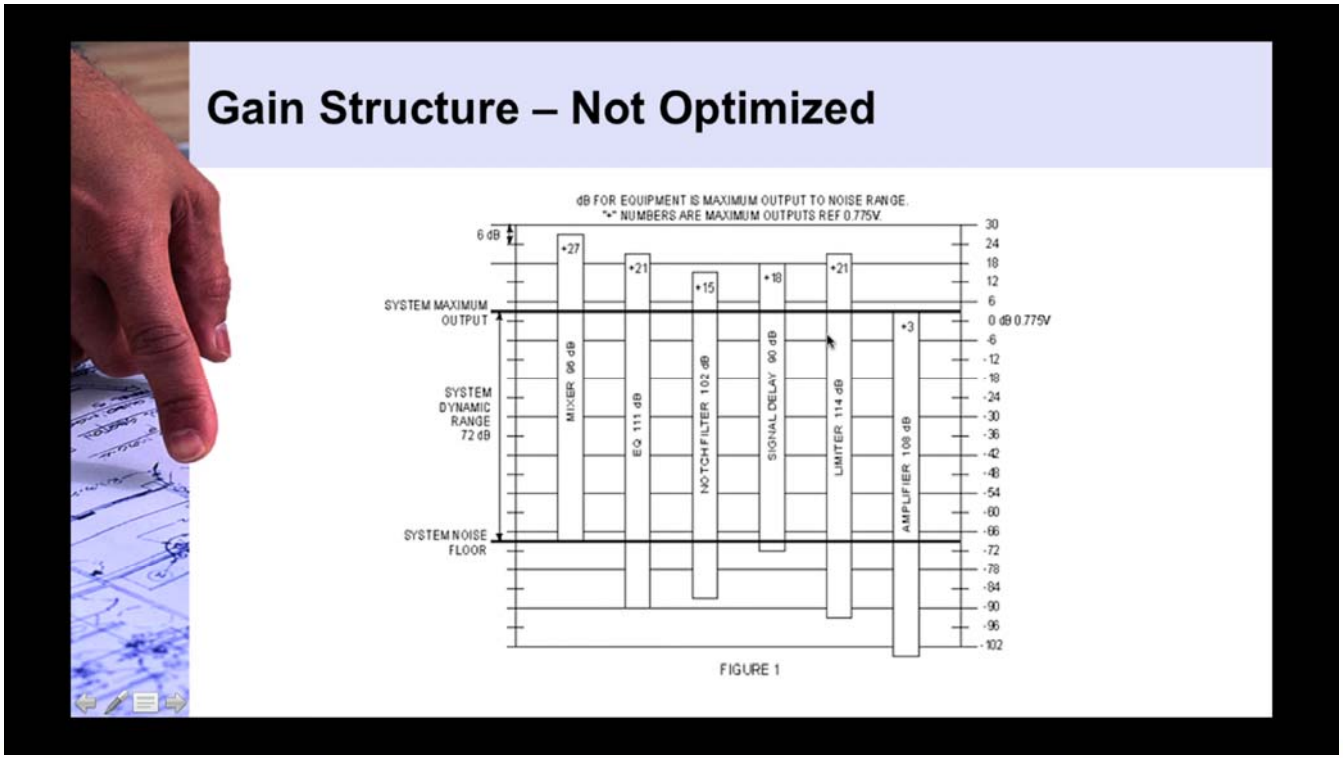


Audio Processing

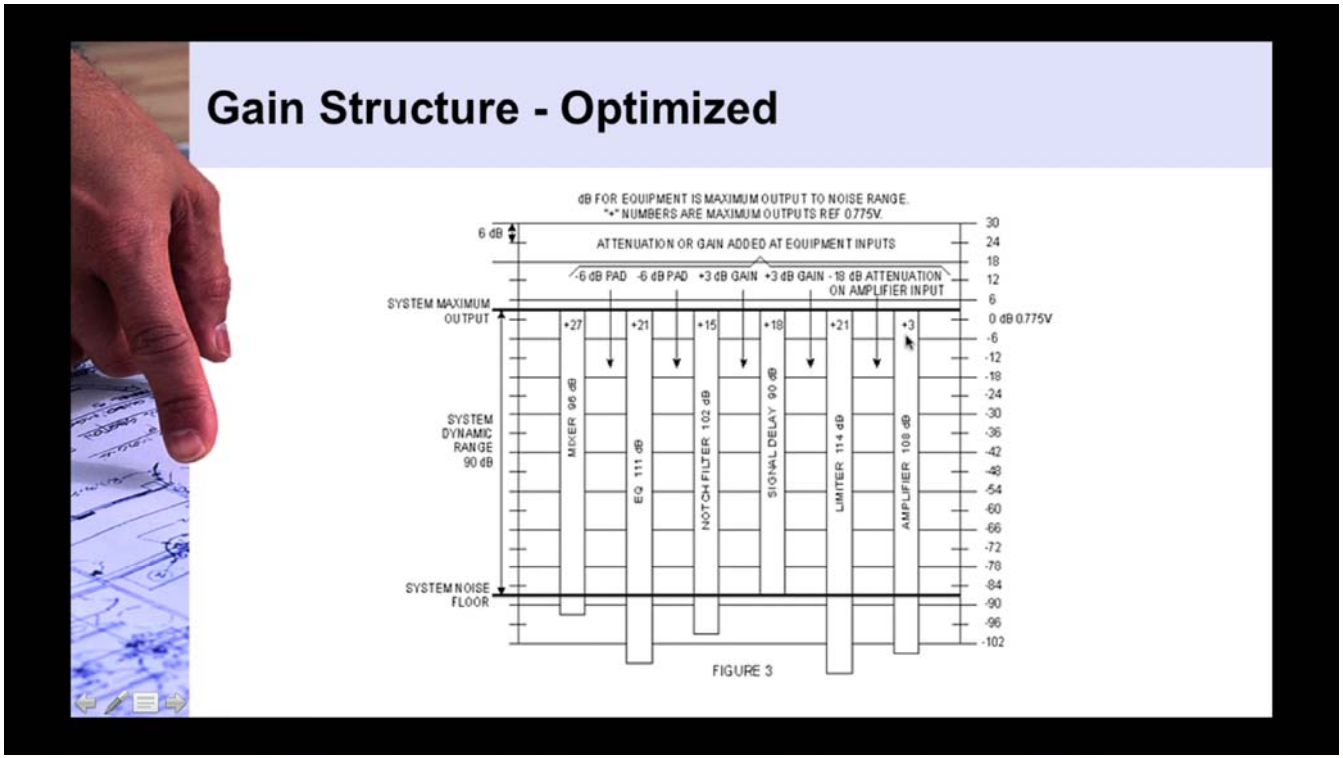
A Real-World System



Audio Processing

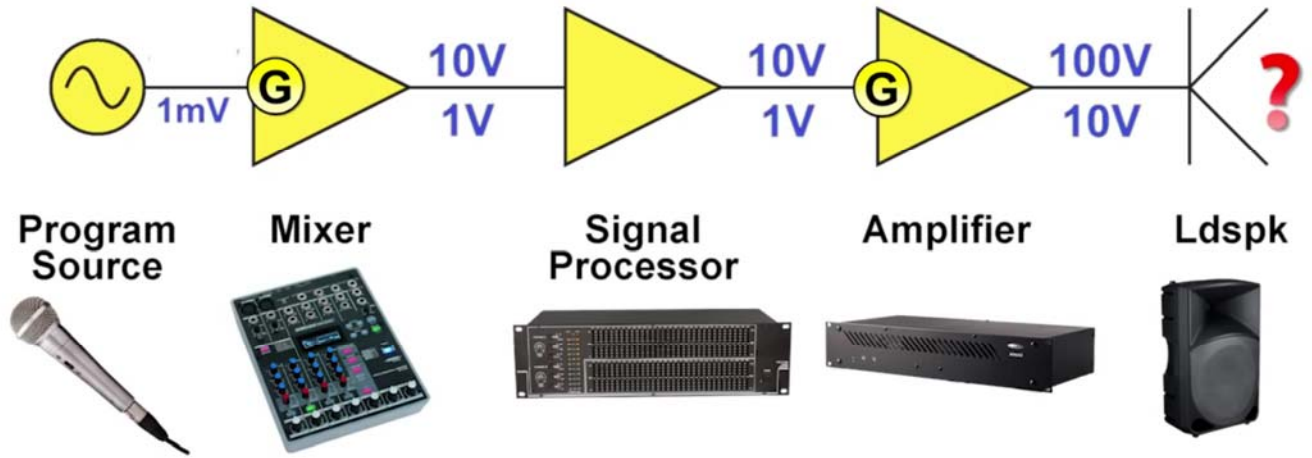


Audio Processing



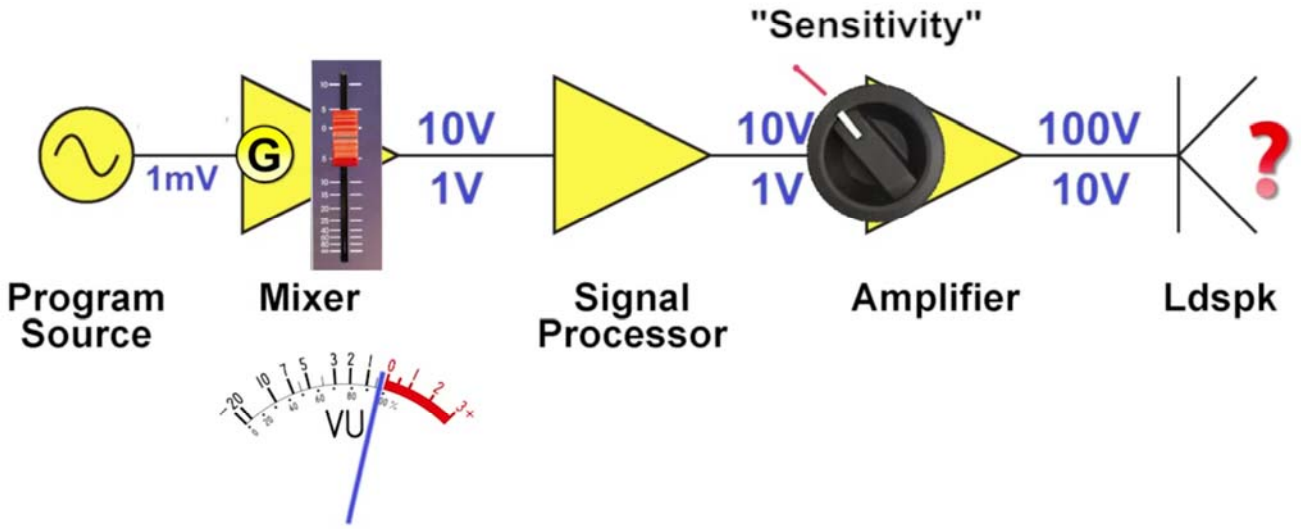
Audio Processing

The Signal Chain

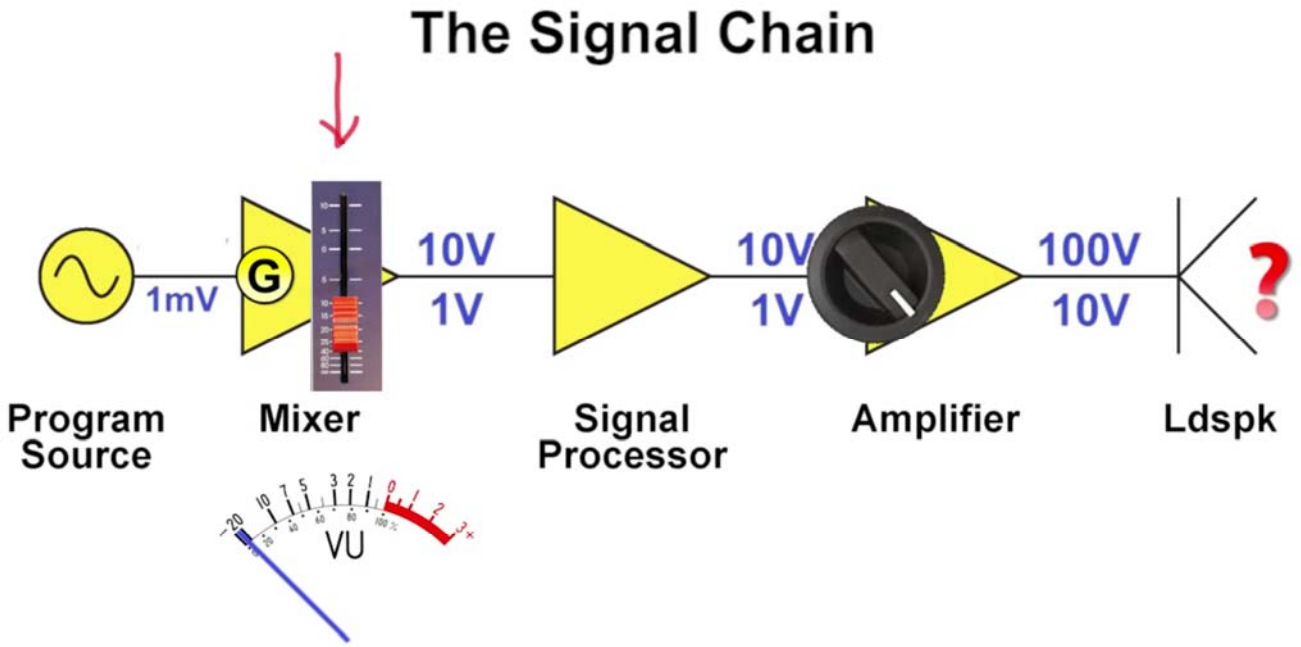


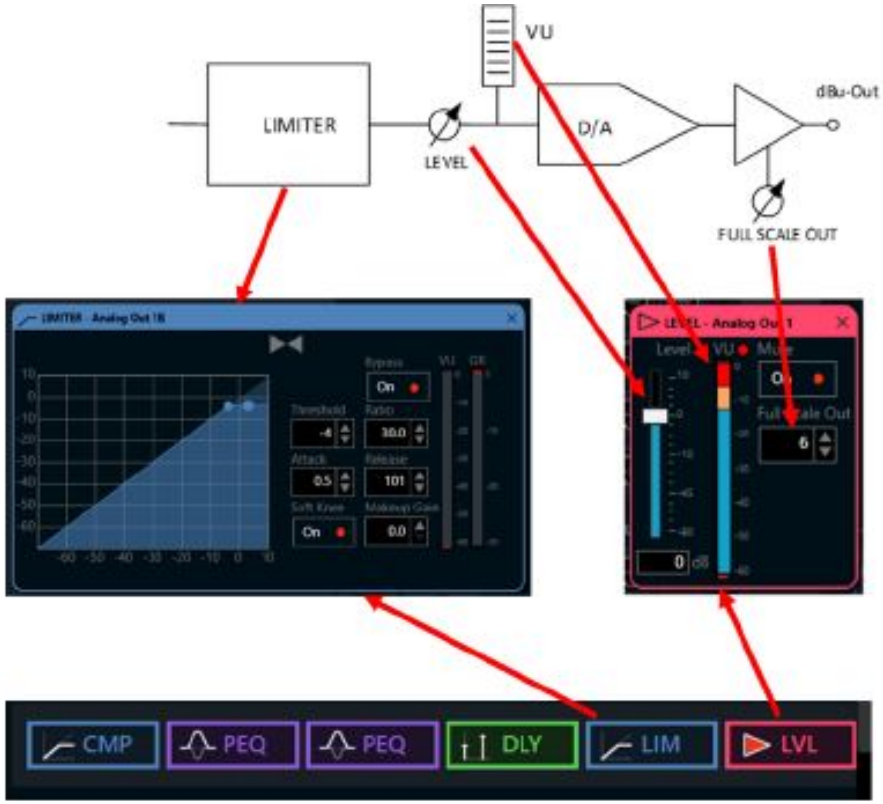
Audio Processing

The Signal Chain

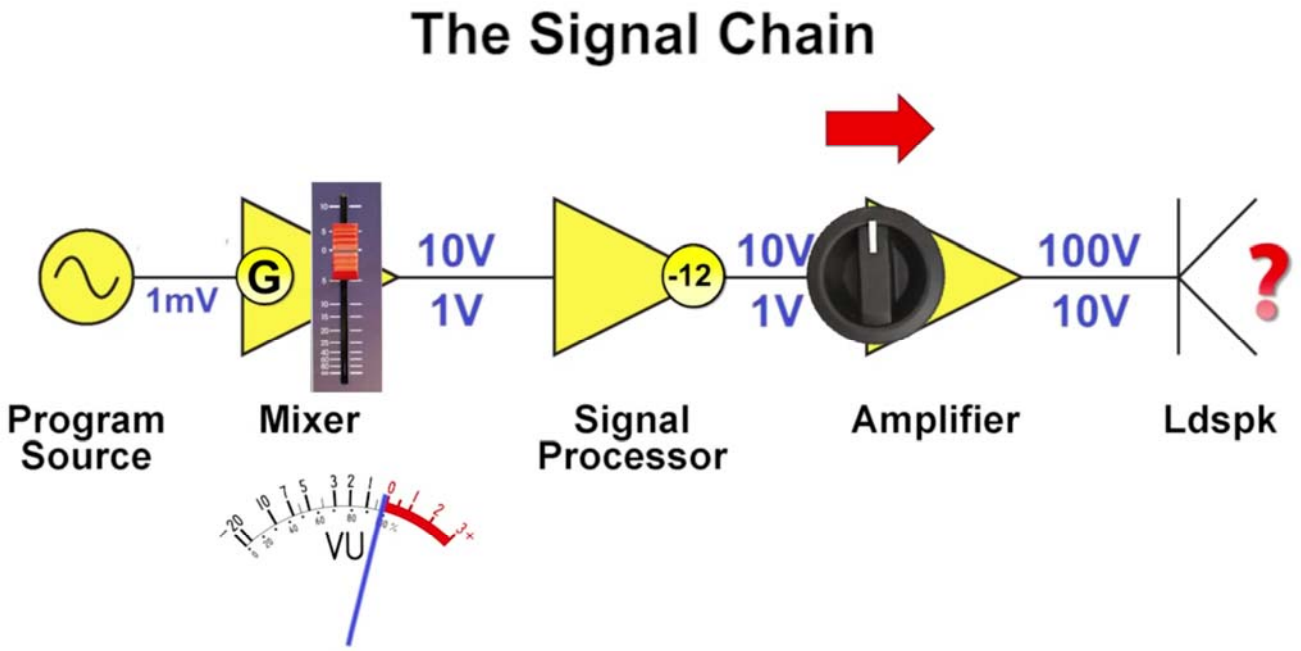


Audio Processing

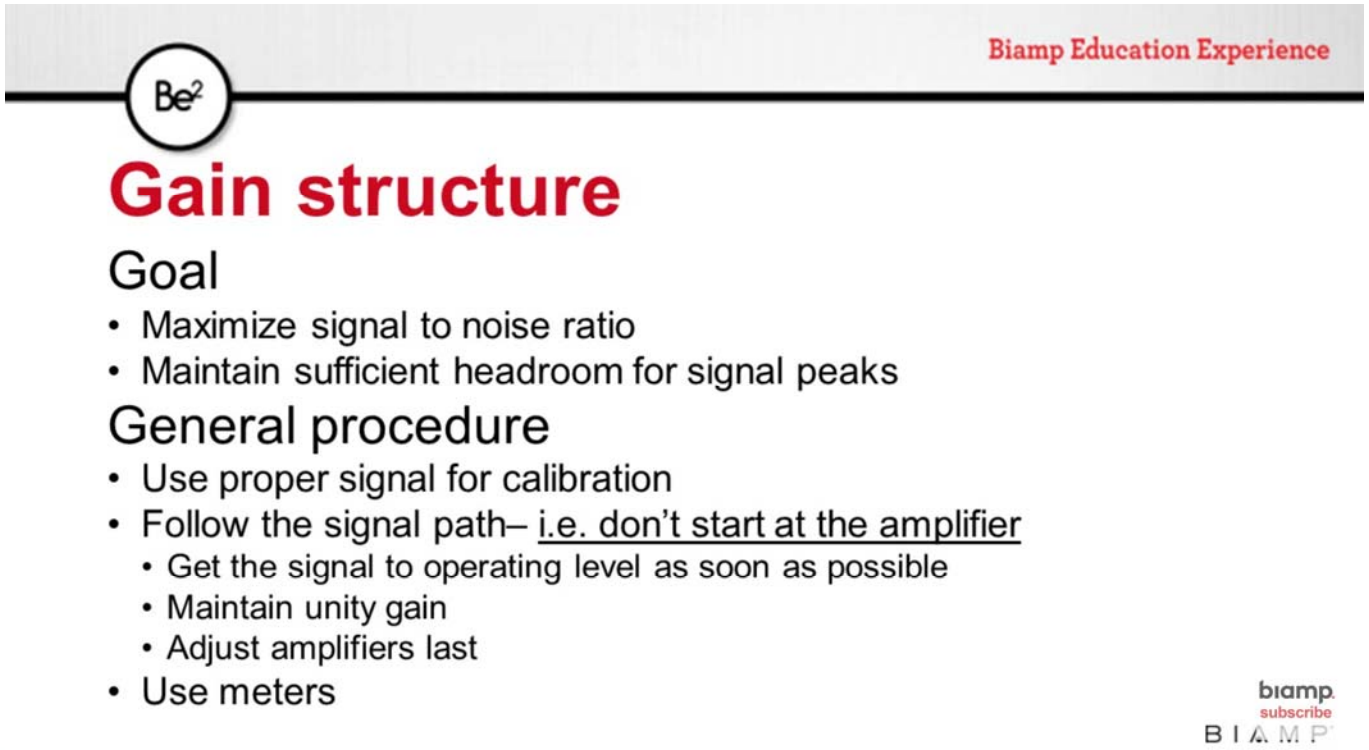




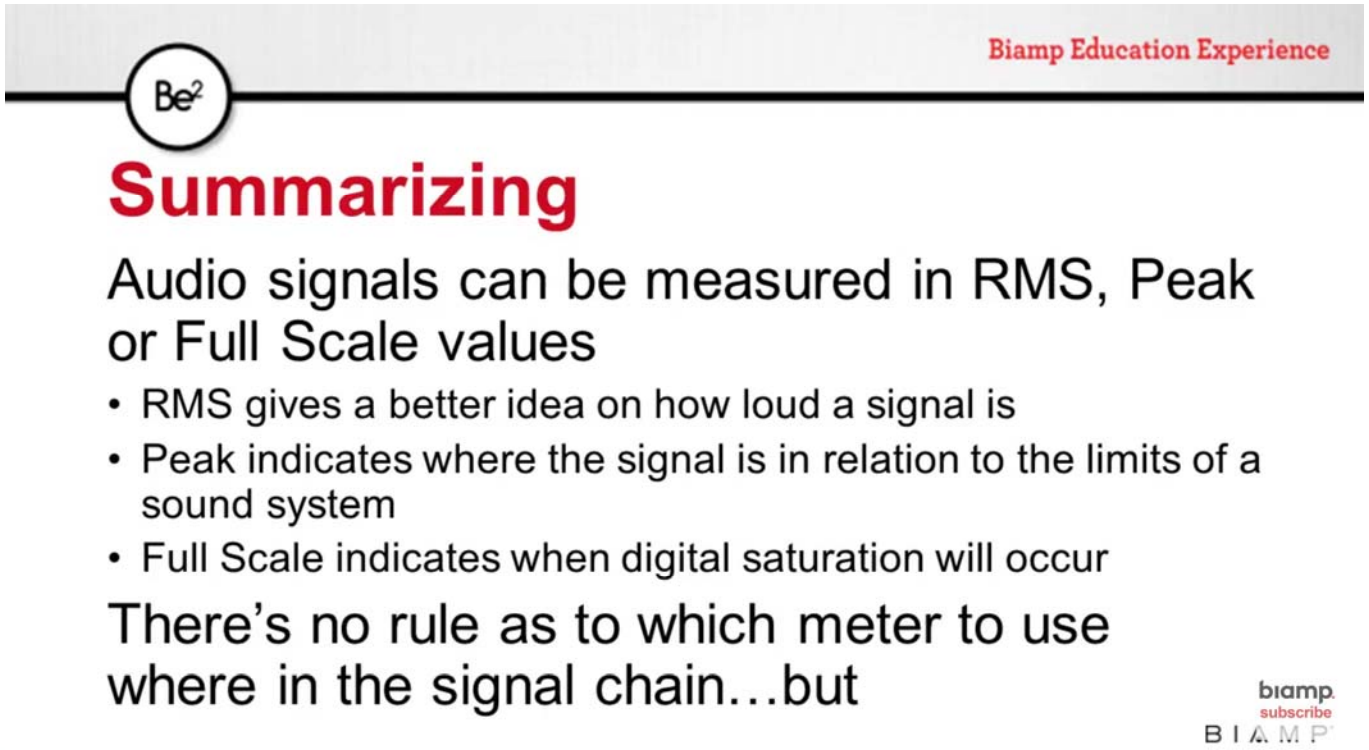
Audio Processing



Audio Processing



Audio Processing



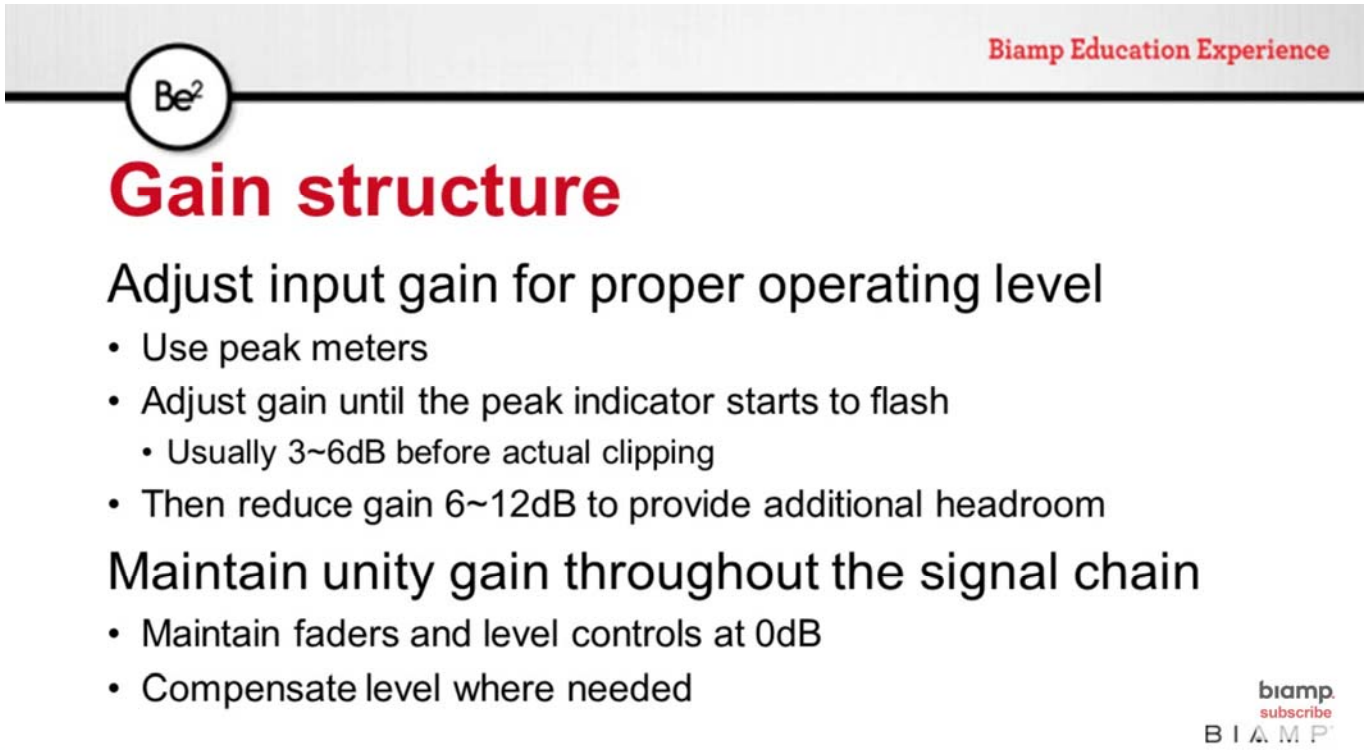
Meters

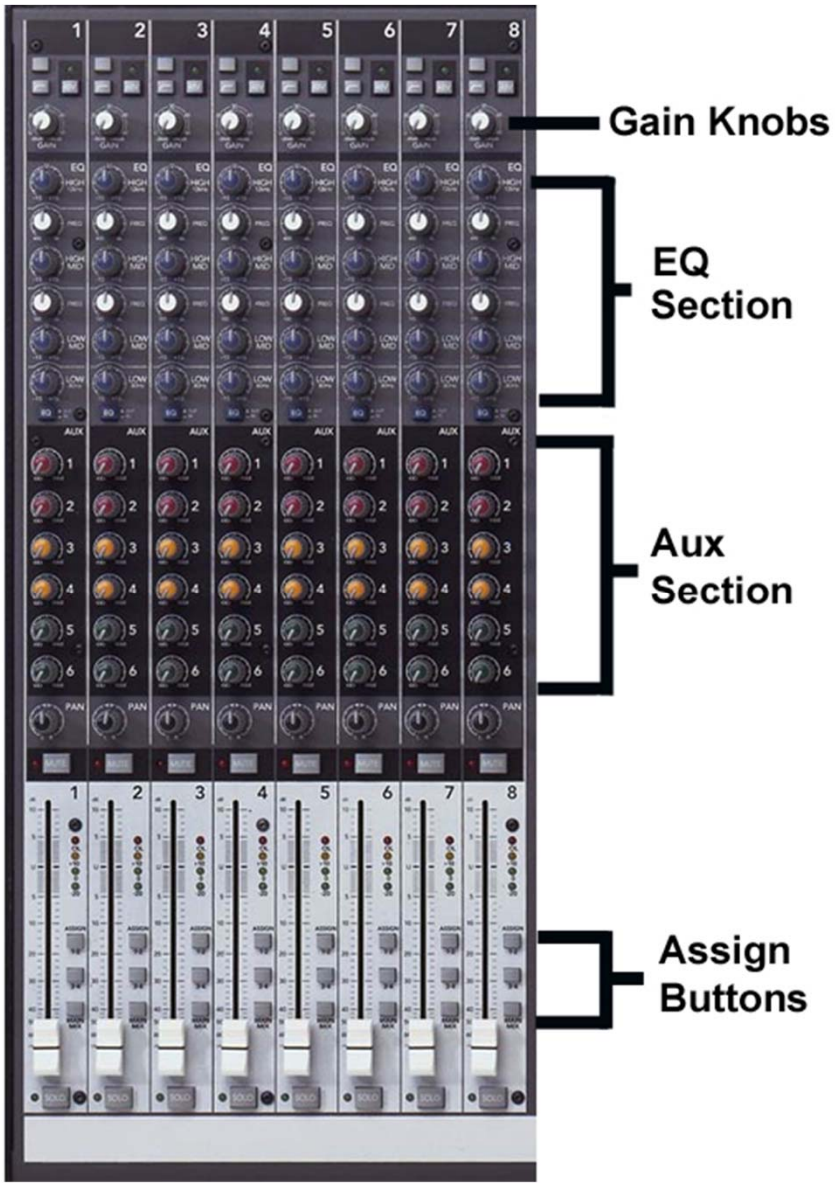
Scales compared

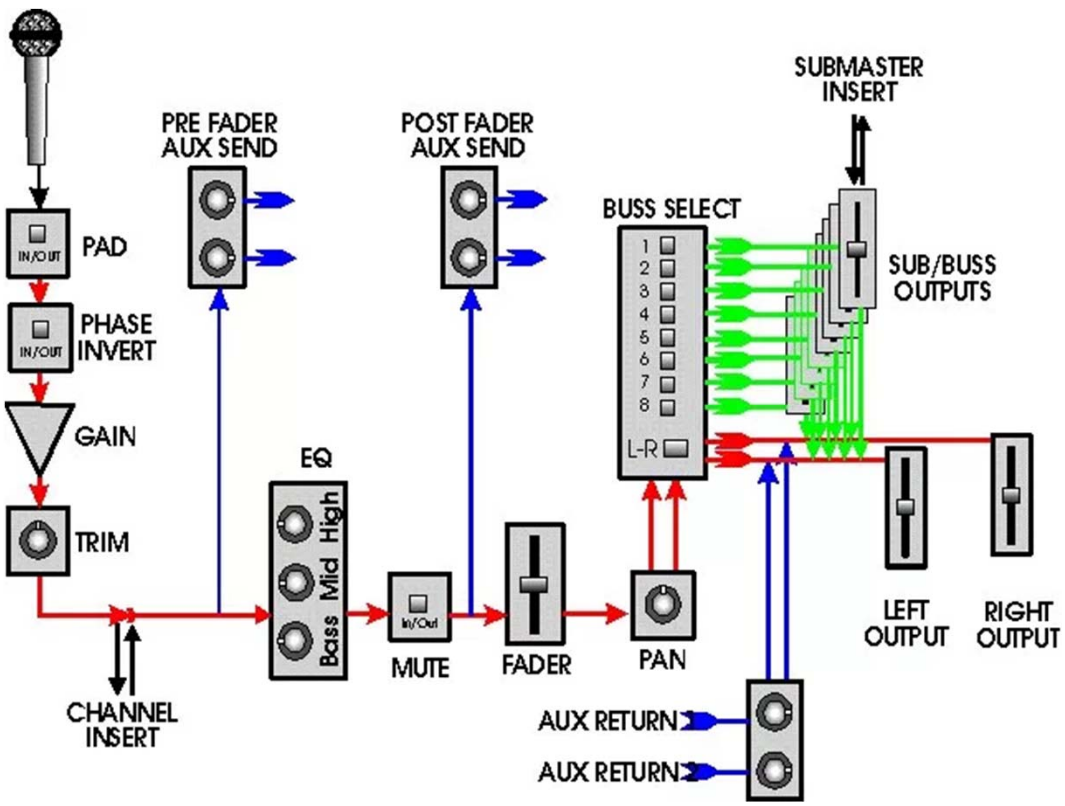
Volts	dBu	VU	dBfs (SMPTE RP155)
12.283V	24 dBu		0 dBfs
9.757V	22 dBu		-2 dBfs
7.750V	20 dBu		-4 dBfs
6.156V	18 dBu		-6 dBfs
4.890V	16 dBu		-8 dBfs
3.884V	14 dBu		-10 dBfs
3.085V	12 dBu		-12 dBfs
2.451V	10 dBu		-14 dBfs
1.947V	8 dBu		-16 dBfs
1.546V	6 dBu	+2	-18 dBfs
1.228V	4 dBu	0	-20 dBfs
0.976V	2 dBu	-2	-22 dBfs
0.775V	0 dBu	-4	-24 dBfs
0.616V	-2 dBu	-6	-26 dBfs
0.489V	-4 dBu	-8	-28 dBfs
0.388V	-6 dBu	-10	-30 dBfs
0.309V	-8 dBu	-12	-32 dBfs
0.245V	-10 dBu	-14	-34 dBfs
0.195V	-12 dBu	-16	-36 dBfs
0.155V	-14 dBu	-18	-38 dBfs
0.123V	-16 dBu	-20	-40 dBfs
97.6mV	-18 dBu		-42 dBfs
77.5mV	-20 dBu		-44 dBfs
61.6mV	-22 dBu		-46 dBfs
48.9mV	-24 dBu		-48 dBfs

biamp. subscribe BIAMP

Audio Processing




1 2 3 4 5 6 7 8
Gain Knobs
EQ Section
Aux Section
Assign Buttons

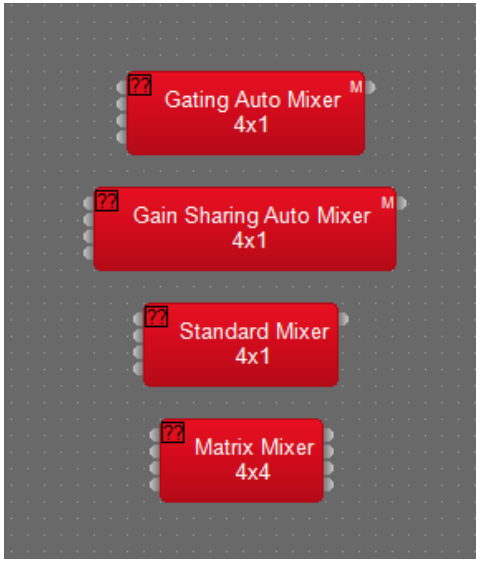

PAD
PHASE INVERT
GAIN
TRIM
CHANNEL INSERT
PRE FADER AUX SEND
EQ
High
Mid
Bass
MUTE
POST FADER AUX SEND
FADER
PAN
BUSS SELECT
L-R
SUBMASTER INSERT
SUB/BUSS OUTPUTS
LEFT OUTPUT
RIGHT OUTPUT
AUX RETURN
AUX RETURN

Audio Processing

- Mixer = adjust sound levels
- Equalizer = adjust frequencies (filter or enhance)
- Reverb and Delay = adjust for reflections
- Compressors & Limiters = adjust frequency range
- Gates and Expanders = eliminate low noise

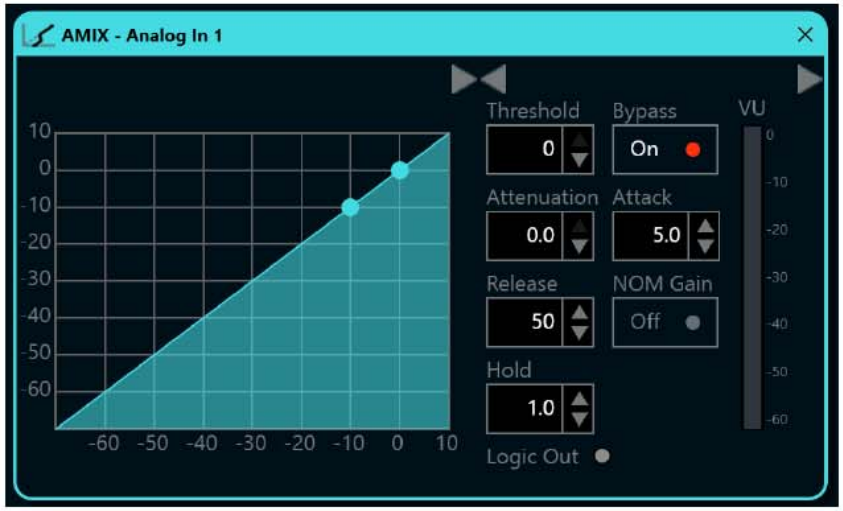
Audio Processing

– Mixer = adjust sound levels



Automatic mixer suggested settings:

- Threshold: -40 dB
- Attenuation: -40 dB
- Attack: 1.0 ms
- Release: 50 ms
- NOM Gain: On
- Hold: 1.0 seconds
- Last Mic: Last
- NOM Limit: 4



Audio Processing

– EQ

– EQ – Starting Points

Vocals

- < 200 Hz: Cut for clarity
- 150 Hz – 600 Hz: Warmth
- 500 Hz – 2 kHz: Nasal (Cut to eliminate)
- 3 kHz – 5 kHz: Sibilance (Cut to eliminate)
- 1.5 kHz – 8 kHz: Clarity and Presence
- 10 kHz+: Airy (Breathy)

– EQ

First, understand that prerecorded program sources like Blu Rays, DVDs, and music CDs have been optimized as audio sources when produced

Therefore, other than gain, these sources do not need any other input processing

If these don’t sound good through the system loudspeakers, look to improper equalization on the output processing strip feeding the loudspeakers

– EQ

Input source parametric equalization is only for

- Microphone
- Telephone
- CODEC optimization

Fixing its response if:

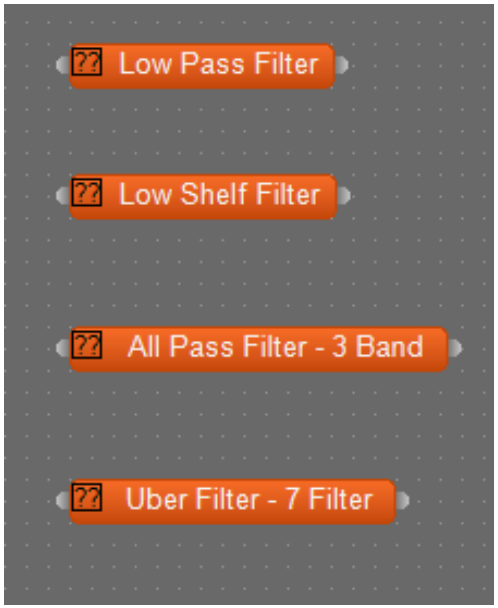
It is too thin or tinny

Has too much bass

To notch out feedback ringing in the case of local mics

Audio Processing

– Filters



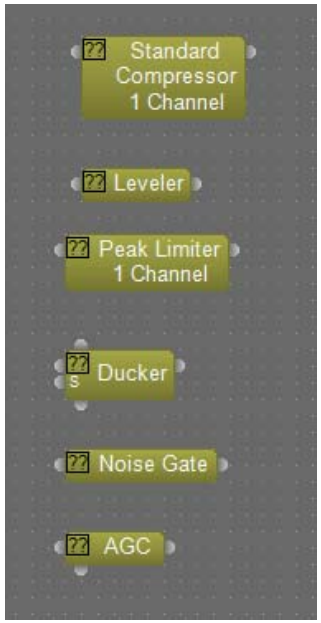
Audio Processing

– Filters

Filters
• Use High Pass Filters on speech microphones to reduce rumble • Use Low Pass Filters on conferencing microphones to reduce noise and reflections in problematic rooms • Boost to 2KHz range for enhanced speech intelligibility • User higher "Q" filters to remove unwanted resonances

Audio Processing

– Dynamics



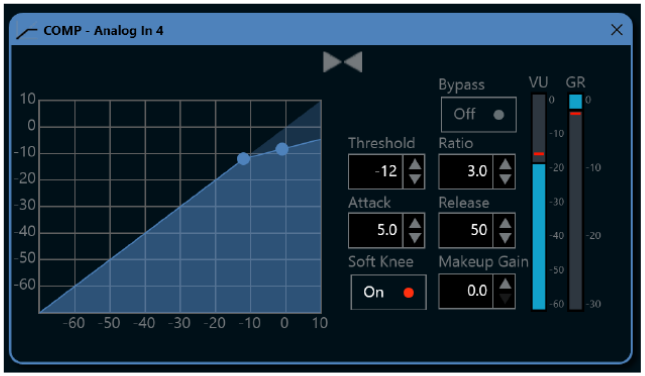
Input CoMPression (CMP):

A compressor is used to reduce the level of overly loud signal sources

Since recorded and broadcast sources are already level-limited, only microphone, telephone and CODEC conference sources can benefit from compression

A good rule of thumb for setting parameters of an Avia input compressor is:

- Threshold: -12 dB, Ratio: 3:1
- Attack: 5.0 ms, Release: 50 ms
- Soft knee: On, Makeup gain: Off



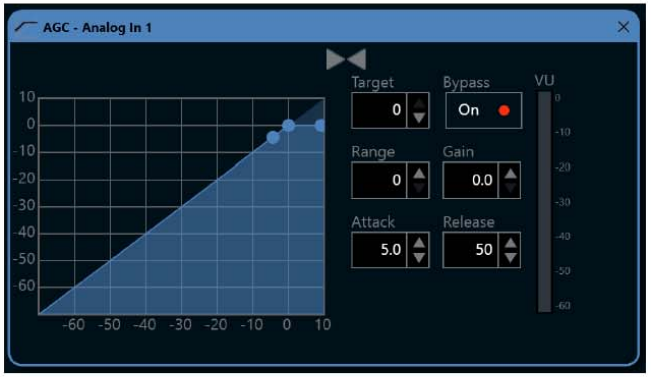
Input Automatic Gain Control (AGC):

Automatic Gain Control (AGC) is generally used in broadcasting to limit the dynamic range of a signal source whose nominal level varies too much

It is tempting to employ AGC for that soft talker who is afraid to speak loudly into their mic, and isn't loud enough in the local loudspeakers

But often feedback will occur before they are loud enough

AGC should only be used if absolutely necessary, and only on remote outputs like far-end teleconferencing telephones & CODECs or recording feeds



CRESTRON

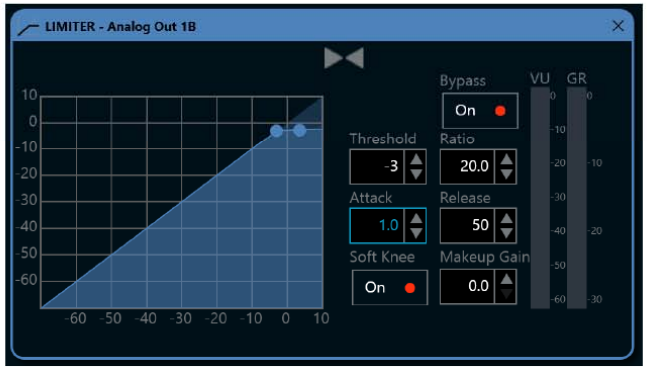
Output LIMiter (LIM):

To prevent excessive output levels:

- Threshold: -3 dB
- Ratio: 20:1
- Attack: 0.1 ms
- Release: 50 ms
- Soft knee: ON
- Makeup Gain: 0 dB

For a 14-dB crest factor (headroom):

- Threshold: -10 dB
- Ratio: 10:1
- Attack: 0.1 ms
- Release: 50 ms
- Soft knee: ON
- Makeup gain: +6 dB



CRESTRON

Audio Processing

Dynamics

• Use limiters on outputs to amplifiers and recording devices to prevent overdriving
• Use compression on microphones:
  ○ 2:1 to 4:1 on conversational speech
  ○ 4:1 to 6:1 on lecture/presentation
  ○ 4:1 or greater on dynamic instruments
• Use gates on conferencing microphones when automixing is not used
• Use AGC on telephone and recording device feeds

Audio Processing

Automixing
• Use gated automixing for conferencing • Use gain sharing automixing for panel discussions and recording applications

General Procedures
• Equalize using a "subtractive" process (use cut rather than boost) • Understand the bandwidth of any content • Know loudspeaker frequency response and power handling capabilities • Perform delay alignments before performing equalization • Understand the target levels for your application • Understand how to accurately use your test equipment • **Practice**

Audio Processing

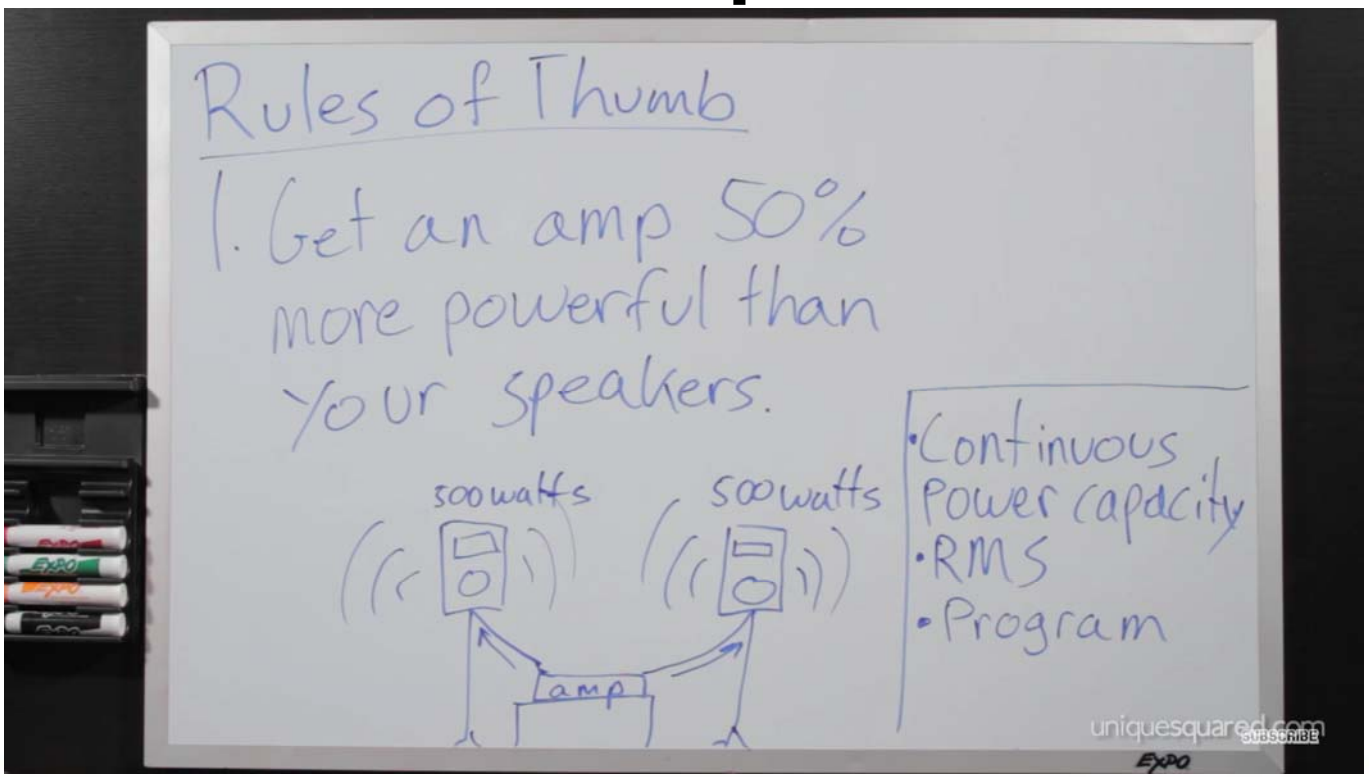
Room Acoustics

Reflection

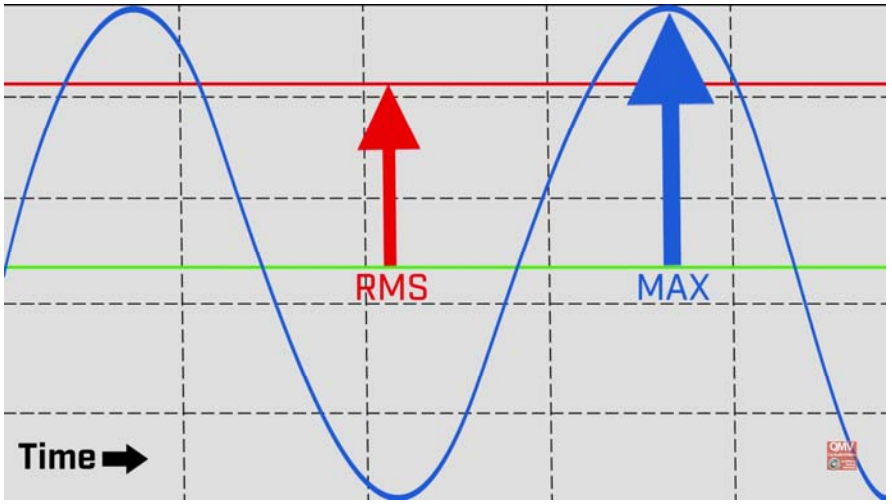
Absorption

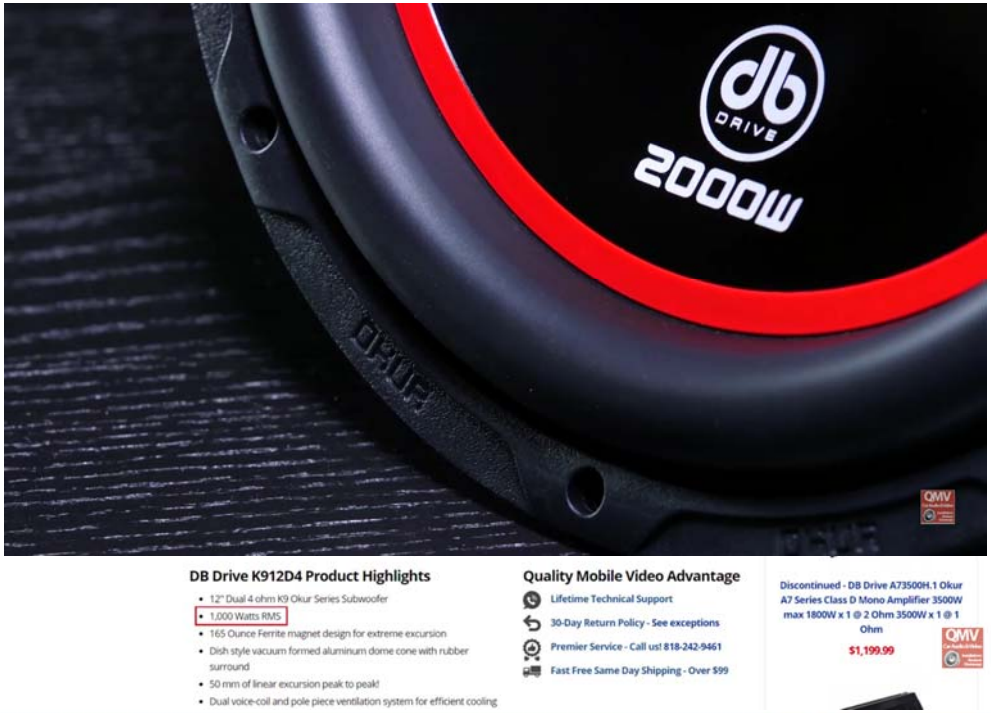
Diffusion

Audio Amplifiers



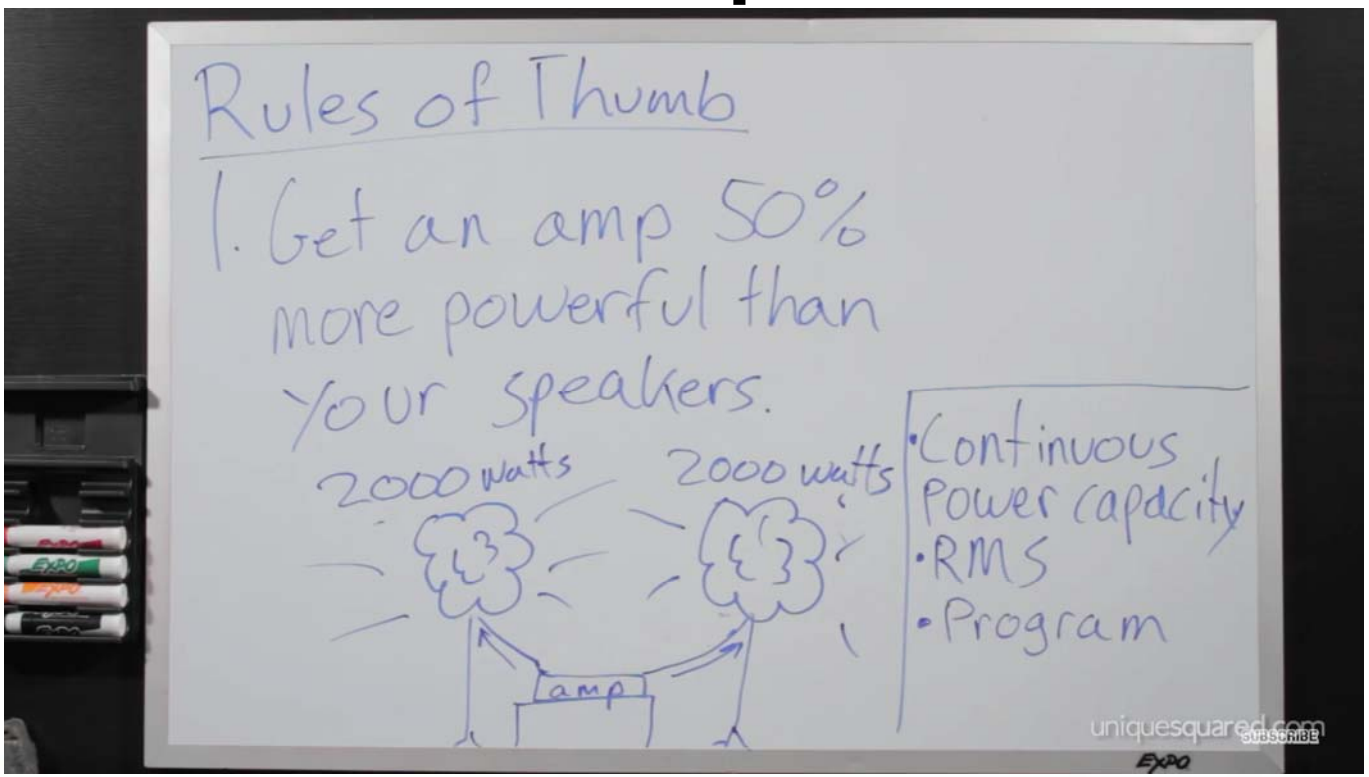
Audio Amplifiers



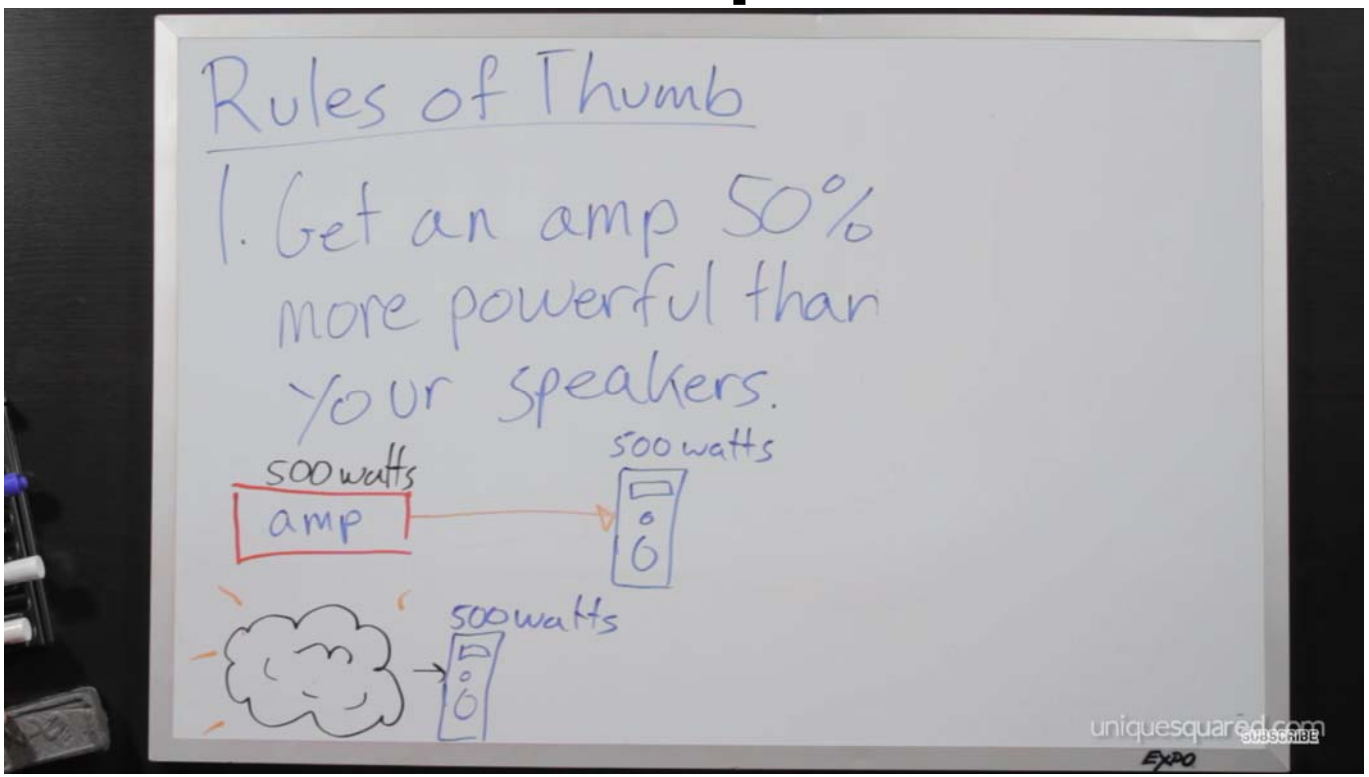


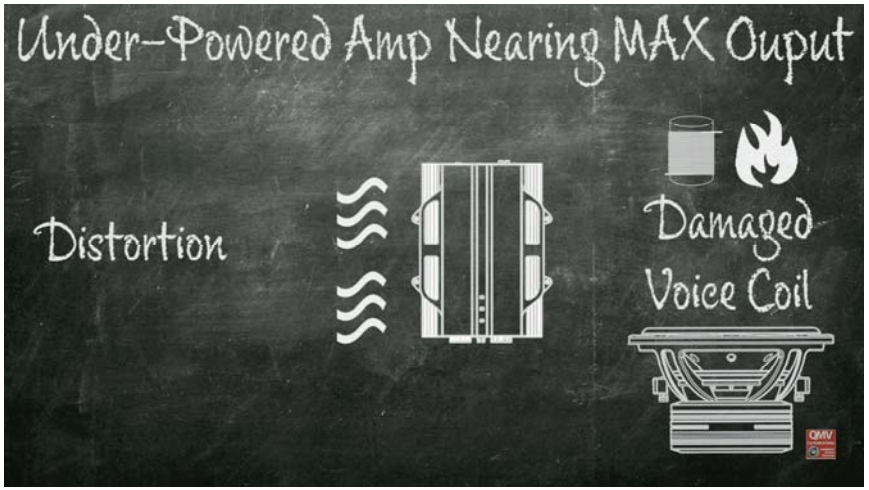
Audio Amplifiers

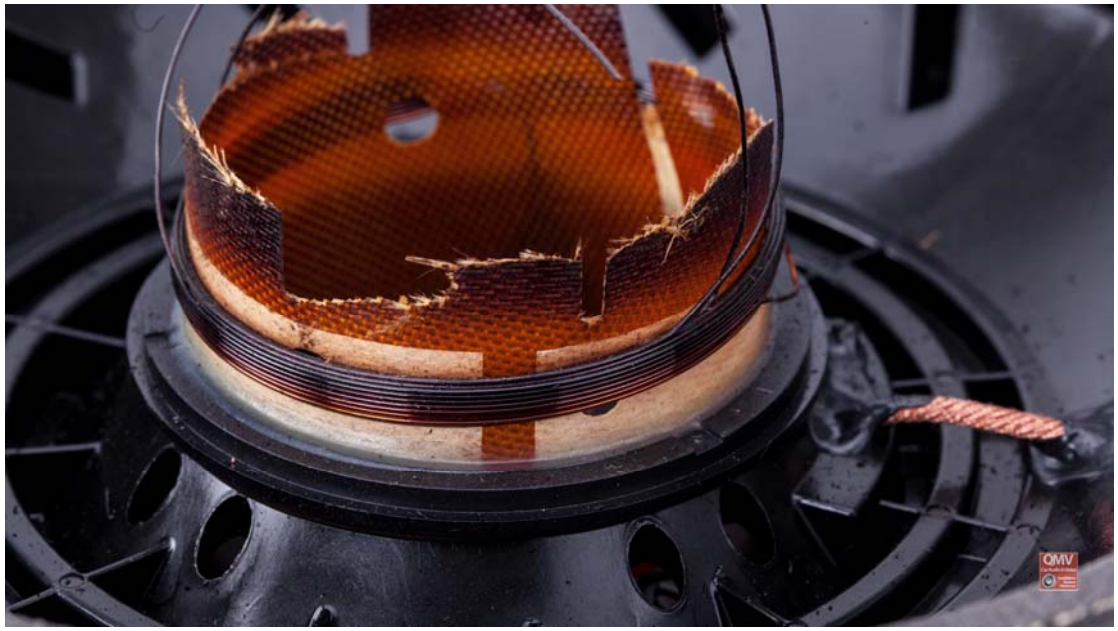
Audio Amplifiers



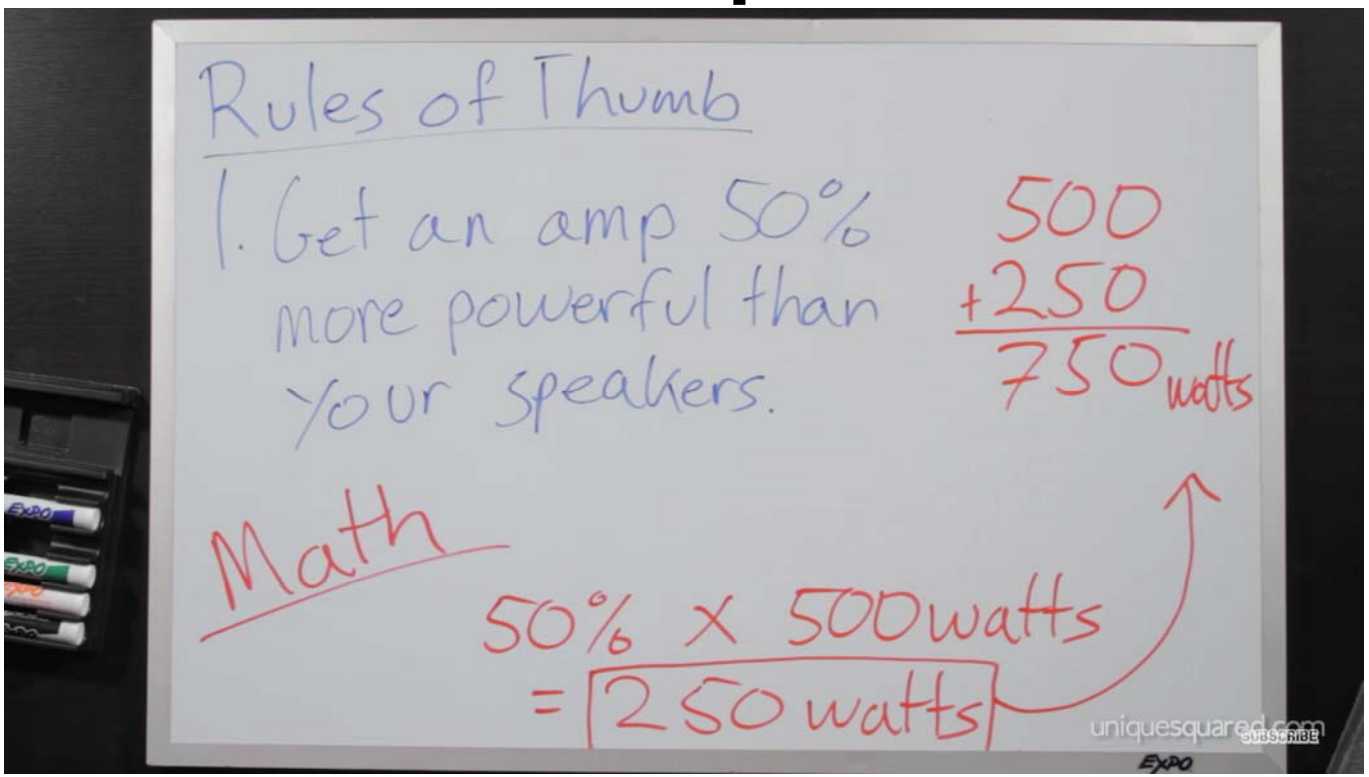
Audio Amplifiers

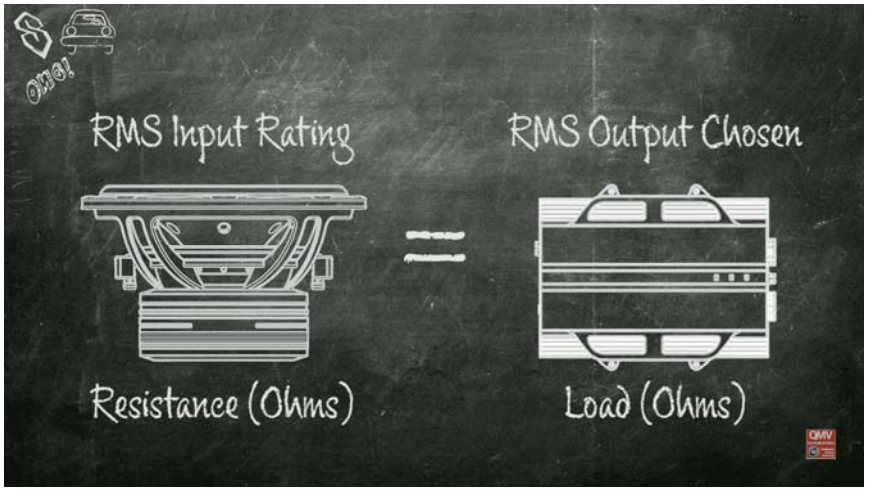


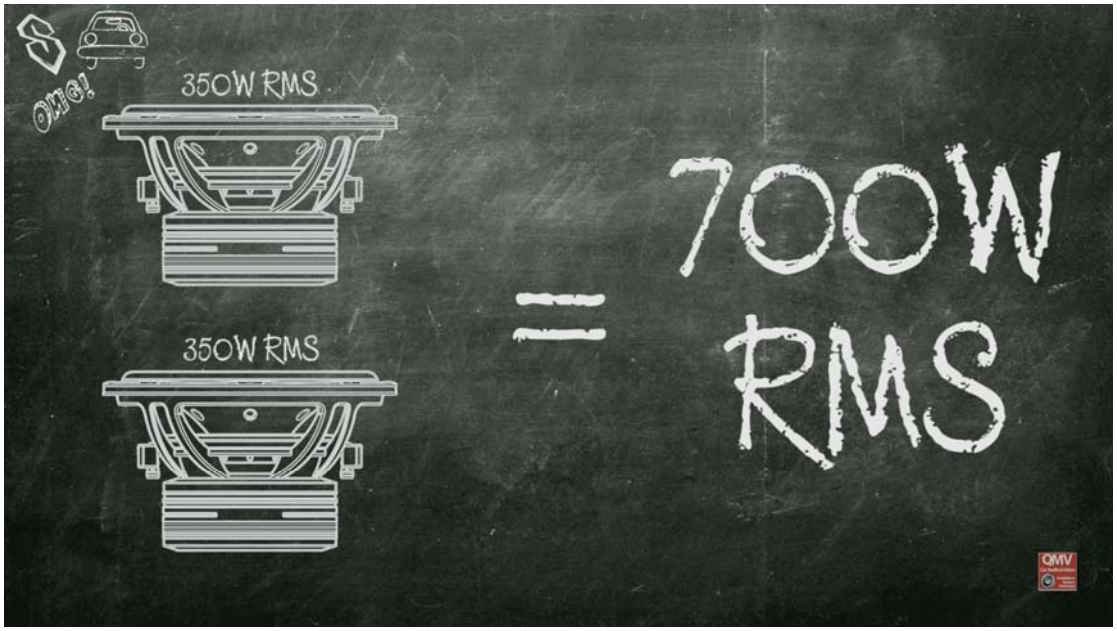


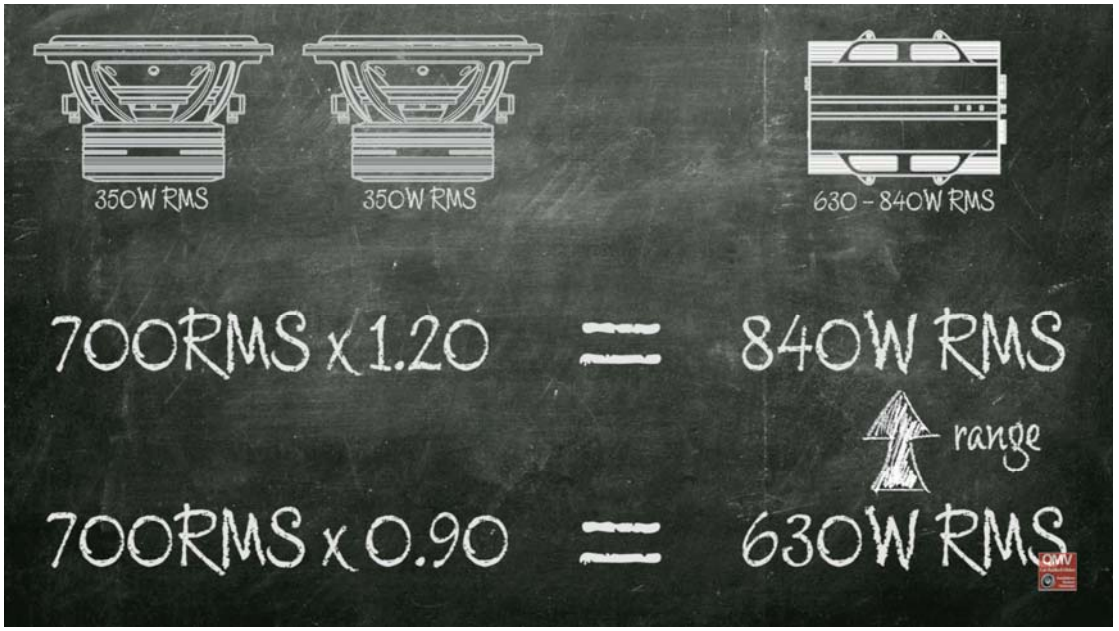


Audio Amplifiers

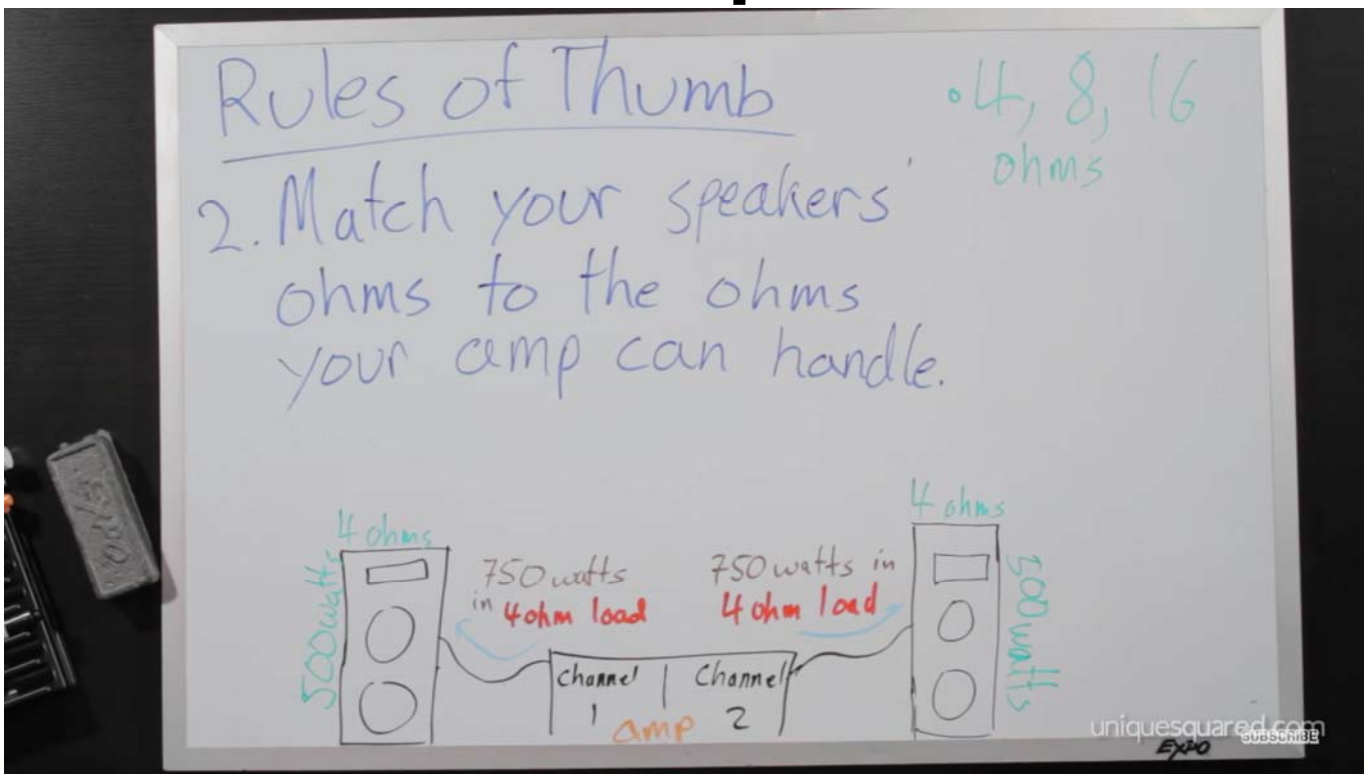








Audio Amplifiers



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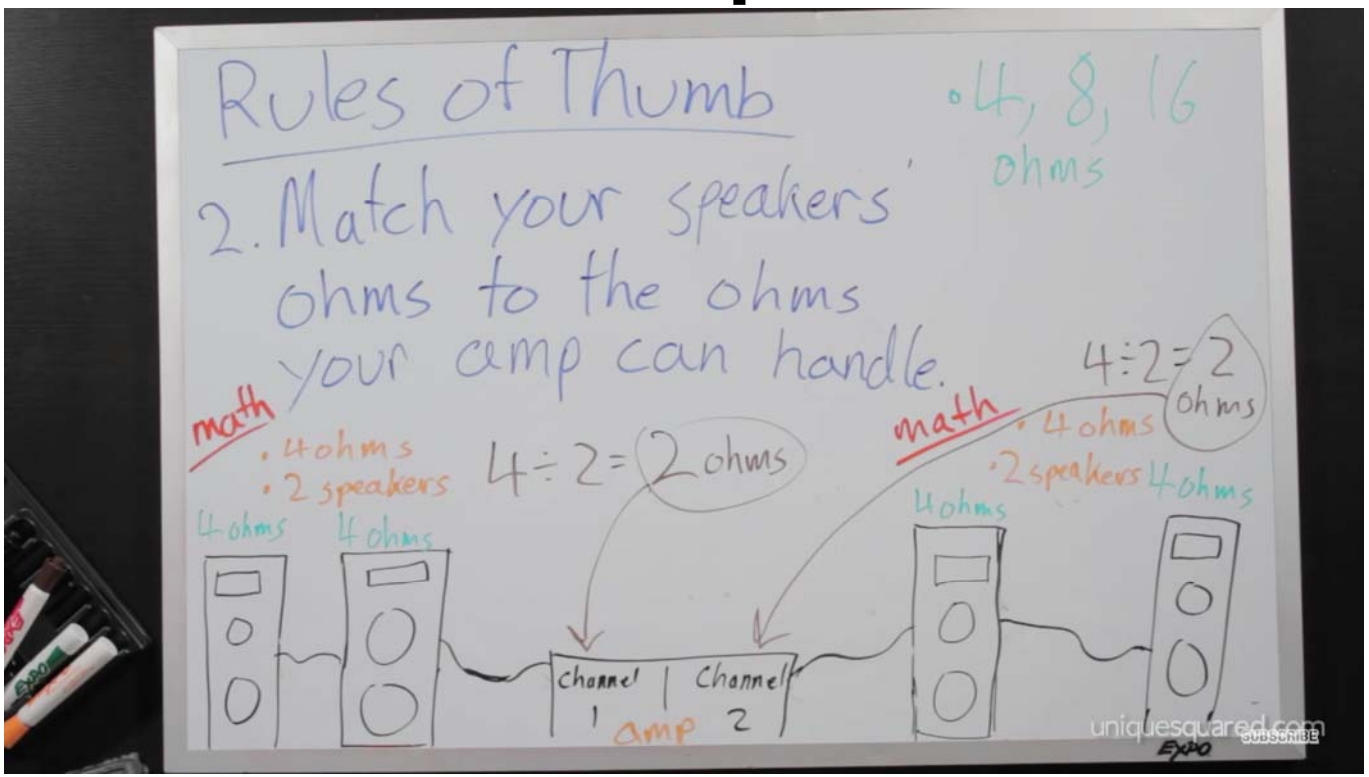
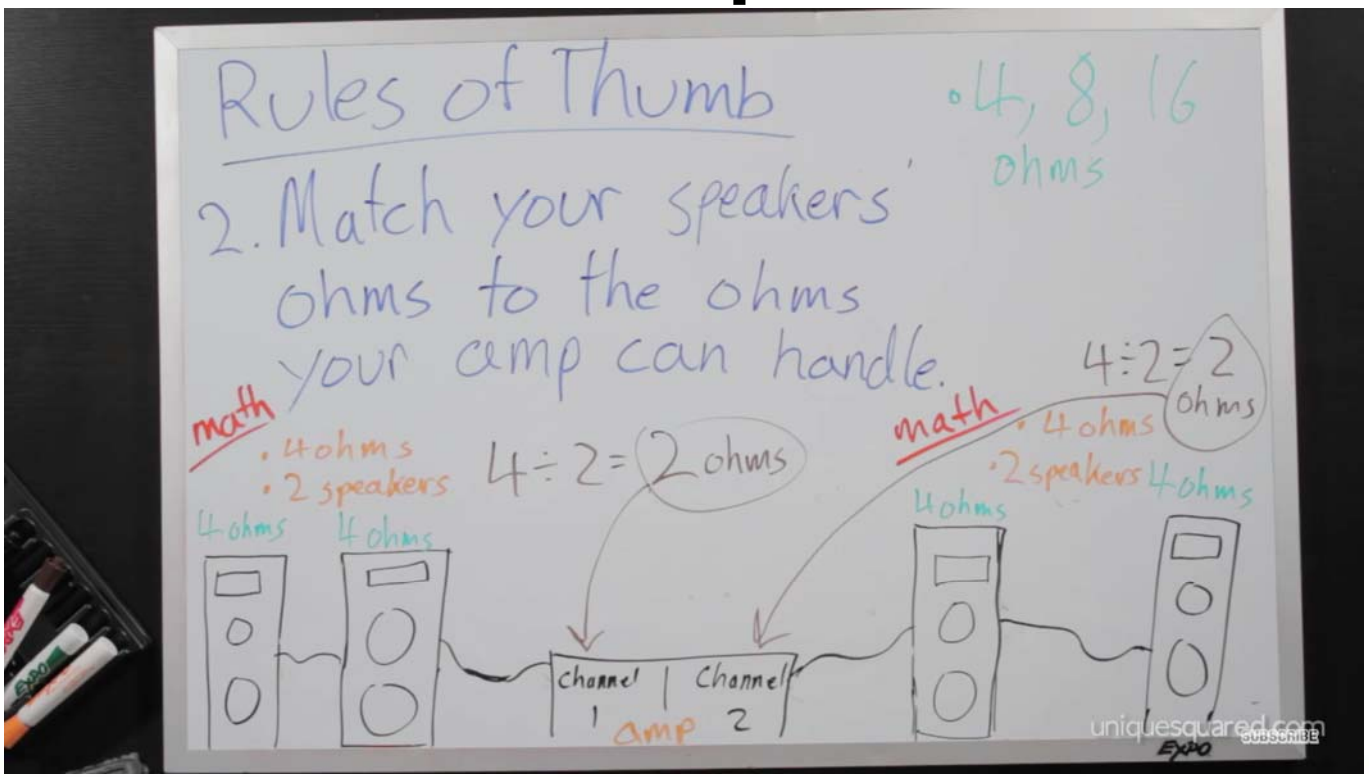
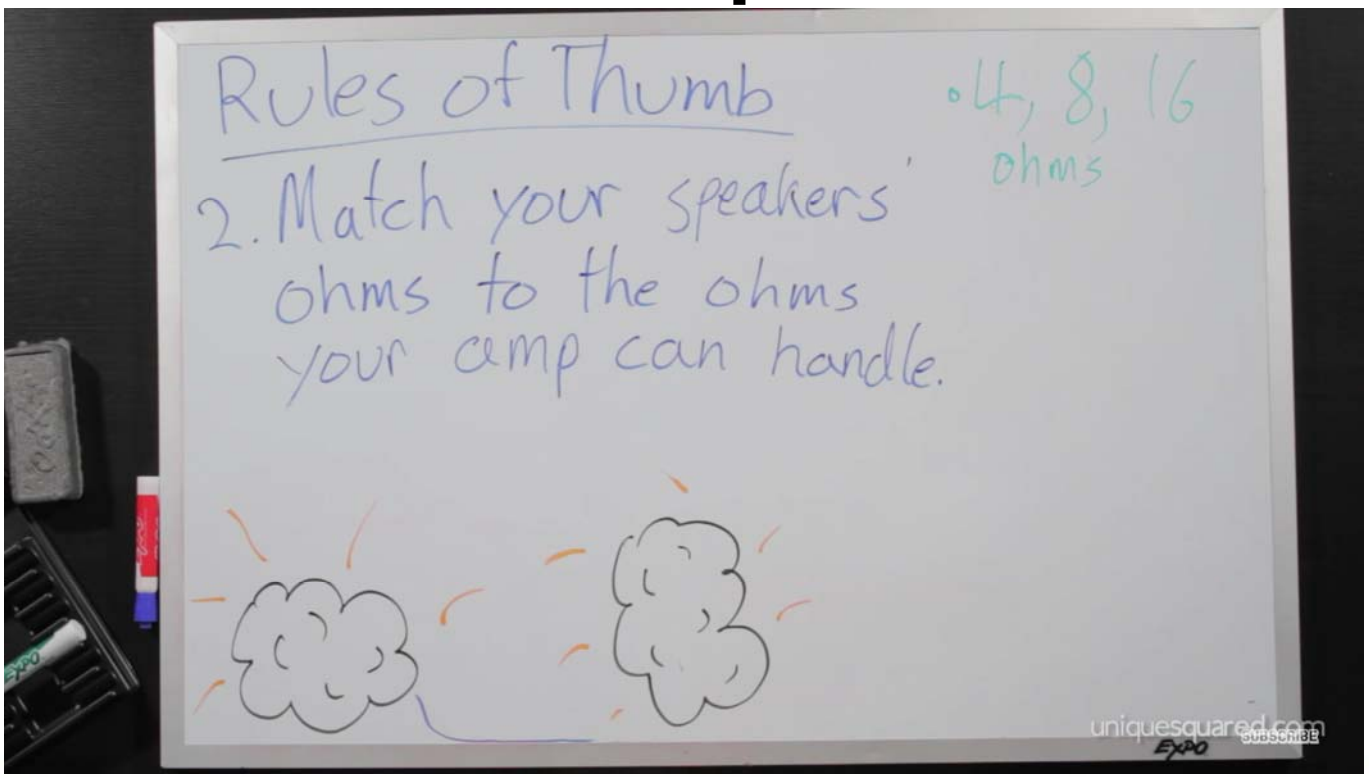


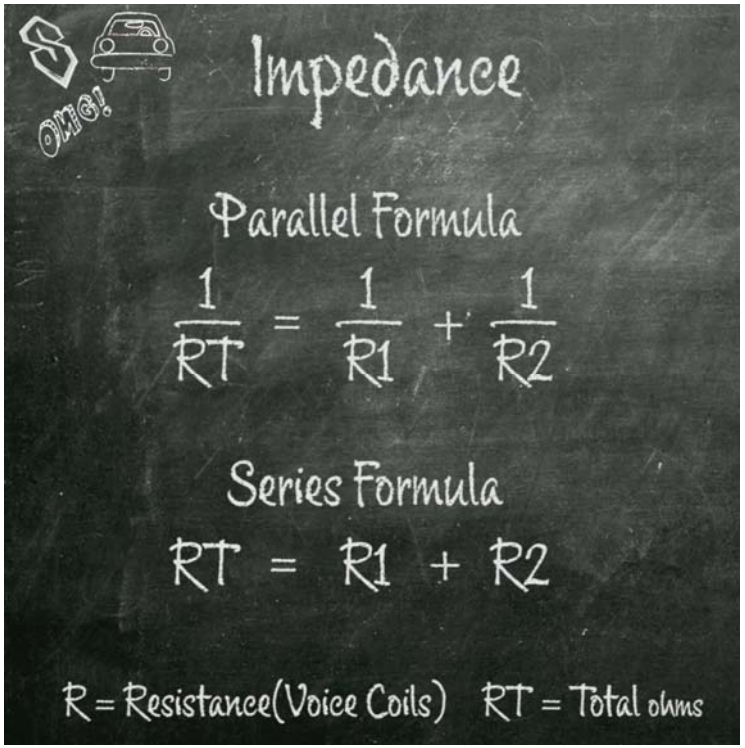
Audio Amplifiers

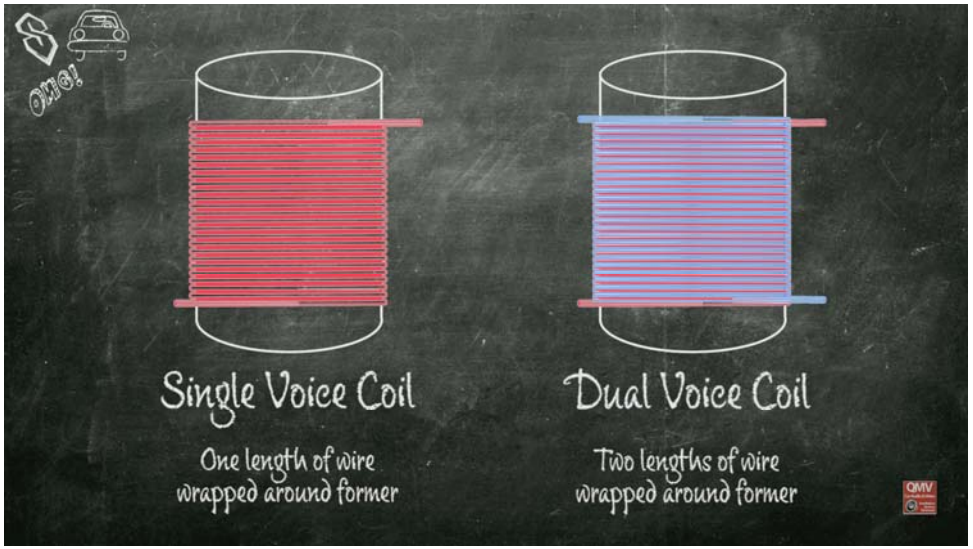


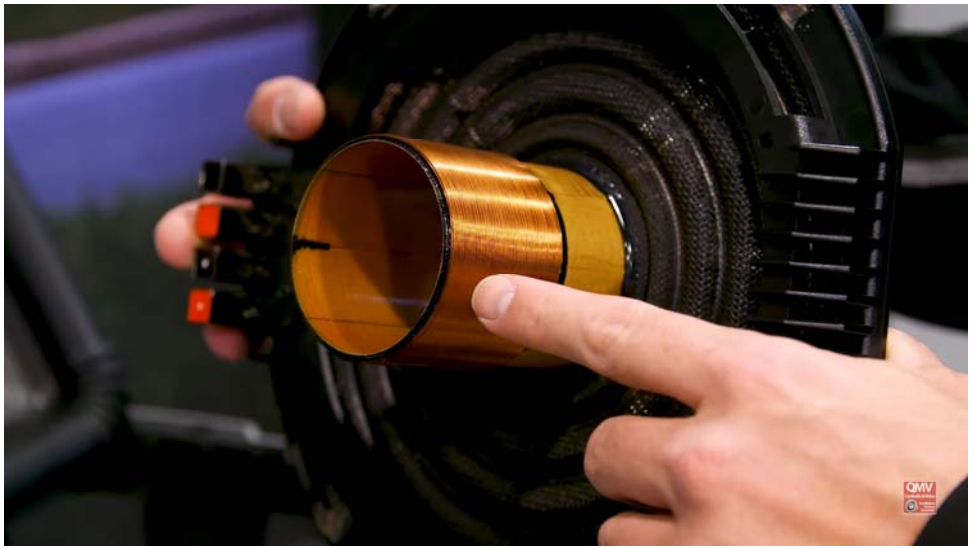
Audio Amplifiers

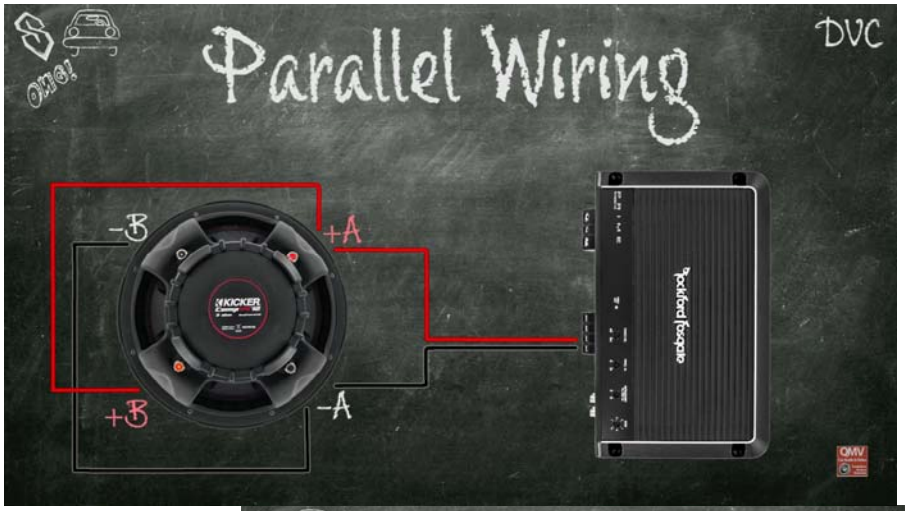


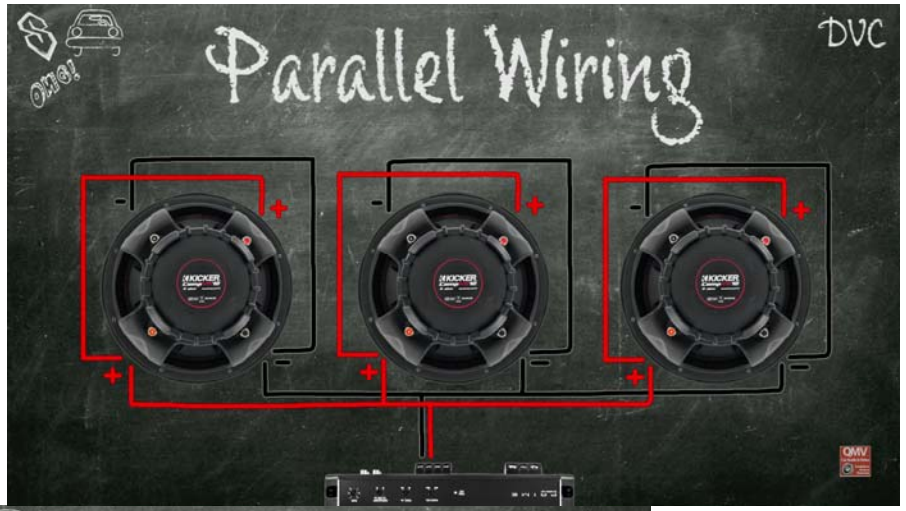
Audio Amplifiers

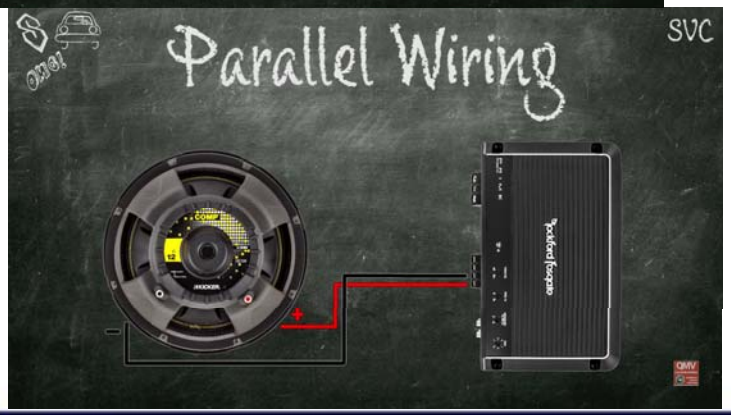


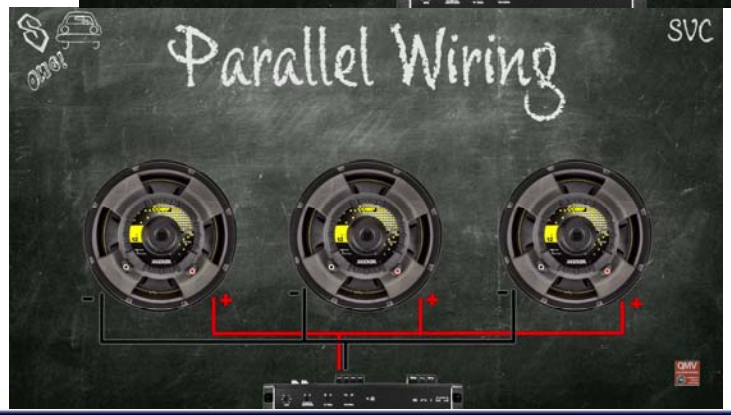


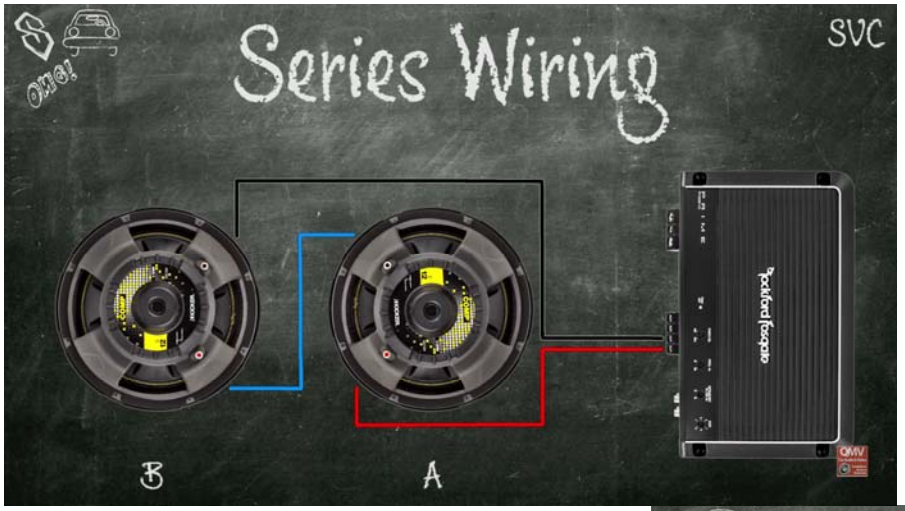


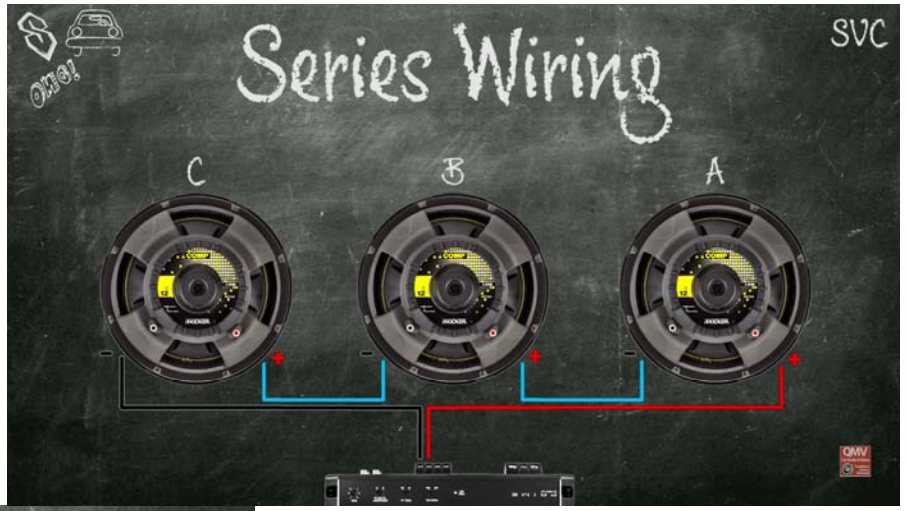


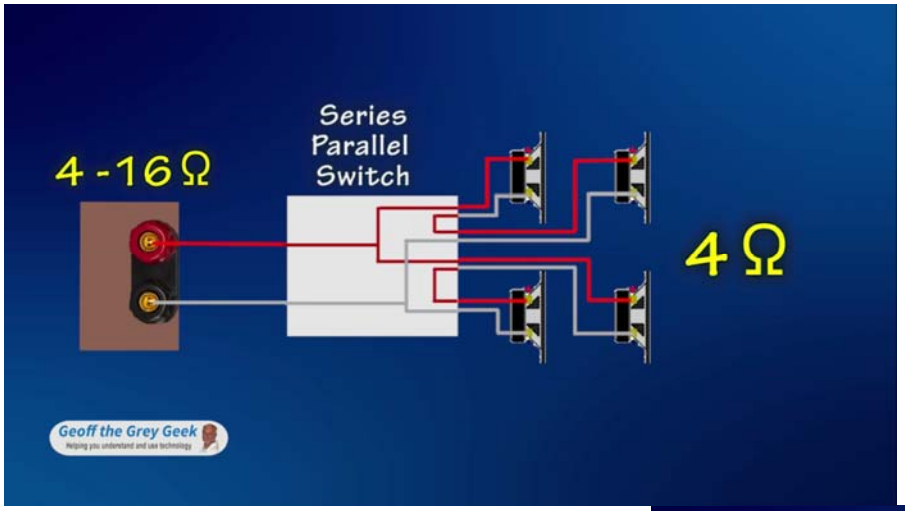


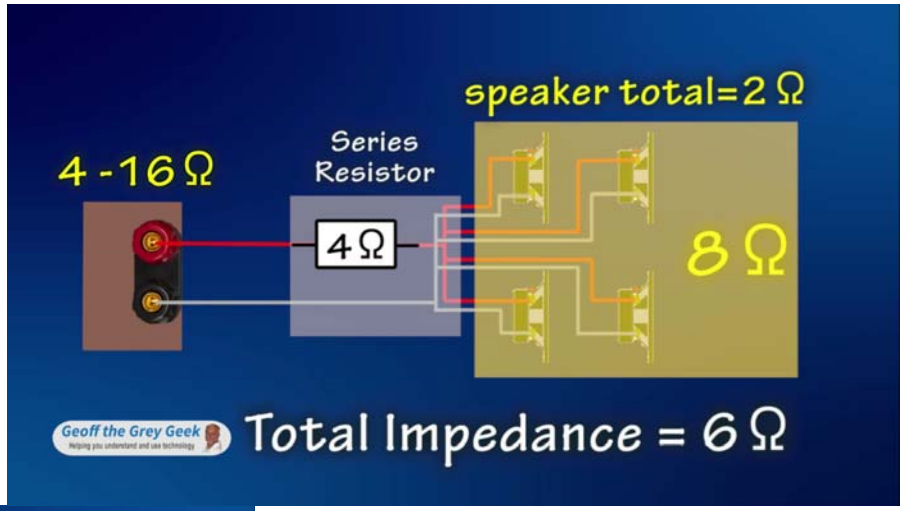


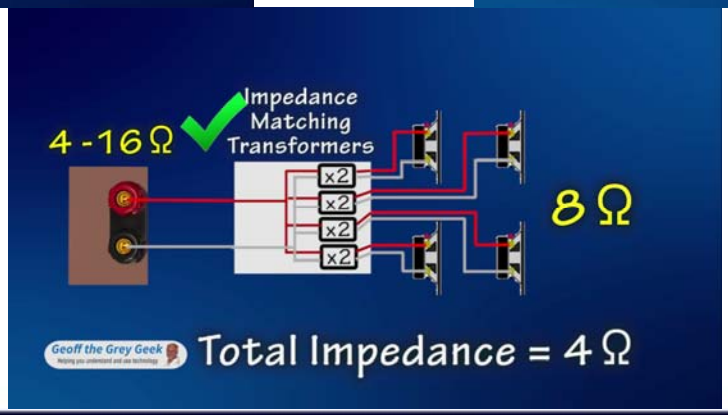


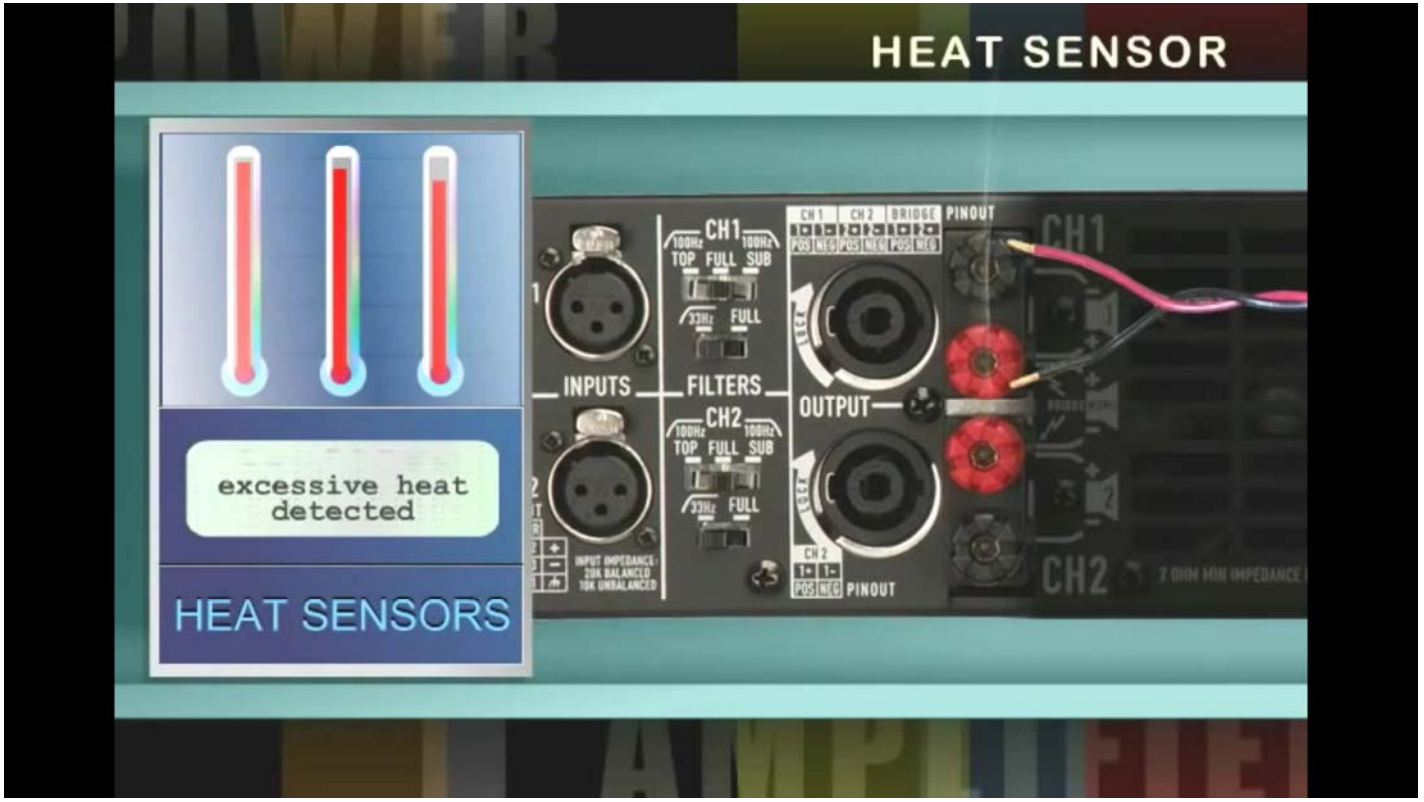


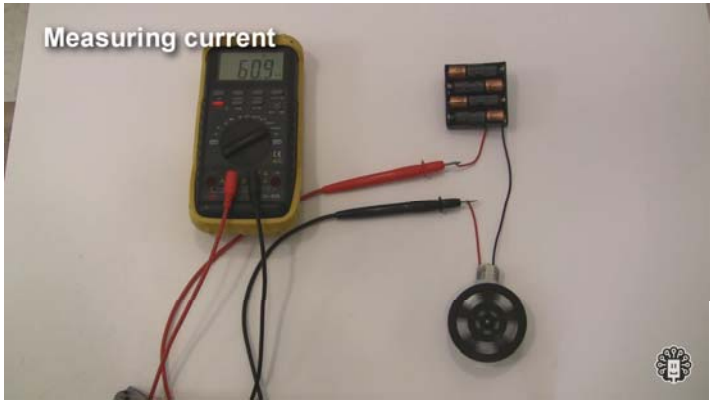


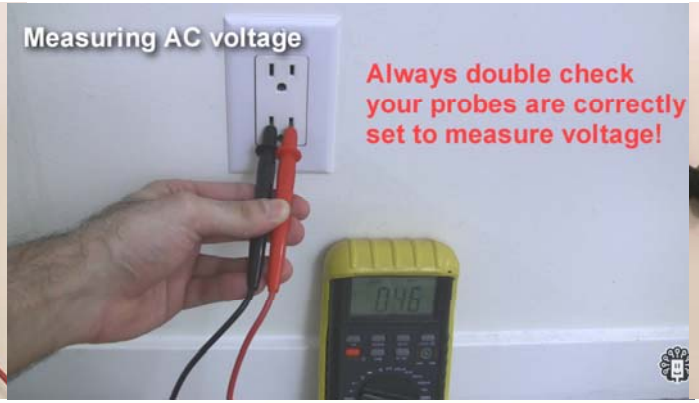




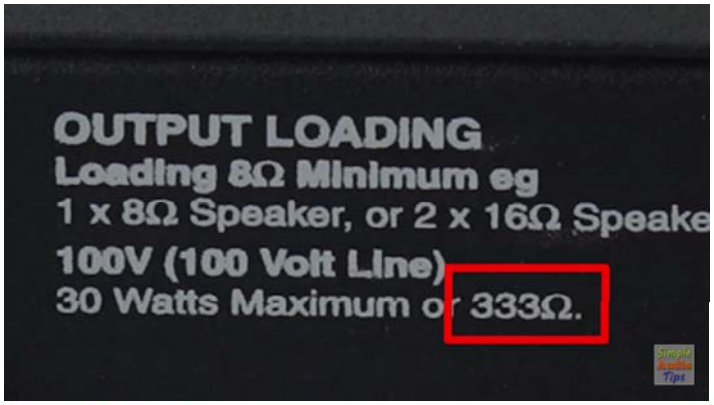


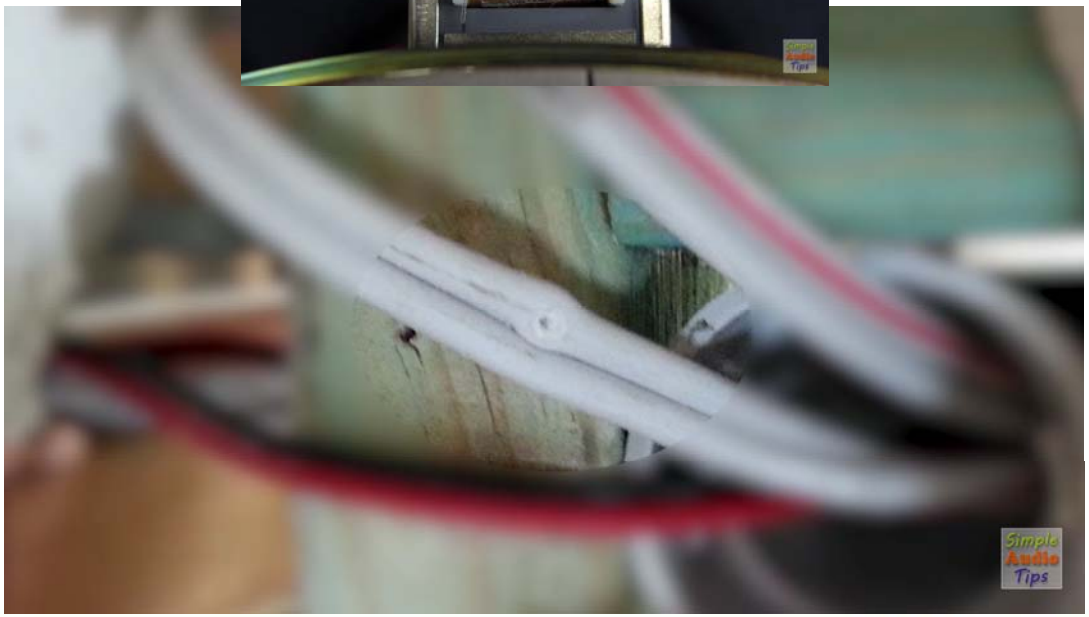







Standard
meter (DC)
Impedance
meter (AC)
OFF
ON
AUDIO IMPEDANCE METER
Simple
Audio
Tips
2018 BICSI WINTER
CONFERENCE & EXHIBITION
Orlando, FL | February 4-8
E.R.I.C.
Low Voltage Services





MID POWER AMPLIFIER

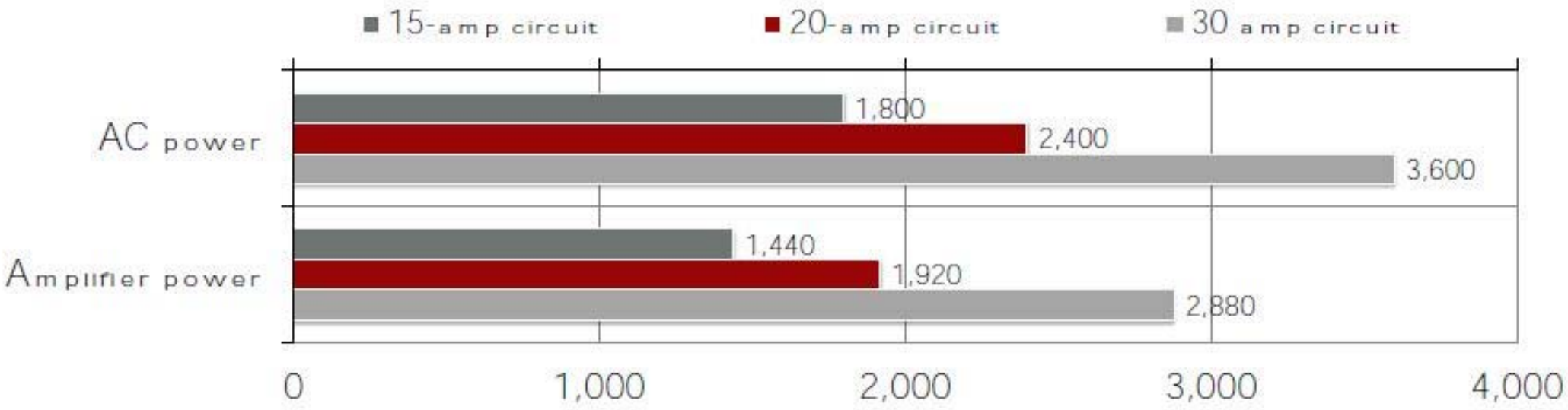
HIGH POWER AMPLIFIER

REMEMBER

THE POWER AMPLIFIER IS DEPENDENT ON THE AC POWER SOURCE TO PRODUCE THE POWER IT WAS DESIGNED TO DELIVER

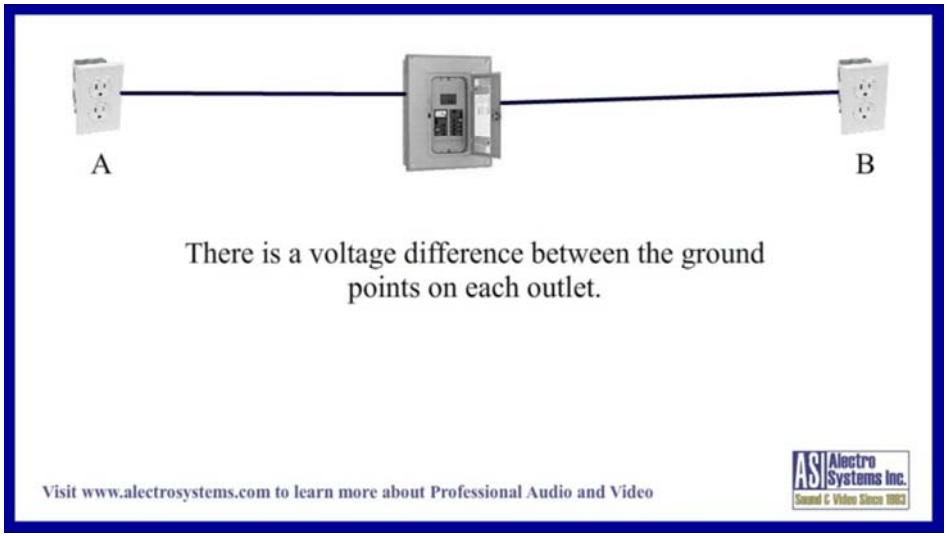
Amplifier sizing:

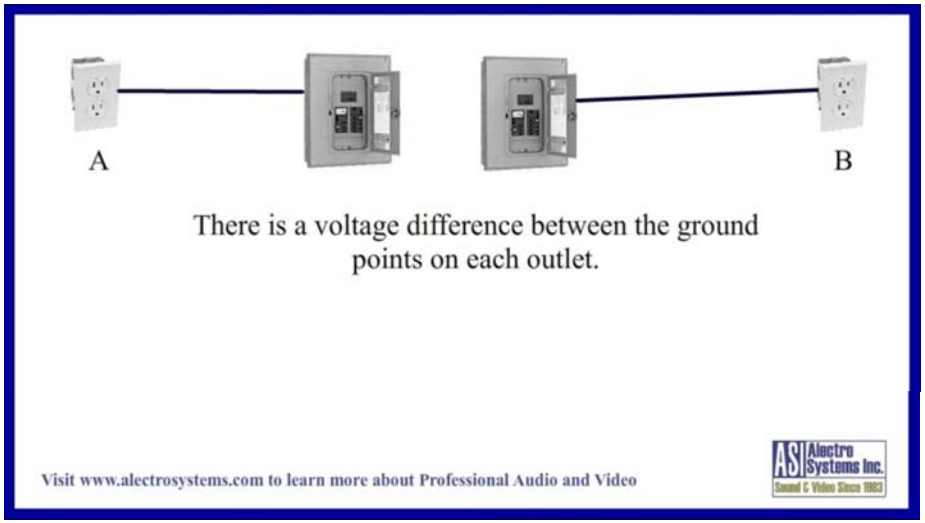
Class D amplification is fairly efficient, so given 80% efficiency:

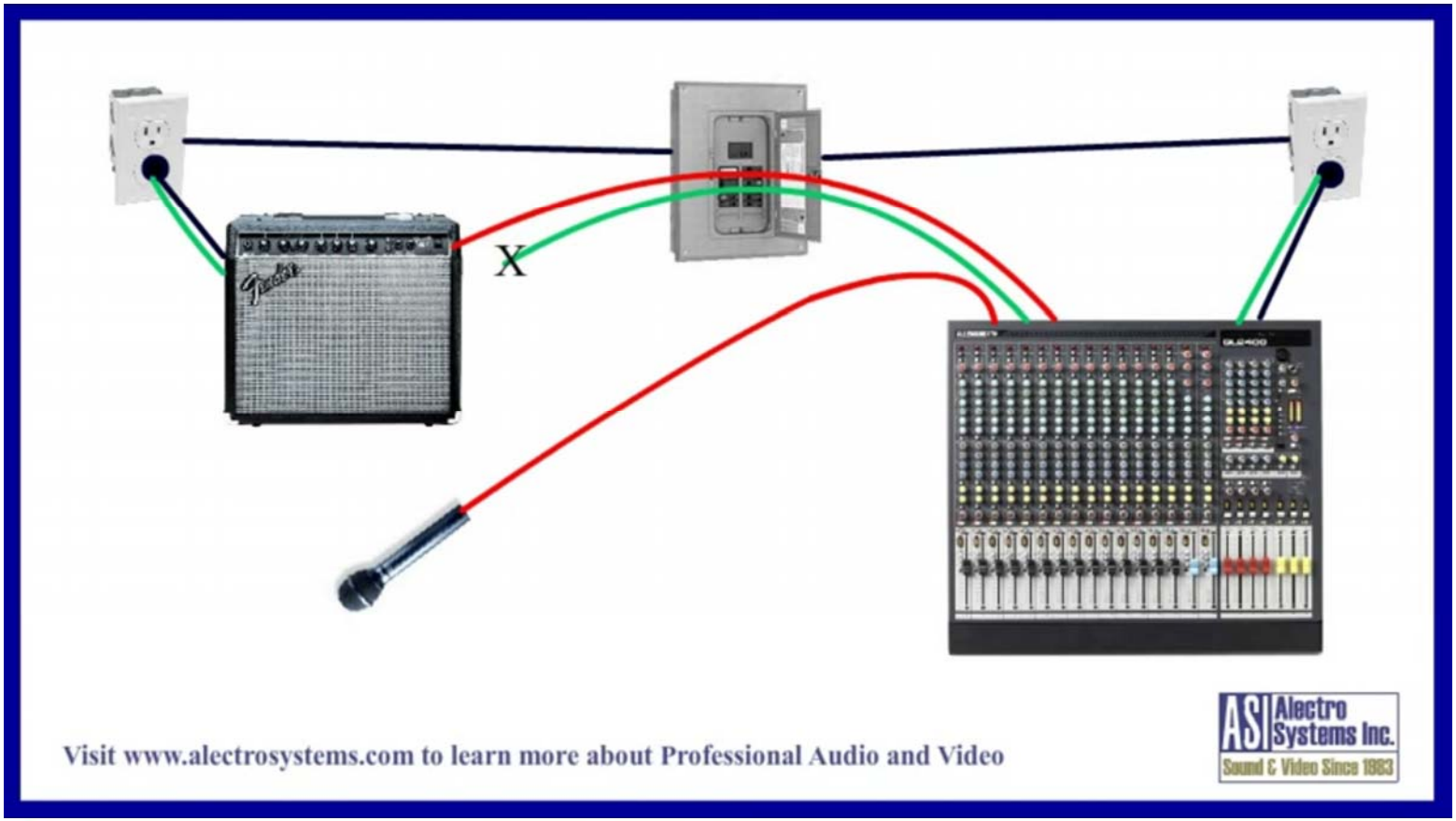


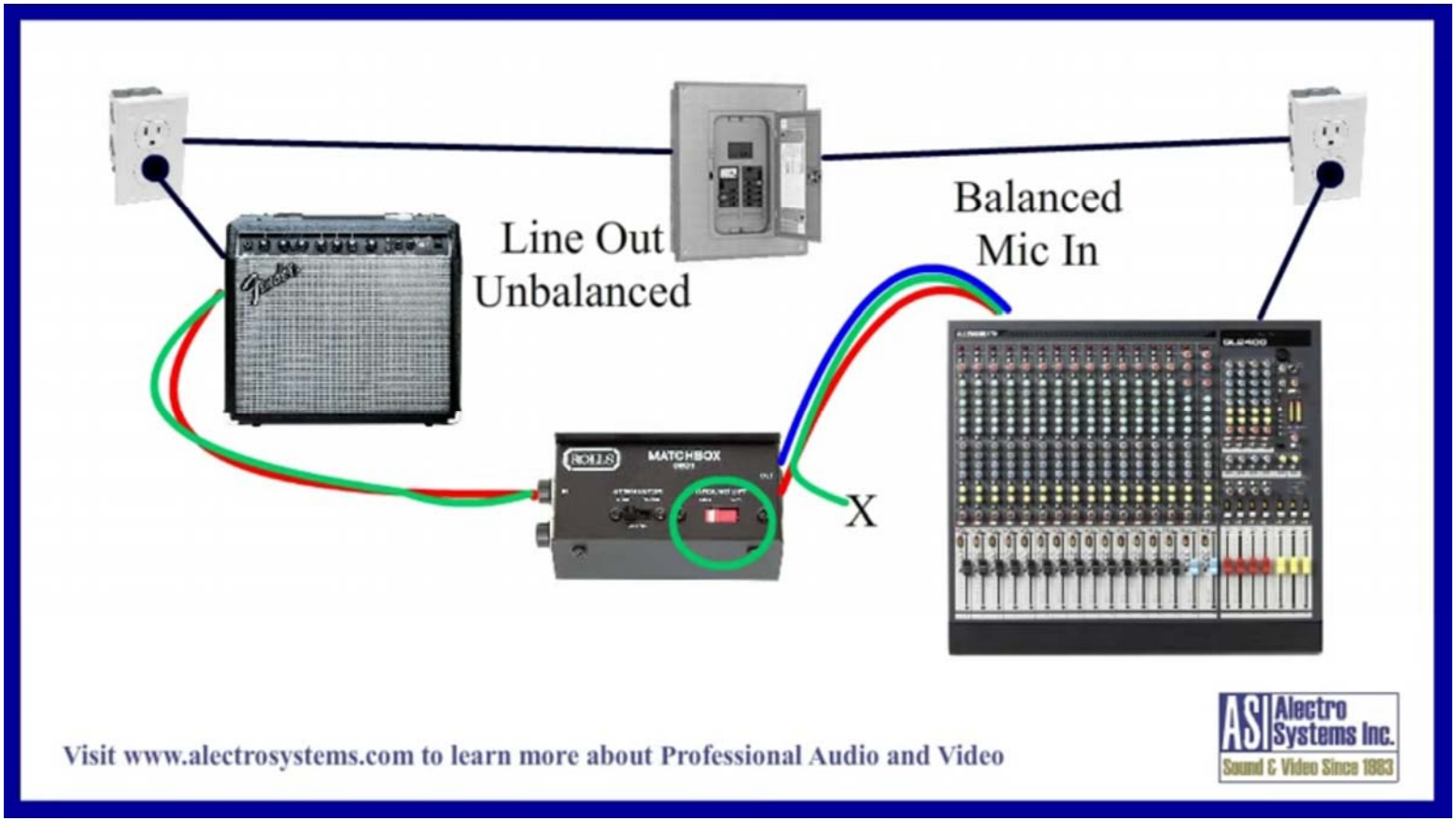
IF THE AC SOURCE IS NOT CLEAN,

OR IF PROPER GROUNDING IS NOT IMPLEMENTED,

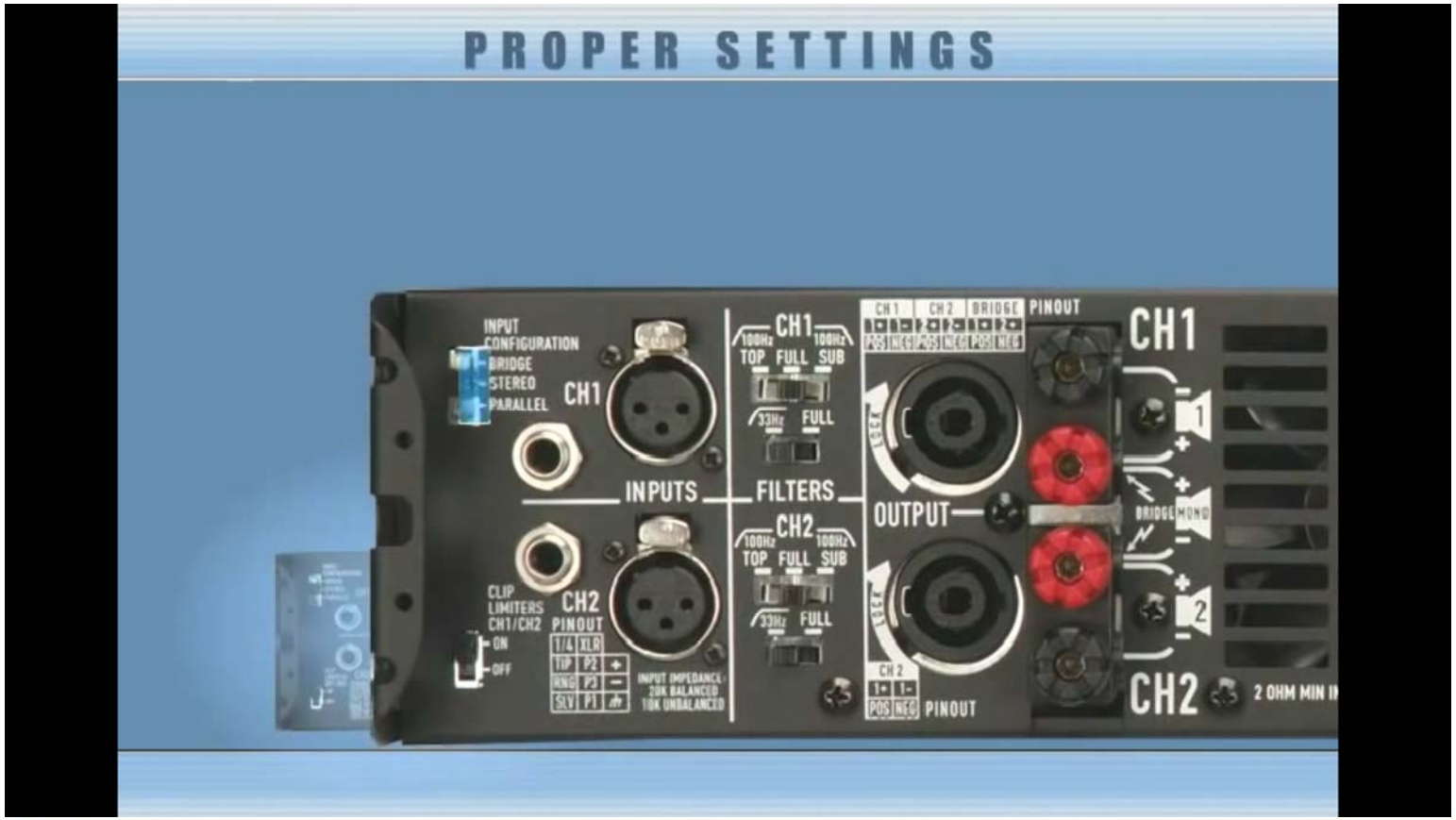


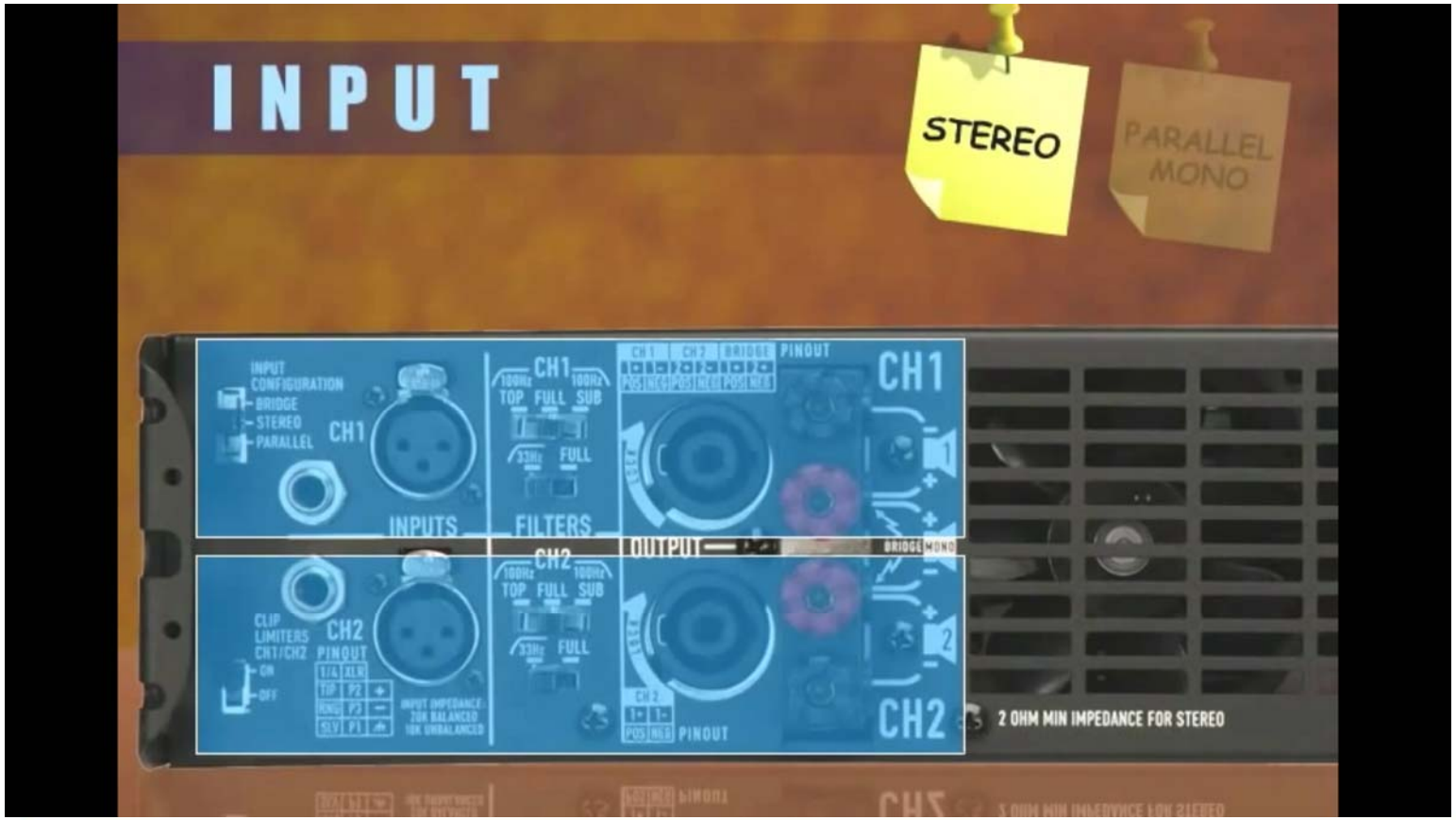


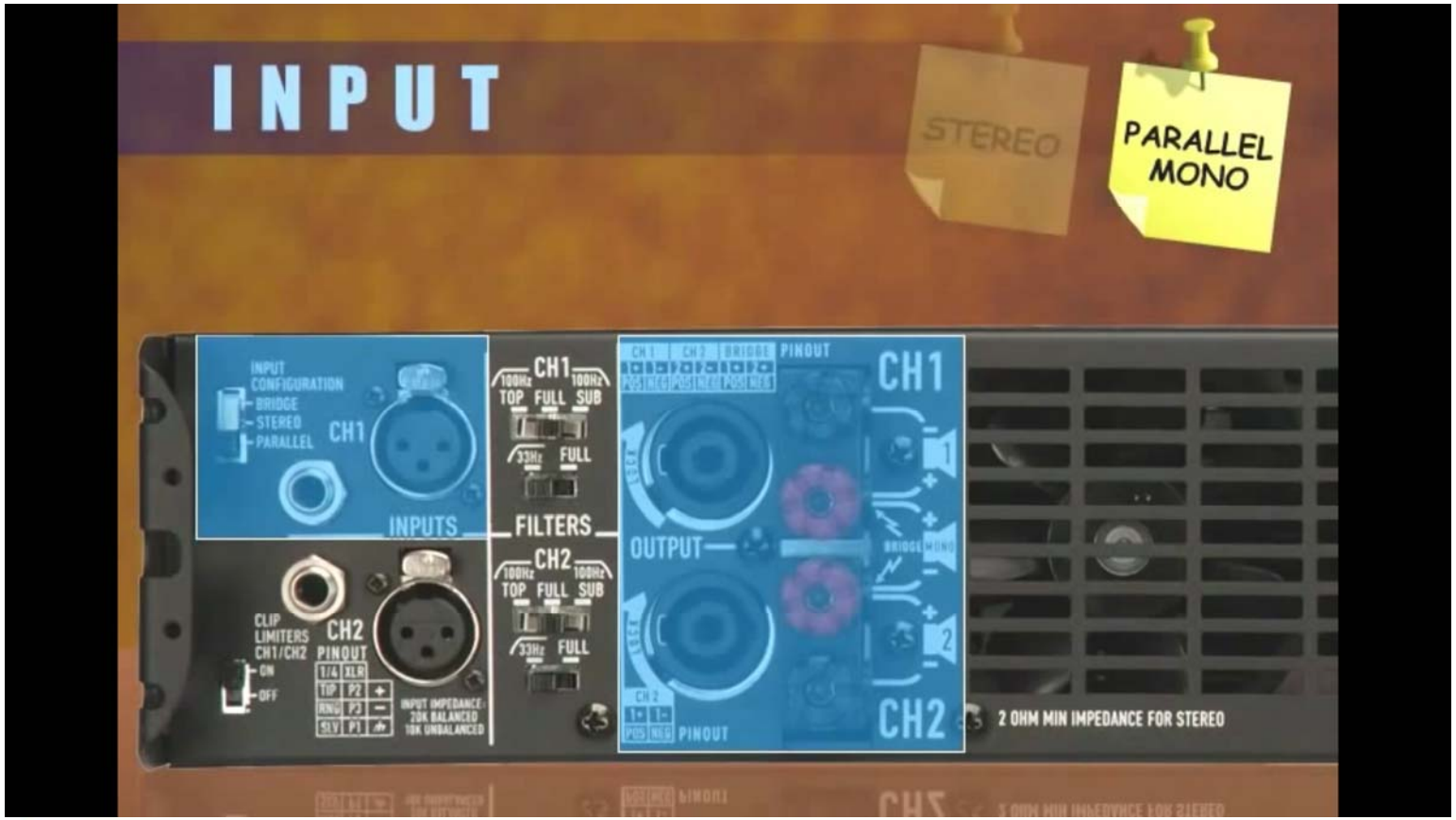


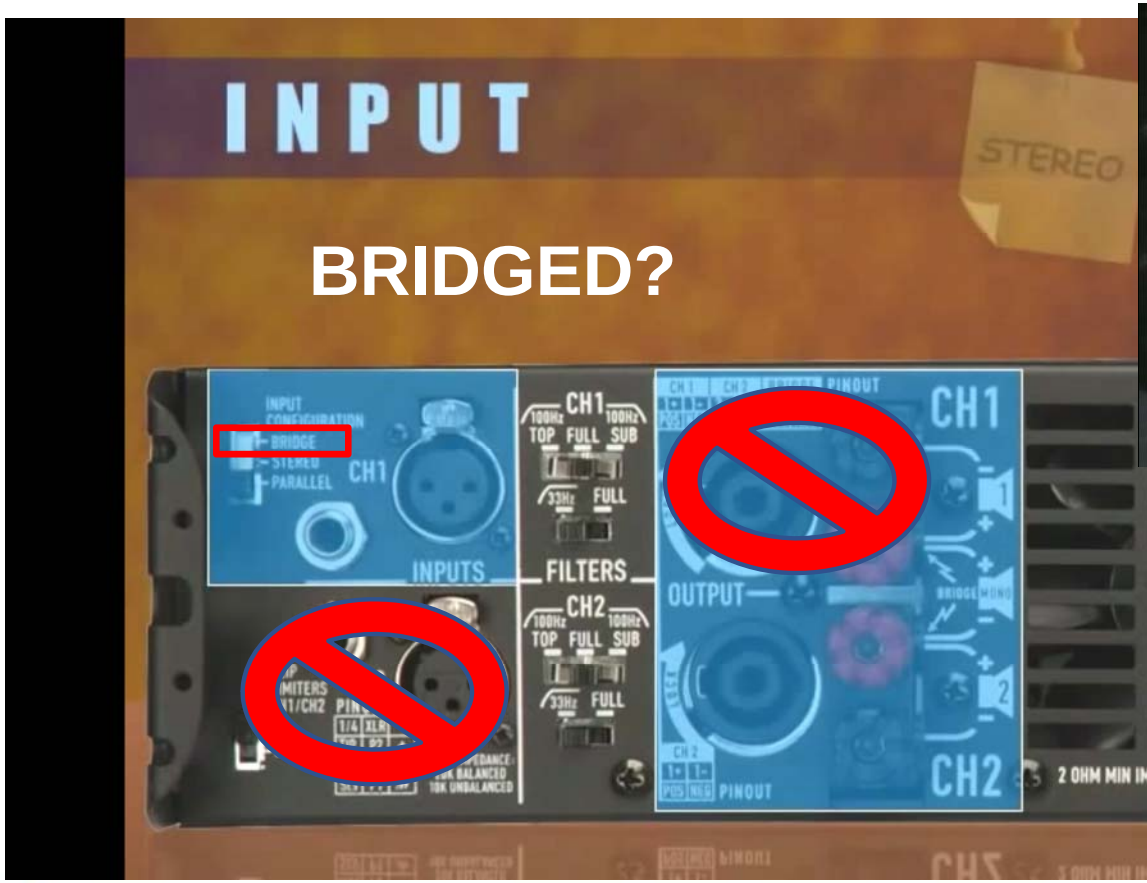


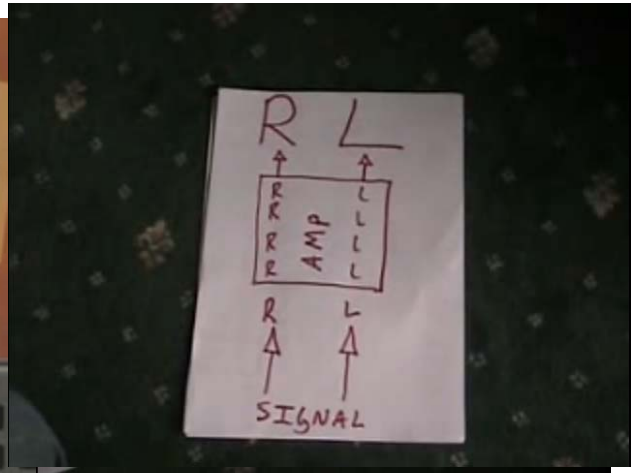
PROPER SETTINGS

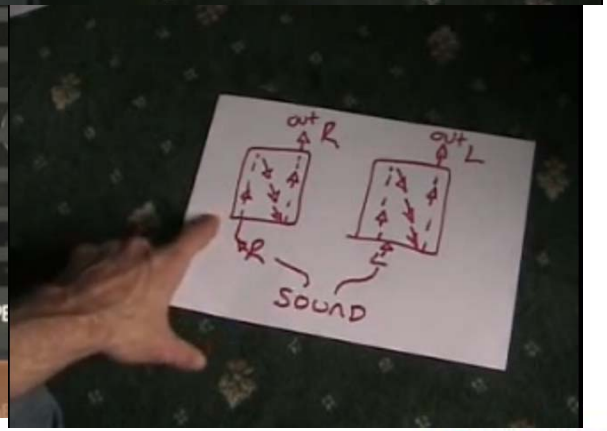


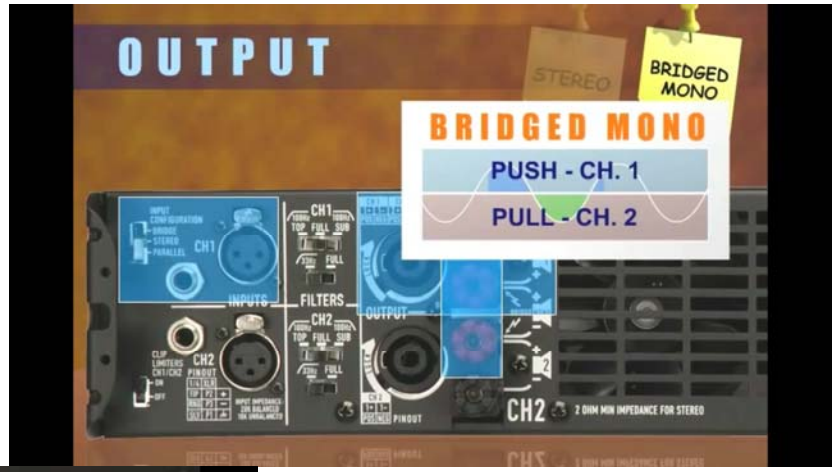





INPUT
STEREO
BRIDGED?
INPUT CONFIGURATION
BRIDGE
STEREO
PARALLEL
CH1
INPUTS
CH1
100Hz
TOP FULL SUB
33Hz FULL
FILTERS
CH2
100Hz
TOP FULL SUB
33Hz FULL
PINOUT
CH1
OUTPUT
CH2
PINOUT
2 OHM MIN IMPE


R L
AMP
SIGNAL


out R
out L
SOUND



Sound Pressure Level –SPL:

Loudspeaker Sensitivity: dB
SPL 1 watt @ 1 meter
Power: +3dB for every 2x watts
Distance: -6dB for every 2x distance

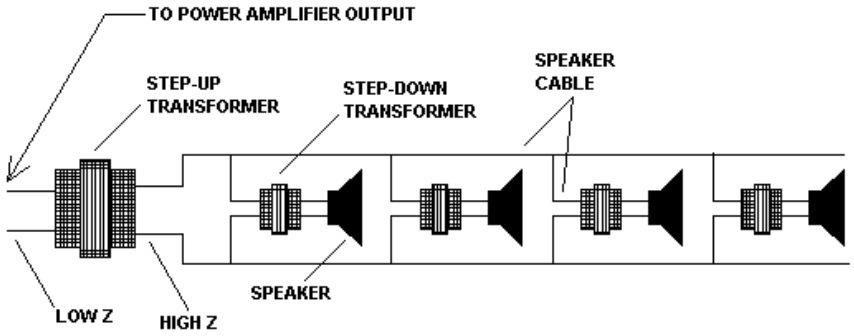
- 0dB faintest audible sound
- 50-60dB normal conversation
- 120dB painful

96 dB SPL @ loudspeaker1W/1M
+ 24 dB (250 W) [8 x 3dB] Amplifier Gain
-30 dB (32 M) [5 x -6dB] Distance Loss
---
90 dB SPL at the listener

To make the system appreciably louder, the amplifier should be replaced with an amplifier 4 to 10 times more powerful

- 4X the power =6 dB louder, which is perceptively louder in volume
- 10X the power =10 dB louder, which is perceptively twice as loud
- Be sure that the existing loudspeakers can handle the additional power

Crestron – “If you are without a 70-volt amplifier, but need to drive a 70-volt loudspeaker line, a low-impedance amplifier channel rated for 600 watts @ 8 ohms supplies a 69-volt line, for a 100-volt line, 1250 watts @ 8 ohms”

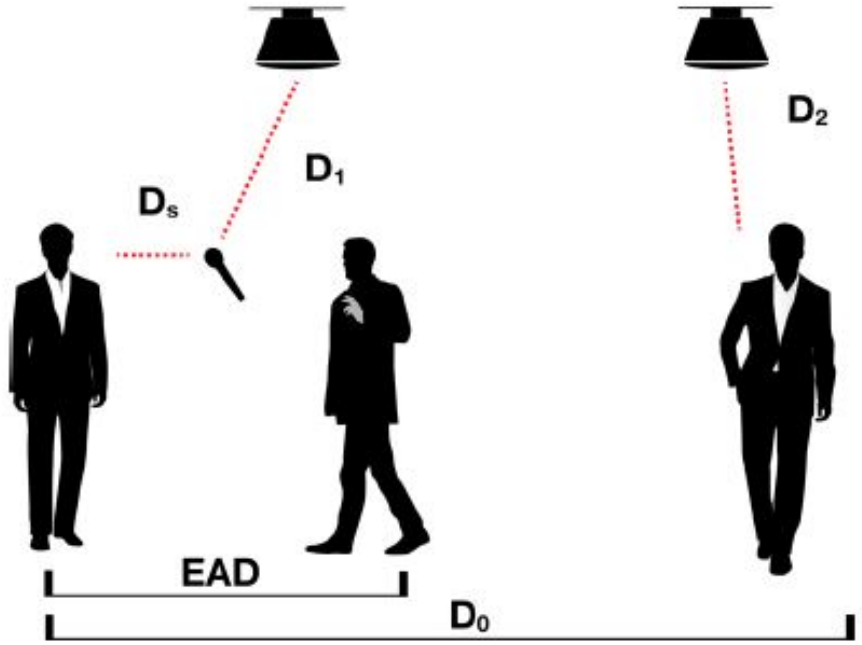


CONSTANT-VOLTAGE DISTRIBUTED SYSTEM

PAG/NAG (Potential Acoustic Gain/Needed Acoustic Gain):

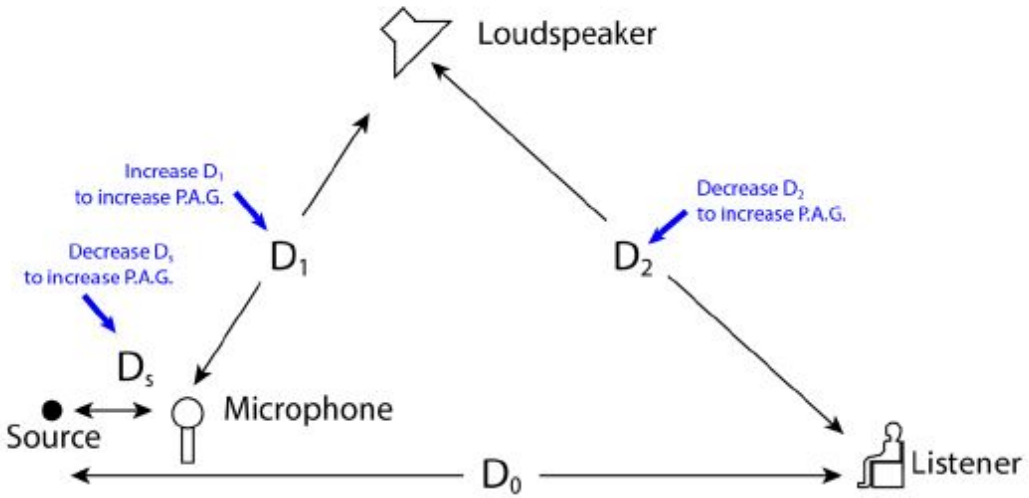
Definitions:

- **D0**Talker-to-farthest-listener distance
- **D1**Mic-to-closest-loudspeaker distance
- **D2**Listener-to-closest-loudspeaker distance
- **DS**Talker-to-mic distance
- **EAD**Equivalent Acoustic Distance, the desired virtual distance between the talker and furthest listener
- **NOM**Number of Open Microphones, always set to 1 when using automatic mixer function
- **FSM**Feedback Stability Margin



Potential Acoustical Gain:

P.A.G. = Potential Acoustic Gain



$$\text{P.A.G.} = 20 \log_{10} \left[\frac{D_1}{D_s} \times \frac{D_0}{D_2} \right] \text{ in decibels}$$

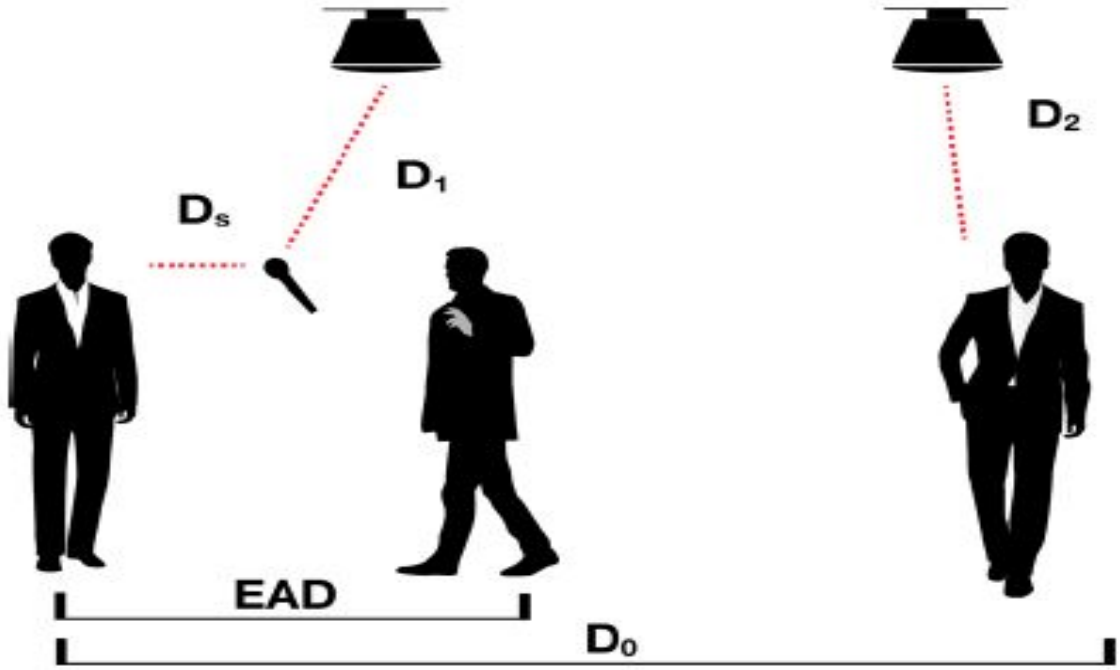
PAG/NAG (Potential Acoustic Gain/Needed Acoustic Gain):

NAG formula:

- NAG = 20Log(D0/EAD)

For example (imperial):

- NAG = 20Log(50 ft./8 ft.)
- NAG = 20Log(6.25)
- NAG = 15.9 dB

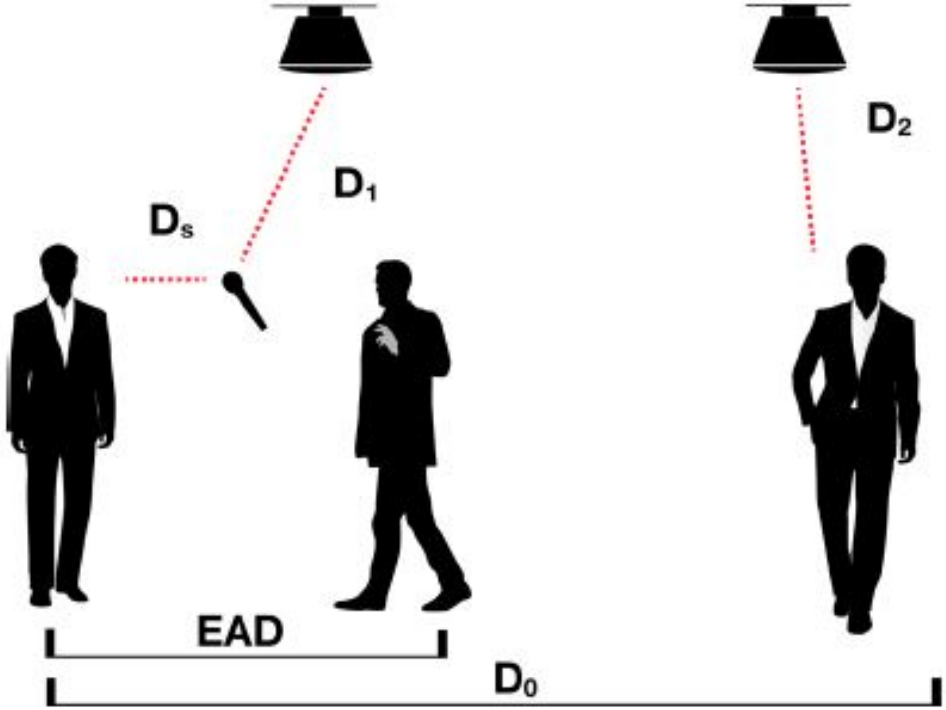


PAG/NAG (Potential Acoustic Gain/Needed Acoustic Gain):

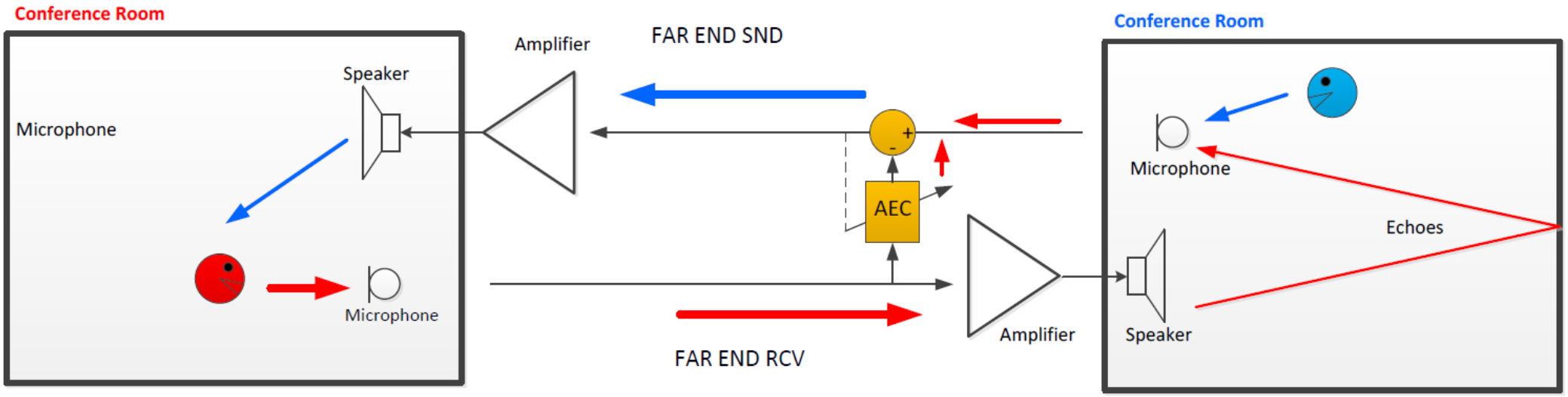
PAG = 22.5 dB [22.4 dB]

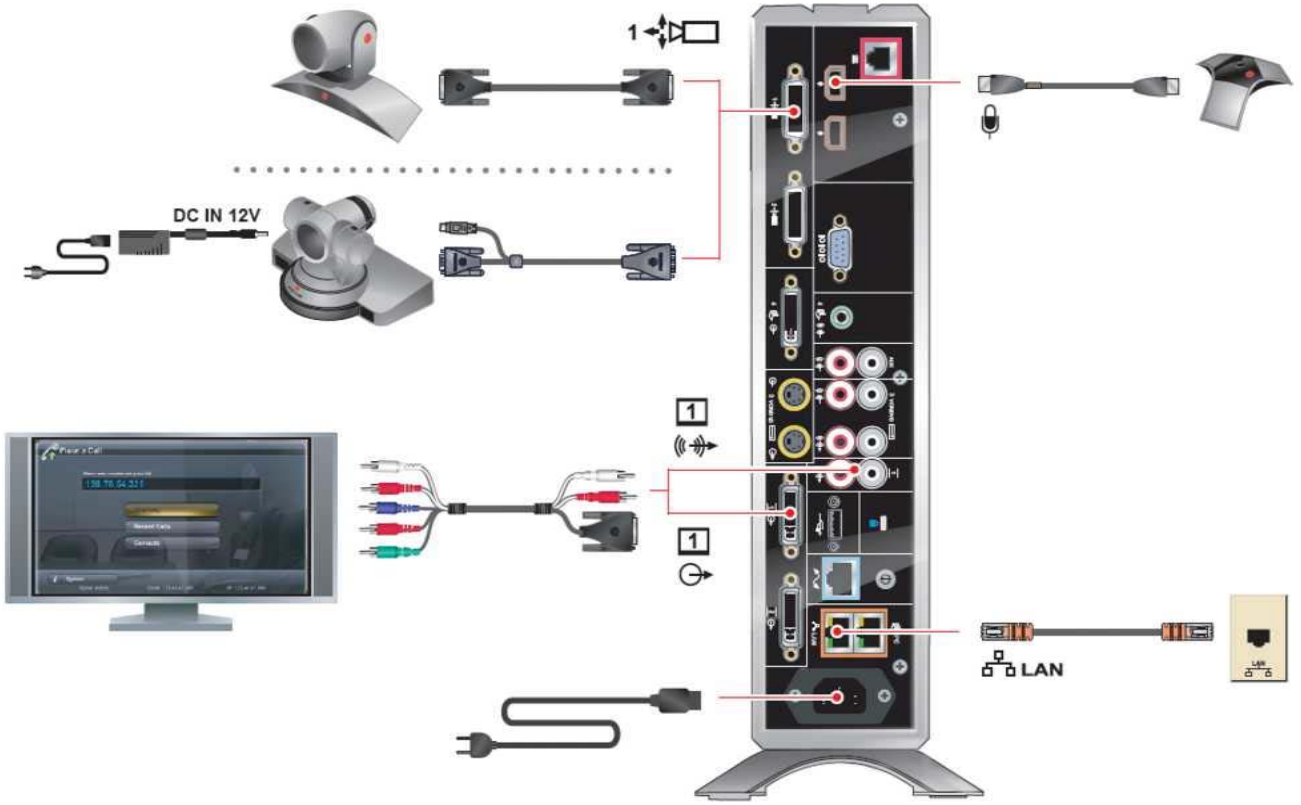
NAG = 15.9 dB [15.6 dB]

PAG > NAG
The system parameters will provide enough gain-before-feedback to acoustically locate all listeners within 8 ft. [2.5 m] of the talker

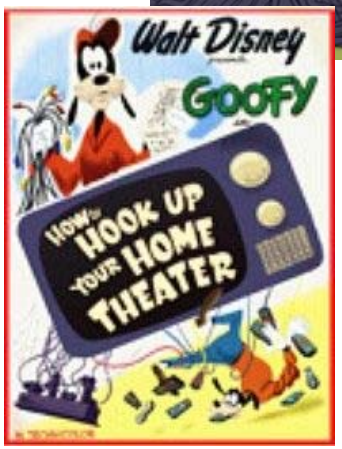


AEC





Step 4 – Distribute



High Res Coax

Shielded & Control

Twisted Pair

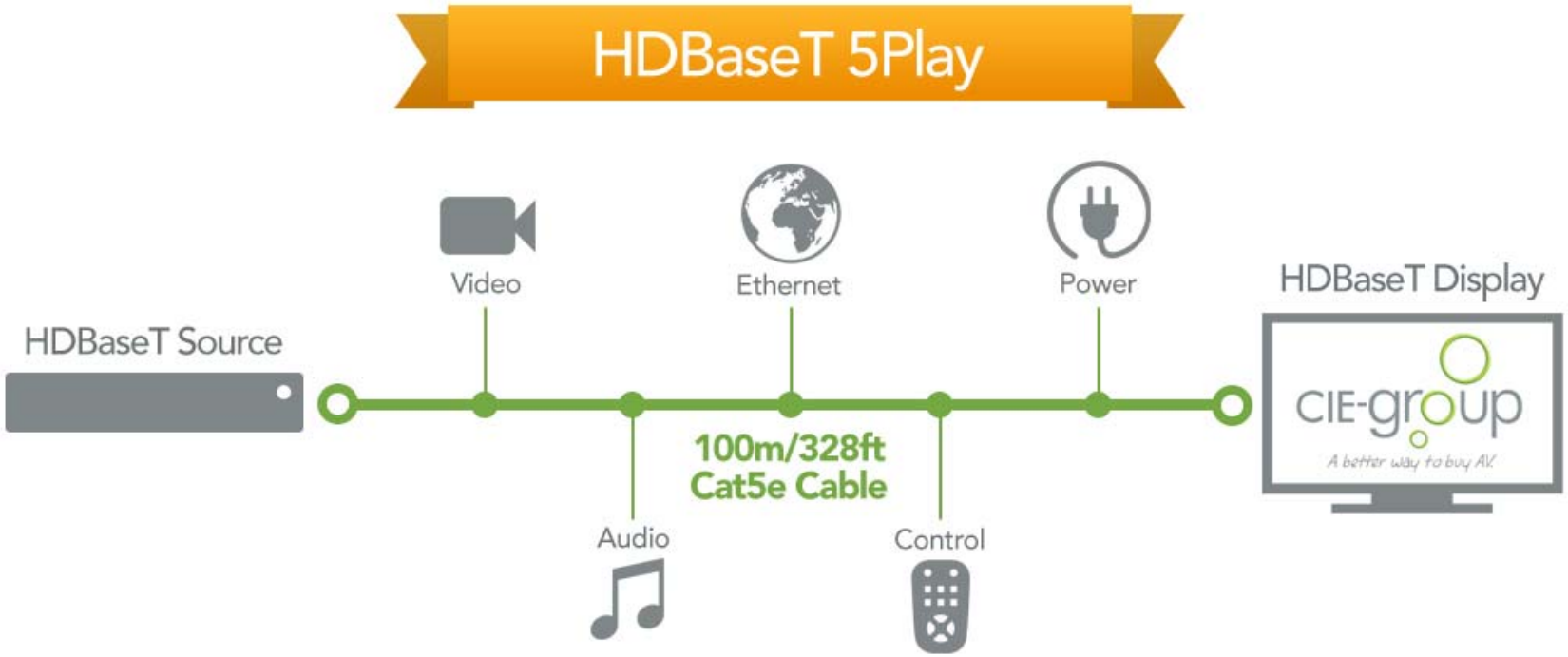
Fiber

Plug & Play

Skew Free / Low Skew UTP

- Not to be used for Digital
- Mark with colored tag for easier identification
- Terminate with different colored jack than data

HD Base T



Audio over Ethernet

Dante™

CobraNet®

IEEE 802.1 AVB

Audio over Ethernet

Dante Recommended Network Switch Features

- No EEE or Green Ethernet features enabled 
- Gigabit switches
- Unmanaged Switches
  - Single network switch applications
  - Dedicated Dante traffic
- Managed Switches
  - Multiple network switch applications
  - Mixed traffic

EDSP – Dante Network Connectivity

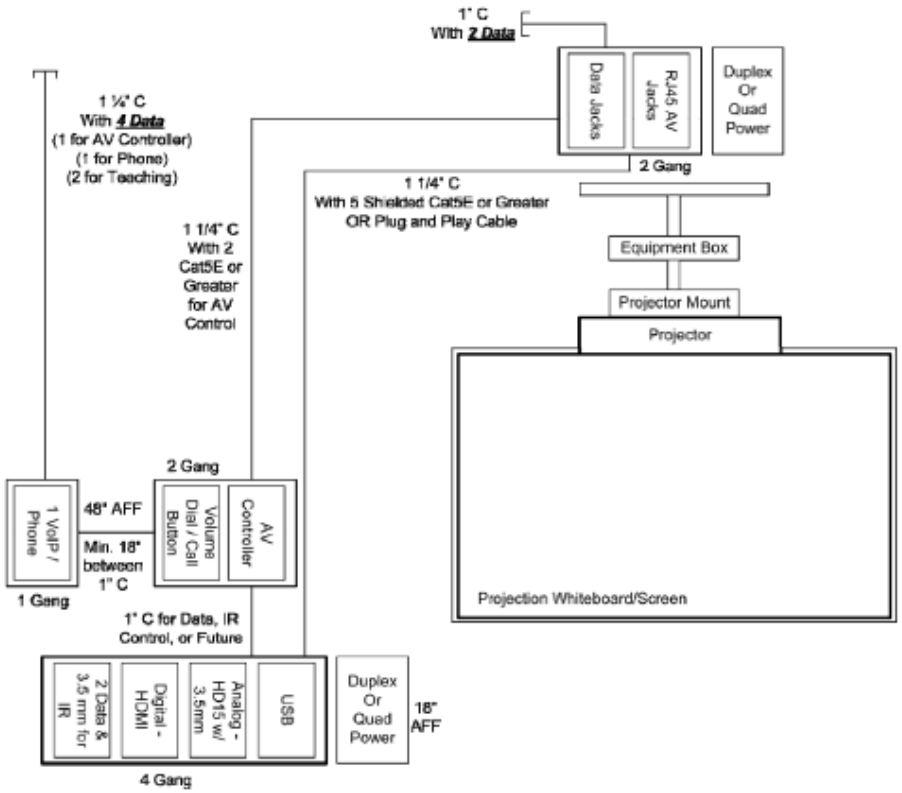
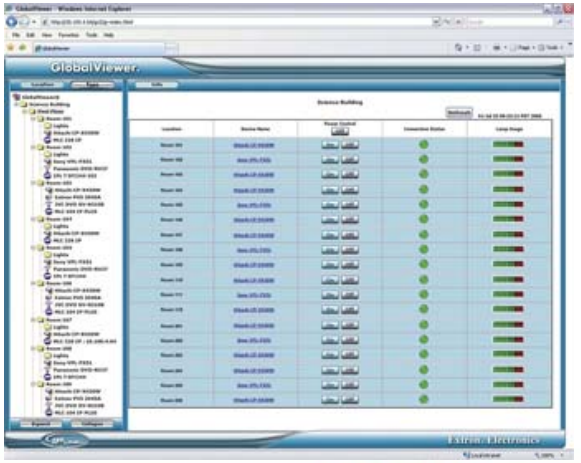


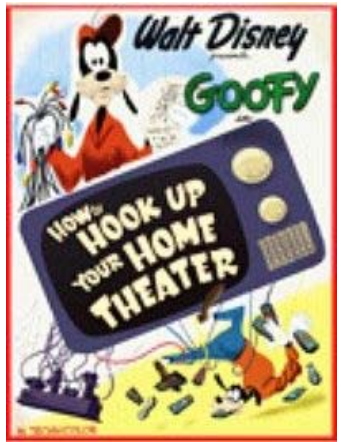
Figure 7-3
Minimum Recommended AV Infrastructure

Make sure to have data connections:

- At input locations
- At displays
- At processing and control equipment



Step 5 – Control



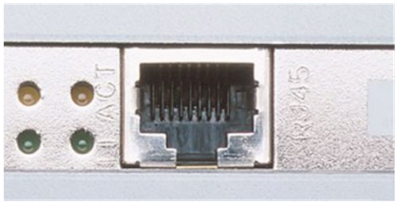
Touch Panels

Keypad

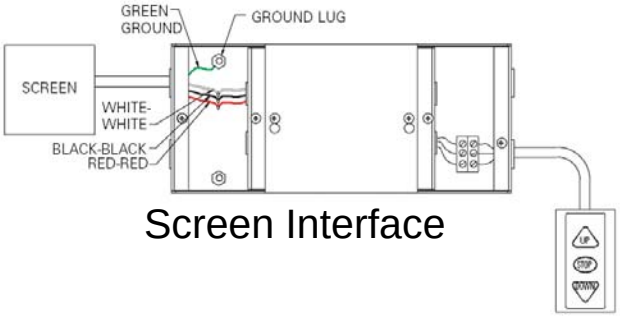
User Interfaces

Control Processor

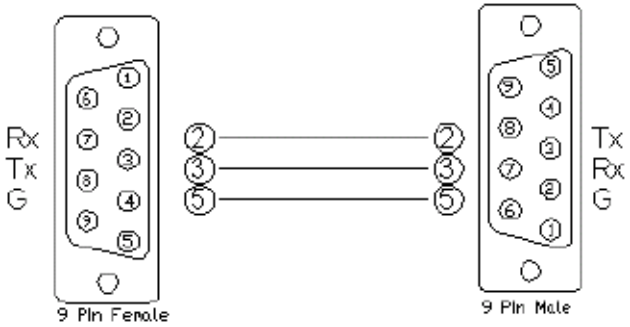
- Control processor with touch panel/software app
- Button panel
- Browser control
- Control anything with
  - Serial
  - IR
  - Ethernet
  - Relay /Contact Closure



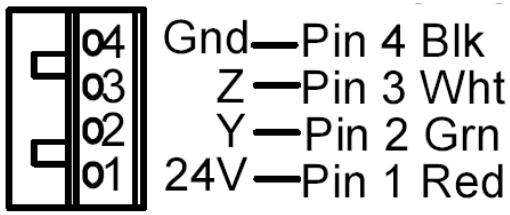
Infrared Emitter



Screen Interface



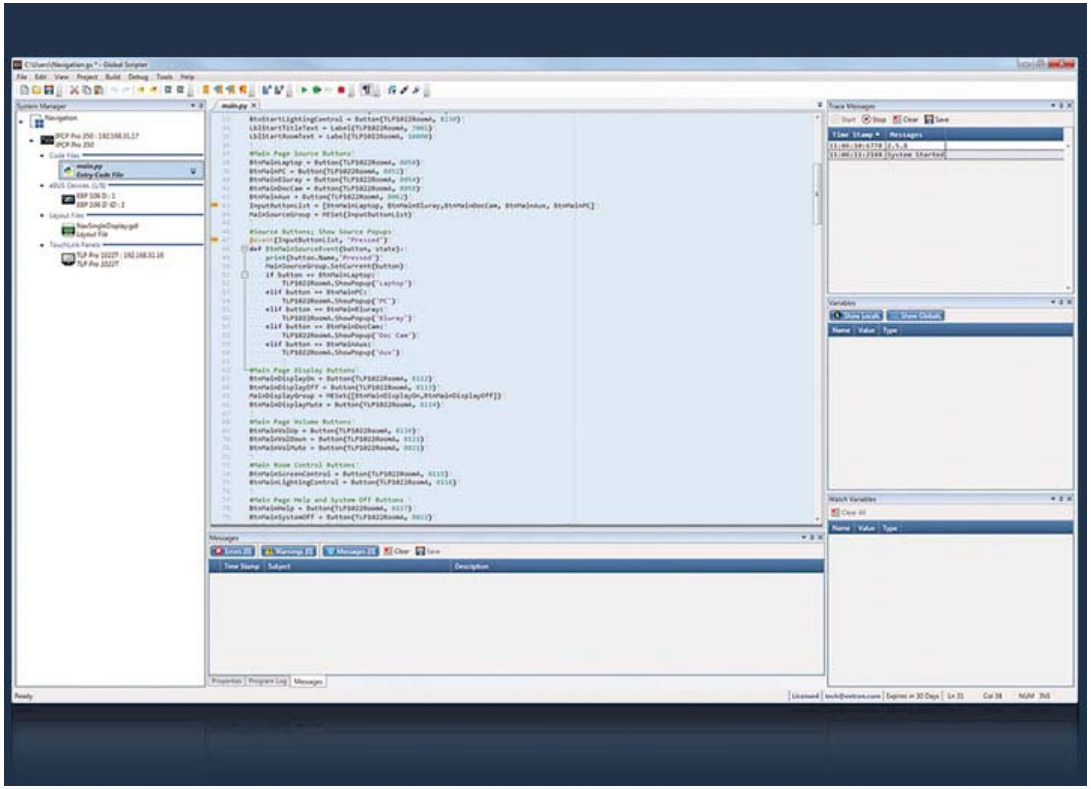
RS232 Cable



Cresnet Wiring

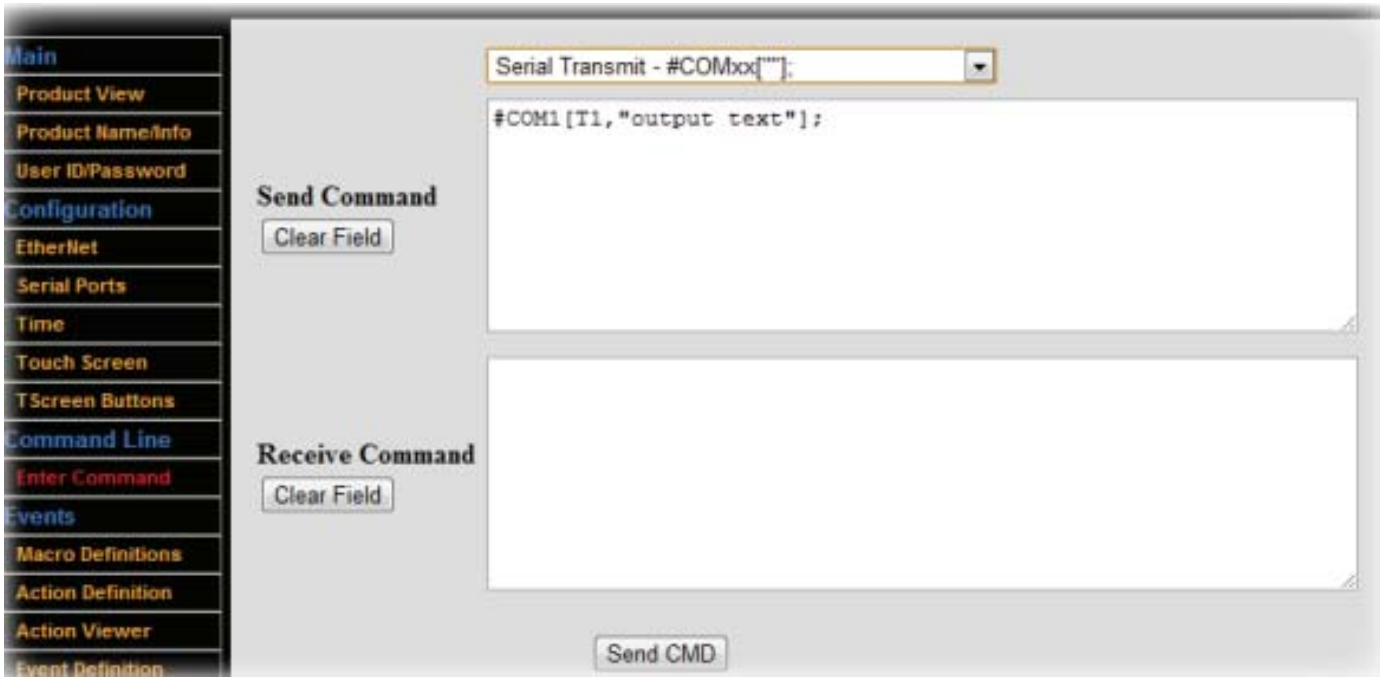
Projector Lift

Programmable Systems



Configurable Systems

Conprogable Systems



Let’s Put into Practice

Let’s Put into Practice

What you do, ask, and look for in a job walk/review?

- ❖ Determine sources & outputs – “Uses of system”
- ❖ Determine locations, distances, pathways
- ❖ What’s existing – likes and dislikes
- ❖ Customer Expectations
- ❖ Determine existing network and required additions
- ❖ Who are the contacts and roles
- ❖ Expected timelines

Let’s Put into Practice

What tools do you need on a job walk?

- ❖ Camera
- ❖ Digital Notepad
- ❖ Distance Meter
- ❖ Stud finder
- ❖ Ladder & Tools for access
- ❖ Keys

Let’s Put into Practice

Scenario 1

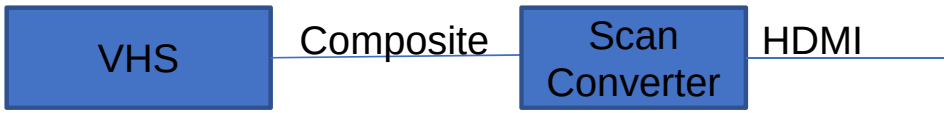
Customer wants a VHS, Blu Ray, Rack PC, and Laptop

Show on a TV in a room that seats about 6 people

Does not want multiple remote controls

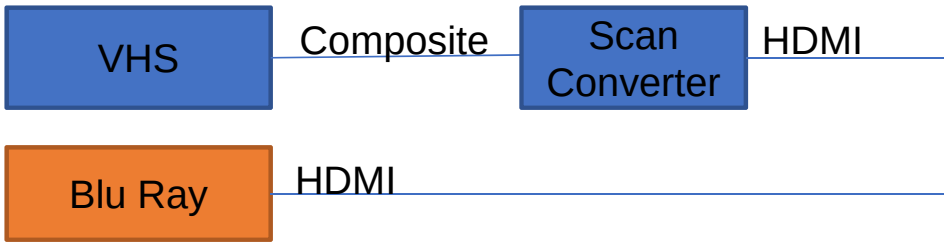
Scenario 1

Customer wants a VHS



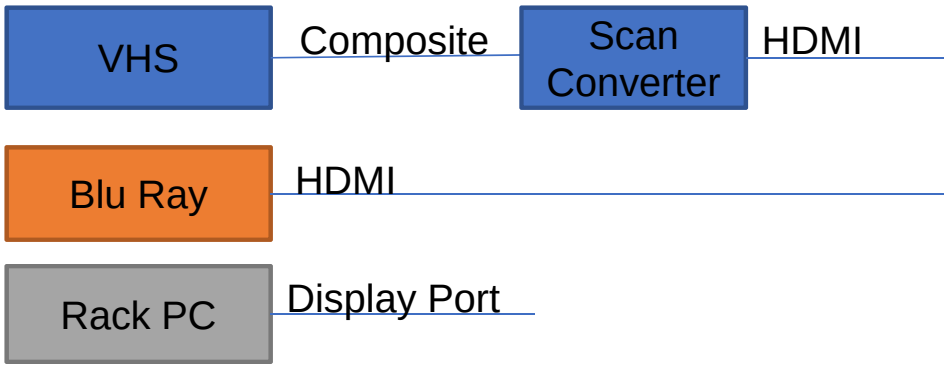
Scenario 1

Customer wants a Blu Ray



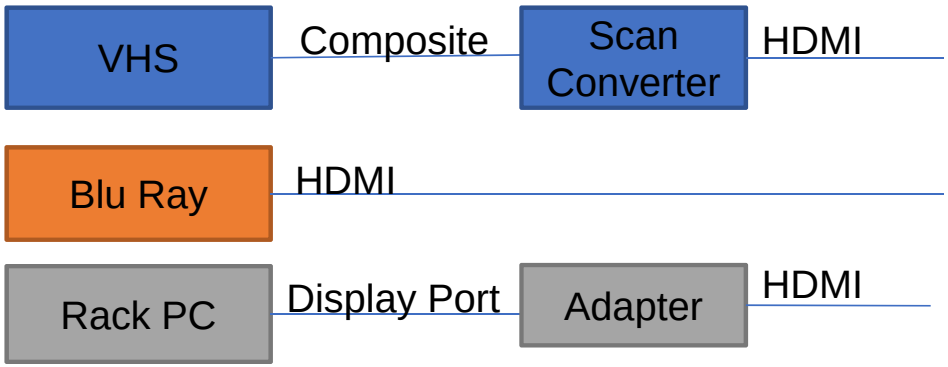
Scenario 1

Customer wants a Rack PC



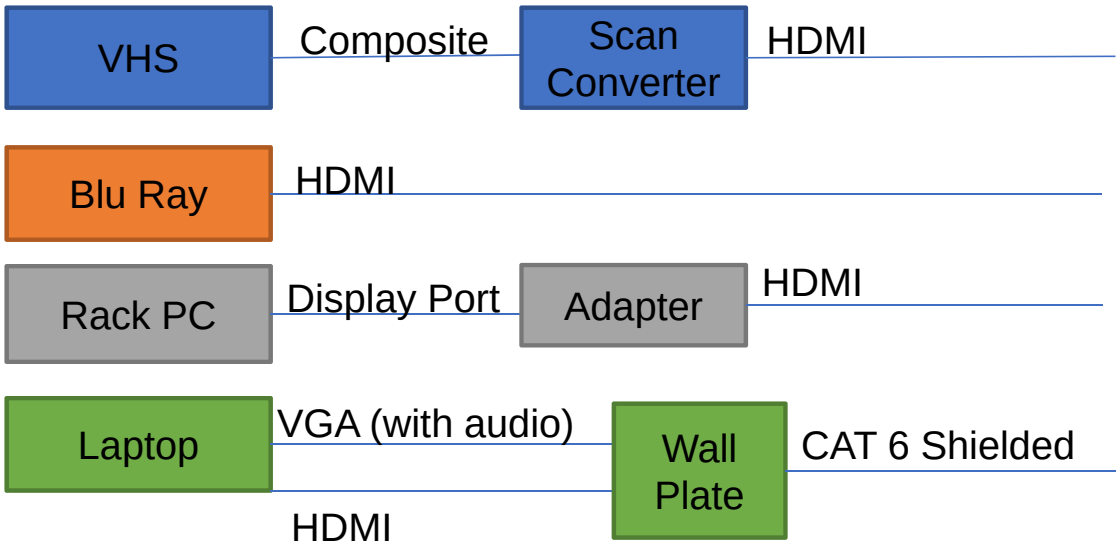
Scenario 1

Customer wants a Rack PC



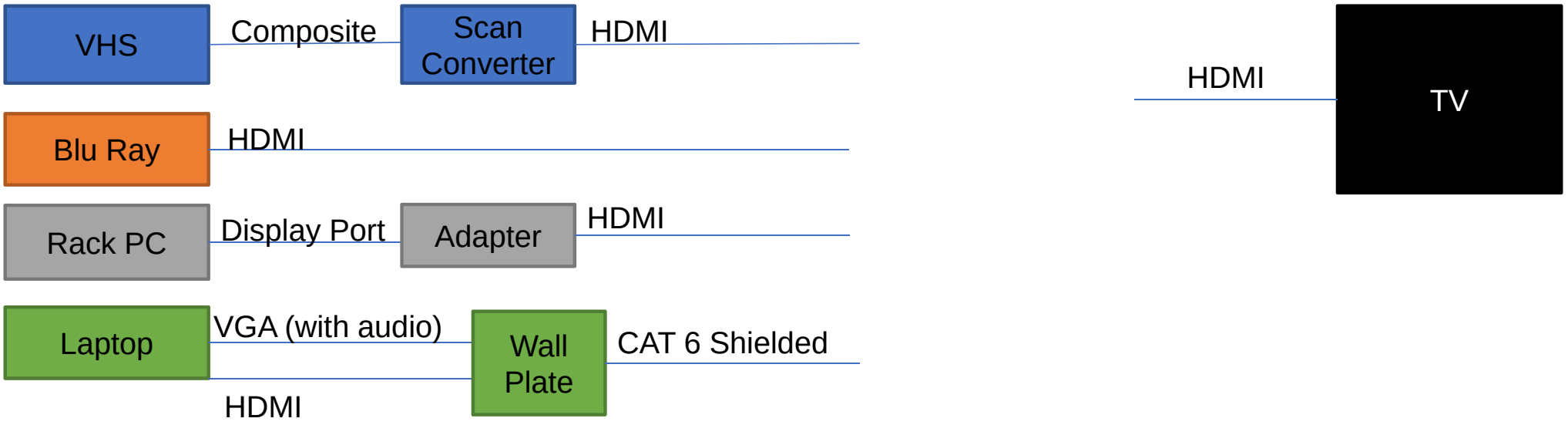
Scenario 1

Customer wants a Laptop



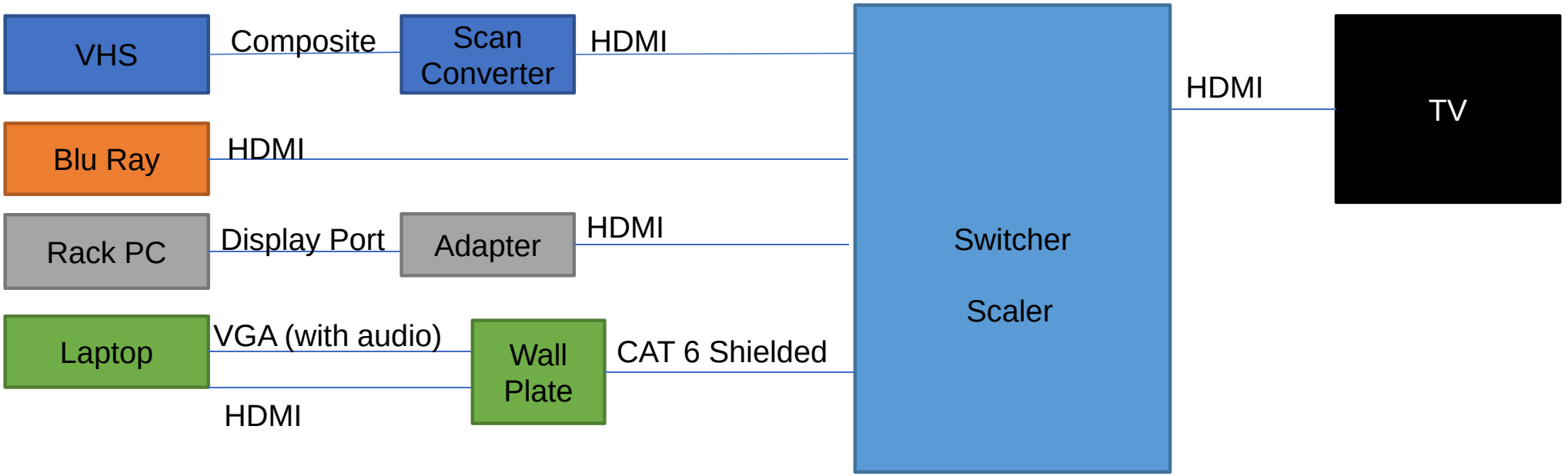
Scenario 1

Customer want a TV



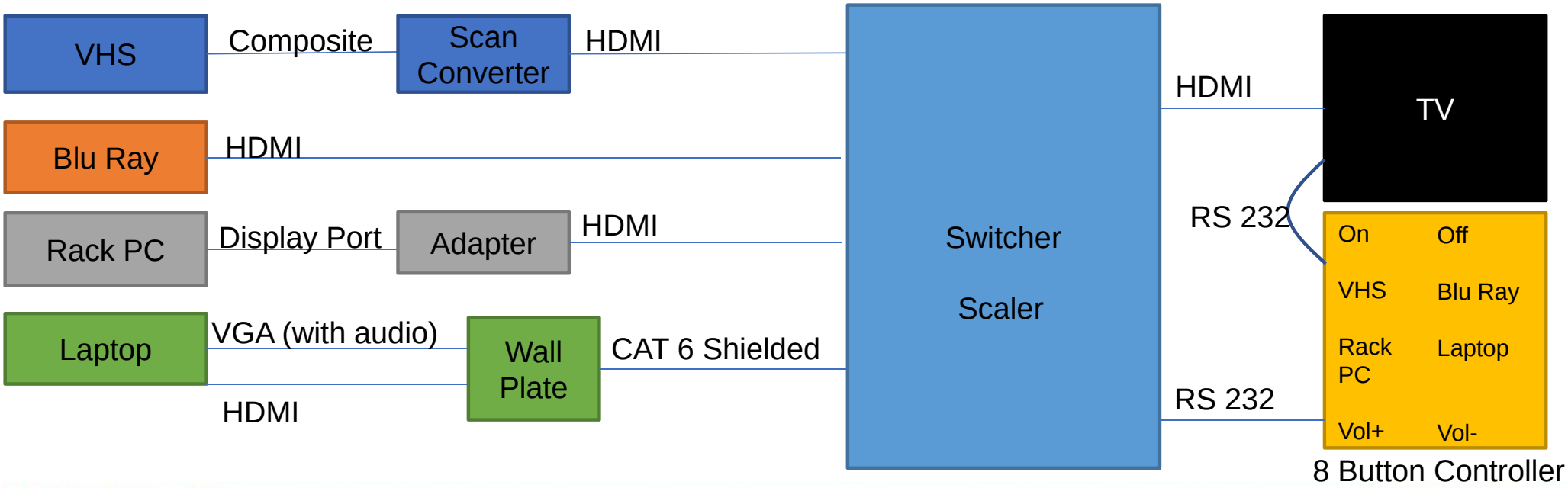
Scenario 1

Connect them



Scenario 1

Customer wants one remote



Let’s Put into Practice

Scenario 2

2 - Divisible Room with TV tuners, Floor Box Input, BYOD

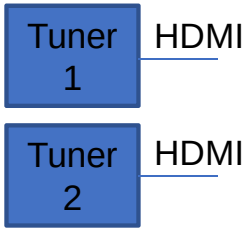
Automatic Switch of controls based on wall status

Projector in each room and monitor at lectern

Want Lesson capture/Streaming

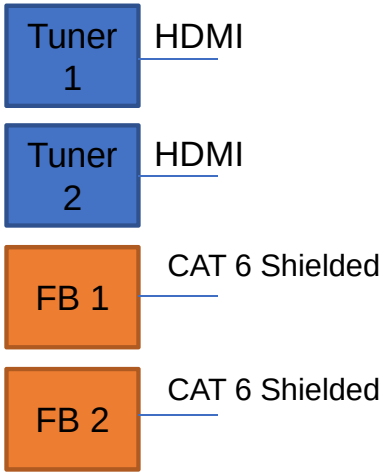
Scenario 2

Customer wants TV Tuners



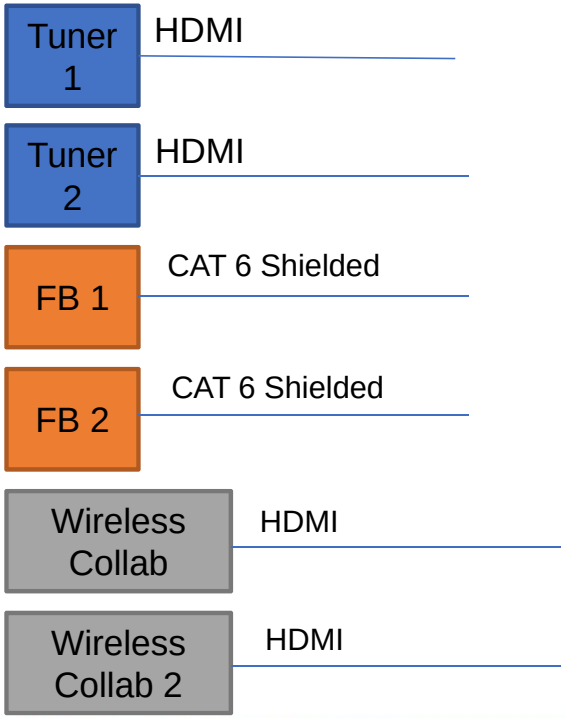
Scenario 2

Customer wants Floor Box Inputs



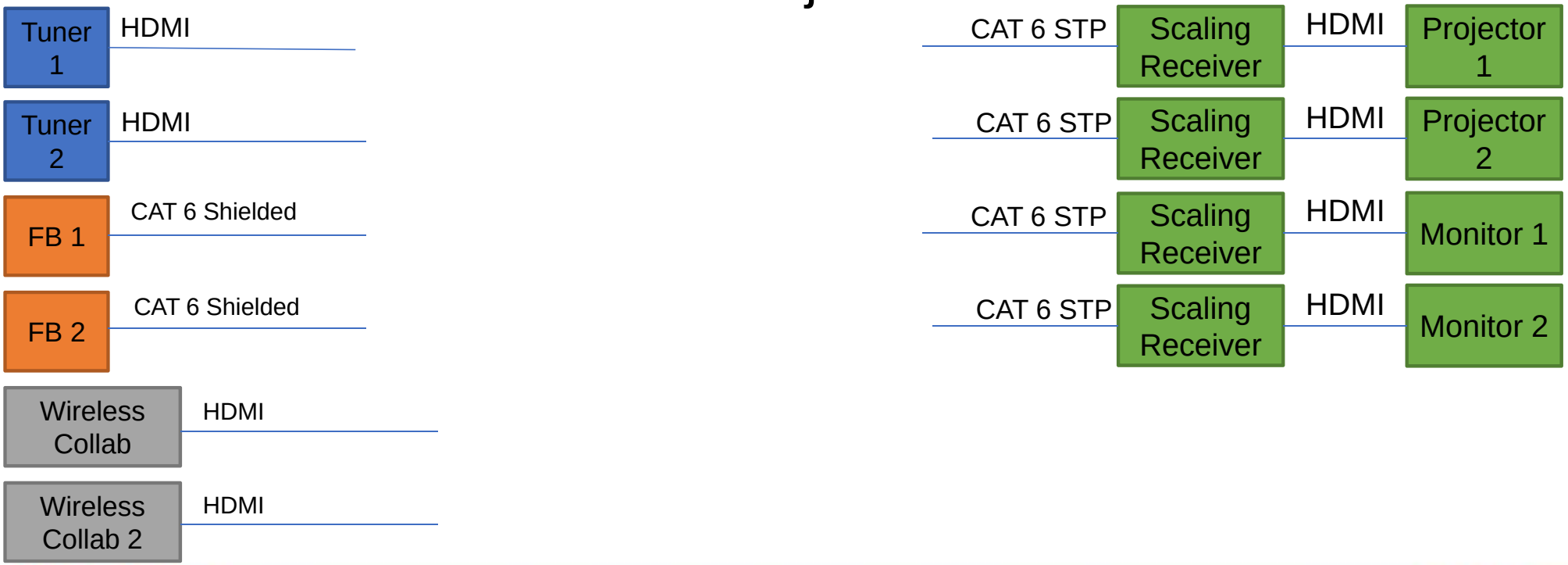
Scenario 2

Customer wants B.Y.O.D.



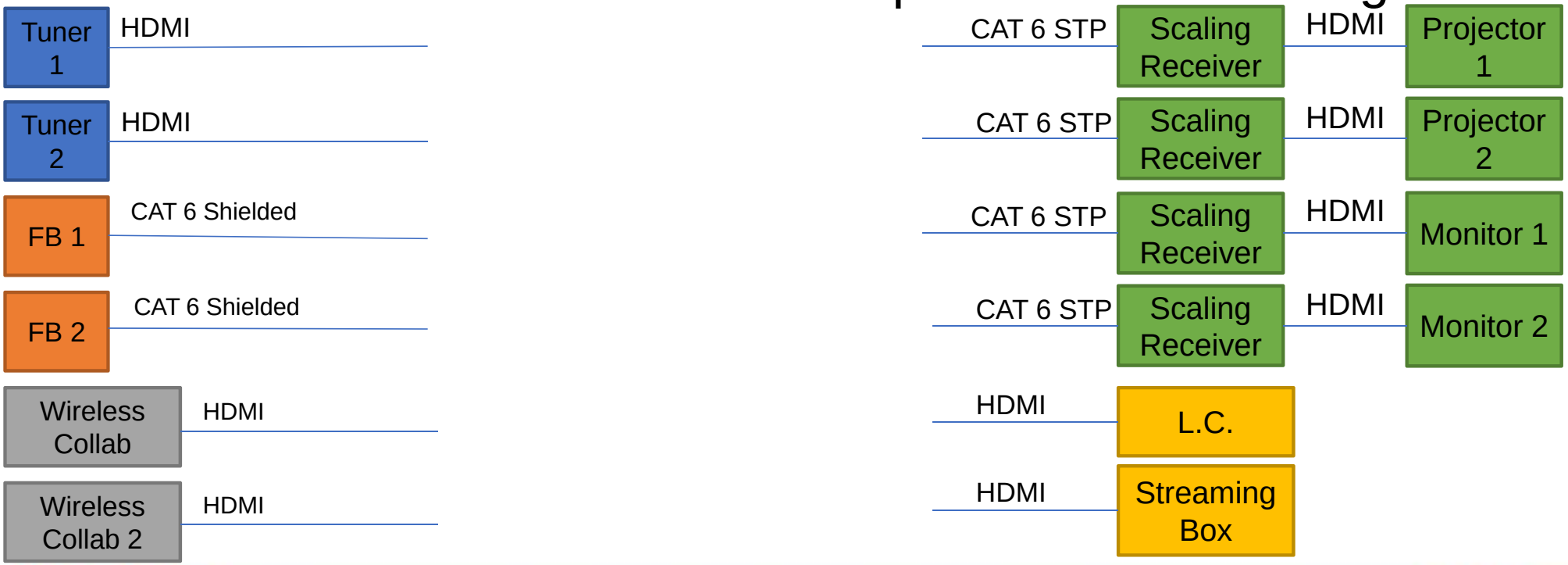
Scenario 2

Customer wants Projectors and Monitors



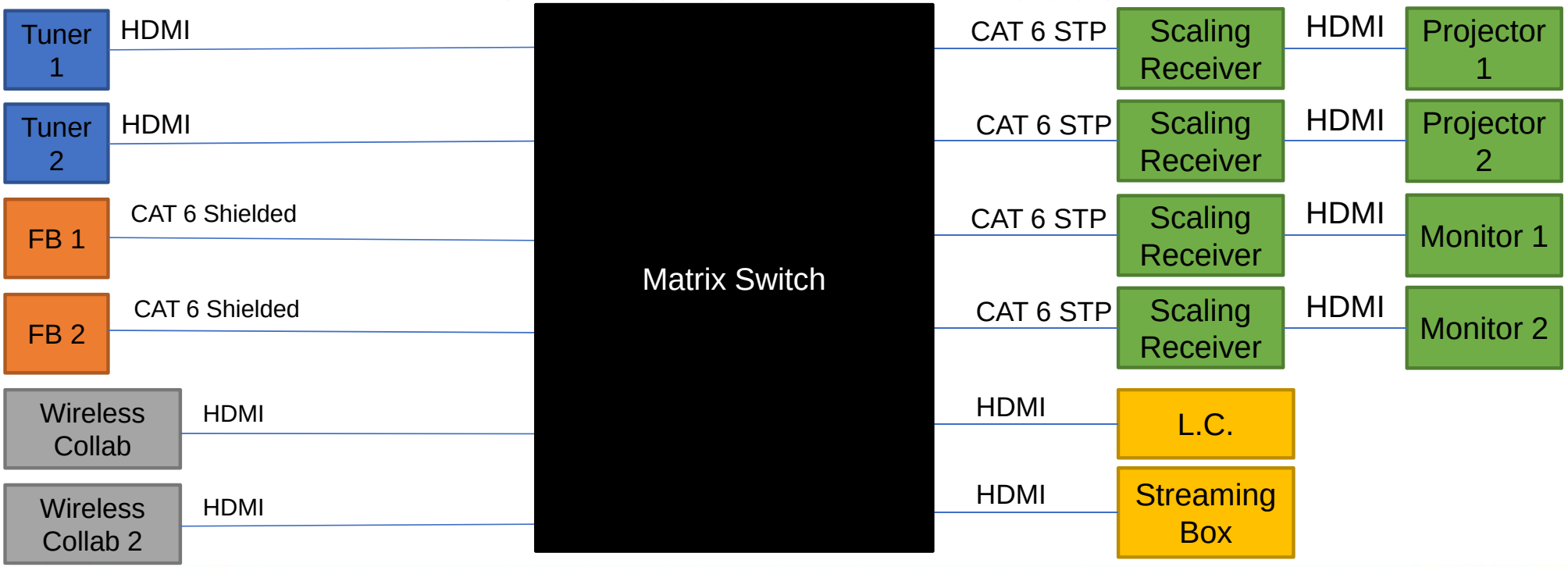
Scenario 2

Customer wants Lesson Capture and Streaming



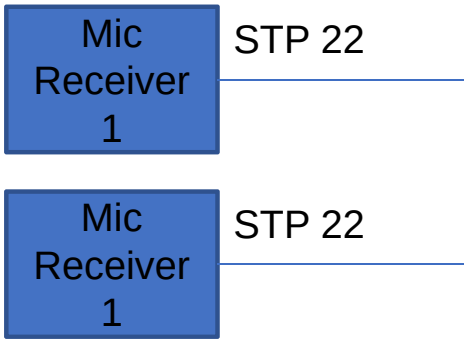
Scenario 2

Connect our Video Pieces



Scenario 2

Don’t Forget the Audio!



Scenario 2

Don’t Forget the Audio!

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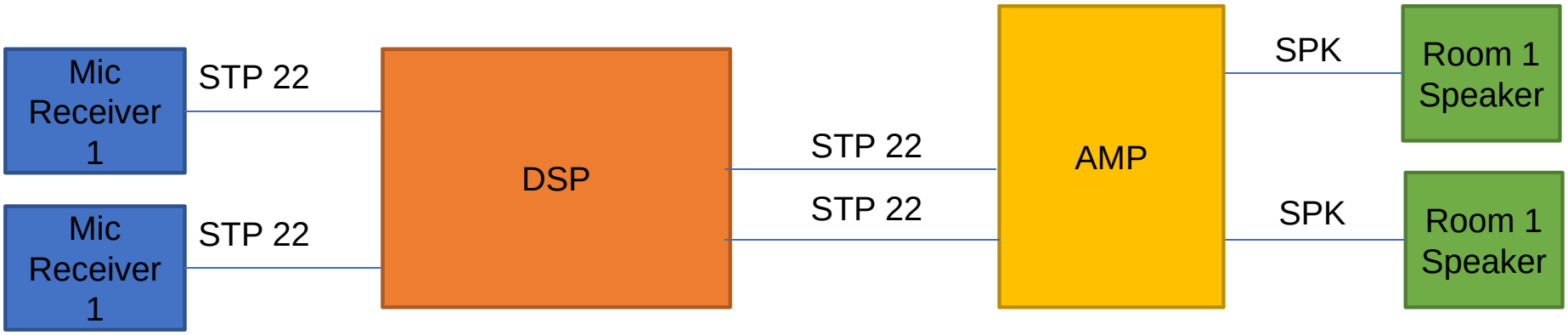
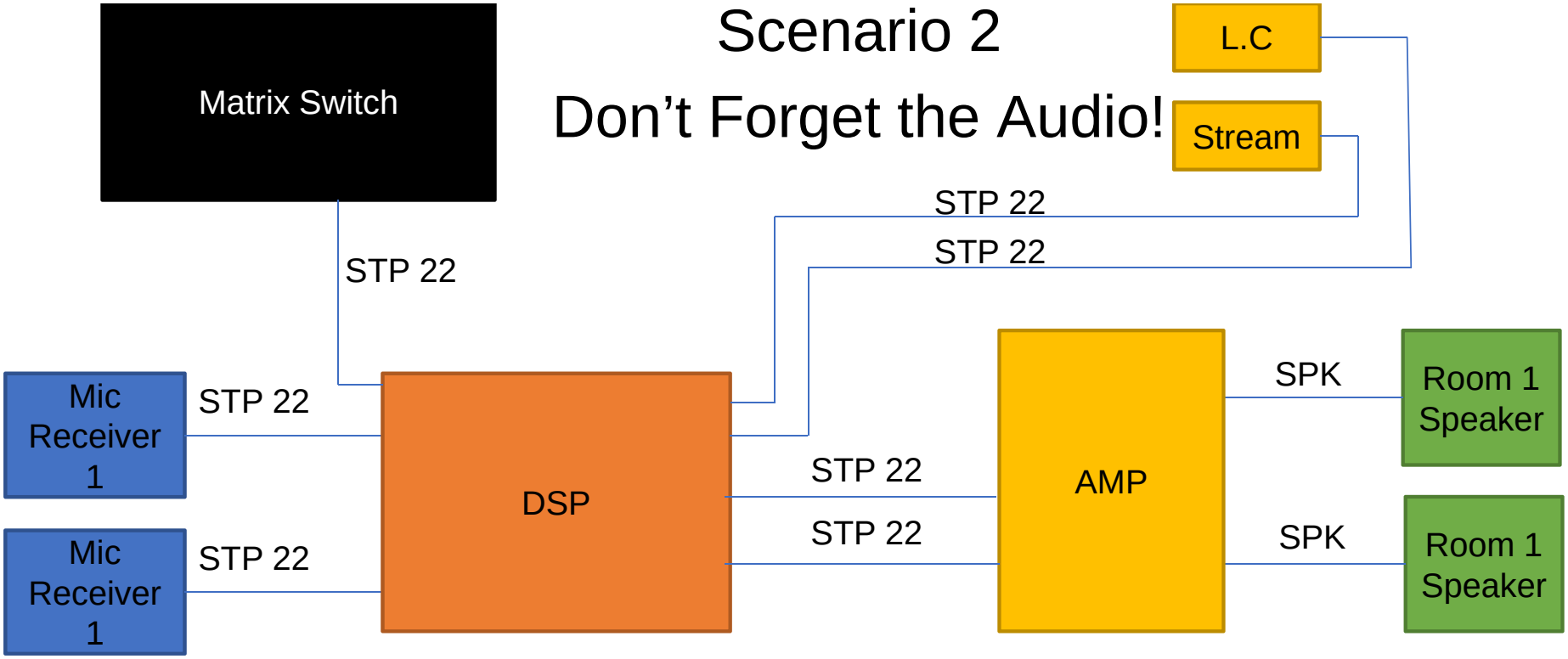


Scenario 2

Don’t Forget the Audio!

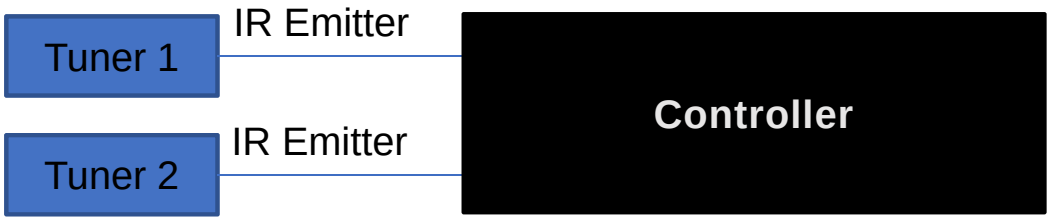


Scenario 2

Don’t Forget Control!

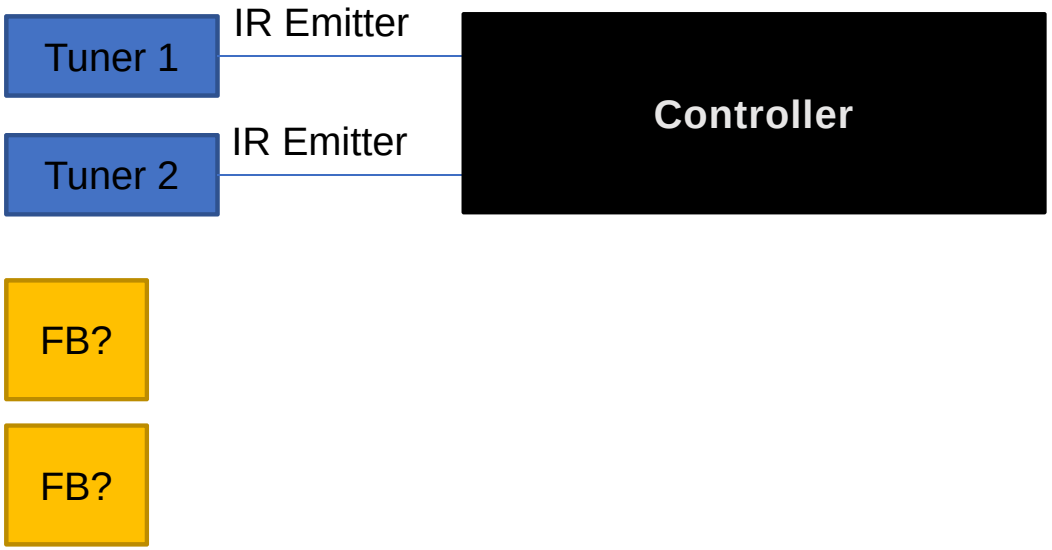
Scenario 2

Don’t Forget Control!



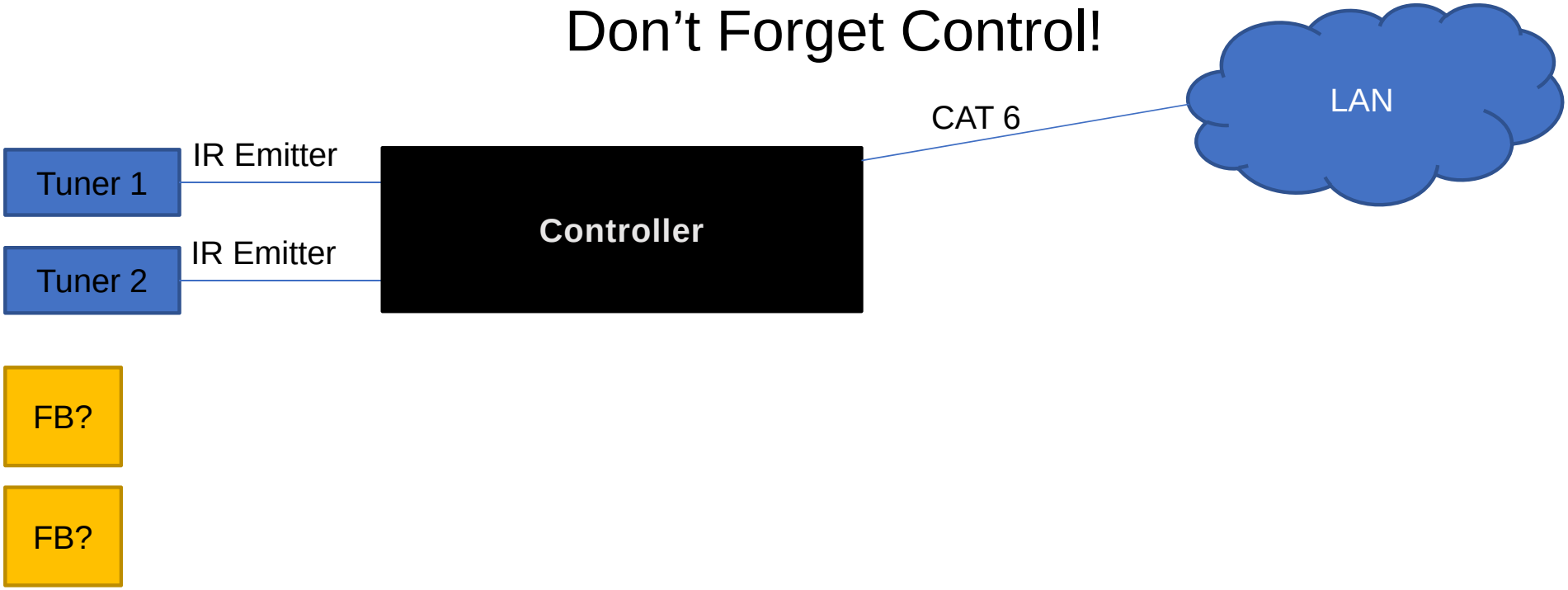
Scenario 2

Don’t Forget Control!



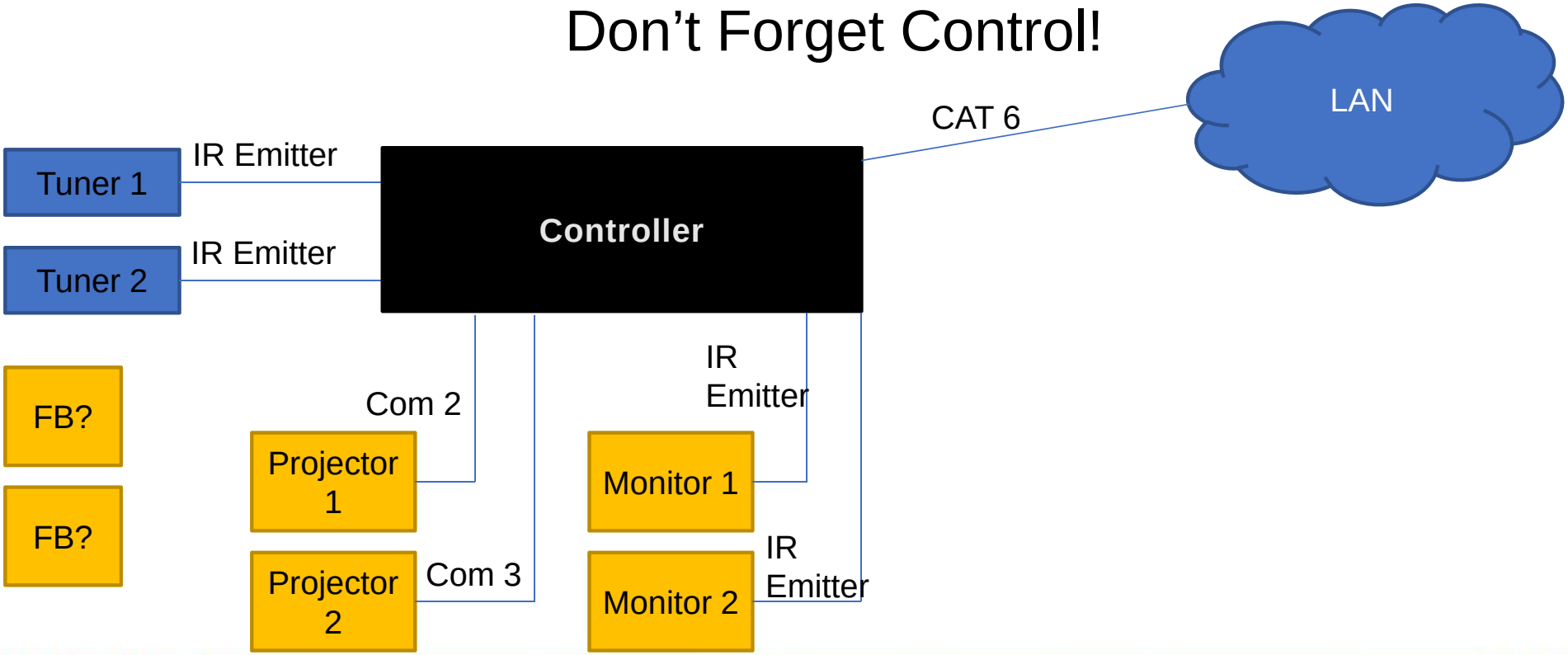
Scenario 2

Don’t Forget Control!



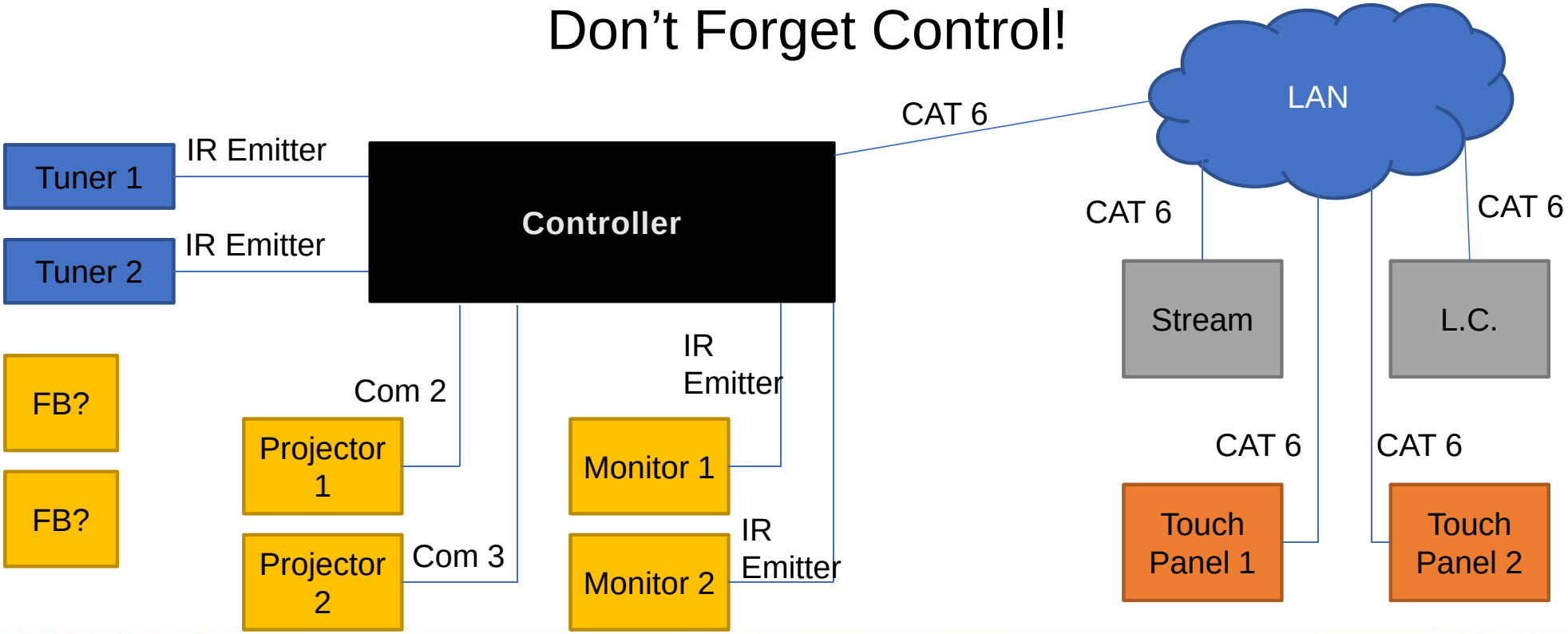
Scenario 2

Don’t Forget Control!



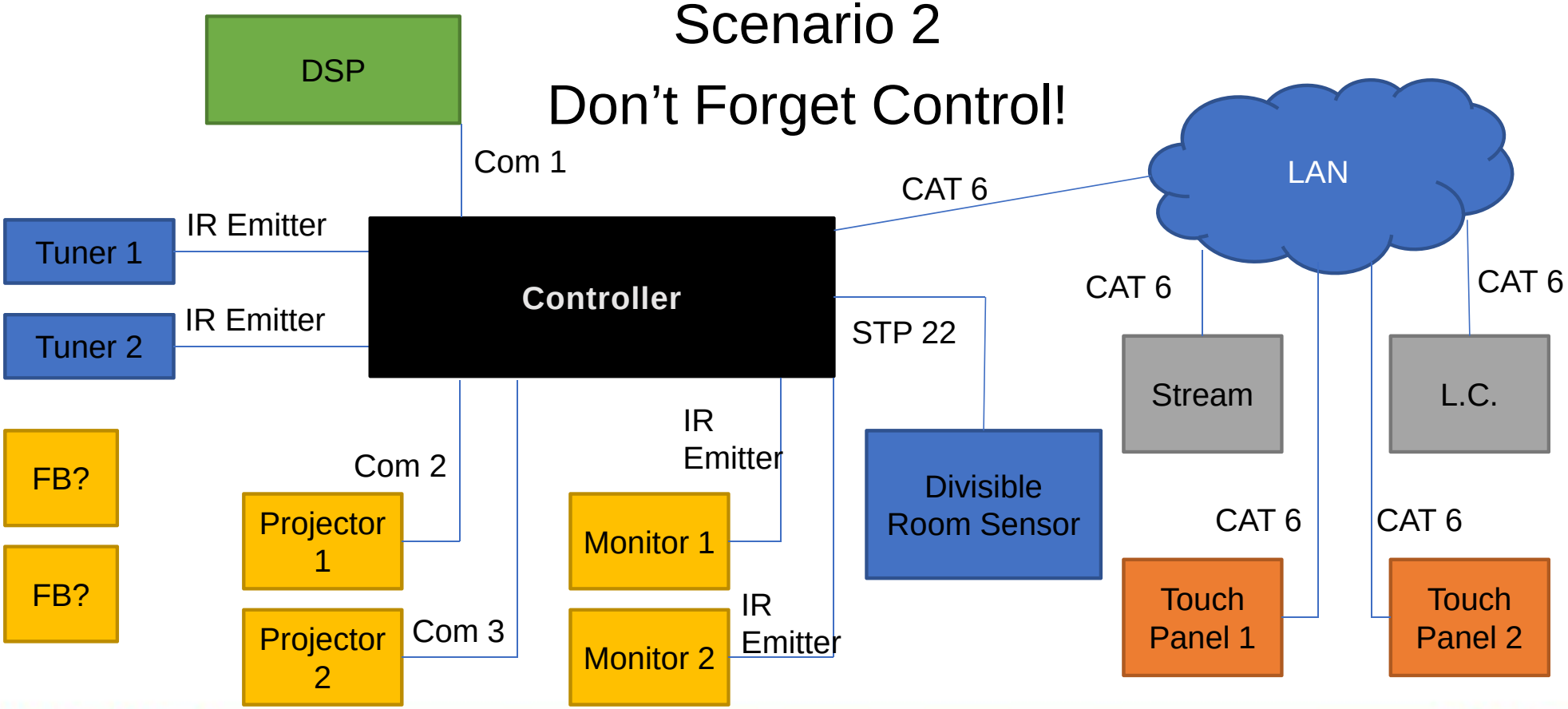
Scenario 2

Don’t Forget Control!



Scenario 2

Don’t Forget Control!



Let’s Put into Practice

Scenario 3

Board Room with – Rack Pc, 1 Table inputs, BluRay, TV Tuner, 1 Guest Input, Document Camera, Two Room Cameras

2 Side TVs for Audience

10 preview monitors for Board Table

Recording Streaming

Video Conference

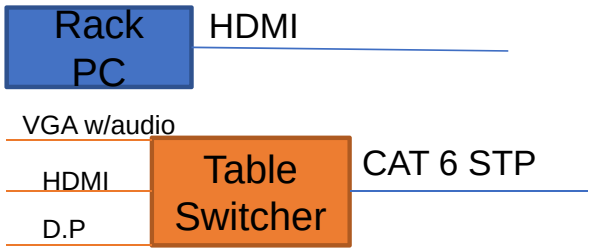
Soft Codec conferencing

Scenario 3

Customer wants Rack PC

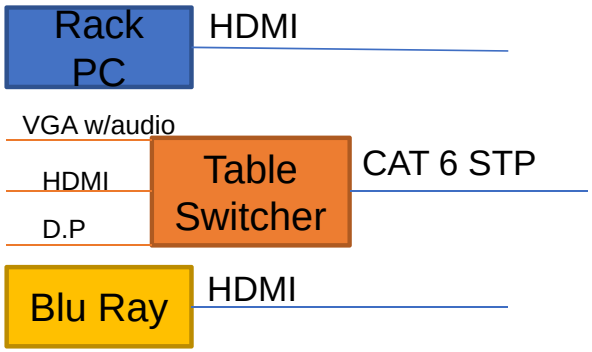
Scenario 3

Customer wants Table Input



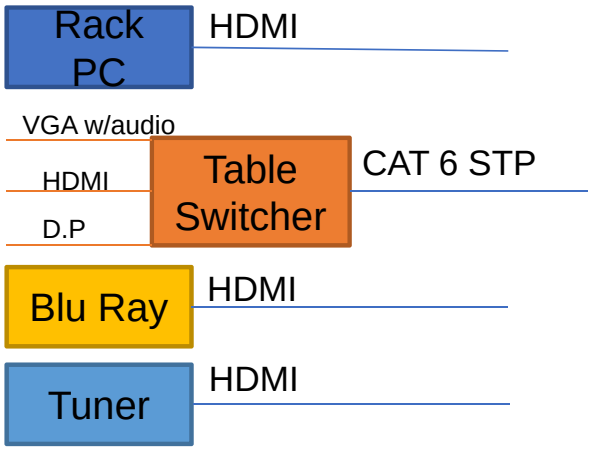
Scenario 3

Customer wants Blu Ray



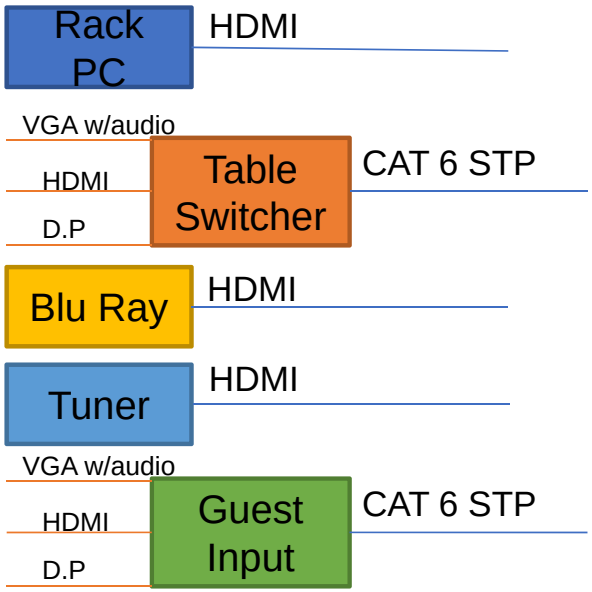
Scenario 3

Customer wants TV Tuner



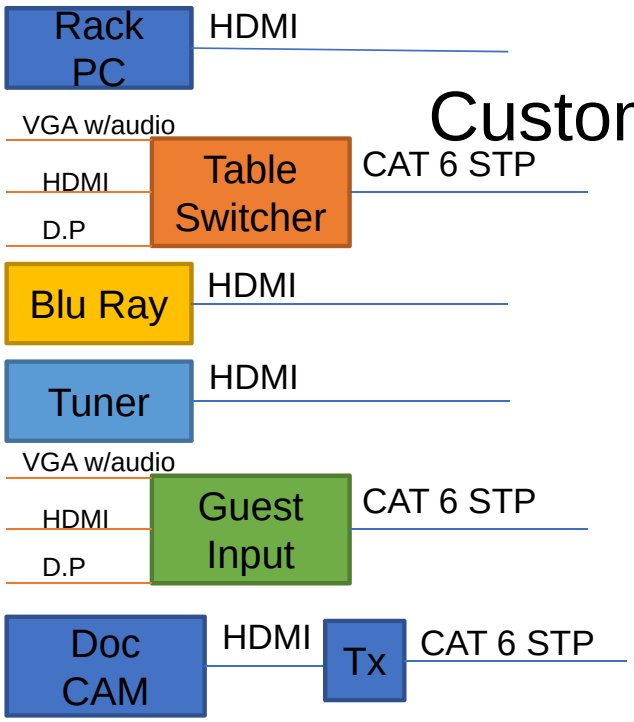
Scenario 3

Customer wants Guest Input



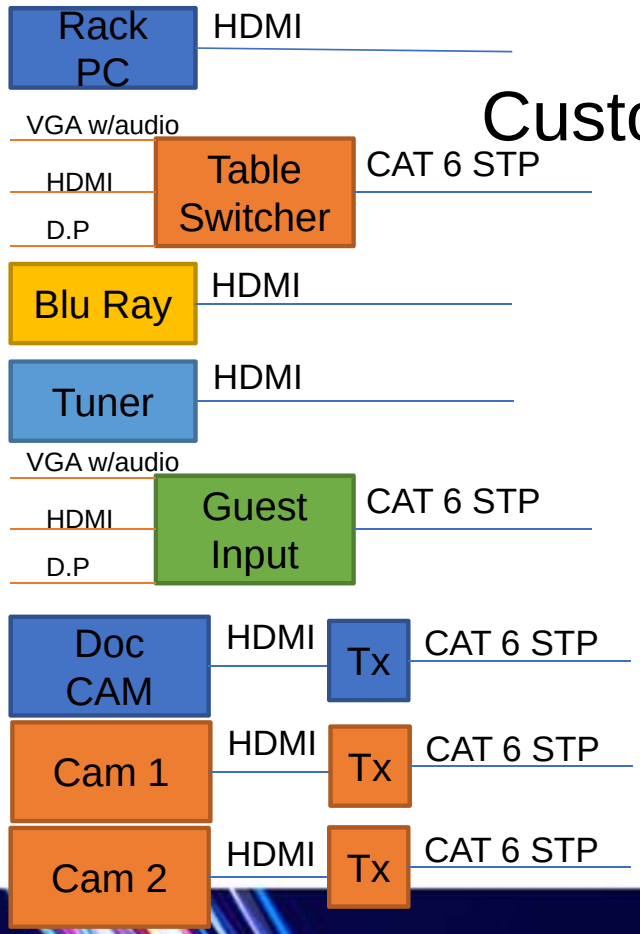
Scenario 3

Customer wants a Document Camera



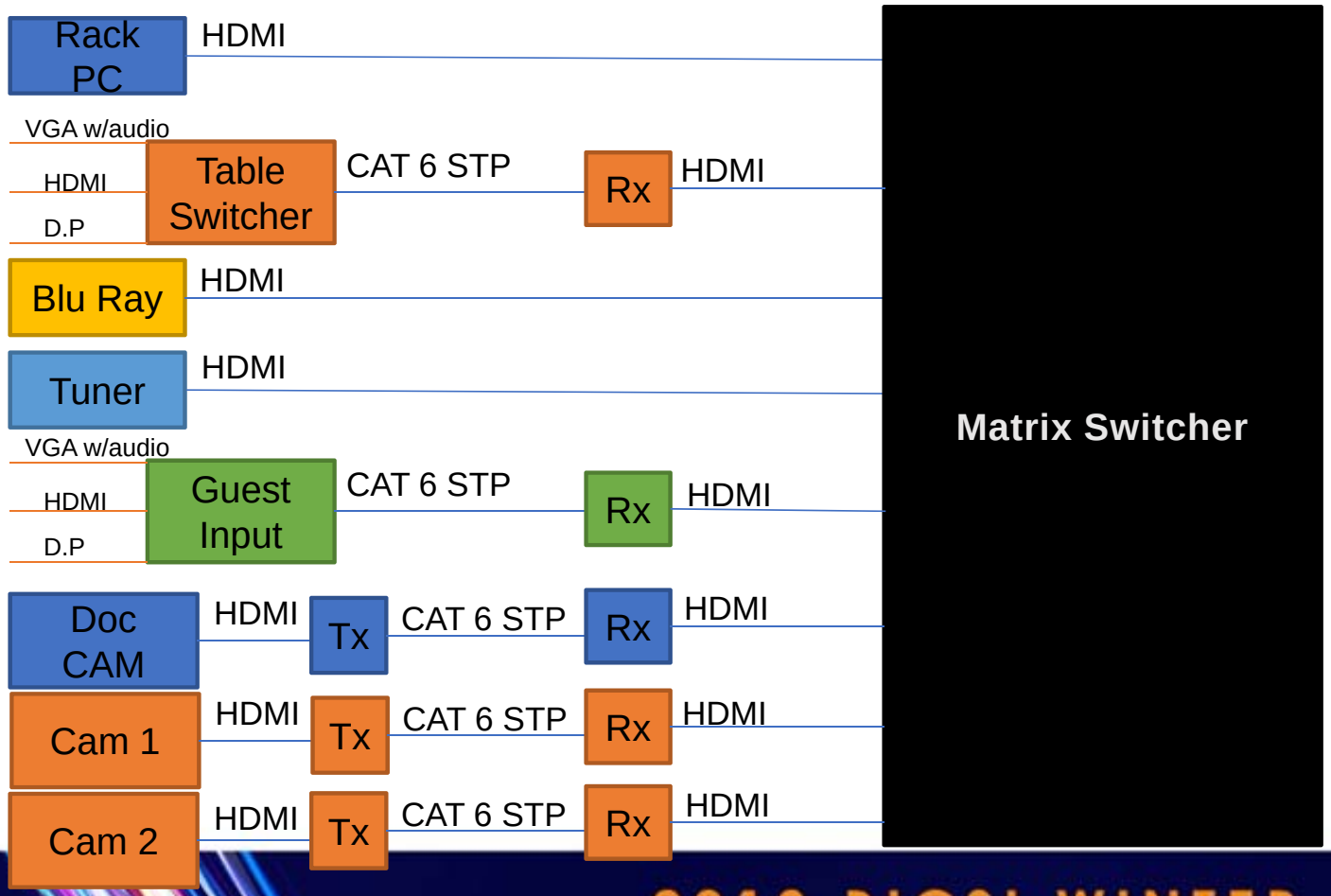
Scenario 3

Customer wants 2 Room Cameras



Scenario 3

Connect to Matrix

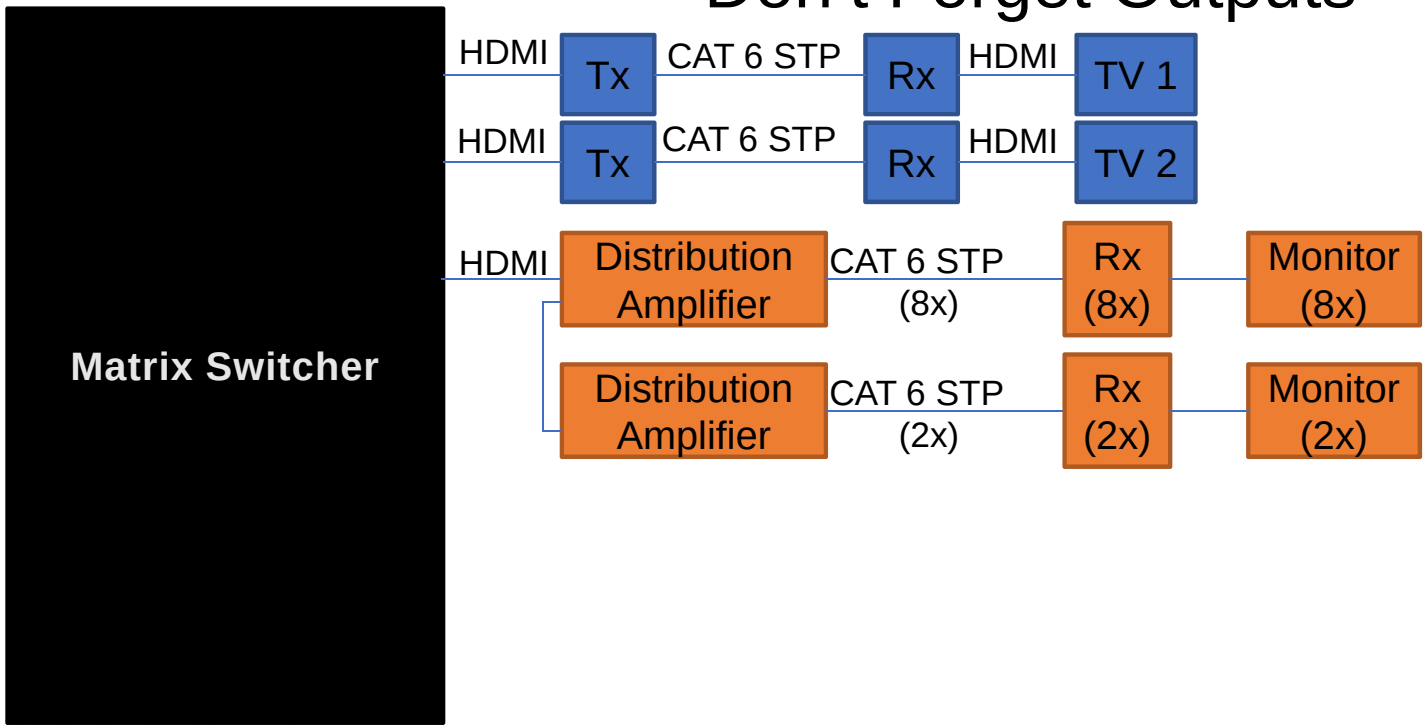


Scenario 3

Don’t Forget Outputs

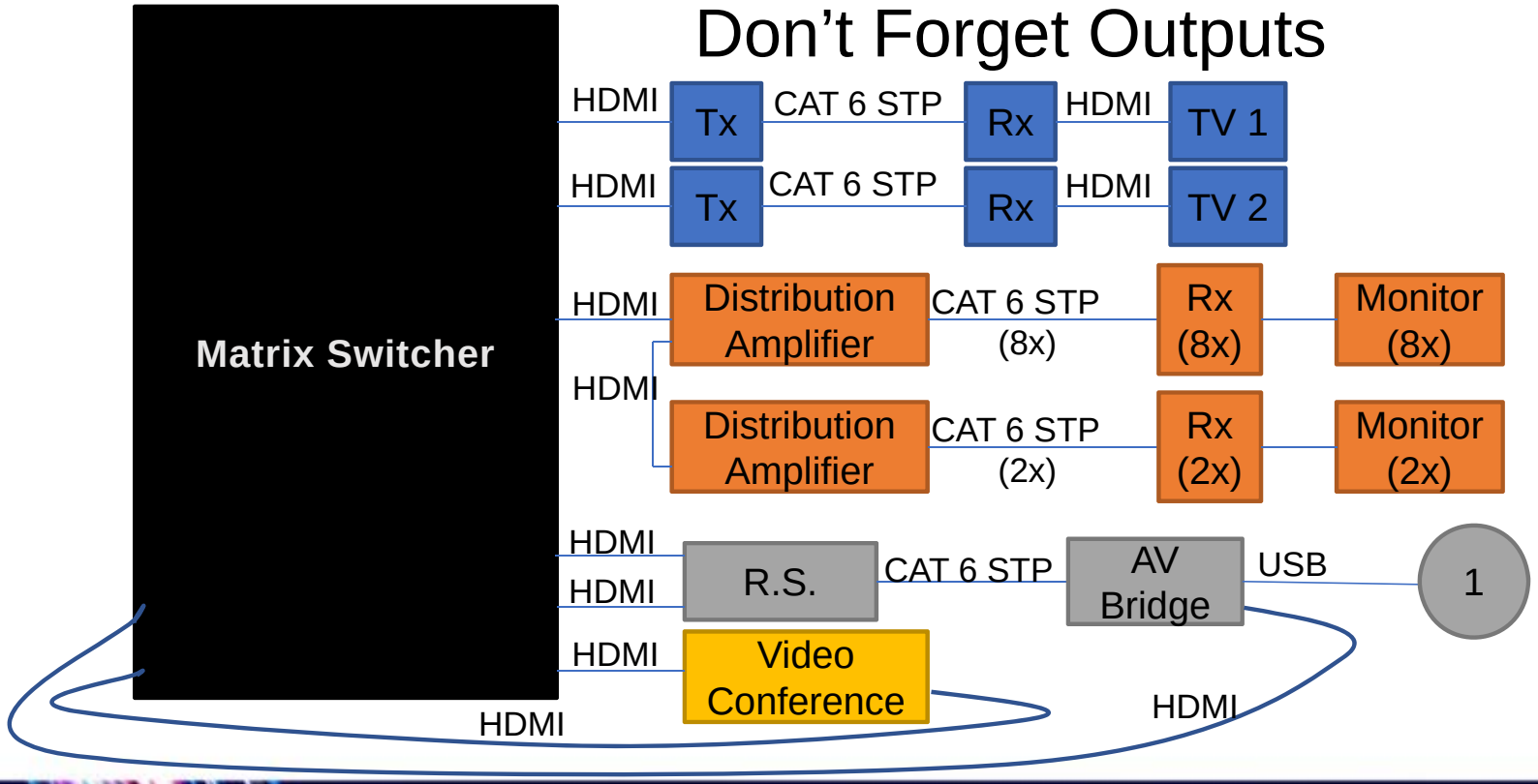
Scenario 3

Don’t Forget Outputs



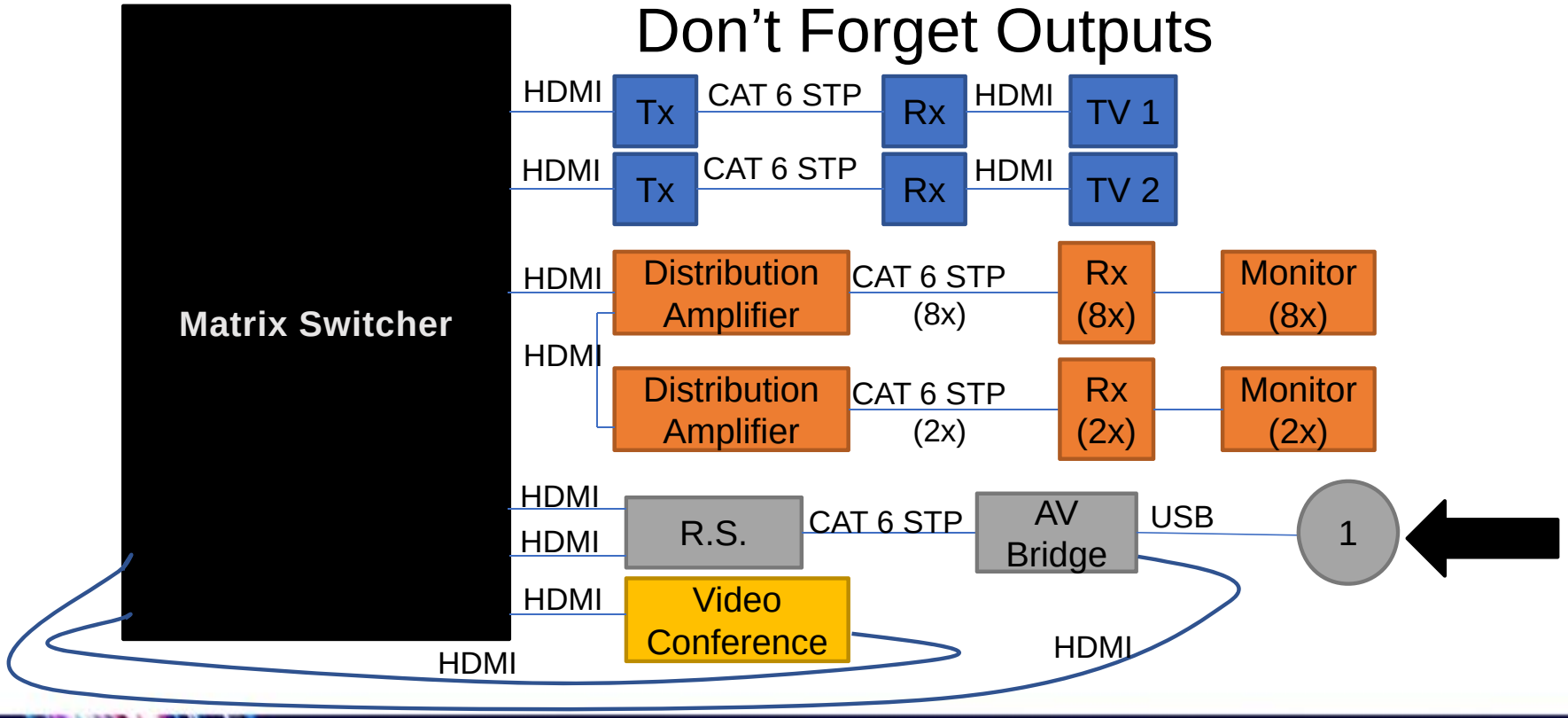
Scenario 3

Don’t Forget Outputs

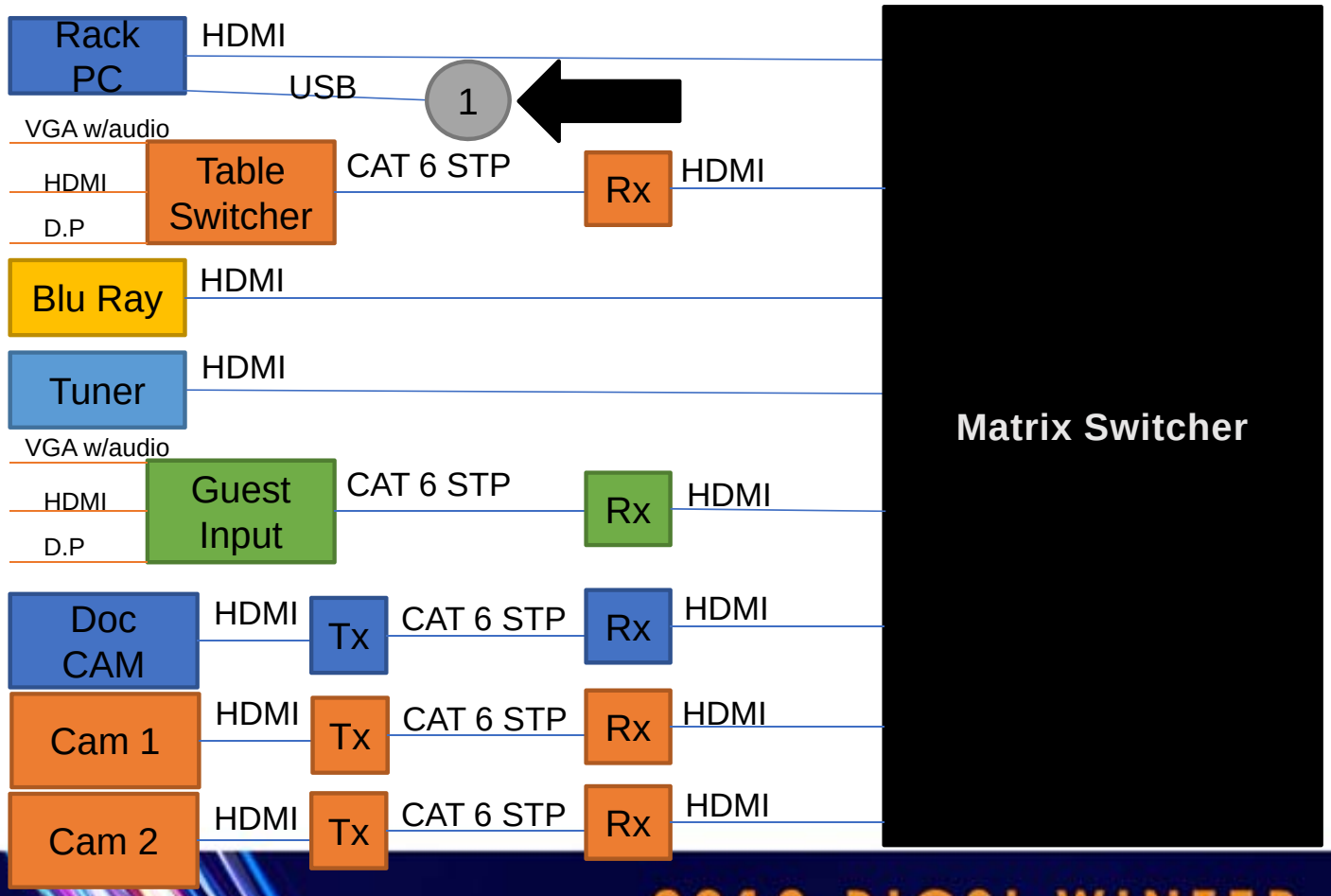


Scenario 3

Don’t Forget Outputs

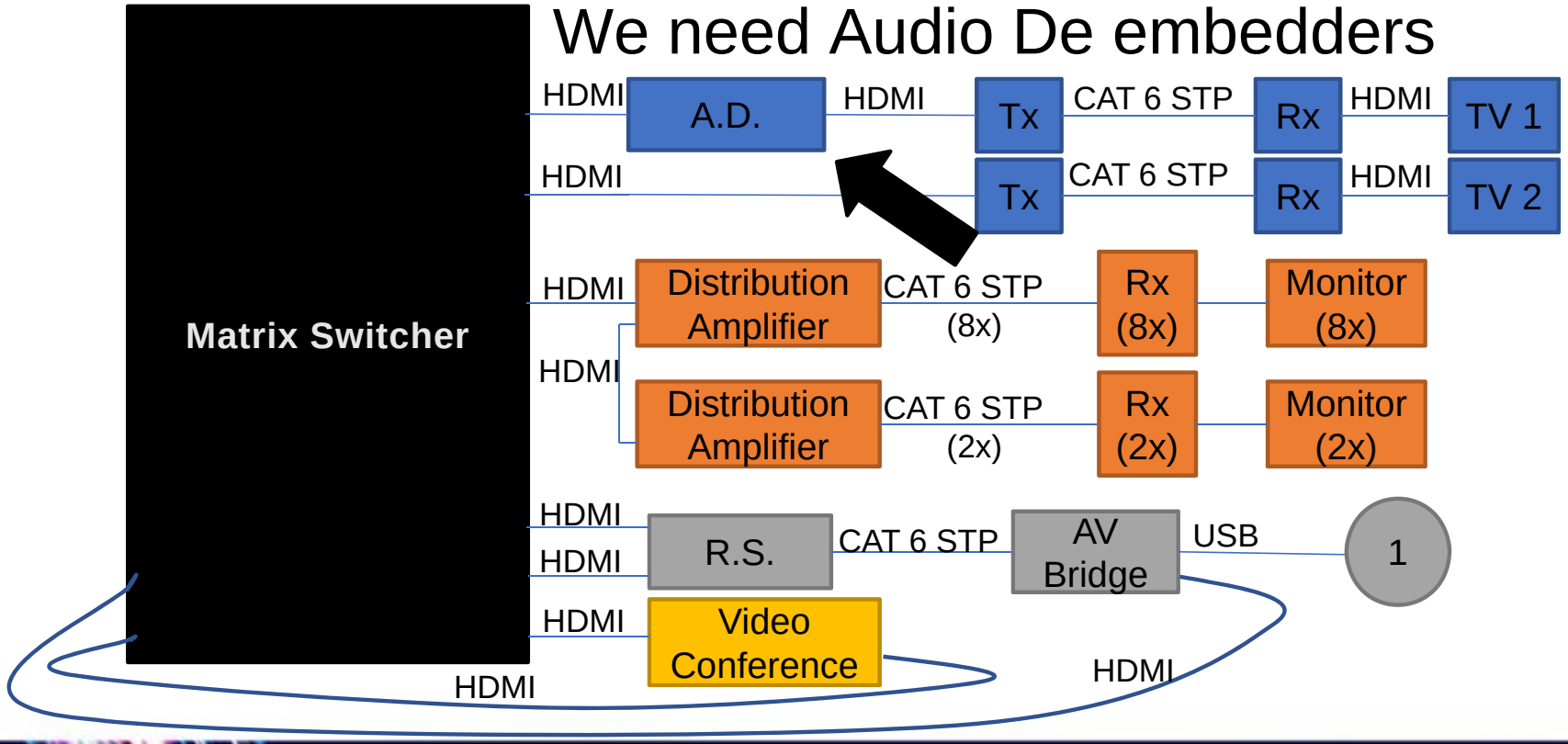


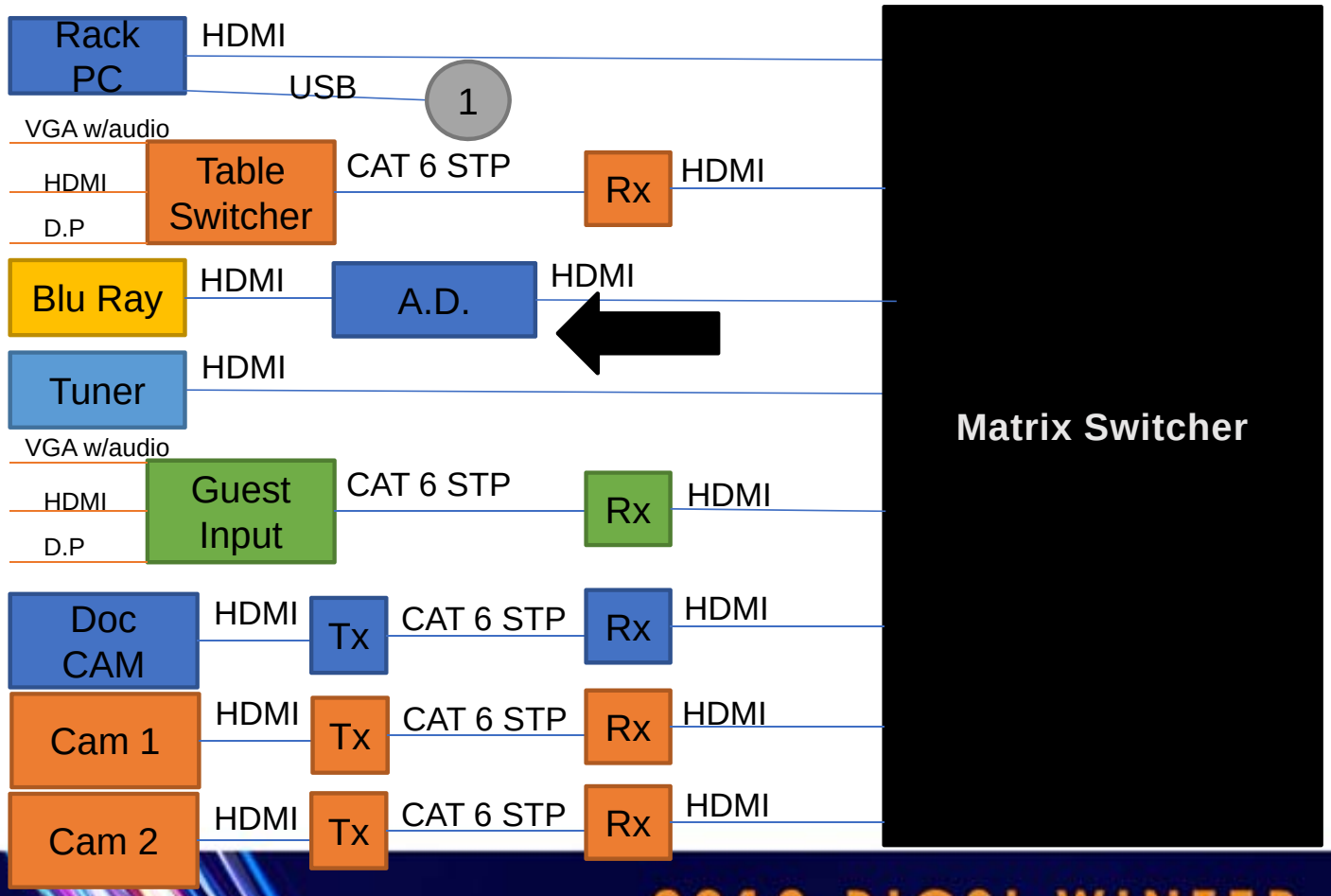
Scenario 3
USB Connection



Scenario 3

We need Audio De embedders





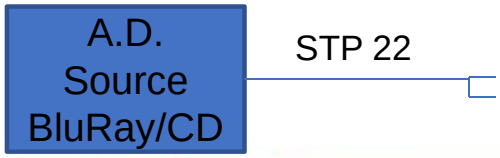
Scenario 3

We need Audio De-embedders

Scenario 3
Don’t Forget Audio

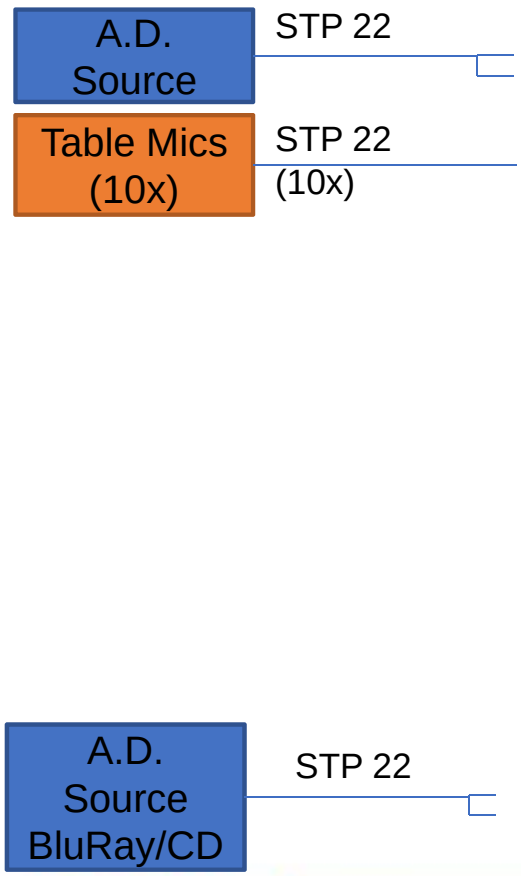
STP 22

STP 22
(10x)

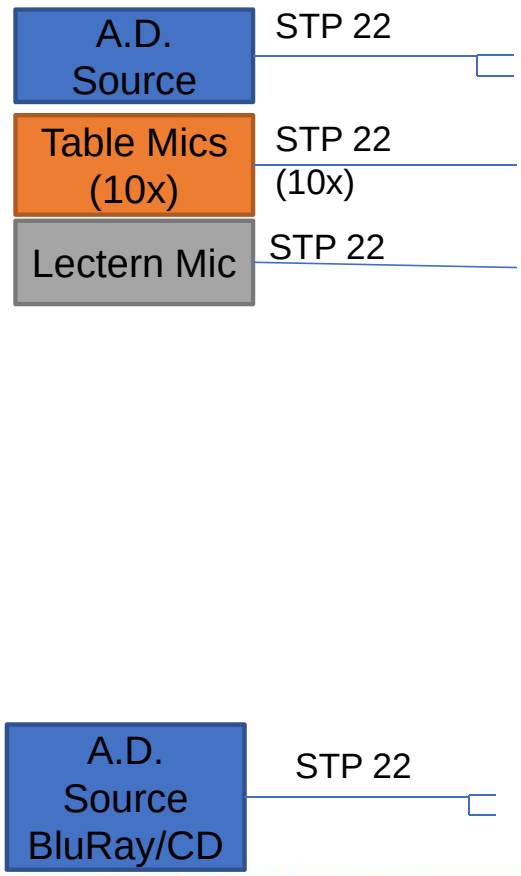


STP 22

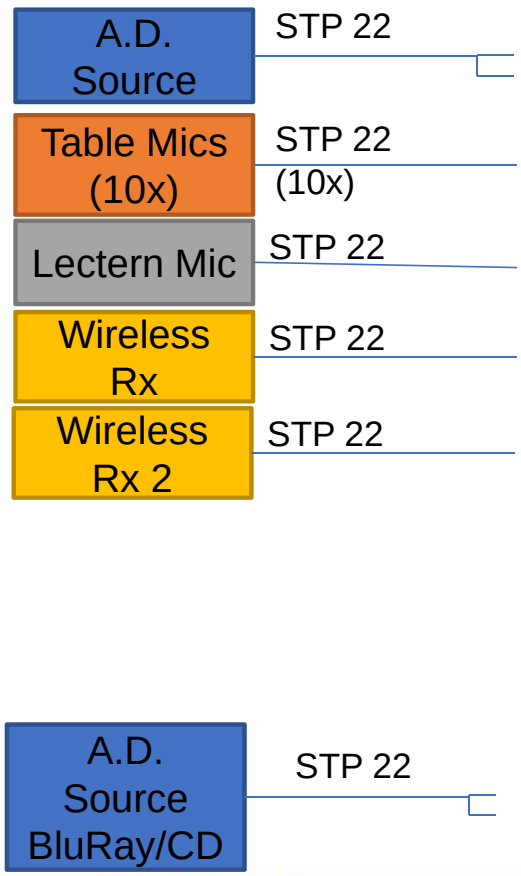
Scenario 3
Don’t Forget Audio



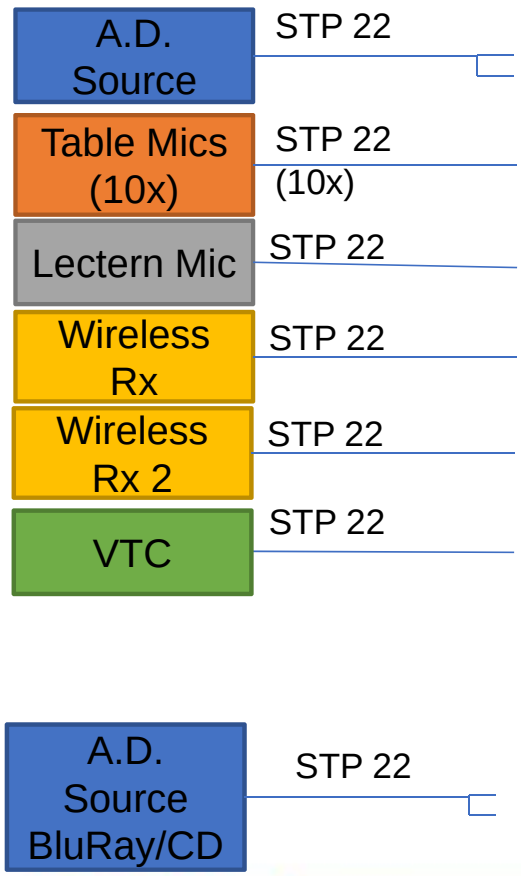
Scenario 3
Don’t Forget Audio



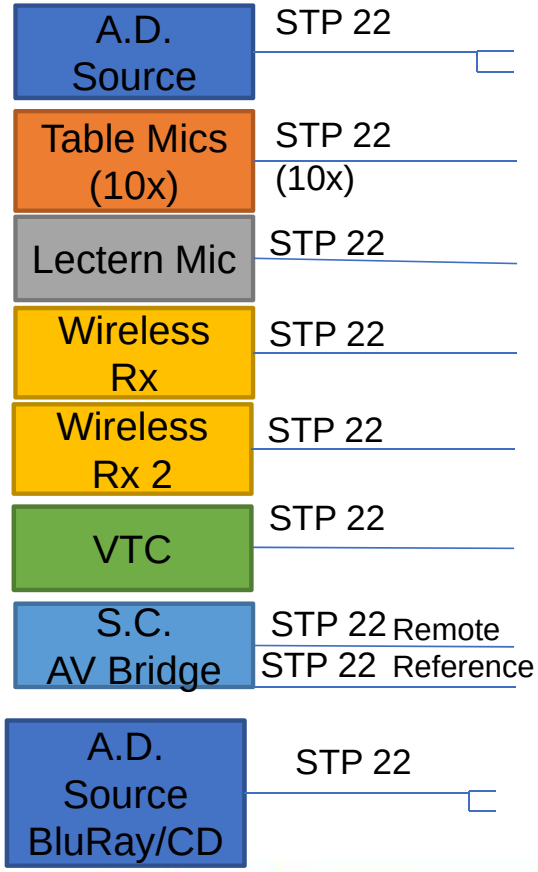
Scenario 3
Don’t Forget Audio



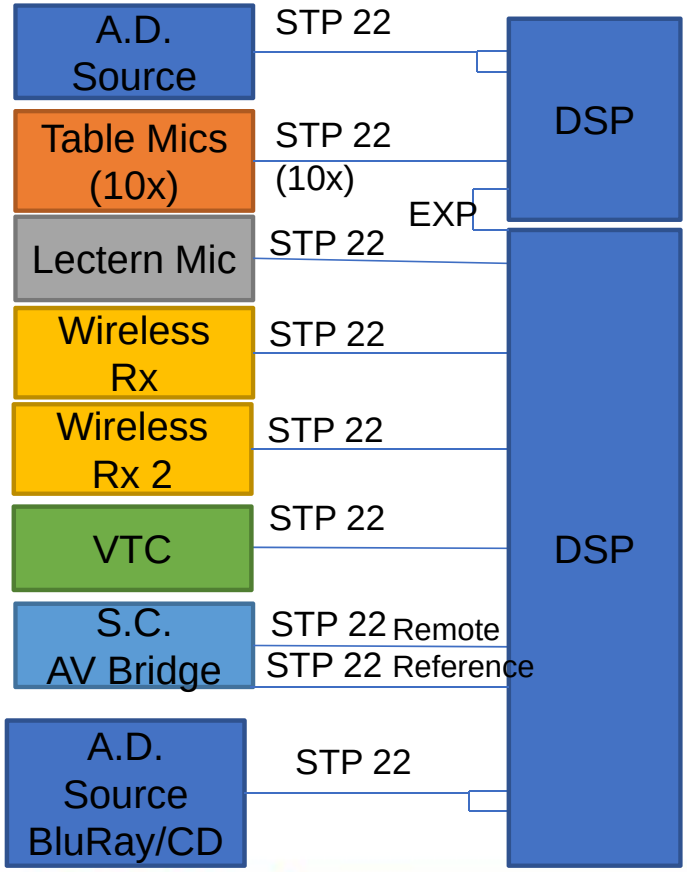
Scenario 3
Don’t Forget Audio



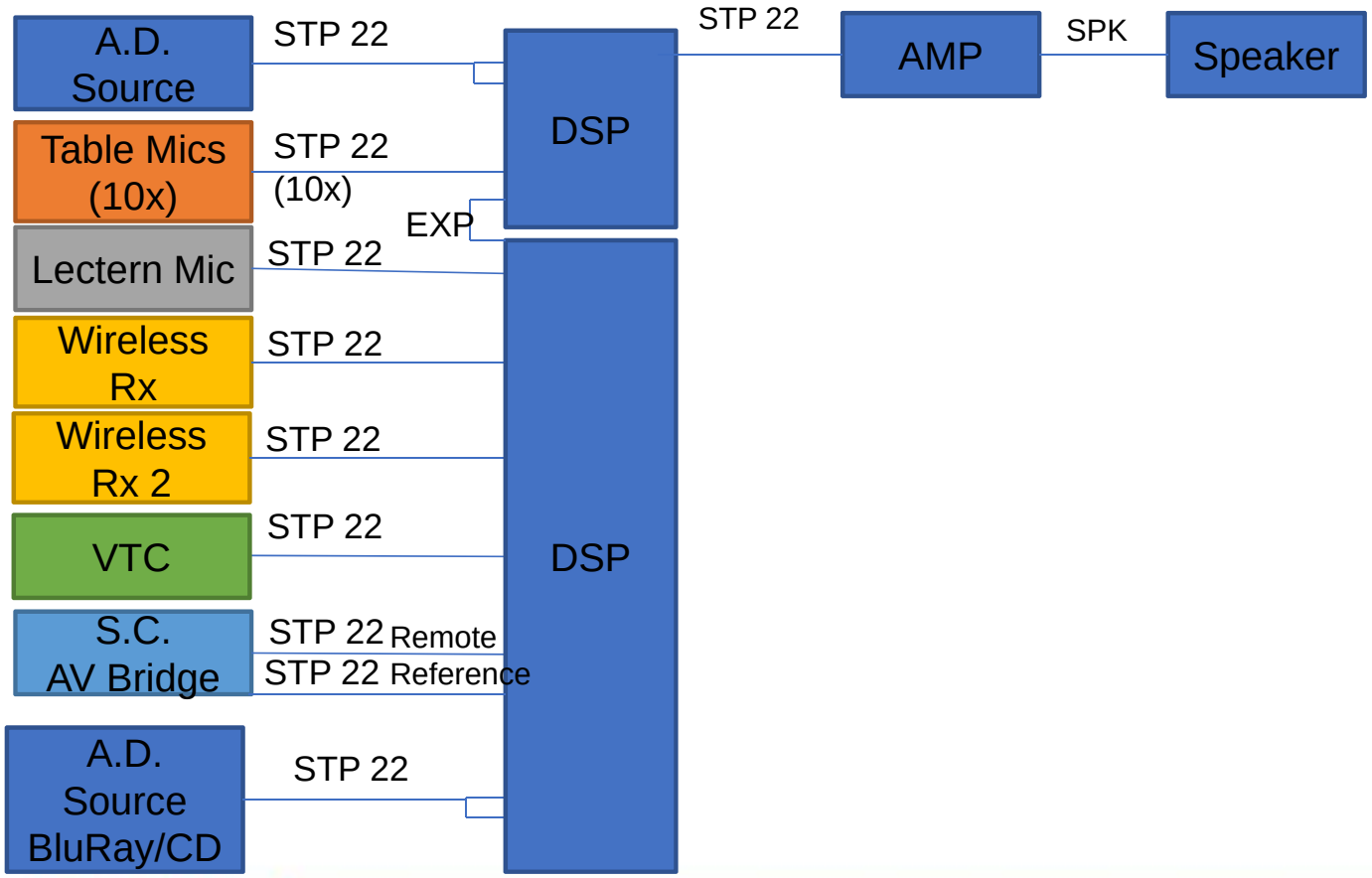
Scenario 3
Don’t Forget Audio



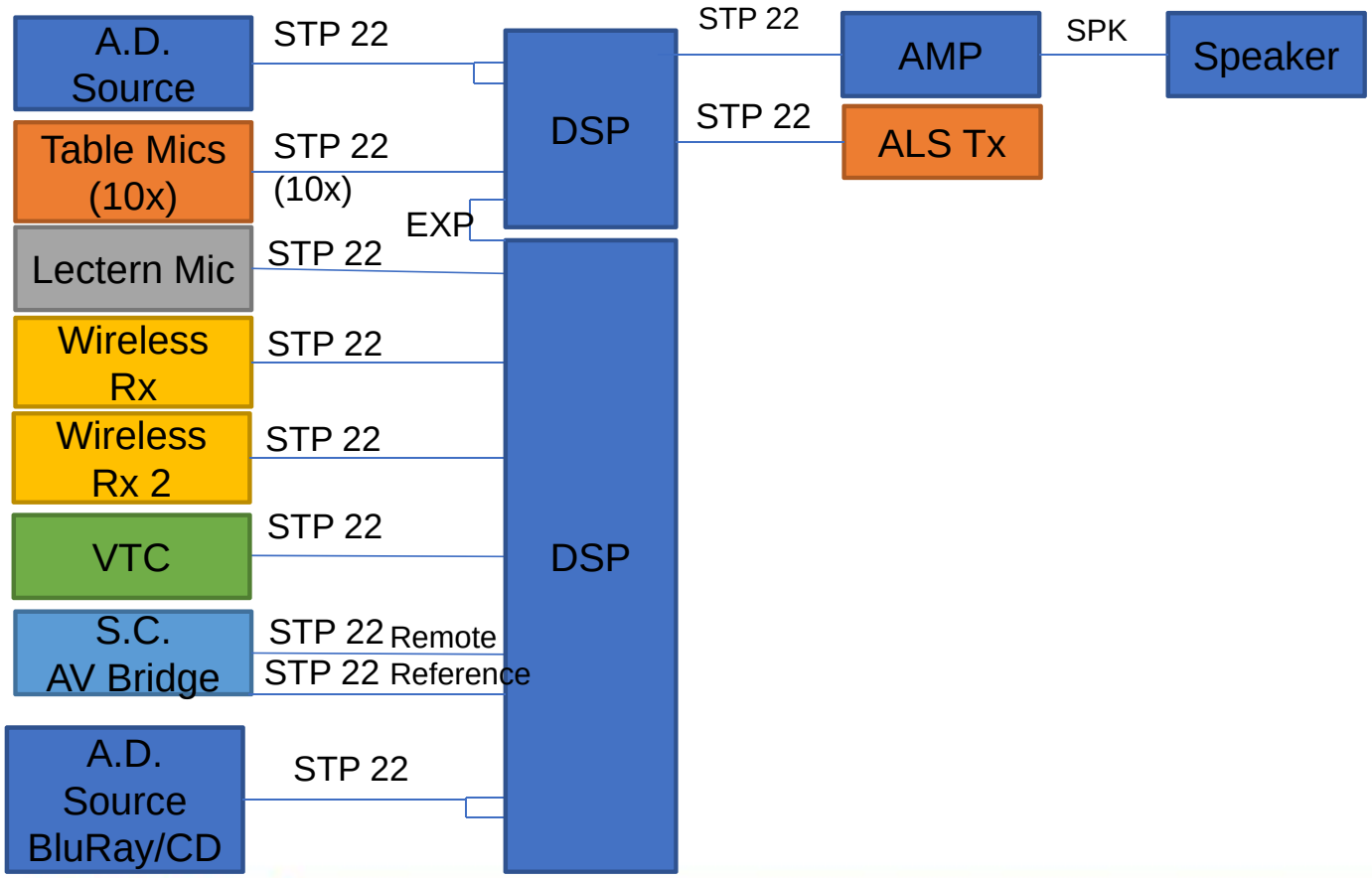
Scenario 3
Don’t Forget Audio



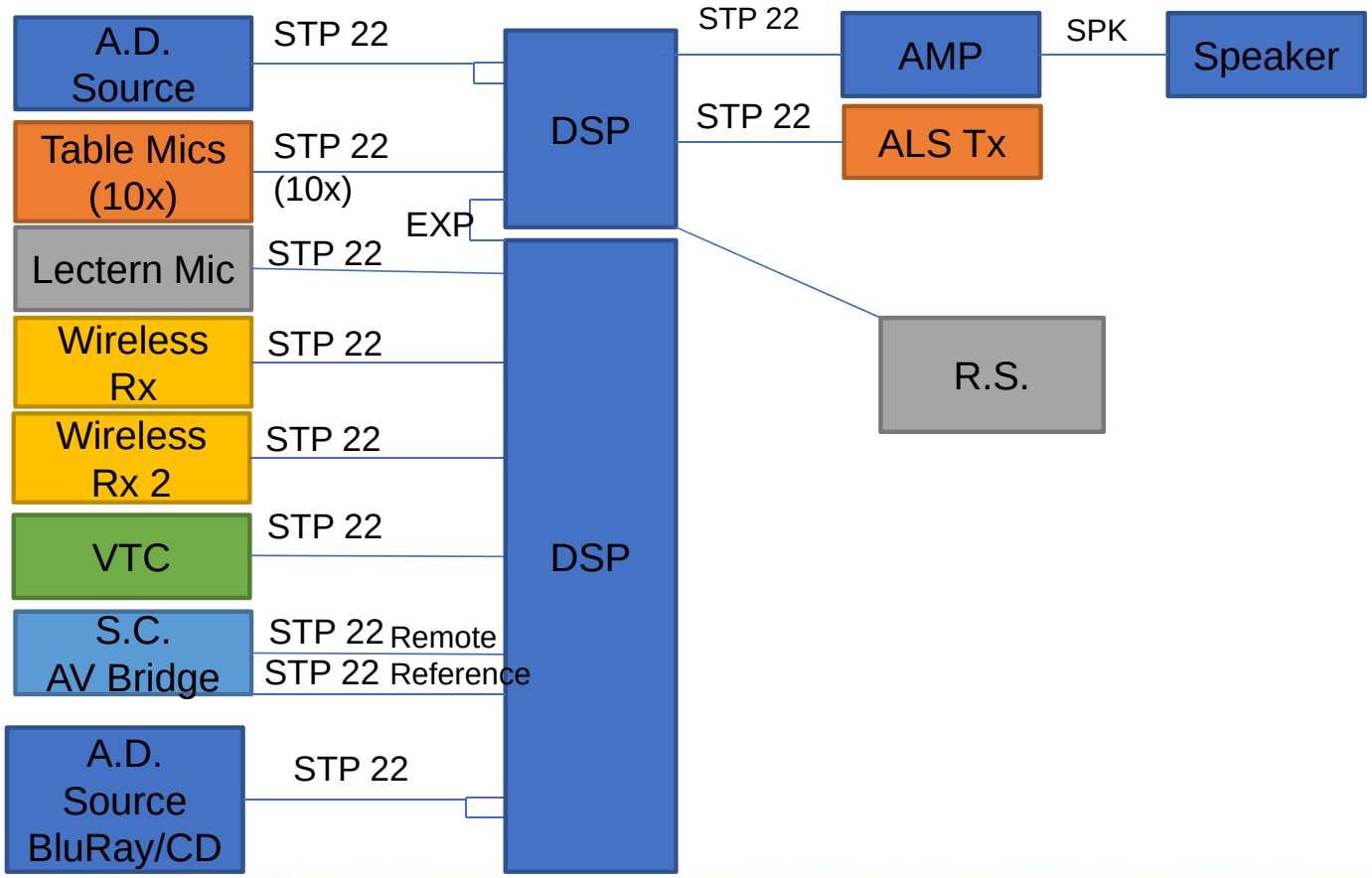
Scenario 3 Don't Forget Audio



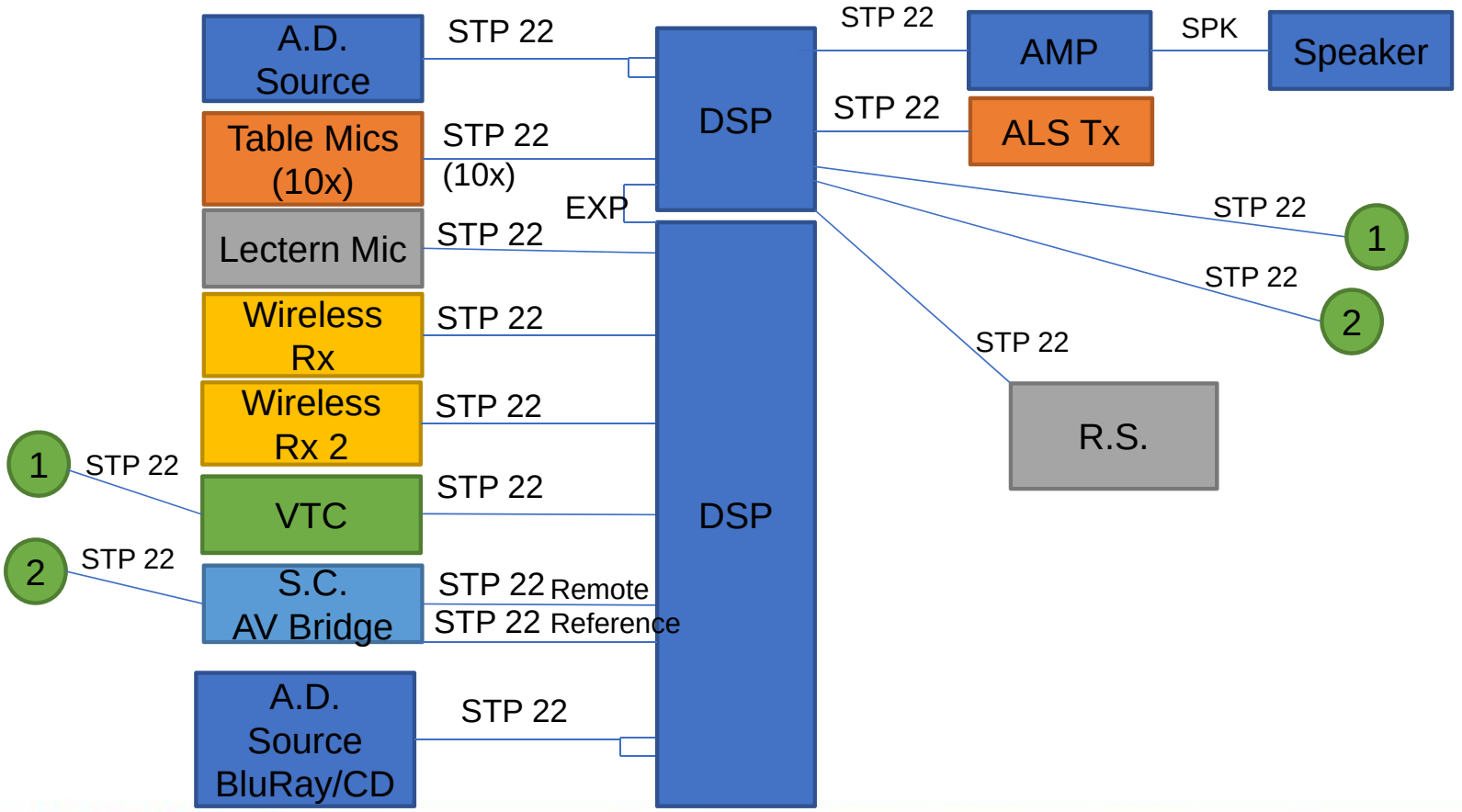
Scenario 3 Don't Forget Audio



Scenario 3 Don't Forget Audio



Scenario 3 Don't Forget Audio



Scenario 3

Push to Talk Buttons

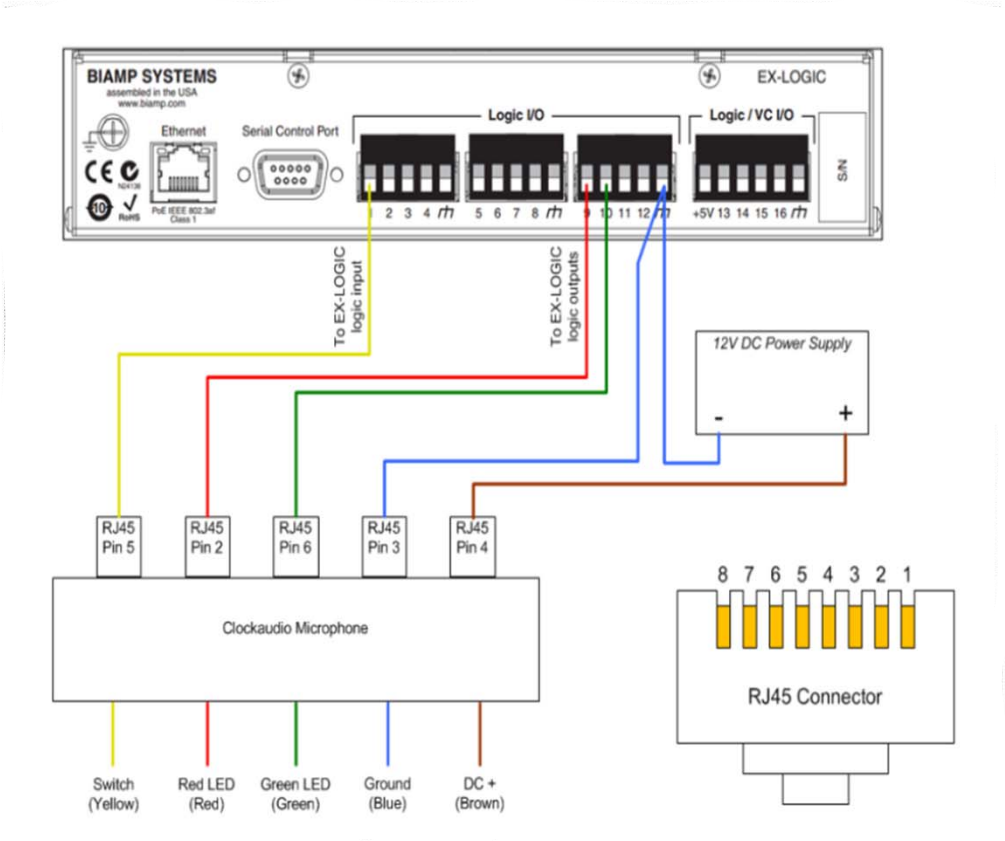
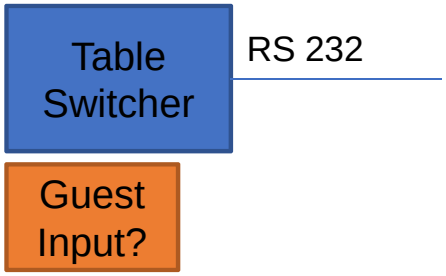


Table Switcher

RS 232

Scenario 3

Don’t forget Control!



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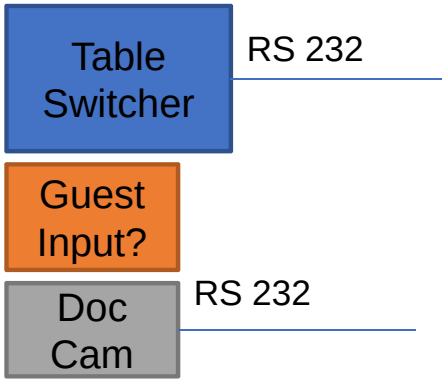
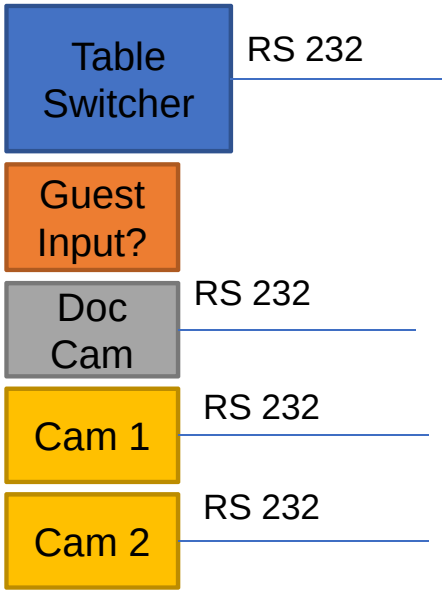
Don’t forget Control!



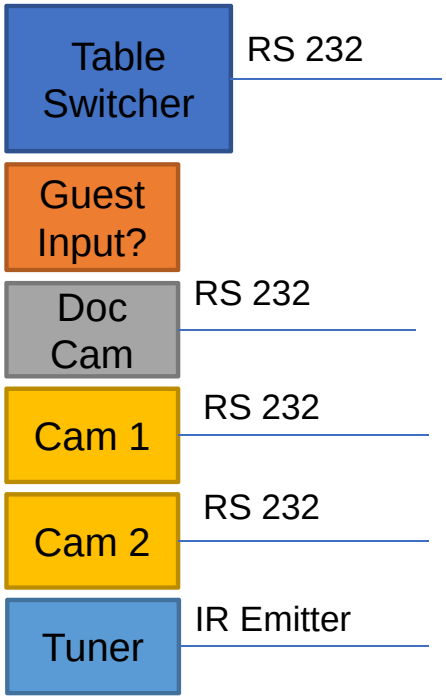
Scenario 3

Don’t forget Control!



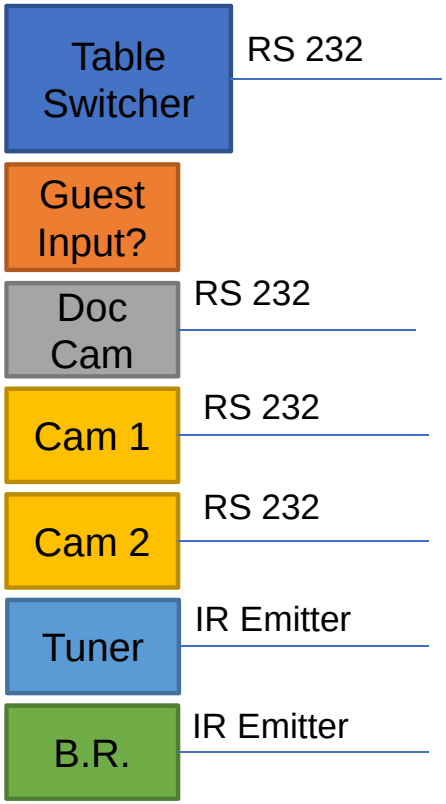
Scenario 3

Don’t forget Control!



Scenario 3

Don’t forget Control!



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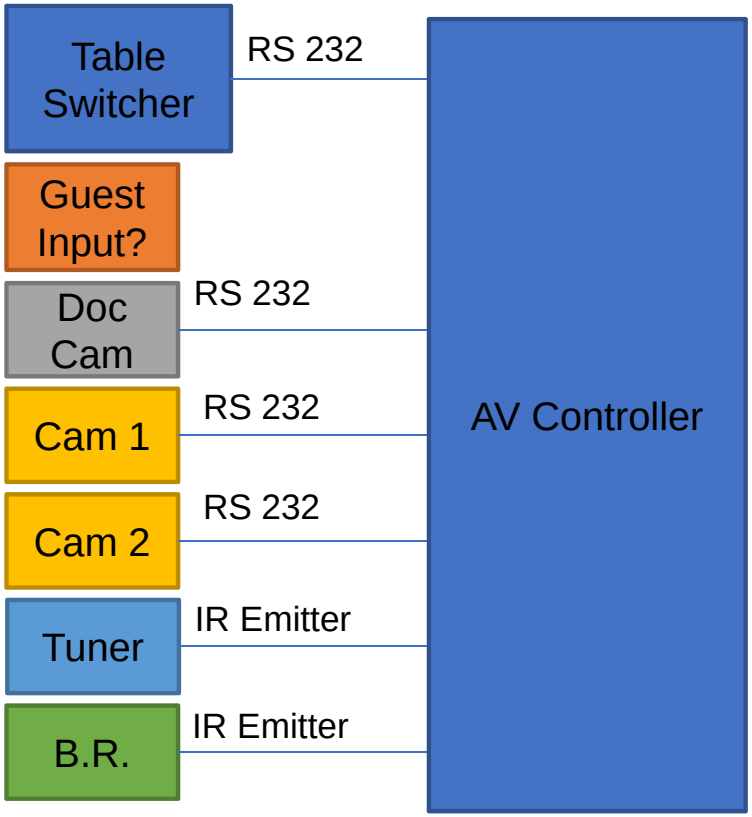
Don’t forget Control!



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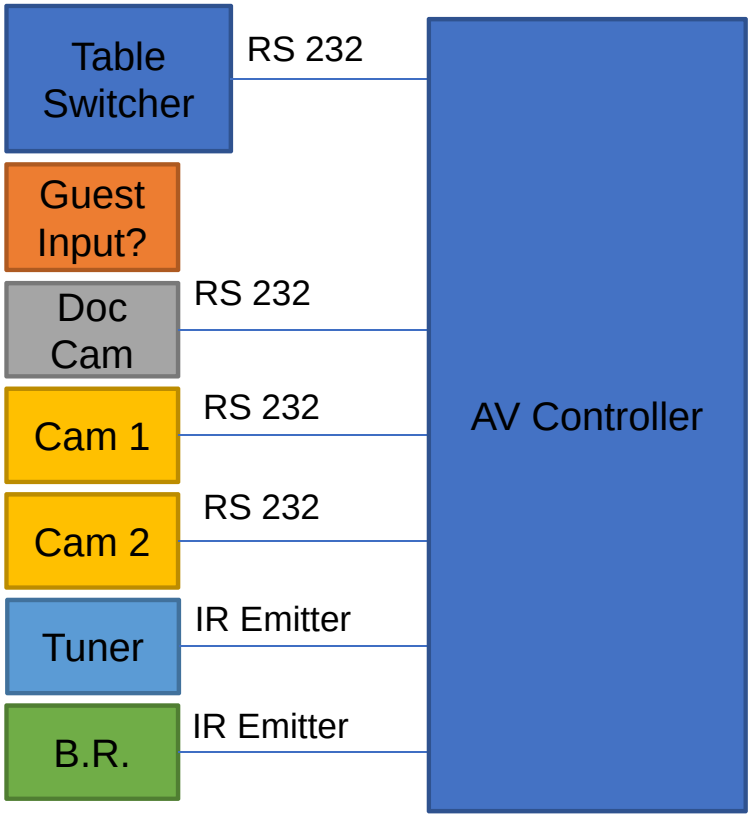
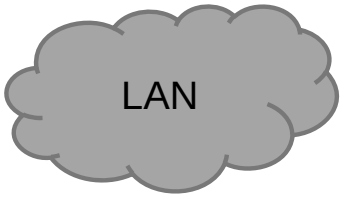
Don’t forget Control!





Scenario 3

Don’t forget Control!

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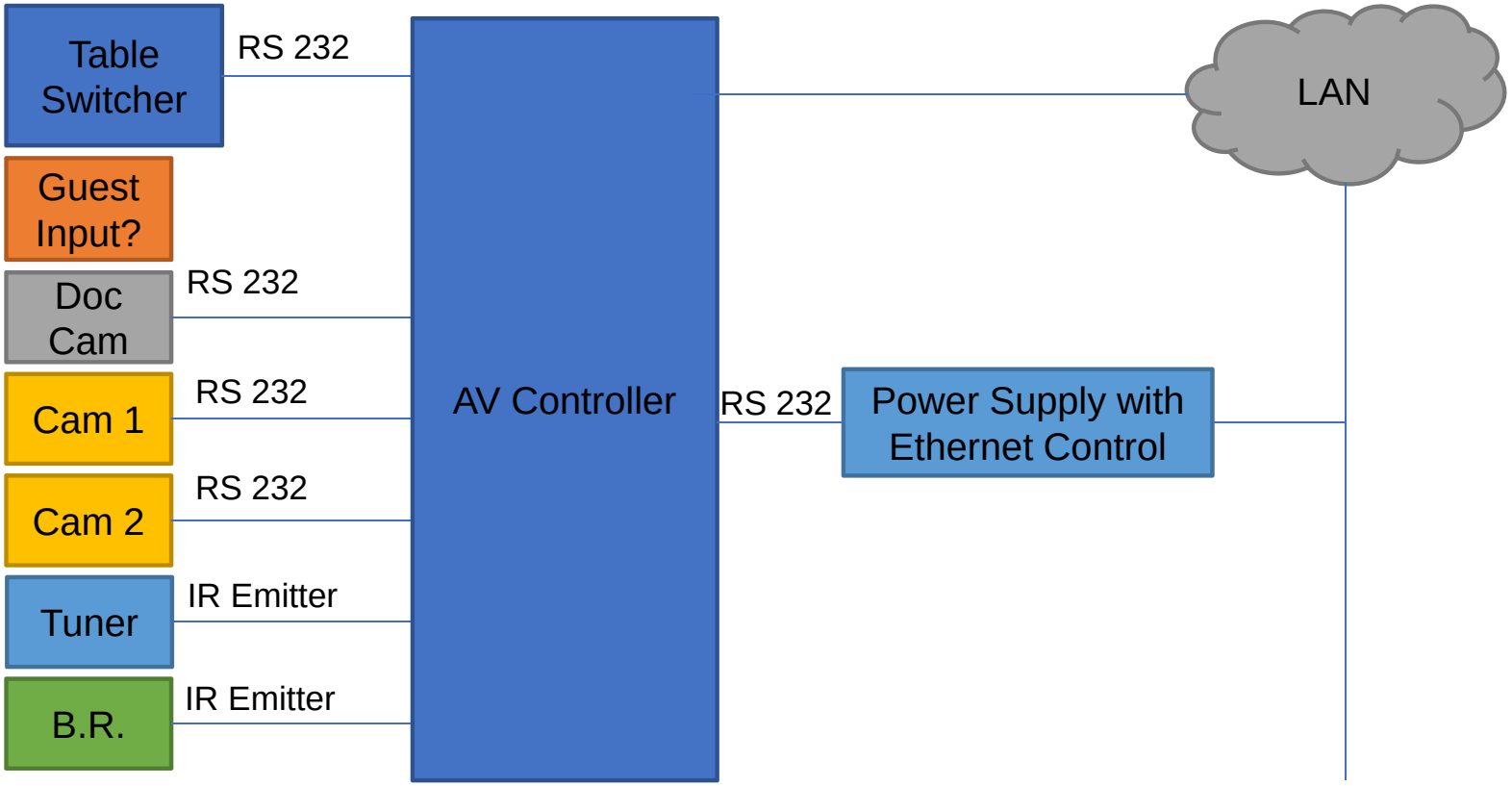
Don’t forget Control!



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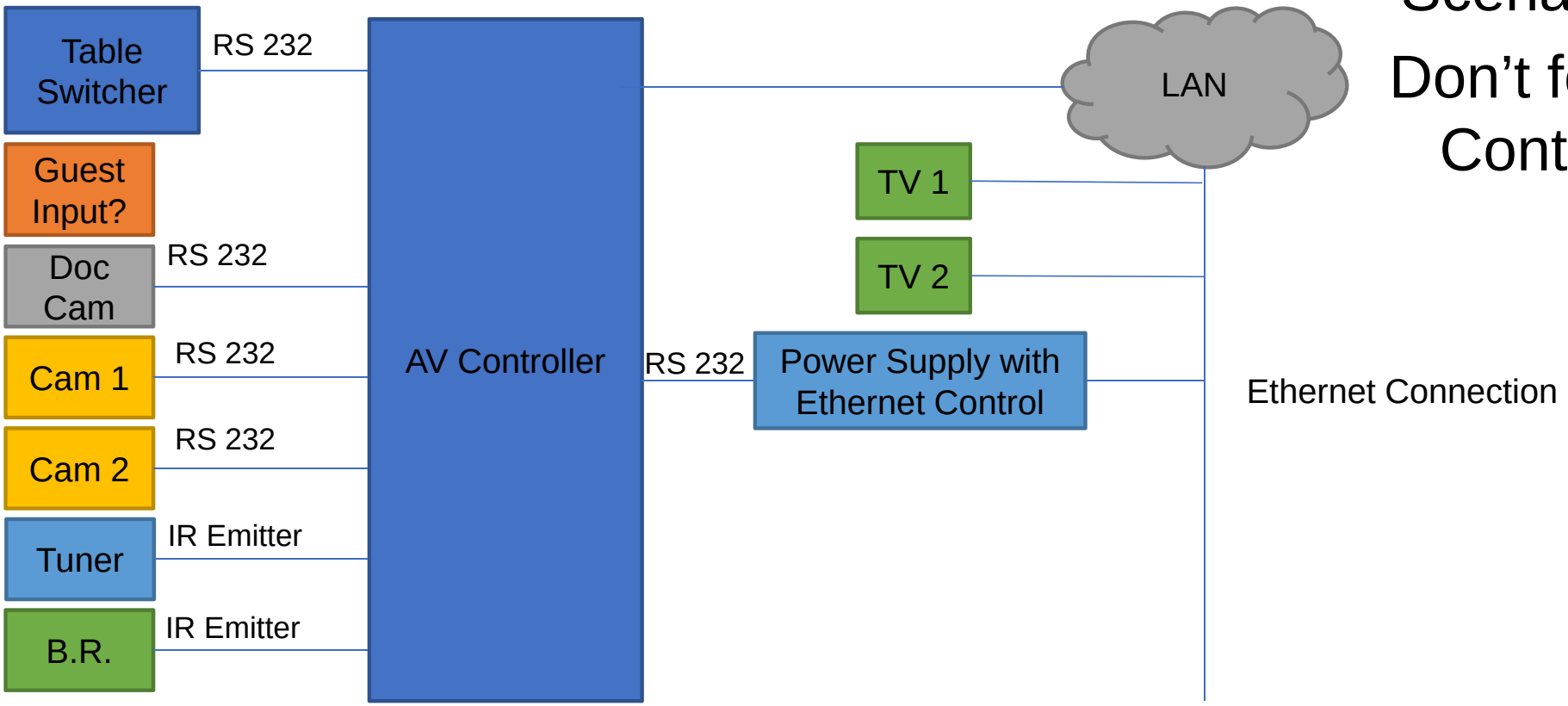

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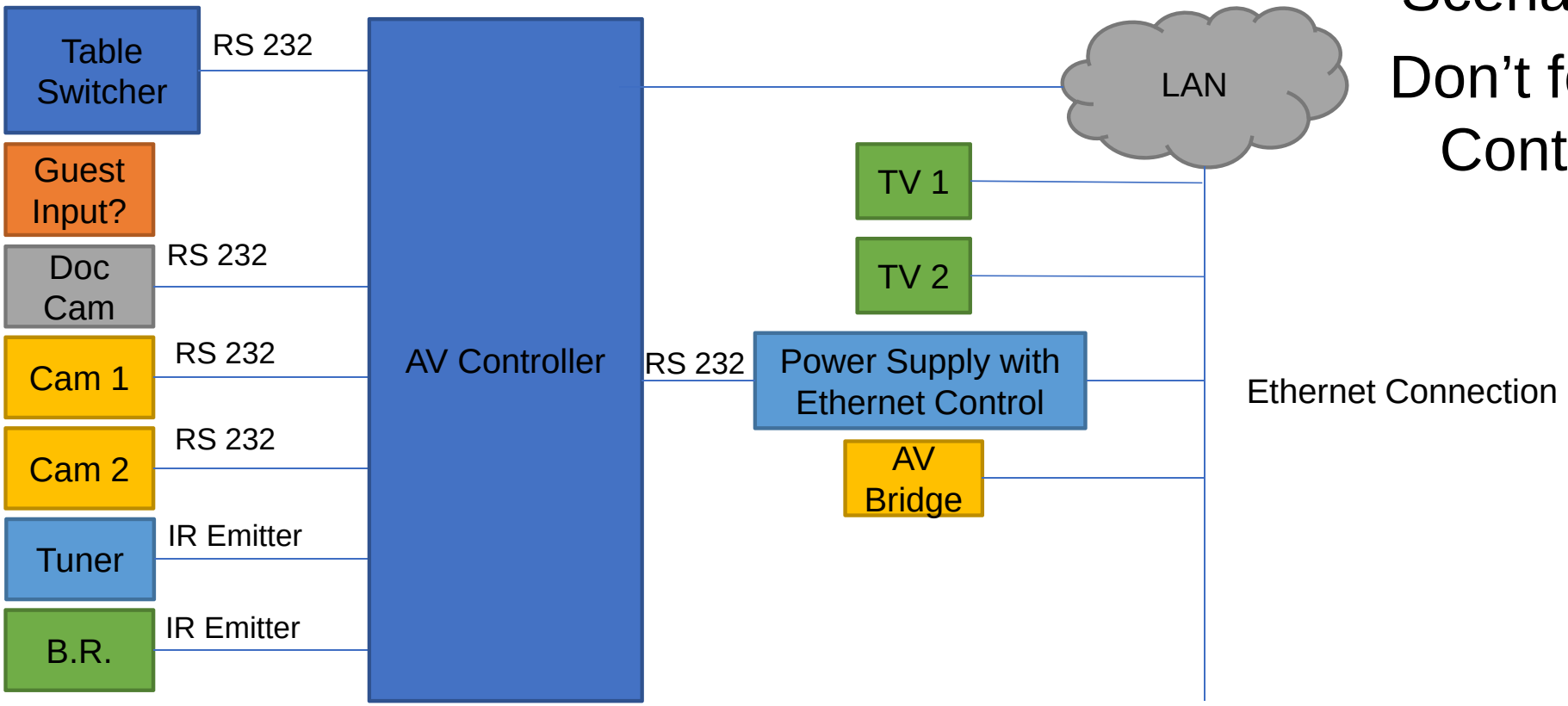
Don’t forget Control!



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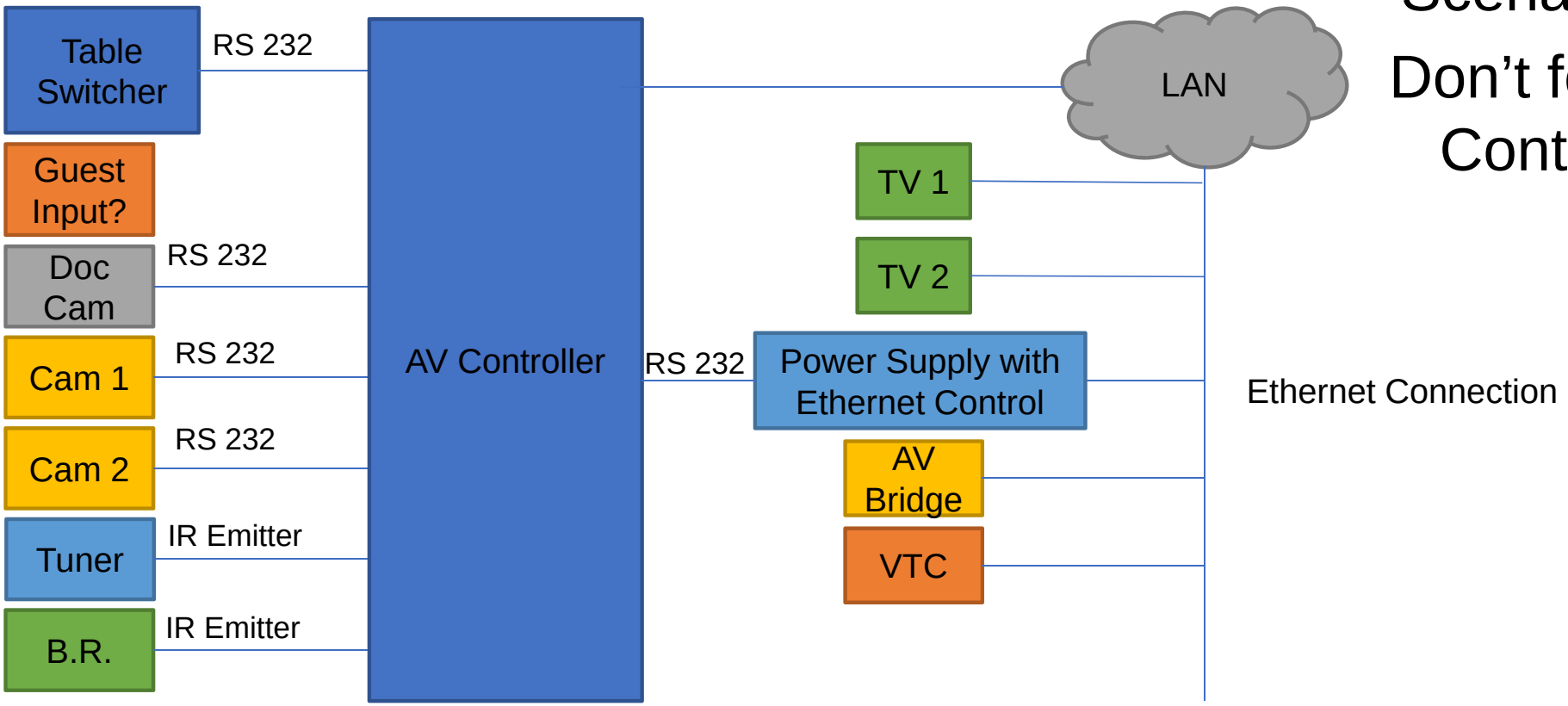

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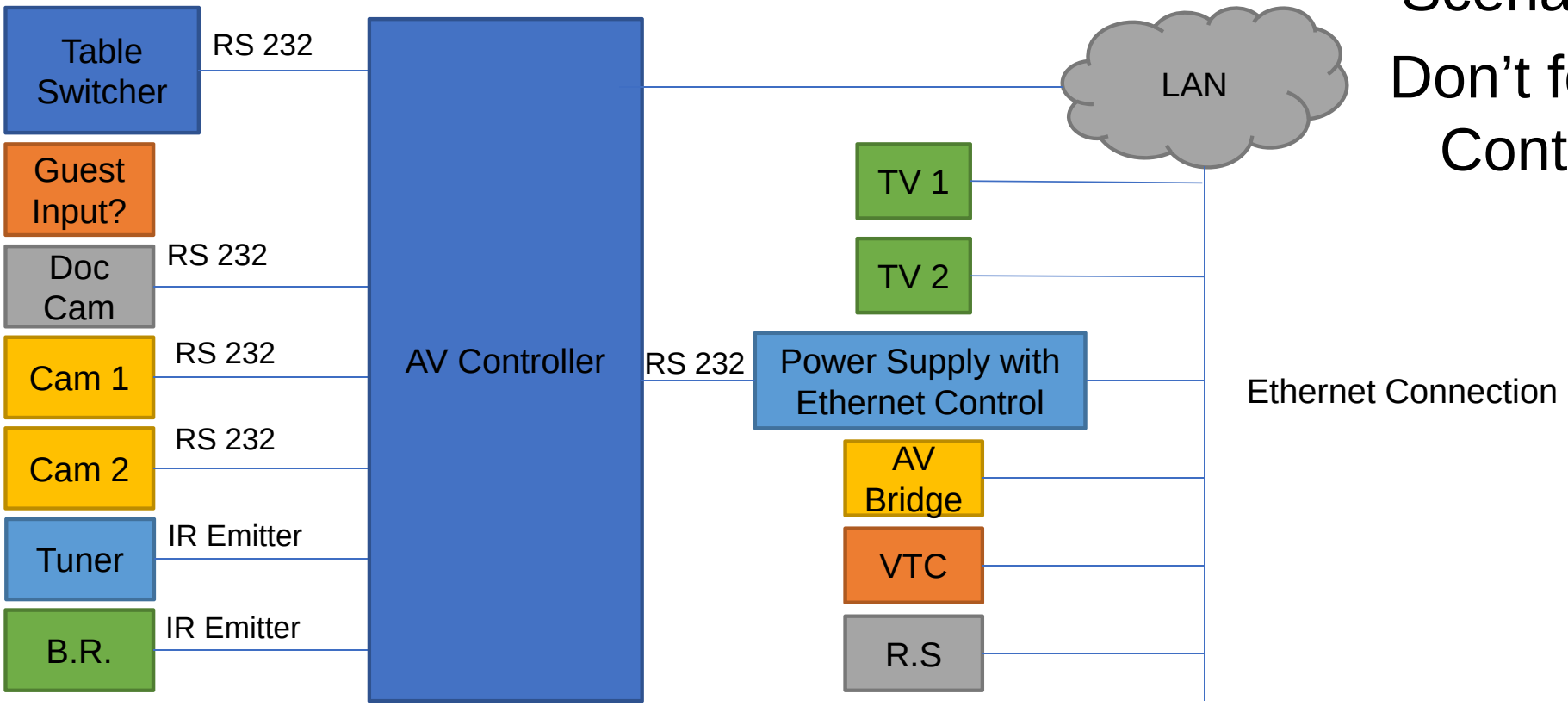
Don’t forget Control!



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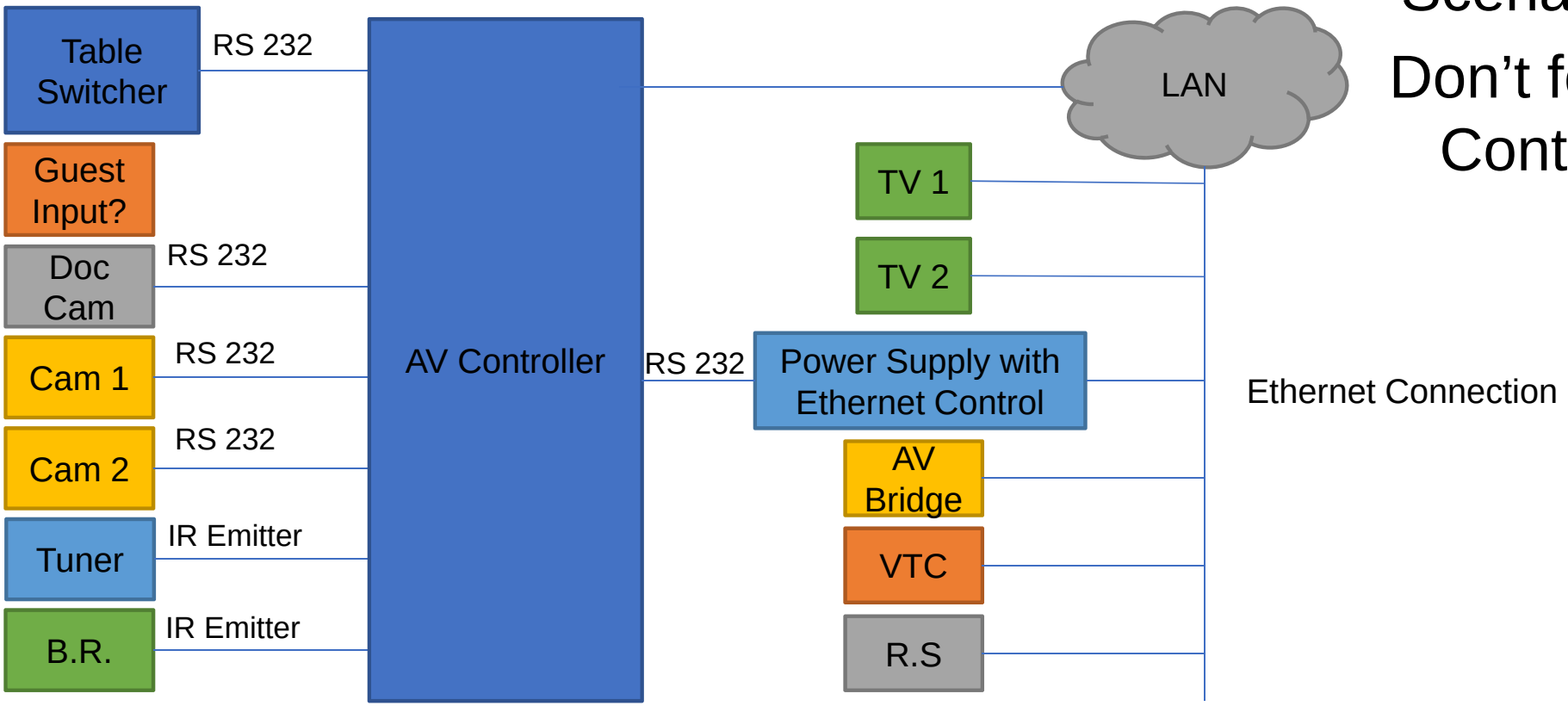
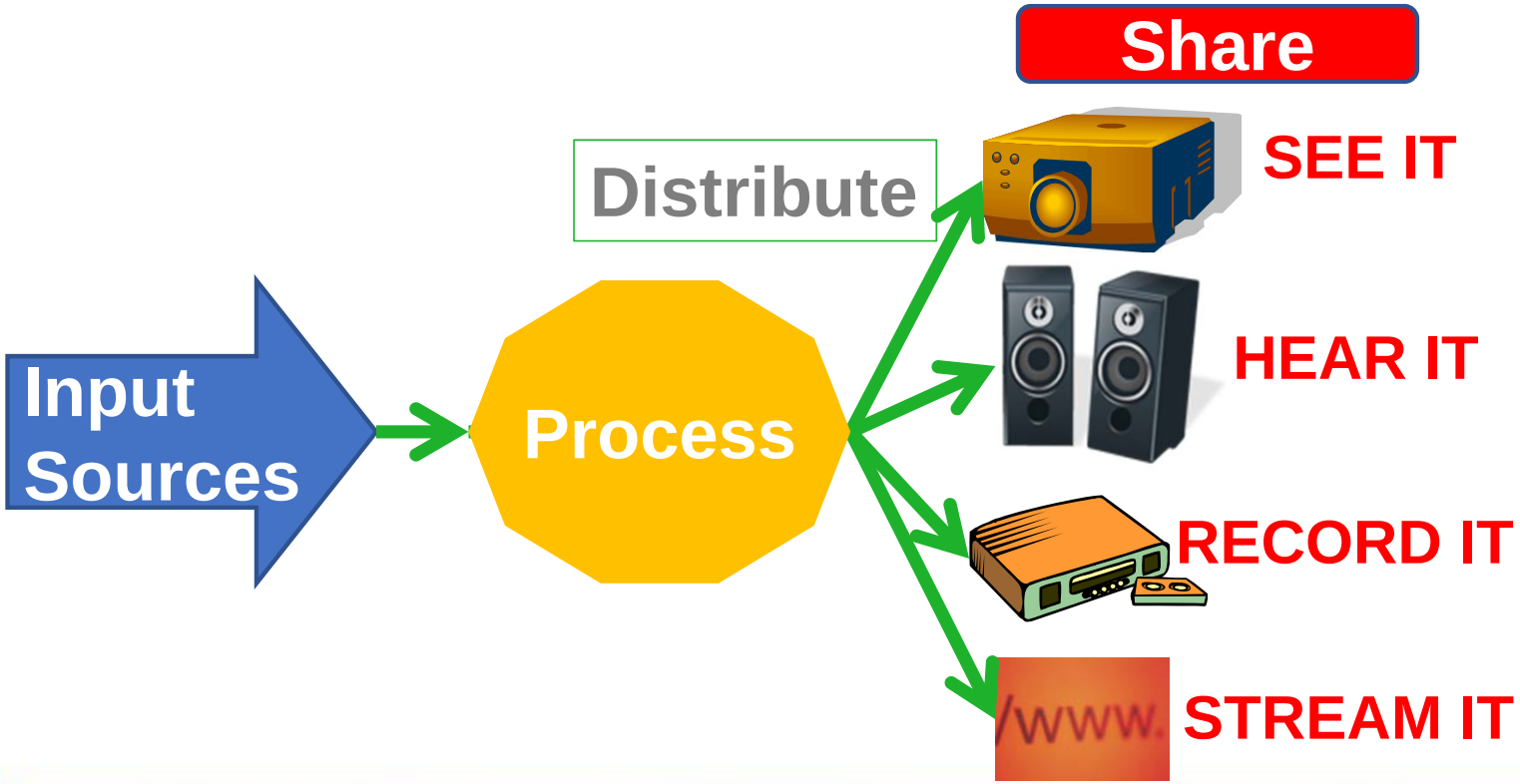
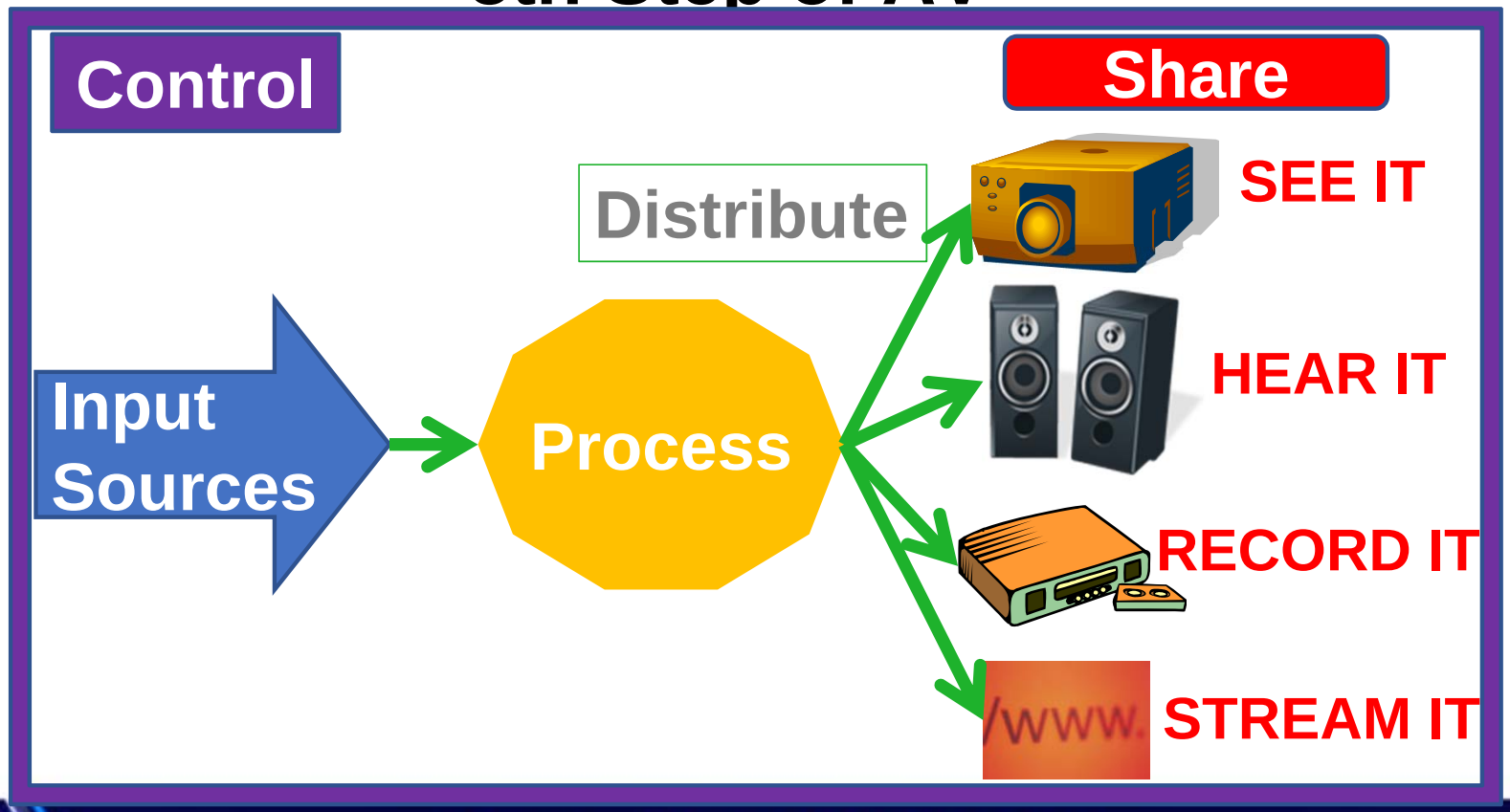
Don’t forget Control!



4 Steps of AV



5th Step of AV



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