



UNIVERSITY OF
Nebraska
Lincoln[®]

AUDIO VISUAL SYSTEMS GENERAL STANDARDS & GUIDELINES

Prepared For

University of Nebraska-Lincoln

Prepared By Information Technology Services Audio Visual Design Build

Revision 2

Date Prepared 27Mar17

Contact Greg.Carstens@unl.edu

P. 402-472-0396

Table of Contents

Section 1 - Version Revision History	6
Section 2 - Introduction	6
Section 3 - Definitions	6
Section 4 - Compliance and References.....	7
4.1 Industry standards, guidelines, and best practices (InfoComm):	7
4.2 Quality Management is guided by The Association for Quality in Audio Visual Technology (AQAV, and that association’s standard)	7
4.3 Acoustical guidelines for classrooms, consult:	7
4.4 Intelligibility of sound systems and public address systems:.....	7
4.5 Further Reference	8
Section 5 - Physical Requirements for AV Systems.....	8
5.1 Equipment Racks.....	8
5.2 Lecture Benches	8
5.3 Ventilation.....	9
5.4 Room Layout	9
5.5 Projection Surfaces	9
5.5.1 Single Screen Projection	9
5.5.2 Dual Screen Projection.....	9
5.5.3 Projectable Dry Erase Wall Coverings (No formal screen).....	10
5.6 Display Devices.....	10
5.6.1 Multimedia Projectors	10
5.6.2 Multimedia Projector Ceiling Mount	10
5.6.3 Flat Panel Displays.....	10
5.6.4 Flat Panel Display Mounts.....	10
5.7 AV Control and Switching	11
5.7.1 AV Control.....	11
5.7.2 AV Switching	11
5.8 Audio.....	11
5.9 Source equipment.....	12
5.10 Video Conferencing.....	12
5.10.1 Hardware Video Conferencing Solutions.....	12
5.10.2 Web Based Collaboration Solution	12
5.11 Lighting.....	13

5.12 Lecture Capture	13
5.13 External AV Input Plates.....	13
6 Network and Security Infrastructure Requirements	13
7 Audio Visual Systems Cabling Installation Specifications	13
7.1 Cabling.....	13
7.2 Cable Labeling	14
7.3 Cable specifications.....	14
8 ADA Compliance and Integration.....	15
8.1 Hearing Augmentation.....	15
8.2 Mounting Heights for Visually interactive devices	15
9 System Programming.....	15
9.1 Manufacturer Specific.....	15
9.1.1 AMX Programming.....	15
9.1.2 AMX Resource Management Suite Enterprise (RMS) Connectivity.....	16
9.1.3 AMX Web Configured Devices	16
9.1.4 BSS Audio Architect.....	16
9.1.5 ClearOne	16
9.2 Hardware Administrative Rights	16
9.3 AV Integrator Programming Bidder Qualifications	16
10 Audio Visual System Installation Process.....	17
10.1 General Guidelines.....	17
10.2 Commissioning.....	17
10.3 Inspection and Testing.....	17
10.4 Operator Training.....	18
10.5 Project Documentation.....	18
10.6 Warranty, Service Support.....	18
10.7 Additional Documentation.....	19
11 Recommended Hardware List.....	19
11.1 Display Options	19
11.1.1 Projector	19
12.1.2 Projector Mounts	19
12.1.3 Projection Screens Surface mounted.....	19
12.1.4 Projection Screens Recessed.....	19
12.1.5 Commercial Display.....	20
12.1.6 Commercial Touch Screen Display.....	20

12.1.7 TV Display Options	20
12.1.9 Display Mount Options	20
12.2 AV Control & Switching Options	20
12.2.1 AV Controller.....	20
12.2.2 User Interfaces.....	20
12.2.3 Video Switching.....	20
12.3 Audio	21
12.3.1 Audio Processor	21
12.3.2 Amplifiers	21
12.3.3 Microphones	21
12.3.4 Speakers	21
12.3.5 Hearing Assistance	21
12.4 Video	21
12.4.1 Document Camera	21
12.4.2 Source Devices	22
12.5 Rack Cabinets/Frames.....	22
12.5.1 Free Standing Rack.....	22
12.5.2 Wall Mount Racks	22
12.5.3 Power Conditioner/Distribution	22
12.6 Network Devices	22
12.7 Video Conferencing.....	22
12.7.1 Video Conferencing Codecs	22
12.7.2 Video Camera HDMI/USB PTZ.....	23
12.7.3 Video Camera USB only	23
12.8 Other	23
12.8.1 Lecterns.....	23
12.8.2 Whiteboard or Whiteboard Material.....	23

Section 1 - Version Revision History

Version Details Date By

Version	Change Description	Date	By
0	Draft Document	01May16	GC
1	Revision with IPBaseT additions	24Feb17	GC
2	Approved by ITS Leadership	27Mar17	HT

Section 2 - Introduction

The purpose of this publication is to ensure that all audio visual facilities are designed and constructed to the standard as set out by UNL Information Technology Services, Audio Visual Design Build (ITS AV).

These guidelines will be used as the standard to which the facilities will be designed or updated over time. Where these standards cannot be met, consultation during the design stage, and prior to the commencement of any construction works, with UNL Information Technology Services staff, must be undertaken.

This publication details the physical, programming and security requirements for the audio visual equipment to be used in classrooms, meeting rooms, PC labs and lecture auditoriums. UNL ITS AV notionally endorses the INFOCOMM, AV/IT Infrastructure Guidelines for Higher Education as a companion document subject to the specifics of the UNL ITS Audio Visual Specifications.

Section 3 - Definitions

ITS – UNL Information Technology Services, Audio Visual (AV) design staff or authorized representative.

ADA – American’s with Disabilities Act

AFF – Above Finished Floor

ANSI – American National Standards Institute

Audio Visual Integrator – Any person or company commissioned by UNL to perform work on UNL audio visual systems other than UNL ITS AV staff.

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

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). It 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, 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

InfoComm – Trade association representing the professional audiovisual and information communication industries worldwide.

IPBaseT – Internet Protocol based connectivity similar to HDBaseT but 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

Section 4 - Compliance and References

4.1 Industry standards, guidelines, and best practices (InfoComm):

1. INFOCOMM, AV/IT Infrastructure Guidelines for Higher Education
2. ANSI/INFOCOMM 1M-2009, Audio Coverage Uniformity in Enclosed Listening Areas
3. ANSI/INFOCOMM 2M-2010, Standard Guide for Audiovisual Systems Design and Coordination Process(Project Management process)
4. ANSI/INFOCOMM 3M-2011 Projected Image System Contrast Ratio
5. ANSI/INFOCOMM 4: 2012 Audiovisual Systems Energy Management
6. ANSI/INFOCOMM V202.01:2016, Display Image Size for 2D Content in Audiovisual Systems
7. AV Design Reference Manual, from INFOCOMM International.
8. Audiovisual System Design and Coordination Components, from INFOCOMM International.

4.2 Quality Management is guided by The Association for Quality in Audio Visual Technology (AQAV, and that association's standard)

1. AV 9000:2012 Quality Management System Conduit, pathway, and dedicated equipment room considerations
2. ANSI/TIA-569B Commercial Building Standard for Telecommunications Pathways and Spaces

4.3 Acoustical guidelines for classrooms, consult:

1. ANSI/ASA S12.60; Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools

4.4 Intelligibility of sound systems and public address systems:

1. NFPA 72; National Fire Alarm and Signaling Code

4.5 Further Reference

1. 2010 Standards for Accessible Design, Americans with Disabilities Act
2. Davis and Davis, 1987 "Sound System Engineering"
3. Giddings, 1990, "Audio Systems Design and Installation"

Section 5 - Physical Requirements for AV Systems

5.1 Equipment Racks

Audio visual equipment is typically mounted in standard 19-inch racks. Racks must be provided with a minimum clearance to the front, rear and one side of 36 inches unless wall mounted. All equipment, where possible, will have rack ears for mounting. If equipment is not suitable for rack mounting a minimum of a 1RU cantilevered shelf will be provided to appropriately support each piece of equipment.

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 power conditioners with power overload switches will be provided as required. Power conditioners will have no more than 80% of load designed so that a 15A unit will have a maximum 12A load and so on. Load calculations are to be included in with all project designs along with BTU calculations for each rack assembly.

Where 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 UNL ITS AV.

Where rear access cannot be provided, the cabinet must allow for a sliding rack to be easily mounted for servicing. There must be sufficient width and depth (clear of obstructions such as hinges) for the rack and loop of cables.

5.2 Lecture Benches

Lecture benches or lecterns typically will be specified and provided by UNL ITS AV.

The audio visual equipment for the presenter is to be mounted in suitable 19-inch wide racks, within the lectern assembly and will be determined during the design consultation process.

Any lecture bench design will include a lockable enclosed cabinet section and an opened fronted cabinet section. Any lockable section will be keyed alike and restrict unauthorized access.

Open sections will be typically for user accessible playback equipment or PC and will include some form of physical and/or electronic security system. Similarly any equipment located on top of benches must, in consultation with UNL ITS AV, include some form of physical and/or electronic security system.

Suitable cable paths throughout a lecture bench will be provided. Final lecture bench design will be determined during the design consultation process. The audio visual integrator is to provision for external audio visual inputs, such as laptops, which will retract and be hidden away when not required.

All power and network outlets required for connection to the AV equipment must be provided inside the lecture bench cabinet space and should, where possible, be run out of the wall, with the outlets positioned 18 Inches AFF. A cable path should be sufficient in capacity to allow for all of the signal cables and future expansion.

5.3 Ventilation

Regardless of location, there must be sufficient ventilation (air flow) to prevent unacceptable temperature rise.

Ventilation, air flow 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.

Recommended ventilation is an air inlet grill in the front and rear doors and an outlet grill in the cabinet top, mounted to the rear of the compartment. Should an outlet grill in the cabinet top not be possible, in consultation with UNL ITS AV, a grill shall be mounted as high as possible on either side of the rack cabinet suitable with provision for an internal fan.

Mechanical devices that contain moving parts, such as fans, that are located at a lectern or close to teaching positions, should be quiet enough not to distract users of the space. Noise should be no louder than 30 dB at 1m from the AV Rack so not to interfere with any teaching or recording.

5.4 Room Layout

The lectern is to be positioned in a suitable location in consultation with UNL ITS AV.

Any final lectern position will allow a gap of 48 to 60 inches between the front wall and the lectern, to comply with ADA regulations.

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

Alternative room layouts will be considered where appropriate in consultation with UNL ITS AV and determined during the design consultation process.

5.5 Projection Surfaces

5.5.1 Single Screen Projection

The data projector images/screens are to be centered as close as practically possible to the room center line and positioned either flush with ceiling or above the whiteboard assembly as close to the ceiling as possible, to allow uninterrupted viewing from anywhere in the room. As necessary the audio visual contractor is to supply 6 inches off the wall mounting brackets to allow for the screen to drop down in front of wall mounted whiteboards.

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 UNL ITS AV before installation.

5.5.2 Dual Screen Projection

Typically dual-screen projection will have the projection screens mounted as close as practically either side of the room center line and positioned either flush with ceiling or above the whiteboard assembly as close to the ceiling as possible, to allow uninterrupted viewing from anywhere in the room. As necessary the Contractor is to supply six inches off the wall mounting brackets to allow for the screen to drop down in front of wall mounted whiteboards.

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 UNL ITS AV before installation.

5.5.3 Projectable Dry Erase Wall Coverings (No formal screen)

Wall coverings that are specifically suitable for projection images and are additionally suitable for dry erase markers such as MattRite or ProjectRite by Koroseal. Alternative products may be considered but will not be accepted unless written permission with relevant data sheet is supplied to the UNL ITS AV before installation. The projection surface will be unobstructed, i.e. no power or network outlets, light switches etc., in this area.

The final dimensions of any projection area will be determined by UNL ITS AV during the design consultation process.

5.6 Display Devices

All display devices must have a minimum native resolution of 1920x1200 and an aspect ratio of 16:10 with the only exception being for ultra-short throw projection, which may have a lower resolution of 1280x800. Any display slaved to an ultra-short throw must be of the same aspect ratio.

Display devices must be capable of accepting digital inputs such as DVI-D or HDMI.

5.6.1 Multimedia Projectors

Multimedia projectors will be supplied and installed as specified by UNL ITS AV. The projector is to be installed at a distance back from the screen so as the projected image will completely fill the nominated screen with the projector's zoom range at a center setting. UNL ITS AV has preferred range of models of projectors and any variation to this will not be accepted unless written permission is supplied by UNL ITS AV before installation.

5.6.2 Multimedia Projector Ceiling Mount

Multimedia projector ceiling mounts must be of a suitable high quality professional grade universal product. Final choice of bracket will be at the discretion of UNL ITS AV. The provided mount is to have a white powder coat finish with a locking arm that secures the projector to the base plate, the locking arm being secured by padlocked or key locking system. Two keys should be provided for any locking mechanism. The projector mounts adjustable settings are to be firmly tightened.

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

Mechanical (projector cages) and electronic security (tamper switches) may also be required. This will be specified during the design consultation process by UNL ITS AV.

5.6.3 Flat Panel Displays

All flat panel displays must have a minimum of RS-232 connection capability. Manufacturers bi-directional control protocol must be supplied with the specifications prior to installation. Any alternative and final panel selection will be at the discretion of UNL ITS AV.

5.6.4 Flat Panel Display Mounts

Flat panel mounts being either floor; wall or ceiling mountable, must be installed as per the manufacturers' specifications and should be of a high quality professional grade product unless alternative is approved by UNL ITS AV prior to installation.

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 alternative mounting methods.

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

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 UNL ITS AV before installation.

5.7 AV Control and Switching

5.7.1 AV Control

UNL ITS AV control equipment is exclusively AMX unless otherwise specified by UNL ITS AV. Should a design require a control product not able to be supplied by AMX any variation will not be accepted unless written permission with relevant data sheet is supplied to UNL ITS AV before the design is approved and installation can be arranged.

5.7.2 AV Switching

The University utilizes AMX switching equipment for typical spaces, alternatively utilizing Extron as required to meet design goals. Any space that has been designated to be converted from analogue to digital, or any space that is designated to be configured to output High Definition, will require the use of a High Definition Digital HDMI switcher/matrix. The switcher will be capable of at least:

1. HDCP 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. 1920x1200@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 UNL ITS AV before the commencement of works.

5.8 Audio

Any audio system either program playback, speech reinforcement or a combination of both will be individual specified per space in consultation with UNL ITS AV during the design process.

Special attention should be given to any speech reinforcement system and will be independently designed for each individual 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. Final size and position of all speakers must be determined in consultation with UNL ITS AV 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. Similarly ceiling speakers will be securely mounted to ceilings and additional support will be provided across ceiling T-bar rails as required.

The number and style of microphones (hardwired or radio), audio processing/mixers including digital sound processors (DSP) and amplifiers are at the discretion of UNL ITS AV.

All products will be individual specified for each space in consultation with UNL ITS AV during the design process. 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. Unbalanced line-level runs will only be accepted in consultation with UNL ITS AV. All microphone cable must be run fully balanced XLR without exception.

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

5.9 Source equipment

All playback, Apple and PC based source equipment will be individually specified for each space in consultation with UNL ITS AV during the design process. Typically these units are readily and easily assessable to all users and may require additional mechanical or electronic security measures as deemed suitable by UNL ITS AV.

5.10 Video Conferencing

UNL ITS AV has identified several key aspects that are required for the design of all video conferencing facilities within the University. These design requirements are based on the technical aspects of video conferencing system and the room environment.

A high quality omnidirectional table microphone equipped with a shock mount is the standard. In rooms where a table microphone is not suitable ceiling microphones may be used, however care must be taken to keep them physically separated from air conditioning outlets, lighting fixtures and existing cameras.

The lighting in all video conference spaces will require special consideration and design to ensure a high quality image from the camera. Every effort should be made to remove or restrict any light bleeding into the room from windows, glass doors/wall, etc. Blackout curtains or blinds are to be used but will require consultation with UNL ITS AV during the design process.

Additional consideration to ensure a positive video conference experience includes the type of video conferencing system, display size, camera position, furniture design, color selections, room size, signage (including UNL branding), etc.

5.10.1 Hardware Video Conferencing Solutions

The Cisco Integrator Package is the standard use at UNL

Generally the Integrator package includes:

1. Codec and Precision HD 1080P 12x optical zoom camera, 2x HDMI cables, table microphone and Natural Presenter Package.
2. 12x Zoom Premium Resolution (1080p60)
3. Dual Display Option
4. 36 Months Maintenance
 - a. Unlimited business hours helpdesk support
 - b. Loan unit in event Cisco system needs to be sent away for repair
 - c. Access to video helpdesk for test calls.
 - d. Access to software upgrades / updates
 - e. 36 months maintenance package

5.10.2 Web Based Collaboration Solution

Dedicated hardware is required in teaching spaces or meeting rooms which offer web collaboration such as WebEx, Cisco Jabber, Zoom, BluJeans or Adobe Connect to ensure a good user experience.

For small meeting rooms and teaching spaces which seat no more than 12 people a USB webcam and echo cancelling speakerphone is recommended. The current recommended PTZ web camera for video is the Huddlecams HD HC3XW-WH-G2 and for audio digital sound processor (DSP) with acoustic echo cancelling (AEC), the recommended product is an AMX Alero.

For Medium to large meeting rooms and teaching spaces a dedicated DSP with AEC such as BSS BLU-102 should be used along with high quality speakers and high quality microphones. Speakers and microphones should provide enough coverage so both parties can hear each other clearly with no echo. For video a high quality high definition pan tilt zoom camera should be used so participants can be seen clearly at the far end. The recommended camera is the ClearOne Unite 200 USB PTZ Video Conferencing Camera HD.

5.11 Lighting

If lighting control is required provision for the control of both 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.

5.12 Lecture Capture

Lecture capture facilities are required in many of the University's teaching spaces. Additional video and audio feeds to lecture capture equipment must be as determined during the design consultation process.

5.13 External AV Input Plates

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

6 Network and Security Infrastructure Requirements

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

No non-approved ITS data switches of any kind are to be used in any project unless expressly pre-approved in writing by the Network Services Team Manager.

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

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

7 Audio Visual Systems Cabling Installation Specifications

7.1 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 15ft tails provided.

Attention must be given to plenum rated installation to make sure the proper cable type is used such as riser rated versus 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.

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.

7.2 Cable Labeling

All cables must be labeled within 2 inches of the connector with a printed self-laminating label indicating where it is/should be connected.

For example, VGA 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 hand written with permanent pen must not be used for labels and will not be accepted.

On completion of the works, an accurate cable schedule must be provided to UNL ITS AV department for archiving.

7.3 Cable specifications

7.31 Audio Visual Cable Specifications

The following cable are considered acceptable for UNL audio visual installations for in room use only. Substitutes or any non-specified cable types must be approved before installation by submitting data sheets to UNL ITS AV.

Type	Description	Manufacturer
HDMI	HDMI1.4 rated	AMX, Extron, Liberty
HDMI Fiber Hybrid	HDMI1.4 rated	Liberty, FSR
Audio	Speaker cable 12-2 thru 18-2	West Penn, Belden, Liberty
USB3.0 Hybrid	Thunderbolt	Corning
USB3.0 Hybrid	Active Extension	DigitaLinx
Data	CAT6STP, CAT6UTP, CAT5E UTP	Liberty, West Penn, Belden, CommScope
Audio	12-2 through 18-2 speaker cabling	West Penn, Belden, Liberty
Audio shielded	18/2 OAS through 22/2 OAS	West Penn, Belden, Liberty

7.32 Network Cable Specifications

For all UNL Network cabling standards, please refer to their design guidelines for Division 27 at <http://facilities.unl.edu/design-guidelines/division-27-communications>

8 ADA Compliance and Integration

8.1 Hearing Augmentation

The audio visual 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. ADA Standards for Accessible Design
2. Infra-Red receivers with a minimum of 95% coverage
3. 1 IR receiver for every 25 persons up to 500 persons
4. Test results for audit purposes that the installed system meets or exceeds the current standards

8.2 Mounting Heights for Visually interactive devices

Acceptable height of 54-inches is allowed if it is side approachable otherwise the maximum height of 48-inches applies.

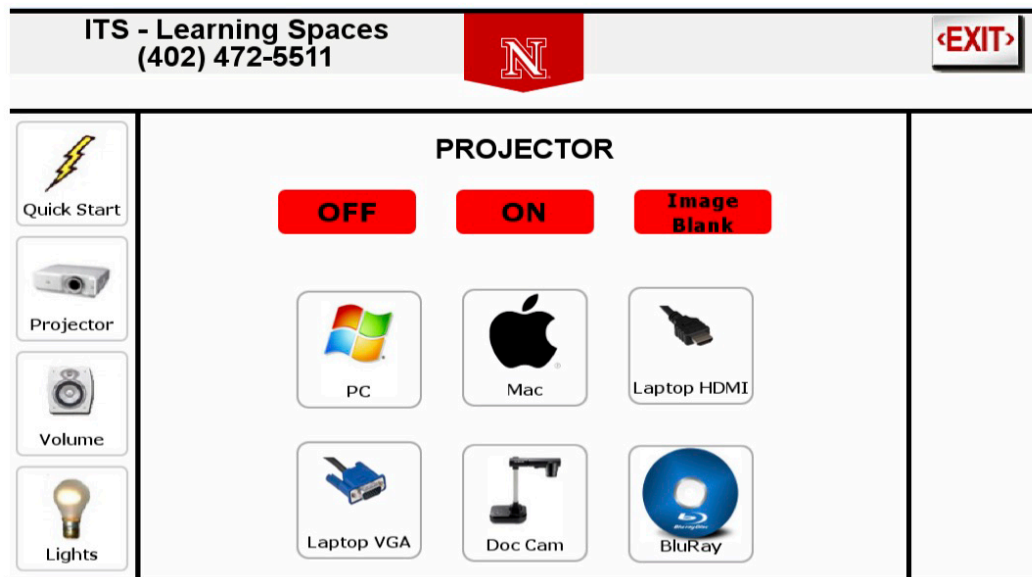
9 System Programming

9.1 Manufacturer Specific

9.1.1 AMX Programming

AMX programming is to be provided to allow for easy and logical user system operation.

The touch panel layout and graphics/font is to resemble the format displayed in the following example:



Please note that a warm-up and cool-down popup page must be displayed when a lamped projector is being turned on and off. This popup displays progress in terms of a % count and progress bar graph. All system user interfaces must be approved by UNL and adhere to UNL-supplied template

The AMX program must be created in AMX Netlinx Studio, AMX Design Suite and AMX TP Design. All complete programs in un-compiled format, iPad modules and graphics files must be supplied to the University on a USB memory stick or CD/DVD ROM at practical completion.

9.1.2 AMX Resource Management Suite Enterprise (RMS) Connectivity

All systems shall be capable of RMS-ENT v4 connection with the following minimum requirements:

Client Gateway Assets

1. All AMX hardware devices
2. Video input sources
3. Displays
4. All controlled devices

Asset Parameters

1. Power State
2. Display usage hours and/or projector lamp hours
3. Input source usage hours
4. Display source selection

Control Methods

1. Display on/off control

9.1.3 AMX Web Configured Devices

Any AMX web configured devices will have a copy of their configuration files saved as part of the project record and submitted to UNL ITS AV as part of the commissioning process.

9.1.4 BSS Audio Architect

Any BSS configured devices will have a copy of their Audio Architect files saved as part of the project record and submitted to UNL ITS AV as part of the commissioning process.

9.1.5 ClearOne

Any ClearOne web configured devices will have a copy of their configuration files saved as part of the project record and submitted to UNL ITS AV as part of the commissioning process.

9.2 Hardware Administrative Rights

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

9.3 AV Integrator Programming Bidder Qualifications

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

1. Be a certified dealer of the respective products, recognized by the manufacturer.
2. 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. The audio visual integrator is to 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.

10 Audio Visual System Installation Process

10.1 General Guidelines

The audio visual 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. UNL ITS AV 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 cutout with a diameter no greater than 0.25inch of that of the pole itself.
7. Equipment racks - refer 5.1.
8. In consultation with UNL ITS AV, provide adequate power to the projector, lectern and projection screen. Typically a ceiling mounted double GPO is to be provided at the projector with a double GPO provided to the cabled end of the projection screen (ideally within ceiling cavity where possible) and two double GPO's 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 72 and any other relevant US Standards. Final number of power outlets to be determined during the design consultation process.

10.2 Commissioning

The audio visual 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 as minimum for that signal type.

10.3 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 audio visual 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 UNL ITS AV 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 check list to be followed up within 5 days of handover to the integrator.

10.4 Operator Training

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

10.5 Project Documentation

A project folder is to be provided by the audio visual 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 AMX program is to be supplied on a USB memory stick or CD/DVD ROM. Please note that all separate equipment control modules used within the program are to be provided in a separate file folder titled 'Modules'. All TP Design touch panel 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.

10.6 Warranty, Service Support

All equipment supplied under the audio visual 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 audio visual 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 audio visual integrator is required to temporarily install a University provided replacement to any faulty component, ensuring possible teaching space audio visual system down time is kept to an absolute minimum.

The audio visual integrator will be responsible for all labor cost and transportation of equipment cost within 100 miles of the UNL 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.

10.7 Additional Documentation

This document should be used as a minimum general reference guide for any AV installation within UNL ITS AV. As part of any project UNL ITS AV may include additional documentation including an audio visual system block line diagram. The audio visual 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.

11 Recommended Hardware List

11.1 Display Options

11.1.1 Projector

Panasonic is the University of Nebraska-Lincoln's preferred manufacture for video projectors. The University utilizes Panasonic's enterprise management tool and therefore unless there is a design requirement that Panasonic cannot meet, Panasonic projectors will be used.

Type	Description	Manufacturer
Laser	Commercial Installation Projectors	Panasonic
Lamped		Panasonic
Large Venue		Panasonic

12.1.2 Projector Mounts

Type	Description	Manufacturer
Ceiling acoustical	Suspended Ceiling Projector System with 2-Gang Filter & Surge	Chief
Projector lift	Electric lift	Chief
Ceiling hard finish	2'x2' recessed equipment box with power	FRS

12.1.3 Projection Screens Surface mounted

Type	Description	Manufacturer
Contour/Cosmopolitan		Da-Lite
Premier/Baronet		Draper

12.1.4 Projection Screens Recessed

Type	Description	Manufacturer
Electrol		Da-Lite
Access		Draper

--	--	--

12.1.5 Commercial Display

Type	Description	Manufacturer
		Samsung Commercial
		NEC Commercial
		Sony Commercial
		Sharp Lite Commercial
Displays must be at least 1080P/60 and have RS232 interface capability		

12.1.6 Commercial Touch Screen Display

Type	Description	Manufacturer
		Samsung Commercial
		Elo Display

12.1.7 TV Display Options

Type	Description	Manufacturer
		NEC
		Sharp
		Samsung

12.1.9 Display Mount Options

Type	Description	Manufacturer
Wall mount w/wo tilt		Chief
Ceiling suspended		Chief

12.2 AV Control & Switching Options

12.2.1 AV Controller

Type	Description	Manufacturer
NX series		AMX
Enova series		AMX
Massio Series		AMX

12.2.2 User Interfaces

Type	Description	Manufacturer
Touch panel	Wall or table	AMX
Massio	Keypad control	AMX
iPad	Apple with AMX App	Apple

12.2.3 Video Switching

Type	Description	Manufacturer
------	-------------	--------------

Solecis	Switcher scaler	AMX
Enova Services	All in one	AMX

12.3 Audio

12.3.1 Audio Processor

Type	Description	Manufacturer
DSP	BLU series	BSS
DSP	Converge/Interact	ClearOne
DSP	Alero	AMX

12.3.2 Amplifiers

Type	Description	Manufacturer
DCI, CTI		Crown
CSA/CSMA		JBLPro
		Extron
		Kramer

12.3.3 Microphones

Type	Description	Manufacturer
Wireless lapel/handheld	QLX-D Frequency Band G50	Shure
Gooseneck		Shure
Wireless conferencing		Revolabs
Ceiling/choir		Beyerdynamic

12.3.4 Speakers

Type	Description	Manufacturer
Lay in 2'x2'	70v	Extron
Lay in 2'x2'	70v	Bogen
Recessed	70v	JBLPro
Line Array	70v	JBLPro
Pendant	70v	JBLPro

12.3.5 Hearing Assistance

Type	Description	Manufacturer
Loop Type		Listen Tech
FM		Listen Tech

12.4 Video

12.4.1 Document Camera

Type	Description	Manufacturer
Epson	DC-21	Epson
Ceiling	CL500	Lumens

12.4.2 Source Devices

Type	Description	Manufacturer
Wireless iOS	Apple TV 4 th Gen	Apple
Wireless PC	Wireless Microsoft Adapter	Microsoft
Wireless App iOS or PC	Enzo	AMX
Blu-ray		Sony

12.5 Rack Cabinets/Frames

12.5.1 Free Standing Rack

Type	Description	Manufacturer
Open frame		Lowell
Open frame		Middle Atlantic
Wheeled cabinet		Spectrum
Wheeled cabinet		Middle Atlantic
Credenza		Middle Atlantic

12.5.2 Wall Mount Racks

Type	Description	Manufacturer
Wall mount		Middle Atlantic
Wall mount		Lowell
Wall mount		Chief

12.5.3 Power Conditioner/Distribution

Type	Description	Manufacturer
UPS	Powerware	Eaton
Surge/conditioning		Furman
Surge/conditioning		Middle Atlantic

12.6 Network Devices

Type	Description	Manufacturer
POE+ injector	30w+	AMX, Cisco
POE+ switches	POE+ (See http://facilities.unl.edu/design-guidelines/division-27-communications) for more information	

12.7 Video Conferencing

12.7.1 Video Conferencing Codecs

Type	Description	Manufacturer
Integrator series	SX20	Cisco

12.7.2 Video Camera HDMI/USB PTZ

Type	Description	Manufacturer
3X wide	90deg	HuddleCamHD
12x	HDMI, USB3.0, H.264 in parallel, RS232 - Unite200	Clearone
12x	USB3.0 RS232	HuddleCamHD

12.7.3 Video Camera USB only

Type	Description	Manufacturer
Wide angle, w/beam mic		AMX
		Logitech
USB wireless audio		HuddleCamHD

12.8 Other

12.8.1 Lecterns

Type	Description	Manufacturer
		Spectrum
		Middle Atlantic

12.8.2 Whiteboard or Whiteboard Material

Type	Description	Manufacturer
	Wall Talker	Koroseal