

Section 3 Audio Visual.



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Document Control

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3.1 Overview

3.1 Overview

3.1.1 Purpose

This document describes and defines the recommended Audio Visual technology specifications for the successful implementation or upgrade of learning and teaching spaces within the University of Canterbury. It represents the minimum standards expected for teaching space design and installation on campus.

This section of the Design Standard Guidelines is intended to be read and applied during design in conjunction with **Section 01 – General** and any project specific brief and agreements.

3.1.2 Modern Learning Space Technology Systems

The University is committed to providing modern learning space technology systems which support the ability to:

- Display images and video on a presentation wall that may be adequately assimilated by all participants in the room
- Amplify audio content or spoken word that is able to be clearly understood by all participants in the room. To allow for the amplification of any participant in class, large and medium teaching and learning spaces may be provisioned with handheld, lapel and fixed microphones. Speech audio can be recorded and is replayed via speakers distributed throughout the room.
- Easily control services in the room without the need for a high level of training or assistance
- Display presentations and material from input devices such as; a resident computer, laptops, mobile devices, document camera, and other sources as required
- Allow students to interact using wireless mobile devices
- Support new methods of teaching which also allow for the use of more flexible delivery by being able to annotate over content, participate in active learning sessions, invite remotely located participants and speakers 'electronically' into class, and record presentation content.
- Allow presenters to easily access or bring their own content into the learning space.



3.2 Design Concepts

3.2 Design Concepts

3.2.1 Teaching Space Types

Below are the following categories that are currently defined and associated with teaching spaces with audio visual technology, and a breakdown of the minimum standards in equipment and services in each category.

These category types align with the University timetabling booking system to allow users to select the type of audio visual requirements they need when they are requesting a room booking on campus.

3.2.1.1 AV Low – Meeting Rooms & Small Teaching Spaces

Small teaching or meeting rooms can range in size from 5 – 30 students. These spaces are equipped with fixed or flexible furniture. The focus of the technology and furniture in these spaces is to support small group teaching, meetings, collaboration or research sessions.

Small teaching or meeting spaces have either a flat panel screen or a projection display. General control will be via a button / touch panel. Equipment is located in either mobile cabinet units, behind televisions, or in credenzas on the wall. Other tools available in small spaces are web video conferencing; whiteboard or annotatable surfaces, a Wi-Fi network, and provision for cables and power to connect to the display.

3.2.1.2 AV Medium – Seminar & Teaching Spaces

Seminar rooms with AV presentation systems typically range in sizes from 25 – 60 students. Flat-floored spaces equipped with flexible furniture (movable tables and chairs) can be configured on the fly at the start of class by teacher and students to support whole class instruction, group work, class discussion, and other collaborative learning styles.

Standard seminar rooms typically include a single projection display and a small lectern with a variety of inputs including resident pc, document, camera, and laptop and mobile device inputs.

Technology in seminar rooms should not interfere or disrupt the collaborative nature of the spaces e.g. projector screens are not placed in front of whiteboards, nor should cabling restrict furniture or lectern movement.

3.2.1.3 AV High – Small & Large Lecture Theatres / Teaching Spaces

Lecture theatres are widely regarded as effective, efficient space to support the delivery of teaching content 'face to face' to larger audiences. The dominant focus of a lecture theatre is presentation of instructional materials to an audience for the purpose of teaching and learning. Other common uses include information meetings, conferences, events, and public lectures. While lecture theatres allow for little versatility of use i.e. contemporary collaborative group work, they are suited where audience focus is towards a lecturer and electronic presentation content.

Standard presentation tools in lecture theatres include large projection display screens and a lectern equipped with presentation tools i.e. resident computer, media players, speech microphones and lecture capture ability.

Where possible, dual image projection is provided to support simultaneous display of complimentary image material e.g. PowerPoint with document camera image.

Furniture layouts are concentrated together to maximise seating capacity. Typical tiered spaces will have rows that are arranged in rising tiers, ensuring clear viewing lines to the front for rows seated behind others. Capacities can range from 60 to beyond 400 seats.

3.2.1.4 Non-Standard Spaces and Solutions

In order for the University to benefit in standardisation, cost effectiveness, safety, consistency, and effective support to spaces, all audio visual related requests for installations either in scope or out of scope need to have the involvement of Audio Visual Services, and all non-standard solutions must be approved by Audio Visual Services on a case-by-case basis before either procurement or work commences.

3.2.1.5 Summary Table

Equipment / Services	AV Low	AV Med	AV High
Integrated Equipment			
AV Control Touch / Button Panel	✓	✓	✓
Single Display	✓	✓	✓
Dual Display			✓
Laptop Input (VGA & HDMI)	✓	✓	✓
Resident Computer	✓	✓	✓
Document Camera		✓	✓
DVD Player		✓	✓
Front of House Speakers	✓	✓	✓
Speech Reinforcement Speaker System			✓



3.2 Design Concepts

Handheld Microphone			✓
Wireless Microphone(s)			✓
Presentation Lectern		✓	✓
Annotation Tablet Monitor			✓
Lecture Capture			✓
Non Integrated Equipment			
Portable/Wall-mounted Whiteboards	✓	✓	✓
Services			
Telephone		✓	✓
Internet Access (wired)	✓	✓	✓
Internet Access (wireless)	✓	✓	✓

3.2.2 Sightlines, Size & Screen Specifications

The following guidelines may assist in accomplishing a minimum standard of viewing comfort for viewers of displayed images within a teaching space from all seating positions provided.

The term 'displayed images' used here includes any images projected from 'data video projectors', flat display panels (e.g. LED TVs), and also applies to the use of any white board and annotation surfaces.

3.2.2.1 Viewing Size & Distance

Viewing surfaces must be of sufficient size to facilitate comfortable reading of printed characters from any viewing position in the room. Typically the farthest seats of an auditorium could be considered the least advantaged. Consequently determination of screen size for a space should not be an arbitrary decision, but rather the result of applying the following size rule (based on PISCAR ANSI/InfoComm 3M standards and AETM guidelines).

- Maximum viewing distance = **5.3 x Image Height**
- Closest Viewing Distance = **2 x Image Height**

Diagonal Size & Maximum Viewing Distance in metres (based on AETM guideline)	Screen Viewable Width & Height	Viewable Width & Height	Maximum Viewing Distance
2.1m (84")		1.8m x 1.1m	6m
3.3m (130")		2.8m x 1.8m	9.5m
7.6m (300")		6.5m x 4.0m	21.2m

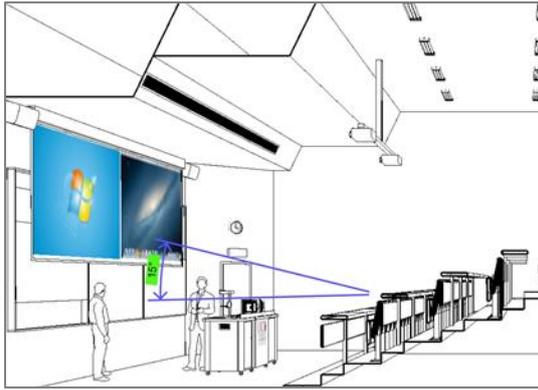
All room seating arrangements and screen selections shall be designed in accordance with these parameters. Areas where an adequately large screen size is prohibitive and/or an optimal seating arrangement is not achievable, an additional relay screen(s) towards the rear of the room should be considered.

3.2.2.2 Viewing Angle Limits

A vertical viewing angle maximum of 15 degrees exists where no viewer should be looking upwards at any angle greater than 15 degrees (from parallel to the floor) to the centre of a displayed image. This rule usually applies to viewers seated closer to a displayed image.

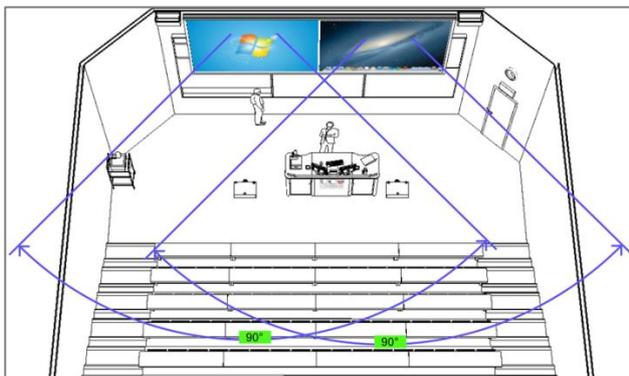


3.2 Design Concepts



The maximum horizontal angle of which a viewing surface is presented to a viewer is 45 degrees. At angles which exceed this, text appears horizontally compressed and becomes increasingly difficult to read with increased angle. The 45 degree angle is measured from a perpendicular axis at each outside edge of the image creating a 90 degree viewing cone. All seating should be positioned within this cone.

Where a space employs more than one screen, this same guideline is applicable to each seating location's position being within the acceptable 90 degree viewing cone of every image display surface being used in the room. Where space and aesthetics permit, angling side by side display surfaces inward may assist with ensuring all seating positions locate within 90 degree viewing cones of each display surface.



3.2.2.3 Image, Screen & Ceiling Heights

Factors which inform the height at which an image is placed on the presentation wall include the ability of viewers to see all (or most) of a displayed image over and above a lectern, and other viewers heads whom are seated in forward rows.

Factors which may improve viewing of an image for viewers seated behind the front row include; use of a larger image, staggered or tiered seating rows.

The minimum distances from the floor to the bottom of the projected screen image shall apply to the following types:

- Flat Floored Teaching Spaces = **No less than 1.2m**
- Tiered Teaching Spaces = **No less than 1.35m or more**

Flat floored teaching spaces are particularly challenging i.e. where the guidelines above are observed, it is difficult to seat more than 30 - 32 students at desks sized at 1400long x 700wide in front of a single display in a flat floored space before less than 50% of a displayed image is not visible to the back row without much moving of heads and kneeling on chairs.

Ceiling height is an important factor for architects when designing a teaching space. While the equation between the following parameters can be a difficult challenge to space design project teams to balance – the outcome is critical to the effective performance of a space.

- Acceptable image size for the viewing length and viewing requirements of a space
- Image positioned high enough on the media wall to suit viewers toward the rear rows
- Front row viewing positions compliant with a vertical viewing angle maximum of 15 degrees

The table below is provided as a 'quick reference' guide:

Distance to Furthest Audience Member	Required Ceiling Height
<7.5m	2.7m
7.6m – 8m	2.8m
8.1m – 8.5m	2.9m
8.6m – 9.1m	3.0m
9.2m – 9.6m	3.1m



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9.7m – 10.1m	3.2m
10.8m – 11.2m	3.4m
11.8m – 12.2m	3.6m
12.9m – 13.3m	3.8m
13.9m – 14.4m	4.0m
For every 475mm extra, add 100mm ceiling height	

3.2.2.4 Projection Surface

The University has a preference for framed premium project screen kit material surfaces on walls, Projecting images directly on to a flat painted presentation surface in teaching spaces is also an option. Framed material kits and painted projection surfaces reduce the amount of mechanical infrastructure in the room and increase the flexibility for future projection standards.

Drop-down screen (whether manual or motorized) are to be used as a secondary means if whiteboards are required in the centre of the teaching wall.

3.2.3 Speech Reinforcement

Implementation of a well configured speech reinforcement system (distributed ceiling or wall loudspeakers) can go a long way to improving speech intelligibility to an audience in problematic spaces.

Speech reinforcement is playback of presenter's speech captured by microphone and replayed to the audience. Microphones in a large teaching space include a lectern or podium microphone, wireless lavalier (lapel) microphones, and wireless handheld microphones.

Speech is replayed via beam steering speakers or ceiling speakers located above the audience. To reduce the likelihood of feedback issues, do not position speech reinforcement speakers directly over the lectern area.

The system must be capable of producing a suitable acoustic gain so that even quietly spoken presenters can be heard clearly in all parts of the space. Tiered spaces may have speakers configured in rows where volume levels can be adjusted according to the distance between listener and ceiling speaker.

When compared to program speakers used for speech reinforcement, the distributed ceiling speaker model increases speech intelligibility by:

- Reducing the overall amount of sound energy required into a space thereby reducing room reverberation and increasing system headroom (gain before feedback)
- Ensuring speech from ceiling speakers heard by an audience is always louder than room reverberation

3.2.4 Assistive Learning Systems

Assistive Listening Systems are to be provided in all teaching spaces with audio visual systems and all publicly accessible rooms with audio reinforcement that seat more than 250 people to comply with the New Zealand Building Code of Compliance. The University may choose to install Assistive Listening Systems in spaces below this number and will be considered on a case by case basis according to the needs of the room and users.

All installed Assistive Listening Systems at the University shall be designed by contracted experts in accordance with AS60118.4-2007 standards.

Assistive Listening Systems shall be provided to deliver audio coverage. Depending on the building and room type variables, consideration must be taken in deciding the best hearing solution. For new buildings, inductive loops are preferable. For existing buildings, other solutions may be more cost effective due to issues on installing inductive loops into existing spaces. This will be determined on a case-by-case situation. Assistive Listening Systems are not to interfere with any other AV equipment within the teaching space.

Rooms with Assistive Listening Systems shall be clearly labelled. If the loop coverage is less than the entire room then the coverage area must be marked on the sign.

3.2.5 Internet / Network Access

Wired access options in teaching spaces to the University network will be available via the resident computer and a network cable on the lectern.

For wired access connections to the internet, users will need to authenticate with valid the University credentials by using such applications like 'Internet Enabler'

For wireless access connections to the University network and the internet, users will need to authenticate with valid University credentials to the available wireless network.

3.2.6 Projector Placements

It is important to ensure that equipment is placed in the best possible area of any audio visual install so as to provide a clean, safe, and practical teaching space. Below outlines some of the key areas.

All installed projectors and associated equipment need to be accessible relatively easily in the unlikely event of needing to quickly replace the projector, or for maintenance tasks.



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As a first preference where possible, projectors are to be mounted in the ceiling at the manufacturers recommended projection distance to obtain the best possible image. If this is unable to be achieved due to not being able to easily access the projector, then an alternate solution such as placing the projector at the rear of the lecture theatre and using telescopic lenses is acceptable.

Projector placement types should be discussed and decided on a case-by-case basis with Audio Visual Services due to the diversity of different room types on campus, as well as the core needs of the teaching space.

3.2.6.1 Booth / Projection Room / Bio Box Projectors

The key benefits of this placement are:

- Projector is installed at the rear of theatre where noise and heat are kept away from audience
- The use of ladders or elevated platform working surfaces are not required to perform maintenance or replacements

The key risks of this placement are:

- Expensive long throw lenses may be required to achieve suitable image size on viewing surface
- Often telescopic lenses have fixed focal length with no zoom adjustment - making achieving the correct image size difficult
- Expensive long throw lens may not be compatible with future projector replacement choices
- Loss of brightness inverse 2 law
- Persons moving in front of projector may cast shadows on image surface

3.2.6.2 Ceiling mounted Projectors

The key benefits of this placement area:

- Closer to viewing surface for crisper brighter image
- Projector brightness power requirement less
- Can utilise standard zoom lenses as supplied with projector

The key risks of this placement are:

- Under-slung weight above audience is potential risk during seismic event
- Ladders required for service
- Service only possible when space is not booked for teaching
- Having to relocate services, which may be in projection path between lens and image surface i.e., light fittings.



3.3 Materials & Equipment

3.3 Materials & Equipment

All equipment is to be chosen from the approved Equipment List refer **Section 01 – General, Appendix A** for details.

3.3.1 Projectors

All aspect ratio of installed projectors at the University shall be 16:10, and native resolution must be WXGA (1280x800) or WUXGA (1920x1200).

All new projectors must either have a greater brightness lamp output of 5000 ANSI lumens, or should achieve PISCR (Projected Image System Contrast Ratio) standards in accordance to ANSI/InfoComm 3M-2011.

The lens ratio should be close to 2:1, (i.e. 4 metres back to obtain a 2 metre wide image), unless the particular venue dictates otherwise. However when the installation of the projector is undertaken, correct measurement and checking using the projector's own throw distance calculators are essential to determine exact positioning.

The projector shall have Ethernet control capability and provide access to the in-built webpage interface of the projector. Projector selection should take into account:

- All projector fixed installations from 2019 are to be laser projectors
- The ability to access detailed information of projector stats via a webpage interface
- Remote monitoring and control for issue resolution

In addition, the following minimum requirements are required for any projector purchase at the University

Attributes	Minimum Requirements
Brightness	5000 ANSI lumens
Native Aspect Ratio	16:10
Resolution	1280 x 800 (minimum)
Contrast	Minimum 3500:1
Compatibility Aspect Ratio	16:9, 16:10
Compatibility Resolution	640 x 480 – 1900 x 1200
Digital Input Terminals	HDMI
Control Inputs	Ethernet
HDCP Compliant	Yes
Fan Noise	Less than 39 dBA
Zoom / Focus / Lens Shift	Vertical lens shift. Motorised Focus and Zoom Lens preferable
Manufacturers Warranty	3 years minimum

3.3.1.1 Projector Screens & Surfaces

For teaching spaces that will use a flat projection wall surface, a premium screen material frame kit is to be used in the first instance where possible. If projecting on to a surface, the projection surface must be finished in flat matte white paint. Zero-gloss matte pure white paint shall always be used. No colour tints are acceptable. A high industry grade quality plaster finish including paintwork must be used to ensure the best surface finish possible. The wall must be flat and vertical with no bows.

Projector screens shall always have a 16:10 aspect ratio and shall provide approximately uniform reflectance out to beyond 60 degrees off-axis. In certain exceptions, 16:9 aspect ratio can be used if approved by UC AV architect.

Motorised projection screens are to be linked to the AV control system.

Enclosures and casing for motorised, recessed projector screens must be used and factored into any design where possible to minimise the visual appearance. The motorised screens shall have a motor mounted inside the roller with noise silencer, oiled for life, automatic thermal overload cut-out, integral gears, capacitor and an electric brake to prevent castings. It shall have pre-set but adjustable limit switches to automatically stop the picture surface in the up and down positions. The roller is to be of rigid metal, and mounted on vibration and noise absorbing supports.

Screen fabric shall be flame and mildew resistant with matte white picture surface with black masking borders. Screen end caps shall be heavy duty, and installed to cover exposed roller pins.

3.3.1.2 Single / Dual Projector Setups

Larger teaching spaces (generally 'AV High' category rooms) are to be equipped with two side-by-side projectors as standard. This provides for dual display presentations of various types and provides a fall-back safety net should one projector fail. Images must be adjusted to exactly the same height and size as each other.

Smaller teaching rooms such as 'AV Low' & 'AV Medium' category rooms may be equipped with a single projector.



3.3 Materials & Equipment

Meeting rooms may be equipped with either a single projector or single flat screen panel depending on the size, natural room light, and user needs.

3.3.2 Flat Panel Displays

LED TV screens are the only acceptable flat panel display.

Attributes	Minimum Requirements
Native Aspect Ratio	16:9
Resolution	4K
Compatibility Aspect Ratio	16:9
Compatibility Resolution	640 x 480 – 4K
Digital Input Terminals	HDMI
Control Inputs	Ethernet
HDCP Compliant	Yes
Energy Star Power Rating	8 or above

All LED displays installed must be controlled via IP over Ethernet .

3.3.3 Resident Computer

A resident desktop computer is to be permanently integrated into the lectern. Resident computers are supplied by the ICTS Services and all support is provided by the ICT Service Desk who are contactable on ext. 6060.

The resident computer will be imaged by ICTS with the currently supported lecture theatre image used inside teaching spaces. The general software and hardware support of this computer will be provided by ICTS.

Attributes	Minimum Requirements
Supported Aspect Ratio	SXGA, WXGA, WUXGA
Video Card Resolutions	1024 x 768 – 1920 x 1200
Digital Input Terminals	DisplayPort and/or HDMI
Analog Input Terminals	DVI-A or VGA (RGB D-sub 15 pin)
HDCP Compliant	Yes
USB 3.0 Compliant	Yes
Operating Noise	Less than 29 dBA
USB DVD Drive	Yes
Manufacturers Warranty	3 years minimum

The monitor, keyboard & mouse shall be placed on the working surface of the lecture theatre desk. The keyboard and mouse are to be hard wired and connected to the rear USB ports of the resident computer in the lectern. The mouse should be a laser mouse and capable of working on a variety of different lectern surfaces.

The computer is to be mounted securely within the lectern rack shelf via Velcro stripping so as to keep it firmly in place, but also easy to swap out the computer in the event of a failure.

Easy access will need to be provided to allow users to access the USB DVD drive, USB ports and computer power on/off button. This will generally be done by having a hole section cut out of the door on the lectern.

Both DisplayPort / HDMI and DVI-I display output capability are essential to providing compatibility with both newer digital based AV video matrix equipment as well as older analogue based VGA video matrix equipment.

Audio output from the computer by either DisplayPort/HDMI or stereo line level L+R audio output via a 3.5mm jack is essential to provide audio for computer-based content.

Line-in or USB on the resident computer can be used for recording/video conferencing using computer applications.

The resident computer needs to be at an acceptable ambient noise level (no excessive fans!)

The computer may also run other approved University hardware USB peripheral devices such as wireless mouse, keyboard sets, webcams. USB ports at the front of the computer should remain unpopulated and available for users to plug in devices easily.

3.3.4 Laptop / Guest Device Connectivity

All teaching spaces and meeting rooms shall be equipped with laptop and mobile device input capability. These inputs shall be via:



3.3 Materials & Equipment

- **Analog connection** - VGA DB15 connector and 3.5 mm stereo jack plug for audio.
- **Digital Connection** – HDMI connector

An Ethernet network connection shall also be required alongside the video and audio inputs as well as a power plug. Lectern built-in leads for these connections are to be made available and must be retractable cables to avoid cable congestion on the lectern surface.

Users of laptops that only have DisplayPort / Mini-DisplayPort as their video output are responsible for providing their own adapter for connecting to the University standard teaching space AV cables.

3.3.5 Video Matrix Switchers

UC no longer uses dedicated video matrix switchers, and now users networked AV encoders and decoders.

3.3.6 Confidence / Annotation Monitors

A 'confidence' monitor(s) for presenters to view their own content during a presentation will be on the lectern top. This monitor can be a standard computer screen or an annotation tablet. Where identified as required, an annotation tablet monitor will be supplied and installed as part of the audio visual system.

A standard confidence computer monitor should be securely attached to the lectern top and the wires neatly cabled. An annotation monitor should be secured to the lectern in a way that still allows tilt adjustment for comfort and presenter height differences.

3.3.7 Document Cameras

A document camera is an input video visualiser device and often replaces an overhead projector. It has higher resolution than an overhead projector and allows the user to project text, photos or three-dimensional objects on a screen in the classroom.

The University accepts only high quality document cameras. The benefits of a high-resolution colour document camera enable the near picture perfect display of printed matter, handwritten annotations, and objects.

Document Cameras are to be mounted on the right hand side of the lectern where possible and must be able to be secured firmly to the lectern or desk for usage and security purposes.

Attributes	Minimum Requirements
Lens	CMOS lens
Frame Rate	30 fps (in all types of lighting scenarios)
Native Signal Output	Full HD 1080p
Converted Output Signals	UXGA (1600x1200), SXGA (1280x1024), XGA (1024x768), SVGA (800x600), 720p HD (1280x720), WXGA (1280x800), WUXGA (1920x1200)
Support for Transparencies	Yes
Support for whiteboard marker surface	Yes
Anti-theft Device	Kensington Lock
Light Source	Yes (must display excellent image in dark environments by only using built-in light source)
Digital Input Terminals	HDMI
Control Inputs	LAN
Optical Zoom	12x
Power Requirements	PoE preferable
Manufacturer Warranty	3 years minimum

3.3.8 Media Players (Blu-ray/DVD)

A USB DVD player will be provided alongside any resident pc. Playback will be through VLC software available on the pc.

Stand-alone DVD, Blu-ray, & VCR players will not be installed in new or upgraded teaching spaces.

3.3.9 Audio Input

Use of microphones in large teaching spaces increases the ability of all audience members to understand and comprehend words spoken during the presentation. Audience members using an Assistive Listening System will only hear words spoken if a microphone is utilised. Microphone use is mandatory if recording content or participating in web based video conferencing.

3.3.9.1 AES67 Transport



3.3 Materials & Equipment

All audio transport that requires audio to be routed outside of the physical lectern is to be done via the AV VLAN network using the AES67 audio standards protocol.

Only with written approval from the UC AV Architect is this to be an exception to use dedicated audio cabling for routing to other devices, rooms, or buildings.

3.3.9.2 Wireless Radio Microphone Frequencies

Each radio microphone shall have its own dedicated radio channel allocated, such that the channel does not clash with any other channel in the venue or in any other venue within range. Allocated channels shall be recorded in the University of Canterbury radio microphone channel allocation Microphone Map register.

Channels shall be allocated and recorded according to the required Audio Visual Services process.

Any person or persons using a wireless microphone transmitter and receiver on campus that is not owned by Audio Visual Services must first contact Audio Visual Services to ensure that no interference is made on the UC chosen frequencies.

3.3.9.3 Wireless Lapel Microphone

A wireless lapel microphone system consisting of a cardioid condenser lapel microphone connected to a belt/pocket worn RF transmitter pack, and a RF receiver installed into the equipment rack shall be the standard at the University.

Some venues will require more than one wireless lapel microphone as with venues supporting conferences to provide flexibility.

The wireless system transmission frequency must be compatible with New Zealand audio frequency standards and should be operated within a legal radio frequency range, clear of 3G/4G telecommunication transmissions, digital TV transmissions, and free from local interference. Ideally the units operate within a selectable range of frequencies appropriate for NZ.

Wireless microphones must not interfere with any WiFi channels using 2.4 / 5 Ghz.

When not in use, the lapel microphone must be able to be easily stored and charged in a dockable battery charging station.

Remote monitoring of the wireless microphone units and battery status levels are essential.

3.3.9.4 Wireless Handheld Microphone

A handheld wireless microphone consisting of a hyper-cardioid handheld microphone with built in RF transmitter, and RF receiver module which is installed into the equipment bay rack shall be the standard at the University.

Some venues will require more than one wireless handheld microphone as with venues supporting conferences to provide flexibility.

The wireless system transmission frequency must be compatible with New Zealand audio frequency standards and should be operated within a legal radio frequency range, clear of 3G/4G telecommunication transmissions, digital TV transmissions, and free from local interference. Ideally the units operate within a selectable range of frequencies appropriate for NZ.

When not in use, the handheld microphone must be able to be easily stored and charged in a dockable battery charging station.

Remote monitoring of the wireless microphone units and battery status levels are essential.

3.3.9.5 Lectern / Podium Microphone

Where possible, a gooseneck podium microphone is to be installed on the lectern to reinforce presenter's speech and for recording.

3.3.10 Audio Output

Meeting rooms and teaching areas with video based displays shall always be provided with audio playback capabilities. Source or content playback known as program audio shall typically be provided via ceiling speakers or a set of stereo Front of House (FOH) speakers.

3.3.10.1 Program Audio

By default, program audio should be delivered by ceiling speakers, however FOH speakers may be used also if the room design better suits this. They are to be located on either side of the screen, at least half way between screen edge and the side wall, i.e. closer to the side wall than to the screen, so as to leave the viewing area and its surrounds uncluttered. The dispersion pattern and power output must be chosen to suit each space. Speaker enclosures are to be focused to the centre of the venue.

Users adjust volume levels via the lectern mounted touch control panel or button interface.

Audio playback should be free from perceptible noise from any source whether air-borne interference or machine oriented.

3.3.10.2 Speech Reinforcement Equipment

Low-level distributed audio systems are the preferred option for speech reinforcement. A well-designed ceiling array using quality drivers must be used wherever possible with partial overlap of speaker coverage.

High quality white flush mount speaker and grill assemblies are preferred.

3.3.10.3 Amplifiers



3.3 Materials & Equipment

Depending on the scale of the room and building, it is typical that an amplifier resides in the lectern or at another appropriate place within the room for connecting to the speakers.

For buildings that require centralised speaker systems for PA and overall connectivity, consideration should be made for centralisation of amplifiers in an AV rack.

For building or room requirements that require high wattage output, powered speakers can be used instead of amplifiers upon written permission from the UC AV architect.

3.3.10.4 Audio Processing & Echo Cancellation

The details of this section have yet to be fully completed. Please consult with Audio Visual Services on this section in the meantime.

3.3.10.5 Assistive Listening System Equipment

The loop shall consist of using two core (minimum 2.5mm² cable) which is spiralled out and clipped under each row of seats. The total length should be not less than 30m and no more than 80 m and should be placed according to the consultant's documentation. Care should be given to avoid crosstalk between adjacent rooms. Both ends of the loop cable must be taken back to the lectern rack leaving 4 metre tails.

3.3.11 Video Cameras

A ceiling or wall mounted PTZ (pan, tilt, zoom) IP camera located at the room rear. Uses include presentation recording and remote assistance. Use as main camera for lecture capture and web conferencing with University's recording solution.

Camera output shall consist of various video formats over TCP/IP, as well as AV output formats. Camera PTZ motion are to be controllable on pre-sets via lecture theatre AV control system, of which may recall minimum of 4x PTZ pre-sets stored on the camera. An appropriate digital video output is useful where cameras are expected to be connected to a recording appliance.

3.3.11.1 Lecture Capture (recording)

Where an Echo360 capture appliance is installed, all video signals are to be output to 1080p unless specified otherwise.

The recording status, ability to pause and stop as well as video preview and countdown timer shall be available on the touch panel.

All audio inputs for the room need to be able to be captured and sent to the Echo 360 capture appliance.

All audio connections to the Echo360 box shall only be balanced stereo.

3.3.12 Video Conferencing Systems

The details of this section have yet to be fully completed. Please consult directly with Audio Visual Services on this section in the meantime.

3.3.13 Telephones

A telephone in each teaching space is mandatory to allow staff and users to gain easy phone access to the ICT Service Desk, as well as for emergencies. A University standard analogue telephone shall be provisioned in each teaching space as close to the lectern as possible without interfering with other AV equipment in the room.

Telephones may be installed directly into the lectern, or may be installed on a wall nearby a lectern.

In accordance to ICT Network policy, it is essential that the telephone wiring is connected directly back to the central network communications room. Under no circumstances should a telephone be connected via a local patch connection solution.

3.3.14 Whiteboards

The details of this section have yet to be fully completed. Please consult with Audio Visual Services on this section in the meantime.

3.3.15 Network Switches

All network switches and other networking appliances will be provided and setup by University network staff only. No exceptions.

For details on how to correctly patch AV equipment to the right specified ports on any University network switch, please refer to Appendix A.

3.3.16 Cabling

3.3.16.1 Twisted Pair

The University currently standardise on CAT6A twisted pair cabling. No other type of twisted pair cabling shall be used on campus unless authorized by the ICTS Network Team Leader. Refer to **Section 05 – Communication Cabling** for further details.



3.3 Materials & Equipment

Where possible, all audio visual signals shall be distributed over the same twisted pair structured cabling system in use by IT networks, with the exception of powered audio cabling between amplifiers and speakers and inter-device cabling co-located within the audio visual rack.

3.3.16.2 Encoders / Decoders vs Dedicated AV Cable

Native audio, video and control signals shall be distributed to/from network based AV encoders and decoders via the UC AV VLAN. Only approved network encoders and decoders shall be used to convert the native audio, video and control signals for twisted pair delivery.

Cost considerations may determine that it is more appropriate to run dedicated AV cables (eg. HDMI) between a projector and a lectern. Network cabling should still be run at the same time in conjunction with the dedicated cables to future proof the room as additional cable runs are much cheaper to do at the same time rather than having to do a retro-install.

3.3.16.3 Termination / Cable Colour / Labelling

Twisted pair cabling for AV must be identified as such with the approved labelling affixed to the RJ45 wall plate.

Twisted pair cabling for AV must terminate directly onto RJ45 patch-panels in the AV rack patch panel for fixed lectern installations. For mobile lecterns, cables are permitted to terminate at the floor box.

The details of this section have yet to be fully completed. Please consult with Audio Visual Services on this section in the meantime.

3.3.17 Fibre Optic

Fibre optic cabling should only be used on cable runs that may jeopardise maximum twisted pair cable lengths, and/or where there will likely be a high risk of power interference near where AV cabling will need to be run.

Consultation and approval from the Audio Visual Services Team Leader will need to be given in writing for fibre cabling to be run. Consideration into fibre transmitters and receivers will need to also be factored into the AV schematics of the install to ensure a successful AV solution for the teaching space.

3.3.18 Audio Visual Cables

The following cables are approved for installation at the University:

Outside of a rack lectern or cabinet and going between AV devices	Inside of a rack lectern or cabinet
Twisted Pair (UTP & STP)	Twisted Pair (UTP & STP)
HDMI	HDMI
Speaker wire	DVI
	VGA (only when connecting to analog AV equipment)
	Speaker wire
	Audio cable types as necessary

Note: VGA, Analog, or Coaxial based cables shall not be used for dedicated cable runs outside of any AV rack, lectern, or cabinet unless specifically approved.

3.3.18.1 RS-232 System Control Cabling

RS-232 system control is only to be used if Ethernet control is not an option. IP based to RS-232 adapters should be used so as to still maintain an IP based solution before then converting to RS-232 into the hardware item.

3.3.18.2 USB Subsystems

Provide latest USB cabling for connecting such devices as USB flash drives to the resident PC inside of the lectern.

3.3.18.3 Front of House Speaker Cabling

Provide front of house speaker cabling to all front of house speakers. Speaker cabling shall be 14AWG 2 core high performance cabling.

3.3.18.4 Ceiling Speaker Cabling

Provide 100 volt line cabling to all ceiling speaker outlet locations. Supply and install speaker cabling to all speaker outlet locations. Speaker cabling shall be 14AWG 2 core high performance cabling.

Ceiling speakers shall be cabled in rows off a main speaker wire line back to the lectern.

The ceiling end of the cable shall be left terminated and coiled within the ceiling void with the location clearly identified on the as-build drawings allowing future relocation to the first ceiling speaker position.

For ceilings with no service access, a service loop for each speaker in ceiling must be provided for maintenance/repair. This should allow for the speaker to be lowered to ground level for servicing.



3.3 Materials & Equipment

3.3.18.5 Microphone Cabling

Supply and install microphone cabling to all microphone connection locations. Microphone cabling shall be Belden 8723 or equivalent.

3.3.18.6 Line Level Cabling

Where required, supply and install line level cabling to all audio input connection locations. Line level cabling shall be Belden 8723.

3.3.18.7 HDMI

Direct device-to-device HDMI cables may be used subject to the following mandatory requirements:

- Maximum end-to-end length 15m
- No joins
- Category 2 "High Speed" compliant cable (i.e. certified to 340 MHz and 10.2 Gbit/s)
- Type A (19 pin) connectors
- Where wall-plates are employed overall end-to-end length must still fit within the 20m limit (15m + 5m fly-leads) and maintain "High Speed" performance. Otherwise, digital video HDBaseT over TP shall be used (see below).

3.3.18.8 HDBaseT

HDBaseT is not to be used unless directly approved by UC AV Architect. The UC standard is to use network based encoders and decoders via the AV VLAN multicast network.

3.3.18.9 DVI

DVI cabling shall be DVI-D Dual Link and based on the manufacturer's specifications of connectivity to a device.

3.3.18.10 VGA

VGA solutions are no longer supported in new installs and teaching spaces.

3.3.18.11 Fly-Leads on Lectern / Wall

Fly leads to connect in laptops and mobile devices will be provided in each lectern with the ability of retracting back to avoid any unnecessary cable clutter.

3.3.18.12 Small AV Components

Transceivers, amplifiers, power-supply units and other electronics shall not be installed in inaccessible locations and are not to be installed:

- In or behind floor-boxes
- Within walls (e.g. behind wall-plates)
- In ceilings where difficult to access
- In 'hard to reach' areas behind a wall mounted LED TV

3.3.19 Equipment Housing

3.3.19.1 Lecterns

The presentation lectern provides an ergonomic, standing height work surface with a 'confidence' monitor for presenters to view their own content as well as a touch panel control system allowing presenters to manage content delivery and space with ease.

The lectern should be equipped to house all local services and connectivity for the teaching space.

Such items to be housed inside and on the presentation lectern include:

- Resident computer and easy access USB device connectivity to computer
- Touch Control Panel
- Document Camera
- Confidence monitor on moveable monitor arm
- Keyboard & Mouse (hard-wired)
- Wireless and / or Lectern microphone and charging station
- Device and power connectivity for analog and digital laptops, mobile devices, UC network, and 3.5mm stereo audio
- Telephone, but not necessarily on the lectern
- Any control, audio, or networking components required to aid in services within the room

Note all AV equipment shall be securely mounted in a manner which shall provide access to equipment and connections for testing, and allow sufficient cable room for the doors to open and close without disturbing the cables or plugs.

3.3.19.2 Rack Cabinets



3.3 Materials & Equipment

Internal rack cabinets located within presentation lecterns shall typically be installed by the lectern manufacturer.

Racks shall be a standard 19" rack with vented top panel and front and rear metal doors (unless otherwise specified) are required. This shall meet International standard IEC60297.

For all rack cabinet installations, a minimum of 600mm in depth is required. For external rack cabinet installations, a minimum of 18RU in height is required.

Regardless of location, there must be sufficient ventilation (air flow) to prevent temperature rise beyond equipment manufacturer's specifications.

A patch panel(s) shall be located at the top or bottom of each rack. The patch panels shall be provided and installed by the Telecommunications Contractor in accordance with ICTS Networks team.

It is the AV contractor's responsibility to advise the communications cabling contractor of the minimum quantity of outlets required in every audio visual rack.

3.3.19.3 6.3 Placement of Equipment in Lecterns & Racks

The following illustrations show the recommended placement of audio visual equipment with the different types of teaching spaces categories.

3.3.19.4 AV Low & Medium Category



3.3.19.5 AV High Category



3.3.20 Power

A rack mountable power board 1RU/2RU shall be used as a source for connecting all AV devices.

Under no circumstances will the University allow the use of double adaptors or domestic grade power boards in any AV teaching space installation.

3.3.21 Ventilation

For the protection and safe operation of audio visual equipment, the maximum allowable operating temperature for any audio visual rack, lectern, cabinet, or credenza fitted to house equipment must not exceed 40 degrees C. It is the contractor's responsibility to ensure sufficient air flow and ambient temperature will maintain the equipment within this limit.



3.3 Materials & Equipment

The solution must provide necessary air-flow / cooling so that equipment remains within manufacturers' specified temperature limits. Use of low-noise or low revolution in-rack fans is permitted only as a final resort.

There should be sufficient gaps between AV equipment in the rack to allow adequate ventilation.

Where equipment is to be fitted into an existing rack, cabinet or credenza supplied by the University, the contractor will work with the audio visual team to ensure that sufficient airflow to the equipment can be established.

3.3.22 Control Systems

3.3.22.1 Control Panels

The AV Contractor shall provide a control systems to enable the control of audio visual equipment.

The Control Panel shall typically be interfaced to the following items of equipment:

- Projectors
- Projector Lifts
- Motorised projector screens
- Document Cameras
- Media Players
- Audio DSPs
- Microphones
- LCD screens
- Video Cameras
- Lecture Capture Appliances
- Video & Audio Matrix Switcher systems
- Sound reinforcement systems
- Touch screen control panels
- Lighting dimmers
- Motorised Blinds
- Air Conditioning Units

3.3.22.2 Touch Panels

The touch screen shall provide facilities to fully control all audio, data and video functions via the standardized University touch panel interface touch screen menus from within the room.

The touch screen control panel shall be capable of controlling all equipment specified. The contractor shall design the layout of buttons and controls on this touch screen using the approved UC layout.

An ongoing provision should be provided at no-charge to the university for revisions of the 'control system software application' and the 'custom programmed control system operating code' as and when released for a period of two (2) years.

3.3.22.3 Button Panels

Button panels are to only be used where it is not feasible to put a touch panel in place.

3.3.23 Interface to Building Management Systems

The University run and operate a Building Management System (BMS) throughout many buildings on campus. This system uses the KNX protocol.

If a teaching space due for install or upgrade is in a building that has a BMS installed, then it is required that the AV Contractor utilises this.

The AV Contractor shall provide all necessary control wiring, control equipment and interface equipment as required. It shall be the AV Contractor's responsibility to fully coordinate the interface requirements between the various parties (e.g. Facilities Management) to ensure complete functioning of these controls.

3.3.23.1 Motion Detection

A suitable motion detector(s) shall be installed into every automated space. The motion detector should be able to reliably detect the smallest amount of motion in any part of the room, for example the amount of motion caused by a few people sitting still watching a movie. Multiple detectors can be used if this is not achievable with a single detector and these should cover entry/exits, lecturers and front/middle audience.

The preferred method is to connect to any potential existing motion sensors installed in the room via the University BMS.

Upon entry to the space, the system should be programmed to turn on the lighting and to wake the touch panel. After an hour of no activity, the system is to shut down the audio visual equipment. This "Shut Down" routine will return all equipment back into a standby mode and turn off all lighting within the venue with the exception of the Resident PC, lecture capture device, and AMX controller which must remain powered on at all times.



3.3 Materials & Equipment

3.3.24 Control Signalling

Order of preference, and further limited for use as specified in maximum cable length section

- Ethernet (IP based)
- RS-232 (via IP based adapter)
- Contact closure
- Self-adhesive IR

3.3.24.1 Ethernet

Ethernet is the preferred method of connection and must be delivered to all panels using approved patch leads.

Only University standard Ethernet switches may be used. These may be installed in AV racks as required and require ICTS Network approval.

Connection to the University network shall be via the patch panels located within the audio visual rack and cross patched into the University network switches via the rack mounted patch frame provided by the Telecommunications Contractor.

3.3.24.2 Wireless

Wireless shall not be used for AV control signalling.

3.3.24.3 RS-422, RS-232, RS-485

Where possible, RS-232 to CATx adapters should be used at either end of the cable. For installations that require this to be hard-wired, it shall be installed using University data network standard CATx UTP cable as shown below.

Conductor	RS-422	RS-232
Blue / White	TxD+	TxD
Blue	TxD-	Gnd
Brown / White	RxD+	RxD
Brown	RxD-	Gnd



3.4 Installation Requirements

3.4 Installation Requirements

3.4.1 Electrical & Power

Unless agreed to in writing, or in specific project contracts, no one other than approved University electricians are authorised to modify or add to any power related cabling, circuitry, or equipment on the University campus.

All equipment must be electrically safety tested and tagged prior to handover. It is the responsibility of the AV contractor to organize and arrange for this to happen prior to sign off.

3.4.1.1 AC Power

The AV Contractor shall connect all AV devices to the dedicated power feed designated to the lectern and projector.

A 19" AC power rack rail shall be provided in the lectern to connect all AV equipment to.

AC power wiring must be run separately from signal cable and all power circuit cabling.

3.4.1.2 Power Boards

Only approved industry-grade power boards are to be used to ensure proper power termination between a power socket from a floor box or wall into the lectern. No power double adapters or domestic-grade power boards are to be used as part of any installation or upgrade.

3.4.1.3 Grounding

Equipment grounding shall include all cable and installation hardware. All audio visual equipment shall be connected to earth ground via internal building wiring, according to NZ Electrical Regulation Codes.

All audio visual designated circuits within an installation shall all be derived from the same load centre and maintain the same neutral and earth relationship throughout the installation.

The AV Contractor shall ground all contractor installed equipment to eliminate all shock hazard and to minimize, to the maximum extent possible, all ground loops, common mode returns, noise pickup, cross-talk, etc.

System

The AV Contractor shall ground all OFE to earth ground, via an approved electrical ground with wires run inside of the building, to eliminate all shock hazards. The number of ground connections shall be kept to a minimum. In all cases, total ground resistance shall be 0.1 Ohm or less. The use of conduit, signal duct, or cable trays as system or electrical ground is not acceptable.

Under no conditions shall the AC neutral, either in a power panel or in a receptacle outlet, be used for system control, sub-carrier or audio reference ground.

Cabinet Bus

A common ground bus of at least #10 AWG solid copper wire shall extend throughout each equipment cabinet and be connected to the system ground.

Equipment

Self-grounding equipment enclosures, racks or cabinets, that provide original equipment manufacturer certified functional ground connections through physical contact with installed equipment, are acceptable otherwise equipment shall be bonded to the cabinet ground bus with copper wire or braid equivalent to at least #14 AWG.

3.4.2 Cable Management

3.4.2.1 Cable Segregation

The minimum segregation requirements from power cables in accordance with AS2834 shall be observed for all audio visual cabling including earthing cabling.

Circuit Rating kVA @ < 415V AC	Unshielded Power Cables	Shielded Power Cables
≤ 1	300 mm	25 mm *
≥ 1 ≤ 2	450 mm	50 mm
≥ 2 ≤ 5	600 mm	150 mm
> 5	1500 mm	300 mm

* Interposing insulating barrier or earthed, continuous metal barrier required.

The audio visual contractor shall co-ordinate his works with and the works of other trades to ensure segregation requirements are maintained throughout the audio visual cabling installation.

3.4.2.2 Cable Joins & Bends



3.4 Installation Requirements

Cable joiners must NOT be used in any cable.

Wherever a change of direction occurs in cable/conduit runs, cables and conduits shall be curved with a minimum inner radius of bend as prescribed in the manufacturer's specification or 8 times the cable diameter, whichever greater.

Where cables of different sizes run together the minimum radius of bend for all cables should be that applicable to the largest cable in the group.

Cables not installed within conduits should be anchored immediately before the start and after the finish of the bend.

3.4.2.3 Cable Length Limits

Maximum cable lengths differ depending on technology and shall not exceed the maximum cable length standards at the University. All copper cabling must remain within the one earthing zone of the one building. No exceptions. Only optical fibre may be run between buildings or (where a physical building is comprised of multiple electrically independent 'buildings') between power system earthing zones.

Cable Type	Maximum Length
HDBaseT over CAT6A or better	100m end to end including allowance for all fly-leads and patch-leads
HDMI	20m end to end including allowance for all fly-leads and patch-leads. Regardless of length, it must meet or exceed HDMI "High Speed" (Category 2) Standard i.e. certified to 340 MHz and 10.2 Gbit/s end to end
VGA	Refer to cable manufacturer's specifications
Analog AV over CAT6A	Refer to cable manufacturer's specifications
10/100/1000 Mbit/s Ethernet over CAT5e or better	100m end to end including allowance for all fly-leads and patch-leads
RS-232 over any CAT6A TP	50m end to end including allowance for all fly-leads and patch-leads, or manufacturer's recommended maximum cable specifications if using active or embedded tx/rx devices
RS-422 over any CAT6A TP	200m end to end including allowance for all fly-leads and patch-leads, or manufacturer's recommended maximum cable specifications if using active or embedded tx/rx devices
RS-485 over any CAT6A TP	200m end to end including allowance for all fly-leads and patch-leads, or manufacturer's recommended maximum cable specifications if using active or embedded tx/rx devices
Line level audio – balanced (STP)	<1 dB attenuation at 10 kHz end to end with matched (low-Z ~100Ω) drive; high-Z (>1kΩ) termination.
Line level audio – unbalanced (coax)	<1 dB attenuation at 10 kHz end to end with matched (low-Z ~100Ω) drive; high-Z (>1kΩ) termination.
Figure 8 speaker wire	Round-trip impedance <10% of speaker impedance. Both resistive impedance (measured at DC) and inductive impedance measured at 1kHz, e.g. if speaker resistance is 8Ω over 0Hz to 1kHz then cable AWG must deliver less than 0.8Ω round-trip impedance, i.e. single conductor end-to-end 0.4Ω

3.4.2.4 Tray Support Systems

Tray systems and supports where used shall comply with the following requirements:

- Trays carrying audio visual cabling shall maintain segregation from other services;
- Trays shall have a minimum clearance or stand off from walls of 25 mm to allow suitable cable fasteners to be used;
- Trays shall provide a minimum vertical open working space of 150 mm;
- Changes in tray direction shall be made using commercially pre-made standard formed bends compatible with the main tray;
- Bolts or sharp objects shall not protrude through the cable bearing surface;

All external cabling is to be covered using white tubular braided sleeving. Joints in the tray shall be butted and present a smooth finish to the cable bearing surface.

3.4.2.5 Floor Boxes

Floor boxes are to be used underneath where any lectern will be housed. This removes any potential tripping hazards of cables, and provides a clean solution for the room with or without a lectern present. For teaching spaces that have two projector installs, two floor boxes are to be used side by side to ensure there is adequate space for AV and power cabling to each of them.

The floor boxes are to be a minimum 300 mm x 300 mm sized and deep enough to be able to house all the services required for the desk. Two empty 32 mm conduits as a minimum with draw wires should be provided to a floor box to enable future expansion. All floor ducts are to have removable lids.

3.4.2.6 Wall & Cupboard Plates



3.4 Installation Requirements

All audio visual cabling shall terminate on suitable connectors and plates (excluding where noted), both in the field and at the equipment side. The connectors shall be mounted on suitable plates and labelled to identify the function of all terminations.

Plates to be mounted in the field or in floor boxes shall match power and communications plates.

3.4.2.7 Securing, Mounting, & Supporting

The following methods shall be used when securing, mounting, and supporting any type of AV cable within a teaching space:

- A velcro-based cable tie solution is the approved method for securing and tying AV cables together. Care must be given to ensure that cables are neat and tidy and professionally bundled together inside a rack, lectern, or cabinet, as well as other items that expose cabling to or from an AV device in the teaching space.
- Audio visual cabling should be supported on cable tray or catenaries in ceiling spaces. Cables support ties should be attached to catenaries at 200mm intervals ensuring Velcro ties are firm but do not distort or apply undue pressure to the cables in any way.
- Catenary wires shall be galvanised steel of 2.5 mm diameter minimum, securely fixed to the building structure at each end and supported at intermediate points as required. Catenary wires shall support cables clear of all structures, services and other equipment. Provide turnbuckles of suitable size to permit future adjustment.
- A service loop is required for audio visual cabling within the rack, projector and speakers (this will allow for future re-termination). A gentle drip loop is required at each termination for strain relief of the cable, between the termination point and where secured to the threaded rod in the rack.
- All cables shall be provided with strain-relief slack and tether solution. Slack shall be sufficient to allow equipment disconnection without dismantling the tether.
- Cables shall NOT be embedded directly in concrete or plaster.
- For large cable bundles that need to be secured together, WHITE techflex cable sleeve shall be used to provide a neat and tidy solution eg. Cable bundle between project and ceiling tile.
- Cable 'mouse' grommets in ceiling tiles and lectern desk are permitted. The use of similar coloured grommets to the surface where they will be installed shall be used.
- Zip-up or twisted based plastic cable ties shall NOT be used to tie up any cable bundles.
- Any AV device that requires securing, mounting, or supporting should use a manufacturer's supplied rack-mount, rack-mount kit, rack-mount tray, surface-mount kit, under-table mount kit, or custom 3rd party mount kit.
- Self-adhesive Velcro should only be used as a way of securing, mounting, or supporting if all of these other options above are not available.

All fixings, fastenings and supports shall be of adequate strength and arranged to ensure the installation against mechanical failure under normal conditions of use and wear and tear.

Cable bundles shall not obstruct installation and removal of equipment in equipment racks.

Apart from twisted pair cables, all other cabling, including inter-device cables, shall comply with the requirements outlined above.

3.4.2.8 Cable Protection

Where cables are liable to environmental damage, they shall be protected in a suitable manner.

Where building features make it necessary to run cable through block walls or concrete slabs and the like, any such cable shall be protected within PVC conduit.

All cables shall be protected where they pass through any openings, gaps, holes etc., by ensuring that surrounding surfaces are smooth and free of sharp edges etc., and that holes are bushed where necessary with close fitting plastic bushes.

3.4.2.9 Cable Provisioning

The table below indicates data and power cabling requirements for all audio visual components.

Device / Cabling Requirements	Data Outlets	Power Outlets (SSO)	Notes
Projector	2	1	1 x Video & Control 1 x LAN / Spare
Flat Panel Screen	3	1	1 x Video & Control 1 x PC 1 x LAN / Spare
Document Camera	1	1	
Resident PC	1	1	
Laptop Connection	1	1	
Table Microphones	1	0	1 RJ45 per 2 microphones
Audio DSP	1	1	
Wireless Microphone Receivers	1	1	
Amplifier	1	1	



3.4 Installation Requirements

Projector Lifter	1	1	
Motorised Projection Screen	1	1	
Video Camera	2	1	1x video 1x LAN
Lectern Rack / AV Rack	12	2	1x24 port patch panel 1/2 terminated

3.4.2.10 Decommissioned Cabling

All redundant or disused cabling and wall plates must be completely removed upon any upgrade to a teaching space, unless such cable is correctly installed and terminated at both ends in a manner that complies with this Standard and will still be of use.

It is the responsibility of the Telecommunications Contractor to remove old cabling.

3.4.3 Software & Code

The AV Contractor must provide control panel and system code specifically engineered to deliver constant and reliable operation. The importance of reliability cannot be emphasised enough. Typically lecture theatres are booked for teaching from 8.00am through to 6.00pm with only 10 minute breaks between classes. Opportunities for emergency maintenance during business hours are often non-existent. Programmed maintenance has to be reserved until student breaks/holidays.

Compiled programming files must be immediately available for reloading in the event of equipment failure or for minor/major revisions being applied.

Where programming is undertaken by the AV Contractor, programs shall be written to conform with current programming techniques to interact with the University's AV monitoring system and be compiled for each room.

Prior to sign off at the completion of the contract, all source and/or compiled code, and documentation written for the operation of a facility, shall be delivered in electronic copy for each room in a format readily programmable.

3.4.3.1 Framework

The AV Contractor must ensure that programming is based on a mature framework layer which has seen service in a similar lecture theatre environment for at least 12 months (i.e. not fresh code written to a 'clean canvas').

Code should be assembled following a proven, standards-based methodology. The AV Contractor is to ensure that each room or sub system (where more than 1 room) is programmed in an identical manner using standard labelling, layout and resources etc. to aid streamlining of fault finding and future upgrade paths.

The framework must support the following:

- Fast response to commands
- Control support for all the University mainstream AV auxiliary 'plug in' devices (including VC and Recording)
- Hot swap-ability of a limited number of University nominated backup AV devices - without requiring code revision, re-compilation, e.g. various brand/models of projectors, DVD players and VC Codec's etc.
- Framework code must support full functionality of RMS Enterprise that is in use at UC
- Logical upgrade path to accommodate additional functionality
- Availability of control system generated logs for monitoring and debugging system faults.
- Future user interface improvements may be identified through usability testing. It is highly desirable that any usability improvements can be readily rolled out to all teaching spaces through routine software upgrades

3.4.3.2 Application Layer

The Control Functionality Overview outlines the Audio Visual System functionality that is required. Listed below are examples of control functionality to be provided. This list is a brief summary and is not exhaustive.

- Full function control of all source components, display units, processing devices and switching electronics.
- Per function status feedback indicating active/passive modes of operation.
- Separate program and microphone audio level control with mute function.
- Default audio playback levels for each audio source.
- Touch Control Panel layout to include user screens.
- Raise and lower projection screens and motorised blinds
- Four (4) main lighting pre-sets with independent control for the separate lighting zones and or circuits.
- Four (4) pre-sets for each installed remote controllable video camera.



3.4 Installation Requirements

- Automatic system shutdown.
- Audio visual system reset and standby.
- Remote monitoring interface.

Note every effort is required of the AV contractor to replicate the features and functionality of the existing University standard control system. This is essential to maintaining a continuity of system 'look and feel' across the University wide network of presentation venues.

3.4.4 UC AV Remote Monitoring System

For every teaching space that has an IP based AV hardware installed into, it shall be required to connect to the University AV monitoring system to monitor and maintain; lecture theatres, teaching spaces, meeting rooms, other associated audio visual devices supported by Audio Visual Services.

3.4.5 Commissioning & Handover

3.4.5.1 Testing & Commissioning

Appropriate commissioning of equipment and systems will be carried out by the AV Contractor to ensure that the as-designed performance, functionality and reliability of equipment and systems are proven and documented prior to any project sign off and handover. 3 sign-off stages by Audio Visual Services staff are required to be carried out prior to handover.

- Termination: Inspection that proper termination has been carried out on all cabling.
- Equipment install: Inspection that the right equipment has been installed in the correct way.
- Operation and training: Space is shown to be operating correctly.

Checklists will be provided. It is mandatory that the supplied checklist is completed and signed by all participants before any work is considered for signoff.

Testing and commissioning shall be carried out prior to completion to clearly demonstrate and record that the installation meets the specified performances and have been successfully commissioned as a complete and integrated installation.

The AV Contractor shall supply all necessary testing equipment, measuring instruments and the appropriately skilled labour required for conducting the tests. Testing and commissioning results shall be recorded on Test Sheets, the sheets signed and dated, and submitted for review prior to sign off and handover.

Testing and commissioning results shall demonstrate performance within the accepted criteria. Prior to starting the tests, the AV Contractor shall check:

- The complete installation is strictly in accordance with the specification.
- All materials are in proper working order.
- All instruments to be used for the testing are suitable for the purpose and have been calibrated by an IANZ accredited laboratory within 6 months of the start of the test.
- The commissioning checklists are available for recording all testing information and results.

The AV Contractor is responsible for furnishing all test equipment required to test the system in accordance with the parameters specified. Unless otherwise stated, the test equipment shall not be considered part of the system. The AV Contractor shall furnish test equipment of accuracy better than the parameters to be tested.

The AV Contractor will require the following test equipment to be able to accurately carry out acceptance testing:

- HDMI signal generator and analyser
- VGA signal generator
- Impedance meter
- Media for each installed device
- Network cable tester
- Light meter
- Oscilloscope
- Spectrum Analyzer
- Signal Level Meter
- Volt-Ohm Meter
- SPL Meter
- Sine wave and random Noise Generator
- Assistive Listening Systems test kit
- Portable Appliance Tester (PAT)

All test equipment used by the AV Contractor will be within calibration expiry

Failure of any part of the systems that precludes completion of that system's testing shall be cause for retesting of that entire system and shall be rescheduled at the convenience of the University.

3.4.5.2 Education, Training, & Product Knowledge Transfer

The AV contractor must provide education, training and knowledge transfer services to the University technical support staff with Audio Visual Services.



3.4 Installation Requirements

The AV contractor shall provide the services of a technician familiar with the functions, equipment and operation of the entire system to conduct a (1) one hour training and knowledge transfer session for each project install. Instruction shall include:

- Corrective and preventive maintenance of each system's equipment components
- Detailed instructions and processes on how to hot swap each item upon failure
- Web interface and user interface setup details
- Any other support information that will be useful for Audio Visual Services acting as a first line of support

This shall take place on campus at an agreed date no later than (2) two weeks after an installation is operational and the Acceptance Tests have been completed.

Device	Parameter	Units	Threshold	Alert Type	
Projector	Lamp Hours	Hours	1950	Maintenance	
	Communicating	Yes/No	30 secs	Control System	
	Power Status	On/Off	-	Equipment Usage	
	Input	HDMI / Comp1 / etc	-	Equipment Usage	
	Lamp Mode	Standard / Eco	-	Equipment Usage	
	Image Mute	On/Off	-	Equipment Usage	
Document Camera	Communicating	Yes/No	30 secs	Control System	
	Light	On/Off	-	Equipment Usage	
Audio DSP	Communicating	Yes/No	30 secs	Control System	
	Mic Mute	On/Off	-	Equipment Usage	
Control / Touch Panel	Online	Yes/No	-	Equipment Usage	
Lighting	Communicating	Yes/No	30 secs	Control System	
	Room Light Preset		-	Equipment Usage	
Master Controller	Power	On/Of	-	Equipment Usage	
	Communicating	Yes/No	30 secs	Control System	
	Service Mode	Normal / Maintenance	-	Maintenance	
Video / Audio Matrix Switcher	Communicating	Yes/No	30 secs	Control System	
	Laptop Source Signal	Yes/No	-	Equipment Usage	
	Laptop Source Usage	Hours	-	Equipment Usage	
	Resident PC Source Signal	Yes/No	-	Equipment Usage	
	Resident PC Source Usage	Hours	-	Equipment Usage	
	Doc Camera Source Signal	Yes/No	-	Equipment Usage	
	Doc Camera Source Usage	Hours	-	Equipment Usage	
	Media Player Source Signal	Yes/No	-	Equipment Usage	
	Media Player Source Usage	Hours	-	Equipment Usage	
	Audio Output Level	% number	-	Equipment Usage	
	Audio Mute	Yes/No	-	Equipment Usage	
	Motion Sensor	Communicating	Yes/No	30 secs	Control System
		Movement	Minutes till shutdown of projectors	35 mins from 9pm – 7am	Equipment Usage
Wireless Mic Receiver	Communicating	Yes/No	30 secs	Control System	
	RF Mute	On/Off	-	Equipment Usage	
	Battery Level	%	-	Equipment Usage	
	Battery Status	Low	30 secs	Equipment Usage	
Lecture Capture	Communicating	Yes/No	30 secs	Control System	
	Recording	Yes/No	-	Equipment Usage	
	Recording Usage	Hours	-	Equipment Usage	



3.4 Installation Requirements

Media Player	Communicating	Yes/No	30 secs	Control System
Air Conditioning	Power	On/Off	-	Equipment Usage
Screen	State	Up/Down	-	Equipment Usage
Video Conferencing	Communicating	Yes/No	30 secs	Control System
	Call Rate	Kbps	-	Equipment Usage
	In a Call	Yes/No	-	Equipment Usage
	Connected	Hours	-	Equipment Usage

3.4.6 Documentation

Documentation shall include any item or quantity of items, computer discs, as-installed drawings, equipment, maintenance, and operation manuals, and each original equipment manufacturer materials needed to completely and correctly provide the systems documentation as required by this document and explained herein.

Project documentation is to be submitted to the UC Project Manager in electronic format before handover and signoff. Project documentation consists of the following:

- Provide copies of all system diagrams and as-built diagrams in both AutoCAD (.dwg) files and Adobe Acrobat Portable Document Format (.PDF) files
- Editable versions of all configuration files for any digital signal processing (Audio DSP) along with any associated software required for editing those files
- E-Copies of equipment user manuals, installation/integration manuals, test reports, warranties and commissioning progress record sheets
- Schedule of equipment supplied with serial number or service tags and all other submittals

3.4.7 Sign Off & Handover

Prior to completion, the AV Contractor will notify the AV Project Manager four days prior to substantial completion of the work. An inspection will be performed to determine the completeness of the work and a punch list will be provided to the AV Contractor. All test reports, certificates and inspections records shall be submitted to the AV Project Manager.

Final handover and signoff of work will be tracked in the Commissioning and Signoff Document. Any installation that does not meet the standards presented in this document will need a signed off exemption from Audio Visual Services staff before it is completed.

A 'Scope of Works' and checklists must be signed off by all parties.

After completion of all punch list items, submissions and final clean-up, the AV Project Manager will issue an acceptance letter to the AV Contractor.

3.4.8 Post-Installation Processes

3.4.8.1 Local Support

The AV contractor must be able to provide support directly from a Christchurch base.

During the warranty period, any AV contractor responsible for any work or equipment that falls within the operational jurisdiction of Audio Visual Services shall agree that initial fault finding may be necessary to be carried out by Audio Visual Services technical staff. This requirement covers those situations where it may not be possible for the contractor to reach the site within a reasonable amount of time. The contractor shall then provide the required follow up warranty service.

AV contractors must indicate whether they can offer direct support or have an arrangement with a third party vendor. If the technical support is provided through a third party, details will need to be provided of their expertise, qualifications, and length of relationship with this third party.

AV contractors must support all supplied hardware and guarantee direct access to the required technical skills for ongoing support of the AV system provided.

3.4.8.2 Online Fault Reporting

The AV contractor must have a robust online fault reporting system in place whereby the AV Project Manager can log and track faults online, obtain reports, and manage the maintenance of the AV system after installation and commissioning is completed.

These reports are used for discussion at regular University/AV Contractor account management and service meetings.

3.4.9 Maintenance & Warranty

The University requires a single point of responsibility for AV system issues in addition to maintenance technicians who are familiar with the design and functionality of the systems installed who can respond in a timely fashion to system issues and upgrades.

The AV Contractor shall have a contractual relationship or technical certification with respective equipment manufacturers and shall be authorized by that equipment manufacturer to pass through the manufacturer's certification and equipment warranty to the university.



3.4 Installation Requirements

3.4.9.1 Guarantee Period of Service

The AV Contractor shall guarantee that all provided material and equipment will be free from defects, workmanship, and will remain so for a period of (1) one year from date of final acceptance of the system by the University. The AV Contractor shall provide original equipment manufacturer's equipment warranty documents, to the UC Project Manager that certifies each item of equipment installed conforms to each original equipment manufacturer's published specifications.

The university shall have the ability to contact the AV Contractor and original equipment manufacturers for emergency maintenance and logistic assistance, remote diagnostic testing, and assistance in resolving technical problems at any time. This contact capability shall be provided by the AV Contractor and each equipment manufacturer at no additional cost to the university.

Response Times During the Warranty Period

The AV Contractor shall include a detailed statement of warranty on the entire system and the individual pieces of equipment with a minimum 10 hours per day, 5 days per week, one-hour phone response for initial fault diagnosis, and a two-hour onsite call out response provided by a qualified technician as a standard on all audio visual system components and control system programming.

The overall installed 'AV turn key' system's warranty including full service shall be for a minimum of twelve (12) months, from the date of Acceptance of the complete system. Software shall be warranted for two (2) years from the date of Acceptance.

The University's AV Project Manager is the AV Contractor's reporting and contact official for system fault calls during the warranty period.

Due to the nature of the University's core business, the AV Contractor shall respond to and correct onsite system fault calls during the standard work week within the following response times:

- A phone response within one-hour of a fault report for initial diagnosis for any faults notified.
- An onsite maintenance call visit within one working day of its report for routine system faults. A routine system fault is considered a system fault which causes a single interface, or component to be inoperable, but which does not render the AV system as a whole inoperable for presentations or teaching
- A priority onsite maintenance call visit within two hours of its report for an emergency system fault. An emergency system fault is considered a system fault which causes the entire display or audio system to be inoperable at anytime

If a system component failure cannot be corrected within four hours (exclusive of the standard work time limits), the AV Contractor shall be responsible for providing alternate items of equipment. The alternate equipment and/or systems shall be operational within a maximum of four hours after the four hour system fault trouble shooting time and restore the effected location operation to meet the system performance standards. If any sub-system or major system fault cannot be corrected within one working day, the AV Contractor shall furnish and install compatible substitute equipment returning the system or subsystem to full operational capability, as described herein, until repairs are complete.

On-site Visits During One Year Guarantee Period

The university has an expectation that the AV solutions provided will perform operationally as specified for a minimum of 99.5% of planned operating time throughout the year.

The AV Contractor is encouraged to visit the AV installation at regular intervals throughout the guarantee period to verify its operation and functionality and to proactively perform preventative maintenance, with the prior approval of the AV Project Manager.

Access to the installation space must be scheduled in advance with the University through Audio Visual Services administration to book and confirm space availability.

The AV Contractor shall maintain accurate up to date records on their online fault reporting system and provide the AV Project Manager with a written report itemising each deficiency found and the corrective action performed during each required visit or official reported system fault call.



3.5 Numbering & Labelling

3.5 Numbering & Labelling

3.5.1 Labelling

All cables, data outlets, video and audio outlets shall be labelled with a label conforming to University requirements for each application. All audio visual cables should be labelled at both ends in a plain text format indicating the source and destination.

3.5.2 Asset Tagging

The AV contractor will provide the following information on each AV equipment item for the University to supply asset tags prior to installation.

- Serial Number
- MAC address (for all network devices associated to the equipment)
- Purchase Order Number
- Purchase Order Date
- Make
- Model
- Part Number

3.5.3 Network Naming

3.5.3.1 Hostnames & DNS Entries

AV equipment requiring network connectivity shall be provisioned and centrally configured according to the University Network Hostname standards prior to being commissioned onto the University network.

A list of all devices intended for IP communication shall be given to Audio Visual Services by the AV Contractor prior to any connections being made. AV Contractors shall provide MAC addresses for all such devices to Audio Visual Services no later than one (1) week prior to installation.

The university accepts the following devices to be able to be used for IP communications over their networks. An example of this for a single projector located room 210 in the James Hight building would be:

av-jh-210-proj-1.canterbury.ac.nz

Prior to signoff of a completed install or upgrade, the audio visual contractor shall confirm all IP addresses and patching details to Audio Visual Services in written electronic format.

The following table shall be used for defining hostnames for AV devices.



3.5 Numbering & Labelling

IP Device	Naming Standard
AV Controller	<support dept>-<building>-<room number>-ctrl-<device number>.canterbury.ac.nz
AV Touch / Button Panel	<support dept>-<building>-<room number>-panel-<device number>.canterbury.ac.nz
Video Matrix Switcher	<support dept>-<building>-<room number>-matrix-<device number>.canterbury.ac.nz
Projector	<support dept>-<building>-<room number>-proj-<device number>.canterbury.ac.nz
Document Camera	<support dept>-<building>-<room number>-doc-<device number>.canterbury.ac.nz
Flat Panel Display Screen	<support dept>-<building>-<room number>-display-<device number>.canterbury.ac.nz
Audio DSP	<support dept>-<building>-<room number>-audio-<device number>.canterbury.ac.nz
Video Conference Codec	<support dept>-<building>-<room number>-vcu-<device number>.canterbury.ac.nz
Wireless Mic Receiver	<support dept>-<building>-<room number>-mic-<device number>.canterbury.ac.nz
Video Camera	<support dept>-<building>-<room number>-cam-<device number>.canterbury.ac.nz
Power Distribution Unit	<support dept>-<building>-<room number>-pdu-<device number>.canterbury.ac.nz
DXLink transceiver	<support dept>-<building>-<room number>-dxlink-<device number>.canterbury.ac.nz



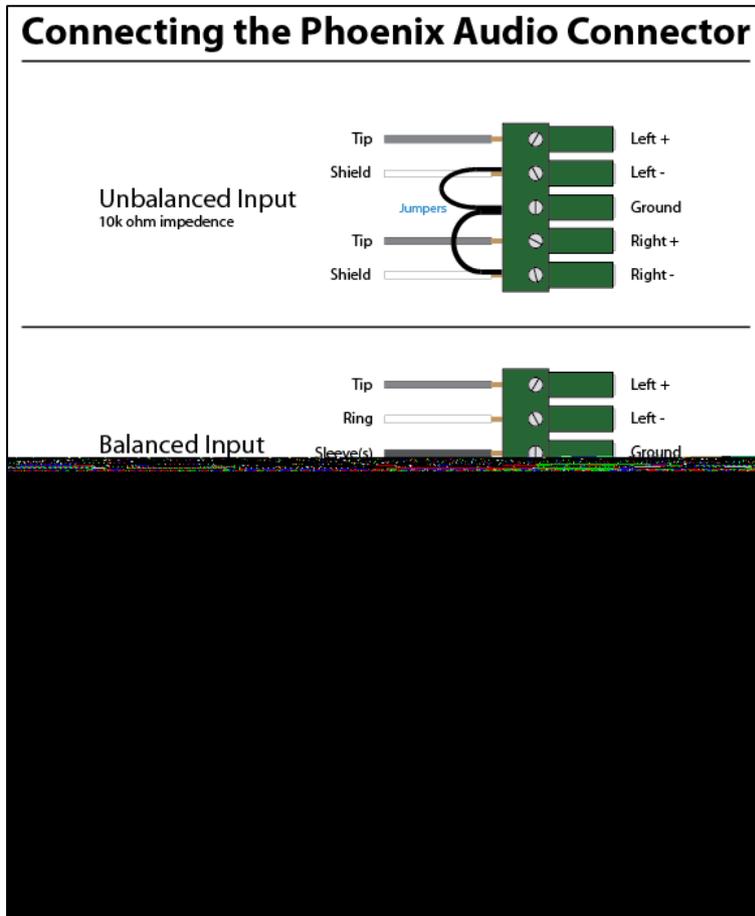
Appendix A – Wiring & Setup Standards

Appendix A – Wiring & Setup Standards

Echo 360 Wiring

The following wiring solution must be used when connecting a balanced audio connection to the Echo 360 capture appliance. For further details – please refer to:

<http://confluence.echo360.com/display/40/Audio+Bare+Wire+Block+Diagram+for+the+EchoSystem+SafeCapture+HD>



Cisco SG300 Network Switch



Network Port no.	Network	Connected Device via Ethernet
1	UC	Resident Computer
2	UC	Laptop guest network cable
3	UC	Lecture Capture Appliance
4	AV VLAN	Matrix Switcher
5	AV VLAN	Touch Panel
6	AV VLAN	Document Camera
7	AV VLAN	Wireless Receiver Unit 1
8	AV VLAN	Audio Mixer Unit
G9	AV VLAN	



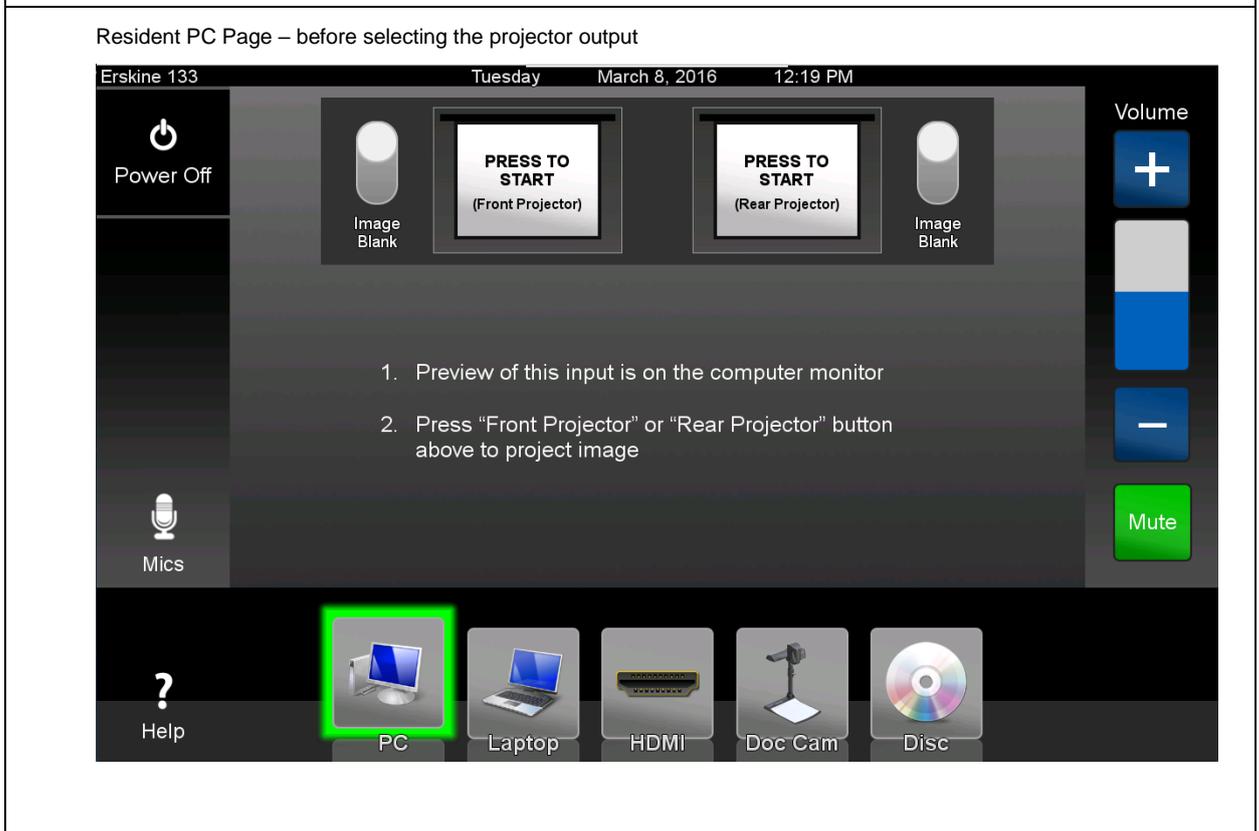
Appendix A – Wiring & Setup Standards

G10 (Uplink)		Back to network communications switch (always use far right uplink port)
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Appendix B – Touch Panel Design

The following pictures illustrate the type and style of layout that the University currently adopts for its user interface for touch panels.



Appendix B – Touch Panel Design

Laptop Page

Erskine 133 Tuesday March 8, 2016 12:20 PM

Power Off Image Blank **PRESS TO START (Front Projector)** **PRESS TO START (Rear Projector)** Image Blank Volume (+, -, Mute)

1. Connect the VGA cable to your laptop (in cable cubby)
2. Use the laptop's function keys to enable external display mode. Eg. Function + F5 / Function + F7
3. Press "Front Projector" or "Rear Projector" button above to project image

Mics ? Help PC **Laptop** HDMI Doc Cam Disc

Laptop / HDMI Page

Erskine 133 Tuesday March 8, 2016 12:20 PM

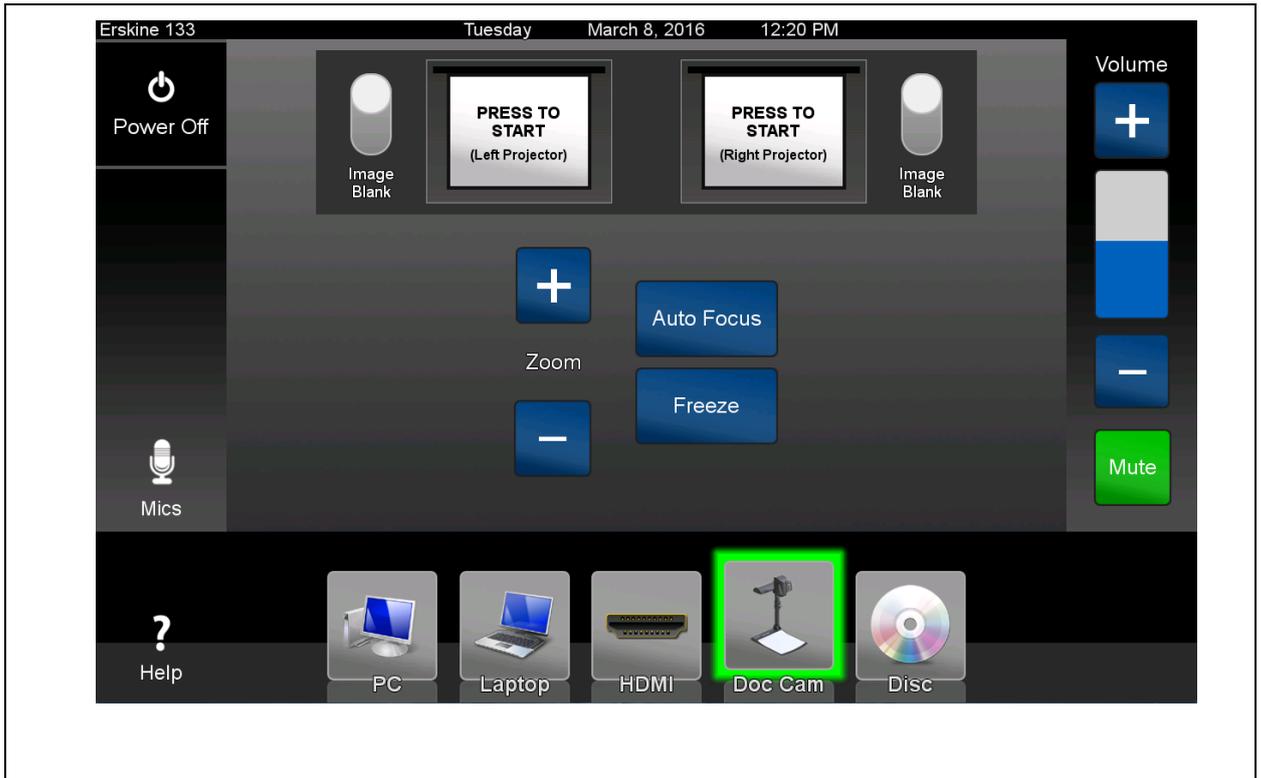
Power Off Image Blank **PRESS TO START (Front Projector)** **PRESS TO START (Rear Projector)** Image Blank Volume (+, -, Mute)

1. Connect the HDMI cable to your laptop (in cable cubby)
2. Use the laptop's function keys to enable external display mode. Eg. Function + F5 / Function + F7
3. Press "Front Projector" or "Rear Projector" button above to project image

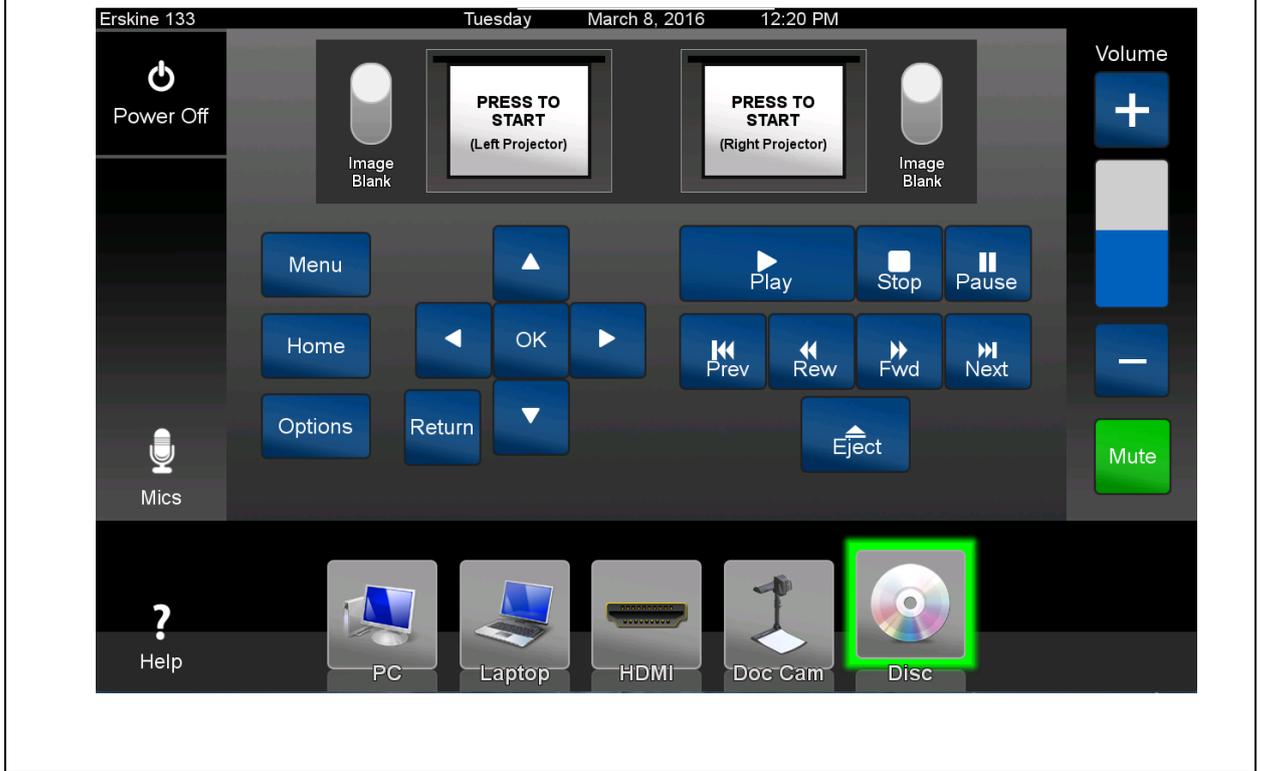
Mics ? Help PC Laptop **HDMI** Doc Cam Disc

Document Camera Page

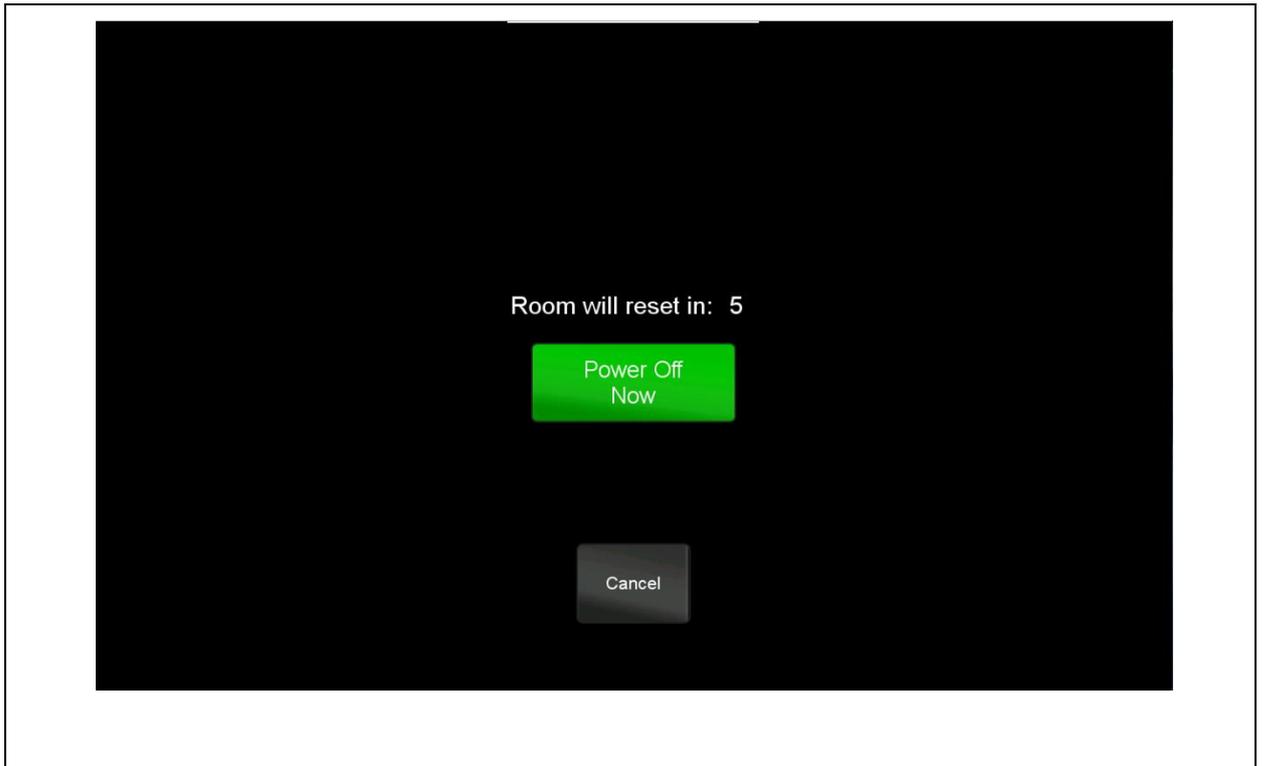
Appendix B – Touch Panel Design



Disc Page – For DVDs, Blu-rays, and CD-Roms



Shutdown



Appendix C – Cabling Specification

The following is a compiled list of information and specifications relating to cabling standards which have been adopted in many Universities in New Zealand and Australia. Please use this as a reference and a guide.

Cable Specification Table

Signal Type	Cable Type	Approved Cables	Max dist.
Audio			
Mic Level	Screened Twisted Pair	Belden 1503A, Belden 8723	
Line Level	Screen Twisted Pair	Belden 1503A, Belden 8723	
Speaker Level	Twisted Pair	Belden 8477	50m*
70/100V Line	Pair	Belden 8471	50m*
Video			
Digital	HDMI	Generic	10m
Digital	DVI	Generic	10m
VGA	VGA	T.E. VGFA-M-M-20	20m
VGA + Audio	VGA + Audio	T.E. VGA-A-M-M-15	15m
RGBHV	multi Coaxial	Belden 7789A	60m
Composite	Coaxial	Belden 1505A	60m
S-Video (YC)	Coaxial	Belden 1505A	60m
Component (YPbPr)	multi Coaxial	Belden 7789A	60m
Control			
RS-232	Multi Pair	Belden 9536	15m
RS-422	Multi Pair	MCP3S	1000m
RS-485	Multi Pair	MCP3S	1000m
Infra-red	Pair	Belden 8761	
I/O	Pair	Belden 8761	
Relay Contact Closure	SV	Belden 8761	
USB	USB	ATEN UE250 (x4 max)	5m/20m
Power			
12VDC	Pair	Belden 8471	50m*
UTP			
Cat6	Cat6	refer University Communications Cabling Specification	
Composite + Audio	Cat6	Extron MTP AV RCA Kramer	300m
S-Video + Audio	Cat6	Extron MTP SV RCA Kramer	300m
VGA/RGB + A + RS-232	Cat6	Kramer TP-125/126 Magenta XRTx-SA	100m 300m
DVI/HDMI + RS-232	Cat6	Extron DVI201xi	30m/60m**
USB	Cat6	iCron Ranger 2101/2104	100m
HD Base T	Cat6	e.g. AMX DX Link	100m x8 hops
Fibre Optic			
Composite + Audio	Multimode	Extron FOX 2G AV	2000m
S-Video + Audio	Multimode	Extron FOX 2G AV	2000m
Component + Audio	Multimode	Extron FOX 2G AV	2000m
VGA/RGB + A + RS-232	Multimode	Extron FOX 4G VGA	2000m
HDMI/DVI + RS-232	Multimode	Magenta Infinea M-HDX	600m

* run lengths exceeding stated maximums must be calculated with consideration for signal, proximity to interference sources and configuration

** 30m = 1080p and above. 60m = 1080i and below

Cable Bend Radius

To maintain cabling performance integrity care should be taken when bending cables around corners to conform to cabling pathways and conduits. Bending a cable beyond its intended design can alter its internal structure, causing impedance variation from specification and thus altering signal transmission characteristics, or in the extreme, damage to the cable.

Cable Bend Radius Specification



Appendix C – Cabling Specification

The following specification should be adhered to for all AV cable installations.

Cable Type	Bend Radius*
Single core	4x
UTP (Cat5/Cat6)	4x
Multi pair cable	10x
Fibre optical	10x
Cables in tension	20x

* times cable diameter

Signal Separation

Signal integrity is a critical factor in any AV system design. Signals which are compromised by extraneous outside interference invariably create issues when the signal is reproduced.

Electromagnetic interference (EMI) in a cabling sense is characterised by the induction of noise into a signal, which may often stay with the signal throughout the entire signal path until it is finally reproduced for the viewer/listener audience.

Interference can affect audio and video signals adversely. Unbalanced lower voltage signals are more susceptible to EMI.

Signal Groupings	Recommended Separation
Microphone audio	300mm
Line audio	300mm
Speaker audio	300mm
Video	300mm
Control, data and communications	300mm
Power (DC)	300mm
Power (AC)	1000mm*

* cross AV and electrical power cables at perpendicular 90 degree angles to one another. This has the effect of collapsing EMI fields where cables cross and avoids radiated EMI interference.

Cable Pathways

Cable pathways are a significant aspect of cabling management. Planning is required to ensure cable management is simple, prevents damage to cabling, preserves signal integrity and allows for future expansion and service access.

Common cable management pathways include cable duct (often referred to as 'tray') and conduit. Short runs of cabling may also be supported on catenary wire.

Consideration should be given to the number of cables, weight and signal types for a given cable run. Observation of signal types separation, cable bend radius and proximity to power cabling are necessary. Conduit maximum fill capacity guidelines are provided below.

AV Cabling Conduit Specification

The following specification should be adhered to for all AV cabling installations.

Cable conduit/duct should have a minimum 50mm diameter

Number of Cables	Maximum Fill*
1	53%
2	31%
3 + **	41%

* Maximum fill of total conduit/duct area

** to avoid cable jam when running 3 of the same cables, conduit/duct area should not fall between a ratio of 2.8 and 3.2 times the total cross-sectional area of the cables

Labelling



Appendix C – Cabling Specification

In order to effectively manage signal cabling and their pathways, it is important to accurately label cables and record pathway, source and destination details in an organised cable schedule. Cable schedules can assist to show grouping of cables sharing a common path and highlight similar cable types within groups.

Availability of accurate cabling labelling, schematic diagrams and cable schedules can facilitate fast and effective trouble shooting, cable tracking and adding additional cabling for future expansion.

AV Cable Labelling Specifications

The following specifications should be adhered to for all AV cable installations.

Text Size: 8pt or 8mm height minimum

Label Type: adhesive or bonded

Label Location: both ends of the cable, at or within 100mm of the end of the cable

Label Orientation: towards service entrance view (for AV racks and lecterns)

Labelling Nomenclature: As below, numbers correspond as per documented cable schedule

Cable Type	Naming Convention
Audio - mic, line, speaker, utp	A001, A002, A003... ~
Video - composite, component, s-video, vga, dvi, utp	V001, V002, V003... ~
Combined AV - hdmi, udm, display port, utp, fibre	AV001, AV002, AV003... ~
Control - rs-232/422/485, relay, i/o, ir	C001, C002, C003... ~
Data - usb, ps/2	D001, D002, D003... ~
Network - Ethernet category cabling cat5/6/7	N001, N002, N003... ~
Power - dc supply	P1, P2, P3... ~
Future - any	F1, 2, 3... ~

AV Rack

With so many different cable and signal types within such confined areas as AV equipment racks and lecterns, special consideration is required for effective management of them all. Cable separation by signal type, labelling, termination, lacing and bend radius are factors for consideration along with cable security, over hang and cable length.

AV Rack Cabling Specifications

The following specification should be adhered to for all AV Rack and Lectern installations.

- Cables entering a rack or lectern should be firmly secured to cabinet casing at the cable entry point for tension relief
- Cables entering a rack or lectern should be firmly secured to cabinet casing at the cable entry point for tension relief
- Cable paths should be established throughout the cabinet interior, typically rising up cabinet side walls while securing to fixtures or cable duct/tray before crossing on to horizontal lacing bars providing the shortest practicable run distance between cabinet entry and device connection while observing guidelines regarding grouping cables by signal type and segregation distance between disparate types.
- Cables should be secured with Velcro ties every 300mm or less
- Where possible, cables should be terminated to length with enough over hang to allow device connection with tension.
- Rack chassis and any connection panels within must be grounded to a common electrical earth point.
- Multiple rack chassis should be earth bonded where possible

Cable Termination

Cable termination usually refers to the terminating of a bare cable to a plug or jack which then plugs or connects to a device to receive and transmit signals.

Improper or poor cable termination can reduce the quality of a signal, create instability in a system or even result in no signal getting through a connector.

AV systems described here include a wide variety of cabling and signals many of them utilising their own unique type of connector which come in a large variety of shapes and sizes from tightly bonded HDMI plugs to clamping bare wires under screw terminal phoenix connectors.

Many connector types have their own tools and methods associated with their termination. To ensure signal integrity and reliability cable termination should be performed by skilled technicians with appropriate tooling and resources.

Cat5/6/7 Cable Specifications



Appendix C – Cabling Specification

Details for Cat5e, Cat6 and Cat7 cabling currently specified for use in your institution should be referenced from your Telecommunication Cabling Specification (or equivalent standard) maintained by your telecommunications and networks department.

AV Wall Plates and Connection Panels

AV wall plates and connection panels are the front line of any systems interface with users, allowing connection and display of content from a variety of devices, or in the case of an AV technician, to output signals for use with external devices.

These points of connectivity are often embedding into furniture, lecterns, wall surfaces and equipment racks. Special consideration must be given to design and provision of these panels such as; ergonomics, ease of use, labelling, electrical safety, robustness and reliability and types of connections.

AV Wall plate and connection panels specifications

The following specifications should be adhered to for all AV cable installations.

Type	Connections
Laptop	VGA + phono L+R (x2) inputs
Laptop with interactive whiteboard, eBeam, Webcam	VGA + phono L+R (x2) + USB inputs
iPad, Android tablets	VGA + phono L+R (x2) via adaptor or HDMI via adaptor
Analogue AV	Phono x3 (R, W, Y) inputs
Digital AV	HDMI input
Network/Data	1 outlet per staff device connection
Power 240VAC	1 outlet per device connection



Appendix D – Systems Acceptance Forms

Purpose and Use

Use this appendix to record details about the status of a newly provisioned audio visual system and room environment relating to effectiveness for use as a teaching and learning venue/system.

The appendix is a series of tables listing form, functionality and performance levels normally expected from a typically functioning teaching and learning room outfitted with an audio visual system.

Use the prompts offered as a guide to evaluate the readiness and suitability of the systems for teaching and environment control supplied. For ease of reviewing this document by others it's recommended the following details are recorded:

- Provide type, make, model and serial number of items where requested
- Provide information on aspects of the AV system or environment that might negatively impact on teaching and learning performance by reporting on any systems, devices or functionality which:
 - appears to be absent
 - performs or functions differently to expectation
 - items supplied which differ to that requested in the specification used
- An “Additional Comments” row is provided at the bottom of each table for notes and comments.

Suggestion: For ease of review, enter markings for items, issues or system attributes which do not reach acceptance. Use highlighter or bold contrasting coloured rings for marking and adding notes.



Compliance Checklist

Project Name:

Date:

Submitting Consultant:

Design Stage:

Section 03 – Audio Visual

Compliance Checklist

	Complies	Does Not Comply	Not Applicable	Comments:
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1.0 Section 01 – General

#	All Clauses	<input type="checkbox"/>	<input type="checkbox"/>	
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3.1 Overview

3.1.1	Purpose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.1.2	Modern Learning Space Technology Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.2 Design Concepts

3.2.1	Teaching Space Types	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.2.2	Sightlines, Size & Screen Specifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.2.3	Speech Reinforcement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.2.4	Assistive Learning Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.2.5	Internet / Network Access	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.2.6	Projector Placements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3 Materials & Equipment

3.3.1	Projectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.2	Flat Panel Displays	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.3	Resident Computer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.5	Video Matrix Switchers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.6	Confidence / Annotation Monitors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.7	Document Cameras	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.8	Media Players (Blu-ray/DVD)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.9	Audio Input	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.10	Audio Output	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.11	Video Cameras	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.12	Video Conferencing Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.13	Telephones	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.14	Whiteboards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.15	Network Switches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.16	Cabling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.17	Fibre Optic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.18	Audio Visual Cables	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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3.3.19	Equipment Housing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Compliance Checklist

Project Name:	Date:
Submitting Consultant:	Design Stage:

Section 03 – Audio Visual		Complies	Does Not Comply	Not Applicable	Comments:
Compliance Checklist					
3.3.20	Power	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.3.21	Ventilation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.3.22	Control Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.3.23	Interface to Building Management Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.3.24	Control Signalling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4	Installation Requirements				
3.4.1	Electrical & Power	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.2	Cable Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.3	Software & Code	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Error! Reference source not found.	Error! Reference source not found.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.5	Commissioning & Handover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.6	Documentation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.7	Sign Off & Handover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.8	Post-Installation Processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.4.9	Maintenance & Warranty	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5	Numbering & Labelling				
3.5.1	Labelling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.2	Asset Tagging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.5.3	Network Naming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Date:	<input type="checkbox"/> Acceptable
University Reviewer:	<input type="checkbox"/> Acceptable subject to comments



Compliance Checklist

Project Name:

Date:

Submitting Consultant:

Design Stage:

Section 03 – Audio Visual

Compliance Checklist

Complies

Does Not Comply

Not Applicable

Comments:

Signed:

Resubmission required

