

DIVISION 27000 | COMMUNICATIONS

This section includes guidelines and requirements for the design and construction of campus audiovisual systems. Unless specifically noted, all standards apply to both the healthcare campus and the education campus.

The standards are a resource for the designer of record. This Standard supersedes all previous versions. The requirements are to be reviewed by the design team and incorporated into the contract documents. The standards themselves will not be included in the contract documents. It is the responsibility of the design team to incorporate them throughout the drawings and specifications.

The standard is not intended to encompass all components required in a complete system design, but to indicate the university's preferences where they exist. Exceptions to these standards may be considered on a case-by-case basis for extraordinary projects or where value engineering is required. Designers are encouraged to present the university with new or different systems, equipment, or materials when they may provide a better or more valuable product. All deviations must be approved by the University of Kentucky ITS AV Design Engineering Team and the Capital Construction Project Manager.

Section 274100 – Audiovisual Standard

Table of Contents

SECTION	SUBSECTION	STANDARD	PAGE
1.0		Introduction	4
2.0		General Information	5
	2.1	Current Contact Information	
3.0		Definitions	6
4.0		Compliance and References	8
5.0		Physical Requirements for AV Systems	9
	5.1	Electrical Requirements	
	5.2	Rack Requirements	11
	5.3	Lecterns	13
	5.4	Ventilation	14
	5.5	Room Layout	15
	5.6	Projection Surfaces	16
	5.7	Display Devices	17
	5.8	Interactive Touch Experiences	19
	5.9	Interactive Way Finding (Kiosks)	21
	5.10	Digital Signage	22
	5.11	AV Control and Switching	23
	5.12	Audio	24
	5.13	Source Equipment	
	5.14	Video Conferencing	25
	5.15	Lighting	
	5.16	Lecture Capture	26
	5.17	External AV Input Plates	
	5.18	Network and Security Infrastructure Requirements	27
	5.19	Audiovisual Systems Cabling Installation Specifications	29
	5.20	ADA Compliance and Integration	30

	5.21	System Programming	31
	5.22	Audiovisual System Installation Process	33
	5.23	Warranty, Service and Support	36
6.0		Appendix 1 – Specific Design Standards by Space	37
	6.1	Single Display Classroom Standards	
	6.2	Dual Display Classroom Standards	
	6.3	Collaboration Space Classroom Standards	
	6.4	Conference Room Standards	
	6.5	Digital Signage Standards	
	6.6	Digital Wayfinding Standards	
7.0		Appendix 2 – General Standards	38
	7.1	Standard Projection Screen Size Standard	
	7.2	Standard GUI Design Standard	
	7.3	Standard AV Pathways Standard	
8.0		Appendix 3 – Project Documentation and Commissioning	39
	8.1	AV Project Planning Checklist / Customer Expectations	
	8.2	Project Line Drawings	
	8.3	IP Address Request List	
	8.4	Project Commissioning Checklist	

1. Introduction

The purpose of this publication is to ensure that all audiovisual facilities are designed and constructed to the standards as set forth by UK Information Technology Services, Audio Visual Services Engineering Design Team known henceforth in this document as the UK ITS AVSEDT. All projects that plan to incorporate any audiovisual systems should send notification to the UK ITS AVSEDT at the beginning of the Schematic Design (SD) in order to allow for planning of staff and for the assignment of an UK ITS AVSEDT Project Manager and an alternate Project Manager. All A/V designs must be provided to the assigned UK ITS AVSEDT Project Manager with Design Development (DD) plans with at least 20 university workdays for review. Meetings may be requested by the UK ITS AVSEDT to discuss various aspects of the initial designs with the key designers and stakeholders throughout the review process as deemed necessary. A final review of all comments and changes will be provided in writing by the UK ITS AVSEDT Project Manager at the end of the review process. At that point, a meeting will need to be scheduled with the UK ITS AVSEDT as a group and the key designers and stakeholders to discuss any changes and review acceptable alternatives if agreed upon. Following this meeting, all changes by the UK ITS AVSEDT or agreed upon alternatives must be sent forth into the Construction Documents (CD). Any changes to these documents that impact the layout of the room, placement of any equipment, utilities, lighting, controls for in-room systems, Fire Alarm devices, ceiling design/layout/style, or location/style of Audiovisual pathways and equipment must be brought immediately to the attention of the UK ITS AVSEDT Project Manager or their alternate in order to ensure the original design will still apply. This is to ensure that they do not interfere with equipment placement or use, or the Audiovisual equipment will not obstruct their use or designed purpose, such as a fire alarm strobe behind a projection screen. Due to project scope, the University is able to single source based on equipment training, system standardization, and spare equipment availability. Therefore, this document will be used as the standard to which the facilities and equipment will be designed or updated over time. In situations where these standards cannot be met, any alterations to plans and standards included in Appendix 6, consultation with UK ITS AVSEDT must happen as soon as possible.

This publication details the physical, programming and security requirements for the audiovisual equipment to be used in classrooms, meeting rooms, PC labs, lecture halls, auditoriums, and other spaces to be determined on a case-by-case basis. UK ITS AVSEDT in practice endorses the [AVIXA, AV/IT Infrastructure Guidelines for Higher Education](#) as a companion document subject to the specifics of the UK ITS Audiovisual Specifications.

2. General Information

2.1. Current Contact Information

Contact information for the UK ITS Audiovisual Engineering Design Team:

Phone: 859-323-6455

Email: itsavsdesignteam@uky.edu

Current Management and Engineering Design Team:

Rex Stidham

Mark Hughes

Rich Rice

Mark Ferrito

Zach Smith

Mark Minor

Jim Morris

3. Definitions

UK ITS or UK ITS AV – UK Information Technology Services, Audiovisual (AV) design staff or authorized representative

UK ITS AVSEDT – University of Kentucky Information Technology Services Audiovisual Design Engineering Team

ADA – Americans with Disabilities Act

AFF – Above Finished Floor

ANSI – American National Standards Institute

Audio Visual Consultant – Any person or company commissioned by UK or contractor to perform design work other than UK ITS AVSEDT staff and to serve as the project manager of the installation.

Audio Visual Integrator – Any person or company commissioned by UK to perform work on UK Audiovisual systems other than UK ITS AVSEDT staff.

AVIXA (formally known as InfoComm) – Trade association representing the professional audiovisual and information communication industries worldwide.

Dante – Digital Audio Network Through Ethernet is a combination of software, hardware, and network protocols that deliver uncompressed, multi-channel, low-latency digital audio over a standard Ethernet network using Layer 3 IP packets.

DSP – Digital Sound Processor

DTP – A proprietary digital twisted pair protocol developed by Extron that sends HDMI (up to 4K @60Hz, 4:4:4 at data rates of up to 18Gbps, while supporting HDMI 2.0b, 1.4 and is HDCP 2.3 and 1.x compliant), audio, power and bidirectional RS-232 and IR signals.

EDID – Extended Display Identification Data is a data structure provided by a digital display to describe its capabilities to a video source (e.g. graphics card or set-top box). This is what enables a modern personal computer to know what kinds of monitors are connected to it.

HDBaseT – promoted and advanced by the HDBaseT Alliance, this is a consumer electronic (CE) and commercial connectivity standard for transmission of uncompressed high-definition video (HD), audio, power, home networking, Ethernet, USB, and some control signals, over a common category cable (Cat5e or above) using the same 8P8C modular connectors used by Ethernet

HDCP – High-bandwidth Digital Content Protection is a form of digital copy protection developed by Intel Corporation to prevent copying of digital audio and video content as it travels across connections.

HDMI – High-Definition Multimedia Interface is 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.

IPBaseT – Internet Protocol based connectivity similar to HDBaseT, but this technology is able to connect devices over gigabit IP networks instead of dedicated connections.

NFPA – National Fire Protection Association (National Fire and Electrical Code)

POE – Power over Ethernet

RU – Rack unit equivalent to 1.75 inches of vertical space in an AV rack

SANS – Institute for information security training and information security standards

SDVOE – Software Defined Video Over Ethernet

TIA – Telecommunications Industry Association

4. Compliance and References

Industry standards, guidelines, and best practices (AVIXA):

ANSI/AVIXA 1M-2009, Audio Coverage Uniformity in Enclosed Listening Areas

ANSI/AVIXA 2M-2010, Standard Guide for Audiovisual Systems Design and Coordination Process (Project Management process) *

ANSI/AVIXA 3M-2011 Projected Image System Contrast Ratio*

ANSI/AVIXA 4: 2012 Audiovisual Systems Energy Management*

ANSI/AVIXA V202.01:2016, Display Image Size for 2D Content in Audiovisual Systems*

AV Design Reference Manual, from AVIXA*

AVIXA, AV/IT Infrastructure Guidelines for Higher Education*

AVIXA, Audiovisual System Design and Coordination Components*

United States Access Board Americans with Disabilities Act Accessibility Standards*

University of Kentucky Construction Standards 260000, 270000*

Note: * - indicates "or latest versions of guidelines or standards"

5. Physical Requirements for AV Systems

5.1. Electrical Requirements

Electrical service for all outlets intended for use with the installed audiovisual equipment should be a minimum of 20A duplex outlets unless otherwise specified in the design requirements, such as recessed outlets, floor outlets, or wired power strip.

All outlets should be marked with appropriate printed or engraved labeling indicating the following information:

- Room Number of Power Panel supplying outlet
- Panel Identification
- Breaker or Circuit Number

For example, 330-EL1-29

This will be used for troubleshooting purposes and to ensure equipment does not exceed the circuit total designed capacity.

Power should avoid being run in conduit with circuits supplying power to motors, capacitors, or near radio transmission equipment, coax and antennas.

All racks that are not mobile must be bonded/grounded as per the University of Kentucky Communications and Network Systems Telecommunications Standard 270000S01, Section 12. ([Divisions 20 - 29 - Facility Services Subgroup | Capital Project Management \(uky.edu\)](#)).

Audiovisual racks that extend from a wall should have a quad receptacle (two duplex outlets) rated at 20A located on the wall beside the rack between 6" from the front edge of the rack and 6" from the rear of the rack and mounted at the standard 18" AFF. The outlet should be either flush with the wall as best as able or as low profile as possible. The faceplate should be stainless steel and marked with the information above.

Projector power should be installed in the single gang cut-out within the 2x2 grid mounting pan if in an acoustic tile drop ceiling with an electrical whip with 4' supported slack in the event of rotation of the mount or movement to an adjacent tile. If it is an open ceiling, then beside the flange mount is required if height of the outlet is under 12' high or above installed seating or stadium sloped flooring. Otherwise, the power will need to be pole mounted below the ceiling at a height below 12' or the projector power will need to be provided through a projector lift and an outlet extended to the lift cover.

Projection screen power should be installed as called out in specification drawings in section 5.1 of this standard.

Large flat panel monitors shall be equipped with a backbox and shall be wired as per the backbox manufacturer's instructions. In the event that a backbox cannot be used on a project, a standard duplex in-wall outlet should be installed and coordinated with the AV Installer to ensure the mount will not block access to the outlet. The mount should be installed in a way that does not block access to electrical work on the outlet in the future. If the project requires surface mount due to construction materials (such as concrete, cement block, renovation), the outlet should be as low-profile as possible and coordinated with the AV Installer in order to ensure the mount will not block access. The mount should be installed in a way that does not block access to electrical work on the outlet in the future.

5.2. Equipment Rack Requirements

Audiovisual equipment is typically mounted in standard 19-inch panel width racks. Typical standard classroom systems use a 21RU rack, which has exterior dimensions of 28" deep, 40.88" high, 22" wide with a load limit of 2,500 lbs. Unless otherwise directed in documents from the UK ITS AVSEDT, the color is to be powder coated black. The rack should stand on 4 adjustable threaded rubber isolating feet. The rear door should consist of a vented and unblocked rear door with a standard key lock and the hinge on the side opposite the teaching lectern. The front door should be externally hinged on the side opposite the teaching lectern, size 21RU, provide at least 64% passive ventilation and be equipped with a thumb lock.

Standard classroom placement of audiovisual racks extends from a wall either side of the front of the classroom with 6" space between the wall and the edge of the rack. It must be at least 36" (preferred 48") from the front of the rack to the closest obstruction or wall, and at least 28" from the back of the rack to the closest obstruction or furniture. The four (4) rubber isolation feet must set directly on the finished floor. This ensures ADA compliance in the front of the rack on the user's side and technician access where items may be full rack depth that require removal through the back door of the rack. Racks mounted in closets must be provided with a minimum clearance to the front, rear and one side of 36 inches. See Appendix 1.

All equipment, where possible, will have rack ears or rack shelf specifically designed for intended equipment mounting. If equipment is not suitable for rack mounting, a minimum of a 1RU cantilever black vented shelf should be provided to appropriately support each piece of equipment. The rack shelf should be appropriately sized to handle the weight and depth. All items intended to be inside the rack must be mounted in such a way that the front and rear doors close completely without issue. No battery backups, power conditioners, etc. are allowed to be placed beside the rack.

Rack design must allow for only a maximum of 75% fill to accommodate future growth. For example, if it is a 10U rack, only 7U may be used for design fill. A suitable number of 120V AC rack mounted network power distribution units with power overload switches will be provided as required. Network power distribution units will have no more than a combined 80% of load designed; for example, the combined total capacity of a 15A unit will carry a maximum load of 12A combined. If the project calls for additional power load, it must be requested at time of design with specific needs including plug type/rating, plug amperage, grounding requirements, etc. Load calculations are to be included with all project design proposals along with BTU calculations for each rack assembly.

Racks that extend from a wall should have a quad receptacle (two duplex outlets) rated at 20A located on the wall beside the rack between 6" from the front edge of the rack and 6" from the rear of the rack. The outlet should be either contained in the wall as best able or as low profile as possible. The faceplate should be stainless steel and marked as required in Section 5.1.2 in this standard.

Audiovisual equipment racks installed in casework, cabinets with limited airflow, or other furniture that the manufacturer has not specifically designed for equipment racks should be avoided if at all possible. If this option is to be used, it should be discussed prior to design with the ITS AVSEDT. If the racks must be installed in cabinetry, rear access in the form of a lockable door is to be provided. The lock will be the AV standard key. All cabinets and rack barrels will be keyed alike and at least 2 keys for each install will be provided to UK ITS AVSEDT upon completion. Cabinetry or custom lectern/racks must provide adequate airflow/ventilation.

Where rear access cannot be provided, the cabinet must allow for a sliding rack to be easily accessible for servicing. There must be sufficient width and depth (clear of obstructions such as hinges) for the rack and loop of cables. The rack and cabling should be able to be slide out on glides fully and turned without resistance. Plastic cable ties should not be used to secure cables in place.

5.3. Lecterns

Lecture benches or lecterns will be specified by UK ITS AVSEDT. The audiovisual equipment for the presenter will be determined during the design consultation process.

The standard classroom lectern is a customized ADA-compliant Sit-to-Stand Desk that is 48" W x 30" D or 60" W x 30" D. The height of the worksurface is adjustable using the motorized lift and the controls are mounted under the corner closest to the common entry side of the teaching space. The lectern will rest on adjustable feet, not casters. See Appendix for more detail.

All cabling beneath the worksurface shall be secured to its underside with screw-fastened supports. Adhesive-based solutions shall not be used, as they are prone to long-term failure. Exposed cabling from the rack to the lectern should be encased in 2" flexible split-loom sleeve that is velcroed at the base of the leg and at the top of the leg with the table fully raised. A metal surface-mount 5-outlet power strip will be mounted with screws under the worksurface to provide power to the desk and other electrical needs at the desk.

A single monitor arm will be installed using the grommet closest to audience side of the worksurface, on the end closest to the rack. The cabling to the monitor should allow for adjustment of at least one full turn of the arm and monitor. This should be a bolt and flange penetration mount, not a clamp-on mount. If the control system is a pushbutton panel, the surface-mounted box should be a 5-gang box as specified in Appendix 1. If the control system is a touch panel, the network cabling will route through backside of the surface-mounted box.

The laptop HDMI cable will run through the remaining grommet and should be at least two feet long.

Any variations to the standard lectern design will be discussed and approved by the ITS AVSEDT during the design consultation process.

5.4. Ventilation

Ventilation, airflow and equipment operating temperature will require consideration when designing the physical layout of the active equipment in the AV rack to prevent unacceptable temperature rise. The university often shuts down airflow to classrooms overnight and during the summer and winter breaks. Therefore, this should be considered when evaluating potential designs.

Recommended ventilation is an air inlet grill in the front and rear doors and an outlet grill in the cabinet top sides of the rack. Passive ventilation will be supplemented by forced air ventilation using 2 1RU unit containing two fans that are at least 120mm, variable speed, thermally activated mounted in the racks as specified in Appendix 1 and ventilate through the front door. A combination of vented and solid rack plates should be used to ensure adequate horizontal and vertical air flow in the rack. Should a ventilated doors and ventilated racks not be possible, in consultation with UK ITS AVSEDT, an alternative solution will need to be explored and approved.

Mechanical devices that contain moving parts, such as fans, which are located at a lectern or close to teaching positions, should be quiet to ensure no distraction is caused to users of the space. Noise should be no louder than 30 dB at 1m from the AV Rack.

Filtered and humidity-controlled forced air conditioning ventilation is required for racks carrying a heat load greater than 1,000 BTUs or if located in a closet or other non-HVAC conditioned space. This should be done in coordination with the MAP and UK ITS AVSEDT.

5.5. Room Layout

The lectern is to be positioned in a suitable location in consultation with UK ITS AVSEDT.

To comply with ADA regulations, the final lectern position should provide a gap of 48 to 60 inches between the front wall and the lectern.

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

AV Consultant must submit room sightline diagram during submittal phase. AV Integrator will confirm and document any issues with sightlines during proposal.

Alternative room layouts will be considered where appropriate in consultation with UK ITS AVSEDT and as determined during the design consultation process.

5.6. Projection Surfaces

Screen sizes shall be in compliance AVIXA V202.01-2016. BDM/ADM. (See Appendix 7) <https://www.avixa.org/standards/discas-calculators/discas/adm>.

Single Screen Projection

The data projector images/screens should be 16:9 ratio and are to be centered as close as possible to the room center line and positioned either flush with ceiling or above the whiteboard assembly as close to 2" below the finished ceiling as possible. This is done to ensure uninterrupted viewing from anywhere in the room. Avoid the lectern obstructing the viewing angles when at all possible, including placing the lectern between the projector and the screen. Typically, the projection screen should be mounted using 6" metal wall mounting brackets, specifically designed for this purpose, to allow for the screen to drop down in front of wall mounted whiteboards and other obstructions. Use all mounting holes and that the mounting hardware is appropriate for the weight and wall construction. The lowest acceptable height of a screen is 48" unless on an unobstructed stage.

Final screen position will be determined during the design consultation process, and any variation to this will not be accepted unless written permission is supplied by UK ITS AVSEDT before installation.

Dual Screen Projection

Dual-screen projection will have the projection screens mounted as close as practically either side of the room center line. Follow the standards provided in the Single Screen Projection above.

Final screen position will be determined during the design consultation process, and any variation to this will not be accepted unless written permission is supplied by UK ITS AVSEDT before installation.

5.7. Display Devices

All display devices must have a minimum native resolution of 1920x1080 at 60fps (1080p) (with pixel masking to 1920x1080) and a final output aspect ratio of 16:9.

Display devices must be capable of accepting at least 1 HDMI input.

All display devices must be compliant with HDCP implementation. At a minimum HDCP compliance shall be version 2.3 or higher.

All display devices shall be considered for HDR and full gamma color at the discretion of UK ITS AVSEDT and as the application dictates.

All display devices must be equipped with a control port that uses standard RS-232 protocols.

Multimedia Projectors

Multimedia projectors will be purchased under educational programs that provide discounted pricing for higher education when applicable. Projectors should follow standard models specified in Appendix 1 unless determined by UK ITS AVSEDT that a deviation from the standard is required due to usage, environment, brightness, etc. The projector should be installed at a distance from the screen to ensure the projected image will completely fill the screen.

Multimedia Projector Ceiling Mount

Multimedia projector ceiling mounts must be of a suitable high quality professional grade universal product. Typical projector mounts are included in Appendix 1 Any variations of projector mount model will be at the discretion of UK ITS AVSEDT. The provided mount should have a white powder coat finish with a locking arm that secures the projector to the base plate. The locking arm should be secured by padlocked or key locking system. Security screws should be installed in mounting arms, if provided. Two keys should be provided to UK ITS AVSEDT for any locking mechanism. The projector mounts adjustable settings are to be firmly tightened. All unused hardware will be provided to UK ITS AVSEDT at the completion of the project.

Projector ceiling brackets must be mounted in accordance with the manufacturers' specifications.

Flat Panel Displays

Flat Panel Displays shall have a minimum of UHD (3,840 X 2,160 pixels).

All flat panel displays must have a minimum of RS-232 connection capability for control. Manufacturer's bidirectional control protocol must be supplied with the specifications prior to installation. Any alternative flat panel display must be submitted for review to UK ITS AVSEDT prior to purchase.

Flat panel displays using CEC for control is acceptable if the application dictates.

Flat Panel Display Mounts

Flat panel mounts that are mountable on the floor, wall or ceiling must be installed as per the manufacturers' specifications. The flat panel mounts should be of a commercial grade product unless alternative is approved by UK ITS AVSEDT prior to purchase. All mounts shall be rated for 5X the weight of the device it is to support.

Backing for wall mount displays will be minimum 3/4" CDX grade or better plywood in steel stud construction. Lag screws into wood studs or lag shield anchors into solid concrete are approved alternative mounting methods. All mounting hardware and wall backing options should be approved by General Contractor, Architect or Engineer.

Mechanical and electronic security may also be required. This will be specified during the design consultation process by UK ITS AVSEDT.

Final product selection and mounting position will be determined during the design consultation process and any variation to this will not be accepted unless written permission is supplied to UK ITS AVSEDT prior to installation.

5.8. Interactive Touch Experiences

For Conference Rooms, coordinate with ITS ServiceOne Team.

For Digital Signage/Wayfinding, coordinate content with UK SMART Campus Team.

For Room Scheduling, See Appendix 5.

For Control System Touchpanels, refer to Appendix 1 depending on room type.

Hardware Requirements:

- Touchscreen Display
- Projected Capacitive Touch (PCAP) capable of 10+ simultaneous touches.
- Brightness shall be based on screen location and appropriately sized for the lighting, both ambient and electric light, of the space. 500 nits minimum.
- 2X HDMI inputs located on rear of device, no inputs to be located on front or sides.
- Screen size as indicated on drawings.
- Full HD resolution 1920 x 1080 @ 60Hz is the minimum requirement.
- Bezel-less
- Built in stereo audio capable of being toggled off if other audio systems are integrated with display.
- Function buttons shall be capable of being disabled.
- Operating Temperature: 32 degrees F to 104 degrees F
- Rated for 24 hour/day operation.
- Display shall be no more than 3" thick and meet all applicable building requirements for protrusion from wall, etc.
- Warranty: 3 years.
- Manufacturers: ELO, NEC, Planar

Micro Form Factor Computer:

- Intel Core Processor (i7)
- Intel HD Graphics Processing Unit (GPU)
- HDMI out
- Built-in hardware EDID emulation
- Minimum of 16GB DDR4-2133 RAM
- 802.11ac Wireless
- Bluetooth
- Warranty: 3 years
- Manufacturers: examples include iBase, Intel, Dell

Installation Requirements:

- **Mounting Hardware**
 - Locking
 - Full motion
 - Device mounting provisions on mount for easy access.
- **Architectural Details**
 - Refer to architectural details for installation conditions.
 - Appropriate wall blocking/support shall be installed prior to installation of mount and display.
- **Ventilation requirements**
 - All ventilation requirements shall be confirmed prior to installation to avoid premature equipment failure.
- **Infrastructure Requirements**
 - Pathways
 - Cabling
 - Box size/type
- **Emergency Management – If required – refer to drawings**
 - Emergency power
 - UPS
 - Generator

Content management/ownership:

- **Software Requirements – Content Management System (CMS)**
- Centralized software managed by UK IT
- Content shall be able to be managed from schedules.
- Control power to devices
- Any capital project shall include latest software update and licensing fees associated with system.

5.9 Interactive Way Finding (Kiosks) / Coordinate content with UK SMART Campus Team

Hardware Requirements - Unless Otherwise Noted on Drawings:

- Touchscreen display – Projected Capacitive Touch (PCAP)
- 400 nits minimum depending on ambient light levels.
- 3 HDMI inputs
- Full HD resolution min

Micro Form Factor Computer

- Intel Core Processor (i7)
- Intel HD Graphics Processing Unit (GPU)
- HDMI out
- Built-in hardware EDID emulation
- Minimum of 16GB DDR4-2133 RAM
- 802.11ac Wireless
- Bluetooth
- Warranty: 3 years
- Manufacturers: examples include iBase, Intel, Dell

Installation Requirements:

- Mounts
- Architectural details
- Ventilation requirements

Infrastructure Requirements:

- Pathways
- Cabling
- Box size/type

Emergency Management

- UPS

Content management/ownership:

- Software Requirements – Content Management System (CMS)
- Centralized software managed by UK IT
- Content shall be able to be managed from schedules.
- Control power to devices
- Any capital project shall include latest software update and licensing fees associated with system.

5.10 Digital Signage Player

Coordinate content with UK SMART Campus Team

Hardware Requirements

- Touchscreen display – Projected Capacitive Touch (PCAP)
- Micro Form Factor Computer – iBase or equal.

Content management/ownership:

- Centralized software managed by UK IT
- Content shall be able to be managed from schedules
- Control power to devices
- Any capital project shall include latest software update and licensing fees associated with system.
- Coordinate software requirements with UK ITS.

5.11 AV Control and Switching

UK ITS AVSEDT control equipment in complex control environments needs to be Extron unless otherwise specified by UK ITS AVSEDT. AV Control Systems specified for each typical classroom type in Appendix 1. If a design requires a control product that is not able to be supplied by Extron, the recommended variation will not be accepted unless written permission with relevant data sheet is supplied to UK ITS AVSEDT before the design is approved and installation can begin.

The University utilizes Extron switching equipment for typical spaces, alternatively utilizing others as required to meet design goals. Typical Classroom Designs are provided in Appendix 1. Any space that requires multiple HDMI sources will likely require the use of a Digital switcher/matrix. The switcher will be capable of at least:

1. HDCP 2.3 or higher compliance with full key management on all inputs and outputs.
2. EDID management
3. Scaling/frame rate conversion
4. HDMI Audio embedding and de-embedding
5. 1920x1080@60Hz
6. Color space management

Any variations, such as for spaces that require more switching capability that can be provided through a listed solution, must be approved by UK ITS AVSEDT before the design is approved and installation can begin.

5.12 Audio

Typical classroom audio designs are included in Appendix 1. For unique spaces, each piece of audio system equipment, including program playback equipment and speech reinforcement equipment (or a combination of both) must be specified per space in consultation with UK ITS AVSEDT during the design process.

Wall-mounted speaker brackets allow speaker adjustment both horizontally and vertically and allow the speaker to be physically locked into position. Ceiling speakers will be securely mounted to ceilings and additional support will be provided across ceiling as required.

The number and style of microphones (hardwired or wireless), audio processing/mixers including digital sound processors (DSP) and amplifiers will be at the discretion of UK ITS AVSEDT.

The audio in each space will need to be individually tuned to maximize the audio.

All unbalanced audio signals to be run greater than 6 feet must be converted to a balanced audio signal.

Outside of standard designs in Appendix 1, unbalanced line-level runs will only be accepted in consultation with UK ITS AVSEDT. All microphone cable must be run fully balanced XLR without exception.

NOTE: Special consideration should be given to any installation which may include video conferencing equipment.

5.13 Source Equipment

PCs will be owner-furnished unless otherwise specified in consultation with UK ITS AVSEDT during the design process. Typically, these units are readily and easily accessible to all users and may require additional mechanical or electronic security measures as deemed suitable by UK ITS AVSEDT.

5.14 Video Conferencing

UK ITS AVSEDT is transitioning to software-based videoconferencing options. As classrooms are designed, software-based videoconferencing options should be considered and included if deemed necessary. When needs exceed the standard classroom designs included in Appendix 1, the design should be jointly developed between the Engineering firm and UK ITS AVSEDT.

Web Based Collaboration Solution

Dedicated hardware is required in teaching spaces or meeting rooms which offer web collaboration such as **Zoom, Teams**, etc. to ensure a good user experience.

For small meeting rooms and teaching spaces that seat no more than 12 people, a USB webcam and echo-cancelling speaker/microphone is recommended. Refer to Appendix 1 for the current options.

For medium to large meeting rooms and teaching spaces, or when needs exceed the standard classroom designs included in Appendix 1, the design should be jointly developed between the Engineering firm and UK ITS AVSEDT.

5.15 Lighting

It is preferred that building operations integration **not** be tied into the AV control system whenever possible. If lighting control is required, a provision that provides the ability to control the house and stage lighting dimmers will be coordinated with the AV control system. Integration into existing lighting systems will be determined during the design process by UK ITS AVSEDT.

Independent lighting controls should be provided to turn off lighting within 4' of any projection screen or monitor.

Cameras should not be located where lighting can flair/blind the camera or block the image.

5.16 Lecture Capture

Lecture capture facilities are required in many of the University's teaching spaces. Unless otherwise specified, all lecture capture and streaming appliances will be owner furnished. Typical video and audio feeds to lecture capture equipment is specified in Appendix 1. Variations to these designs must be as approved during the design consultation process by UK ITS AVSEDT.

5.17 External AV Input Plates

Suitable AV input plates will be specified by UK ITS AV. The Contractor may supply an alternative manufacturer with prior approval from UK ITS AV. All plates specified must be engraved with black text.

5.18 Network and Security Infrastructure Requirements

IP networking between AV systems may be accomplished in one of two manners:

- **Air-Gapped Installation** – In this scenario AV equipment is not connected to a UK managed network. All IP networking is the responsibility of installer and / or end user. No equipment may receive an uplink or data connection from the UK network, and no device may be dual-homed to both the AV network and the UK network. As such, the AV network is completely isolated and cannot communicate with any other device connected to the UK network. Equipment selection used to interconnect devices in this scenario may be selected at the discretion of the installer, vendor, or end user. Equipment installation must be completed in accordance with all applicable ITS standards.
- **ITS Managed** – In this scenario ITS Networking & Infrastructure will be responsible for the design, procurement, installation, management, and maintenance life cycle of an IP network to support AV systems. Prior to purchase or installation ITS Networking & Infrastructure must provide approval for any net-new system being installed and connected to this network. ITS shall:
 - Select network equipment based on appropriate enterprise standards and compatibility.
 - Efforts should be made to ensure that any and all connections to the UK network are made within an Intermediate Distribution Frame (IDF).
 - Should conditions exist which dictate that connections be made outside of an IDF, an appropriate ITS managed network device must be installed (per enterprise standards) at an agreed upon location in order to accommodate these connections. Appropriate rack, power, and environmental conditions must exist within that location (typically a podium or credenza type installation) to accommodate switch gear and UPS equipment. A requirement may exist for either fiber or copper uplinks from this location and will be dependent on a design for each location.
 - Hubs or unmanaged layer 2 switches may not be used to “split” an existing network connection or uplink into multiple connections.
 - Provision all unicast and multicast address:
 - The size of broadcast domains will be at the sole discretion of ITS, and no application should assume that Layer 2 adjacency shall exist between any 2 application components.
 - All components must be capable of obtaining a unicast IP address via Dynamic Host Configuration Protocol (DHCP). Should a host require a “static” IP address assignment, that assignment will be accommodated via a DHCP reservation and should not be hard-coded. A DHCP reservation should not be needed for every device, only those devices which offer services consumed by other clients

may require a DHCP reservation. This addressing will be provisioned out of RFC 1918 address space. Any needs for non-RFC 1918 addressing must be discussed and agreed upon prior to purchase and / or implementation.

- All multicast addressing assignments will be made and documented by ITS. These assignments will be made out of the RFC 2365 administratively scoped address block range. Applications must be capable of configuration that allows for the uses of ITS provisioned multicast addressing, and no other multicast address should be used unless it is part of an IANA defined multicast address scope for a specific and appropriate use.
- Be responsible for the security of systems attached to the enterprise network. At a minimum these devices will be located behind the enterprise firewall. Should additional segmentation be required or desired, it is incumbent on the customer, integrator, installer or end-user to request a design which meets these needs.
- Provide written approval of AV design based on submitted designs and equipment specifications.

Registration of devices will be managed through UK ITS. All devices when deployed will have the latest available firmware installed and documented along with serial numbers and MAC addresses of each installed device.

The use of IPBaseT or Network audio design protocols may be considered if the necessary infrastructure is in place and is pre-approved by UK ITS.

Devices that require POE need to be identified along with requirements and specific location. A power management plan for POE devices should be included.

5.19 Audiovisual Systems Cabling Installation Specifications

Conduit

All AV conduits shall be

- Blue in color
- Minimum of 1.25" diameter
- Centralized junction box per room as noted in Appendix 1

Cabling

- All cabling must be neat and secure. Where equipment is mounted on slides, sufficient cable length must be provided to enable the item to be withdrawn to the limit of the slides while remaining fully operational and without stress on cables or connectors. Typically, cables terminating at the equipment racks or lecterns will have 10-ft tails provided.
- Attention must be given to plenum rated installation to make sure the proper cable type is used such as riser rated vs plenum rated. Contractor is responsible for verifying the installation requirements.
- Velcro must be used to secure cabling at racks for the looms and cable ties may only be used to secure the termination point to the equipment. Cables terminating at the equipment, i.e. data projectors, speakers etc. must have 6ft tails provided.
- Any in-ceiling cabling must be suspended above ceiling tiles on J-hooks or cable tray. J-Hooks must be closed by spring clip when installation is complete.
- At least one pull string must be run from the AV rack to the ceiling space.
- All connections must be to industry standard. Connectors terminated on site are to be of a high quality and professional standard.

Cable Labeling

AV Integrator shall follow AVIXA cable labeling standard ANSI/AVIXA F501.01

- All cables must be labeled within two inches of the connector with a printed self-laminating label indicating where it is/should be connected.
- For example, HDMI input A of a projector should be labeled 'Input A'. Output 3 of VDA2 should be labeled 'VDA2 Out 3 to PROJ Input A'.
- Masking tape, insulation tape and handwritten with permanent pen cannot be used for labels and will not be accepted by UK ITS.
- On completion of the works, an accurate cable schedule must be provided to UK ITS AVSEDT department for archiving.

Network Cable Specifications

For all UK ITS Network cabling standards, please refer to their design guidelines for Division 27 at <http://www.uky.edu/cpmd/design-standards>

5.20 ADA Compliance

The Americans with Disabilities Act requires that effective communications be provided for people with disabilities.

Hearing Augmentation

Auxiliary aids will be provided as needed to enable effective classroom communications.

Mounting Heights for Visually Interactive Devices

An acceptable height of 54 inches is allowed if it is side approachable, otherwise the maximum height of 48 inches applies.

5.21 System Programming

All programming will need to be coordinated through UK ITS AVSEDT in order to follow layout standards and brand identification.

Hardware Administrative Rights

All hardware will be programmed with UK having full administrative rights to all system components.

AV Integrator Programming Bidder Qualifications

Any audio-visual integrator providing quotation for any specified system must meet the following criteria regarding the product supply and programming:

1. Must be a certified dealer of the respective products, recognized by the manufacturer.
2. Must have at least one in-house certified programmer within the organization. The audio-visual integrator is to provide programmers details with suitable reference to past projects completed and training/certification obtained.
3. Must provide references of previously completed audio visual projects incorporating integrated control systems. It is required that at least two references have accompanying contact details for the University to check upon customer satisfaction.

5.22 Audiovisual System Installation Process

General Guidelines

The audiovisual integrator is to install all equipment for the teaching space audio visual system as outlined throughout this scope of works/specification and University provided system block line diagram.

All works are to be completed to a high standard with a fully functioning audio-visual system handed over at completion of the project:

1. In accordance with AV industry best practices, all mounting hardware will be a 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.
2. UK ITS AVSEDT will supply all network connections in the form of a POE port.
3. Audio is to be free of any buzz, hum and any other undesired noise. Exact speaker positions are to be based on a practical determination of best sound coverage from the front of house (key decision factors being careful consideration of room layout, possible sound obstructions, and dispersion properties of speakers).
4. Video/Data projection is to be free of any hum bars, shimmer, flicker, ghosting, or any other undesired artifacts, up to the native input resolution of the projection device.
5. Installed 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 a minimum Grade 5 or better and be matching for that specific item type.
6. Audio visual integrator provided ceiling cutouts for a projector ceiling mount pole are to be neatly cut out with a diameter no greater than 0.25inch of that of the pole itself.
7. Equipment racks - refer to 5.1.
8. In consultation with UK ITS AV, provide adequate power to the projector, lectern and projection screen. A standard ceiling mounted duplex receptacle is to be provided at the projector with a quadruplex receptacle provided to the cabled end of the projection screen (ideally within ceiling cavity where possible) and two quadruplex receptacles to the lectern. All circuits must be linked to a common earth. All electrical works must be provided by a licensed electrician and completed to NFPA 70 and any other relevant Codes. Final number of power outlets to be determined during the design consultation process.

Commissioning

The audiovisual integrator must provide the University with a commissioning schedule/program before commencement of the project. This schedule will be approved by the University before the contractor fully commissions the system/systems. All necessary equipment used by the audio-visual integrator to competently test and commission the system is to be outlined in its provided commissioning schedule/program. For example, it would be expected that video signals would be tested/commissioned using a color bar graph generator at a minimum for that signal type.

Inspection and Testing

The University may throughout an installation inspect and undertake QA assessment of the works performed. Any inspection will be arranged prior and in consultation with the audiovisual integrator and will not interfere with works being carried out on site. Following practical completion of the works the audio-visual integrator must perform a full system test of all supplied equipment, operating functions and connectivity in the presence of UK ITS AVSEDT as part of system handover. This will be assisted by ITS AV by providing a detailed checklist to follow. Part of this testing and commissioning phase, ITS AV will also conduct a detailed test of the system that will be documented into a defect, issues and improvements checklist to be followed up within 5 days of handover to the integrator.

Operator Training

The audiovisual integrator must provide a structured training session for UK ITS AVSEDT on system operation. This training session is to take place at the final handover stage of the project. The number of hours involved will vary depending on the project and will be agreed to prior to the commencement of any installation.

Project Documentation

Shall comply with ANSI/AVIXA **D401.01:2023**.

A project folder is to be provided by the audiovisual integrator at handover.

The project folder is to contain:

Section 1: A complete easy reference list of service contact details for each supplied equipment component in the system. This list is to also include service contact details for the audio-visual integrator (standard working hours and out of hours service contacts).

Section 2: All equipment manuals, software and warranty details provided from the Manufacturer.

Section 3: A copy of the 'As Built' system block line diagram. In most cases, this will be a simple copy of what the University has already provided the audio-visual

integrator, unless changes have been made to the standardized system design during the project with authorization from the University in writing.

Section 4: A complete unprotected and un-compiled copy of the control system program is to be supplied on a USB memory stick. Please note that all separate equipment control modules used within the program are to be provided in a separate file folder titled 'Modules'. All touchpanel GUI design files will be provided in a separate file folder titled 'Touch Panel'.

Section 5: A complete list of supplied equipment with reference to what room each item is located in. The list will include item make, model, description, serial number, MAC address and IP address.

Section 6: Hearing Aid Loop / IR design and design certification.

5.23 Warranty, Service and Support

All equipment supplied under the audiovisual contract must be guaranteed free of defects in hardware and software arising from faults in materials or poor workmanship/programming for at least 12 months from the date of practical completion of the works covered in the contract or agreement.

This warranty must cover a guaranteed faulty equipment service call out response time of 24 hours (within the working week). All reasonable efforts must be made by the audiovisual integrator to have faulty equipment repaired and returned to the University within 5 working days. As part of a faulty component service call out, the audiovisual integrator is required to temporarily install a university provided replacement to any faulty component, ensuring possible teaching space audiovisual system down time is kept to an absolute minimum.

The audiovisual integrator will be responsible for all labor cost and transportation of equipment cost within the UK Campus during the 12-month warranty period.

A complete list of equipment serial numbers and MAC addresses installed into each teaching space is to be provided in required documentation at the time of project handover.

Additional Documentation

This document should be used as a minimum general reference guide for any AV installation within UK ITS AV. As part of any project, UK ITS AVSEDT may include additional documentation including an audiovisual system block line diagram. The audiovisual integrator is to use this diagram in conjunction with the scope of works/specification for system configuration reference and instruction. Any variation to this system design and format will not be accepted without prior written consent from the University's authorized delegate.

6. Appendix 1 – Specific Design standards by Space Type

6.1 Single Display Classroom Standards

See 274001D01 Standard Single Projection Classroom Equipment List PDF
(Equipment List)

See 274001D02 Standard Single Projection Classroom Schematics PDF
(Schematics)

6.2 Dual Display Classroom Standards

See 274001D03 Standard Dual Projection Classroom Equipment List PDF
(Equipment List)

See 274001D04 Standard Dual Projection Classroom Schematics PDF
(Schematics)

6.3 Collaboration Space Standards

See 274001D05 – Standard Collaboration Space – Level 1 PDF
(Equipment List)

See 274001D06 Standard Collaboration Space – Level 1 Schematic PDF
(Schematics)

See 274001D07 – Standard Collaboration Space – Level 2 PDF
(Equipment List)

See 274001D08 Standard Collaboration Space – Level 2 Schematic PDF
(Schematics)

See 274001D09 – Standard Collaboration Space – Level 3 PDF
(Equipment List)

See 274001D10 Standard Collaboration Space – Level 3 Schematic PDF
(Schematics)

6.4 Conference Room Standards

Available upon request

6.5 Digital Signage Standards

Available upon request

6.6 Digital Wayfinding Standards

Available upon request

7. Appendix 2 – General Standards

7.1 Standard Projection Screen Size Standards

Basic Decision Making (BDM)						
Screen Height = (Vert Image Resolution x Distance to furthest viewer)/6480						
Furthest Seat	Height		Width		Diagonal	
(feet)	(inches)	(feet)	(inches)	(feet)	(inches)	(feet)
12	24	2.0	43	3.6	49	4.1
15	30	2.5	53	4.5	61	5.1
18	36	3.0	64	5.3	73	6.1
20	39.6	3.3	70	5.9	81	6.7
24	48	4.0	85	7.1	98	8.2
28	54	4.5	96	8.0	110	9.2
30	60	5.0	107	8.9	122	10.2
36	72	6.0	128	10.7	147	12.2
40	80.4	6.7	143	11.9	164	13.7
45	90	7.5	160	13.4	184	15.3
50	99.6	8.3	177	14.8	203	16.9
55	110.4	9.2	197	16.4	225	18.8
96	192	16.0	342	28.5	392	32.7

7.2 Standard GUI Design Standards

Available upon request

7.3 Standard AV Pathways Standards

See Standard 274001D11 Power and Raceway Standards PDF

8. Appendix 3 – Project Documentation and Commissioning

8.1 AV Project Planning Checklist / Customer Expectations

Available upon request

8.2 Project Line Drawings

Available upon request

8.3 IP Address Request List

Available upon request

8.4 Project Commissioning Checklist

See next page.

University of Kentucky Classroom Technology Installation Inventory Checklist

Building & Room number: _____

Technician Name: _____

Date: _____

Control Interface:

Brand, Model / Serial No.: _____

Test for image/ L&R audio on all sources: _____

Does this control the projection screen properly? _____

Projector and/or Monitor(s):

Brand / Model / Serial No.: _____

Mount (Wall / Ceiling): _____

Data connection/IP information: _____

Test for image/ L&R audio on all sources: _____

Computer(s):

Brand / Model / Serial No.: _____

Test for image and L&R audio: _____

Wired and/or Wireless Network: _____

Data connection/IP information: _____

Document Camera(s):

Brand / Model / Serial No.: _____

Test for image color/brightness (all lamps): _____

HDMI / Laptop / Auxiliary input(s):

Test for image and L&R audio: _____

PA / Sound System:

Brand / Model / Serial No.: _____

Microphone(s): _____

Speaker(s) wall/ceiling: _____

Identification numbers (UK property tag, other): _____

Test all inputs for audio: _____

Projection Screen(s):

Brand / Model / Serial No.: _____

Format: 16:9 16:10 Size: _____

Mount (Wall / Ceiling / Recessed): _____

Test for interface control (or manual operation): _____

(Screen should activate with interface power on = screen down, power off = screen up. Control switch should work regardless of interface status.)

Instructor Lectern(s):

Brand / Model / Serial No.: _____

Test for ADA functionality: _____

Other Equipment:

9.0 Document Revision History

<u>Version</u>	<u>Date</u>	<u>Change Description</u>	<u>By</u>
0	01Jan18	Draft	MS
1	02Apr18	Various	MS
2	10Apr18	Networking Requirements	MS (CMB)
3	22Nov19	Various Updates	MS (RS)
4	5Jan20	Various Updates	MS (RS)
5	28Oct24	Design/Tech Updates, Section number change.	RS
6	29Apr26	Design/Tech Updates, Reviewed for ADA compliance	RS, BL