UNIVERSITY of HOUSTON

UNIVERSITY INFORMATION TECHNOLOGY

AUDIOVISUAL (AV) DESIGN STANDARDS

Academic, Administrative, Auxiliary and Residential Spaces

Prepared by UIT Classroom Technology, UIT Unified Communications and UIT Web Technologies

Version 2.01 — April 19, 2023

-TABLE OF CONTENTS

1.0   REVISION NOTES

Revision history

2.01   April, 19, 2023
1.05   July 24, 2022
1.04   May 12, 2020
1.02   March 20, 2020

2.0   PURPOSE AND SCOPE

2.1   INTRODUCTION

The purpose of this publication is to ensure that all Audiovisual (AV) for UH spaces is designed and constructed to the standards set by University Information Technology (UIT).

These guidelines will be used as the AV standards for renovations and new construction projects to promote consistent learning spaces that effectively meet the needs of faculty, staff, and students.

This document covers the basic physical requirements for audiovisual equipment used in Academic, Administrative, Auxiliary and Residential Spaces.

This document is not intended to cover all types of spaces or scenarios on campus. If for any reason these standards cannot be met, consultation with UIT is mandatory prior to solicitation of AV Design Services and implementation of any construction work.

University Information Technology updates this document periodically as functional needs and technology evolve. Each updated edition includes its effective date on the cover and in the page footers. The current version and earlier editions are available on the UIT website at:

https://uh.edu/infotech/services/computing/networks/network-infra-standards/

To ensure that all current installation standards are followed, all contractors and outside Information Technology (IT) consultants must receive approval of their design documents from University IT Network Services (UITNS) before submitting them for execution. The Contractor must meet with the assigned UITNS Project Manager before beginning installation.

2.2   CLASSROOM PHILOSOPHY

The UIT philosophy for designing general purpose academic technology spaces at the University of Houston is to make them PC centric, centrally managed and supported by. All general-purpose classrooms will have a designated timeline for technology refresh.   Before departmental classrooms are transitioned to general-purpose classrooms, they must meet the UIT standard.

3.0   CONTACT INFORMATION

University Information Technology, Classroom Technology (UIT CT)	Attention: UIT CT 4333 University Drive Houston, Texas 77204

713-743-1411

UIT, IT Customer Service Director
Leroy Mays
SSC 320L
832-842-4618
lmays@uh.edu

UIT, Academic Technology
Support Center Manager
Patrick Iglehart
MDA 58G
713-743-1195
piglehar@uh.edu

UIT, Classroom Technology
Assistant Manager
Danny Truong
GEN 11E
713-743-1281
dhtruong@uh.edu

University Information Technology, Web Technologies (UIT WT)

UIT, Web Technology Manager
4333 University Drive, 11D
Houston, Texas 77204
Matthew Castillo
713-743-1513
matthew@uh.edu

UIT, Web Technology Manager — E-Communications
Mark Rosanes
4365 Cougar Village Drive
Houston, Texas 77204
832-842-4639
mrosanes@uh.edu

University Information Technology, Unified Communications (UIT UC)

Attention: UIT UC
4211 Elgin St. RM 105
Houston, Texas 77204
832-842-4628

Unified Communications and
Telecom Manager
GEN 105
832-842-4628

Technology Services and Support Director
Rita Barrantes
GEN 103
832-842-4702
rbarrantes@uh.edu

Network Standards Coordinator
Rex Gillit
GEN 106
832-842-4685
jrgillit@uh.edu

4.0 DEFINITIONS

- **ADA** - The Americans with Disabilities Act which prohibits discrimination against people with disabilities in several areas, including employment, transportation, public accommodations, communications, and access to state and local government' programs and services.
- **ANSI** - The American National Standards Institute (ANSI), a private, not-for-profit organization dedicated to supporting the U.S. voluntary standards and conformity assessment system and strengthening its impact, both domestically and internationally.
- **Audiovisual Integrator** - Any person or company commissioned by UIT to perform work on audiovisual systems who is not UIT Classroom Technology staff.
- **AV Systems** - Audiovisual Systems include all equipment necessary to fulfil the intent of communicating audio and/or video content to an audience.
- **AV/IT** - Audiovisual Information Technology.
- **AVIXA** - A trade association representing the professional audiovisual and information communication industries worldwide.
- **CampusTV** - A cost recovery service that provides additional pay TV channels to faculty and staff for offices, conference rooms, lobbies, lounges, and common-areas throughout campus.
- **DSP** - Digital Sound Processor, a microprocessor that is dedicated to receiving the signal from the source and then routing it to an amplifier.
- **HDMI** - High-Definition audio/video interface for transmitting uncompressed video data and compressed or uncompressed digital audio data from an HDMI-compliant source device, such as a display controller, to a compatible computer monitor, video projector, digital television, or digital audio device.
- **Multimodal Classroom** – The Multimodal classroom is a phrase used to describe technology classrooms designed for hybrid and flexible learning. These classrooms are designed for both online learning and in person learning.
- **INFOCOMM** - Former name of AVIXA before 2017; still seen in some publication references.
- **NFPA** - The National Fire Protection Association, an international nonprofit organization devoted to eliminating death, injury, property, and economic loss due to fire, electrical and related hazards. (National Fire and Electrical Code)
- **POE** - Power over Ethernet, a technology that lets network cables carry electrical power.
- **Rack (cabinet, enclosure)** - A frame or enclosure with mounting rails to house AV equipment.
- **RU** - Rack unit which, as defined in IEC 60297-3-100: 1 rack unit = 44.45 mm (1.75 inch) height.
- **UIT CT** - University Information Technology, Classroom Technology departmental staff.
- **UIT UC** - University Information Technology, Technology Services & Support, Network Services, Unified Communications.
- **UIT WT** - University Information Technology, Web Technologies departmental staff.

5.0 COMPLIANCE AND REFERENCES

5.1 INDUSTRY STANDARDS, GUIDELINES AND BEST PRACTICES

TABLE 1

Authority	Title	Document Number
AVIXA[1]	AV/IT Infrastructure Guidelines for Higher Education	None
AVIXA	AV Implementation Handbook (to be used with ANSI/INFOCOMM 2M-2010)	None
AVIXA	Cable Labeling for Audiovisual Systems	F501.01:2015
AVIXA	Audio Coverage Uniformity in Listener Areas	A102.01:2017 *(revises ANSI/InfoComm 1M-2009)*
AVIXA	Standard Guide for Audiovisual Design and Coordination Processes	D401.01:201X — pending *(revises ANSI/InfoComm 2M-2010)*
AVIXA	Projected Image System Contrast Ratio	V201.01:201X — pending *(revises ANSI/InfoComm 3M-2011)*
AVIXA	Audiovisual Systems Energy Management	S601.01:201X — pending *(revises ANSI/InfoComm 4:2012)*
AVIXA	Display Image Size for 2D Content in Audiovisual Systems	V202.01:2016
AVIXA	Rack Building for Audiovisual Systems	F502.01:2018
USDOJ[2]	2010 ADA Standards for Accessible Design	None
UH	UIT Network Infrastructure Design Standards	None

---

[1] AVIXA™ and InfoComm International® are a trademark and a registered trademark, respectively, of AVIXA, Inc., also known as Audiovisual and Integrated Experience Association.

[2] United States Department of Justice

6.0 TYPES OF ACADEMIC SPACES

6.1 FORMAL

- **General Classroom, movable furniture**: a flat-floored academic space with a capacity of 24-90 students, with movable furniture for flexibility of use. Suitable for many purposes, the most common type of classroom. Basic standard technologies include PC, projector(s), projector screen(s), control, audio, and wall/floor plate for inputs cables (HDMI, Power, Network).

- **General Classroom, fixed furniture**: a flat-floored academic space with a capacity of 24-90 students, with fixed tables and/or seating. Various table layouts are employed to suit different types of use. Basic standard technologies include PC, projector(s), projector screen(s), control, audio, and wall/floor plate for input cables (HDMI, Power, Network).

- **Computer Classroom, fixed furniture**: a flat-floored academic space with a capacity of 24-90 students, fixed tables and/or seating, computers installed for each seating space. Basic standard technologies include PC, projector(s), projector screen(s), control, audio, and wall/floor plate for input cables (HDMI, Power, Network).
- **Seminar Room**: a flat-floored academic space for small-section courses with a capacity of fewer than 24 students. Most suitable for small-group discussion and highly interactive material. Basic standard technologies include PC/input device, projector(s) and screen(s) or display(s), control, audio, and wall/floor plate for input cables (HDMI, Power, Network).
- **Lecture Hall**: a tiered or sloped academic space with a capacity of 30-200 students. Most suitable for traditional lectures, input presentations, basic distance learning, and demonstrations. Lecture Hall standard technologies include PC, projector(s), projector screen(s), control, audio, wall/floor plate for input cables (HDMI, Power, Network), wireless screen casting, and video conferencing technologies.
- **Auditorium**: a tiered academic space with a capacity that exceeds 200 students. Most suitable for traditional lectures, AV presentations, distance learning, and demonstrations. Standard technologies for Auditorium include PC, projector(s), projector screen(s), control, audio, wall/floor plate for input cables (HDMI, Power, Network), wireless screen casting, and web conferencing technologies.
- **Active Learning Classroom (ALC)**: a flexible, grouped-seating academic space that includes a high level of technology. This room type is designed to maximize student interaction and engagement. The basic standard technologies for an Active Learning Classroom include PC/input device(s), projector(s) and screen(s) or display(s), control, audio, collaborative technologies, Wi-Fi, wireless projection, and connectivity for input cables (HDMI, Power, Network) at each seating group. These are now called Multimodal spaces.
- **Distance Learning Classroom**: a remote or hybrid learning environment with web or video conferencing technology, dual stream capture, and cloud based technological innovation. The basic distance learning classroom will include PC/input device(s), projector(s) and screen(s) or display(s), control, audio, collaborative technologies, Wi-Fi, stationary PTZ cameras, wireless projection, and video conferencing technology. These are now called Multimodal spaces.

6.2 INFORMAL

- **Huddle/Study Room**: a small conference area for collaboration with the option to include audio, video, and display system technology. This type of academic space is often used by student groups.
- **Conference Room**: an academic space equipped with video conferencing functionalities. Each conference room can vary in size and configuration, with requirements determined on a case-by-case basis.

7.0 TYPES OF CONFERENCING SPACES

7.1 DEFINED

- **Focus Room**: a small room seating one to four people; may be fixed or with movable furniture for flexibility of use. Suitable for bring-your-own-device (BYOD), small group collaboration or individual use. Minimum audiovisual is non-interactive single TV (45-inch), HDMI for external source, power, and Wi-Fi coverage. Room may be equipped with a USB camera, microphone, speaker (all-in-one), fixed PC and wired network connection.
- **Huddle Room**: a small room seating no more than five people with fixed furniture for Wi-Fi consistency of use. Suitable for small group meetings, video conferencing and collaboration. Minimum audiovisual is interactive/noninteractive single TV (45-inch to 55-inch), HDMI for external source, power, fixed PC, USB camera, microphone, speaker (all-in-one) and Wi-Fi coverage or wired network connection.
- **Medium Room**: a room seating ten to twelve people with fixed furniture for consistency of use. Suitable for medium group meeting, video conferencing and collaboration. Minimum audiovisual is interactive/noninteractive single TV (65-inch to 75-inch), HDMI for external source, power, fixed PC, USB camera, microphone, speaker (all-in-one or wall/cart mounted) and Wi-Fi coverage or wired network connection. Additional hardware may be a table or display hub to control the audiovisual equipment and to connect to meetings with one-touch capabilities.
- **Large Room**: a room seating more than twelve people but no more than sixteen people. Suitable for large group meetings, video conferencing and collaboration. Minimum audiovisual is interactive/noninteractive single TV (85-inch to 110-inch), HDMI for external source, power, fixed PC, USB camera, two microphone pods/ceiling tile, two to four speakers (tabletop or ceiling configuration) and Wi-Fi coverage or wired network connection. Additional hardware may be a table or display hub or wall control panel to control the audiovisual equipment and to connect to meetings with one-touch capabilities.
- **Boardroom**: a room seating more than sixteen people. Suitable for executive meeting for a large group presentation, meeting, video conferencing and collaboration. Minimum audiovisual is interactive/noninteractive multiple TVs, HDMI for external sources, power, fixed PC, USB camera, two microphone pods/ceiling tile, two to four speakers (tabletop or ceiling configuration) and Wi-Fi coverage or wired network connection. Additional hardware may be a table or display hub or wall control panel to control the audiovisual equipment and to connect to meetings with one-touch capabilities.

8.0 TYPES OF CAMPUSTV SPACES

8.1 RESTRICTIONS

CampusTV can be used in spaces such as offices, conference rooms, lobbies, lounges, break rooms and public spaces.

Currently, it cannot be used in dorms, private events that charge admission, establishments that sell alcohol, and sporting event venues.

9.0   TYPES OF DIGITAL SIGNAGE

9.1   DEFINED

- High traffic area with short view time opportunities (transitory spaces where audience will not stop to watch)
  Includes: hallways, entries, elevators

- Low/High traffic areas with long view time opportunities
  Includes: lounges, dining areas

- High traffic area with short view time opportunities AND includes lounge areas with long view time opportunities
  Includes: lounge areas and waiting rooms

- Restricted use with windows of signage content
  Includes: classrooms

- High/low traffic areas where needed
  Includes: interactive kiosk

10.0 PHYSICAL REQUIREMENTS FOR AUDIOVISUAL (AV) SYSTEMS

10.1 SITE SURVEY

It is incumbent on the AV integrator to do a site survey of the space(s) before the acceptance of the bid. Specifically, the AV integrator should request regulations regards attaching items to the load bearing structures, examine walls, floors, and HVAC systems to make sure these areas don't interfere with the installation or the intended usage of the audio-visual equipment. The proximity to the mechanic rooms, air handlers, intake or other areas known for vibration or noise should be avoided.

10.2 EQUIPMENT RACKS

10.2.1 DESIGN AND ASSEMBLY

Rack design must allow for only a maximum of 75% fill to accommodate future growth. All racks should be enclosed. Racks installed in cabinetry should have a rear access, in the form of a lockable door. All racks will be assembled per the manufacturer's guidelines/instructions for assembly.

In some cases, accessories such as doors and side panels will be installed and checked for proper fit, but then temporarily removed to aid in the subsequent loading/populating and cabling of the rack.

Once all rack parts and accessories are fully assembled, final adjustments will be made before the loading/populating of AV equipment. This includes the final adjustment and location for the front, mid, and rear rack rails, and all vertically mounted accessories such as vertical cable management.

10.2.2 RACK INSTALLATION

All mounting will adhere to serviceability, electrical interference, cable, and thermal management requirements as part of the design decisions documented prior to the rack building. Fixing/fastening of AV equipment to one another is not acceptable unless specified by the manufacturer. All fixings/fasteners must be fully tightened and secured. The use of fastening methods relying on adhesives is not acceptable.

10.2.3 CABLE MANAGEMENT

Elements of proper cable management include cable handling, serviceability, and signal separation. Pay careful attention to placement and support of individual cables and cable looms in horizontal and vertical space.

10.2.3.1 RECOMMENDED WIRING & SIGNAL SEPARATION

TABLE 2

		RECOMMENDED MINIMUM SEPARATION BETWEEN CABLES						
Signal Type	Common Level(s)	Audio Micro-Phone Level	Audio Line Level	Video Cable	Data Twisted Pair Cable	RF Coax Cable	Speaker Cable	AC Power Cable
Audio Micro-Phone Level	-60 dBV (0.001 volt) to -40 dBV (0.010 volt)	No Spacing Required	Separate Bundles	Separate Bundles	100 mm (≈4 in) minimum	100 mm (≈4 in) minimum	100 mm (≈4 in) minimum	300 mm (≈12 in) minimum
Audio Line Level	0 dBV (1.000 volt)	Separate Bundles	No Spacing Required	Separate Bundles	Separate Bundles	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	100 mm (≈4 in) minimum
Video Cable	0.8 volts	Separate Bundles	Separate Bundles	No Spacing Required	Separate Bundles	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum
Data Twisted Pair Cable	max 125 VDC, 30 watts (add signal level)	100 mm (≈4 in) minimum	Separate Bundles	Separate Bundles	No Spacing Required	Separate Bundles	Separate Bundles	50 mm (≈2 in) minimum
RF Coax Cable	0 dBmv to 50 dBmv	100 mm (≈4 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	Separate Bundles	No Spacing Required	Separate Bundles	50 mm (≈2 in) minimum
Speaker Cable	1 watt to 1,000 watts, max 100 VRMS	100 mm (≈4 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	Separate Bundles	Separate Bundles	No Spacing Required	50 mm (≈2 in) minimum
AC Power Cable	120/240 volts 50/60 Hz	300 mm (≈12 in) minimum	100 mm (≈4 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	No Spacing Required

Source: AVIXA F502.01:2018

Refer to *UIT Network Infrastructure Design Standards* for additional details.

10.2.4 RACK COMMISSIONING

At the completion of the building process, clean the rack to remove all dirt, dust and debris. Remove all temporary labeling, ties, and tape. Remove stray wire pieces, cable offcuts, tie cut-offs and other debris. Excessive cable, more than 3 feet should not be wrapped on rack rails or coiled up and left in the rack or on equipment. All classroom equipment racks must have power conditioners to protect against spikes or voltage surge. The type of power conditioners used in the classrooms will be decided by calculating the load supported, measured in watts or volt-amps.

10.3 LECTERNS/PODIUMS

Mount audiovisual equipment within the lectern/podium assembly with specifications determined during the design consultation process.

Academic spaces lecterns/podiums should not have casters unless approved by UIT.

Specialty academic spaces may require a mobile lectern/podium. If AV equipment is not housed in the lectern/podium, mount it separately with wireless capabilities within the system.

All lectern/podium designs will include a lockable, enclosed cabinet section and an open-fronted cabinet section. Any lockable sections will be keyed to restrict unauthorized access. Open sections will be accessible for users' AV equipment. Physical or electronic security will be present.

A connectivity panel with HDMI, USB, network connections and power outlets will be on or near the lectern/podium. Cables for the device connections will be routed through the lectern/podium. Cable management is necessary when the connections are running under the carpet. If possible, all power and network outlets will be provided inside the lectern/podium cable cubby. The cable path should be adequate in capacity to allow all signal cables and future expansion.

Final lectern designs will be determined during the design consultation process. The audiovisual integrator will provide external audiovisual inputs, such as laptops, which will retract and be hidden away when not required.

10.4 HVAC & VENTILATION

All AV equipment generates heat in space. Regardless of the location, there must be adequate ventilation (air flow) to prevent unacceptable temperature rise. Cooling and ventilation characteristics will vary according to the AV equipment. The AV integrator will calculate the BTUs in a system based on wattage to determine the cooling necessary for optimal operation.

The HVAC system may not be adequate for rack equipment in closets and other tight spaces. Additional HVAC resources may be necessary to keep the rack at the optimal temperature.

All closed racks and lecterns/podiums require airflow vents. Mechanical devices that contain moving parts, such as fans, located in or near the lectern, should have minimum noise, to eliminate a possible distraction in the academic space.

10.5 ROOM LAYOUT

The space dimensions and orientation affect the AV design. Careful placement of AV equipment is necessary to ensure ADA requirements are met.

Room layouts will be considered in consultation with UIT during the design process.

See AVIXA, *AV/IT Infrastructure Guidelines for Higher Education* recommendations regarding sightlines, viewing angles, image heights and other critical room design considerations.

10.6 PROJECTION SURFACES

Matte white is the recommended screen color choice for high optimization.

10.6.1 SCREENS

Motorized data projection screen(s) will be centered in front of the audience. This provides uninterrupted viewing from each angle, and if possible, recessed in the ceiling. The screen (s) will be positioned 6 inches away from the wall or whiteboard, flush to the ceiling. The number of screens, size and exact location will vary depending on the academic space. Each screen will include a manual switch, housed to the left of the screen, for raising and lowering.   Typical screen sizes are 109" diagonal (57 1/2" X 92")

All projection screens recessed in the ceiling or self-contained enclosures must have a service access pathway of at least 2' X 2'. The enclosure must be easily accessible for maintenance.

All projection screens will have a 16:10 aspect ratio to accommodate high-definition format. To calculate the distance from the projection screen to the seats, the following formulas are adequate:

- Minimum distance to front row = 2x the image height
- Maximum distance to back row = 6x the image height

Final screen position will be determined during the design process with feedback from UIT.

See Figure 1 through Figure 4 for the basic layout of projected images and seating.

FIGURE 1: FRONT WALL ELEVATION WITH STANDARD MEASUREMENTS

FIGURE 2: FLAT-FLOOR ROOM SECTION WITH STANDARD MEASUREMENTS

FIGURE 3: TIERED-FLOOR ROOM SECTION WITH RETRACTABLE SCREEN, WITH STANDARD MEASUREMENTS

FIGURE 4: TIERED-FLOOR ROOM SECTION WITH WALL PROJECTION, WITH STANDARD MEASUREMENTS
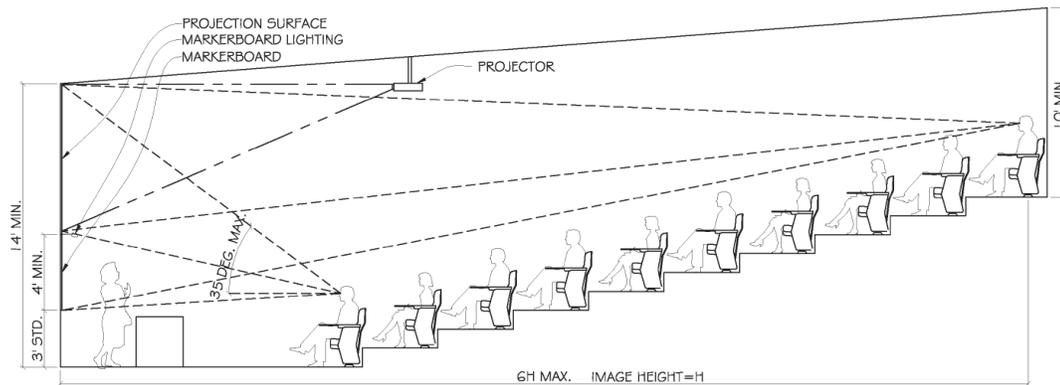
10.7 DISPLAY DEVICES AND INSTALLATION

10.7.1 LASER AND LCD PROJECTORS

WXGA Laser Projectors with an output of 5,000+ lumens are recommended for low maintenance. The number of lumens recommended will vary according to the space. The minimum resolution is 1920x1200 with an aspect ratio of 16:10. Ultra-short throw projectors may have a lower resolution of 1280x800. Any display fixed to an ultra-short throw must be of the same aspect ratio.

At each projector location, the following infrastructure is required:

- A quad power outlet
- Two jacks for data connection
- Wi-Fi or Wireless capabilities
- Conduit
- Ceiling box or drop plate

10.7.2 LASER AND LCD PROJECTION CEILING MOUNTS

High-quality, professional grade projector ceiling mounts shall be used. Final choice of brackets will be determined by UIT CT. Firmly tighten the projector mount's adjustable settings. Security screws and other security features are required for tamper resistance.

All projector ceiling brackets and mounts will be in accordance with the manufacturers' specifications and rated to accommodate the weight of the projector.

AV integrator will coordinate with the architect, contractor, or sub-contractor to determine the type of lighting used in each project. When pendant style lighting is used, it will require lowering the projector or running the pendant lighting differently to avoid interfering with the projected image.

All projector mounts must be tethered to the red metal or concrete above the ceiling. The tethering provides added security to prevent the projector from falling from the ceiling.

10.7.3 FLAT PANEL DISPLAYS

The minimum size for 4K flat panel commercial displays is 55 inches. Flat panel displays require at least two HDMI inputs. Size recommendations and display locations will vary according to the academic space. See Maximum Viewing Distance section for the recommended display size that will work for the space.

10.7.4 FLAT PANEL DISPLAY MOUNTS

Flat panel display mounts design options are wall, ceiling or mobile. All mounts will be of high-quality professional grade and installed according to the manufacturers' specifications. The brackets must be secured to the display in a manner where it cannot be dislodged from the mount without authorization.

10.7.5 INTERACTIVE DISPLAYS

Interactive displays shall include commercial grade designs that are lightweight, 4K resolution and anti- glare. These displays should have a 20-point IR touch capability or more. Interactive touch and wireless content sharing features are necessary for collaboration. Make and model recommendations may vary according to the space needs. See Maximum Viewing Distance section for recommended display size.

10.7.6 CAMPUSTV DISPLAYS

CampusTV requires a set-top-box, which UIT can provide for a fee. A wired network connection is required for this service. The Samsung, Sharp and LG are brands providing the necessary specifications for these displays.

For more information: CampusTV - University of Houston (uh.edu)

10.7.7 DIGITAL SIGNAGE

10.7.7.1 NETWORK CONNECTIVITY FOR DIGITAL SIGNAGE

Campus digital signage hardware requires network connectivity (wired or wireless) so that it can be integrated with the UH Emergency Notification System.

10.7.7.2 DISPLAY CONSIDERATIONS FOR DIGITAL SIGNAGE

Viewing distance is an important consideration when determining the type and size of content to display on a digital sign. Signage located in open, high traffic areas will require different content than displays located in smaller, enclosed locations for maximum usefulness. The viewing distance can be considered in three increments: Optimal, Marginal, Visible. Calculate monitor size based upon Optimal view:

(Distance from monitor to viewer divided by three equals the diagonal monitor size)

- **Optimal**: The distance that the audience will be able to observe the content without loss of detail.
- **Marginal**: The distance at which the audience can see the content without detail.
- **Visible**: The distance at which the audience will be able to recognize general themes and information presented in the largest formats. Content is targeted to draw the audience into the Optimal range to provide more information.

FIGURE 5: VIEWING DISTANCES FOR DIGITAL SIGNAGE

1. **Optimal Distance**
Provides full detail for extended viewing of complex content
2. **Marginal Distance**
Provides less detail for casual viewing
3. **Visible Distance**
Provides little detail for rapid viewing or to attract closer viewing

$$\frac{optimal}{monitor\ size} = \frac{distance\ from\ monitor\ (inches)}{3}$$
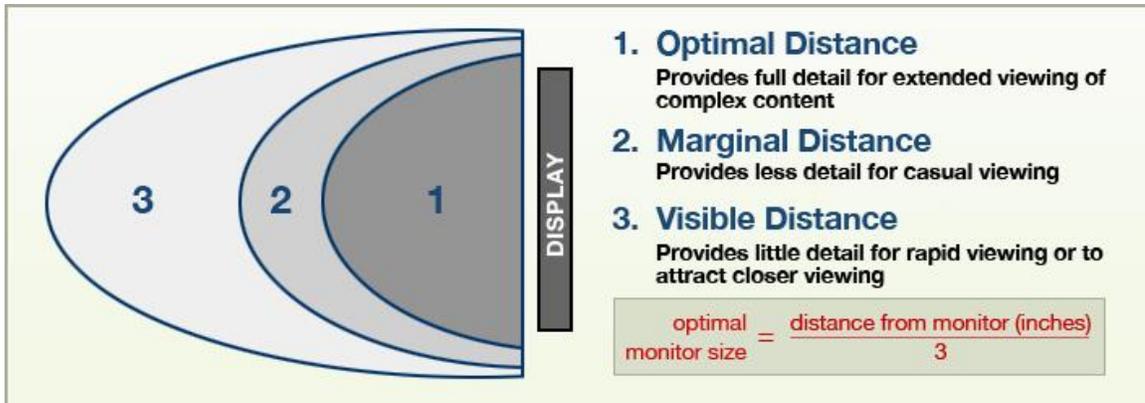
10.7.7.3 DIGITAL SIGNAGE IN NON-CLASSROOM SPACES

Computer hardware for digital signage in non-classroom spaces must meet the following specifications:

- Computer with Windows OS that supports Four Winds Interactive's Content Player software

  https://www.fourwindsinteractive.com/products/digital-signage-platform/content-player

- Minimum 128 GB solid-state drive storage
- Minimum 4 GB RAM
- Screen-size will vary depending on installation location

  - Multi-screen installations (video wall) should have thin bezels to look seamless between displays
  - Touch-screen displays should have at least 5 -10-point capacitive touch

10.7.7.4 DIGITAL SIGNAGE IN CLASSROOM SPACES

Computer hardware for digital signage in classrooms must meet the following specifications:

- Android OS and support native Android apps
- Screen size between 10-24 inches, depending on classroom size and room orientation.
- Wall-mounted near exits

10.7.8 MAXIMUM VIEWING DISTANCE FOR DISPLAYS

There are several formulas used to determine screen size. However, in a conference room the most critical one is text viewing distance and the maximum distance a viewer can see that text.

$$D = (H_s \ x \ 150 \ x \ P_{txt}) / P_{im}$$

- D = Distance to farthest Viewer
- H_s = Minimum recommended screen height
- 150 = The recommended maximum distance for comfortable viewing of text (150 times the text height).
- P_{txt} = Height of text in pixels. Example – 11-point text will be 15-pixel height
- P_{img} = Height of image in pixels (vertical resolution)

FIGURE 6: RELATIONSHIP BETWEEN SCREEN SIZE AND VIEWING DISTANCE

Viewing Distance calculation The calculator is based on how far the audience is from the screen, measured in feet. Then the size and aspect ratio (4 X 3 or 16 X 10) of the screen is needed. The size of type of the font (type) will also determine the viewing distance.

Text size and maximum viewing distance

2" Text   4" Text   8" Text

100
200 ft
400 ft
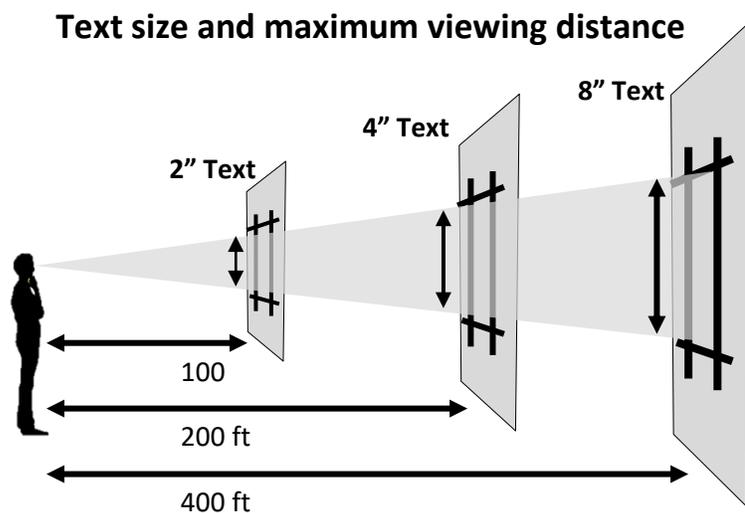
10.8 AV CONTROL AND SWITCHING

10.8.1 CONTROLS AND SWITCHERS

Control panels must be installed in appropriate locations within the room, ensuring easy accessibility within the environment. Switchers may be installed in data rooms or in the AV equipment racks. The make/model recommendation will be determined during the designing phase.

10.8.2 TOUCH PANELS

Extron touch panels are used for classroom technology control.

10.9 AUDIO

10.9.1 AUDIO

Most spaces will require the ability to play audio from a PC, laptop, or auxiliary source. Larger spaces will require voice reinforcement. Academic spaces, like auditoriums, require special acoustic expertise to provide effective audio systems.

Special attention should be given to any speech reinforcement system, which will be independently designed for each space. Typically, a system capable of program playback and speech reinforcement will consist of suitable front-of-house, low impedance speakers supplemented with delay flush mounted ceiling speakers suitably positioned throughout the space.

10.9.2 AMPLIFIERS

Multi-source amplified with at least 25 Watts for average classrooms. Auditoriums and other larger spaces will require at least 80 Watts.

Some switchers may have an amplifier built in and this is acceptable if it meets the standard.

10.9.3 SPEAKERS

Ceiling mounted speakers are preferred and will be securely mounted to ceilings and additional support will be provided.

> 2'X 2' speakers designed to fit in the ceiling grid are preferred.
> 85 Hz to 20 kHz frequency range
> 30 watts of continuous program power
> 86 dB sensitivity (1W/1m)

All products will be individually specified for each space in the design consultation process.

Zoning the audio provides a move even and distributed sound experience. In most classrooms, there will be 4 to 8 speakers. The AV integrator designers must provide a schematic or zoning diagram detailing the number of speakers and their location.

10.9.4 MICROPHONES

The typical classroom will have a wireless lavalier microphone. The number and style of microphones (hard-wired or wireless), audio processing/mixers including digital sound processors (DSP), and amplifiers will vary according to the space.

10.10 VIDEO

Sources will include auxiliary inputs for HMDI and inputs for the stationary classroom computer.

The video signal will be routed from the switcher to the projector, typically using CAT6E or extenders which run CAT6E and then convert to HDMI. Video input cables will include HDMI,

USB-C, and Mini Display Port connectors where possible. VGA is not part of the design. A converter to HDMI may be used for special situations. Video should output a display 1920 X 1080 or above.

10.11 SIMPLE INPUTS AND SWITCHING

Basic learning spaces may have an HDMI input to a source device (e.g., a laptop), but most spaces provide a switching and control system along with the ability to select multiple source devices to use in presenting material. The choice of source devices should be determined in conjunction with the user group and depends on the type of material to be presented in the space.

10.12 WEB CONFERENCING (SIMPLIFIED)

The following technologies are the standard web conferencing solutions for the spaces within the University:

- Display, typically a projector
- Camera (USB – 1080p or higher) 930-E Logitech or similar
- Microphone (USB or Converted to USB or built into camera or audio speakers)
- Computer or laptop (i5 or higher, 16 GB RAM recommended) with wireless/Bluetooth keyboard and mouse
- Wireless/wired Network (Wired network provides better performance and faster speeds)

Additional considerations to ensure a positive web conference experience will include the type of display size, camera position, furniture design, color selections, room size, lighting, speakers.

10.13 LIGHTING

Different activities in a teaching space require different lighting conditions. It is essential that the light sources used can be switched on, off, or dimmed quickly. Lighting that requires long delays between extinguishment and re-strike, or fixtures that take more than 10 seconds to achieve maximum brightness, are not suitable for academic spaces.

To reduce levels of ambient-light spill onto projection surfaces, select light fixtures of a glare-free design with direct-light distribution only (no upward, incident light), and that have reflectors with cut-off or shielding angles in the direction of the screen(s). Recessed lights with non-reflective louvers, and suspended lights with sufficient side-shielding reflectors and non-reflective louvers are usually suitable. Task lights and spotlights that are not turned off during projection must also have either internal cutters or external barn doors to enable illumination of people near the screen, while preventing direct light from falling on the screen.

Near the projection screens, house lights, stage lights, and lectern spotlights must all be carefully positioned to avoid spilling on the screen. Careful consideration must also be taken

when placing spotlights so that the body of the spotlight does not impede a projector's beam. The vertical positioning of stage lights and lectern spotlights is often a difficult balance between sufficient light on the presenter's face and glare in their eyes. A commonly agreed balance is to position these lights between approximately 45 degrees and 60 degrees above horizontal from the presenter's eye line.

If an AV control system is employed in the space, expect lighting control to be integrated into the system with a redundant wall switch. Exact lighting designs will be determined during the design process.

10.14 LECTURE CAPTURE

Any implementation of lecture-capture systems must be in conformance with existing UIT systems. Any installed systems should be fully compatible with existing content management systems and other back-end systems. Lecture capture systems should be PC based, allowing the use of Microsoft Teams videoconferencing platforms. This is an area where significant consultation with UIT personnel is required.

Careful consideration must also be given to recurring licensing fees to ensure that the proposed systems will fit into the department's funding model.

Lecture capture equipment will be determined during the design consultation process.

10.15 EXTERNAL AV INPUT PLATES

Suitable AV input plates shall be provided as specified by UIT. The Contractor may supply an alternative manufactured version of this plate type, with advance approval from UIT. All specified input types on the plate must be engraved in text.

10.16 ELECTRICAL

All installed AV equipment will require dedicated circuits and receptacles to be incorporated into the electrical design. It is not acceptable for electrical cables to be run along walls or across the floor where students, faculty or staff walk. AV equipment will need dedicated outlets in proximity — inside cabinetry, high on walls for monitors or loudspeakers, and outside the ceiling for projectors.

It is best practice to put all equipment in a single space on the same electrical phase. This helps to eliminate electrical differences that can produce noise in audio or video systems. Enough outlets should be installed, particularly in the front and back of academic spaces for portable equipment.

Outlets should be provided adjacent to projector mounts, monitor mounts, electric screens, and any other powered equipment, such as amplified loudspeakers or infrared, assistive listening emitters. Outlets should be mounted within the ceiling space or recessed so that they are

unobtrusive. Best practice for monitors and projectors is to provide dual outlets for ancillary equipment.

11.0 NETWORK INFRASTRUCTURE COMPONENTS AND SECURITY

11.1 REQUIREMENTS

As AV systems are designed and planned, it is important to ensure the designs comply with the University of Houston *UIT Network Infrastructure Design Standards*.

When designing AV systems, security concerns must be considered. Unauthorized access to AV devices, whether for malicious intent or otherwise, can wreak havoc on a system, and cause unnecessary interruptions in campus operations. Registration of devices will be necessary. At the time of deployment, all devices will have the latest available firmware installed. The serial number and MAC address of each installed device are to be documented.

12.0 AUDIOVISUAL CABLING INSTALLATIONS

Refer to *UIT Network Infrastructure Design Standards* for details.

13.0 ADA COMPLIANCE AND INTEGRATION

13.1 HEARING AUGMENTATION

The audiovisual integrator must supply and install an under-floor induction loop with low spill design to ensure there is no audio audible in adjacent spaces. Where there is danger of spill into adjacent rooms, above or below, an ultra-low spill, phased array loop must be provided. In the situation where an under-floor solution is not possible an FM or IR solution must be installed.

The supply and installation of any hearing augmentation system into a teaching space is to comply strictly with the following:

1. *2010 ADA Standards for Accessible Design*
2. Infrared receivers with a minimum of 95% coverage
3. One IR receiver for every 25 persons up to 500 persons
4. Test results that the installed system meets or exceeds the current standards, for audit purposes.

13.2 MOUNTING HEIGHTS FOR VISUALLY INTERACTIVE DEVICES

A height of 54 inches is acceptable if the device is side approachable.

13.3 Access to AV and Computer

1. Adjustable monitor arms should be used to provide access to the computer monitor.
2. A maximum height of 48 inches applies to access controls, peripherals, and ports.
3. Wireless keyboards should be made available if necessary.

13.4 Podium and/or Teacher's station

1. Teacher's station, desk or podium should have a minimum egress of 32" from the furniture to the wall.
2. There should also be an egress from the teacher's station unobstructed to the entrance and exit. Chapter 4: Accessible Means of Egress (access-board.gov)

14.0 System Programming"

14.1 Extron

The end-user will define the devices and use case scenarios. Specific recommendations for each learning space will be provided by UIT CT according to the user's needs. The AV integrator will provide a picture of the touch panel GUI for approval before completion.

The AV integrator will provide all programming files, and source code used in the project at the time of completion.

15.0 Audiovisual (AV) System Installation Process

15.1 General Guidelines

The audiovisual integrator is to install the AV equipment as outlined throughout the scope of work specified. All work should be completed to a high standard and the product will be a fully functioning audiovisual system.

- In accordance with AV industry best practices, all mounting hardware will be at minimum Grade 5 hardware. All load calculations will use a minimum 5x safety factor so that each fastener can carry the load of the object by itself plus the redundant anchors. Utilize fasteners that are rated for overhead use where appropriate. Prior to installation, all anchors shall have their specifications sheets approved by the project structural engineer.
- Cables cannot be laid on top of the ceiling grid. All cabling must be on "J" hooks above the tile.
- Wall plates, controller, screen, duct or conduit, speaker brackets, projector bracket and wall equipment cabinet are all to be installed square, flush and level. The mounting screws/washers/bolts used to fix a specific item are all to be at minimum Grade 5 or better and be matching for that specific item type.

- UIT Network Services will supply most or all network connections.
  - Refer to *UIT Network Infrastructure Design Standards* for networking guidelines.
- The preference is to avoid floor boxes whenever possible. If floor boxes are part of the design and approved, there must be coordination with the GC to determine the product used, location, and size.
- When furniture and desks are flushed against the wall, the preference is to use wall plates in lieu of Connectrac and other products used for wire management. Connect Trac requires coordination with facilities, electricians, GC's and flooring contractors.
- Audio will be free of any buzz, hum, or other undesired noise. Exact speaker positions are to be based on a practical determination of best sound coverage. Key decision factors include room layout, possible sound obstructions, and dispersion properties of speakers.
- Audio should be adequate for the space when the volume is adjusted to 50%.
- Projection devices will be free of any hum bars, video noise, shimmer, flicker, ghosting, or any other undesired artifacts, up to the native input resolution of the projection device.
- All ceiling and wall cut outs are to be neatly made and positioned to meet the needs of the space. Any holes or openings not used must be filled in or covered with a blank wall plate.
- The University of Houston prefers electric screens recessed in the ceiling. Unless otherwise specified, the UH facilities team will install the screen. The facilities team will cut out the ceiling grid and frame the opening supported by a wooden frame to hold the screen. The screen will be tethered to the substructure. Power and control cabling will be hidden behind the wall. If the AV integrator is responsible for the screen, the same requirements are expected.
- In consultation with UIT to provide adequate power, all electrical works must be provided by a licensed electrician and completed to relevant US Standards. The final number of power outlets will be determined during the design consultation process as well as a calculation of the overall load demand on the circuit.
- The AV integrator will provide documentation for all installed devices including manuals, signal flow diagrams, end user's documentation, and all warranty information.

15.2 PROJECT RESPONSIBILITIES BY PHASE

TABLE 3

Stages	Tasks	Responsibility
Planning & Procurement	Functionality needs analysis: Pedagogical uses	Faculty/end user
	User interviews, focus groups, wish lists	UIT, Faculty, Adm
	Site survey of the space(s) with contractors/Vendors	UIT, Vendor
	Tentative timeline and initial budget estimate	Vendor
	Research on emerging technologies and pedagogies	UIT
	Review of existing equipment and structures. (Reusable OFE equipment)	UIT, Vendor
	Conceptual design estimate from vendor(s) and contractors	Vendor
	Cable pathways and technical requirements identified	Vendor
	Architectural integration and aesthetic requirements identified	UIT
	Equipment selection based on supply chain availability	UIT, Vendor
	Detailed design submittal reviewed, including value engineering	UIT, Vendor
	Timeline based on contractors, installers, and equipment availability	Vendor
	Budget approval for final design quote, PO's issued to all contractors	UIT
Preparations & Installation	Work assigned to other trades: Service requests	UIT
	Network security assessment: IP addresses and network layout planned	Networking
	Physical location of equipment (sharing of IDF closets)	Networking
	Pre-wiring: Cable pulling and labeling	Vendor
	Layout of user interface: GUI design	Vendor
	Shop drawings and signal flow diagrams created	Vendor
	Programming, installation, testing and debugging	Vendor
	Coordination with other trades, timelines	Vendor
	Staging and prefabrication (Rack building off campus, programming)	Vendor
	Physical installation	Vendor
	Substantial completion and punch list items identified	Vendor
	Completion of punch list items	UIT, Vendor
	Testing and commissioning	Vendor
Post-install	Training documentation created	Vendor
	Support (Technical) staff training	Vendor
	End user training	UIT, Vendor
	Equipment serial numbers provided inventory documented	Vendor
	Networking information, MAC addresses, IP's, ports, VLAN	Vendor
	Servicing and SME information	Vendor
	Support plan and warranty information	UIT
	Inspection of items and payment of final vendor invoices	UIT, AP
	360 Lessons learned (Internal)	UIT
	Project Review (External)	UIT, Vendor

15.3 CLOUD-BASED PROJECT MANAGEMENT

When working with AV Integrators, the preferred methodology for project management is using a cloud-based solution allowing for interaction, a single repository of project information including a communication channel. MS Teams has this functionality. The goal is that all official project information is kept in one area, and the responsible, accountable, consulted, and informed individuals (RACI) have access to input information and see the status real-time.

15.4 CURRENT UH EQUIPMENT STANDARDS

TABLE 4

Equipment Type	Preferred brand (s) types
Amplifiers	Crown, Extron, Biamp
AV Cabling	Extron, Kramer
AV Controllers/Touch panels	Extron, (Touch panels are preferred)
AV Rack Cabinets/furniture	Middle Atlantic, Spectrum
AV switchers	Extron, HD
Commercial Displays	Samsung, LG, Sharp, Sony, Phillips
Computer monitors (Touch screens)	Dell, 3M Sympodium
Connectrac (Wire ways)	Legrand (Holds 12-24 Data cables)
Data Projectors	Lasers preferred, Panasonic, Sony
Data Screens	Da-Lite, Draper (Electric preferred)
Desktops	Dell
Document Cameras	Epson, Elmo, 30fpc, HD (USB)
Flat Panel Display Mounts	Chief, Peerless
Hearing Assistance	Listen Tech
Interactive Touch Screens	ViewSonic, Sharp, 3M
Lecterns (Height adjustable)	Spectrum, VFI, CCI
Microphones	Shure, Sennheiser, Clear One
Network cabling	Currently shielded, CAT6E (RJ45)
Power Conditioners/distributers	Eaton, Furman, Middle Atlantic
Projector Mounts	Chief, BMS, locking
PTZ and Auto-tracking cameras	Aver, One-Beyond
Source device connectors	HDMI, Ethernet, Wireless, USB C
Speakers	Extron, JBL, KSI (Prefer 2X2 tile sized and zoned)
Web Cameras	Logitech, Vaddio, Aver, Auto-tracking preferred
Web conferencing soft Codec	MS Teams
Wireless projection systems	Extron Sharelink