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 1.04 — May 12, 2020

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1.0 Revision Notes

Revision history

1.04 May 12, 2020
- Final edits completed for the first edition of this document

1.02 March 20, 2020
- Added material related to non-academic spaces

1.01 June 10, 2019
- Initial draft of design standards for academic spaces

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 an installation.

3.0 CONTACT INFORMATION

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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 Multimedia Interface, a proprietary 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.
- **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.
- **Pro:Idiom** - Encryption technology developed by LG for use in hospitality TV solutions for the secure delivery of high definition digital television and video on demand (VOD) signals.
- **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

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 to include: PC, projector(s), projector screen(s), control, audio, and wall/floor plate for multimedia 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 to include: PC, projector(s), projector screen(s), control, audio, and wall/floor plate for multimedia 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 to include: PC, projector(s), projector screen(s), control, audio, and wall/floor plate for multimedia 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 to include: PC/input device, projector(s) and screen(s) or display(s), control, audio, and wall/floor plate for multimedia cables (HDMI, Power, Network).
- **Lecture Hall**: a tiered or sloped academic space with a capacity of 30-200 students. Most suitable for traditional lectures, multimedia presentations, basic distance learning, and demonstrations. Lecture Hall standard technologies to include PC, projector(s), projector screen(s), control, audio, wall/floor plate for multimedia 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, multimedia presentations, distance learning, and demonstrations. Auditorium standard technologies to include PC, projector(s), projector screen(s), control, audio, wall/floor plate for multimedia cables (HDMI, Power, Network), wireless screen casting, and video 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, wireless screen casting, and connectivity for multimedia cables (HDMI, Power, Network) at each seating group.
- **Distance Learning Classroom**: a remote or hybrid learning environment with 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, wireless screen casting, and video conferencing technology.

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 noninteractive 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 consistency of use. Suitable for small group meeting, 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 meeting, 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.

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 Equipment Racks

10.1.1 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.

10.1.2 Mounting

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. Fully tighten all fixings/fasteners. The use of fastening methods relying on adhesives is not acceptable.

10.1.3 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.

10.1.3.1 Recommended Signal Separation

TABLE 1

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.

10.1.4 Rack Cleaning

At the completion of the build 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.

10.2 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 provision for external audiovisual inputs, such as laptops, which will retract and be hidden away when not required.

10.3 Ventilation

All AV equipment generates heat in a 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 determine the thermal units in a system to provide the best cooling system.

All 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.

10.4 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.

10.5 Projection Surfaces

10.5.1 Single and Dual Screen Projection

Motorized data projection screen(s) will be centered to the room for uninterrupted viewing from each angle, and if possible, recessed in the ceiling. The screen (s) will be positioned 1 foot 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. Matte white is the recommended screen color choice for high optimization.

All projection screens must be 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

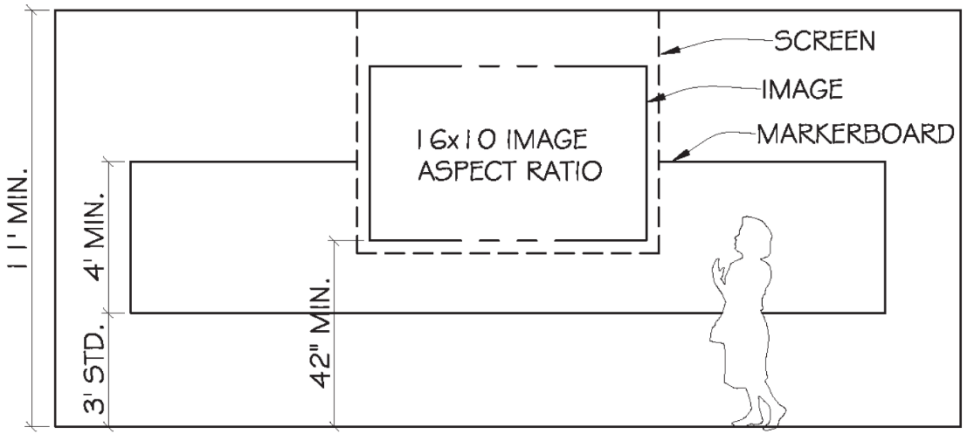


FIGURE 2: FLAT-FLOOR ROOM SECTION WITH STANDARD MEASUREMENTS

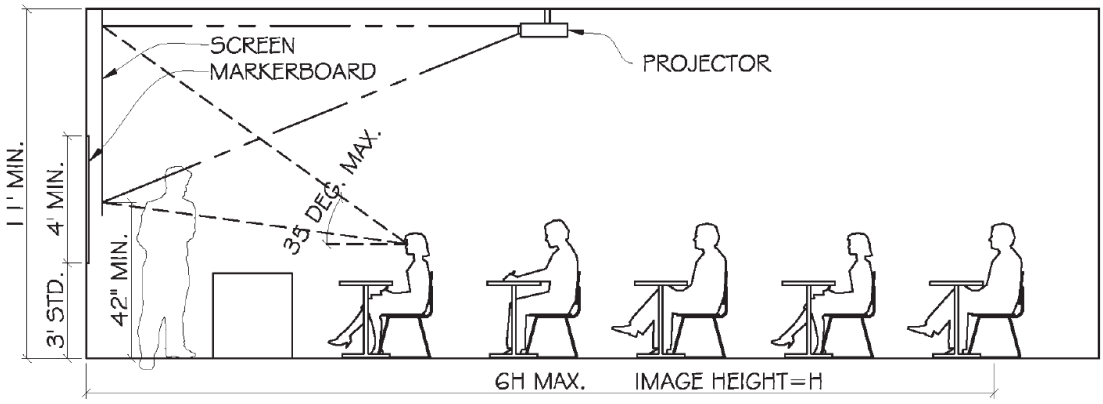


FIGURE 3: TIERED-FLOOR ROOM SECTION WITH RETRACTABLE SCREEN, WITH STANDARD MEASUREMENTS

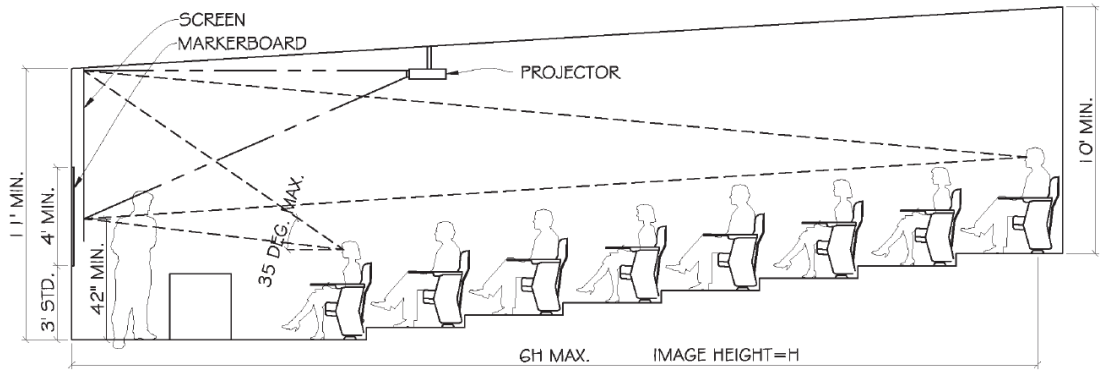
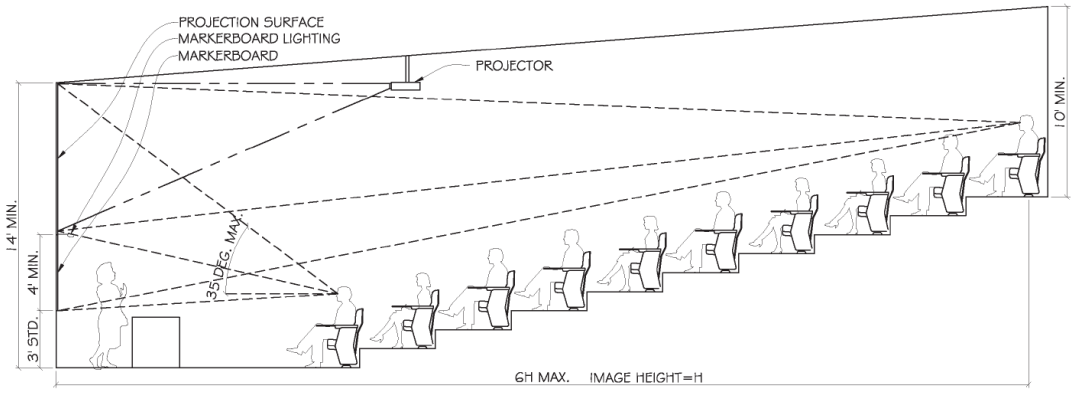


FIGURE 4: TIERED-FLOOR ROOM SECTION WITH WALL PROJECTION, WITH STANDARD MEASUREMENTS



10.6 Display Devices

10.6.1 Multimedia 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 AV power outlet
- Two jacks for data connection
- Wireless capabilities
- Conduit
- Ceiling box or drop plate

10.6.2 Multimedia Projection Ceiling Mount

High-quality, professional grade multimedia 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.

10.6.3 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.

10.6.4 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.

10.6.5 Interactive Displays

Interactive displays shall include commercial grade designs that are lightweight, 4K resolution and anti- glare. 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.

10.6.6 CampusTV Displays

CampusTV requires Premium Hotel Pro:Idiom enabled TV displays or a Pro:Idiom set-top-box, which UIT can provide for a fee. Pro:Idiom is the encryption used for the service and is required. Pro:Idiom displays are available from LG and Samsung. A wired network connection is required for this service.

10.6.7 Digital Signage

10.6.7.1 Network Connectivity for Digital Signage

All campus digital signage hardware must have network connectivity (wired or wireless) so that it can be integrated with the UH Emergency Notification System.

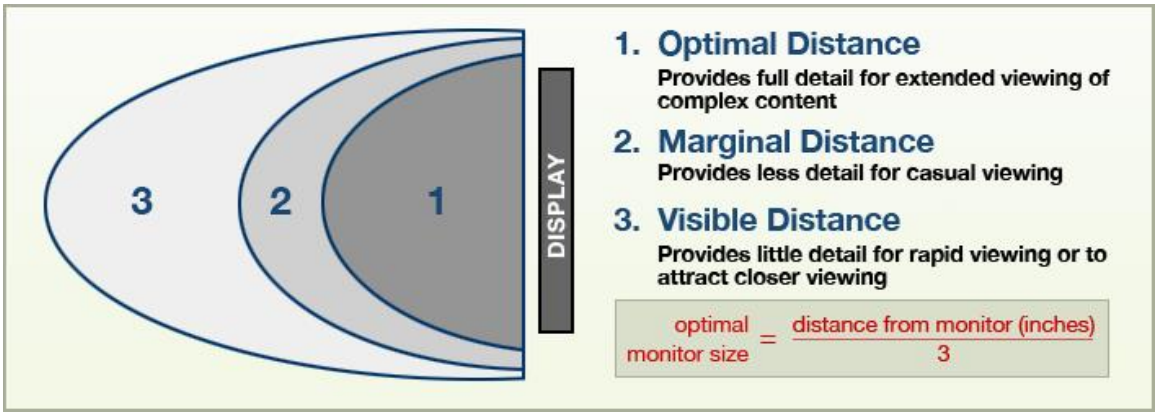
10.6.7.2 Display Considerations for Digital Signage

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 great 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



10.6.7.3 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 120 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 5-10 point capacitive touch

10.6.7.4 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

10.6.8 10.6.8 Maximum Viewing Distance for Displays

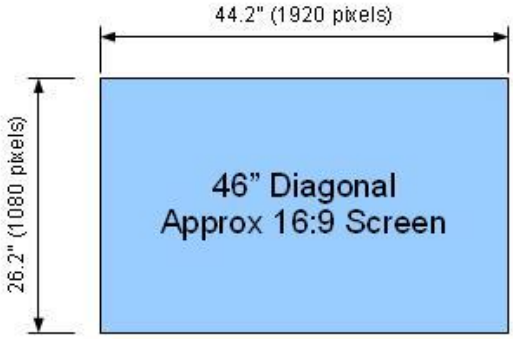
There are several formulas used to determine screen size. However, in a conference room the most critical one is text viewing distance and the maximum distance a viewer can see that text.

$$D = (H_s \times 150 \times P_{txt}) / P_{img}$$

Where

- 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



Font Size: 18ppt (this equals 22 pixels from the conversion chart)

Solve for Maximum Viewing Distance (D)

Since Hs = (D*Pimg)/(150*Ptxt)
D=(Hs*150*Ptxt)/Pimg

D=(26.2 * 150 * 22) / 1080
D=86460/1080
D=80.05"
Divide by 12 to get feet = 6.67'

10.7 AV Control and Switching

10.7.1 Controls and Switches

Control panels must be installed in appropriate locations within the room, ensuring easy accessibility within the environment. Switches 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 Audio and Video

10.8.1 Audio

Most spaces will require the ability to play audio from a PC, laptop, DVD or other 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.

Wall-mounted speaker brackets are allowed for speaker adjustments and to lock the position physically. Similarly, ceiling speakers will be securely mounted to ceilings and additional support will be provided.

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.

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

10.8.2 Video

Video sources will include HDMI. USB-C and Mini Display Port connectors are allowed where possible. VGA must only be used in circumstances where the source equipment does not support the HDMI standard. A convertor to HDMI may be used for special situations.

10.9 Source Equipment

The simplest spaces may provide a single connection point to a source device (e.g., a laptop), but most spaces provide a switching and control system along with a selection of 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.

10.10 Video Conferencing

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

1. Skype for Business
2. Microsoft Teams
3. Zoom

These design requirements are based on the unique technical aspects of video conferencing. Each video conferencing system must include the following core components:

- Display
- Camera (USB – 1080p or higher)
- Audio (USB or Converted to USB or built into camera or microphones)
- Microphone (USB or Converted to USB or built into camera or audio speakers)
- PC (i3 or higher, 16 GB RAM recommended) with wireless/Bluetooth keyboard and mouse
- Wireless/wired Network

Additional considerations to ensure a positive video conference experience will include the type of video conferencing system, display size, camera position, furniture design, color selections, room size, signage, controls, etc.

10.11 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 achieve low 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 spill 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 a space, expect lighting control to be an integrated part of the system. Exact lighting designs will be determined during the design process.

10.12 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 and Zoom 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.

10.13 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.

10.14 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 close 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 than can produce noise in audio or video systems. A sufficient number of convenience 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. Otherwise, a maximum height of 48 inches applies to access controls, peripherals and ports.

14.0 System Programming

14.1 Extron

Extron systems are highly recommended to handle any programming and configuration needs to facilitate collaboration, empower learning, and enhance communication and workflow. Specific recommendations for each learning space will be provided by UIT CT according to the user needs.

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.
- 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.
- 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.
- Projection devices will be free of any hum bars, shimmer, flicker, ghosting or any other undesired artifacts, up to the native input resolution of the projection device.
- All ceiling and wall cuts are to be neatly made and positioned to meet the needs of the space.
- In consultation with UIT, provide adequate power. All electrical works must be provided by a licensed electrician and completed to relevant US Standards. Final number of power outlets will be determined during the design consultation process.
- Provide documentation for all installed devices. Include manuals, diagrams, support and end user's documentation.

15.2 Project Responsibilities by Phase

Phase	Tasks
Planning and Programming	• Needs analysis • Physical or virtual benchmarking • Literature search • Existing campus plans analysis • Research on emerging technologies and pedagogies • User interviews • Narrative descriptions of the various spaces and systems • Budgeting
AV and IT infrastructure	• Room geometry, layouts, sightlines, and adjacencies • Cable pathways and technical requirements • Architectural integration and aesthetic requirements • Coordination with other design disciplines
AV and IT systems	• Conceptual design and budgeting • Detailed design and budgeting specification • Supply • Installation design and specification
AV and IT integration planning	• Network security • IP addressing and network layout • Physical location of equipment (sharing of IDF closets)
Lecterns, operator consoles, and other furnishings	• Design and/or selection • Supply • Installation and modification
Control systems	• Layout of user interface • GUI flow and user needs • Programming, installation, testing and debugging • Training
Construction administration	• Shop drawings • Submittal reviews • Infrastructure reviews • Coordination, scheduling and planning • Final checklist and acceptance testing
Installation	• Definition by specific system • Cable pulling and labeling • Physical installation • Configuration, tuning, and optimization • Testing and troubleshooting schedule • Coordination with other trades
Training	• End user training • Support staff training • Training documentation
Service and maintenance	• Instruction for placing service calls • Maintenance plan and proposed schedule

16.0 Recommended Hardware List

16.1 Equipment Make and Model

Equipment Type	Preferred Make and/or Model
Data Projectors	Panasonic, NEC
Data Screens	Da-Lite, Draper
Commercial Displays	Samsung, LG, Sharp, Sony, NEC, ViewSonic
Pro:Idiom Displays	Samsung, LG
Interactive Touch Screens	ViewSonic, Avocor, Sharp, NEC
Projector Mounts	Chief, BMS
Display Mounts	Chief, Salamander
AV Switchers	Extron
AV Controllers	Extron
Desktops	Dell, HP, Smart Podium, Intel NUC
Amplifiers	Crown, Extron, Biamp
Microphones	Shure, Nureva, Clearone

Equipment Type	Preferred Make and/or Model
Speakers	Extron, JBL
Hearing Assistance	Listen Tech
Source Devices	HDMI, Ethernet, Wireless, USB C
Rack Cabinets/frames	Middle Atlantic, Spectrum
Power Conditioners/distributers	Eaton, Furman, Middle Atlantic
Network Devices	RJ45
Video Conferencing Codecs	MS Skype for Business, MS Teams, Zoom
Video Cameras	Logitech, Vaddio, Clearone, Poly
Lecterns	Spectrum, VFI, CCI
Cabling	Extron, Kramer