La Trobe University
Information Services

Audio-Visual Standards

Digital Futures

v1.5

March 2024

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1. Document Control

VERSION CONTROL

Printed and or electronically issued versions of this document are to be considered as uncontrolled. This document will be subject to continual review and updates and the latest version can be downloaded from https://www.latrobe.edu.au/io/working-with-us/design-standards

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1.0	April 2023	Major Update	Alex Farias
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1.5	March 2024	Additional Content	Adriano Salutari

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2. Administration

2.1. EXECUTIVE SUMMARY

La Trobe University (LTU) hosts places of social and personal interaction, where learning takes place and where creative thinking is encouraged. This document provides the standards for consistent arrangement of all Audio-Visual (AV) technology systems across all campuses. Including how the system is to be installed and how it operates. Focus is given to simplification by design and standardisation.

These design standards supersede previous iterations of the La Trobe audio-visual standards. These standards apply to all learning, professional and digital signage spaces, and all other areas where an audio-visual system have been or are being installed. AV design engineers, consultants and integrators are to produce their own detailed specification incorporating the elements and information provided in this document and submit designs for approval to the LTU AV Design Engineer within the Digital futures team prior to any works commencing on site. This document sets out the University's minimum requirements and shall be considered an adjunct to all relevant statutory regulations.

2.2. THE ROLE OF DIGITAL FUTURES

The Digital Futures team resides within the department of Information Services. They are responsible for approving AV designs and installations at the university and accepting completed systems at handover to ensure work is completed satisfactorily and meet the standards herein. Where an AV consultant, contractor, or integrator is engaged, they are required to work with a representative of Digital Futures, commonly an AV Engineer, to ensure requirements relevant to AV equipment and design are addressed prior to the completion of the project.

2.3. ABOUT THIS DOCUMENT

This document provides for the University:

- A consistent experience for end users, designers, and support personnel for all AV system deployments.
- Alignment with I&O standards and requirements.
- Deployment of AV systems that can be supported in a timely and cost-effective manner.
- Define a minimum level of functionality and installation quality.
- Provide guidance to consultants, integrators, architects, and other stakeholders regarding the selection, design, and installation of AV systems.
- Guidelines on the use of common equipment types, enabling consolidation of spares and simplifying vendor support.
- Preferred AV equipment manufacturers and parts list (See Appendix D)
- The procedure and considerations for installations that are unable to abide by these standards.

2.4. REFERENCE DOCUMENTS

2.4.1. Relevant La Trobe University Documents

As well as complying with this document, implementation of AV systems shall also comply with the following:

S0003 (Latest Published Version)	La Trobe University Design Standards
XXXX	La Trobe University Meeting and Collaboration Guidelines
XXXX	La Trobe University Teaching and Learning Guidelines
S004	La Trobe University Cabling Specifications
S026	La Trobe University IS Communications Brief

Where any conflicts exist between any of the above documents and this document the discrepancy shall be brought to the attention of Digital Futures and the principal for an instruction.

2.4.2. Other Relevant Documents

Several standards will be relevant to any AV project. They will apply according to the following order of precedence (higher on the list will take precedence).

- Any Victorian or Commonwealth Legislation that may apply (including referenced regulations) including the National Construction Code (NCC).
- Other Relevant Australian Standards
- LTU Standards (Including this document)
- AVIXA Standards
- AETM AV Design Guidelines

2.4.3. Reference Documents

The following list of documents may be relevant to the AV design for this project. Where LTU standard documents do not specifically address an issue, the below should be consulted for relevant design information.

Standard	Name / description
AVIXA 10:2013	Audio-Visual Systems Performance Verification
AVIXA A102.01:2017	Audio Coverage Uniformity in Enclosed Listener Areas
AVIXA 2M-2010	Standard Guide for Audio-Visual System Design & Coordination Process
AVIXA V201.01:2021	Projected System Image Contrast Ratio
AVIXA F501.01:2015	Cable Labelling for Audio-Visual Systems
AS 1428.1:2021	Design for access and mobility, Part 1: General requirements for access — New building work
AS 1428.2:1992	Design for Access and Mobility - Enhanced and Additional Requirements – Buildings and Facilities
AS 1428.5:2021	Design for Access and Mobility - Communication for People who are Deaf or Hearing Impaired
AS 3080:2013	Information Technology - Generic Cabling for Customer Premises
AS 3084:2017	Telecommunications Installation, Pathways and Spaces for Commercial Buildings.
AS 3760:2022	In-service Safety Inspection and Testing of Electrical Equipment
AS 60118.4-2007	Hearing Aids Magnetic Field Strength in Audio Frequency Induction Loops for Hearing Aid Purposes
AS/ACIF S008:2020	Requirements for Customer Cabling Products
AS/ACIF S009:2020	Installation Requirements for Customer Cabling (wiring rules)
AS/NZS 2107:2016	Acoustics – Recommended Design Sound Levels and Reverberations Times for Building Interiors
AS/NZS 3000:2018	Electrical Installations (Wiring Rules)
AS/NZS 3760-2022	In-Service Safety Inspection and Testing of Electrical Equipment
AS/NZS 60065:2018	Audio, Video and Similar Electronic Apparatus - Safety Requirements
AS/NZS 61000	Electromagnetic Compatibility (EMC) Limits
NCC (BCA)	Building Code of Australia 2021 (BCA)
C-tick:	Complying with Australia and New Zealand EMC Framework requirements.
DDA	Commonwealth Disability Discrimination Act 1992 (DDA)
	Commonwealth Disability Standards for Education 2005 (Education Standards)
Disability Standards 2005	Disability Standards for Education 2005
S003 (Latest published version)	La Trobe University Design Standards https://www.latrobe.edu.au/io/working-with-us/design-standards
S004	La Trobe University IS Cabling Specifications https://www.latrobe.edu.au/information-services-design-standards
S026 (Latest published version)	La Trobe University IS Communications Brief
S042	La Trobe University Standard Lectern

2.5. STAKEHOLDERS

The following La Trobe University stakeholders have been identified as having a role in the use, design, deployment, maintenance, and support of AV service at the university.

Stakeholder	Role
Principal	La Trobe University's representative who has full authority to act on behalf of the University for all technical and design related matters.
LTU Project Management	Project Managers oversee the effective delivery of tasks to a defined timeline and budget. AV deployments may have an I&O Project Manager, IS Project Manager, or both.
LTU I&O Services	I&O manage requirements for building specifications, maintenance and contractors attending campus.
LTU Digital Futures	• Responsible for defining the AV Standards • Defining functionality through stakeholder consultation • Designing the AV solution and/or coordinating with an AV Consultant • Working with AV Integrator overseeing the installation works. • Conduct acceptance testing. • Manage AV defects remediation and project deliverables. • Storing LTU Documentation related to an AV system. • Project handover, at completion, to the Desktop & AV Support team
LTU IS Desktop & AV Support	• Complete witness testing and accept the deployment into service. • Ongoing maintenance and technical support
AV Consultant	Varies dependant on agreed engagement, commonly responsible for the gathering of functional requirements, technical design of the AV system in consultation Digital Futures with and overseeing the successful building of spaces until completion, performing defect identification.
AV Integrator	The company and its sub-contractors, agents and representatives engaged to deliver the AV system as detailed in supporting documents. The AV integrator may be directly engaged or subcontracted under a builder or other services integrator.
User Group	Academics, professional staff, students, and tenants provide advice on end-user experience and desired outcomes.

2.6. DEFINITIONS

The following definitions are used throughout this document.

Name	Description
LTU	La Trobe University
Approval	Formal acceptance of the submitted works. Approval does not relinquish the contractor's responsibility under the applicable contract or engagement.
Authorities	Statutory bodies or inspectors having jurisdiction to enforce current regulations or statutes.
Contract	An enforceable agreement between La Trobe University and engaged contractor.
Contractor	The company, its staff, agents, or sub-contractors that have entered into an agreement to complete the works as detailed in the contract and/or "Scope of Works".
Defects Liability Period	A period from the day that practical completion was obtained where the contractor is to provide a warranty for all supplied goods and services.
Delivery Director – Technology Enablement	La Trobe University's representative who identifies technological business opportunities and facilitates applications for project funding. Assists with high-level stakeholder management.
Instruction	A formal direction issued by the principal or their representative.

Practical Completion	The date that all works have been completed and there are no outstanding defects. Practical Completion may be conditionally granted if defect rectification is delayed by issues outside the contractor's control. DLP for outstanding items will commence from the day of rectification.
Principal	La Trobe University's representative who has full authority to act on behalf of the University for all technical and design related matters.
Builder	Typically engaged by I&O to manage requirements for a particular project to perform building works according to specifications, maintenance and manage contractors attending campus.
Project Manager	La Trobe University's representative responsible for scheduling and liaising with all concerned parties to ensure the delivery of the project is completed in a professional, timely and cost-efficient manner.
Superintendent	La Trobe University's representative who has full authority to act on behalf of the University for all project related matters.

2.7. ACRONYMS

The following acronyms are used throughout this document.

Acronym	Definition
4K	4069 x 2160 pixels
AC	Audio Conference
AEC	Acoustic Echo Cancellation
AFFL	Above Finished Floor Level
ANSI	American National Standards Institute
AV	Audio-Visual
AVoIP	AV over IP
BGM	Background Music
BYOD	Bring Your Own Device
BYOM	Bring Your Own Meeting
CEC	Consumer Electronics Control
dB	Decibel
DDA	Disability Discrimination Act
DECT	Digital Enhanced Cordless Telecommunications
DGPO	Double General Power Outlet
DLP	Defects Liability Period
DP	DisplayPort
DSP	Digital Signal Processor
DVD	Digital Versatile Disc
DVI	Digital Visual Interface
EDID	Extended Display Identification Data
EWB	Electronic Whiteboard
FB	Floor Box
FOH	Front of House
FPD	Flat Panel Display
GPO	General Power Outlet
GUI	Graphic User Interface
HA	Hearing Augmentation
HDCP	High-bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HVAC	Heating, Ventilation, and Air Conditioning
I&O	LTU Infrastructure and Operations
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things

IP	Internet Protocol
IPTV	Internet Protocol television
IS	LTU Information Services
ISDN	Integrated Services Digital Network
IT	Information Technology
IWB	Interactive Whiteboard
K/M	Keyboard and Mouse
KVM	Keyboard, Video and Mouse
LAN	Local Area Network
LMS	Learning Management System
LTU	La Trobe University
MATV	Master Antenna Television
NCC	National Construction Code
OSD	On Screen Display
PA	Public Address
PBC	Push Button Controller
PC	Personal Computer
PDU	Power Distribution Unit
PIP	Picture in Picture
PIR	Passive Infrared
PoE	Power over Ethernet
PSTN	Public Switched Telephone Network
PTZ	Pan Tilt Zoom
QRG	Quick Reference Guide
RBP	Room Booking Panel
RF	Radio Frequency
RT	Reverberation Time
SD	Standard Definition
SPL	Sound Pressure Level
STB	Set Top Box
STI	Speech Transmission Index
TSC	Touch Screen Controller
TV	Television
UC	Unified Communication platform (Zoom/MS Teams)
UCI	User-Computer Interface
UHD	3840 x 2160
USB	Universal Serial Bus
VC	Video Conference
VGA	Video Graphics Array
VWP	Video Wall Processor
WAN	Wide Area Network
WHS	Workplace Health & Safety

3. Who is this document for?

This document forms part of the LTU Standards for building projects and as such it will bind anyone working on these projects including all members of the design and construction team. Everyone working on an LTU AV project should take note of the requirements listed herein.

3.1. RELEVANT SECTIONS

Party	Relevant Information
Architect/Principle	• Room Design Guidelines – Meeting & Collaboration • Room Design Guidelines – Teaching & Learning • Appendix A – Typical Installation Requirements • Appendix B – Preferred Equipment List
AV Consultant	Whole Document
AV Integrator	Whole Document
Electrical Engineer / Project Electrician	Section 6.3, Appendix A – Typical Installation Requirements
User Groups	• La Trobe University Meeting and Collaboration Guidelines • La Trobe University Teaching and Learning Guidelines

3.2. ENQUIRIES AND FEEDBACK

Correspondence related to this document can be sent to the contact details nominated below.

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4. Methodology

4.1. AUDIO-VISUAL STRATEGY

La Trobe University is a non-for-profit organization committed to maximizing the value we provide to our students, staff, and the wider community. While we appreciate the quality and value that vendors and new technologies bring to the table, it is imperative for us to carefully evaluate the financial aspects of any procurement arrangement. Our limited financial resources necessitate a diligent approach to cost management, ensuring that the University's funds are utilized responsibly and efficiently. We understand that vendors and manufacturers rely on a range of factors, such as innovation, reliability, and service excellence, to differentiate themselves in the market. We strive to obtain the best possible value for money, allowing us to allocate resources effectively and maintain the high standards of education and research that define La Trobe University.

AV learning takes place when the instructional process is accompanied and enhanced by the supporting AV technology integrating sound (auditory stimuli) and sight (visual stimuli). LTU's strategy is to create spaces that fulfil this requirement whilst addressing these five key principles:

- Sustainability. Utilise the least number of parts to fulfil the greater number of functions.
- Consistency. Share the same design across many spaces.
- Reliability. Prioritise point-to-point technology that over network dependent alternatives.
- Scalability. Designs and equipment suitable for different size rooms.
- Efficiency: All critical components can be remotely monitored.

4.2. AV PROJECT PROCESS

The design and installation of AV systems requires a coordinated project team and collaboration at the earliest stages. As the technology solution chosen for each space can substantially impact the functionality and budget for a space, it is most efficient to make changes early at the preliminary stage. This will mitigate risk and cost of design challenges later in the build. The LTU project process follows these steps:

Step 1. **Preliminary architectural concept**, this is the initial step where it has been identified that the University will build or refurbish a physical space. An architect or principal will be engaged to draw up plans of the physical space and identify each space's purpose.

Step 2. **Pedagogy alignment**, for each teaching space identified an evaluation is conducted in consultation with LTU Education Services to ensure alignment with the Future Directions for LTU Learning Spaces document. Workshops are conducted where AV system requirements are established, including specific functional and technical requirements, these are typically prepared and provided to an AV Consultant and Digital Futures.

Step 3. **Requirements workshops** are conducted by the AV Consultant or Digital Futures with representatives of the LTU stakeholders to gather a comprehensive understanding of the expected uses of the space and all requirements are identified. This process may take several workshops.

Step 4. **Preliminary audio-visual space guideline identification and matching**, this is completed by the architect or principle in consultation with LTU stakeholders and Digital Futures. At this stage the AV guidelines are utilised to match each physical space to a predetermined AV purpose. As an example, a room may be a Medium Meeting Room, or a Flat Floor Teaching space. At this stage the Manager of Digital Futures will identify if the proposed spaces match pre-defined guideline solutions sufficiently allowing for expedited delivery as pre-existing concept documents\detailed designs exist.

Step 5. **Audio-Visual functional brief**, prepared by the AV Consultant or Digital Futures outlining the system requirements to meet the intended purpose of the space, including specific functional and technical requirements identified during the Pedagogy alignment step. Preliminary design options are produced along. Options are presented to Manager of Digital Futures for approval and then stakeholders for consideration.

Step 6. **Audio-Visual functional brief approval**, required prior to processing to the next step. Digital Futures and the Principle will confer to ensure the process undertaken to document the functional requirements has included all relevant stakeholders. This step is evidenced by the endorsement of the functional brief document at project meetings. Any modification of the functional brief must repeat this step.

Step 7. **Audio-Visual Concept Paper or Detailed Design documents** are prepared by either the Digital Futures team or an AV consultant respectively. Concept papers prepared by Digital Futures allow for expedited delivery of AV solutions. It defines the audio-visual solution, its alignment to LTU AV guidelines and preexisting detailed design documents. This step also identifies the need for a new guideline creation to meet a new or unique use case. In instances where guidelines do not exist or project scope and complexity require an AV consultant, Detailed Desing documents are generated. Elements of a concept paper/Detailed Design include:

- AV Equipment (makes/models)
- Placement within room (drawings)
- Acoustic assessment and identify location to sound treated surfaces.
- Typical Elevations (drawings)
- Structural re-enforcement (backing boards)
- Services (power/data) with elevations
- Cable paths
- Initial Network design (switches, comms rooms, racks AV and LTU Comms)
- Access hatches and easements
- Identification of relocation of existing appliances and services (clocks, thermostats, doors, windows, lights)
- Identification of new furniture arrangements and installation locations (drawings)
- Identification of furniture to be removed.
- Identification of existing AV to be removed.
- AV system programming customisations

Step 8. **Audio-Visual detailed design approval** is required to ensure the principle, Digital Futures and AV Consultant have completed a review of all requirements and identified potential conflict between the AV solution and other services including, mechanical, electrical, HVAC, structural and project budget. This step is evidenced by the endorsement of the AV detailed design document at project meetings. Any modification of the detailed design must repeat this step.

Step 9. **Request for Proposal/Quotes** is conducted by LTU procurement and strategic sourcing team with assistance from the AV Consultant, Digital Futures and principle who prepare documentation to be issued for tender. Where the value of the project does not warrant the completion of a tender then quotes will be requested from the nominated members of the AV integrator panel. LTU may seek pricing from alternate AV suppliers in addition to the suppliers on the LTU AV Panel.

Step 10. **Submission of Proposal/Quotes** is conducted by AV Integrators, detailing the AV equipment, program and relevant documentation requested as part of the prepared tender document. This document should clearly identify components that will be supplied, installed, and commissioned, as well as components to be supplied by LTU or others. If ambiguity arises this is to be addressed by communicating with the identified contact person listed in the RFP documents, AV Consultant, Principle or Manager Digital Futures for clarification.

Step 11. **Quote/Proposal evaluation and award** is completed by the AV Consultant, AV Engineer, in consultation with LTU procurement and strategic sourcing teams. Tender submissions are evaluated for their technical and commercial merit and a recommendation is provided to Manager Digital Futures and the principal. Once awarded the successful AV Integrator will be engaged by the principle.

Step 12. **Power and Network preparation** is delivered by I&O, on the advice of Digital Futures and the AV Consultant, who will review all requirements and ensure the necessary infrastructure is in place before advancing to the Build stage.

Step 13. **Build** is completed by the AV Integrator who installs, programs and commissions AV systems as specified. AV Integrator coordinates works with the LTU nominated Builder, AV Consultant, Principle, LTU I&O Services and other trades as necessary. Any issues, questions or clarifications are issued as prescribed by the principal dependant on project value to the LTU nominated Builder, AV Consultant, LTU AV Engineer or others as an RFI. All RFIs are responded to formally in a Consultant's Advice Notice (CAN) following consultation with the principle and Digital Futures. Throughout the build process the AV Integrator/AV Consultant will laisse with Digital Futures to ensure the project delivers the required solution as detailed in the functional brief. During the build several inspections may be performed by Digital Futures to ensure adherence to these AV Standards.

Step 14. **Defect Inspection** is conducted by the AV Consultant and Digital Futures once the build has been completed. Any remediation works are then identified and completed prior to notification being sent to Digital Futures that the space is ready for practical completion. Digital Futures will verify the space has been built according to the functional brief and detailed design.

Step 15. **Defect Remediation** is conducted by the AV Consultant once the build has been completed. Any remediation works are then identified and completed prior to notification being sent to Digital Futures that the space is ready for practical completion. Digital Futures will verify the space has been built according to the functional brief and detailed design.

Step 16. **Training** is conducted by the AV Integrator to end-users and the LTU IS Desktop & AV Support Team to ensure all users understand how to operate the room, best practice advice, and troubleshooting tips. This step also includes the delivery of support material like Quick Reference Guides (QRG), Operation Manuals and User Guides.

Step 17. **Handover/Practical completion** is submitted by the AV Consultant to the principle. AV Consultant will include any independent inspection of AV systems in conjunction with endorsement from the Digital Futures team. All documents are issued to Digital Futures for archiving, the principle concludes the project.

Step 18. Handover to business-as-usual support and maintenance is submitted by Digital Futures to the LTU IS Desktop & AV Support team. Digital Futures will include any independent inspection of AV systems and relevant documents. This step is evidenced by an Information Services Change Advisory Board (CAB) change artifact being generated and completed successfully. Any modification of the AV design post approval must repeat this step and follow LTU defined ITIL processes.

Step 19. Defects Liability Period (DLP) commences from practical completion and runs for a period of time agreed at the time of the project being awarded. During DLP the AV Integrator will warrant the complete installation, perform routine maintenance and provide call out service for fault rectification.

4.3. RACI MATRIX

Task / Stakeholder	Principal	Project Architect	LTU I&O Services	LTU Project Management	LTU Digital Futures	LTU AV Design Engineer	AV Consultant	AV Integrator	Users Groups	LTU Support
Preliminary architectural concept	**R**	**R**	**R**	**A**	I	I	I	I	I	I
Preliminary AV space identification	**R**	**R**	**R**	**I**	I	I	I	I	I	I
Pedagogy alignment	**A**	**I**	**A**	**A**	A	I	I	I	I	I
Requirements Workshop	**A**	**I**	**R**	**R**	R	A	A	I	A	I
AV Functional Brief	**A**	**I**	**A**	**I**	A	C	R	I	I	I
AV Functional Brief approval	**I**	**I**	**I**	**I**	R	C	I	I	A	I
AV Detailed Design	**I**	**C**	**I**	**I**	A	C	R	A	I	I
AV Detailed Design approval	**I**	**I**	**I**	**I**	R	R	I	I	I	I
Request for Proposal / Quote	**I**	**I**	**I**	**I**	C	I	A	I	I	I
Submission of Proposal / Quote	**I**	**I**	**I**	**I**	I	I	I	R	I	I
Quote / Proposal evaluation and award	**A**	**I**	**I**	**I**	A	I	I	I	I	I
Power and Network preparation	**I**	**C**	**R**	**A**	A	A	A	I	I	I
Build	**I**	**I**	**A**	**A**	C	A	A	R	I	I
Defect Inspection	**I**	**I**	**I**	**I**	A	A	A	A	I	C
Defect Remediation	**I**	**I**	**I**	**I**	C	A	A	R	I	I
Training	**I**	**I**	**I**	**I**	A	I	I	R	I	I
Handover / Practical Completion	**I**	**I**	**I**	**I**	A	A	I	A	A	CI
Handover to business-as-usual support and maintenance	**I**	**I**	**I**	**I**	R	I	I	I	I	I
Defects Liability Period	**I**	**I**	**I**	**I**	I	I	I	A	I	C

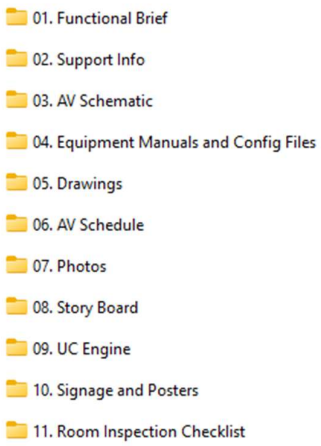
4.4. COLLABORATION/COMMUNICATION AND DOCUMENTATION PLATFORM

La Trobe university operates a collaboration and communication platform based on Microsoft Teams (MS Teams). Once an AV Integrator has been appointed an MS Teams channel will be created with all identified internal and external personnel granted access. The use of the MS Teams platform allows for messages and documents to be stored in a central location. The MS Teams channel also has an email address and it is requested that all email correspondence

addressed to all personnel also include the MS Teams email address as it provides a valuable central repository for such correspondence.

4.4.1. Documentation

Audio-Visual projects require a substantial amount of documentation, all documents related to a particular project are to be stored and updated in the MS Teams site until the project reaches handover to business-as-usual support and maintenance, at which time documents are copied to the Digital Futures document repository and the MS Teams site archived. The documents required vary based on the scope and value of a project, however a sample of the documents required is illustrated below.



4.4.1.1. Functional Brief

An audio-visual functional brief is a document that describes the functional specifications of the audio-visual product that is being developed, such as presentations or web-conferencing. It helps to define the scope, objectives, outcomes, and requirements of the solution, as well as the roles and responsibilities of the project team.

Some of the information that an audio-visual functional brief may include are:

- The purpose and audience of the audio-visual solution
- The key requirements of the audio-visual solution
- The technical and creative aspects of the audio-visual solution, such as sound, lighting, graphics, etc.
- The infrastructure requirements that need to be coordinated with I&O.
- The budget and timeline of the project
- The approval and feedback process of the audio-visual solution
- The distribution and evaluation plan of the solution

An audio-visual functional brief can help to ensure that the audio-visual product meets the expectations and needs of the stakeholders, as well as to avoid any misunderstandings or conflicts during the development process.

Document Format

This Document is to be provided in PDF Format (Preferred)
This Document may also be provided in MS Word Format

4.4.1.2. Support Info

Contains the contact details of the AV Integrator and warranty period information as well as how to engage the AV Integrator for warranty related works. It also contains the contact details of the relevant manufacturers of AV equipment used in the construction of the AV system.

Document Format

This Document is to be provided in PDF Format (Preferred)

This Document may also be provided in MS Word Format

4.4.1.3. AV Schematic

An AV Schematic is a diagram that shows the connections and components of an audio-visual system. It can help with planning, designing, installing, and troubleshooting AV systems. These documents are to be provided at the handover/practical completion. Digital Futures have a template for this document which is available upon request.

Document Format

This Document is to be provided in an editable format to allow for future revisions.

- Microsoft Visio

This Document is also to be provided in PDF Format

4.4.1.4. Equipment Manuals and Config Files

This folder is broken down further into the individual parts of an AV System, with each sub-folder having the name of the corresponding part as identified in the AV Schematic (See: AV Schematic Nomenclature). Also contained in these sub-folders are the configuration files, documented settings, applications used to configure each individual part. Thus, providing a complete and holistic repository allowing for the replacement of any part in the installed system in the event of defect/failure to its installed condition.

Document Format

Various depending on document purpose, as an example and manual from a manufacturer can be in PDF format, and a configuration file for a DSP will be in the format of the manufacturer's application.

4.4.1.5. Drawings

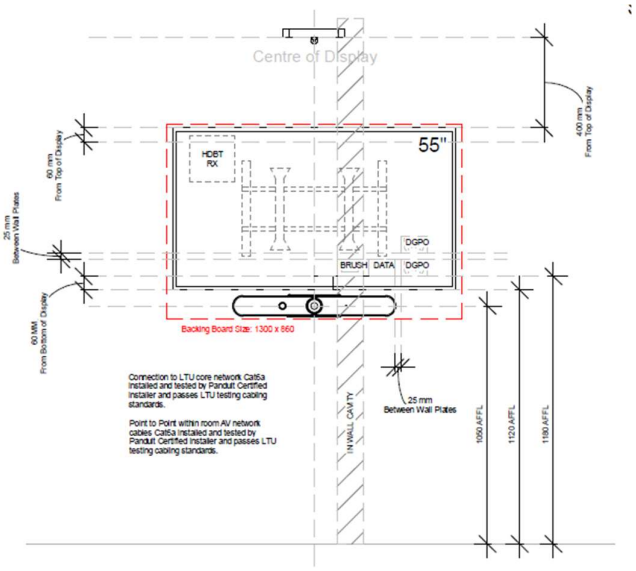
An elevation drawing is a view of a building or structure from one side. It shows the heights, lengths, widths, and appearances of the features in relation to the natural ground level. Also contained in this folder is a reflected floor plan with all AV components marked. It can help designers analyse and communicate their projects from different angles before starting construction. AV Projects are required to have a drawing of each wall that contains a component of the AV system. Also, for each component drawings are to include any relevant services (power, data) and orientation of any fixing's brackets or mounts. Drawings are to include any other services that may need to be considered for the installation of the AV component as an example the location of doors, windows, HVAC etc. Digital Futures have a template for this document which is available upon request.

Document Format

This Document is to be provided in an editable format to allow for future revisions.

- Microsoft Visio
- CAD Program .DWG
- Revit

This Document is also to be provided in PDF Format



1 55 FPD with Sound Bar
1 : 25

4.4.1.6. AV Schedule

Digital Futures have a template for this document which will be prepared at the same time as the MS Teams site is created. This document lists all AV components by nomenclature and details make, model, installation location, network connection information, programming information and other relevant details to complete the commissioning of AV systems.

Document Format

This Document is to be provided in an editable format to allow for future revisions.

- Microsoft Excel

4.4.1.7. Photos

During the build phase of a project at various phases of construction Digital Futures may request that photos be taken. This is to show the location of services (power/data) that may be obscured by cladding or the installation of AV components.
Photos of completed systems will also be required as they are a valuable tool for the LTU Support Team to provide remote assistance.

Document Format

This Document is to be provided in the following format.

- JPEG

4.4.1.8. Story Board

This is a representation of the touch control interface as prepared by the programmer. It is to illustrate every page and every control button with details of its purpose. Also required is a single page that displays all pages of the story board.

Document Format

This Document is to be provided in PDF Format (Preferred)
This Document may also be provided in MS Word Format

4.4.1.9. UC Engine

This folder contains any documents or files related to the installation of a UC Engine, as an example background images, icons or settings related to commissioning the UC Engine. This differs from the Equipment manuals in that it relates to files and settings not installed on the AV component but rather the software platform, e.g. files uploaded to the Zoom admin interface when creating a Zoom room.

Document Format

Various depending on document purpose, as an example a JPEG to be used as a background image or icon.

4.4.1.10. Signage and Posters

This folder contains any documents or files related to signage and posters installed in the room, as an example a quick reference guide on the use of the touch control interface. Additionally, this folder may contain training documents and guides.

Document Format

This Document is to be provided in PDF Format (Preferred)
This Document may also be provided in MS Word Format

4.4.1.11. Room Inspection Checklist

This folder contains any documents related to room inspection and testing of the AV System with results. The folder should include a checklist completed by the AV integrator, as well as a template for the LTU Support Team to utilize during future room checks.

Document Format

This Document is to be provided in PDF Format (Preferred)
This Document may also be provided in MS Word Format

4.5. THE ROLE OF AUDIO-VISUAL CONSULTANTS

An audio-visual consultant may be engaged by the principal or in the case of minor works Digital Futures may perform the role of the AV Consultant. The AV Consultant is responsible for the coordination and delivery of all AV services. The Consultant must be versed on the LTU AV Design Standards and must ensure that all systems strictly comply with university standards and industry best practice.

As a minimum, the AV Consultant will be responsible for the following works:

- Attend design workshops and document AV requirements as nominated by stakeholders. All functional requirements must be captured formally as part of meeting minutes and/or return brief for formal acceptance from user group. Once gathering of requirements is complete the AV Consultant is responsible for the creation of a functional brief.

- Produce AV documentation and system design to be issued for approval by Manager Digital Futures. Documentation shall include:
  - Functional Brief
  - Budget Estimates
  - AV system schematic (combined or split across video, audio and control for large systems)
  - Cable schedules
  - AV equipment rack layout.

- Produce AV drawings for coordination with Architect and Services Engineer. Drawings shall include:
  - Floor plan indicating locations of AV equipment
  - Elevations
  - Reflected ceiling plans.

- Coordinate design requirements for AV equipment with other design consultants including:
  - Spatial requirements
  - Room layouts

  - Integrated control of non-AV elements via AV systems including blinds / architectural features, lighting, and other elements.
  - Routing for AV cabling and other additional spatial requirements
  - Structural Loading requirements including load and vibration requirements of AV systems.
  - Electrical requirements including power outlet's locations and quantities.
  - Coordination with lighting system including spill and zoning.
  - Communications requirements including general data outlets, technical network requirements of AV systems (including PoE and bandwidth) and port counts.
  - Coordinate with Acoustic Consultant / Project acoustician to establish Acoustic requirements for AV systems including Room acoustics, acoustic isolation, and mechanical services noise.
  - Heat loading requirements including load estimates and nominated locations. Coordinate ventilation or cooling requirements with Architect, Interior designer, and mechanical services engineer.
  - Fire services coordination including integration with building EWIS / SSISEP systems.

- Produce technical specification for tender. Technical specifications shall include:
  - AV scope of works
  - Functional and technical description of each system
  - Technical specifications
  - Installation requirements
  - Details of coordination with other trades
  - Specific access requirements and working conditions.
  - Details of defects liability and warranty
  - Returnable Schedule, Bill of Materials to allow for consistent tender responses.
  - Contact equipment suppliers to forecast and secure stock for the project.
  - Project coordination during installation including:
  - Review shop drawings produced by AV Integrator
  - Respond to RFIs issued by AV Integrator
  - Provide design advice as requested by Project Manager
  - Coordinate integration with other services.
  - Coordinate commissioning and testing of AV systems. Conduct independent inspection of AV systems to ensure it meets Stakeholder requirements.
  - Review training material and coordinate training.
  - Review as-built documentation and operational manuals.
  - Testing
  - Approvals
  - All other services required to install AV systems and services.
  - As a minimum the AV Integrator must ensure the coordination of the following:
  - On site coordination of services detailed above. Particular attention must be applied to services co-located with AV equipment and services. This is typically done through the AV Consultant or as stipulated by the Project Manager.
  - The AV Consultant must consult with Digital Futures regarding all the above items throughout the project.

4.6. WORKING AT LA TROBE UNIVERSITY SITES

All contractors and consultants working on La Trobe University sites or projects must conform with all documented policies, guidelines, and procedures. Further to this they must ensure compliance with all statutory and regulatory requirements. AV specific policies, guidelines and procedures are referenced in the relevant sections of this document. All others are managed by La Trobe University Infrastructure and Operations (I&O) Group and can be reviewed on the following website https://www.latrobe.edu.au/io/working-with-us .

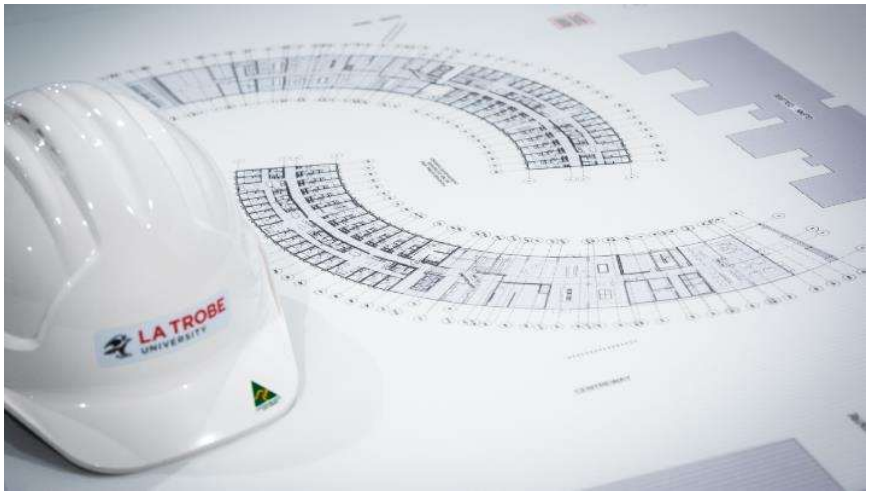
All works conducted at La Trobe University must comply with all relevant Workplace Health & Safety legislation. La Trobe University specific policies can be found in the I&O Design Standards, at the following website, https://www.latrobe.edu.au/io/working-with-us/design-standards.

All AV Consultants and AV Integrators must ensure that their designs or installations do not breach any WHS requirements during its use or maintenance. Potential risks must be identified during the requirements gathering phase and mitigated

during the design phase. Any outstanding risks must be brought to the attention of the principal and the Manager Digital Futures.

All contractors or engaged subcontractor must:

- Complete the La Trobe University induction prior to working on any project.
- Ensure the safety of their staff, La Trobe University Staff, students, and the public at all times.
- All external staff need to sign-in at CS1 (Campus Services 1, next to Car Park 6) prior to commencing work and sign out at the end of their shift.
- Familiarise themselves with the content of the Safety in Design website prior to commencing any works.
- Have a current 'Working with Children Check' (WWCC)



4.7. NON-COMPLIANCE

Where a design or deployment cannot meet the requirements as defined by this document and referenced supporting documents then a non-conformance form is to be submitted to Manager Digital Futures and the principal with approval required prior to proceeding. The letter is to clearly outline the following:

- The section within this document relating to the nonconformance.
- The reason for the nonconformance
- The impact to La Trobe University with consideration to the delivery of a functional AV system that's meets the requirements as detailed in the functional brief.
- The impact of lifecycle support and maintainability of the systems including impact related to accessibility of AV equipment and OH&S related matters.
- Any mitigation actions.

4.8. INSURANCE

All AV Consultants and AV Integrators working at La Trobe University must hold the following insurances:

- Public Liability - $20M.
- Professional Indemnity - $5M.
- Work Cover as required by state or territory laws.
- Any additional coverage as required by the principle.

5. AV Device Selection

5.1. AUDIO-VISUAL EQUIPMENT ASSESSMENT PROCESS

All vendors and manufacturers that would like their products and services approved by La Trobe University will need to be successful across the following four evaluation stages:

- Minimum Requirements
- Technical Selection Criteria
- Procurement Evaluation
- Endorsement from Manager Digital Futures

5.1.1. Minimum Requirements

5.1.1.1. Certification

Manufacturers are required to be ISO companies certified to ISO 9001. This certification is an international standard that specifies requirements for a quality management system (QMS). It is intended to help organizations ensure that they meet the needs of customers and other stakeholders while meeting statutory and regulatory requirements related to the products they create.

5.1.1.2. Fit, Form and Function

Products are required to operate for their intended purpose, in conditions considered suitable and typical of their installation. Meeting or exceeding the AV Performance criteria detailed in the AV Standards. Where a new product is developed it will be graded against the merits of its purpose, design, and ingenuity.

5.1.1.3. Ability to supersede existing products and broaden applicable use in AV systems.

Aligning with our strategy, products that can replace multiple other products in a design are preferred. As are solutions that can cater for several AV elements in a single part, e.g. A product that can act as a controller, DSP, amplifier, or a camera, microphone, speaker soundbar combination alleviating the need to have separate components to create an AV system. Where this is not possible products that can perform a function in as many scenarios as possible, allowing for greatest flexibility and application in a greater number of installations. Also, the ability to source multiple products offered from a single manufacturer is highly desirable.

5.1.1.4. Manufacturers Support Arrangements.

The following is to be considered for the maintenance of devices and support from manufacturers. Manufacturers are to provide a website/s that allows registration of devices. The ability for LTU support staff to subscribe to notifications regarding the release of new firmware and support materials. The ability for LTU support staff to gain access to versions of firmware, product information, and manuals. Mechanisms that allow LTU support staff the ability to raise support requests and complete RMA procedures. Support requests and RMA processes escalations via telephone to call centres that operate during normal Australian business hours. An RMA process that allows diagnosis of fault within 24hours (elapsed) and provide replacement parts within 72 hours (elapsed). Where options are limited, the following is the preferred order of priority:

- A website capable of SSO integration with LTUs Azure tenant which includes:
    - Asset registration
    - Asset information (make, model, serial number)
    - Asset warranty information
    - Asset firmware update notification
    - Ability to apply firmware updates.
    - Asset health (near real time)
- Online product support case creation and RMA procedures
- Phone support during Australian normal business hours
- Interoperability via API with third-party monitoring applications

5.1.1.5. Maintenance System Interoperability

To ensure devices can be supported and maintained in the field LTU is deploying a third-party monitoring application that will provide the following information for all network-enabled devices:

- device uptime
- consumed hours
- health
- telemetry information
    - Asset information (make, model, serial number)
    - Asset firmware version
    - Number of recorded defects and remediations
- Alerting and incident creation

Where options are limited, the following is the preferred order of priority.

- Custom API/Driver (developed by third-party monitoring application)
- SNMP v3
- SNMP v2
- ICMP

5.1.1.6. Remote Access

Remote access for any maintenance or troubleshooting activity must be over secure channels such as SSH or HTTPS. Where possible remote access interfaces must only be accessible to LTU support staff to prevent users from accessing such interfaces.

5.1.1.7. Network Connectivity

All devices connecting to the LTU data network are to be compatible with LTUs DHCP system and be enabled by DEFAULT. Network attached devices are to have as a minimum.

- 1Gbs ethernet interfaces
- Require no greater than PoE Type 2 - Class 4 - 802.3at

Note: Devices with 10/100MB network interfaces are no longer supported on the LTU network. It is expected that AV consultants and integrators will bring this to the attention of the principle and Digital Futures when providing equipment selections or recommendations.

5.1.1.8. Quality of Service (QoS)

LTU operates mechanisms for cross-stack marking, classification, and scheduling superior performance for data, voice, and video traffic at wire speed. QoS includes granular wireless bandwidth management and fair sharing, 802.1p Class of Service (Coos) and Differentiated Services Code Point (DSCP) field classification, Shaped Round Robin (SRR) scheduling, Committed Information Rate (CIR), and eight egress queues per port. AV equipment needing specific QoS settings requires approval from Manager Digital Futures and the LTU network management team to ensure settings are not in conflict with existing settings.

5.1.1.9. Network Security

LTU deploy a multitier approach to ensure a secure network and Information Services environment. As AV devices converge and become netcentric it is critical that all security measures are deployed to minimise any vulnerability. The following security features are required:

- DHCP capable
- Configurable host name
- Disable unsecure ports, as a minimum this includes:
    - 21 TCP – FTP
    - 23 TCP – Telnet
    - 25 TCP – SMTP
    - 80 TCP – HTTP
- Any generic usernames and passwords can be changed. (LTU will issue usernames and passwords)
- Integrate with Active Directory (where deemed necessary by Digital Futures)
- Capable of performing firmware and software updates (where deemed necessary by Digital Futures)

5.1.1.10. Passwords

Device must be capable of having a La Trobe University approved username and password. For security reasons these will be issued upon request. Any item removed for service or repair by a manufacturer, or third party must be capable of having its password set to the default configuration. Any replacement device must have the original username and password set to ensure that service desk staff can remotely manage the device. This process will be managed by Digital Futures and the Desktop/AV Support teams.

5.1.1.11. Risk Assessment (equipment not listed within the approved hardware list)

AV devices undergo a review and approval process conducted by Manager Digital Futures to identify any security vulnerabilities or asses the level of risk. This includes but not limited to:

- Identified cyber security alerts, compromises, and advisories from ACSC and other relevant authorities.
- Documented open protocols and ports.
- Required access to the internet, including all protocols and ports necessary for the normal operation of the device, internet access to perform updates (firmware/software), maintenance, monitoring, and RMA procedures.
- Required user accounts and passwords, limitations on modifying these attributes including password length and complexity.
- The device's support of PKI (certificates)
- Available security measures that can be enabled
- Where options are limited, the following is the preferred order of priority:
    - Third-party monitoring integration
    - Compatible with La Trobe issued Username and password.
    - Factory username and La Trobe University issued password.
    - Operation whilst isolated from the LTU network.

La Trobe University is currently reviewing network access of AV equipment as we plan for the introduction of Software Defined Access (SDA). A device identity security solution that helps protect organizations against cyberthreats by monitoring, detecting, and preventing unauthorized privileged access to critical resources. SDA works through a combination of people, processes, and technology.

5.1.2. Selection Criteria

WEIGHTED EVALUATION TABLE

Category	Weight	Description
PERFORMANCE	**23%**	
Performance	23%	Ability to deliver functional requirements. Also takes into account usability and aesthetics.
SUPPORT	**18%**	
5-year warranty	8%	If provided at an additional cost this should be scored 100%, with the cost scoring “Price (Op Ex)” category lower.
Local technical support	5%	Victoria-based technical support required for full score. Inter-state support will be evaluated as “good”.
24 hours RMA	5%	24 hours will be excellent, 48 hours very good, 72 hours good.
SUSTAINABILITY	**6%**	
Minimum parts and vendors	6%	This is to be assessed across a full system. Designs with a smaller number of parts or vendors receive higher scores.
CONSISTENCY	**7%**	
Common components with existing systems	7%	To reduce number of spares required, as well as training requirements, proposals based on existing designs receive higher scores.
RELIABILITY	**19%**	
Availability	10%	Equipment available within 2 weeks is excellent, 2-4 weeks very good, 4-8 weeks good.
Network requirements	5%	Systems with less demanding network requirements will score higher.
Offline capacity	4%	Systems that can perform critical tasks offline receive higher scores
SCALABILITY	**7%**	
Scalability	7%	Ability for components to cater for larger spaces, or larger quantity of connections or peripherals
EFFICIENCY	**20%**	
Remote monitoring	8%	Ability for critical components to be remotely monitored
Remote troubleshooting	7%	Ability to remotely change settings, reboot and update firmware
Compatibility	5%	Ability for components to be remotely monitored using existing platforms

5.1.3. Scoring Table

Each category should be scored from 1 to 10, following the below details:

Score	Description
9-10	Product is an excellent fit to the requirements
7-8	Product is a very good fit to the requirements
5-6	Product is a good fit to the requirements
3-4	Product is a poor fit to the requirements
1-2	Product does not meet the requirements

6. AV Performance Criteria

It is the responsibility of the AV Consultant and AV Integrator to ensure AV systems comply with all relevant standards, regulations, relevant authorities, and performance criteria outlined in this document. Where there is a conflict between documented performance criteria or a specific performance criterion has not been identified, then the following shall apply in the listed order of precedence:

- Australian National Standards
- LTU AV Standards (this document)
- AVIXA Standards
- AETM Design Guidelines

Note: Safety and legislated requirements must take precedence over all other documented requirements, standards, and guidelines.

LTU endorses all AVIXA standards, and detail additional performance criteria to ensure all AV systems meet or exceed the specified industry best practice. It is accepted that not all AV equipped spaces are ideal, and many contributing factors are outside the scope of this document. If a particular performance level cannot be achieved, then this must be brought to the attention of Digital Futures and the principal at the earliest possible opportunity.

- Large Lecture Theatres and specialist spaces may require more complex calculations and considerations; these should be considered on a case-by-case basis.
- Where viewing sightlines and distances cannot be met with a single display (preferred option) then additional displays can be added to ensure adequate coverage.
- The AV Consultants must provide the following information as part of the design documentation:
  - Sight line study detailing all horizontal viewing angles and distances.
  - Sight line study detailing all vertical viewing angles and distances for raked or specialist spaces where sightlines may be compromised.
  - AV Layout plans
  - Elevation of the presentation area
  - Rack layouts for custom or nonstandard designs
  - Digital Futures have tested and approved AV equipment manufacturer and models to be utilized in AV design. (See: Appendix B)

6.1. IDENTIFY DISABILITY DISCRIMINATION ACT (DDA) REQUIREMENTS

The AV Consultant and AV Integrator are to ensure that all installed AV systems meet legislated DDA requirements and bring to the attention of the principle any planned installations that may breech legislation.

- The Disability Discrimination Act 1992 (DDA) is supplemented by a series of Disability Standards and Guidelines. These provide more detail on rights and responsibilities about equal access and opportunity for people with a disability.
- Standards are legally binding regulations set by the Attorney-General under the DDA.
- Guidelines (or ‘Advisory Notes’) are issued by the Commission to help people and organisations understand their rights and comply with their responsibilities under the DDA and accompanying Standards.
- Standards and Guidelines can be made in the areas of employment, education, public transport services, access to premises, accommodation and the administration of Commonwealth laws and programs.

6.2. EASE OF OPERATION AND PREVENTATIVE MAINTENANCE

Maintenance is always less expensive in time, money, and energy than the repairs necessary when breakdowns occur. Preventive maintenance is the act of performing regularly scheduled maintenance activities to help prevent unexpected failures in the future. It's about fixing things before they break. The benefits of preventive maintenance include lengthening asset lifespan, lower risk of breakdowns, more efficient use of resources. Ensuring regulatory/safety compliance, and the ability to track maintenance history, maintenance standardization, maintenance cost management and forecasting, which leads to effective maintenance scheduling and planning. Below are the considerations when designing an AV system to aid in preventative maintenance tasks.

- Where projectors are ceiling mounted at a height greater than 2.6Mtrs AFFL a projector lifter is required.
- Clear access must be available to all equipment either via clear space, access panel or retractable rack systems.
- Castors should not be fitted to equipment racks unless specifically required for access. For safety reasons castors must not be fitted to AV racks greater than 20RU without approval of the Manager Digital Futures and the principal. Where castors are fitted, they are to be rated to the support the weight of the rack and include a locking mechanism.
- Equipment racks above 20RU are to be physically secured to either a floor or wall surface and sufficient clearance provided to access and service equipment.
- Equipment mounted behind flat panel displays less than 75" must be securely mounted with any critical LED status lights facing outwards and access available via movement of the panel. Equipment mounted behind panels greater that 75" or video walls must be accessible or mounted on an appropriate slide out tray.
- Equipment mounted under joinery must be positioned so there is no risk of injury to people sitting at or moving near the joinery.
- Equipment must not be positioned in ceiling voids without the prior approval of the Manager Digital Futures and the principal.
- Where ancillary equipment, such as signal receivers, is required to be installed with a projector then an appropriate tray is to be included with the projector mounting hardware.
- All equipment is to be labelled with its device host name and IP address. This label must be readable without the use of tools.

Further guidelines can be found in the LTU Design Standards, Design for Maintainability section, at the following website **https://www.latrobe.edu.au/io/working-with-us/design-standards**. The Design of the installation requires a coordinated project team and collaborative process from the earliest stages.

6.3. ELECTRICAL AND DATA CABLING REQUIREMENTS

6.3.1. Overview

This section provides a baseline in line with the relevant industry Electrical and Data standards that impact audio-visual designs and installs. The aim is to help establish a consistent and compliant approach to electrical and communication consultants and contractors and identify what should be considered when coordinating with the audio-visual consultant and contractors. This document may reference or have appendices referencing various other LTU Standards. While this section aims to focus on electrical and data specifically for audio-visual elements, it provides a bridge between LTU Facility Electrical/Network standards and LTU audio-visual standards. As a result, there will be some cross over especially as standards update over time. The relevant LTU standards will take precedence over this document unless there are higher requirements stipulated in this document. Where the project consultant needs to depart from any requirement, they should first agree the departure with the principle and manager Digital Futures on the project.

6.3.1.1. Power Supply and Distribution

LTU have developed the below standards that ensure electrical works are delivered in a manner that is safe, secure and specific to meet the requirements of each AV device as well as facilitating the tasks of the LTU Support Team.

Permanently connected equipment, that only get switched off manually for maintenance

Primary effort should be to have the switches located within the AV Rack cupboard or adjacent to AV equipment permanently housed and locked in the room.

Provide final sub circuit to permanently connected equipment, located adjacent to equipment. Provide isolating switches for each item of equipment complying with the following details:

- Same current rating as the circuit wiring.
- Are type IP56 to AS 60529 where installed externally to the building or in damp situations.

Are protected type and surface mounted, where located in service areas, roof spaces and service ducts. Flush mount in other areas. Are labelled to indicate the circuit and switchboard number.

Conceal final cable connection to equipment. Provide access to any isolating switches or sockets via appropriate means (e.g. Access hatch or panel).

Positioning & Serviceability

Where GPOs are inaccessible, a remote power switch shall be provided. Typically, this might apply to ceiling mounted displays where the GPO serving the AV equipment can't be on the ceiling or close to the access panel. Or in some cases too high (e.g. double height ceilings). Typically, this would apply to projectors, pole mounted LCDs, motorised screen boxes, powered speaker arrays or large LCD displays. The remote power switch shall be installed back at the AV rack, AV smart PDU or a dedicated lockable AV location. A key operated switch or isolator could also be considered if a lockable location is not available. The aesthetics of the switch selected must be confirmed with the principle and manager Digital Futures during design. GPOs located behind AV equipment and displays shall be hidden from view of users but within easy reach for support staff. GPOs can be mounted on walls and ceilings. GPOs on the floor shall be within LTU approved floor boxes. Furniture or joinery shall be fixed should GPOs be permanently terminated on them.

General

Generally, all AV equipment will be powered from a dedicated GPO. Only exception would be rack mounted equipment that is powered from a rack mounted PDU. Power to all AV equipment is to be on the same phase within each room. Circuits for AV equipment shall be dedicated to AV equipment only. If sharing is required due to limited number of AV devices or circuits available, this should only be with low voltage IT equipment and is required to be approved by the manager of Digital Futures. Other power circuit requirements include (but not limited to):

- Provide separate circuits for lighting and power.
- Audio equipment shall be on separate circuits from video and control equipment. This applies to all Audio equipment in the field and back at the racks. This could include but not limited to powered speakers, amplifiers, DSPs and microphone systems.
- Install a maximum of 10 off of a 10A socket outlets per circuit in air-conditioned areas, based on 20Amp RCBO protected circuit.
- Each 10A double outlet will be considered as two socket outlets.
- Provide an individual circuit for each item of permanently connected equipment.
- Provide an individual circuit for each socket outlets rated 15A or over.

The designer shall specify a common manufacturer throughout the system. Where the works are on an existing system the device manufacturer must be as per existing, where practicable. Quantity of outlets allocated should be allowed for at least 1x dedicated outlet per piece of equipment. Spare outlets shall be a minimum of 10% (rounded up) of the total outlets in that location with a minimum of 1x GPO whichever is greater. Segregate all cables from power cabling in accordance with AS/NZS 3080.

Installation

Install all wiring so that it can be readily renewed, repaired or relocated without affecting building finishes and construction. Make sure wiring to power outlets are not installed until the final layout of AV equipment is confirmed by the relevant trades. Install all cables to include the following:

- Adequately fix and support with purpose made clips, cleats or saddles.
- Provide adequate air circulation around each cable.
- Locate between equipment without any joints.
- Use the loop in, loop out principle without the use of connectors for sub circuit wiring.
- Provide ease of removal for the purposes of relocation and/or rewiring.
- Loom on the square grid form, parallel to walls and the like.
- Do not bend through a radius less than the minimum bending radius recommended by the manufacturer.
- Space cables to ensure that any existing adjacent cables are not subject to derating.
- Fix to permanent structural components of the building. Additionally, position these cables above ducts, pipes and other building components that may become dislodged and cause interference to the cables.
- Provide space from telecommunication and other wiring systems in accordance with AS/ACIF S009, AS/NZS 3080 and the normative and informative sections of AS/NZS 3000.
- No cable joints allowed.

Labelling

Label isolating switches and outlets to identify circuit origin. Equipment labels need to be conspicuous, particularly in respect of size and lettering. Manufactured from Traffolyte or LTU approved equal.

Label each cable within 100 mm from the termination point at each end, using wrap around stick on labels or other similar methods by approval of the manager Digital Futures.

Design

When applying the power supply and distribution requirements, the designer/consultant should consider several questions prior to establishing the design:

- What is the purpose of the room or space that is being designed? (e.g. Meeting and Collaboration, Teaching and Learning)
- What is the AV solution for the space?
- Are there any peripheral connections that might be required that complement AV or avoid AV outlets being used for the wrong purpose? (e.g. Cleaner outlets, User laptop charging, chargers for RF receivers & battery packs)
- Are there sufficient clearances for access?
- Is there sufficient spare capacity in existing distribution boards or racks?
- Are there other standards that may conflict with what AV requires?
- Where appropriate, are enough spares being allowed to accommodate expansion in line with LTU Standards?

Outlets

Below is a Table listing common electrical outlets used in audio-visual installations.

General	Description	Performance
Plastic switched socket outlets	General plastic switched GPOs	Standard: To AS/NZS 3112. Type: Integral switched socket outlet. Material: High impact plastic. Colour: Black/White. Current rating: 10 A min. Pin arrangement: Mount outlets with the earth pins at the 6 o'clock position. Mounting configuration: Horizontal. Style: Provide accessories of the same style and from the same manufacturer. 
Weatherproof socket outlets	Weatherproof switched GPOs	Standard: To AS/NZS 3112. Type: Integral switched socket outlet. Material: High impact plastic. Colour: Black/Grey/White. Current rating: 10 A min. Pin arrangement: Mount outlets with the earth pins at the 6 o'clock position. Mounting configuration: Horizontal. Style: Provide accessories of the same style and from the same manufacturer. 
Plugs	230V Male Plugs	Standard: To AS/NZS 3112. Type: Insulated with integral pins 
Plugs	230V Female Plugs	Standard: To AS/NZS 60320-1. Type: Insulated with integral pins 
Isolating switches	Standalone switches to isolate power to outlets	Standard: To AS/NZS 3133.
Power Supplies	Manufacturer supplied equipment power packs or power supplies	No modification or extension of pre-made 12v DC Power Supplies shall be allowed. Manufacturer Power Supplies shall not be cut, extended or altered in any way. Where the 12v PSU lead is not long enough, additional power outlets must be installed.
Power Boards	Power boards used for extension or additional outlets	Not to be used unless approved by the principle and manager Digital Futures. Potential exceptions: • Under meeting room tables (e.g. starter socket) • AV mobile trolleys
Power Distribution Units	Intelligent PDUs	PDUs shall be as per LTU's approved hardware list. All AV equipment power packs that plug directly into a PDU shall be secured by a Velcro strap to prevent them being knocked out or from falling out. PDUs are to be of a type allowing network monitoring and switching of individual outlets.
Uninterruptible Power Supply	UPS requirements	Audio-visual systems do NOT require UPS provisioning. Should a project specifically require a UPS for AV, this should be discussed with manager Digital Futures. The UPS shall be as per LTU's approved hardware list and in accordance with LTU AV Network Standards – Power Provisioning.
Power Over Ethernet	PoE, PoE+, PoE++/UPoE	Where equipment is powered via PoE, coordinate IT requirements with LTU Networks team to ensure the network switches have the correct ports and sufficient power budget. Power requirements above PoE+ require approval from the manager Digital Futures.

6.3.2. Surge Protection

Provide Surge Protection Devices (SPDs) to all audio-visual installations within the scope of works. SPDs shall be located in a common accessible location (at the power source of the incoming comms rack or similar) and be clearly labelled "Surge Protection Devices". SPDs shall be suitable for protecting the connected equipment from lightning strike voltage impulses.

Enclosure and installation to be of a suitable electrical switchboard or panel and protect with a suitable rated circuit breaker equal to or less than the load current rating of the SPD.

Provide SPD to protect equipment in racks and cabinets:

- Standard: To AS 4262.1 and AS 4262.2.
- Surge rating (Imax): ≥ 20 kA (8/20 µs) phase to neutral and 10 kA neutral to earth.
- Voltage protection level (Up):
  -<600 V at 3 kA.
  -700 V at 500 A.
- Visual indicator: Provide visual indication of SPD status.

6.3.3. Lightning Protection

The Electrical Consultant shall confirm if a lightning risk analysis is required in accordance with AS/NZS 1768. Provide lightning protection where it is recommended for the development based on the calculated risk profile.

6.3.4. Electromagnetic Interference

Generally, all electrical, electronic, and digital components and systems provided as part of the Works, meet the requirements of the Australian Communications and Media Authority (ACMA) for Electromagnetic Compatibility (EMC) framework to prevent Electromagnetic Interference (EMI).

Design and installation shall conform to the standards nominated by ACMA and in particular AS/NZS 61000, relevant to the products and where required by the ACMA are labelled with the C Tick mark to establish compliance with the EMC Framework.

The following table provides a guide on separation however the designer and installer are responsible for ensuring the latest industry standards are adhered to for the project.

Telecommunications Cable Separation from Power and Equipment					
	Safety – No Barrier	Safety - Barrier	EMI Minimisation – No Barrier or Non-Metallic Divider	EMI Minimisation – Aluminium Barrier	EMI Minimisation – Steel Barrier
Unscreened power cable and unscreened IT cable	50mm	0mm[1]	200mm	100mm	50mm
Unscreened power cable and screened IT cable	50mm	0mm[1]	50mm[2]	20mm	5mm
Screened power cable and unscreened IT cable	50mm	0mm[1]	50mm[2]	10mm	2mm
Screened power cable and screened IT cable	50mm	0mm[1]	50mm[2]	0mm	0mm
High Voltage – single core	450mm	450mm	1500mm to 3000mm	-	-
High Voltage – multi core	30mm	175 mm measured from the outside of the cable sheaths	1500mm to 3000mm	-	-
Equipment - lighting	-	-	300mm	-	-
Equipment - transformers,	-	-	1220mm	-	-

motors, sources of EMI					
Lightning - down conductors	-	-	9000mm	-	-

1 With barrier of durable, continuous insulating material or metal, timber of metal stud, nogging, joist or rafter.
2 Minimum distance for safety is 50mm.

6.3.4.1. High voltage power separation

Install all cabling with a minimum separation of 3 metres from electrical cables carrying high voltage (HV) cables. With termination points for AV equipment with a minimum separation of 6 metres from distribution panels and transformers carrying HV cables.

6.3.4.2. Low voltage power separation

Install all telecommunications cabling serving AV equipment with a minimum separation of 50 mm from electrical cables carrying low voltages. Where telecommunications cabling serving AV equipment physically crosses LV electrical circuits, provide a 25 mm lap perforated earthed metallic insulation barrier. Where cabling crosses LV electrical circuits install LV electrical circuits so that they cross at 90 degrees of each other, where telecommunications cabling serving AV equipment physically crosses.

6.3.5. Earthing

Provide earthing systems that conform to the requirements of Australian Communications and Media Authority Technical Standard AS/ACIF S 009 and the SAA Wiring Rules AS/NZS 3000.

- Safety earth cabling: Colour safety earth cabling green/yellow.
- Continuous earth cabling: Provide continuous earth cabling throughout its length.
- Earth connections: Manufacture earth connections using machine threaded bolts fitted with spring washers. Rigidly bolt cable terminations to the terminal strips/bars. Do not accept soldered connections or spade connectors.
- Label terminal bars/strips: Label all terminal bars/strips clearly. Identify all bonds using tags with black on white labels.
- Exposed hardware: Provide stainless steel nuts, bolts and washers where exposure of the connections to moisture and rain occurs. Protect and seal any copper lugs or terminals exposed to the elements, to eliminate corrosion.
- Conductive devices: Earth all conductive devices including equipment enclosures, cable tray, catenary wires and equipment cabinets by connecting a safety earth using 4 mm2 copper cable coloured green/yellow.

Provide the following for earthing conductors:

- Run them as straight as practicable and do not bend through less than a 600 mm radius at any point in their run.
- Pass them through any encircling metallic object that may act as a choke to high frequency, such as metallic conduit, cable ties or ducting.
- Label at each end using an approved W/R/W engraved Traffolyte label.
- Route 300 mm away from power cabling where practical. Install all telecommunications cabling serving AV

6.3.6. Cabling General

The following table stipulates the minimum power, lighting and data cabling requirements when connecting to AV equipment. It also includes the minimum cable support requirements.

General	Description	Performance
Power & Lighting	Cabling install requirements for power and lighting circuits	AS/NZS 3013. Report damage to cable insulation, serving or sheathing. Do not use installation methods that exceed the cable's pulling tension. Use cable rollers for cable installed on tray/ladders or in underground enclosures. Unless unavoidable due to length or difficult installation conditions, run cables without intermediate straight-through joints. Locate in accessible positions in junction boxes and/or in pits. Individual wiring of extra-low voltage circuits may be tied together at regular intervals.
Power & Lighting	Tagging & marking for power and lighting circuits	Identify submains at each end with stamped non-ferrous tags clipped around each cable or trefoil group. Marking: Identify the origin of all wiring by legible indelible marking.
Power & Lighting	Submains & final sub-circuits install requirements for power and lighting circuits	Installation: Provide the following: • Cables for lighting systems: Run in conduit, cable ducts, suspend on catenary systems or support on cable trays or ladders. • Inaccessible concealed spaces: Install cable in PVC-U conduit. • Roof spaces: Install cable below heat insulation and sarking. If not protected from high ambient roof space temperatures by thermal insulation, derate the cables, to AS/NZS 3008.1.1 Table 27, for an assumed ambient temperature of 55oC. • Accessible ceiling voids: Do not support and enclose cables on ceiling surfaces or ceiling suspension systems. • Plastered or rendered masonry: Install cable in PVC-U conduit. • Double sided face brick partition: Install cable in PVC-U conduit installed within the brick wall by slotting bricks or using any pathways provided in the brick. • Walls filled with bulk thermal insulation: Install cables in PVC-U conduit. • In metal stud framed walls: Install cable using TPS cable allowing re-wirability. Bush all knockouts in steel framing to prevent cable damage. Earth metal stud frames to the electrical earthing system. • Horizontal cable trays or ladders: Fix cables using proprietary nylon cable ties or straps, cable saddles or clips at 2000 mm intervals. • Vertical cable risers: Fix cables using proprietary nylon cable ties or straps, cable saddles or clips at 1000 mm intervals. • Plant rooms: Install cable in heavy duty PVC-U conduit or on tray, cable ladder or in duct. Derating • Derating considerations: Provide conductors as specified as a minimum size. • During installation design the size, grouping, spacing, enclosure and location of cables to achieve the current rating of the conductors as permitted by the relevant Code. • When calculating the current rating of the conductors, factor in the application of the appropriate derating factors and make sure it is equal to or greater than the specified current rating of the circuit breaker or fuse that protects the conductor. • The current rating of the protective device may exceed the derated current rating of the cable as permitted by the wiring rules. Permit for cables serving items of equipment that are subject to short time overload current, such as motors. • Where conductors are installed, grouped, spaced or enclosed in such a manner that their derated current rating is less than the specified current rating, increase the size of the conductor.
Power & Lighting	Derating considerations for power and lighting circuits	Derating considerations: • During installation design the size, grouping, spacing, enclosure and location of cables to achieve the current rating of the conductors as permitted by the relevant Code. • When calculating the current rating of the conductors, factor in the application of the appropriate derating factors and make sure it is equal to or greater than the specified current rating of the circuit breaker or fuse that protects the conductor.

		• The current rating of the protective device may exceed the derated current rating of the cable as permitted by the wiring rules. Permit for cables serving items of equipment that are subject to short time overload current, such as motors. • Where conductors are installed, grouped, spaced or enclosed in such a manner that their derated current rating is less than the specified current rating, increase the size of the conductor.
Data & Network	Cabling install requirements for data	All network cabling shall be in accordance with the LTU Network Standards. Standard: To AS/NZS 11801, AS/NZS 3084, AS/CA S009 and AS/NZS ISO/IEC 14763.2 & 3. Installed by a licensed person, submit documentary evidence before commencement. Reticulate all cabling from the ceiling space and power poles using the cavity walls where applicable. Install all horizontal cabling in dedicated communication cable trays and flexible conduit at all times. Where communications cabling cannot be run in dedicated communication cable trays and cable ducts, inform the project team immediately prior to commencing works. Cables dropped from these trays: Neatly bunch and tie cables dropped from these trays with hook and loop, minimum 10 mm wide, e.g., Velcro or approved equal cable ties, and separate from power cabling using flexible conduit. Install cable run in partition walls in conduit to the outlet. Observe cable bending radii at all times as kinks, crushed and tight bends will not be accepted. Do not use plastic cable ties for cabling installations as it is strictly prohibited. Only use hook and loop ties, minimum 10 mm wide, e.g., Velcro or approved equal. Use hook and loop ties along the entire length of the installation. If plastic cable ties have been used, remove them at the Contractor's own cost and retest all runs along the affected pathway. Provide adequate protection for installed cables in areas where subsequent damage may occur. Adequately protect any temporary cabling, pre cabling and roughed in cabling against damage or hazards including those of an electrical nature. Provide the following for all cables: • Run concealed throughout the building. • Enclose within concealed conduit, where run on surface. • Adequately fix and support with purpose made clips, cleats or saddles. • Install so that they can readily be withdrawn for the purposes of relocation and rewiring. • Loom and route on the square grid, parallel to walls and other features. • Install so that they are not bent through radii less than the minimum bending radii recommended by the manufacturer. • Install free of joins. Install all cabling with a surplus slack of 1 to 2 metres at equipment cabinets and 700 mm at outlets. Neatly coil the surplus cable in an S or J layout, on tray inside the cabinet with careful attention given to bend radius. At all times run cabling in dedicated communication skirting ducts, cable trays and cable ducts. Where communications cabling cannot be run in dedicated communication skirting ducts, cable trays and cable ducts, provide notification immediately and submit details for approval prior to installation. Use the following methods to support the entire length of the run: • Catenary wire support system, maximum of 24 cables per bundle per wire. • Conduit or duct system. • Cable tray. Observe minimum segregation requirements from power cabling as per AS/NZ 3080 for all unshielded communications cabling and coaxial cabling. In addition, segregate all communications cabling from incoming telecommunication service provider cables by a distance of not less than 50 mm, except where an appropriate separator is used. Installation techniques: • Do not exceed 110 N pulling tension for 4 pair cables to avoid stretching. • In the event that the physical cable sheath is seen to be damaged or of inferior manufacture, e.g., cable twists and uneven sheath shape, set aside and replace the reel. In the event that defects inspections reveal damaged or inferior manufactured cable, replace the complete run at no additional cost. • Make sure terminations and termination procedure requirements conform to international, national and manufacturer recommendations. • Remove only the length of the cable jacket required for termination and trimming. • Make the untwist length in any cable element as short as possible. Do not exceed 10 mm at termination for untwisting of cable pairs. • Provide all cables with appropriate strain relief at terminations. Do not exceed the following bending radii:

		• 4 times the cable diameter for horizontal UTP cables. • 8 times the cable diameter for horizontal ScTP cables. • 75 mm for SFTP cables (non-plenum). • 10 times the cable diameter for multi pair backbone UTP cables. Avoid installation methods that avoid cable stress caused by: • Cable twist during pulling or installation. • Tension in suspended cable runs. • Tight cable ties. Make sure cable ties do not deform the cable sheath.
Cable support	Cable trays, catenary, conduits	Cable trays, Include the following in cable trays: • Connect to electrical safety earth using 4 mm2 cable coloured green/yellow, fit with cable lugs and include a continuous earth throughout. • Fabricate from galvanised steel or aluminium sections. • Fit with manufacturer's standard accessories, bends, risers, and splices. • Make free of sharp edges or corners. • Provide with rolled or folded sides. • Include factory made perforations and slots prior to galvanising in lieu of drilling for suspensions or fixings. • Fix to steel brackets and hangers to provide a rigid fixing. • Fix so that there is sufficient air space between the structure and the tray enabling natural air circulation to occur and for cable access. • Install parallel or at right angles to the building structure and planning grids. • Include facilities for longitudinal expansion at splice joints, including continuity or earth connection. • Incorporate sun screens, where exposed to sunlight. • Include the following in supports: • Design for a safety factor of 2:1. • Space to coordinate with the building structure and other services. • Provide cantilever, or L, type brackets for ceiling mount tray. • Provide Unistrut supports for floor and vertical mount tray. • Fabricate from perforated sheet steel electro zinc plated with 50%, minimum of its surface area open for air circulation. • Support so that the maximum deflection between adjacent supports does not exceed 10 mm, when fully loaded to the ultimate capacity provided with a 2:1 safety factor. • Size so that they are loaded a maximum 80% of their width capacity, including spaces between cables for derating purposes without undue bunching. • Provide high sided type for cable loads in excess of 20 kg per metre. Catenary systems • Catenary should only be used where absolutely necessary and cable tray/conduit are not considered ideal. • Include the following in catenary systems: • Use stranded (7 strands) of galvanised steel wire. • Secure to turnbuckles with U bolts and tension so that they do not sag more than 100 mm when fully laden with cabling. • Install parallel to the planning grid for the structure. • Provide with supports at 8 metre maximum centres. • Fix at each end to substantial building structure. • Secure cables to the catenary with approved hook and loop, minimum 10 mm wide, e.g., Velcro or approved equal cable ties spaced at staggered intervals of 200 mm and 300 mm. • Use to support a maximum of 24 cables or bundle diameter of 50 mm. • Locate at a common plane above ductwork, where used in suspended ceilings. • Connect to safety earth. Conduits, Include the following for conduits: • Labelled. • Free from conduit fittings other than junction boxes, wall boxes, bends or couplings. • No more than three 90-degree bends in a single run between drawer points. • 25 mm minimum diameter and are circular in section. Oval conduits are unacceptable. • Installed so that conductors are only drawn into conduit at outlet positions and draw in boxes. • Install complete with fittings and draw wires before wiring of a particular section is commenced.

		• Conceal from view by running in ceiling spaces, concrete slabs, air space of stud or cavity walls or chased into rendered masonry walls unless otherwise specified or agreed. • Placed above the bottom reinforcing bars, where run in concrete slabs. • Set at all changes of direction, where concealed within the structure. • Set using approved type conduit benders that prevent flattening of the conduit. Direct application of heat in bending conduit is not permitted. • Enclosed within the concrete and not in contact with the fill, where installed in slabs poured on filling. • Installed in a manner that does not necessitate penetration of damp courses or influence the entry of moisture into the building. • Located below the thermal insulation, where installed in ceiling spaces. • Provided with draw in boxes at 20 m, maximum intervals. • Provided with a 1.1 mm diameter, minimum, galvanised steel draw wire, where installed for future wiring or wiring by others with sufficient excess to enable practical use. • Swabbed out to remove all moisture before installation of wiring. • Fitted with a sealed cap to prevent the ingress of moisture or obstructions entering the conduit. • Erected with a maximum of two right angle bends or sets without a draw in box being interposed. • Equipped with flexible couplings for 600 mm across constructional joints. • Spaced not closer than 25 mm, where located within concrete. • Positioned within the centre zone of concrete slabs. • Positioned within masonry walls or columns with a minimum of 25 mm of cover. • Only 50% of the available cross section occupied by wiring. • Fastened with approved saddles at 600 mm centres. • Accurately positioned and aligned where they emerge from the concrete structure and fixed by fastening the upstands to rigid supports that have been approved. • Conforming to relevant sections of AS/NZS 2053.
Teaching Desks & Lecterns	Cabling	Generally, LTU classrooms and teaching spaces are static in their configuration with no requirement for teaching desks or lecterns to be moved or removed within these spaces. • Cabling between teaching desks and lecterns must be via a loom. Loom to include a tether so as not to strain the cable bundle. • Services are not to be terminated at the wall with patch leads to wall plates. • Minimal cable joins are to be prioritised over serviceability via wall plates. Preference is for bull-nose plates sized appropriate for the number and size of looms. • Termination at wall plate and patch leads only to be used where the space requires flexible teaching delivery as defined in the room pack or where approved by the manager Digital Futures.

6.3.7. Lighting

The following are recommended lighting room design criteria to provide optimal user experiences in AV spaces. These requirements form the baseline for every project. The lighting designer/consultant is responsible for achieving these requirements. Due to the differences in project locations, orientation, room designs, finishes and user requirements, the criteria listed below may need to be adjusted to suit a particular project. Should this be required, the designer/consultant will need to provide sufficient evidence, calculations and reasoning to LTU to demonstrate that the best outcome can still be achieved to accommodate the project's requirements.

General	Description	Performance
Lighting levels - People	Face lighting / vertical illuminance for camera capture	Ideally, in a Video Conferencing setup, 400-500 lux (Vertical) on the face while considering the contrast levels. Ideal contrast level of face to wall/desk is 1:1.5. Meaning an average of 500lux on the face would result in 750lux on the table and walls. Minimising the contrast level between the faces and the surrounding environment should be the primary goal. Cameras are most sensitive to different contrast levels and would auto-adjust based on bright spots. The more uniform the levels are in both the vertical and horizontal plains, the better the result. This means that if the ideal contrast level can be achieved, a lower vertical illuminance (e.g. 300-

		450lx) could be considered. This shall be demonstrated by the Lighting Engineer during the project's design phase.
Lighting levels – Learning spaces	Typical learning space average horizontal plane lighting levels	These levels shall be used as a guide only as it may differ from space to space and subject to room finishes, obstructions, layouts and fitting selections. An Exception Report shall be submitted by the Lighting Consultant if the project agrees to any large variation (e.g. >20%) outside the ranges listed below. • All OFF: Aisle lighting ON only. • Projection Mode: 70-240 lux, aisle lighting ON (e.g. 70lx near the projection area, 120lx on seats and 240lx on the desks) • Projection wall or screen (vertical illuminance): 50 lux or less (ideally less than 20 lux) • Lecture/Teaching Mode: 320-400 lux, aisle lighting ON • All ON: 400-500 lux, aisle lighting OFF
Lighting levels – non-Learning spaces	Typical function/training/meeting space average lighting levels	These levels shall be used as a guide only as it may differ from space to space and subject to room finishes, obstructions, layouts and fitting selections. An Exception Report shall be submitted by the Lighting Consultant if the project agrees to any large variation (e.g. >20%) outside the ranges listed below. • All OFF: Aisle lighting ON only (if applicable) • Projection Mode: Horizontal illuminance of 70-240 lux, aisle lighting ON (e.g. 70lx near the projection area, 120lx on seats and 240lx on the table) • Projection wall or screen (vertical illuminance): 50 lux or less (ideally less than 20 lux) • Video Conference or Camera Capture mode: Vertical illuminance of 400-500 lux on faces, aisle lighting ON • All ON: 400-500 lux, aisle lighting OFF
Colour temperature	How warm white light feels/looks.	4000K
Colour rendering index (CRI)	Ability of a light source to reveal the colours of various objects when compared to an ideal or natural light source.	CRI shall be equal or greater than 80.
Colour rendering index (CRI)	Ability of a light source to reveal the colours of various objects when compared to an ideal or natural light source.	CRI shall be equal or greater than 80.
Unified glare rating (UGR)	Determines level of glare and potential discomfort to users	UGR shall be equal or less than 19.
Integration	Lighting and Blinds integration with AV	For some projects, lighting and blinds may be required to integrate with the AV system. Each Consultant (Electrical, Audio-visual and Architect) shall confirm these requirements during the briefing and design phases. The Lighting and Blinds Contractors are responsible for providing the necessary interfaces as per LTU's Facility Standards and coordinating with the AV Integrator for cabling and connecting to the AV control system. The AV Integrator is responsible for facilitating the process where the AV system is required to control the lights and blinds.
General	Additional considerations for lighting	Lighting shall be high efficiency (i.e. neither incandescent nor halogen) and of uniform colour temperature throughout the space. 100lumen/watt as a baseline. Lighting shall be zoned via different circuits or each fitting individually addressable to allow flexibility in either dimming or turning off lights that have any impact on AV display surfaces. Any lights positioned near displays or cameras shall be separately controlled. Lighting calculations shall be carried out for all rooms with Audio-visual requirements by the Lighting Consultant/Contractor. Focus shall be on vertical illumination of faces and glare. To eliminate shadows, a combined lighting arrangement ratio of 60/40 for ceiling and wall lighting is recommended. Lighting in the room must be uniform in brightness, colour temperature, and light source to allow natural looking video on camera. Do not mix different light types (e.g. fluorescent and LED) Use diffuse light on people and presentation materials. Direct light tends to create harsh contrasts and shadows. Spotlights and downlights are not recommended for video conference spaces. Lights shall not be pointed directly at the camera lens. The light source shall be at a height to not be visible in the camera feed. Wall lighting must be indirect. Avoid over illuminating the

		surrounding walls. The key here is to equalize the available light on the participants and eliminate shadows, dark backgrounds, and bright spots in the centre of the conference table. "Daylight" type lamps (e.g. colour temperature around 4000K and high CRI) are most effective. Do not use coloured lighting that might tint the camera image. Minimize natural light from entering through windows. Sunlight is very different in nature from artificial light in terms of colour temperature, and creates sharp contrasts in the room, which in turn may confuse the automatic adjustment mechanisms of most cameras for video conferencing systems. Use curtains or opaque blinds to cover the windows. If the room is expected to be used with the blinds up, lighting calculations involving a daylight study shall be carried out by the Lighting Consultant/Contractor to include natural light. Do not use highly reflective or glossy surfaces behind people, or where lighting may reflect and cause glare. Ensure lighting does not cause excessive glare on whiteboards. There must be NO direct lighting (natural or artificial) on presentation surfaces. Avoid completely white walls or tables, a colour with reflection value (LRV) of 50 percent is recommended. Where AV is being installed in an existing space and a display or camera is being installed near an existing light fitting, the light fitting shall be removed. Avoid use of lighting or sensor products that may interfere with the Audio-visual or Data network wireless infrastructure.

6.3.8. Data Networks (General)(Not Audio-Visual related)

All network related requirements shall be in accordance with the LTU Network Standards. The criteria below are minimum requirements based on industry Telecommunication standards. Where LTU Network Standards provide a higher requirement, the higher criteria will take precedence.

General	Description	Performance
Cabling	Bulk Network cabling	See LTU Networks Data Cable Standards

6.3.9. Data Cable (HDBaseT, AVoIP, TCP/IP, Dante, AES67, Q-LAN Audio-Visual related point to point within a space)

All network related requirements shall be in accordance or exceed the LTU Network Data Cable Standards. The criteria below are minimum requirements based on industry Telecommunication standards. Where LTU Network Data Cable Standards provide a higher requirement, the higher criteria will take precedence. Data Cables connecting audio-visual equipment for the purpose of monitoring, control, audio or video transmission within a space or spaces of a continuous audio-visual solution is detailed below.

General	Description	Performance
Cabling	Bulk Network cabling Panduit (**White**)	TX6A™ Copper Cable, Cat 6A, 23 AWG, F/UTP, CMP, White, PFP6X04WH-UG 
Jacks	Panduit (**Purple/Violet**)	Mini-Com® STP RJ45 Cat 6A TG Jack Module, Violet (CJS6X88TGVLY) 
Wall Plates	Panduit Quad Sloping (White)	Mini-Com®, Classic, Sloped, Faceplate, 4 port, White (CFPSL4WHY) 
Outlets	Installation requirements	General: Mount flush plates on skirting wiring duct cover section, metal wall box for outlets in masonry walls or metal mounting brackets for outlets in plasterboard lined stud walls. Flush plates: The use of standard size flush plates housing multiple outlets is preferred, however alternative solutions for the provision of multiple outlets may be submitted for approval. Horizontal cabling termination: Terminate cabling to the rear of the outlet modular jack with insulation displacement connections forming a gas tight joint. Location of outlets: Determine final locations

		of outlets on site in conjunction with the Contractor and the Architect. Outlet locations may vary by up to 4 metres from the nominated locations and areas documented. Provide all outlets with the following attributes: • Labelling. • Insulation displacement terminating technique. • High quality contact pins with a minimum cover of 50 microns of gold plating, insulation resistance of more than 100 megaohm and contact resistance of not more than 0.1 ohm. • Design to minimise the near end cross talk characteristics of the connected 4 pair UTP cable. Provide outlets in wall boxes, on workstations or outlet clusters with a minimum of 4 metres slack cable in the ceiling to facilitate future relocation of workstations. Generally, there should be no data spares as each data point takes up a switch port. The Electrical and Audio-visual Consultants shall work with LTU on a project by project basis to determine the best approach subject to the room or system type and risks around not having spares. For example, having a spare data behind each LCD would be considered overkill. However, an AV Rack or fixed lectern might warrant spares subject to the AV strategy and design of the space. Unused socket positions to be filled with blank inserts. Arrange the modular sockets with the locking latch in the bottom position, i.e. pins at the top. Wall mounted outlets (upto Quad) Flush mount wall mounted outlets on the plaster board wall with all reticulation of cables in the interior of the wall. Reticulate cabling access to wall mount outlet from the ceiling space or in wall conduits, whichever is applicable. Provide the faceplate for mounting on the wall as follows: • Flushed mounted. • Measuring 70 mm x 114 mm with 84 mm mounting centres. • Make available in single, double, triple or quad sockets for mounting single, double or triple connectors. • Mini-Com®, Classic, Sloped,Faceplate, 4 port, White (CFPSL4WHY) Wall mounted outlets (Quad+) Mini-Com®, Surface Mount Boxes, With Fiber Spool, 12 port, White (CBXF12WH-AY) There may be exceptions for Teaching Desks and Lecterns (as per the Cabling section). This should be discussed and agreed with LTU during the design phase and any departures shall be submitted as an Exception Report. Floor box mounted outlets Prior to starting design, confirm with LTU the floor box types/make/model/size approved for Audio-visual use. Any departures to be approved by the manager Digital Futures. Install floor box mounted outlets within the floor box in a way that allows adequate space for patch cable installation and removal without interference. Reticulate cabling access to floor box outlets from either the access floor, conduits in slab or from the level below, whichever is applicable. Mount the floor box as follows: • Include any custom mounting plate designed for the specific floor box. • Include necessary blanking plates. • Make available in single, double, or triple sockets for mounting single, double or triple connectors. • Install in a consistent outlet numbering/configuration across the entire installation. Where cabling access to the floor box is from the level below, allow the Contractor to install adequate cabling support back to the necessary riser. For new installs, floor boxes dedicated for AV or where they are complementing AV equipment (e.g. user laptop on a lectern, user charging at a table with AV, LCD on wheels, etc) shall not be used more than 50%. The size and quantity shall be appropriated specified by the Electrical Consultant in coordination with the AV Consultant. All floor box lids must close easily without undue effort and have little to no cable slack stored in the box.
Positioning & Serviceability	Outlets shall be out of sight where possible for	All data outlets shall be in accessible positions. Where flush equipment data outlets are mounted in the ceiling space, access hatches or panels must be provided for

	Aesthetic reasons but easily accessible for servicing	easy reach by a service technician without having to enter the ceiling space. The access hatch shall compliment the surrounding ceiling finish. Outlets located behind AV equipment and displays shall be hidden from view of users but within easy reach for support staff. Furniture or joinery shall be fixed should outlets be permanently terminated on them.
General	Label, faceplates, patching	Each socket will be affixed with the label that can be clearly read from above or head-on. It is preferable that labels are not placed in such a position that drooping patch leads will obscure their reading. The information contained on the label shall be identical to the information on the corresponding distribution frame network label and must match the convention used elsewhere within the premises. Where network outlets are installed behind a wall-mounted LCD panel, the outlets shall be affixed using sloped/angled vertical faceplates to allow patch leads to connect in a lower profile manner than 90-degree/perpendicular faceplates. E.g. Clipsal 2000 Series Two Gang Angled Faceplate 2032VHA. Where AV hardware will be mounted flush on the ceiling, the associated network jack shall be terminated above the ceiling using an appropriate network jack housing. E.g. Panduit CBX2WH-AY or equivalent. The patch lead shall be enclosed/covered by the AV hardware itself and patched into the network jack above the ceiling.

6.3.10. Cable fly and patch leads

6.3.10.1. Ethernet Patch Leads

All network and category-based cabling must be Panduit Pan-Net® Patch Cord STP28X(various lengths)MVL Panduit | Patch Cords. All fly and patch leads must be provided as part of the contractors works.

Where a manufacturer has specified a particular cable to ensure correct operation of their product, then this must take precedence. Where this affects structured or network cabling, the principal and manager of Digital Futures must be notified at the earliest possible opportunity.

The AV Integrator may substitute any of the AV cables identified below providing they supply appropriate documentation to demonstrate that the alternative cable meets or exceeds the specifications detailed below and have received approval from the principal.

6.3.11. Audio-Visual Cables (Audio, Line, Control & Various)

The following cable types are to be used on La Trobe University installations. All cables must be manufactured from a reputable manufacturer and be fit for purpose and meet all statutory requirements and standards.

CABLE TYPE	DESCRIPTION	BRAND	ALTERNATIVE
Digital Video	HDMI, DVI and Display Port	Extron	Kramer
Digital Audio	110 ohm (Belden – Purple PVC jacket)	BELDEN 1800B	TC2102DA
Analogue Audio – Balanced stereo	26 AWG stranded 2 pair twisted core with aluminium foil and drain	BELDEN 1172A	TCSPEC003
Analogue Audio – Unbalanced mono/stereo	1 Pair shielded 22AWG	BELDEN 8761	TCAP01E
Speaker - Low impedance	12 AWG stranded 2 core Double insulated, striped, multi strand.	BELDEN 1311A	TCUP01-3
Speaker – High impedance	16 AWG stranded 2 core tinned copper conductors, PVC insulation, twisted pair, PVC jacket.	BELDEN 8471	TC002-1.1
RS232/485	24 AWG two pair data with aluminium foil	BELDEN 8723	TCIP02E

STP/UTP (HDbaseT, TCP/IP, AVoIP applications)	Cat 6a White PVC jacket, Shielded.	Panduit Copper Cable, Cat 6A, 23 AWG, F/UTP, LSZH-3, White (PFL6X04WH-CEG)	N/A

6.3.11.1. Cable Termination

For consistency and to simplify fault-finding, La Trobe University specify the following cable labelling requirements:

CABLE TYPE	DESCRIPTION	BRAND	ALTERNATIVE
Jacks, STP/UTP (HDbaseT, TCP/IP, AVoIP applications)	Mini-Com® STP RJ45 Cat 6A TG Jack Module, **Violet** (CJS6X88TGVLY)	Panduit (**Violet**)	N/A
Analogue Audio – Balanced stereo	XLR		
Analogue Audio – Unbalanced mono/stereo			
Speaker – Low, High impedance	Neutrik NL4FRX SpeakON Connector -Right-Angled	Neutrik	
Speaker – Low, High impedance (Wall Plate)	Neutrik NL4MP 4-pin Speakon Socket Jack	Neutrik	
RS232/485			

6.3.11.2. Cable Installation

Cabling installation must comply with the following:

- Separation of cables in the field and rack as per AS3000.
- Drawing as per manufacturer's specification.
- Bend radii as per manufacturer's specification.
- Cables must be horizontally supported by cable tray or catenary. All cable trays and catenaries must be installed according to the appropriate standards.
- All cables that contain data or video cables must be loomed with Velcro style ties. Nylon cable ties must not be used.
- All cables must be installed as a "home run" and no joins will be accepted.
- Where cables are installed in a rack or an area of collocated equipment the following requirements must be met:
- All equipment must be securely mounted.
- Non-rack mounted equipment must be installed on an appropriate shelf or installed with a suitable mounting bracket.
- Signal cables must be grouped and loomed together.
- Low and high-powered signal cables must be physically separated to minimise interference.
- All cables must be installed with sufficient strain relief.
- The manufacturers recommended bend radius must not be exceeded.
- Where premanufactured cables are used the shortest length that meets the requirements of this document must be used.
- Lacing bars must be installed for cable management.
- Velcro ties must be used for all signal cables. Mechanical cable ties are not permitted.
- Fly and patch leads must be approved and commercially manufactured. No field manufactured leads will be accepted.
- Where more than one cable is deployed as a fly lead or loom, they must be installed in appropriately sized Techflex or equivalent black expandable braid cable sheath.
- All fly leads must be secured against theft or unauthorised removal. Fly leads that are connected directly to an end device that is not accessible to the user is considered secure only if the fly lead cannot be removed by pulling on it. Fly leads that have connections that are user accessible or can be removed by 'pulling' must be secured by a 'P clip' or similar method. Cable standards are detailed below.

6.3.11.3. Cable Labelling

For consistency and to simplify fault-finding, La Trobe University specify the following cable labelling requirements, label and mark equipment using a consistent scheme across all services and elements of the

project. All equipment and patch panels, each jack on the face plate, wall outlets and cables to show their designation as per the AV schematic drawing. Provide equipment labels that are manufactured from Traffolyte or approved equal material and adhere to size and lettering. Labels are to be self-adhesive.

LETTERING HEIGHTS:

- Danger, warning, and caution notices: minimum 10 mm for main heading, minimum 5 mm for remainder.
- Equipment labels within cabinets: minimum 3.5 mm.
- Equipment nameplates: minimum 40 mm.
- Identifying labels on outside of cabinets: minimum 5 mm.
- Isolating switches: minimum 5 mm.
- Self-adhesive flexible plastic labels:
    - Labels less than 2000 mm above floor: 3 mm on 6 mm wide tape.
    - Labels minimum 2000 mm above floor: 8 mm on 12 mm wide tape.
    - Other locations: minimum 3 mm.

Locate labels so that they are easily seen and are either attached to, below or next to the item being marked. Fix labels securely using screws, rivets, proprietary self-adhesive labels, or double-sided adhesive tape and as follows:

- If labels are mounted in extruded aluminium sections, use rivets or countersunk screws to fix the extrusions.
- Use aluminium or monel rivets for aluminium labels.
- Vapour barriers: do not penetrate vapour barriers.
- Metric si units: provide all lettering and numbers in metric SI units.
- All labelling is to be as per AVIXA F501.01 Cable Labelling for Audio-visual Systems
- A label schedule must be provided as part of the deliverables.

Labels must adhere to the following convention:

CABLE TYPE	DESCRIPTION	NAMING CONVENTION
Audio	Mic, line, speaker	A01, A02, A03, …
Video	HDMI, Display Port, SDI	V01, V02, V03, …
Control	Serial RS-232,/422/485, Relay, IR, I/O	C01, C02, C03, …
Data	USB, USB-C	D01, D02, D03, …
Network	Ethernet category cabling, RJ45, SFP, Fibre	N01, N02, N03, …
Power	Mains & DC supplies	P01, P02, P03, …
Specific	Vendor Specific Cables	S01, S02, S03, …
Future	any	F01, F02, F03, …

6.3.12. Power

Power cabling installation must comply with the following.

6.3.12.1. Testing and tagging

All mains powered devices must be tested and tagged in accordance with AS3760-2010 Inservice safety inspection and testing of electrical equipment. As a minimum, the following must apply:

- Be fitted with a “New to Service” tag in accordance with the appropriate legislation.
- Be portable appliance tested and tagged in accordance with the appropriate legislation if it is second hand, reused or has been modified since manufacture prior to installation. Modification includes the shortening or a mains cable to facilitate installation in an equipment rack.
- Supply the following information:

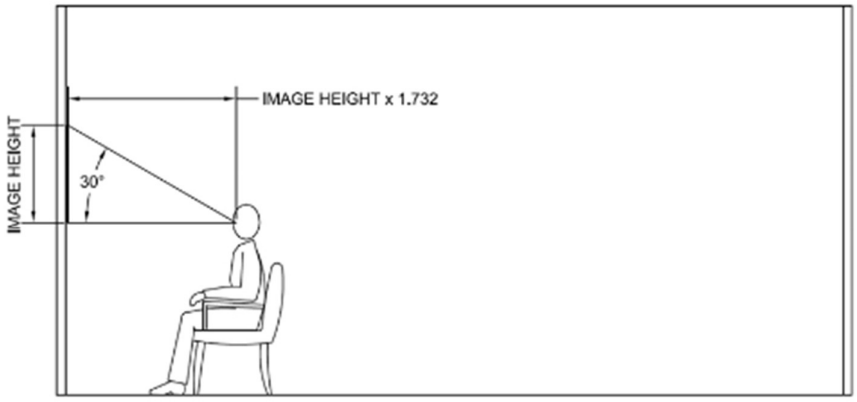
- Equipment type
- Equipment serial number
- Equipment location
- Tested date
- Name of tester
- Test authority

6.4. AV INSTALLATION REQUIRMENTS

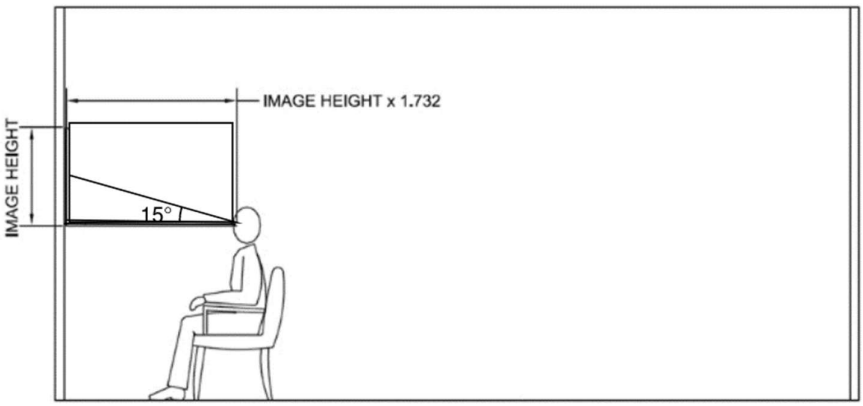
6.4.1. Sight Lines

As a minimum, the viewing angle of a displayed image for any viewer should not exceed the following:

- 30º from the horizontal to the top of the image.
- 15º from the horizontal to the centre of the image.



CLOSEST VIEWER CALCULATION FOR BDM
NO SCALE
IMAGE HEIGHT BASED ON 16:9 (1.78:1) ASPECT RATIO



CLOSEST VIEWER CALCULATION FOR BDM
NO SCALE
IMAGE HEIGHT BASED ON 16:9 (1.78:1) ASPECT RATIO

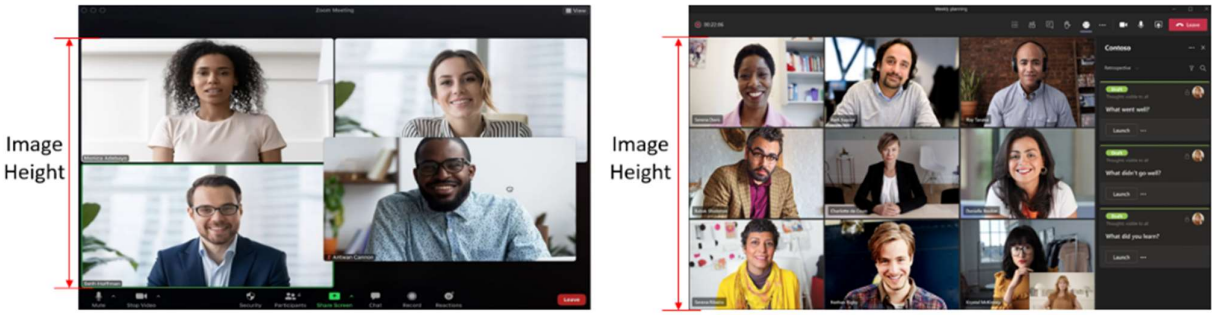
6.4.2. Viewing Distance

As a minimum, the viewing distance of a displayed image for any viewer should not exceed the following:

- The distance to the closest viewer must be greater than 2 times the image height.
- The distance to the furthest viewer must be less than 5 times the image height.

If there are physical factors that limit the image size, then this distance can be relaxed to 6 times with prior approval from the principal. La Trobe University endorses all AVIXA standards, and detail additional performance criteria to ensure all AV systems meet or exceed the specified.

When evaluating the distance to furthest viewer the AV Consultant or AV Integrator must pay special attention to the most common use of the system. In spaces dedicated to VC or web conferencing calculations should be based on the image height of the “Content Share” area of the display, not the entirety of the displayed image, as per example below.



6.4.3. HDCP & HDMI Specifications

As a minimum, all display devices must have the following functionality:

- HDCP 2.2
- HDMI 2.0 minimum one (1) required – HDMI 2.1 acceptable.

There is a known issue with a number of BYODs (such as Apple and other brand laptops) where the video port initiates an HDCP compliant connection regardless of the protection status of the content. In most situations this does not present a problem because all devices in the video chain are HDCP compliant. This issue is problematic when a lecture capture or video conference appliance is deployed as part of the AV system. In this case the Capture or VC appliance will see all incoming content as protected and therefore not recorded or transmit this content even if it is unprotected. In all spaces where lecture capture or videoconferencing appliances are deployed the HDCP on the BYOD input must be disabled.

6.4.4. Projectors

6.4.4.1. Projector General Requirements

All projectors will have a laser light source, LCD technology, minimum WUXGA resolution, aspect ratio set at 16:9, consistent with flat panel displays.

The projector must have, at least,

- 1 x HDMI input,
- 1 x HDBaseT input (not used simultaneously with the above)
- Allow for remote monitoring.
- Minimum brightness for teaching spaces will be 6,000 lumens.
- Projectors will be ceiling mounted utilising a lockable plate.
- If the projector position is to be above 2600 AFFL a motorised lift will be required
- Where fitted a motorised lift will have a “service” position where LTU Support staff can access the projector without the need for Elevated Work Platforms or Scaffold.
- The preferred projection surface will be a smooth wall with level 5 white paint finish.

- Where this is not possible projection screen will be required, with white surface and 1.0 gain. Aspect ratio will be 16:9. Preference will be given to fixed frame screens. If a motorised screen is required control will be via IP.

6.4.4.2. Projector Resolutions & Aspect Ratio

All projectors will have a laser light source, LCD technology, minimum WUXGA resolution, aspect ratio set at 16:9, consistent with flat panel displays. As a minimum, all projectors must provide the following:

- WUXGA (1920 x 1200 – 16:10, set to 16:9)
- 4K (4096 x 2160 – 1.9:1 or 3840 x 2160 – 16:9 – Application depending) for specialised spaces only.

6.4.4.3. Projector Image Geometry

As a minimum, the projected image must conform to the following:

- Image is to be rectangular with parallel edges and 90o corners.
- Projected without the use of digital correction methods such as “Keystone”.

Note: Where there are physical restrictions that do not allow for the above, then this must be brought to the attention of the principal at the earliest possible opportunity for approval.

6.4.4.4. Projector Lamp Source

Laser based projection across all spaces.

6.4.4.5. Projector Installation

As a minimum, the AV Integrator must configure the projector for the following functionality:

All source selection and projector setting information must be displayed for between 2 & 5 seconds (to assist service desk staff with fault diagnostics)

- Locked to 16:9 aspect ratio.
- All warning notifications must remain persistent until the fault is rectified.
- Display a Blue (or other available colour – other than black) when no input is applied.
- Internal speaker is muted.
- All eco-mode, auto dim or timeout functionality must be disabled.
- Projectors must be colour matched when multiple projectors are deployed to produce adjacent or blended images.

All external buttons are disabled, locked out or physically obscured to prevent unauthorised tampering if installed in a location accessible by unauthorised person.

6.4.5. Flat Panel Displays

6.4.5.1. General Requirements

All projectors will have a laser light source, LCD technology, minimum WUXGA resolution, aspect ratio set at 16:9, consistent with flat panel displays.

LCD will be the preferred technology for displays, minimum resolution will be 4K, with a minimum brightness of 350 cd/m2 in areas with controlled ambient light. In areas of high ambient light brighter displays are required. The LCD display must have:

- 2 x HDMI inputs
- 1 x Audio output
- Allow for remote monitoring.

Displays in standard teaching spaces and meeting rooms must be rated 16/7, with automatic shutdown when not in use. Displays set in public spaces must be rated 24/7.

6.4.5.2. Flat Panel Displays Resolutions

As a minimum all flat panel displays must provide the following:

- UHD (3840 x 2160 – 16:9)
- FHD (1920 x 1080 – 16:9) for specialised spaces or applications, only with prior approval from the principal.

Note: Check current preferred equipment list at time of design as the current model may have been superseded. The new model may be of a different resolution. Higher resolutions will be accepted where no other option is available with approval of Digital Futures.

6.4.5.3. Flat Panel Displays Installation

As a minimum the following must be considered when installing a display device:

- Provide recommendation to architect and builder on the installation of additional strengthening members to be used when a flat panel display is mounted to a partition or stud wall. Structural members may include mounting brackets that span multiple studs, structural rated ply or additional noggins in the wall cavity. (See: Appendix A - Minimum strengthening requirements for flat panel displays)
- Power supplied via PDU, accessible power point or remote power switch (to assist service desk staff with fault diagnostics)
- All mounts must be commercially manufactured, rated with the appropriate engineering loads, and fit for purpose.
- All primary attachments must be commercially manufactured and rated for the intended application.
- Structural members used for mounting of devices must be free from vibration and movement to minimise shake of the projected image.
- Where ceiling mounted in throughfare or injury risk to a person, flat panel displays must be mounted at least 2400mm AFFL to the lowest point.
- Wall mounted flat panel displays must be located so as not to create a hazard to pedestrians.
- Display devices must be installed to minimise the impact of ambient and other light sources.
- Where multiple displays are installed side-by-side specialized video-wall brackets are required to ensure correct alignment of the displays.

6.4.6. Touch Interactive Whiteboards & Displays

6.4.6.1. General Requirements

The mounting of Interactive panels requires special consideration to accommodate user interactions. As a minimum the following must be considered when installing an Interactive whiteboard or flat panel display:

- Fixed Height installation – they must be installed with the top of the screen a maximum of 2000mm above finished floor level (AFFL) and the bottom edge of the displayed image is no lower than 900mm AFFL. Note: Due to the restricted mounting heights associated with interactive devices additional measures may be required to meet the viewing guidelines specified in this document. The following additional measures may be considered to assist in this area:
- Installation of a raised plinth to increase the height of the screen relative to the room whilst allowing access to the user as defined above.
- Deployment of additional displays to reinforcement the content on the interactive display.
- Where deployment of an interactive devices is a training aide it is to be treated as an additional input source to the main AV system.
- Ensure that a USB connection is provided to the resident PC or BYOD connection plate.

6.4.6.2. Touch Interactive Whiteboards & Displays Installation

As a minimum the following must be considered when installing an Interactive displays and whiteboards device:

- Provide recommendation to architect and builder on the installation of additional strengthening members to be used when a flat panel display is mounted to a partition or stud wall. Structural members may include mounting brackets that span multiple studs, structural rated ply or additional noggins in the wall cavity. (See: Appendix A - Minimum strengthening requirements for flat panel displays)
- Power supplied via PDU, accessible power point or remote power switch (to assist service desk staff with fault diagnostics)
- All mounts must be commercially manufactured, rated with the appropriate engineering loads, and fit for purpose.
- All primary attachments must be commercially manufactured and rated for the intended application.
- Structural members used for mounting of devices must be free from vibration and movement to minimise shake of the projected image.
- Wall mounted flat panel displays must be located so as not to create a hazard to pedestrians.
- Display devices must be installed to minimise the impact of ambient and other light sources.

6.4.6.3. Touch Interactive Whiteboards & Displays Installation (Mobile/Trolley)

As a minimum the following must be considered when installing a touch Interactive Whiteboards & Displays device on a trolley or mobile stand:

- A DGPO 240v power point is to be available on at least three(3) walls of the room intending to house the mobile trolley. The power point is to be situated in the centre of the wall at 300AFFL or other suitable location to allow easy access for connection and disconnection. Mobile trolleys are to use Wi-Fi networking avoiding the need for a cable connection.

6.4.7. Video Distribution - HDBaseT

All video distribution will be via a dedicated presentation switcher capable of receiving and outputting 4K60, 4:4:4 signals. At a minimum the switcher must have 1 x spare input and 1 x spare output that could be HDMI or a combination of HDMI and HDBaseT. In environments where signal must be distributed to multiple screens it is preferred to utilise the same, standard, presentation switcher, and add the appropriate distribution amplifier. This ensures a consistent rack build, cabling, and programming across different spaces. The Presentation Switcher must also have at least two dedicated audio outputs to send audio signal to the DSP. The presentation switcher must be remotely programmed and monitored. Video switching is to be programmed in the following preferred order.

- First – Wireless Presenter
- Second – Room PC
- Third – BYOD Laptop (HDMI)
- Fourth – BYOD Laptop (USB-C)
- Fifth – Document Camera (if required)
- Sixth – Digital Signage Player (if required)
- Any other source determined by Digital Futures

Point-to-point technology has proven reliable and cost effective. Consideration must be given to scaling as different manufacturers handle this function in different manners. It is to be assumed that scaling is always required and shall not be performed by the display device. It can be achieved via EDID management, scaling by the presentation switcher or by the receiver.

6.4.8. Video Distribution - AVoIP

LTU has recently included video distribution via AVoIP in their AV Standards as it aligns with our Audio-visual Strategy to deploy systems that are flexible, utilising fewer quantity of parts and fewer manufacturers.

The AVoIP technology must be capable of outputting 4K60, 4:4:4 signals, have scaling capabilities and be able to embed and de-embed audio signals, which will be available to a dedicated DSP via analog or digital transmission.

AVoIP encoders and decoders located within the AV rack must be fitted into a chassis, simplifying installation, heat management and power requirements.

AVoIP can also be utilised for USB distribution, particularly for managing the interactive component of Touch Interactive Whiteboards and Displays.

Structured category cabling required for each AVoIP endpoint is the responsibility of the AV Integrator. These must be Panduit certified, purple or violet, as defined in Section 6.3.9. Cabling will be terminated at a local AV rack, connected to a local network switch that will facilitate the management of AV related network traffic, while restricting upstream traffic to the wider LTU network.

Each AVoIP device must be remotely programmed and monitored.

6.4.9. Video Sources

6.4.9.1. Wireless Presenter

Wireless Presenters to be compatible with Android, Apple, and Windows devices, and allow content to be sent to the video switcher via an HDMI cable with a minimum format of FHD (1920 x 1080 – 16:9). Network security requirements shall allow all users including guests, access to use the wireless presentation system. Rooms are programmed to display the wireless presenter by default when system starts. The wireless presenter will be programmed to display a custom background image in the absence of any connected device sharing content.

6.4.9.2. Room PC

PCs will be installed below the lectern or benchtop and allow content to be sent to the video switcher via a HDMI cable with a minimum format of FHD (1920 x 1080 – 16:9). USB ports are to be easily accessible for USB drive usage. A keyboard and mouse are to be supplied on the lectern or benchtop. Video switching is to be programmed to display the Room PC by default when system starts unless fitted with a wireless presenter.

6.4.9.3. BYOD Laptop (HDMI)

BYOD Laptops are connected at the lectern of benchtop or adjacent wall by a HDMI cable and wall plate. The wall plate allows content to be sent to the video switcher with a minimum format of FHD (1920 x 1080 – 16:9). Video switching is to be programmed to display the BYOD Laptop by default when system starts unless fitted with a wireless presenter or Room PC.

6.4.9.4. BYOD Laptop (USB-C)

BYOD Laptops (USB-C) are connected at the lectern of benchtop or adjacent wall by a USB-C cable and wall plate. The wall plate allows connection to a device able to convert the content into HDMI format and sent to the video switcher with a minimum format of FHD (1920 x 1080 – 16:9). Video switching is to be programmed to display the BYOD Laptop (USB-C) by default when system starts unless fitted with a BYOD Laptop (HDMI), wireless presenter, or Room PC.

6.4.9.5. Document Camera

Document cameras have the ability to share to the screen physical writing, documents or objects the academic places below the camera. The camera must be at least 3MP, with an HDMI output and can be turned on and off from the control system. The standard document camera does not have a lightbox to capture X-Rays, but this will be required in certain medical laboratories. Document cameras are currently considered optional as most of the functionality they provide can now be solved using other available technologies, like a virtual whiteboard available through the web conferencing platform.

6.4.9.6. UC-Engine (Primary Display)

UC-Engine is a software-based video conferencing solution that provides a simple and intuitive user interface for users to join meetings. It is designed to work with various peripherals. The primary display by default will contain the content to be shared within the space and the far end participants. Video content from the UC-Engine is to be sent to the video switcher via a HDMI cable with a minimum format of FHD (1920 x 1080 – 16:9).

6.4.9.7. UC-Engine (Secondary Display)

UC-Engine is a software-based video conferencing solution that provides a simple and intuitive user interface for users to join meetings. It is designed to work with various peripherals. The secondary display by default will contain the far end participants cameras to be shared within the space. Video content from the UC-Engine is to be sent to the video switcher via a HDMI cable with a minimum format of FHD (1920 x 1080 – 16:9).

6.4.9.8. PTZ Camera

PTZ cameras are required in all spaces enabled for web conferencing, with most spaces requiring two PTZ cameras, for simultaneous presenter and audience capture. Minimum resolution for PTZ cameras is Full HD, though 4K is preferrable. Camera to be powered over PoE and data stream can be carried over HDMI, SDI or USB.

6.4.9.9. Digital Signage Player

A digital signage player is a device that plays digital content on a display. ONELAN is the preferred digital signage player that provides solutions for content management and delivery. The ONELAN player will be connected via a HDMI cable capable of outputting minimum format of FHD (1920 x 1080 – 16:9).

6.4.10. Video Destinations

6.4.10.1. Confidence Monitor

All teaching spaces will have at least one confidence monitor, mounted above the lectern. In spaces enabled for web conferencing two confidence monitors are required. The left monitor will display the shared content/presentation, while the right monitor will display the online participants.

6.4.10.2. Projectors/Displays

All teaching spaces will have at least one data projector or LCD display to display presentations. In spaces enabled for web conferencing two data projectors, LCD displays, or a combination of both are required. The left data projector or LCD will display the shared content/presentation, while the right data projector or LCD will display the online participants.

6.4.10.3. Lecture Capture

All teaching space will have lecture capture capability. Echo 360 Pro is the preferred method with only one HDMI input required. During Lecture Capture recordings a red indicator light is to be visible from the audience.

6.4.10.4. Hybrid/Online/Web Teaching

La Trobe University has selected Zoom as the preferred teaching web conferencing platform. All teaching rooms will be Zoom enabled and BYOD enabled, for users to have access to the technology in the room while utilising their web conferencing platform of choice, hosted on their own device. Zoom enabled rooms will be equipped with a dedicated UC Engine that manages content sharing and provides two outputs, one for content sharing and one for online participants. For meeting and collaboration spaces La Trobe University has selected Microsoft Teams as the preferred web conferencing platform. Consequently**,** it is required that all relevant equipment is compatible with both Zoom and Microsoft Teams platforms.

6.4.11. Digital Signage

Where required Digital Signage will be managed via Cloud-based platforms, built upon La Trobe University templates that can easily be populated, scheduled, and managed by the relevant staff. Digital Signage displays should be rated 24/7, minimum 500cd/m2 brightness, 4K resolution.

6.4.12. Clinical Recordings

La Trobe University has endorsed a cloud-based clinical recording platform provided by Laerdal. This system will be utilised across every campus that teaches Speech Therapy, OTARC, Psychology, Nursing and Midwifery. The Laerdal system, in combination with third-party hardware, will capture high resolution video and audio recordings of

- Patients in clinical settings.
- Staff and students working in clinical settings.
- Students under examination in clinical settings.

In addition to the clinical recordings the platform also can control and interact with simulation manikins, as used in the nursing and midwifery teaching spaces providing the ability to

- Record vital signs.
- Facilitate feedback under simulation conditions.
- Provide remote control of the manikin responses establishing visual/audible cues. Laerdel does not manufacture cameras or microphones to enable these systems. It is necessary when designing one of these systems to obtain the latest list of approved equipment by Laerdel. This equipment will supersede the LTU Preferred Equipment List in order to provide these specialised spaces with a fully working system.

6.4.13. Acoustics

As detailed in the general section, the AV system's primary role is to reproduce the audio and video. La Trobe University endorse all AVIXA standards to ensure all AV systems meet or exceed the specified industry best practice.

The physical acoustic properties of an environment have a direct impact on the performance of the electroacoustic system which in turn impacts learning outcomes. An internationally accepted measurement of the acoustic environment is the Speech Transmission Index (STI). The architectural parameters that affect STI are outside of the scope of this document and generally not applicable during a redevelopment or lifecycle upgrade of a space. What is to be considered as in scope is when:

- An existing space has proven to be problematic and simple acoustics strategies, such as wall panels and soft furnishings could provide an improvement, then they must be considered in the design or recommended to the principal.
- Green field projects where the services of an Acoustic Consultant must be engaged to assist with room acoustics, room insulation, service noise mitigation design or any other design relevant to the performance of the electroacoustic system.

La Trobe University aims to offer the highest standard of teaching and learning possible, and I&O have specified the minimum acoustic requirements for teaching and meeting spaces. These requirements are detailed in the following sections.

6.4.13.1. Acoustic Performance

As a minimum, the following acoustic performance criteria should be met.

Spaces	Ambient Noise L_{Aeq} dB(A)	Reverberation Time – RT60	**STI**
Offices	As per I&O Design Standards	As per I&O Design Standards	0.6 to 0.75
Meeting rooms	As per I&O Design Standards	As per I&O Design Standards	0.6 to 0.75
Classrooms	As per I&O Design Standards	As per I&O Design Standards	0.6 to 0.75
Lecture Theatres	As per I&O Design Standards	As per I&O Design Standards	0.6 to 0.75
Video/web conference spaces	As per I&O Design Standards	As per I&O Design Standards	0.75 to 1.0

STI requirements are higher for VC and web conferencing spaces, and while not all spaces at La Trobe University will be enabled with this technology, it is important to consider this functionality may be added at a later date to any space. Therefore measures should be taken to design audio-visual systems with the highest acoustic performance in consideration.

Notes:

- The principal will advise if these criteria are in scope.
- The AV Consultant or AV Integrator must notify the principal, at the earliest opportunity, if the acoustics in any space, covered by the contract, will have a negative impact on the performance of the installed AV system.
- The minimum LAeq period should be:
  - HVAC - 30s
  - Road noise - 2m
  - Building occupancy - 5m

Further guidelines can be found in the I&O Design Standards, section 5.06 – Acoustics and Vibration, at the following website **https://www.latrobe.edu.au/io/working-with-us/design-standards** .

6.4.13.2. Acoustic Reinforcement

The audio system is currently based around the audio processing capabilities of an external Digital Signal Processor (DSP). Digital Futures or the AV Consultant must provide the following information as part of the design documentation:

- Audio coverage plan including speaker placement (may be part of the AV plan).
  - System Requirements
  - As a minimum, the audio system must deliver the following requirements:
    - Program audio reinforcement
    - Speech reinforcement as required (As per section 3.5.1 above)
    - Hearing augmentation
  - Audio processing as required.
- All wired and wireless microphones are processed by the DSP.

6.4.14. Microphones

All teaching spaces will be equipped with one or more of the microphones below:

- One or Two gooseneck microphones at the Lectern
- One lapel microphone for presenters to roam the room
- One handheld microphone for audience interaction
- Ceiling Microphones

The lapel and handheld microphones will be equipped with a charging dock, network enabled to be able to remotely monitor battery levels. All microphones are connected to the DSP via either an analog or DANTE audio connections.

6.4.15. Digital Signal Processing

Audio will be managed by a Digital Signal Processor, capable of receiving all required audio sources via either an analog or DANTE audio connections, providing AEC for all microphones, as well as having the capability to send and receive USB audio for web conferencing. Mute Sync for web conferencing is also required but can be achieved via an external device if not supported internally. Remote monitoring is required for the DSP.

6.4.16. Amplification

Amplifiers must be Class D, capable of outputting the required power plus 20% overhead. The amplifier must have a minimum of two channels and compatible with low and high impedance speakers.

6.4.17. Speakers

Speakers must be passive in all teaching spaces. They may be surface speakers, ceiling speakers, or a combination of both, depending on the physical characteristics of the space.

- Max SPL above 105 dB
- Sensitivity above 90 dB
- Multiple transformer taping
- White and Black options

Positioning of speakers must be mindful of providing best audio cover while mitigating acoustic feedback risks. To achieve this preference is for surface speakers to be wall mounted above 2000 AFFL and in front of the lectern position. The above speaker specification does not apply to performance spaces. These spaces are bespoke, and requirements will vary accordingly.

6.4.18. Audio Coverage

Audio coverage shall conform with the AVIXA A102.01:2017. While this standard is the benchmark that specifies a minimum acceptable reference, it is very onerous and is typically used as a general guide. Full testing of conformity to the standard has also been rarely undertaken until recently. Results within the acceptable range are expected although it is

anticipated that this may not be possible in some circumstance due to existing physical factors. Data obtained from these tests will be used to inform future designs and built environments. Following is the minimum, acceptable, requirements that the AV systems must be designed to meet:

Quality	Desirable	Acceptable	Unacceptable
System Noise – Above Ambient, LAeq dB(A)	< 0	0 – 5	> 5
Program System SPL, dB(A)Slow	<85	75 – 85	< 75
Program Frequency Response (100Hz – 10kHz)	± 3dB	+3/-6dB	> +3/-6dB
Speech System SPL, LAeq dB(A)	65 – 70	60 – 65	< 60
Speech Frequency Response (100Hz – 10kHz)	± 3dB	+3/-10dB	> +3/-10dB
Coverage Uniformity (%)	> 90	> 75	< 75
Speech Transmission Index (STI)	> 0.68	0.68 – 0.56	< 0.56

6.4.19. Hearing Augmentation

Further details can be found in the Design Standards – Occupational Health and Safe and the Disability Discrimination Act, at the following website **Design standards, Infrastructure and Operations, La Trobe University**.

Hearing augmentation systems are required as per the NCC for all spaces where an inbuilt amplification system, other than one used for emergency warning, is installed. At a minimum this applies to all teaching and public spaces.

For meeting and collaboration spaces hearing augmentation systems are not required in every room. Digital Futures will advise the principal which rooms require hearing augmentation, based on the quantity and availability of rooms in the vicinity.

The principal will nominate in the scope of works if hearing augmentation is required outside of these guidelines. As a minimum, the hearing augmentation system shall comply with the following:

- IR systems must provide greater than 95% coverage within acceptable tolerances.
- A minimum of one IR receiver for every 25 persons or part thereof must be provided in each space.
- Infra-red modulators, transmitters must be as per the current preferred equipment list.
- Coverage must be even across the designated IR coverage area.
- Hearing augmentation signage must be installed.
- The system must be designed to minimise the effects caused by:
  - Electrical and other cabling.
  - Metal objects, such as ductwork.
  - Other sources.

The system must ensure that the audio DSP is configured correctly to provide a mixed feed of program and microphone audio. The hearing augmentation system must remain active and reproduce boundary and lapel radio microphone audio when the AV system is shut down. This is to allow for hearing augmentation when the AV presentation system is not in use. The AV Integrator must provide a certificate of compliance as per AS1428 for all hearing augmentation systems.

The management of hearing augmentation receivers varies across different LTU departments. It is the responsibility of the AV Integrator to coordinate with the relevant stakeholders, follow their processes and document who has taken delivery of the receivers.

How to access the hearing augmentation receivers should be covered by the AV Integrator during user training.

6.4.19.1. Infra-Red System

As a minimum, the IR Hearing Augmentation system must meet the following criteria:

- IR Hearing Augmentation must provide greater than 95% coverage of the room.
- Multiple transmitters may be required to ensure correct operation for all room configurations.
- Transmitters must not be installed outside or in direct sunlight.
- The number of receivers must meet NCC regulations.
- An induction neck loop option must be provided for each receiver supplied.
- Recharger and rechargeable batteries must be provided for each receiver supplied.
- AV Integrator must conduct a site survey and review line of sight restrictions and ambient light prior to submitting a detail design submission.

The AV Integrator must provide signage indicating the coverage area of the hearing augmentation systems and the location where IR receivers (if used) are located, in each area in accordance with:

- NCC
- AS1428.1 – 2021
- AS1428.5 – 202

6.4.19.2. Induction Loop System – (phasing out)

Induction Loop Systems are not the preferred hearing augmentation solution at La Trobe University. In scenarios where an Infra-red system is deemed unsuitable consideration will be given to Induction Loop Systems. As a minimum, the induction loop Hearing Augmentation system must meet the following criteria:

- Conform to all Standards and Regulation (loop design and expected conformance must be submitted as part of the shop drawings). Loops must be installed below floor coverings using flat copper tape. If loop cannot be installed due to no floor coverings or bare concrete floors an alternative solution must be offered. Typically, an Infrared solution would be acceptable in this instance.
- Consist of an 'ultra-low loss phased array' loop to minimise audio spill into adjacent spaces.
- Ensure greater than 80% coverage of the space.
- Ensure that the hearing loop meets the following minimum acceptance criteria:
    - Field strength inside the area of use must be equal to 400mA/m plus/minus 3dB (tested with 125ms RMS measurement with 1kHz Sine wave).
    - Total variation in signal across the frequency band 100Hz to 5kHz at 1kHz must be within 3dB anywhere in the loop area.
    - Background noise must be less than or equal to -32dB relative to 400mA/m.

6.4.19.3. Wi-Fi System

Wi-Fi based Hearing Augmentation Systems are currently not implemented at La Trobe University but under investigation for future installations. Subsequent issues of this AV standards document will elaborate on this system.

6.4.20. Programming and Control

La Trobe University are currently deploying control systems based on La Trobe University approved GUI templates. The AV Integrator will be responsible to complete programming requirements and detailing information for all devices, and finally test that the supplied programming delivers the required functionality. Some projects may require additional control functionality.

- Emergency Warning Intercommunication System (EWIS) Integration (where fitted). EWIS integration to mute the in-room audio system must be installed in the following circumstances:
    - Where high SPL audio systems are deployed, typically in a theatre or event style environment.
    - As required by the relevant legislation.
    - As detailed in Section 5.07.05 Occupant Warning Systems / EWIS of the Latrobe University Design Standards
    - As directed by the principal.

6.4.20.1. Control System

Learning spaces will be controlled by a button panel or touch control screen, minimum 10", loaded with an approved template that will be consistent across all rooms. The Control Processor will be cloud-based in first preference. The design and functionality of the User Interface (UI), also known as Storyboard, is detailed in Appendix C.

6.4.20.2. Automatic Shutdown

Motion sensors must be installed in each AV enabled teaching space. The AV Integrator must ensure that the motion sensor is integrated with the control system to provide the following functionality:

- Provide a pop-up warning on the touch screen after 2 hours of inactivity. The pop will give an option to cancel the shutdown (reset the timer) or:
    - If unacknowledged after 5 minutes the AV system will raise the lighting levels in the room (if functionality is available).
    - If after a further 5 minutes the pop-up has not been acknowledged the AV system will be shut down.

6.4.20.3. Monitoring

Every device deemed critical for the operation of a room requires remote monitoring. Currently La Trobe University utilises a third-party monitoring application, which operates in collaboration with Crestron XiO, ServiceNow and other platforms already in place. All reporting requirements are to be submitted as part of the control system shop drawings for approval by the Manager Digital Futures.

6.4.20.4. Remote Access

To assist with the support of AV systems, La Trobe University service desk & AV support staff require remote access to AV devices. Where available remote access to AV devices must be enabled and the relevant log on details provided as part of the deliverables. As a minimum the touch panel controller and display device must have remote access capabilities enabled. To ensure the security of the AV system and the overall La Trobe University network, security requirements details are provided by Digital Futures.

6.4.21. Lighting

6.4.21.1. General Requirements

Lighting has a major impact on the perceived quality of a displayed image. Both ambient and artificial lighting must be controlled to ensure optimum performance of the display system. The artificial lighting system must also be correctly designed and interfaced with the AV control. As with acoustics, the design of the lighting system is outside of scope and not applicable during a redevelopment or lifecycle upgrade. What is to be considered in scope is the following:

- An existing lighting system with integration capability. In this instance the lighting system must be integrated with the AV system.
- Where the lighting system is being redeveloped as part of the overall project. In this instance the AV Consultant and/or AV Integrator must coordinate with the Electrical Consultant and/or Electrical Contractor to ensure that the lighting system conforms with the requirements listed below:
    - In the case of green field projects, the AV Integrator must coordinate with the Electrical Consultant to ensure the lighting design conforms with the requirements listed in the sections below.
    - Where the installed lighting system is not covered by the previous points and would have a detrimental effect on the AV system. In this case this must be brought to the principal's attention at the earliest possible opportunity.
    - In situations where there is no separate "Display area - zone" (see below), or there is excessive spill on the display surface that will degrade the performance of the display system then the AV Consultant or AV Integrator must bring this to the attention of the principal at the earliest possible opportunity.

6.4.21.2. Ambient Lighting

Ambient lighting must be controlled to ensure the display system conforms to this standard. To ensure this, the following techniques may be utilised:

- Black out blinds. Motorised and integrated to the AV system is the preferred option.
- Grey out blinds. Motorised and integrated to the AV system is the preferred option.
- Repositioning the main presentation area to avoid ambient light spill – subject to architectural restraints and prior approval by the principal.

6.4.21.3. Artificial Lighting

Ambient lighting must be controlled to ensure the display system conforms to this standard. To ensure this, the following Artificial lighting system must be designed to ensure the display system conforms to this standard. As a minimum the following techniques may be utilised:

- Well defined zones such as:
  - Display area – The area immediately above and adjacent to the display device.
  - Presentation Area – The area typically at the front of the class around the lectern that the academic may occupy during a presentation.
  - Lectern (Podium or bench) – The main joinery item and close surrounding areas where an academic would present from. Where there is more than one, separate control of each is required.
  - Whiteboard – The area immediately above or adjacent to an installed whiteboard.
  - Backlighting – Typically a controlled light to illuminate the Academic from the rear. Its primary use is to make the academic stand out from the background when a camera is used to capture or transmit video. Depending on the vertical angle of the backlighting it may also function as task lighting. A separate backlight with individual control should be installed for the lectern and presentation area.
  - Task lighting – In certain situations, specific, highly focused lighting is required to illuminate an area such as the top of a podium lectern. Typically, this is a local device, such as a Little-lite gooseneck type product installed by the AV Integrator. The AV Consultant is to ensure that a suitable solution is deployed as part of the overall project.
  - Audience area – The areas where students are typically seated.
  - Aisles – Steps and passageways.

- All zones are to be controlled by commercial dimmers. Typically, this includes the following manufacturers:
  - Dynalite
  - Cbus
  - Other manufacturers require prior approval from the principal.

- Where electronic dimmers are not installed the following is required as a minimum. In order of preference:
  - 2 zones of mechanically dimmed lighting
    - Display area
    - Remaining areas
  - 2 zones of switched lighting
    - Display area
    - Remaining areas
  - 1 zoned of switched lighting.

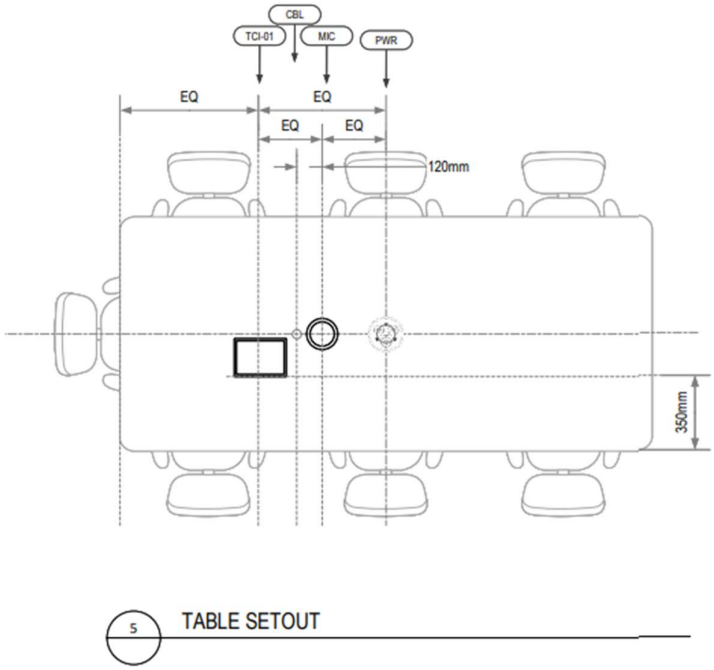
All lighting fixtures must be capable of providing flicker free dimming down to 10%. Wherever possible (lighting control system dependant) the AV system will recall a preprogramed lighting state. All individual channel levels are to be programmed into the lighting control system. The AV Consultant is to ensure that all required coordination between the AV Integrator and the electrical contractor is included in their documentation.

The artificial lighting system must be integrated to the AV control system. Light settings shall be developed following the bespoke lighting design of spaces.

6.4.22. Physical Installation (Meeting Tables)

The installation of services to a meeting table requires careful planning. Typically, installation of services is along the centre line of the table, in certain circumstances devices may be installed closer to the edge of the table by not within

350mm of the table edge. Installation locations and drawings are prepared by the AV Consultant or Digital Futures.



7. Installation and Workmanship

7.1. GENERAL REQUIREMENTS

AV Integrators must complete all work in a professional manner. All works must be undertaken by well supervised and qualified staff. All works must:

- Comply with all applicable Standards with the listed order of precedence:
  - Australian and International Standards.
  - All applicable I&O, IS and Digital Futures Technology Standards.
  - All applicable Facilities and Services Standards.
  - Where there are no applicable Standards, follow industry best practice.
- Be undertaken by qualified staff.
- Follow the intent and requirements as detailed in the scope of works.

The following sections provide additional information to ensure the AV Consultant and AV Integrators are informed of the minimum expectations of La Trobe University. Any areas that are not included in this section that will impact on the quality, functionality, or timely delivery of the project, must be brought to the principal's attention at the earliest possible opportunity.

7.2. QUALIFICATIONS

All contractors, sub-contractors and their representatives must hold appropriate trade, manufacturer, or industry qualifications. The following list is a sample of the typical qualifications required:

- Trade qualifications:

    - Electrician License A Grade
    - White Card
- Manufacturer qualification:
    - AMX
    - Biamp Tesira
    - Extron
    - Crestron
    - QSC – QSYS
    - Dante Certification Level 2
    - Other manufacturers as required
- Industry qualifications:
    - CTS
    - CTS-D, CTS-I as required
    - CCNA or equivalent, as required
    - Network cabling – Panduit as per https://www.latrobe.edu.au/information-services-design-standards
- Professional:
    - All engineering tasks require the services of a suitable competent and qualified engineer with current memberships to all required professional and legislative bodies.
    - All certifications/qualifications must be provided upon request.

7.3. PROVIDE A FULLY WORKING SYSTEM

The AV Integrator must supply all items necessary to provide a fully working system that has been finished in line with the scope of works, design intent and statutory requirements whether specifically mentioned in the project documentation or not. A fully working system must include all sub-systems that interface with the AV systems. As a minimum these may include:

- Remote Monitoring Platform Connection
- Lighting systems
- Motorised blinds and shutters
- Network requirements
- All peripheral equipment
- Control systems and servers
- Audio processors and servers
- Videoconferencing systems
- Lecture capture systems
- Remote controls
- Batteries
- Locks, All contractors, sub-contractors.

7.4. EQUIPMENT AND SERVICES

All supplied equipment must comply with the following:

- Be nominated on the current preferred equipment list which is being developed and will be included as an Appendix. (See Appendix B)
- Not to be substituted (from the preferred list) without prior permission from the principal.
- Where a custom design is required and an item of equipment that is not identified on the preferred equipment list then the AV Integrator or Consultant must advise the principal at the earliest possible opportunity.
- Provided with all applicable licences, options, and accessories to provide the functionality as detailed in the scope of works.
- Installed on site during the construction process.
- Protected from mechanical damage, dust and other hazards until handover or practical completion.
- Installed as per manufacturer's instructions or guidelines.
- Not have its warranties voided due to works by the AV Integrator.
- Be delivered in manufacturers packaging and unopened except for:
    - Item has been pre-deployed into a rack, or
    - Item has been pre-configured in the AV Integrator's factory. In this case it must be repacked into its original package.
- Equipment is the responsibility of the AV Integrator until practical completion or it is delivered into a secure project store and accepted by the builder, La Trobe University or other authorised representative.
- Be provided with appropriate certificates i.e. hearing augmentation compliance certificates, structural and fire certifications.
- Test and Tagging of AV devices.

7.4.1. Warranty

All equipment and services must be provided with all manufacturer's warranties. As a minimum the following must apply in respect to all products and warranties:

- All products must be purchased as new in Australia or through a legitimate supply chain (manufacturer approved sales or distribution agent) – no grey imports (items purchased offshore or outside of the manufacturers approved supply chain) will be accepted without prior approval from the principal.
- All products must be covered for commercial use 16/7 unless otherwise detailed.
- Australian support including technical resources and spares must be available for all products.

- Have a minimum 5 year warranty.
- The AV Integrator must either support the product for the life of the manufacturer's warranty or transfer the warranty to La Trobe University after 36 months.
- All installations must be warranted for a period of 36 months.
- Where second hand equipment is either purchased from a third party (only with La Trobe University approval) or supplied by La Trobe University, the Integrator is to ensure that the equipment is fully operational prior to installation. In this instance the Integrator will only be required to provide warranty for installation and integration of this equipment.

7.4.2. Surface Finishes

All supplied products must be professionally finished with a hardwearing surface finish such as:

- Powder coat
- Two pack paint finish
- Commercial grade clear or stain to raw wooden finishes

7.4.3. Mechanical attachments and fasteners

All methods of attachment and fastening must be:

- Commercially manufactured.
- Designed for the intended use.
- Be suitably rated for the intended use.
- Installed as per manufacturers specifications and appropriate engineering advice.
- Use a threaded construction to allow for the removal and replacement of equipment. Under no circumstances will equipment or terminations be fastened with pop rivets.
- Be approved for use in the designated substrate by La Trobe University Facilities and Services.

7.4.4. Penetration

Any penetration to the following must be in accordance with the appropriate regulations and standards:

- Fire partitions
- Walls
- Floors
- Structural members
- Any penetration through an acoustic seal is to be treated to maintain the appropriate isolation.
- Prior approval from I&O is required prior to the commencement of any penetrations.

7.4.5. Physical Security

AV equipment is considered "valuable and attractive" and must be secured to prevent theft. The following sections detail the relevant measures required.

7.4.5.1. Barrels and Padlocks

La Trobe University uses a master key system to streamline the access requirement for staff across different areas and disciplines. AV equipment is secured with a "0120" key and all joinery, lecterns, cupboards, or racks used to secure AV equipment, must be secured with an appropriate barrel or padlock.

7.4.5.2. Projectors

Projectors deployed in a secured or monitored space does not require any additional physical security measures. Projectors deployed in non-secured or monitored spaces are to be secured with a suitable locking mechanism at time of installation. The AV Integrator is to ensure that the locking mechanism is compatible with either a La Trobe University approved padlock or key.

7.4.5.3. Flat Panel Displays

Any flat panel display deployed in a secured or monitored space does not require any additional physical security measures. Flat panel displays deployed in non-secured or monitored spaces are to be secured with a suitable locking mechanism at time of installation. The AV Integrator is to ensure that the locking mechanism is compatible with either a La Trobe University approved padlock or key. Where there is insufficient room for a padlock, then a 4mm split pin is to be installed into the padlock hole of the mounting bracket locking arm.

Digital Signage Displays are to be secured with a suitable locking mechanism at time of installation. When displays are located within reach of foot-traffic, or in areas where they are exposed to impact, like a sporting venue, special considerations must be given to protecting the integrity of the display. This should be achieved via a polycarbonate screen protector layer.

7.4.5.4. Supply of Locks

For all university based deployments and projects delivered by a builder (typically major projects) the cost of barrels and padlocks must be included in the AV Integrators submissions.

7.4.6. Wall Reinforcement

It is the responsibility of the AV Consultant to provide recommendations to architect and builder on the installation of additional strengthening members to be used when a flat panel display is mounted to a partition or stud wall. Structural members may include mounting brackets that span multiple studs, structural rated ply or additional noggins in the wall cavity. (See: Appendix A - Strengthening recommendations for flat panel displays)

In the instance where these recommendations have not been issued, or were not followed, it is the responsibility of the AV Integrator to coordinate appropriate measures with the builder to ensure displays are mounted securely.

The AV Integrator should provide Digital Futures with photographic evidence that the installation of additional strengthening members took place and meets LTU standards.

7.4.7. General Security

The following general security items must be implemented:

- All equipment must be secured.
- Items mounted in a rack that does not have a locking door or other forms of security must be secured with #14 snake eye security screws.
- Document cameras and other portable devices must be secured with a combination Kensington style lock (contact LTU AV Services for combination number).
- All accessible front panel controls not protected by tamper proof covers, must be locked out or reprogramed by the AV control system on power on.
- Fly leads, such as HDMI cables, must be secured internal to the joinery unit. Fly leads that terminate external to the joinery must be secured with a block nylon “P Clip” or similar.

7.4.8. Equipment Racks

Where multiple pieces of AV equipment are co-located, a suitable equipment rack must be installed. Equipment, power supplies and cabling must be installed in a tidy manner, secured by rack brackets and Velcro ties, and utilizing the least number of connections possible.

In instances where two cables must be joined, and this join lacks a locking mechanism a heat shrink will be required to mitigate any risk of cables disconnecting.

7.4.8.1. Physical

Rack construction and style is application dependent and may include the following:

- Free standing rack sized to suit.
- Rack unit deployed within joinery.
- Rack strip installed in joinery.

As a minimum the equipment rack must conform with the following:

- IEC 297 compliant.
- Commercially built.
- Provided with locking doors, sides top and bottom (if free standing).
- Supplied with all rack trays, supports, shelving, looming bars, blanking/vent panels and accessories as required to support the installed equipment.
- Welded or use permanent fasteners to join members.
- Rack and all panels and doors to earthed in accordance with AS/NZS 3000
- Finished with a matte black powder coat or anodised finish.
- Not be fitted with castors unless specifically required for access to racks 20RU or less.
- On rails with cable support – where rack cannot be accessed from the rear.
- Securely mounted to the floor, or other structural member, if greater than 20RU.
- 700mm deep if over 24RU or free standing.
- Conform to La Trobe University IT requirements if installed in a communications room or similar space.
- Supplied with commercially manufactured IP controlled PDU(s).
- Supplied with tamper proof covers if front panel controls are exposed to users and functions cannot be locked.
- Supplied with 20% spare capacity for future equipment.
- Supplied with Philips M6 screws, plastic cup washers and cage nuts.
- Listed on the LTU AV preferred equipment list, (See Appendix B)

7.4.8.2. Layout

The AV Integrator must ensure that the rack layouts consider the following:

- Provide sufficient, effective airflow and cooling.
- Group similar devices to allow for simplified cabling and cables separation.
- Position user accessible equipment so that the user has clear unobstructed access to the equipment while maintain security to all other equipment.
- Where a device has a service port it must be accessible. If the port is not easily accessible, then an internal patch lead is to be proved and remote socket installed with an appropriate label.
- Position heavy items such as amplifiers at the bottom of the rack.
- Provide black or vent panels to all free rack spaces

7.4.9. Lectern and joinery

Deployment of standard lecterns provide a similar user experience across all AV equipped spaces while conforming to current accessibility requirements. All lecterns must be DDA compliant and if not hard wired, must be powered via a starter socket if the lectern contains a power distribution unit.

- The following equipment is to be deployed internally in the lectern:
  - AV rack and associated equipment.
  - Power supplies associated with user devices.
  - Resident PC

- The following equipment, where deployed, is to be mounted on the top of the lectern:
  - Monitor
  - Keyboard. Mouse.
  - Document camera (Optional)

- Microphone charger.
- Hearing augmentation charger and receivers.
- HDMI and USB connection plate (BYOD)
- GPO for BYOD Laptop charging

- The lectern must be designed to be DDA compliant and as a minimum the following must be considered.
  - The user must be able to access all user related equipment installed on the lectern.
  - Access the touch panel.
  - Access to the resident PC USB ports. If these are not within the defined DDA range, i.e. they are on the PC monitor in the case of an all-in-one, then a clearly labelled USB connection plate must be installed.

7.4.10. Lectern Capture

The successful deployment of lecture capture at La Trobe University requires the coordination of several teams. During deployment, the AV Integrator shall be responsible to ensure the close coordination between the following parties and themselves (the AV Integrator) is maintained:

- Principal
- AV Consultant
- LTU Digital Futures

7.4.10.1. Echo 360 PRO/UC Engine Connectivity

CONTENT	FUNCTION	DETAILS
Primary Video	Display Image	Content displayed on the primary display
Secondary Video	Camera Image	Two presets: • Tight - Lectern head and shoulders • Wide - General presentation
Audio	Stereo L&R audio	A mix of the following sources: • Program audio – recorded as a stereo mix • Speech – recorded as mono on L&R channels Audio levels should average the orange level indicator with peaks to the second orange indicator on the Echo360 Pro/UC front panel. Audio must be limited to ensure they do not exceed the third orange indicator. Audio is provided via the L/R Unbalanced RCA input.

7.4.11. Naming Convention, Functional Object Names, Host Names & DNS

Host names to follow this following format.

CCBBBB-RRRFFFZZ-D

CONTENT	FUNCTION	DETAILS
C	Campus, 2 Characters (campus identifiers)	BU = Bundoora
B	Building, 2-4 Characters	TLC0
L	Level, 2 Digits	02 (Not Used)
R	Room, 3 Digits required	013
-	Delimiter	
F	Function, 3-4 characters	Device or functional description
Z	Sequential function number, 2 digits	02
D	Dedicated Dante	D

Campus Identifiers

SITEID	SITENAME	SITE_CAMPUSCODE
BUNDOORA	Melbourne (Bundoora)	BU
AUSTIN	Austin	AT
MILDURA	Mildura	MI
ALWOOD	Albury - Wodonga	AW
BENDIGO	Bendigo	BE
BALLARAT	Ballarat	BL
FRANKLIN ST	Franklin Street	CI
SHEPTON	Shepparton	SH
ALFRED	Alfred	AL
ECHUCHA	Echuca	EU
MELTON	Melton	ME
BOUVERIE	Bouverie	BV
OFF CAMPUS	Off Campus	OC
CITY CAMPUS	City Campus (360 Collins)	CB

Functional Identifiers

FUNCTION	DETAILS	EXAMPLE
ADA	Audio Distribution Amplifier	Any audio distribution amplifiers
AMP	Amplifier	Network base amplifier
BRC	Bracket	Mounting point for flat panel displays
CAM	Camera	Fixed, PTZ or Document based. Identifier is used for content and control
CSRV	Camera Server/Controller	An appliance that controls camera settings and switching

CSP	System Controller/server	Control system processors. Includes smart buttons and panels with control software installed. If an “All -in-one” device is installed and is used as the room processor it will be given an CSP host name. Host names for server-based control platforms will be issued by IS
CONV	AV and HDMI® over CAT5 to USB	The HD-CONV-USB-250 is an AV and HDMI® over CAT5 to USB Converter. It is one of the components that make up a Crestron Flex UC Video Conference System with Bring Your Own Device (BYOD) functionality.
CIS	Cisco Tandberg or Other Cisco Meeting Device	A meeting device developed by the CISCO company.
DCAM	Document Camera	Dedicated document cameras and visualizers
DSG	Digital Signage Player	Any device that plays locally stored content for the purpose of public information. Note: for streaming based products use “network receiver (NRX)”
DSP	Digital Signal Processing	Dedicated devices that receive and modify audio signals before outputting these to an amplifiers or other devices.
FPD	Flat Panel Display	All flat panel displays used as AV display device (teaching, digital signage, art etc). Where a panel has an OPS PC, media player or internal processor that has a separate IP address, such as digital signage, the panel will have a FPD host name, and the internal controller will have a RPC host name
FPDi	Flat Panel Display Interactive (Touch)	All flat panel displays used as AV display device with touch interactivity (teaching, meeting). Where a panel has an OPS PC, media player or internal processor that has a separate IP address, such as digital signage, the panel will have a FPD host name, and the internal controller will have a RPC host name
GPIO	Audio Interface	Network I/O expanders extend your system’s capabilities to enable streamlined interoperability with non-networked audio and control devices
HRG	Hearing Augmentation	All hearing augmentation transmitters
HTX	HDBaseT Transmitter	HDBT transmitter, includes HDMI, DisplayPort, USB or others
HRX	HDBaseT Receiver	HDBT receiver, includes HDMI, DisplayPort, USB or others
LEC	Lectern	
SCL	Video Scaler	A video scaler is a system which is capable of converting video signals from one resolution to another. It increases or decreases the input resolution for video output at the specified ratio
MSW	Matrix Switcher/Presentation Switcher	Vision distribution of selected inputs to selected outputs
MIC	Microphone	Network-based microphones
MCH	Microphone Charger	Network-based microphone chargers
MCR	Microphone Receiver	Network-based wireless microphone chargers
OAV	Other AV	Not covered above
NDX	AVoIP Decoder	AVoIP Decoder, can be card or enclosed.
NEX	AVoIP Encoder	AVoIP Encoder, can be card or enclosed.

NFX	AVoIP Card Frame	Chassis that houses AVoIP cards
NSW	Ethernet Network Switch	A network switch CISCO or Netgear AV Line
OPT	Optical Storage Device	DVD, CD, Blu-ray
PC	Personal Computer	Installed PC, processor or other device running an AV related application. Does not include the installed room PC used by academics and students
PDU	Power Distribution Units	Power controllers deployed as part of the AV system
PRJ	Projector	All projectors
RAC	Rack	AV Rack used to mount, install, house AV devices
RBP	Room booking panel	All in one room booking systems
REC	Any video or audio recording device e.g. Lecture capture and other media recording appliances.	Physical installed appliances. Does not include server - based appliances
SBR	Soundbar	A combination webcam, microphone, and speaker solution, may include UCE capability
SCR	Projection Screen / Lifter	All motorised projection screens, flat panel, or projector lifters
SEN	Sensor	Motion, pressure pad, location, or user action-based sensors
SPK	Speakers	Network-based and other speakers
SWI	Auto-Switch	An auto switch device that allows for multiple sources to one output
TCI	Touch Control interface	User AV interface device. Includes touch panels, push buttons, devices running dedicated applications or browser applications for the purpose of controlling room AV systems
UCE	Unified Communication Engine	Zoom / MS Teams appliances
VDA	Vision Distribution Amplifier	HDMI or HDBaseT distribution amplifiers
WPR	Wireless Presenter	Wireless media presentation devices such as Air-media, etc

7.4.12. Pre-Installation

In partnership with the Digital Futures team the AV Integrator will fill-in the Equipment Schedule, detailing all the attributes below for each network-enabled device. This step is vital to the provision of the network to support the AV infrastructure; therefore the following information should be provided as soon as practical prior to deployment:

- Brand/Make
- Model
- Serial number
- MAC address.
- IP address
- Assigned host name.
- IP ID
- Room data outlet numbers.
- Switch name
- Switch port
- Port power requirements (N/A, PoE, PoE+, UPoE).
- Multicast requirements
- Device certificate requirements.

7.4.13. Post-Installation

Within 30 days of practical completion the AV Integrator will deliver to Digital Futures the following As -built documentation:

- Equipment Schedule (Host Name Document) with the inclusion of device serial numbers.
- Installation date.
- AV Schematic.
- AV layout plan.
- Hearing augmentation compliance certificates.
- Acoustic testing results (if testing was requested by the principal).
- Audio coverage results (if testing was requested by the principal).
- Copies of any engineering certificates (if any mounting or structure required
- independent engineering advice).
- Test and Tag register.
- Copy of installed control code – Compiled and uncompiled
- Copy of installed audio designs
- Copies of any device configuration data that is not captured by GVE or other centrally
- deployed CMDB.
- Any warranty information, including expiry date.
- Any remotes, spares, documentation, or accessories supplied with the equipment.
- All drawings must be supplied in electronic form, PDF, in no larger than A1 size.

7.4.14. Acceptance Testing

To ensure that the AV installation is delivered to the requirements specified in this document and to ensure a minimum level of quality, the AV Consultant, or Digital Futures where no AV Consultant has been engaged, must ensure the following is completed:

- The AV Consultant (or Digital Futures staff) must complete the commissioning checklist to be detailed by Digital Futures.
- Coordinate with the AV Integrator for the rectification of any defects.
- Advise the principal of any defects that will remain outstanding post Practical Completion at the earliest possible opportunity.
- Verify all deliverables are accurate and delivered prior to Practical Completion.
- Once the room is defect free the AV Consultant is to notify the principal so that La Trobe University staff can conduct an acceptance assessment. Any defects identified by La Trobe University staff will be added to the AV Consultant’s defect list. The AV Consultant must ensure that these defects are rectified in a time frame advised by La Trobe University.

7.4.15. Handover and Defect Management

Practical completion will be granted when the following minimum requirements have been fulfilled by the AV Integrator:

- Completed Project Asset and Equipment schedule has been submitted to Digital Futures, with all serial numbers included.
- System has been tested and commissioned using an LTU approved test plan. A test plan may be provided by LTU Digital Futures upon request.
- System has been inspected by Digital Futures and the AV Consultant and has been deemed to be operational and practically complete.
- All documentation has been approved by the AV Consultant and submitted to Digital Futures.
- All control system source codes, DSP and switcher and other device configuration files have been handed over to Digital Futures and become the intellectual property of the University.
- Interface testing to the Crestron XiO, Biamp SagueVue and Sennheiser Control Cockpit systems have been successfully completed.
- All training has been completed.

- All accessories, software, fly-leads and remote controls have been handed over to Digital Futures. All packages of information handed over to Digital Futures shall be scheduled in a transmittal, copied to the Project Services project manager and AV Consultant
- Any decommissioned equipment needs to be documented via the Asset and IP schedule and sent to Digital Futures Team for instruction. Items will need to be delivered to either Field Services, end user or e-waste.

7.4.15.1. Notice of Practical Completion issued by AV Consultant or Digital Futures

The issuance of a Notice of Practical Completion by the AV Consultant is contingent upon the rectification of any installation defects by the AV Integrator. Defects should be tracked via an online spreadsheet, which will be the Asset and IP spreadsheet for projects run by Digital Futures, or via builder or AV consultant for major construction works.

Installation defects are classified as follows:

SEVERITY	CHARACTERISTICS	EXAMPLES
Critical	Space is unable to be used, no workaround exists.	Network not active for computers. Displays not working. User interface not working. OHS related issues.
Major	Functionality is limited or contains significant performance issues. A workaround can be temporarily implemented to allow use of space.	Some sources not working. Lighting presets not finalized. No source audio present. Some components not supplied. Performance issue may include poor audio quality, distorted video signal.
Minor	Space is usable though some known errors are present, and some functionality may be limited. Some aspects of space may not conform to specification and applicable standards.	Fly-lead missing / adapters not supplied. Equipment not secured, such as touch panel. Hook for fly-leads not present. EDID not set correctly. Display not aligned. AV equipment is not on network for monitoring and remote support.
Trivial	Issues that do not impact on useability of space.	Grammatical errors on user interface. Errors in document submissions such as user guides and as-built drawings.

7.4.16. Training

AV integrator shall allow for a minimum of two training sessions for each AV system. An operator training course and a technical training course shall be provided.

The operator training course shall include but not be limited to training of the following systems:

- Basic operator principles of the system
- Operating principles of video, audio and control system equipment and functions
- Practical training in the operation of each function of the control system
- Best practice when operating the system
- Equipment locations and operation
- How to seek assistance and report faults

The technical training course shall include, but not be limited to, training of the following systems:

- Overall principles of operation of the AV System with specific emphasis on the installed system
- Basic operator principles of the system
- Operating principles of video, audio, and control system equipment
- Practical training in the operation of each function of the control system
- Best practice when operating the system
- Equipment locations and operation
- Maintenance and fault-finding procedures
- How to seek assistance or report faults, including warranty and support procedures
- Fault simulation for practical training in fault finding procedures.
- Remote monitoring and troubleshooting

Training is to be structured, with an attendance sheet filled in and logged with the principal. Training shall be provided prior to the issue of final certificate of the works. Additional training courses may be requested by Digital Futures or the principle.

7.4.17. User Manuals

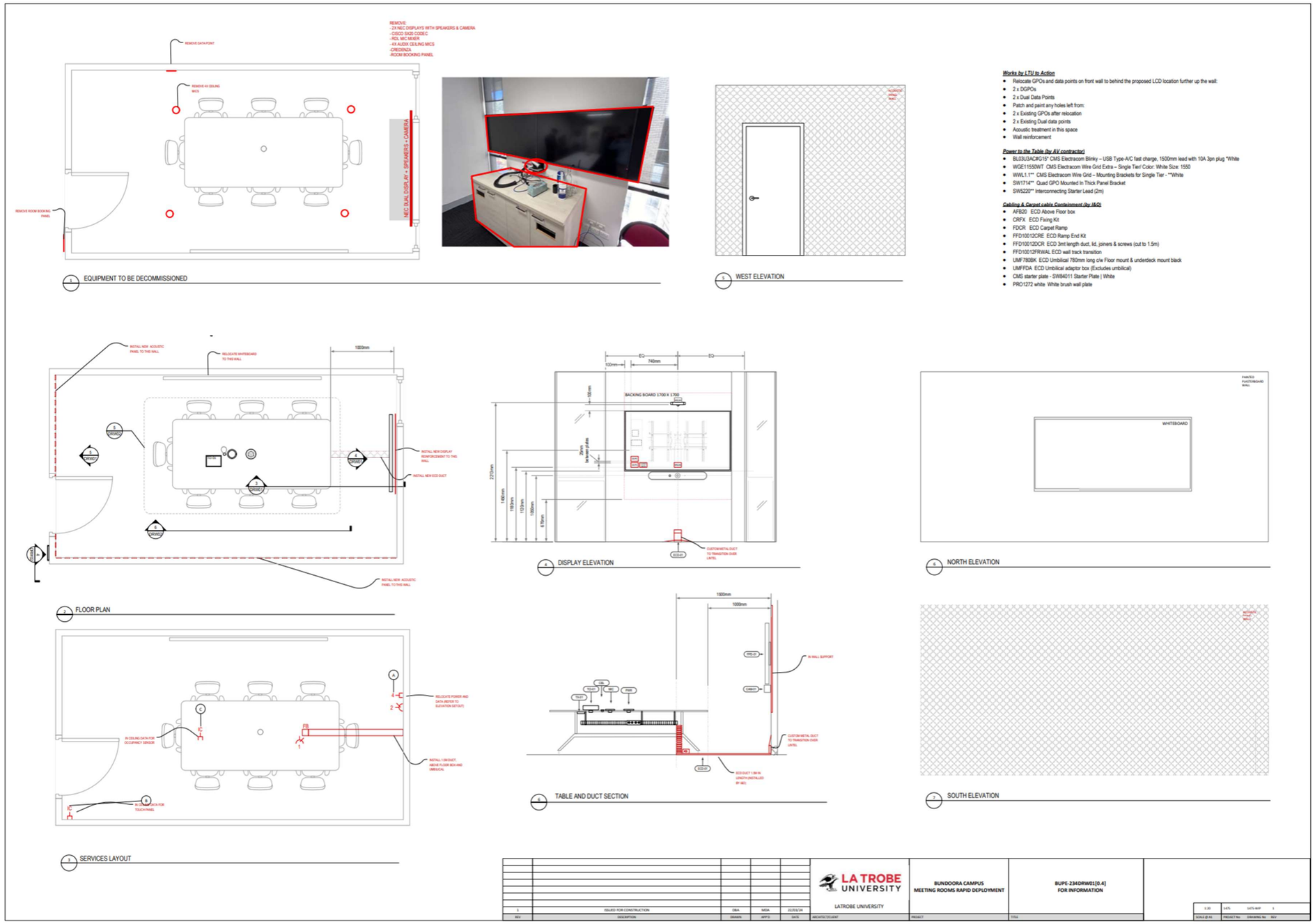
Complementing the operator and technical training the AV integrator should provide operating handbooks, in PDF format, that include:

- Quick Reference Guides
- Instruction Manuals for all equipment

Information provided in these documents should be structured in a logical manner and should only contain information relevant to the project. General brochures or any references to alternative models are not applicable and should not be included.

Appendix A

TYPICAL INSTALLATION REQUIREMENTS (EXAMPLE)



DRAWING NOTES

1. REINFORCEMENT MATERIAL – FORM PLY F17 25MM THICK .

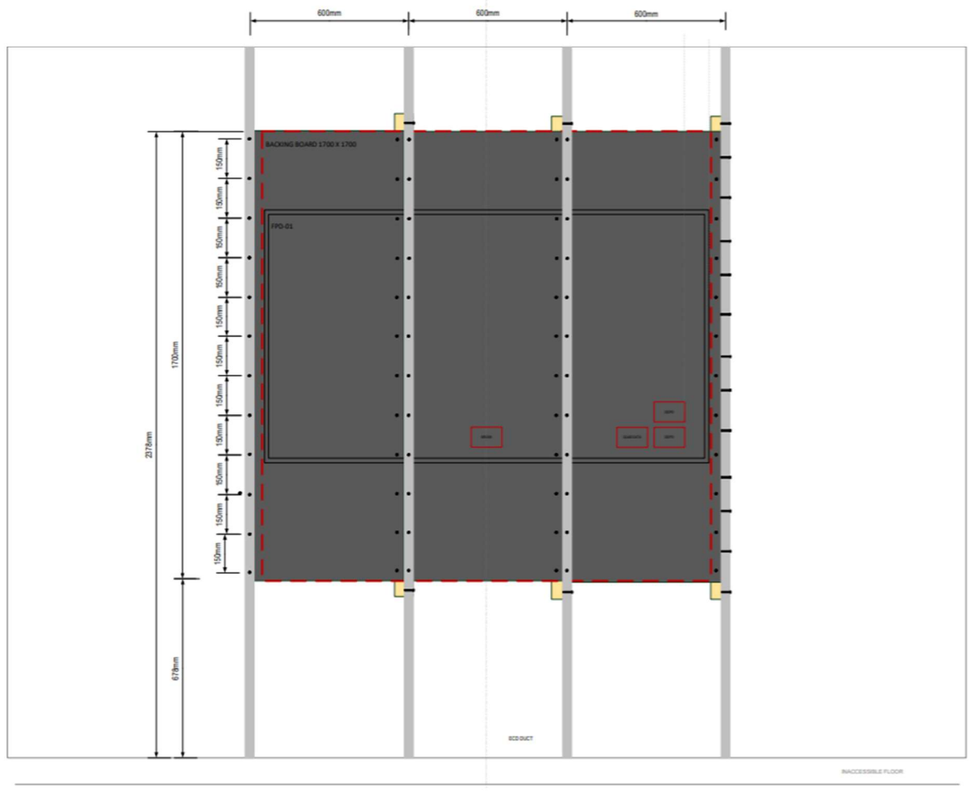
2. PLAY FIXED WITH MIN 25MM SCREWS @150MM VERTICAL SPACING WHEN FIXED THROUGH FRAMING. MIN 90MM SCREWS WHEN FIXED TO NOGGINS

3. USE 70mm x 45mm NOGGINS ON THE CLOSED SIDE OF THE C-SECTION STUDS

4. REFER TO ROOM SPECIFIC ELEVATION FOR THE TOTAL AREA TO BE REINFORCED

5. SPACES WITH DUAL DISPLAYS WILL REQUIRE A HORIZONAL APETURE IN THE STUD TO ALLOW FOR CABLE TO BE PASSED FOR LEFT TO RIGHT – TO BE ALIGNED WITH BRUSH PLATES

4. MIN AREA FOR REINFORCEMENT TO BE A MINIMUM OF 1700MM X 1700MM PER DISPLAY – AS INDICATED WITH THE RED BOX



TYPICAL WALL REINFORCEMENT ARRANGEMENT ELEVATION

TYPICAL WALL REINFORCEMENT ARRANGEMENT PROFILE

TYPICAL WALL REINFORCEMENT EXAMPLE IMAGE

					LATROBE UNIVERSITY	BUNDOORA CAMPUS MEETING ROOMS RAPID DEPLOYMENT	LTU-WALL REINFORCEMENT FOR INFORMATION	
0.1	WIP ISSUE FOR SERVICES INSTALL	DBA	MDA	12/03/2024				
600mm	DESCRIPTION	DRAWN	APP'D	DATE	ARCHITECT/CLIENT	PROJECT	TITLE	1:20 / 1475 / 1475-WIP / 0.1
								SCALE @ A3 / PROJECT No. / DRAWING No. / REV.

Appendix B

Functiona	Category	Brand	Model	Description
Identifier				
Teaching and Learning Room Equipment				
FPD	Flat Panel Display	NEC	M551	55" UHD, 500 nits, 2 x HDMI inputs, 1 x DisplayPort input, 10W internal speakers
FPD	Flat Panel Display	NEC	M651	65" UHD, 500 nits, 2 x HDMI inputs, 1 x DisplayPort input, 10W internal speakers
FPD	Flat Panel Display	NEC	M751	75" UHD, 500 nits, 2 x HDMI inputs, 1 x DisplayPort input, 10W internal speakers
FPD	Flat Panel Display	NEC	M861	86" UHD, 500 nits, 2 x HDMI inputs, 1 x DisplayPort input, 10W internal speakers
FPD	Flat Panel Display	NEC	M981	98" UHD, 500 nits, 2 x HDMI inputs, 1 x DisplayPort input, 10W internal speakers
FPDi	Interactive Display (Touch)	Technology Core	HDi-65 Flex	65" UHD IR, 500 nit, 1 x HDMI input, 15W Internal Speakers
FPDi	Interactive Display (Touch)	Technology Core	HDi-75 Flex	75" UHD IR, 500 nit, 1 x HDMI input, 15W Internal Speakers
FPDi	Interactive Display (Touch)	Technology Core	HDi-86 Flex	86" UHD IR, 500 nit, 1 x HDMI input, 15W Internal Speakers
FPDi	Interactive Display (Touch)	Dell	P2424HT	Dell 24 Touch USB-C Hub Monitor - P2424HT
PRJ	Data Projectors	Epson	EB-L730U	7000lm WUXGA Installation 3LCD Laser Projector
PRJ	Data Projectors	Epson	EB-L630SU	6000lm WUXGA Short Throw Installation 3LCD Laser Projector
PRJ	Data Projectors	Epson	EB-PU1007W	7000lm WUXGA Large Venue 3LCD Laser Projector
PRJ	Data Projectors	Epson	EB-PU1008W	8500lm WUXGA Large Venue 3LCD Laser Projector
PRJ	Data Projectors	Epson	EB-PU2010W	10000lm WUXGA Large Venue 3LCD Laser Projector
PRJ	Data Projectors	Epson	EB-L1505UHNL	12000lm WUXGA Large Venue 3LCD Laser Projector
PRJ	Data Projectors	Epson	EB-L1755UNL	15000lm WUXGA Large Venue 3LCD Laser Projector
WPR	Wireless Presenter	Crestron	AM-3200-WF-I	AirMedia® Receiver 3200 with Wi-Fi® Network Connectivity, International
WPR	Wireless Presenter	Crestron	AM-TX3-100-I	AirMedia® Series 3 Connect Adaptor, International
NFX	Vision Distribution	Crestron	DMF-CI-8	DigitalMedia™ Card Chassis for DM-NVX-C & DMCF, 8 Slots
NEX	Vision Distribution	Crestron	DM-NVX-E30C	DM NVX® 4K60 4:4:4 HDR Network AV Encoder Card
NDX	Vision Distribution	Crestron	DM-NVX-D30C	DM NVX® 4K60 4:4:4 HDR Network AV Decoder Card
NxX	Vision Distribution	Crestron	DM-NVX-360C	DM NVX® 4K60 4:4:4 HDR Network AV Encoder/Decoder Card
NEX	Vision Distribution	Crestron	DM-NVX-E30	DM NVX® 4K60 4:4:4 HDR Network AV Encoder
NDX	Vision Distribution	Crestron	DM-NVX-D30	DM NVX® 4K60 4:4:4 HDR Network AV Decoder
NxX	Vision Distribution	Crestron	DM-NVX-360	DM NVX® 4K60 4:4:4 HDR Network AV Encoder/Decoder
HRX	HDMI Extenders	Crestron	DM-RMC-4K-100-C-1G-B-T	Wall Plate 4K DigitalMedia 8G+® Receiver & Room Controller 100, Black Textured
HRX	HDMI Extenders	Crestron	DM-RMC-4K-100-C-1G-W-T	Wall Plate 4K DigitalMedia 8G+® Receiver & Room Controller 100, White Textured
HRX	HDMI Extenders	Crestron	DM-RMC-4KZ-100-C	DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver & Room Controller 100
HRX	HDMI Extenders	Crestron	DM-RMC-4KZ-SCALER-C	DigitalMedia 8G+® 4K60 4:4:4 HDR Receiver and Room Controller with Scaler
HTX	HDMI Extenders	Crestron	DM-TX-200-C-2G-B-T	Wall Plate DigitalMedia 8G+® Transmitter 200, Black Textured
HTX	HDMI Extenders	Crestron	DM-TX-200-C-2G-W-T	Wall Plate DigitalMedia 8G+® Transmitter 200, White Textured
HTX	HDMI Extenders	Crestron	DM-TX-201-C	DigitalMedia 8G+® Transmitter 201
HTX	HDMI Extenders	Crestron	DM-TX-4KZ-100-C-1G-B-T	DigitalMedia 8G+® 4K60 4:4:4 HDR Wall Plate Transmitter, Black
HTX	HDMI Extenders	Crestron	DM-TX-4KZ-100-C-1G-W-T	DigitalMedia 8G+® 4K60 4:4:4 HDR Wall Plate Transmitter, White
BRC	Brackets	Ultralift	Spider Lock - Various	Fixed Lockable Projector Mounts
BRC	Brackets	ATDEC	AD-WM-9080	Full motion. Max. load 90kg (200lbs). 980mm (39”) extension from wall. Screen sizes 50” to 100”.
BRC	Brackets	ATDEC	AD-WM-7060	Full motion. Max. load 70kg (154lbs). 800mm (31.5”) extension from wall. Screen sizes 32” to 80”.
BRC	Brackets	ATDEC	AC-AP-4612	This utility panel is designed for mini PCs, video conferencing, connectivity, and similar devices.
BRC	Brackets	ATDEC	AD-AC-PS	This sliding panel is designed to house equipment such as mini PC, connectivity, and other technology devices.
BRC	Brackets	ATDEC	ADB-VWP	Pop-out video wall. Max load 50kg. VESA up to 600 x 400
BRC	Brackets	ATDEC	ADWS-1FP-100-W	Large fixed wall mount for heavy displays to 165kg or 364lbs
REC	Lecture Capture	Echo360	Echo360 Pro	The EchoVideo Pro is the newest (3rd) generation full-service capture device by Echo360.
SCR	Projection Screen	Screen Technics	CinemaSnap Matrix White - Various	Fixed Frame Projection Screens of various sizes - 16:9 ratio, 1.1 Gain
SCR	Projection Screen	Screen Technics	ElectriCinema Unity White - Various	Motorised Projection Screen of various sizes - 16:9 ratio, 1.1 Gain
UCE	UC	Crestron	UC-C100-T or UC-C100-Z	Flex Kit, includes Table Top 10" Touch Screen. MS Teams or Zoom
UCE	UC	Crestron	UC-C100-T-WM or UC-C100-Z-WM	As above but with wall mounted 10" Touch Screen.
CONV	UC	QSC	I/O-USB Bridge	I/O-USB Bridge
CONV	UC	Magewell	320900000	USB Capture HDMI 4K Plus
CONV	UC	Magewell	321000000	USB Capture SDI 4K Plus
CONV	UC	Crestron	HD-CONV-USB-300	USB Converter with HDMI® and Analog Audio Input
CAM	Camera	Crestron	IV-SAM-VXP-1B	1 Beyond Automate™ VX Pro Voice-Activated, Multi-Camera Switching Solution
CAM	Camera	Crestron	IV-SAM-VXS-1B	1 Beyond Automate™ VX Voice-Activated, Multi-Camera Switching Solution
CAM	Camera	Crestron	IV-CAMA3-20-SLVR-1B	1 Beyond AutoTracker™ 3 Presenter Tracking Camera, 20x Optical Zoom, Silver
CAM	Camera	Crestron	IV-CAMA3-20-W-1B	1 Beyond AutoTracker™ 3 Presenter Tracking Camera, 20x Optical Zoom, White
CAM	Camera	Crestron	IV-CAMHK-12-SLVR-1B	1 Beyond Hawk™ Dual-Camera Speaker Tracking Solution, 12x Optical Zoom

CAM	Camera	Crestron	IV-CAMPTZ-20-SLVR-1B	1 Beyond PTZ Camera, 20x Optical Zoom, Silver
CAM	Camera	Crestron	IV-CAMPTZ-20-W-1B	1 Beyond PTZ Camera, 20x Optical Zoom, White
CAM	Camera	Logitech	Rally Camera	4K PTZ Camera
CAM	Camera	Logitech	Sight	Tabletop Companion Camera
CAM	Camera	QSC	PTZ-IP 12x72	12x PTZ Camera
CAM	Camera	QSC	PTZ-IP 20x60	20x PTZ Camera
DSP	DSP	QSC	Core 8 Flex	Q-SYS network + analog I/O processor
DSP	DSP	QSC	Core 110f	Unified Core Processor
DSP	DSP	QSC	Core 610	COTS Network I/O processor
DSP	DSP Extenders	QSC	QIO-ML4i	4 mic/line inputs
DSP	DSP Extenders	QSC	QIO-L4o	4 line outputs
DSP	DSP Extenders	QSC	QIO-ML2x2	2 mic/line inputs; 2 line outputs
DSP	DSP Extenders	QSC	I/O-22	Multi-purpose Q-SYS I/O Peripheral
AMP	Amplifier	QSC	CX-Q 2K4	CX-Q 2K4 – 2000 W total power
AMP	Amplifier	QSC	CX-Q 4K4	CX-Q 4K4 – 4000 W total power
AMP	Amplifier	QSC	CX-Q 8K4	CX-Q 8K4 – 8000 W total power
AMP	Amplifier	QSC	CX-Q 4K8	CX-Q 4K8 – 4000 W total power
AMP	Amplifier	QSC	CX-Q 8K8	CX-Q 8K8 – 8000 W total power
AMP	Amplifier	QSC	SPA-Q 60x4	SPA-Q 60x4 - 60 W per channel into 8Ω
SPK	Speakers	QSC	AD-C6T	AcousticDesign Ceiling Mount Speaker - Model AD-C6T
SPK	Speakers	QSC	AD-S6T	AD-S6T Surface Mount Loudspeaker
MIC	Microphone	Sennheiser	TCC M-S-W	TeamConnect Ceiling Medium Mic Array white, audio out analog or Dante, daisy-chainable, suspension included
MIC	Microphone	Sennheiser	TCC M-S-B	TeamConnect Ceiling Medium Mic Array black, audio out analog or Dante, daisy-chainable, suspension included
MIC	Microphone	Shure	SHR-ULXD1H51	Wireless Digital Mic Bodypack Transmitter Frequency H51 = 534-598MHz
MIC	Microphone	Shure	SHR-ULXD2B58H51	Wireless Digital Transmitter Handheld ULXD2/Beta58 Frequency H51 = 534-598MHz
MIC	Microphone	Shure	SHR-ULXD4DH51	Wireless Digital Receiver Dual Channel Frequency H51 = 534-598MHz
MIC	Microphone	Shure	SHR-ULXD4QH51	Wireless Digital Receiver Quad Channel Frequency H51 = 534-598MHz
MIC	Microphone	Shure	SHR-ULXD8H51	Wireless Digital Transmitter Gooseneck Mic Base Black; Frequency H51 = 534-598MHz
MIC	Microphone	Shure	SHR-WL185	Microphone Lapel Cardioid Condenser TA4F Connector
MIC	Microphone	Shure	SHR-WH20TQG	Microphone Headworn Cardioid Dynamic TA4F Connector
HRG	Hearing Augmentation	Williams Sound	Various Models	Infrared Transmitters with Receivers, Charging Station, Neckloops and headphones.
LEC	Lectern	Podion	LU-ORU-1500	Custom La Trobe Lectern
LEC	Lectern	Podion	POD-4-FS	Lectern with 22" Monitor for Signage
LEC	Lectern	Podion	TDP-AVC	Touchdown Point
PDU	PDU	APC	AP7920B	Intelligent power distribution unit
TCI	Touch Control Interface	Crestron	TSW-1070-B-S	10.1" Wall Mounted Touch Screen, Black
TCI	Touch Control Interface	Crestron	TS-1070-B-S	10.1 in. Tabletop Touch Screen, Black Smooth
CSP	Control	Crestron	CP4N	4-Series™ Control System
RBP	Room Booking	Crestron	TSS-1070-B-S-LB KIT	10.1 in. Room Scheduling Touch Screen, Black Smooth, includes one TSW-1070-LB-B-S light bar
IPCAM	IP Camera	Hikvision	DS-2CD2146G2-I-SU	Fixed Dome Network Camera - 4 MP, 120dB WDR, H.265 compression, built-in microphone
NSW	Network Switch	Crestron	CEN-SWPOE-30	30 Port PoE+ Managed Switch
NSW	Network Switch	Crestron	CEN-SWPOE-48	48 Port PoE+ Managed Switch
NSW	Network Switch	Crestron	CEN-SWPOE-ULTRA-12	12 Port Ultra POE Managed Switch

Meeting and Collaboration Room Equipment

UCE	UC	Logitech	Room Compute (Windows 11 IoT)	UC Video Conference Engine
SBR	UC	Logitech	Rally Plus	UC Video Conference Smart Soundbar & Camera
SBR	UC	Logitech	Rally Bar	UC Video Conference Smart Soundbar & Camera
SBR	UC	Logitech	Rally Bar Mini	UC Video Conference Smart Soundbar & Camera
SBR	UC	Logitech	Rally Bar Huddle	UC Video Conference Smart Soundbar & Camera
TCI	UC	Logitech	Tap	10" UC Controller - MS Teams or Zoom - Requires additional mount
TCI	UC	Logitech	TAP Mount	939-001811 Logitech TAP table mount
MIC	UC	Logitech	Mic Pod	989-000430 Logitech RALLY mic pod
MC	UC	Logitech	Mic Pod Mount	952-000002 Logitech RALLY mic table mount graphite
CONV	UC	Logitech	Swytch	952-000011 Logitech SWYTCH
CONV	UC	Logitech	Cable	939-001799 Logitech 10M USB strong cable
CONV	UC	Logitech	Coupler	952-000181 Logitech rally microphone pod coupler
SBR	UC	Logitech	Sight	960-001510 Logitech Sight Camera - GRAPHITE - WW-9004