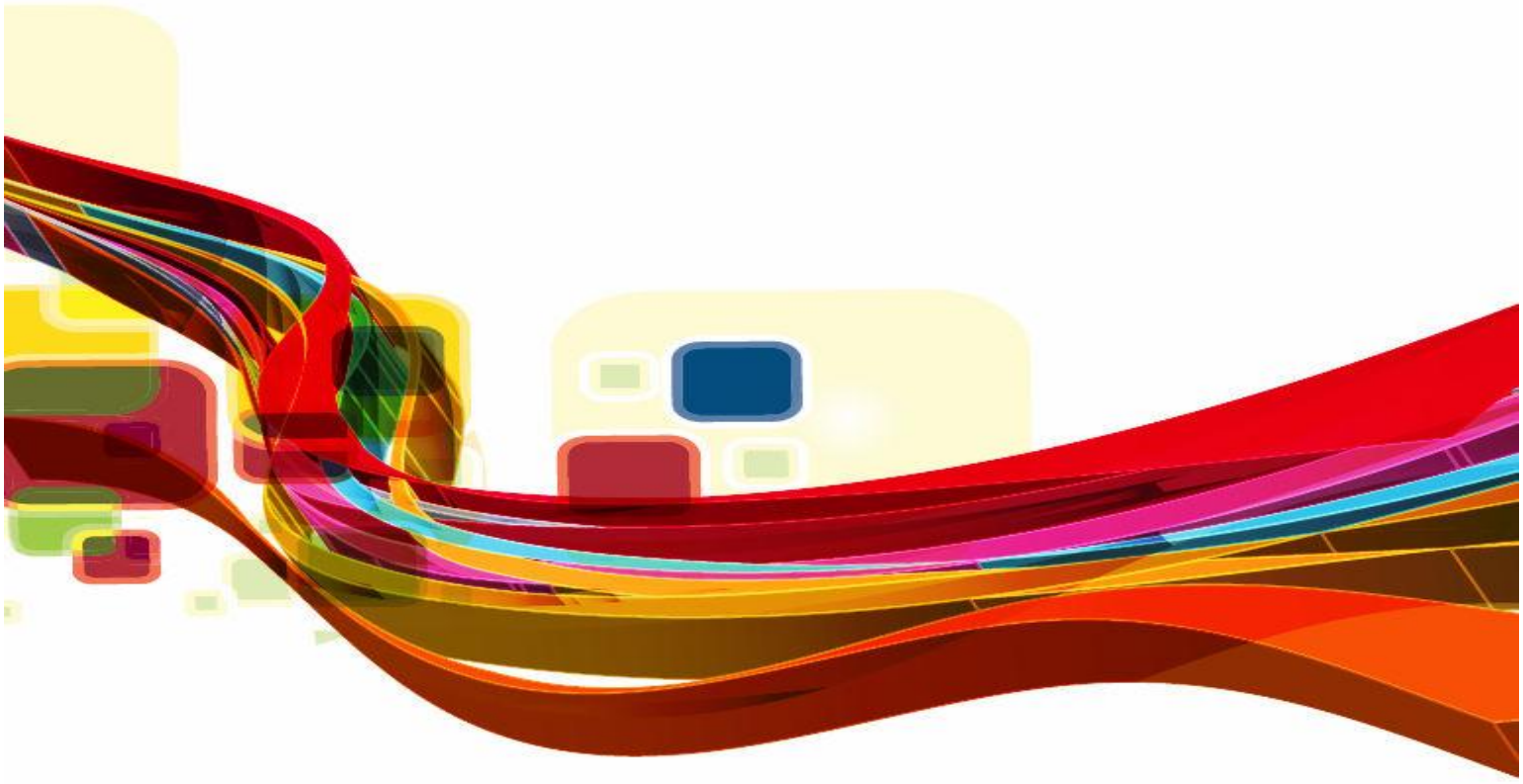
University of South Wales

Audio Visual and Teaching Space Guidelines and Standards

Version 2.0



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Foreword

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[2] http://www.infocomm.org/cps/rde/xbcr/infocomm/InfoComm_AVITHighEd_Dec14.pdf

Audio Visual and Teaching Space Guidelines and Standards

for the

University of South Wales

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1.0 Introduction

The University of South Wales operates from three campuses, Pontypridd (Treforest & Glyn Taff), Cardiff (Atrium, Cromwell House, Atlantic House), and Newport (City, Caerleon) and has two subsidiaries, The College - Merthyr Tydfil and the Royal Welsh College of Music and Drama - Cardiff.

Across the University there are 331 teaching spaces supported with AV provision. These are made up of 182 General purpose teaching rooms, 23 lecture theatres, 99 specialist labs including 55 computer rooms, 19 other virtual classrooms (Moot Court, Virtual Hospital etc.).

The purpose of this document is to set out the AV requirements and specifications across the University so that they are fit for the purpose of learning and teaching, and to set out the roles and responsibilities for each of the departments involved in providing and supporting classroom technology.

2.0 Roles and Responsibilities

Responsibility for the installation and maintenance of classroom technology is shared between the 'IT Services' and 'Estates and Facilities' departments.

The responsibility for defining the minimum classroom technology requirements and providing support for the implementation of associated learning through technology approaches rests with the Centre for Excellence in Learning and Teaching (CELT) in collaboration with the Faculties[3].

The breakdown of each departments responsibilities follow:

2.1 The CELT Department will be responsible for defining the minimum classroom technology requirements and associated pedagogies to support implementation:

1. Liaising with the academic community to define the minimum classroom technology requirements and associated pedagogies to support implementation;

2. Providing support for the implementation of associated learning through technology approaches.

   Any enhanced equipment requirements going into specialist teaching rooms will need to be agreed between the Faculty, Estates and Facilities, and IT Services.

3. Ensuring that the timescales and enhanced AV costs are identified with IT Services and Estates prior to finalising budget costs for funding and before the start of the project.

2.2 The Estates Department will be responsible for: New and Major Refurbishments

1. Deciding the location of the teaching wall and the position of the screen, in agreement with the Faculty;
2. The choice and supply of teaching lectern or table and the position in the room (The design to be agreed in discussion with IT Services);
3. The provision and fixture of appropriate electronic screen and associated 3 position power switch (note the guidance of size of screen within this document);
4. The fixing of the AV ceiling plate CP1, CP2 [see appendix 2.2] ready to accept the projector;

[3] LTEC paper, May 2015

5. The supply and installation of all cables to meet the specification and cable runs as specified in the rest of this document (Note: all network and AV cables will be terminated at the outlets by IT Services or their designated AV integrator);
6. Minimising the risk of H&S in relation to trailing cables between the position of the lectern/table and the associated cabling wall sockets;
7. The support and future maintenance of all components supplied and fitted by them including the network and AV cables, and associated furniture;
8. Installation of the required power outlets in the ceiling spaces and the wall;
9. To include the associated costs for all the above into the project cost;
10. Ensuring that the timescales and full AV costs are discussed and agreed with IT Services prior to finalising budget costs for funding and before the start of the project.

2.3 The IT Services Department will be responsible for: New, Major Refurbishments and Rolling Replacement

1. The specification of AV cables and the location of the associated wall/furniture sockets;
2. Specification, procurement and installation of the AV and associated equipment, Extron Global Viewer management software, along with AV PC;
3. Signing off the installation of all network and AV cables as provided through the Estates and Facilities department;
4. Installation of any data points required;
5. Termination of the network and AV cables at the wall sockets or end points;
6. The support and maintenance of all AV and PC equipment;
7. To include the associated costs for all the above into the project cost;
8. Ensuring that the timescales and full AV costs are discussed and agreed with Estates prior to finalising budget costs for funding and before the start of the project.

3.0 Process

The design of modern learning spaces with integrated classroom technology requires a coordinated project team from the earliest stages of project definition and concept design.

The chosen solution needs to meet the equipment specifications and standards as set out in this document and the minimum equipment required for learning and teaching.

3.1 Pre-Installation & Planning

The IT Services AV team (IT AV Services) would expect to meet with the design team(s), Estates and Facilities, and the appointed Audio Visual Integrators at the earliest opportunity to advice on design decisions that can impact on the performance and effectiveness of the AV system such as ceiling height, lighting, furniture, access, facilities for the disabled, etc.

3.2 Design Process

1. Establish Project team - include Estates department, their nominated contractor, AV integrator, IT AV Services, Network services and Desktop support teams, as required.
2. IT AV Services will
    a. check AV system requirements with users;
    b. produce a system design and cost estimate;
    c. appoint AV integrator;
    d. refine and develop final system with the AV integrator;
    e. place order for AV equipment.
3. AV integrator produces final system drawings, cable schedules and power/network requirements.
4. For Estates projects cabling will be installed by their nominated contractor with the cables specified by IT AV Services in consultation with the AV integrator.

5. For Rolling Replacement upgrades cabling will be installed by the nominated audio visual integrator with the cables specified by IT AV Services in consultation with the AV integrator.
6. IT AV Services will recommend the required timescale for system testing, commissioning, snagging and user training and familiarisation on each project. IT AV Services will look to manage this timetable in collaboration with the AV integrator and the users of the facility.
7. IT AV Services and Estates will liaise in terms of site security and equipment installation timetables. Restricted access to protect high value equipment may affect other trades ability to carry out any other intended programme of works.

The process above can create conflict where information is required on cable routes, power and network requirements etc. before the AV integrator is appointed. ***It is therefore important to appoint the Audio Visual Integrator early in the design process.***

3.3 Post-Installation

On completion of the installation process, a period is required to carry out system commissioning, snagging, user training and familiarisation. Every effort should be made to protect this period from erosion, e.g. due to possible late running of the overall programme, in order to ensure user satisfaction on final handover and user satisfaction during lecture delivery.

If the AV integrator has to leave site due to enforced early occupation, the snagging period may be significantly extended with serious impact on user satisfaction and cost.

1. IT AV Services will ensure that, within projects requiring staged payments, the AV integrator completes all necessary programmes of works before making a recommendation to Estates / Procurement that invoices are passed for payment.
2. IT AV Services will participate in any Lessons Learned and Post Occupancy Survey meetings on completion of a project.
3. IT AV Services and the appointed AV integrator will liaise with Estates Project Manager and Network Services in order to ensure all network, control and power cabling is in place as specified within the design and that all AV cables have been installed as per USW standard specification.
4. Network Services staff will check that the network cables installed by the contractor have been installed to meet USW standard specification.

3.4. Designing AV for Learning and Teaching

The design should take cognisance of the guidelines for the minimum classroom technology required for learning and teaching in general purpose teaching rooms and lecture theatres[4].

- An equivalent, consistent and pedagogically-sound learning environment experience across all campuses for staff and students;
- Adaptability of design to address specific instructional needs for subject contextualisation and associated flexible pedagogical approaches;
- Consistent and easy to use functionality and interfaces across all campuses and all classrooms;
- Effective management and support of systems and equipment with an expectation of a 24/7 responsive system when difficulties are experienced;
- Effective lighting in rooms, blinds as appropriate and comfortable heating levels;
- Subject specific spaces, reflecting individual discipline needs of technology;

[4] 'Learning Environment Review: Minimum Standards for Classroom Technology', LTEC paper, May 2015

- Communication of roll-out across the University to all stakeholders to maximise engagement, benefits and impact in the staff and student experience;
- A programme of staff development to ensure best use of the relevant technologies in learning and teaching.

There are a number of international standards and guidelines used for AV design and installation:

- ANSI/INFOCOMM 2M-2010 Standard Guide for Audio Visual Systems Design and Coordinated Processes.
- BSI Standards Publication – Code of Practice for the installation of audio visual equipment BS 8590:2014
- ANSI/INFOCOMM 2M-2010 – Audio Visual Designer
- INFOCOMM AV/IT Infrastructure Guidelines for Higher Education
- JISC Digital Media – Audio Visual Signal Types and Interconnects

Please refer to chapter 5 – 'Designing a typical teaching space' for suitable positioning of equipment.

4.0 Teaching Spaces

4.1 'Small Teaching Room – 30 seats'

A Small Teaching Room would have seating capacity for up to 30 people. These spaces often have ceiling heights of less than 3m and limited floor space. These smaller spaces would either be considered for:

- Data projector and suitable screen (see appendix 1);
- Large LCD/LED wall mounted screen interactive / non-interactive;
- Associated Extron management control systems as required for all installations;
- Small lectern, small AV cabinet or teaching desk.

4.2 Seminar Room

A Seminar Room would have capacity for up to 100 seats. These rooms can vary dramatically but can often have similar ceiling heights to small teaching rooms i.e. less than 3m. They are occasionally tiered and this can introduce line of sight issues.

The rule of thumb is to install the largest screen possible with a minimum height off the floor of approximately 1.2m to the bottom of the screen. Any lower than this and the audience will be unable to see the bottom of the screen. An Interactive whiteboard may be fitted (see appendix 3 - where minimum and maximum heights of the board are indicated as a guide) but it is more likely to be a pull-down, or electrically operated, screen approximately in the range 1.8m to 2.4m wide (See appendix 1 – Screens, Specifications and Sightlines).

Consideration has to be made for the aspect ratio, usually 16:9 or 16:10 and the fact that users can often come with a variety of source content, which itself, can be anything from a website, a PowerPoint presentation or electronic writing, so issues about visibility can be critical.

The choice of AV furniture (see Appendix 5) will need to be collocated close to the AV control systems (see Appendix 7). It is likely that a presentation lectern fitted with control system is used in these spaces.

Best teaching practice would normally consider the teaching wall as being at the opposite end of the room to any doors to avoid disruption to any lecture or presentation by latecomers etc.

Cable containment is required, in relation to the position of the desk or AV cabinet, the height of the board or screen and in terms of access, power and network.

Lighting, ambient noise, furniture and the room shape and features can all impact on the design.

There will almost certainly be a requirement for a writing surface and this can be particularly important where wall space is limited.

4.3 Lecture Theatre

A Lecture theatre would have capacity for over 150 seats.

These spaces can vary dramatically in shape and size but can often include tiered seating, suspended ceilings, column board systems [see figure 2], Data Projection etc.

Dual data projection can often be installed as standard in lecture theatres of this size to allow the audience to view presentations that include material from more than one source. This provides less line of sight issues but creates more complex systems and control.

The rule of thumb is to install the largest screens possible ensuring those seated nearest to the screen are not viewing the projected image at an uncomfortable angle.

Screen sizes present real problems as we move to high definition, widescreen presentations and many teaching walls will need to be re-designed to accommodate this trend as well as the need to display electronic writing. As was mentioned in relation to Seminar Rooms the issue of screen size is complicated by standards for resolution, the different sources and the material displayed.

A suitable lectern is preferred, which would house the majority of the Audio Visual control system. This makes for easier wiring but can cause complications if the desk needs to be removable.

Figure 2

The teaching desk [Figure 3] should be designed in such a way as to allow the users access to certain, appropriate equipment, such as the DVD player or the dedicated PC but not to interact directly with the control equipment etc. See diagram.

Figure 3

This configuration leads to the systems being much more reliable but does require the desks to be well designed to incorporate issues such as access to equipment for maintenance or repair, ventilation, disability access, etc.

The control systems used in lecture theatres should allow the user to control pre-set audio levels, select equipment and sources as well as in some theatre setting the lighting levels.

The teaching wall should be at the opposite end of the room to any doors to avoid disruption to any lecture or presentation by latecomers etc.

Cable containment needs to be considered in relation to the position of the desk and to the equipment external to the desk such as the data projectors, the induction loop *[Appendix A10.9]* and the loudspeakers etc.

As in other rooms, lighting, ambient noise, furniture and the room shape and features can all impact on the design.

There will almost certainly be a requirement for a writing surface and this can be a difficult issue with many academic colleagues' still favouring chalk or whiteboards as a writing medium and the issues of maintaining whiteboards as well as the trend towards electronic writing mediums grows. The focus should now be directed to electronic presentation such as visualiser's, tablets *[Appendix A11.1]* and Bring Your Own Device (BYOD) along with collaborative tools that allow academics to interact with the students and the students to interact with the class and academic.

Again, viewing distances and how they relate to screen sizes and the seating layout are critical. USW generally use front projection but consideration needs to be taken for the possibility of rear projection for reasons such as the lack of a suitable location to wall or ceiling-mount a data projector. The screen surface itself can be an important consideration with the drive towards ever-brighter data projectors and ever-higher resolution images making demands on screen surfaces, which previously would have been fit for purpose.

Lecture theatre AV installations have to be seen as an integral part of the infrastructure and the related wiring and network all need to be allowed for on any project. There may be some lecture theatres that could be considered for Video Conferencing and these will most certainly increase the complexity of the wiring. Other features such as audience response systems, related welcome / information screens, panel discussions, conference or event use etc. all go to making lecture theatre design one of the most challenging parts of many AV projects.

5.0 Designing a Typical Teaching Space

When designing a teaching space the point of entry into the room should normally be at the back of the room with the presenter at the front of the room. This avoids disruption to any lecture or presentation by latecomers etc.

In order to facilitate the installation, IT AV Services would require cable containment, which needs to be considered in relation to the height of the whiteboard or screen and in terms of access, power and network.

Lighting, ambient noise, furniture and the room shape and features can all impact on the design. There may also be a requirement for a vitreous enamel writing surface and this can be particularly important where wall space is limited.

5.1 - Floor plan

The room layout shown in figure 1 is used for general information and guidance. A detailed specification would be developed in consultation with users for each individual project.

The cabling in any teaching space will be solely dependent on the position of the teaching desk / lectern. This said once the Estates department has determined the location and type of teaching position then the cabling follows the same pattern (See Appendix A10.8 – Wiring diagrams).

Data Projector – Position 'A'

The data projector is one of the key elements in the configuration. The decision on the appropriate projector is determined by the room size (Ht x Wd x Lt) along with lighting considerations.

Please refer to Appendix 2 – Projector Technology, for information on selecting the appropriate projector for the room.

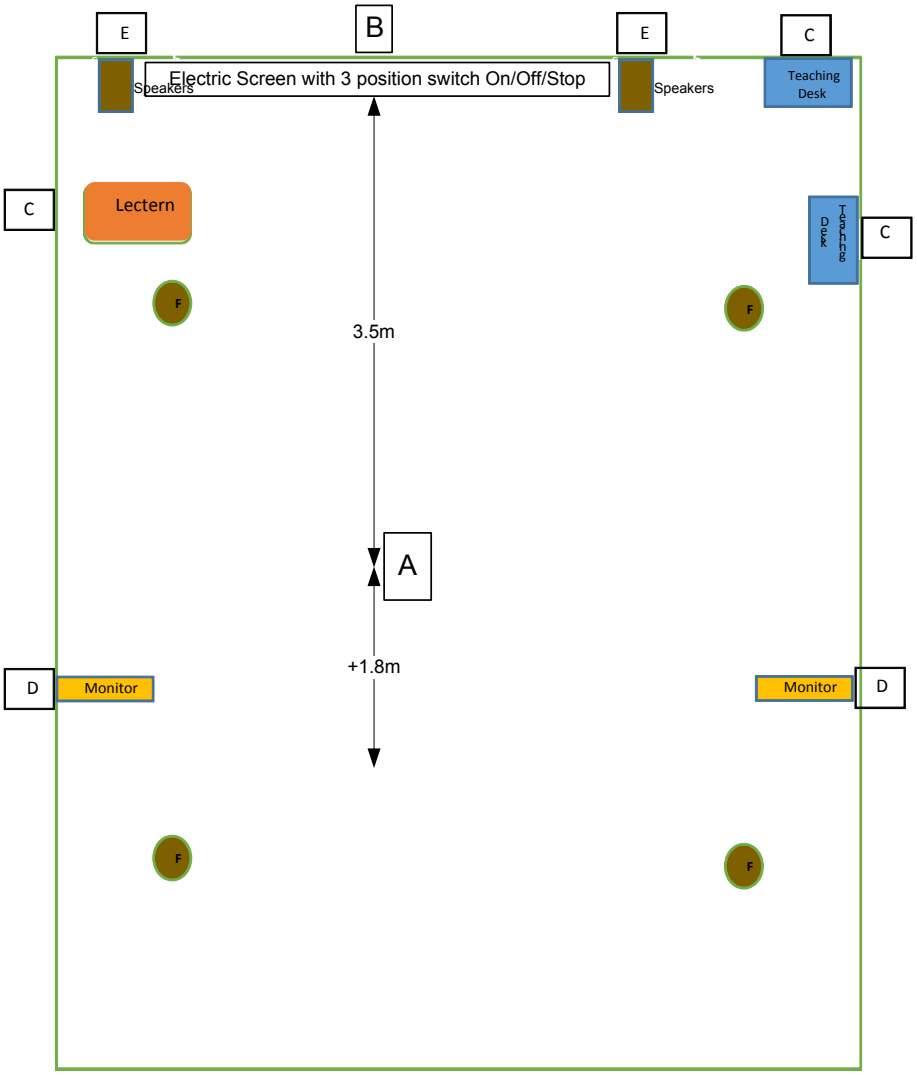
Screen – Position 'B'

Most Classrooms and lecture theatres are general purpose and may cater for two types of tasks.

- Detailed viewing tasks (Note taking, text based slides/PowerPoint)
- Inspection viewing tasks (viewing graphical material such as complex maths / engineering drawings / medical slides, x-rays etc.)

The screen could be described as the lynch pin between the data projector and the audience. The USW standard is a wide screen of 16:10 ratio. All monitors and data projection are now adopting the wide screen format rather than the square format of 4:3 which is now virtually obsolete.

Figure 1 – Layout of AV equipment in a room



Please refer to Appendix 1 – Screens, Specifications and sightlines, for further information on appropriate screen sizes and positioning.

Some teaching spaces based on the above will require additional monitors to ensure that the audience can read the information from further back. This will then need additional power and cabling

Lectern / Teaching Desk – Position 'C'

The choice of whether to use a teaching desk/table or a lectern to hold the PC that is used to drive the projector is determined by a number of factors:

- the size and shape of room;
- how the furniture will be positioned to avoid the lecturer from blocking the teaching wall;
- whether it will interfere with other obstacles e.g. doors;
- the amount of AV equipment to be housed within the footprint of the desk/lectern/table.

Please refer to Appendix 5 – AV Furniture, for further information on choosing the right furniture.

Monitor – Position 'D'

Depending on the depth of a room, it may be necessary to fit additional monitors to the sides of the room that would replicate what is being projected onto the screen.

Speakers – Position 'E' and 'F'

A smaller teaching space may use speakers located at the front of the room (position 'E'), whilst a larger room may require speakers housed in the ceilings (position 'F').

The cabling in any teaching space will be solely dependent on the position of the teaching desk / lectern. This said once Estates has determined the location and type of teaching position then the cabling follows the same pattern. (See Appendix A10.8 – Wiring diagrams).

5.2 – Power Requirements

Power Requirements.- Teaching Desk

Power at Point – **A**

- 13 amp socket for data projection
- 13 amp socket for switcher
- 13 amp socket for amp
- 13 amp socket for splitter box

Power at point – **E**

Logical side for the power would be on the same side as the teaching point

- 13 amp socket for powered screen
- 13 amp socket for powered speakers Front of House (FOH)

Power at Point - **C**

- 13 amp socket for PC
- 13 amp socket for Monitor
- 13 amp socket for notebook

Power at Point – **D** if additional screens required.

- 13 amp x 2

Power Requirements.- Lectern

Power at Point – **A**

- 13 amp socket for data projection
- 13 amp socket for amp

Power at point – **B**

- 13 amp socket for powered screen
- 13 amp socket for powered speakers FOH

Power at Point - **C** Lectern wall

- 13 amp x 2 to get power to lectern

Power at Point – **D** if additional screens required.

- 13 amp x 2

5.3 – Cable Standards and Requirements

Cable Standards

The standard used to be installing the various cables (VGA/Audio/Data etc.) within trunking. This was often clumsy and offered many challenges.

The current method of cabling requires the running of Cat5e, Cat6a, Cat7 data cables. These are then terminated by the Audio Visual integrator for the various outputs required. These take the place of the more cumbersome cables.

The positioning of the cables will directly correspond to the designated teaching area chosen by Estates and the type of teaching position – Desk or Lectern will have differing requirements. *[See Appendix A10.8 – Wiring diagrams].*

There should be enough cabling to ensure that the cable is:-

- Not pulled tight and has enough slack within the containment as not to put pressure on the cabling.
- Sufficient length at each end to ensure that there is sufficient to be able to place the cable and properly terminate the cable. (2m)
- If the cable has to pass through ceiling or surface mounted conduit / containment then this should be three partition / compartment type.
- The conduit should be either 3 compartment square such as –MTDQ3 or for skirting 3 compartment - MTS3
- The correct cable types should be used as per the AV Cabling Standards and as specified / recommended by the AV integrator.
- If cabling is being placed in conduit / containment then consideration should be made to the:-
    - Thickness of the cable
    - Weight of the cable – place the heavier cable within the bottom of the tray to avoid crushing other cables unnecessarily.
- Although the CAT* can carry the control signal form the data projector etc to the Extron control box, it is preferred that a separate RS232 control cable is included as this makes for better connection and control.

- All cables used must be shielded.

<u>Cable Requirement – Teaching Desk</u>

Requirement;

- 5 x cat5e / Cat6a shielded non terminated (Cat6a recommended) – Run from Point **A *to Point* C** – Teaching Desk Position
- 2 x draw / Pull through (see below)
- 2 x RJ45 data points at point C Teaching point in the ceiling – For Control and Extron system
- 1 x RJ45 data point at point A for data projector

Connection plates vary at the termination point at the desk and the lectern therefore it is better to have blanking plates in position and the AV integrator will terminate and apply the correct output terminals.

<u>Cable Requirement – Lectern</u>

- 5 x cat5e / Cat6a shielded non terminated (Cat6a recommended) – Run from Point A coiled in ceiling
- 2 x RJ45 data points at point C Lectern around ground level at lectern point. From this point two network cables on a loom will connect into the lectern. Care and consideration should be given to the location of the wall placed connection points to ensure that from a health and safety perspective the loom runs in the correct manner to the lectern. Ideally in new builds floor boxes should be placed to allow for connection in several points
- 1 x RJ45 data point at point A for data projector
- 1 c cat5e / Cat6a shielded from point **D** to **C**

<u>Draw/ Pull Through Cables</u>.

These give an added advantage of allowing cables to be pulled through in the future and allow for contingency when a cable failure has occurred.

It is recommended that in new builds that 3 such cable types are installed alongside the existing cable runs from data projector to Extron control box.

It is recommended in remodelling spaces that two such cable types are installed. alongside the existing cable runs from data projector to Extron control box.

5.4 – Audio Requirements

<u>Audio Requirement.</u>

Audio is subjective to each person therefore the design will determine a good sound experience to cater for differing source outputs.

Room size dependant then the initial requirement would be;

- Powered Front of House (FOH) speakers with a good frequency range at point **E**
- Ceiling speakers for sound re-enforcement. Quantity dependant on points **F**
    - Room size
    - Ceiling height

Ceiling speakers will require low impedance cabling run in an unbroken circuit around the room space. Then being taken down the containment if no lectern

If a lectern is used in the teaching space then the cable can be left in the ceiling void.

The above is intended as a guide as each teaching space may have a requirement that differs from the standard audio visual requirement.

Appendix 1- Screens, Specifications and Sightlines

A1.1. Introduction

Design Goals

Screen based presentations are a crucial part of modern Teaching and Learning practice. The content displayed can vary between:

- PowerPoint presentations
- Video and cinema
- Websites of all kinds
- Spreadsheets
- Detailed graphs, charts, plans and illustration
- Fine text from books, magazines and websites
- Scientific data and visualisations
- Specialist software
- Etc.

Presentation Screens and Ceiling Heights

As a rule, the screen should be appropriate for the audience rather than the projector and must be able to be viewed from all reasonable positions in the room. The screen needs to be in proportion to the distance of the furthest audience member.

The decision on the screen size is not an arbitrary figure but must be made on the application of the viewing distance rule.

As a "Rule of Thumb" the aim is to achieve a large enough screen for those in the back row of seats to be able to read a 10pt body of text from a standard web page, but not so large as to be far too big for the closest viewer.

The ceiling heights within buildings can be insufficient to allow for the appropriate screen size. A rule to remember is that if the room is longer than 7.5m then the ceiling height must be greater than 2.7m to provide an acceptable screen viewing. (See Chart below)

Ceiling height calculations based on 5.3 ratio, 1.2m off floor and projection screen case under the ceiling	
Distance to Furthest Audience Member	**Required Ceiling Height (m)**
<7.5m	2.7
7.6 - 8m	2.8
8.1 - 8.5m	2.9
8.6 - 9.1m	3.0
9.2 - 9.6m	3.1
9.7m - 10.1m	3.2
10.8 -11.2m	3.4
11.8 - 12.2	3.6
12.9 - 13.3m	3.8
13.9 - 14.4m	4.0
For every 475mm extra distance add 100mm ceiling height	

Aspect Ratio

There are standard screen sizes based on the aspect ratio of the projected image. Historically OHP, 35m slides and video were viewed on a 4 x 3 ratio screen but 16 x 9 (also 16 x 10) is now the more common aspect ratio to allow for widescreen presentations. Modern film, video and television programming, output from wide screen laptops and monitors from desktops tend to use 16:9 / 16:10 ratio.

A1.2 Rules for Screen Size and Sightlines

In order to determine the optimum screen size and position it is necessary to take note of the room dimensions, the ceiling height, the seating layout and the content of the presentation.

There are some useful rule-of-thumb guidelines, for instance…

1. It is usual to install the largest screen possible.

2. The bottom of the screen should be at least 1.2m above the finished floor level.

3. In many locations, the top of the screen will be as high as practically possible (see Ceiling height note above).

4. The maximum horizontal viewing angle is generally considered to be 45degrees (see Viewing Wedge note and chart below).

5. The maximum vertical viewing angle is generally considered to be 30degrees (see Viewing Wedge note and chart below).

6. The minimum distance for the first row of the audience is twice the screen height.

7. There is a standard rule-of-thumb for establishing the screen size, which is the 4-6-8 rule (see note below).

A.1.2.1 Ceiling height:

In general, the minimum floor to ceiling height required to accommodate a standard 1.8m wide screen is 3m.

As a rough guide 1.6m plus the screen height is about right. This can usually be achievable in new buildings if it is included in the planning process along with building systems that share the space between the suspended ceiling and the underside of the floor above. A possible solution is to raise the ceiling at the teaching wall end of the room but to leave enough space above it to install the screen housing. If it is practically impossible, at least try to mount the screen housing above it.

A1.2.2 Screen Height and Viewing Distance – Rule 1

Screen Size Overview

One of the most fundamental decisions to be made in any location using AV is the screen size, which is influenced by the size, shape and ceiling height of the location, the seating arrangement and capacity and the viewing distance as well as the content and format of the material being viewed. The screen itself may typically be specified as wall-mounted, ceiling-mounted, rail-mounted or as part of a column board system etc. Screens can also be either manual or designed to be electrically operated. Issues such as the height from the floor, surface material and whether it is front or rear projection need to be considered. Then there is the issue of the format of any projected material i.e. video or data and the screen ratio i.e. 1:1, 4:3, 16:10 etc. It is effectively impossible to specify an all-purpose screen. Without referring to complicated calculations for establishing the correct screen size for any given function a few general rules-of-thumb. For all practical purposes the screen should be as large as possible. The bottom of the screen should be no lower than 1.2m from the floor and the distance from the teaching wall to the furthest away seat should not be more than five or six times the diagonal size of the screen. For instance, a 1.8m wide screen will have a diagonal size of 2.25m so the maximum viewing distance would be just over 11m. There are no universally recognised standards for screen sizes, only guidelines, all of which ultimately depend on the content of the presentation. With the move toward the widescreen high-definition output from laptops this has made it difficult to accommodate older standards as well as the most demanding formats. Some people use the 4-6-8 rule when the distance is four times when viewing CAD content, six times for spread sheets and eight times for video. However, rooms are rarely booked out with that kind of flexibility in mind. Others use the 5.3 x H rule where H = Height of the screen. This rule takes into consideration that most classrooms and lecture theatres are general purpose (GPT's) and may cater for both kinds of tasks identified above. There is the Screen diagonal x 6. Screen width x 6. All are not exact and probably never can be unless the room is designed to a specific formula.

Screen Height v Viewing Distance

There are a number of 'rules' for Screen Size and Sightlines that the University is adopting in-order to give the best viewing experience for the students and the best teaching experience for the staff.

It is appreciated that the rules that govern the size and position of the screen in relationship with the room and teaching space seating will not always fall into the rule exactly and in this case it would need to be the best fit for the user experience.

ICIA recommendations Detailed Viewing Tasks (text based) are:

The height of the projection screen or flat panel display shall be no less than the distance from the centre of the screen to the furthest audience member divided by 6 [see Figure 4] viewing distance is also governed by the screen ration (16:10) [Figure 6]

- Where H = height of projection screen (6 x H)
- Ceiling height is another factor that needs consideration. [Figure 5]

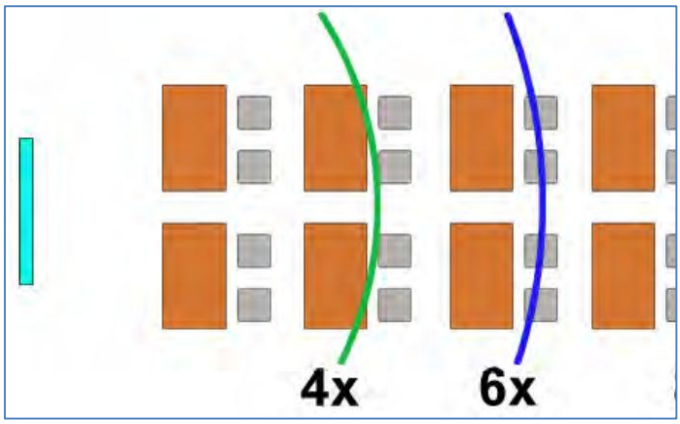


Figure 4

Ceiling height calculations based on 5.3 ratio, 1.2m off floor and projection screen case under the ceiling	
Distance to Furthest Audience Member	**Required Ceiling Height (m)**
<7.5m	2.7
7.6 - 8m	2.8
8.1 - 8.5m	2.9
8.6 - 9.1m	3.0
9.2 - 9.6m	3.1
9.7m - 10.1m	3.2
10.8 -11.2m	3.4
11.8 - 12.2	3.6
12.9 - 13.3m	3.8
13.9 - 14.4m	4.0
For every 475mm extra distance add 100mm ceiling height	

Figure 5

The calculation of the minimum allowable screen height or the maximum allowable viewing distance for the screen height also relates to the material being shown.

It is worth noting out that because of things like restricted ceiling heights and other practical limitations it is not always possible to install the optimum sized screen.

A1.2.2.1 The 4-6-8 rule:

The minimum screen size must allow viewers at the back to clearly read information presented on the screen and the furthest the audience should be from the screen is no more than four, six or eight times the screen height. This depends on the following…

1. Four times is for content like CAD or Photoshop files.

2. Six times is for detailed reading (spreadsheets or text with images).

3. Eight times is for watching a video or photos. (generally not used unless specified in design)

A1.2.2.2 The 6 times rule:

However, there is an alternative rule-of-thumb that can be used to determine the screen size and / or the maximum viewing distance, which is that the furthest away row of seats should be six times the diagonal of the screen. This six times rule is always best used as a general guide.

A1.2.2.3 The 720 x 576 rule:

There is yet another view; that the maximum viewing distance of six times the width of screen. This rule is based loosely around 720 x 576 video information, a calculation based on the maximum distance that the eye can discern pixels from each other.

Viewing Distance 16:10 screens

The table below indicates examples of maximum distances serviced by standard, commonly available 16:10 screen sizes – "Maximum viewing distance" is the distance to the furthest audience member measured in meters, to the nearest 10cm.

Maximum Viewing Distances
16:10 Screens

Diagonal Inches (mm)	**Width** (viewable area in mm)	**Height** (viewable area in mm)	**ICIA Detailed Viewing** H x 6	**ICIA Inspection Viewing** H x 4	**AETM Recommended** H x 5.3
84 (2130)	1810	1131	6.8 m	4.5 m	6.0 m
96 (2440)	2070	1294	7.8 m	5.2 m	6.9 m
100 (2540)	2155	1347	8.1 m	5.4 m	7.1 m
120 (3050)	2585	1616	9.7 m	6.5 m	8.6 m
130 (3300)	2880	1800	10.8 m	7.2 m	9.5 m
150 (3810)	3230	2019	12.1 m	8.1 m	10.7 m
200 (5000)	4300	2700	16.2 m	10.8 m	14.3 m
300 (7600)	6450	4000	24.0 m	16.0 m	21.2 m

Figure 6

A1.2.3 Screen Size

One of the most fundamental decisions to be made in any location using AV is the screen size, which is influenced by the size, shape and ceiling height of the location, the seating arrangement and capacity and the viewing distance as well as the content and format of the material being viewed. The screen itself may typically be specified as wall-mounted, ceiling-mounted, rail-mounted or as part of a column board system etc. Screens can also be either manual or designed to be electrically operated.

Issues such as the height from the floor, surface material and whether it is front or rear projection need to be considered. Then there is the issue of the format of any projected material i.e. video or data and the screen ratio i.e. 1:1, 4:3, 16:10 etc. It is effectively impossible to specify an all-purpose screen. Without referring to complicated calculations for establishing the correct screen size for any given function we have used a few general rules-of-thumb.

For all practical purposes the screen should be as large as possible.

The bottom of the screen should be no lower than 1.2m from the floor

The distance from the teaching wall to the furthest away seat should not be more than six times the height of the screen.

Example

For instance, a 2m wide screen will have a screen height of 2.27m so the maximum viewing distance would be just over 13m. There are no universally recognised standards for screen sizes, only guidelines, all of which ultimately depend on the content of the presentation. With the move toward the widescreen high-definition output from laptops this has made it difficult to accommodate older standards as well as the most demanding formats. Some people use the 4-6-8 rule when the distance is

- four times when viewing CAD content,
- six times for spreadsheets
- eight times for video.

However, rooms are rarely if ever booked out with that kind of flexibility in mind. They are typically booked out as a space to teach in. Therefore six is considered the all-rounder. See examples below.

A typical screen aspect and dimension calculator can be seen at…

http://www.silisoftware.com/tools/screen.php

Example 1. Detailed Viewing Tasks (Text Based):

A 2m wide screen has a screen height of approx. 2.27m

This would give a maximum seating distance of:-

2.27(screen height) x 6(multiplier) = 13.62m (max seating distance)

Example 2. Detailed Viewing Tasks (Text Based):

Room length 13.62 requires a screen height of minimum 2.27m

13.62(Room length) / 6 (divider /multiplier) = 2.27m (min screen height)

A.1.2.4 Viewing Wedge:

The area where students can see the image with little loss of legibility or distortion is called the “viewing wedge.” [figure 7] It is a 90-degree arc drawn from the centre point of the screen and extending 45 degrees to each side of the perpendicular triangle. It should extend to the maximum viewing distance (see previous note).

Seats can sometimes be arranged in a series of concentric arcs whereby students can see each other more easily. In this arrangement, eye contact increases significantly, leading to improved interaction and engagement.

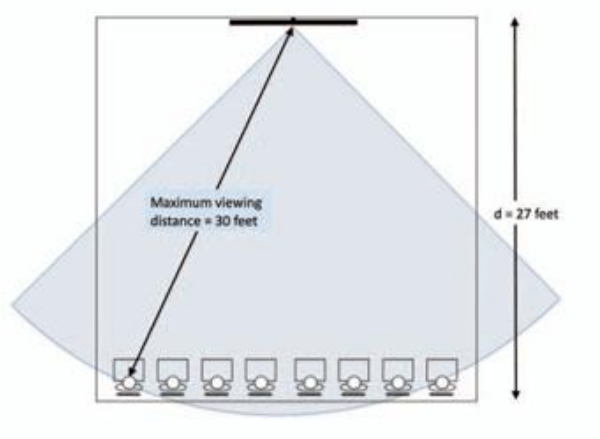
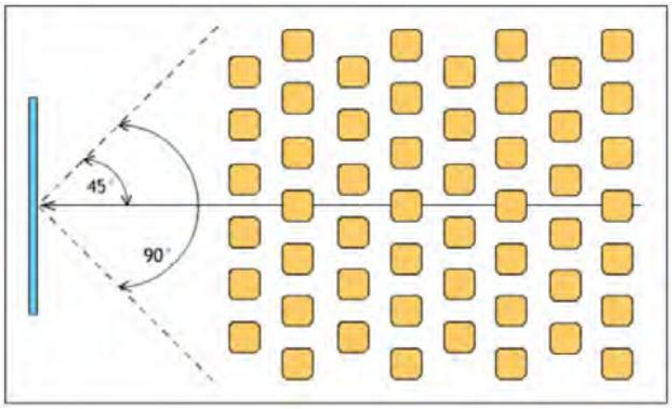
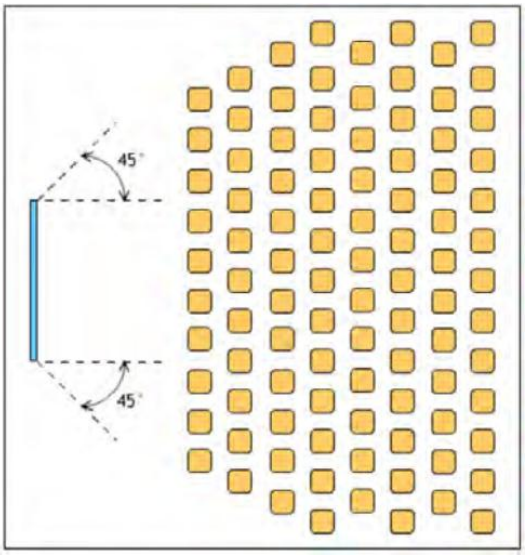


Figure 7

The viewing wedge narrows towards the front of the room, resulting in visually suboptimal space on either side. This space may be recovered by angling the walls inward. The result is a room shaped like the viewing wedge, a bit larger, and with the tip sliced off. The area outside the wedge is available for other purposes. The wedge shapes fit neatly together in a circle or side by side, alternating in direction. Any odd shaped leftovers might be used for demonstration equipment storage, seating, and so forth. Rooms, which follow these rules, are quite space efficient, as well as superior pedagogically.

Figure 8 & 9





A.1.2.5 Horizontal, vertical viewing angle – rule 2, 3

Rule 2: Maximum Horizontal Viewing Angle

The maximum horizontal viewing angle shall be 45 degrees from the centre line of the screen.

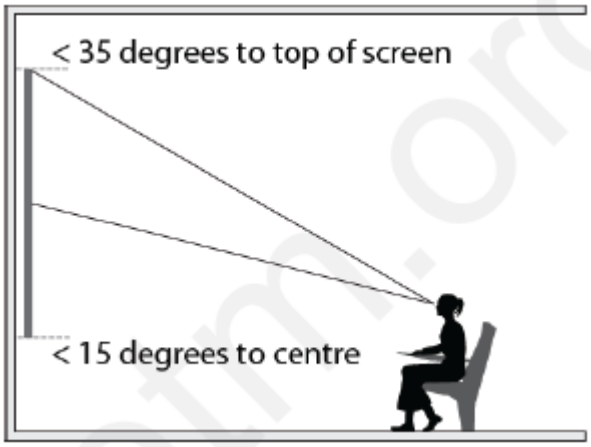
The legibility of any text and images would be compromised at any greater angle. If using this in a large teaching space then the consideration of repeater screens should be considered as an option.

Rule 3: Maximum Vertical Viewing Angle

The maximum vertical viewing angle should be no more than (+-) 15 degrees to the centre of the image, measured from perpendicular at a seated eye height. (1270mm).

This rule is designed to prevent neck and eye strain.

Figure 10



A.1.2.6 Screen height rule 4, and screen recommendations

Rule 4: Screen Bottom Edge Minimum Distance from the Floor

For single level teaching spaces with an unobstructed view the screen should be positioned so that the bottom edge of the viewable area. (Exclude any border) is approx. 1.2m above the floor.

Notes:

The preferred height is 1.35m or more. In tiered lecture theatres the height may be lowered marginally to suit, however the decision on the screen position must take into account the potential issue of glare in the presenters eyes from the projector. In labs or other spaces where there are obstructions, the screen must be positioned to allow for a clear view over or around the obstructions while at the same time taking into account the maximum viewing angles.

Illustrations

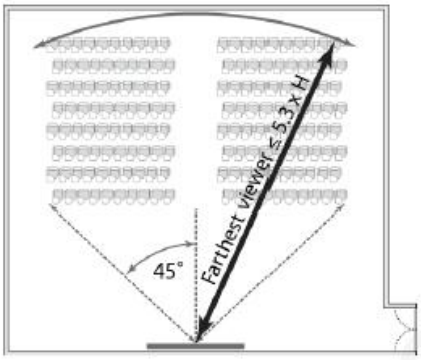


Figure 11

Shows the floor plan of a rectangular lecture theatre which meets the requirements for viewing angles and distances.
H = screen height.

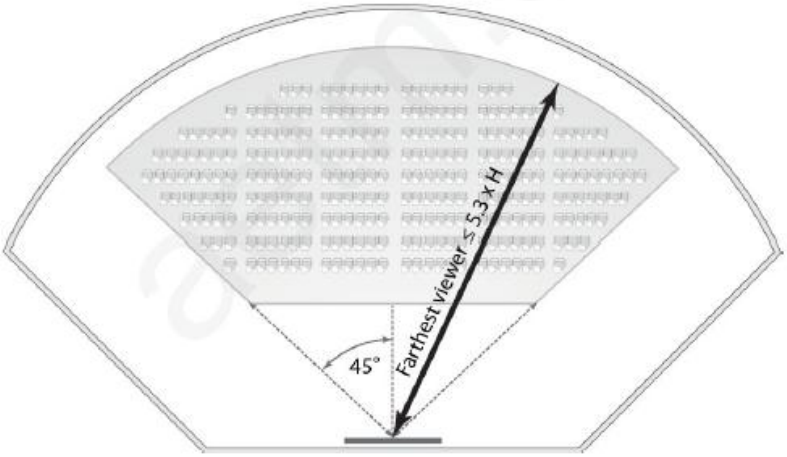


Figure 12

Shows the floor plan of an auditorium style lecture theatre which meets the requirements for viewing angles and distances.
H = screen height.

A.1.2.7 Screen Recommendations

Viewing Conditions for Dual or Multiple Screens

Where a teaching space is fitted with more than one screen, the rules should be applied to each screen to ensure that, where different information is to be displayed on each screen, the viewing area falls within the maximum distances and within acceptable angle of view for both screens. This means calculating the distance and angles for 'the worst' case screen.

Recommendations for Dual Projection/Display

Dual projection is recommended for larger venues presenting educational material on screen. The benefits are

- Ability to present complementary and / or comparative material simultaneously.

- The ability for most presentations to continue should a lamp or projector fail.
- Improved sightlines for the audience members.

Recommendations for Screen Aspect Ratio

A projection area or screen with a 16:10 (width to height) ratio is recommended for lecture theatres. This is ideal for the typical display ratio adopted by most wide screen PC's and laptops and also suits modern film and television programming presented in 16:9 ratio.

Appendix 2 - Projector Technology

The brightness of a projected image can vary enormously, from as little as 100 lumens in small Pico projectors to 40,000+ lumens for major event systems. Anything above 10,000 lumens is generally regarded as 'high brightness', but manufacturers are constantly striving to increase the brightness of their products, to the point where they are now beginning to match LED video walls.

The brightness required depends on the amount of ambient light and reflectiveness of the screen (custom-built screens produce brighter images than a plain wall). As a rule of thumb, in average lighting conditions you need about 2,000 lumens per 16 square feet of screen, so a 6ft x 3.4ft screen will need 2,500 lumens while a 10ft x 5.6ft screen will need 7,000 lumens.

For very high-brightness applications it may be cheaper to 'stack' two or more lower-specification projectors all overlaying the same image rather than invest in a single model with higher brightness.

Image resolution is increasing, too, roughly in line with that of flat panel displays. HD (1,080 pixels wide) is widely available and affordable, with up to 4K (four times HD) now coming to market.

Higher resolutions can be achieved by dividing the image between multiple projectors. Edge blending software enables overlapping of each projector's output, creating a single, seamless image.

A.2.1 Image Quality and Lighting

Contrast Ratio Standard for Projected Images

Standards Compliance

To provide acceptable legibility for projected images, the contrast ratio (the difference between peak white and 'black' in the projected picture.) must fall within defined minimum limits. The contrast ratio achievable in a teaching space depends upon the brightness of the projected image (the 'peak white') and the amount of ambient light falling on the projection surface. (This determines the 'black' or minimum level)

ANSI/INFOCOMM 3M-2011: Projected Image System Contrast Ratio Standard

Application of the ANSI/INFOCOMM 3M-2011Standard In Learning Environments

In teaching space design, and in particular in lighting design, ambient light from all sources must be controlled so that the following minimum recommendations regarding contrast ratio are achievable at any point on the image area. Measurement should be according to the procedure outlined in the ANSI Infocomm standard.

Projected Contrast Ratios		
Projection Type	Examples	Minimum Contrast Ratio
Text and Numerals	Bullet point text, documents, spread sheets, charts and graphs	7:1
Pictorial	Black and white or colour photographs, artwork, illustrations	15:1
Motion Pictures	Film, video, or television programs	80:1 (best practice) 50:1 (minimum acceptable for classroom viewing)

Table 4-1

In lecture theatres and other educational presentation spaces the standard lighting pre-set for projected presentations also provides workable levels of light for student note taking. This pre-set would correspond with the 7.1 contrast ratio as above.

The next lighting pre-set in a lecture theatre provides lower light levels in the space. The purpose of this pre-set is to provide lower light levels in the space. The purpose is to provide the best quality of image possible while still accommodating note taking by students. The 15:1 contrast ratio is appropriate for this pre-set

The final pre-set in a theatre is usually for the presentation of cinema or similar material. A 50:1 contrast ratio is best for these in an educational environment.

These can be difficult to achieve while at the same time providing sufficient light to illuminate the presenter and the students writing surfaces. However it is essential this is achieved. All uncontrolled light that reflects off surfaces can be detrimental. Light coloured floor coverings and furniture near the projection screens should be avoided as much as possible as these types of colours will reflect significant amounts of light from the room lights, spot light etc.

Recommendations for Minimum Projector Brightness

Large venues require large screens which in turn require powerful projectors. For example, using the inverse square law a screen twice the width requires a projector 4 times as powerful to achieve the same brightness on the screen.

ANSI Lumens is a measure of light emitted by a projector and a LUX is a measure of light falling on a given area.

A common target for projection is 500 Lux for any given screen size. This is normally achievable for small to midsized spaces. It becomes more difficult to achieve this in large venues without the use of expensive equipment. For large venues a 300 Lux target can be looked at providing the target for ambient light is carefully controlled.

Recommended Minimum Projected Light Output

Recommended Minimum Projector Light Output			
Screen Size (Diagonal)	Screen Width	Screen Height	Projector ANSI Lumens
100" (250cm)	2.15m	1.35m	3000
120" (330cm)	2.6m	1.6m	4000
150" (380cm)	3.2m	2.0m	5000
200" (500cm)	4.3m	2.7m	7000
>200" (500cm)	>4.3m	>4.3m	Specialist Hi Power

Recommended Projection Surfaces

Projection should ideally be onto matt white, purpose manufactured projection screen material with a gain of 1.0 (The gain is a measure of screen surface reflectivity). Screens may be fixed or retractable (manual or electric). Where high gain greater than 1.0 or rear projection is used then the manufacturers recommendations must be followed regarding the optimum angle must be followed.

Recommendation for Walls as Screens

Walls are acceptable as projection surfaces so long as they are painted flat (matt) white and are uniformly flat and perpendicular to the projector and the audience. Specialist paint is also available for projection walls and can be used for projection.

Whiteboard and Writable Surfaces

Whiteboards are generally not suitable for use as a projection screen surface as the shiny surfaces causes an unacceptable level of glare and hot-spotting. Where whiteboard surfaces are used in special circumstances (i.e. interactive whiteboard) the projector used should be of the ultra-short throw so that most glare is reflected away from the audience area. Glass writing surfaces are not normally recommended as projection surfaces however there are some manufacturers that are currently utilising glass surfaces for projection and writing surfaces. (TK-Team).

Recommendations for Flat Screen Technology

The cost of flat screen technology has rapidly dropped over the years with the initial run on Plasma, then LCD, LED, OLED, Standard definition, High Definition and now 4K resolution on the market place.

For smaller venues and smaller video conferencing areas it should be the main choice option.

The selection and placement of a flat screen must be governed by the same size and sight rules as for projection. Therefore a display of around 165cm (65") diagonal will be able to go into a room of approx. 4.5m in length.

A2.2 Data Projector Mounts and Fixings

Data projectors requiring to be ceiling mounted require a ceiling plate to fix the projector to the ceiling and a pole cut to the correct length to enable the data projector to display correctly onto the screen.

Plates

The standard fixing plate is the Unicol CP1 or CP2 plate. The difference being the maximum load and the securing spacing holes on each. These plates are utilised when there is a clear flat fixing point above the ceiling or on high ceilings directly fixed to the ceiling. Weight limits need to be observed and in the cases where the floor above is a wooden floor or subject to movement when walked on, some form of anti-shock, vibration dampening is used to stop/ reduce the vibration down to the data projector

Alternative plates are available for situations that require spanning between struts or coming off 'corrugated' concrete spaces. Examples below.

Unicol CP1 Standard Ceiling Plate.

Used as part of the modular ceiling mount Range from Unicol which is a flexible range of ceiling mounts that offers a range of top fixing plates, column lengths up to 3m and a range of flexible tv mounts to suit all sizes of tv screen.

- Max load: 60Kg
- Colour: Black
- Plate fixing holes: 120x120mm

Unicol CP2 Standard Ceiling Plate.

Used as part of the modular ceiling mount range from Unicol which is a flexible range of ceiling mounts that offers a range of top fixing plates, column lengths up to 3m and a range of flexible tv mounts to suit all sizes of tv screen.

- Max load: 120Kg
- Colour: Black
- Plate fixing holes: 240x240mm

A.2.3 Recommendations for Projector Placement

Vertical Position

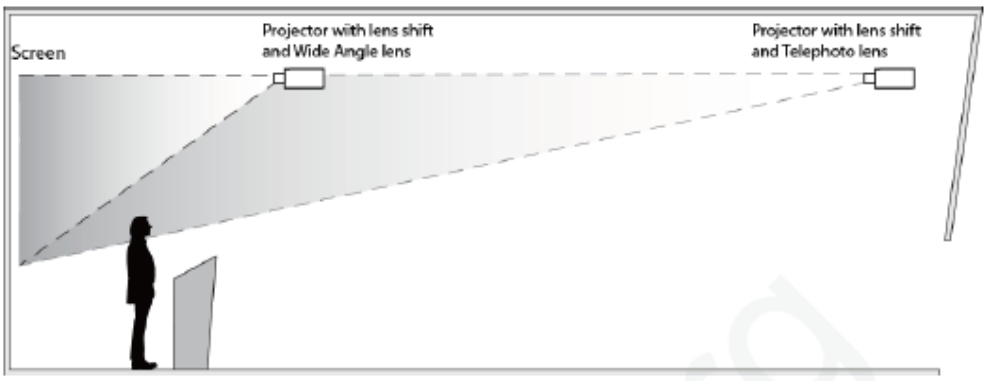
The height that a projector is positioned is dependent on a number of factors. Each projector has a different optical characteristics and a manufacturers recommended vertical position in relation to a given screen size. To ensure a high quality image the projector must be installed in the manufacturers' recommended vertical position. Some projectors will have a lens shift option which allows for a range of vertical positions to be used. In all cases the projector should be installed horizontally level. A projector with a motorised lens shift capability can be aligned with the top of the screen. The use of electronic keystone correction to correct the image is still however regarded as unacceptable as even the small amount of correction degrades the clarity of the image.

Horizontal Position

The decision for this is also influenced by a number of considerations.

- Ease of maintenance
- Projector noise
- The presenter's workable area in front of the screen free from projector glare.
- The additional cost of a telephoto or short throw (wide angle lens) Can nearly double the cost of the projector
- Security concerns.

The ability of the presenters to walk in front of the screen without having to put up with glare from the projector in their faces is an important factor and should not be ignored. It can have possible H&S implications. The closer a data projector is to the screen the steeper the angle of light and the more glare free work area is created. See diagram



This becomes more critical when an interactive whiteboard is installed. Where this is installed there are a variety of ultra-short throw data projectors that come with them to alleviate the problem. These should always be used in conjunction with an interactive whiteboard.

Currently Short Throw data projection is only suitable on a screen with a gain of 1 or less. Where gain is a factor (i.e. rear projection) manufacturers recommend that the projector be placed at a distance greater than 1.6 x screen width (16:10) to avoid excessive angles of incidence which will cause brightness issues at the edges of the picture. If short row projectors are being considered then look at the large monitor option as a viable alternative.

A2.4 Short Throw Data Projectors

A drawback of older projectors was the tendency for the image to be interrupted by a shadow of the presenter's arm or audience members' heads. Short throw projectors aim to eliminate the problem by placing the projector closer to the screen – typically less than 3ft, and as little as 12in in the case of ultra-short throw models. Image correction software within the projector ensures the image is not distorted.

Short throw models project high-quality images, and are useful for interactive settings where users must get within touching distance of the screen. On the downside, they can only project on to flat surfaces, may be more difficult to set up and are not as portable. Brightness is also an issue as most only go up to 2500 ansi lumens along with screen size being limited.

The image size can also be a restriction. The Short Throw (ST) or Ultra Short Throw (UST) are therefore best utilised in smaller teaching spaces with a low level of ambient light.

A2.5 Lamped Data Projectors

However, the main issue with traditional projectors is the light source. Incandescent lamps are energy-hungry and run so hot that they require noisy cooling fans. And although lamp life is improving (some vendors now have lamp life from 8-10,000 hours compared with the traditional 1-2,000 hours) lamps still have a limited lifespan, making them prone to fail at inconvenient moments, while replacements can be expensive. Lamps may also contain mercury, a hazardous substance that environmentally-conscious organisations are keen to eliminate.

A2.6 LED Data Projectors – 'Lampless'

So the major breakthrough in projector design in recent years has been the advent of solid state light sources, most commonly LED or laser (or a combination of the two). These typically have a rated life of around 20,000 hours and should last for a projector's lifetime.

LED and laser are also highly adjustable and do not degrade significantly over time, so the image maintains its brightness and colour quality and the projector is less likely to need servicing or recalibrating. They do not require long warm-up or cool-down times so the device can be powered up and down almost instantly. They can be mounted in almost any orientation, not just horizontally like most lamp-based models.

They use a lot less energy, which cuts running costs, benefits the environment, and does away with the need for cooling fans, enabling virtually silent running. No fan also means no filters to change, and cool running means more flexibility over where to install the projector – close to a wall or ceiling, for example, or even inside a box.

A2.6.1 Downside to Lampless

Solid state projectors are expensive compared with lamp-based models, and cannot yet generate sufficient brightness to fill very large spaces. They have also suffered from inferior image quality and colour reproduction, although these are improving. However, their rapidly growing market share demonstrates that many buyers feel the advantages outweigh the drawbacks, and they are likely to become the dominant technology before long. Most vendors now offer three-dimensional projection capabilities, although the best results require high brightness and resolution. 3D holographic images can be effective, but currently their use is limited owing to the complexity of creating the content.

A2.7 Firmware

The University requires that all hardware that can be upgraded via firmware have the latest firmware installed to minimise potential problems with the equipment.

A2.8 Seat to Screen Viewing Distances – (TV)

Before considering purchasing a High Definition television it is important to take the **viewing distance** into consideration. While large screens are great, you'll need to ensure that your room does allow for a comfortable distance between the TV and where viewers will sit.

Minimum and Maximum Television Viewing Distances

How far you sit from your television can be a personal choice; however you must take others into consideration in this environment. There are certain recommendations to keep in mind.

Because of their high resolution, wide screen High Definition televisions allow you to sit closer to the screen and still view crisp pictures. You'll enjoy a movie-like experience without eyestrain. Generally speaking, you can view an HDTV screen from as close as 1.5 times the screen's diagonal measurement. If you view a High Definition television from too far, you greatly reduce the impact of the viewing event. But... if you sit *too* close you may see horizontal scan lines and pixels.

Viewing Angle

Most modern flat screens offer a viewing angle much more accommodating than previous display types. The best in this regard would still some would argue be Plasma, However Plasma are being greatly overtaken by the new generation TV's not only because they are lighter, brighter and look cool, but because they are much cheaper to run. The LED, which provides just about the same 160 degree angle of viewing as the Plasma.

The chart below makes it easier for you to choose the right size television for your room:

16:9 TV diagonal screen size	Min. viewing distance (in feet)	Max. viewing distance (in feet)
19-23	3.3	6.5
29-32	3.8	7.6
39	4.3	8.5
40	5.3	10.5
46-47	5.9	11.8
50-51	6.3	12.5
55-58	6.9	12.8
60	7.5	15
65+	8.1	16.2

Other things to consider when deciding what size High Definition television to purchase

Ventilation

You should allow approximately six inches of space on each side of your television for proper ventilation.

Depth

Make sure your HDTV will fit all dimensions. Some sets are very slim (LED), while others are more bulky (DLP).

Eye Level

High Definition televisions are best viewed at eye level. Make sure your room has large enough wall or floor space to accommodate a set that can be placed at this optimal height.

Ambient Light

While modern flat screen displays, especially LED, offer brightness which can easily overcome most brightly lit viewing environments, care should be taken to avoid lighting or sunlight which is oriented directly on to the screen. Most displays, even the latest LED offerings are designed with a mirror-like screen covering which will tend to cause reflectivity of any direct

light. This could interfere markedly with the image being displayed. However, with careful lighting control this potential issue should not be a problem

Appendix 3 - Interactive Boards

An interactive whiteboard is an electronic whiteboard, which looks like a standard whiteboard but it connects to a computer and a projector in the classroom so that when connected, the interactive whiteboard becomes a large, touch-sensitive version of the computer screen.

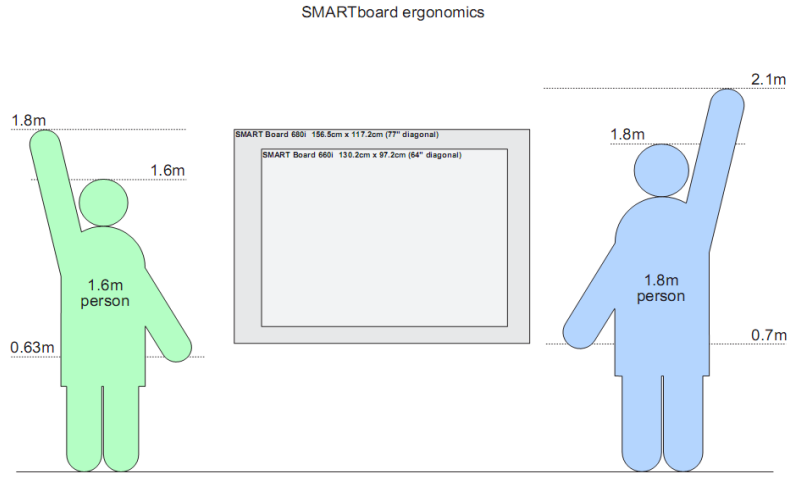
Instead of using the mouse, you can control your computer through the interactive whiteboard screen just by touching it with a special pen or even, in some cases, with your finger. Anything that can be accessed from your computer can be accessed and displayed on the interactive whiteboard, for example Word documents, PowerPoint presentations, photographs, websites or online materials.

Using special software included with the interactive whiteboard, you can also interact with images and text projected on the board: rearranging them, changing their size, colour, etc. This offers a much more interactive experience than using a standard whiteboard or using a data projector alone.

It is important that when considering installing something like a 70" LCD Interactive Board that you take into account the brackets and the structure required to support a screen that can weigh almost 120kg.

The rule of thumb for locating an interactive board [figure 6] is to consider that a person 1.6m in height has a nominal upper reach limit of perhaps 1.8m and a person whose height is 1.8m would have a limit of 2.1m. As it is vital that all parts of the board can be comfortably reached by an average person. It is important to bear these measurements in mind. It is also important not to obstruct the location of a wall-mounted board with dado rails or containment. The bottom of an Interactive Board should be set around about 1.2m from the floor to enable the audience to see the presentation. There are boards available with height adjustable mounts to allow for different users, including disabled users

Figure 6



Appendix 4 - Lecture Capture

The USW is currently using Panopto for standard lecture capture in classrooms. This comprises of;

- Microphone on the desk
- Webcam located on the data projector mounting.

To enable this to work then the University requires the following as part of the cable infrastructure.

- USB Powered extender cable from the webcam to the PC
- USB connection point on the faceplate to allow connection of a microphone.

Appendix 5 - AV Furniture

Audio Visual furniture includes teaching desks, presentation desks, floor-standing lecterns, desktop lecterns, teaching studio tables, study pods, AV cabinets and a variety of bespoke items.

We often consider the AV furniture as essentially being a unit to house the AV equipment, which can sometimes be two racks of equipment (as in the case of a lecture theatre), as well as the unit for housing the control panel or touch-screen. It is very much the working area for many lecturers and requires space for a laptop and notes. It needs to be well ventilated and supplied with power and network as well as signal and control cabling. It should be accessible and designed with wheelchair users in mind as well as being comfortable for keyboard use whilst standing.

In larger rooms it may be necessary to incorporate a desk microphone and a desk light as well as a pull-out tray to house the PC keyboard. Designs for AV furniture are constantly revised as demands change, usage develops and technology changes. It may even be practical to have a bespoke university design.

AV furniture should be sympathetic to the same finish as the surroundings, and as ergonomic as possible although function should always over-ride aesthetics.

Appendix 6 - Disability Considerations

Audio Visual facilities for the disabled can cover a wide range of issues and equipment from the induction loop for the hard of hearing to teaching desks designed to allow for wheelchair access etc. The list also includes…

- Projection screens designed to maximise the viewing angles and contrast to improve presentations for the visually impaired or dyslexic etc.
- Tie-clip radio microphones and Kensington presenters to allow users to be less restricted by presentation areas.
- Vocal reinforcement, infra-red hearing helpers and induction loops.
- Lecture capture and streaming including audio capture.
- Touch-screen control systems with layouts that include graphics and text.
- Welcome / Information screens that permit the display of text etc.
- Interactive Boards and electronic writing tablets that permit text to be displayed in better contrast etc.
- Motorised screens and writing boards.

Appendix 7 - Control Systems

A control system [figure 7] can be considered as replacing all the remote controls by effectively allowing communication between equipment. This does not mean that a control panel can replace all the functionality of a remote control but it can replace enough basic functions to allow the user to utilise the equipment under the vast majority of circumstances. It uses a touch button pad (see below left) or a touch screen (below right) in order to carry out functions such as powering a data projector, selecting sources or controlling the audio levels. It can provide the ability to monitor and remotely control equipment in the system as well as providing maintenance and security alerts.

Control systems are an essential part of the infrastructure of any teaching and learning space and normally require power and network as well as control cabling. We generally deploy

Extron http://www.extron.com/index.aspx control panels.

Control systems have allowed for less support by providing the same user interface regardless of the different equipment in a location. Essentially, the user no longer needs to become familiar with a host of remote controls; they merely need to spend a few minutes familiarising themselves with a touch screen or button pad that they will find repeated throughout the University's teaching and learning spaces.

Control systems can also be used to control lighting, blinds, curtains, screens etc.

Figure 7

USW requires that all firmware and patches are to the latest versions. If the hardware is not at the latest version then this must be applied prior to commissioning.

A7.1 Control Connection

The USW utilises DHCP for its network services. All control hardware linked directly to the internet for reporting to Global Viewer its AV monitoring and control management system must be set to DHCP when installed.

Prior to installation the MAC addresses of the hardware must be passed to the USW network team to apply the MAC address to the nominated network port.

Once connected the hardware will pick up the IP address assigned to that port and be uploaded to Global Viewer.

Appendix 8 – Fittings

A8.1 Brackets

There are a variety of specialist brackets and shelving associated with AV equipment for use with things like ceiling-mounted data projectors, wall-mounted pull-down screens, information screens, interactive boards, cameras, monitors, etc. In particular, consideration has to be taken to where ceiling-mounted data projector brackets and ceiling-mounted loudspeaker brackets may be located in relation to lighting grids and to reinforcing walls where a large LCD or plasma screen may be installed.

See section 'A2.2 Data Projector Mounts and Fixings'.

A8.2 Signal & Control

The wiring requirement associated with signal and control in a lecture theatre are concentrated in the teaching desk with additional cables being run to external devices such as the data projectors, the induction loop, cameras, additional microphones, loudspeakers etc.

For smaller locations the cable numbers would be scaled down but there will generally be a minimum requirement for cabling and containment between the AV cabinet or presentation desk and the data projector, Interactive Board or LCD screen.

In all spaces where audio visual equipment is to be fitted lockable, ventilated, purpose designed space must be reserved for the equipment which comprises the audio, video, control and lighting sub systems. Provision must be made for power and data access to this space and for fitment and maintenance of interconnecting signal cables.

Adequate bench space must be allowed for the fitment of control panels, preview monitors, and microphones In addition to user operated equipment such as Visualisers and graphics tablets. This space allowance should be In addition to space for lecturers to place a laptop or portable PC, lecture notes and presentation aids.

While some equipment (such as power amplifiers) are desirably located away from the teaching area because of considerations of fan noise and heat, space must be reserved close to the presentation area for the accommodation of equipment which needs to be accessed to insert media (disks, USB keys, tapes etc.) at the start of a teaching session. This may Include PCs, disk players, (tape players) and recording devices.

Provision must be made to secure this equipment in a way, which still allows access to loading slots, trays and connectors.

A8.3 Faceplates and Connectors

All AV equipped teaching spaces and meeting rooms shall be equipped with a laptop input point in addition to the PC input of VGA / HDMI. This input shall be via VGA DB15 connector and 3.5 mm stereo phono jack plug for audio. There should also be an HDMI connection to facilitate newer style laptops. The USW currently has a mixture of older style with VGA connection and newer laptops with HDMI Staff and Students will have a mixture of both. The plate also requires a USB connection to be able to connect a microphone to enable lecture capture through Panopto. [figure 8]

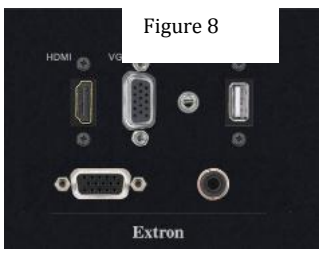


Figure 8

Appendix 9 - Provision for housing equipment

A9.1 Access for Maintenance

Audio Visual equipment in professional use needs to be accessible for routine maintenance (such as filter cleaning) and for emergency maintenance should failure or miss-operation occur during a teaching session.

Professional equipment typically has operational controls and mounting security screws at the front, while power and signal connection Is made at the rear. It Is Important therefore that provision is made for ready access to both the front and rear of equipment racks.

Where rack frames are mounted in lecterns, front and rear access doors should be fitted which are lockable and wide enough to allow removal of the rack without disassembly of the rack or removal of the door.

Where racks are fitted in rooms such as Communications rooms, space must be large enough for provision to be made to access the front and rear of the rack. Communications room access doors should be lockable and wide enough to allow removal of the rack without disassembly of the rack or removal of the door.

If audio visual equipment such as projectors and speakers are to be fitted to a space with flush plasterboard ceilings, ITS Audio Visual team from should be consulted at DD stage to determine the type and location of access hatches required to mount and service this equipment.

A9.2 Ventilation

Active equipment (including PC based equipment) generates significant heat when in operation and excessive operating temperatures dramatically affect system reliability and service life.

A9.3 Racks in Lecterns

Where active equipment is fitted to racks contained in lecterns, the space must be air-conditioned. The rack space within the lectern must be ventilated with provision to pull in fresh air at the bottom and exhaust hot air at the top. Often, forced air ventilation is required, typically using low voltage fans which can operate at very low levels of noise. Two or more fans should be fitted if the active equipment power consumption exceeds 100 watts.

Ventilation provision should be such that the air temperature in the interior of the equipment enclosure (worst case) does not rise by more than 10 degrees Celsius above ambient.

It is essential that any lecterns, cupboards or rack enclosures are provided with ventilation slots at the bottom (to draw in fresh air) and at the top (to exhaust hot air).

Ventilation provision should be such that the air temperature in the interior of the equipment enclosure (worst case) does not rise by more than 10 degrees Celsius above ambient.

A9.4 General Provisions for Equipment

Unless required to be portable when in use, all equipment should be firmly secured to minimise the possibility of unauthorised removal.

Appendix 10 – Standards

Wiring materials and standards of workmanship shall fully comply with the relevant standards required by the USW and the International Organisation for Standardisation (ISO), Including subsequent amendments applicable to any part or item forming part of the installation. [See Appendix E & G]

Cabling standards based on Belden Commercial AV standards

BSI Code of practice for the installation of audio-visual equipment – BS 8590:2014

A10.1 Power

The power requirement associated with a lecture theatre would normally be for a 30amp supply to the teaching desk. Distribution inside the teaching desk to the equipment racks etc. would be either via switched master supply to un-switched sockets or 24 hour supply for switched sockets (those not controlled via the master power switch in order to allow some equipment a constant, uninterrupted 24hour supply) with a possible further distribution via a surge protection unit.

Power and network provision would also be required for AV equipment external to the teaching desk i.e. data projectors, cameras, interactive boards etc. In the case of locations where some equipment may be located in a projection room or booth or an AV cupboard it is important to note that all the AV equipment should be wired from the same ring mains in order to avoid hum on the audio or any distortion of the projected image.

A10.2 Network

The USW network system uses Krone cables throughout its network infrastructure. The cables required for the connection to the control and network port will be provided by the USW network team.

The network requirement associated with a lecture theatre can be in the region of eight network points in the teaching desk to allow for the dedicated pc, the control system and to control and monitor the audio. This assumes wireless network provision in the theatre for laptops and allows some room for expansion of the system if required. Similarly, there would be a provision of up to four network points at the rear of the theatre to allow for cameras and data projector connectivity if required.

For smaller locations these numbers would be scaled down but the minimum requirement might reasonably be considered as four in the teaching desk / presentation area and two at the rear (wherever the camera and data projector is located).

Typical network requirements would be included in the AV wiring diagram along with power, signal and control cables.

A10.3 DigitalVideo

Computer chip makers Intel and AMD and computer manufacturers have jointly announced the end of life for analogue computer video (VGA). The announced end for VGA is 2015; however laptops are already appearing with only digital display outputs. Consequently, all AV system design must now include digital video infrastructure.

Digital video potentially provides improved Image quality, however to be successfully Implemented it

requires careful attention to cable and signal processing design and adherence to cable quality, termination, and installation standards.

Some DVI/HDMI Installations have been plagued by Issues related to the transmission or management of:

- EDID (Extended Display Identification Data)
- HDCP (High-bandwidth Digital Content Protection)

EDID is an electronic hand shaking process where the resolution capability of the display device is communicated to the sending device. The successful transmission and management of EDID Information Is essential.

HDCP Is a copyright protection system that is now incorporated Into DVD players, Blu-ray players and protected computer based media content such as purchased movies. The behavior of each HDCP protected device can vary depending on the media being viewed and the operating system of the device. In some cases, the device can stop working if it detects a non-compliant device attached to the system.

A10.4 Cable Management

A10.4.1 Labelling and Numbering

All connectors patch leads, audio/video leads, controls, equipment and components, terminal blocks and equipment racks shall be permanently labeled. Full schematic diagrams with the labeling must be provided. Labels affixed to cables must be permanent, waterproof and legible.

Labels shall be affixed at both ends of each cable. There shall be no unmarked cables at any place in the system. If cables are left in the system for potential expansion these should also be labeled accordingly.

A10.4.2 Cable Layout and Covering

- All inter-rack and Intra-rack cabling shall be neatly laced, covered and adequately supported.
- All exposed cable shall be covered with heavy duty neoprene heat-shrink tubing Nylon Cable Management Jacket:
- The AV integrator shall organise all signal and power cables which connect equipment racks to adjacent electrical devices. These cables shall be bundled and installed within black nylon woven mesh fabric. This fabric Jacket shall be manufactured for such purposes and shall be sized appropriately according to the quantities and sizes of cables in the bundle.
- All cables shall be grouped according to the signals being carried to reduce signal contamination. Separate groups shall be formed for the following:
    - Power
    - Control Cables
    - Computer Data Cables
    - Video Cables
    - Audio Cables carrying signals less than -20dbm
    - Audio Cables carrying signals between -20dbm and +20dbm
    - Audio Cables carrying signals more than +20dbm

Audio Visual cables should be easily identifiable as AV cabling. If Cat* cable is used then the USW requires that the installer use.

- Purple for connection to Extron GVE

- Blue for Audio-Visual links and connections

This will allow easy visual inspection within ceiling spaces and containment.

Each group shall be spaced at a minimum segregation of 50mm or that specified by current wiring regulations for that signal type (whichever is greater). In all cases, separation will be used to ensure no measurable induced current shall flow in the lower voltage cable as a result of its proximity to a higher voltage cable. Where cables of different signal level must cross they should do so at an angle of 90 degrees for at least 500mm from the crossing point.

Route all cable and wiring within equipment racks and lecterns according to function, separating wires of different signal levels (microphone, line level, amplifier output, AC, intercom, etc.) by as much distance as possible. Neatly arrange and bundle all cable with plastic or Velcro ties ensuring that no undue pressure is placed on the cabling resulting in breaks or crushed cables.

As a general practice, all power cables, control cables and high level cables shall be run on the right side of an equipment rack as viewed from the rear. All other cables shall be run on the left side as viewed from the rear.

A10.4.3 Cable Termination

All cables, except high frequency cables which must be cut to an electrical length, shall be cut to the length dictated by the run with spare cable at the end to allow for adequate termination and sighting of the input terminal(s) etc.. Terminal blocks, boards, strips or connectors, shall be supplied for all cables which interface with racks, cabinets, consoles or equipment modules.

Cables must be of the correct type and manufacturer provided for in the drawings and specifications unless equivalents are approved in writing by the University.

A10.4.4 Minimum bending radius

All cables have minimum specification for bending radius, which is equivalent to 8 x the cable diameter

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, which ever 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.

A10.5 Cable Tray support containment

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 black tubular braided sleeving.

Joints in the tray shall be butted and present a smooth finish to the cable bearing surface.84.7 Joints in cables

Mid-run joints in cables are **not permitted**.

A10.6 Securing and supporting cables

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.

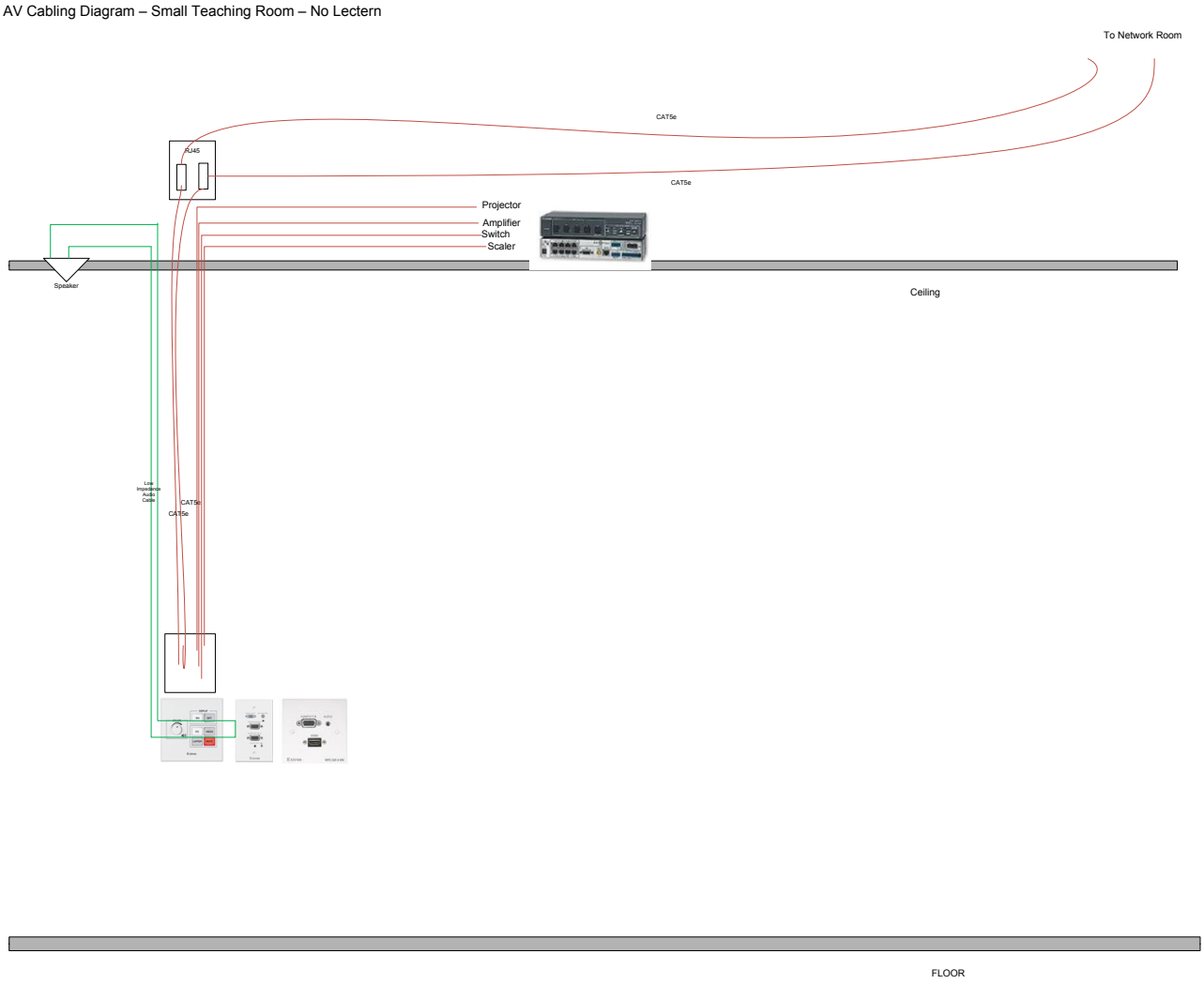
Cable bundles shall not obstruct installation and removal of equipment in equipment racks. Method of support for cable runs:

- Catenary wire support.
- Conduit or duct system.
- Cable tray.

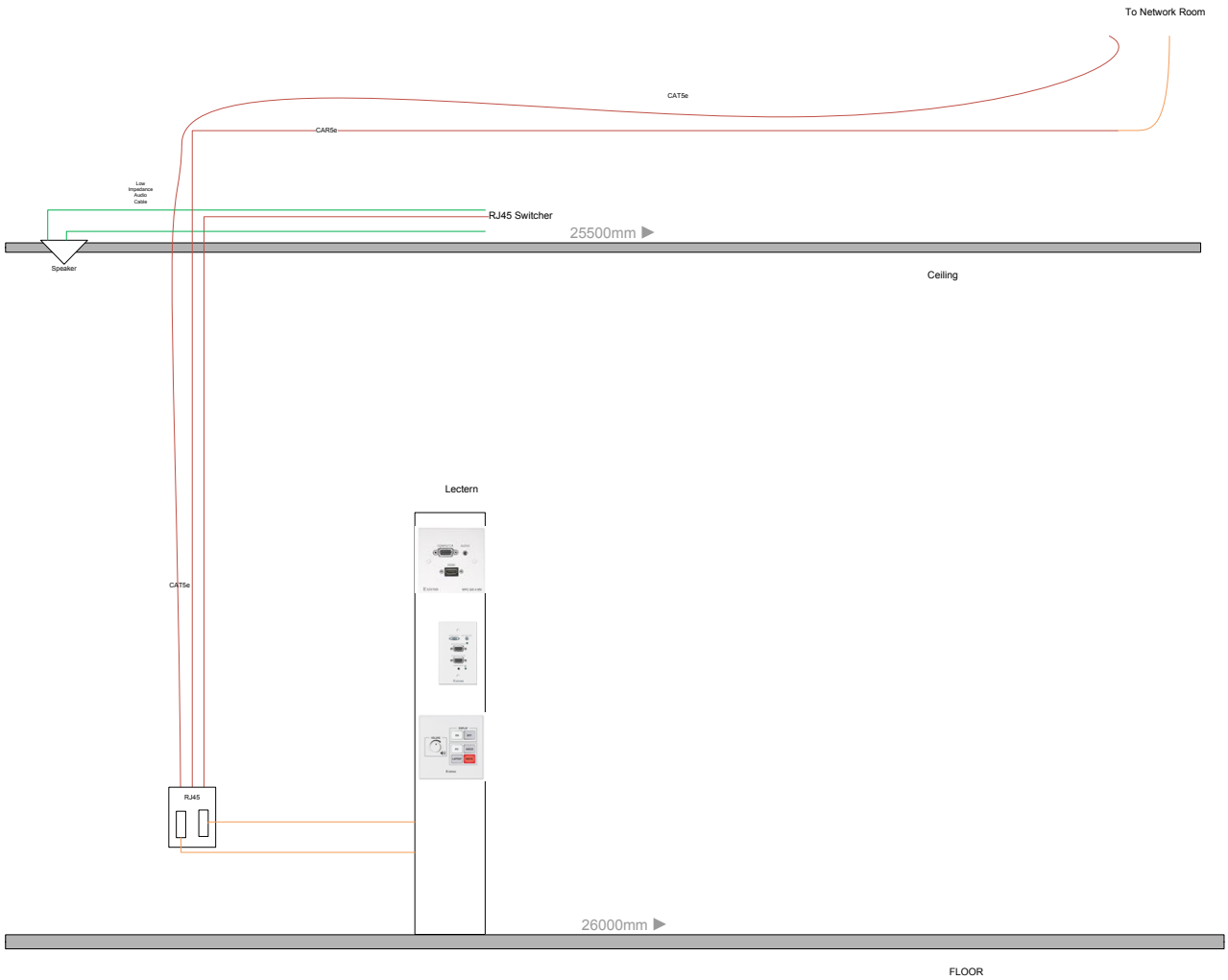
A10.7 Removal of redundant and de-commissioned cabling

All redundant or disused cabling and wall plates must be completely removed, and disposed of. The University expects new cabling to be installed when undertaking a Rolling Replacement Program (RRP)

A10.8– Wiring Diagrams



AV Cabling Diagram – Small Teaching Room – With Lectern



A.10.9 Induction Loops

Legislation for induction loops comes under the

- Disability Access Legislation 2010
- Induction Loop Performance Standards IEC60118-4 2006
- The Building Regulations 2010(12)
- British Standards 8300 – Code of Practice
- Disability Discrimination Act 1995 (DDA)

Audio Induction Loops - Are you meeting the standard?

Providing hearing assistance is a vital way for many organisations to help their customers and staff. With over 14% of the population suffering significant hearing loss, the benefit of hearing assistance systems can be very significant for both the provider and for those who suffer from hearing loss.

However simply installing a system is not sufficient; a hearing assistance system such as an Audio Induction Loop must provide a genuine benefit to the hearing aid user. A poorly designed or installed hearing assistance system is unlikely to meet legislative requirements as the provider is not giving assistance to the hearing impaired. Standards can provide performance benchmarks that will ensure that systems provide a genuine benefit.

The international standard for audio induction loop systems – IEC60118-4 – sets out requirements and test methods for any loop system. As hearing assistance is increasingly mandated by equal access legislation around the world, IEC60118-4 has become the reference for all loop systems, often appearing in specifications and tenders or directly in hearing assistance legislation.

IEC60118-4 sets a clear performance standard for loops. There are four main requirements:

	Purpose	**Test**
Field Strength	Sets the output level for the system, ensuring sufficient signal is delivered to the hearing aid to provide enough volume but no distortion.	• Capable of 400mA/m RMS with 1kHz sine • Variation 4 ±3dB over the required volume of use
Frequency Response	Sets the requirement for flat frequency response to give good speech intelligibility, the most critical requirement for loop system and the most frequently failed.	• Field strength variation 4 ±3dB from 100Hz to 5kHz over the required volume of use (referenced to the level at 1kHz).
Background Noise	Sets a requirement for a maximum acceptable level of background noise. Suppression of background noise is essential to give the intelligibility required by the hearing impaired.	• A-weighted background noise to be <32dB relative to the signal (400mA/m RMS) • Ideally <47dB where possible.
Subjective Test	To ensure the system provides an undistorted clear signal to hearing aid users using the actual system sources (microphones etc.).	• Ideally hearing aid users will validate the system performance. • If not, someone from the service provider must assess the system with suitable receiving equipment.

What action should you take?

If you are specifying, designing, commissioning or maintaining an audio induction loop system, you must do everything reasonable to meet the requirements of IEC60118-4. This will ensure that you provide a system that is a benefit to the hearing impaired and that will comply with any legislative requirements for assistive listening. Here are a few pointers to help you to comply:

Appendix 11 Interactive Technologies and BYOD

A11.1 Visualisers, Tablets and Touch Screen Monitors

These are now taking the place of Overhead Projectors, Interactive Whiteboards, slide projectors and even video players.

The emphasis is now on digital display and presentation. The new age academic and students are more used to the current technological trends and are more comfortable with these methods of presenting.

A11.2. Visualiser

Fundamentally the Visualiser / Document Camera is a more modern over-head project (OHP). Instead of an extremely primitive light projection, a visualiser uses a high-quality camera mounted to either an arm or gooseneck. Most of our Visualisers come with LED lighting and a lightbox to ensure whatever you are displaying, the image is crisp and vibrant, even in the darkest room. Unlike the OHP there is no requirement to copy or use acetate to operate, however more exciting, you can use anything you want.

A Visualiser is an extremely flexible teaching / presentation tool which allows presenters, teachers or students to display just about anything from a piece of paper to ancient artefacts or even people on the interactive whiteboard or an interactive / touch screen. Visualisers are extremely simple to use and can open up a whole new range of materials that can form part of your lesson or presentation.

Visualisers come with many handy features. You can point, mirror image, annotate, split screen, save and recall images, record videos, zoom in and out, or get different views by turning the arm/camera-head of the Visualiser / Document Camera.

A11.3. Tablets

Classrooms Are Ready for Tablets

although tablets are a fairly recent phenomenon, many students in higher education have been using smartphones for years, and are already well-acquainted with touchscreen technology. Because they've become so accustomed to using these devices, students are increasingly expecting to use them in the classroom setting. When classrooms don't implement what has now become "everyday" technology, we're doing students a disservice. Even driving students away.

Additionally, students — and consumers in general — are becoming more comfortable using tablets for advanced tasks. According to a new Nielsen survey, 35% of tablet owners said they used their desktop computers less often or not at all now, and 32% of laptop users said the same. Most tellingly, more than 75% of tablet owners said they used their tablet for tasks they once used their desktop or laptop for. While tablets can't totally match laptops in terms of functionally (yet), they can get today's students most of the way there.

Tablets Fit Students' Lifestyles

The appeal of tablets to a student is obvious: They're thin, lightweight, and spring to life without delay, making them much easier to take to (and use in) class than a laptop or netbook. Longer battery life means that students don't have to worry about carrying a charger with them. Forgot what the professor said at the end of class about the mid-term? Launch any university lecture capture program via the tablet and the content can be streamed straight away, anywhere for the student to watch whenever they like. That's faster than texting a half-dozen classmates and waiting for what might be an inaccurate response.

Tablets Integrate With Education IT Trends

Cloud-based solutions have become ever more popular with colleges and universities, which are looking to deliver synchronized experiences that are device agnostic. Tablets align well with this trend, given their portability and options for constant connectivity. With tablets and cloud-based systems, students can work anywhere on campus and make sure that their work is saved in a central location and accessible from all of their devices. They also don't have to pay for computing power that they no longer need.

[http://mashable.com/2011/05/16/tablets-education/]