Deakin eSolutions (Information Technology Services Division)

ICT Volume 2: Audio Visual Standards

ICT 2.2 2017 Audio Visual Technical Design Standards

Audio Visual and Networks Unit
Document Version 4.1.1

Abstract
This document provides audio visual specifications, technical standards, installation procedures associated with the total or partial development of the audio visual component within lecture theatres, teaching spaces and meeting rooms. This document represents the minimum acceptable standards for audio visual system design and installation.

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1 General Instructions

1.1 Standards Brief

This document provides audio visual specifications, technical standards and installation procedures associated with the total or partial development of the audio visual component within lecture theatres, teaching spaces and meeting rooms. This document represents the minimum acceptable standards for audio visual system design and installation.

For works where Deakin University eSolutions do not provide designs, all works described in connection with the design and documentation of audio visual services shall be the responsibility of the specialist audio visual contractor and/or consultant appointed to undertake the project.

Similarly, unless specifically noted otherwise within this document, all works described in connection with the actual provisioning of audio visual systems (e.g. implementation) shall be the responsibility of the specialist audio visual contractor and/or consultant appointed to undertake the project.

Other stakeholders responsible for specifically identified aspects of project delivery include:

- Deakin University eSolutions – Audio Visual & Network Services (DeS)
- Deakin University Facilities Services Division (FSD)
- Head contractor and associated trades sub-contractors (e.g. communications, electrical, security and heating, ventilation and air conditioning)

This standards document incorporates both technical and operational assertions which are based on developed criteria and shall be adhered unless an exemption is provided in writing from the DeS AV and Networks Unit Leader.

Deakin University has a strong commitment to sustainable design initiatives, and these standards will be continually reviewed to ensure new opportunities in this field are incorporated as deemed appropriate. Influences upon the current version of these standards include motion sensing equipment to facilitate the 'power down' of audio visual systems in response to lack of room utilisation, and the selection of low energy consumption display panel technologies.

Where customer equipment is being interfaced into an installation, manufacturer’s specifications shall be adhered to otherwise installation practices shall follow this standard, provided that these practices do not breach occupational health and safety (OH&S) requirements.

This document has been compiled using drawings which may be updated periodically. Where there may be some doubt as to the interpretation of an instruction, it is the responsibility of the consultant or any agent or contractor associated with the consultant to clarify the situation with Information Technology Services Division before work commences.

1.2 Policy

This standard applies to all audio visual systems throughout Deakin University and associated locations managed by Deakin eSolutions.

1.3 Standard Document Access

All Deakin University DeS staff and contracted personnel are provided access to this document. Designers, installers and contractors must ensure they have the most current version of all standards prior to engaging in any work.
The most recent version can be found on the web at: 

1.4 Related Documents
Many aspects of the system design requirements are specified in other companion documents within Volume 2 of the Deakin ICT Standards. All documents within Volume 2 must be read together to constitute the complete Standard.

1.5 Conflict of Information or Clarification
Whenever a conflict of information occurs or clarification of instruction is required all queries shall be made to the DeS AV and Network Manager.

1.6 Approved hardware models
DeS AV Engineering maintain a list of Approved Hardware. Items on this list have been tested and approved for use at Deakin. Items not on the Approved Hardware list require written approval from DeS AV Engineering for use at Deakin.

1.7 Non-standard configurations
All non-standard implementations must be approved in writing by the DeS AV and Network Manager strictly on a case-by-case basis.
2 Installation standards and conditions

This document does not replace, supersede or override formal contractual terms and conditions between the parties. This section draws suppliers’ attention to some important requirements

2.1 Variation agreements

Any deviation from the stated specification must be agreed to by the DeS AV and Network Manager prior to commencement of any work or as an addendum during the construction process.

Any building features such as:
- Plaster
- Ceiling tiles
- Carpet tiles

that are altered during the installation process must be restored to original condition, to the satisfaction of the site supervisor.

2.2 DeS site inspections

The contractor shall agree to regular site visits from DeS project representatives and have in place a means of communication between senior technical staff and DeS prior to commencement of work.

2.3 Contractor to fully self-inform

The contractor shall fully self-inform and not rely on representations.

2.4 Fit-for-purpose

Solutions shall be fit-for-purpose.

2.5 Contractor obligations to documentation

Unless otherwise noted, drawings supplied by DeS shall be considered shop drawings and are to be used on-site by contractors for the audio visual works. Where requested by DeS, contractors are to supply documentation in electronic form including: as-built drawings, operational manuals.

Deakin University may engage contractors and consultants for initial audio visual designs. In such cases, the contractor and/or consultant shall develop shop drawings for review and sign-off by DeS. This shall occur immediately following engagement of the audio visual contractor and/or consultant, and prior to commencement of any work being undertaken.

2.6 Warranty period agreements

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

2.7.1 Video codec

Video codecs shall be commissioned according to the required DeS process. Refer to https://blogs.deakin.edu.au/avn-docs/standards-documents/vc-standards/

2.7.2 Radio microphones

Each radio microphone shall have its own dedicated radio channel allocated, such that the channel does not clash with any other channel in the venue or in any other venue within range. Allocated channels shall be recorded in the Deakin radio microphone channel allocation Mic Map register. Channels shall be allocated and recorded according to the required DeS process, giving consideration to:

- Allowed frequencies for geographic regions, as prescribed by ACMA.
- Clear frequencies with the allowed range.
- Other nearby systems transmitting in the same frequency block.

2.8 Cabling compliance

Cabling work carried out shall comply with:

- the appropriate requirements of this Technical Standard;
- Manufacturer’s specifications;
- Australian Standard installation and electrical tagging codes, AS3000, AS1000, AS3760;
- IEC 1010-1 Over voltage protection CAT (1 - 1V);
- ACMA technical standards
- DeS Network cabling standards
- Deakin and current legislative OH&S standards.

2.9 Equipment and component protection

- All components of the installation shall be adequately protected from vandalism, mechanical damage, the ingress of moisture, corrosive fumes, dust, high temperature (>35 degrees Celsius) or any other circumstance under normal operating conditions which may expose the system to unreliable performance.
- Where equipment is likely to be exposed to unwanted environmental elements as a result of surrounding building works, the contractor shall provide sufficient temporary protection to the equipment to ensure its safety while the unwanted environmental elements remain. If temporary equipment removal is deemed the only reliable method of providing such protection, a strategy shall be agreed to with DeS regarding removal, temporary storage and re-installation of such equipment.

2.10 Source code agreement

- Prior to sign off at the completion of the contract, all source code and documentation written for the operation of a facility shall be delivered in electronic copy for each room in a format readily modifiable by any programmer qualified through appropriate AMX® technical training. It will thereafter become the usable property of Deakin University.
• Deakin requires both the non-compiled (editable) and the compiled versions of the AMX® source code, and Touch Panel files. Source code and compiled modules are not to be password protected.

• These conditions are not negotiable under any circumstances.
3 Audio visual design principles

Deakin University’s core principles for all audio visual design and installation are:

- **Safety**
  Healthy workplace with no OH&S hazards.

- **Standards compliance**
  Conformance to all relevant regulatory, international and industry standards as well as Deakin standards, including in particular:
  - Mandatory BCA and DDA requirements.

- **Flexibility**
  Deakin standards and resulting standard designs to be flexible so as to meet the diverse needs of the University’s varied business requirements.

- **Consistency and familiarity**
  Uniformity of function and user interface across Deakin and where possible externally (e.g. by adopting common supplied technologies unmodified) to improve efficiency and ease-of-use as staff and students move around the University, and as they enter from other institutions, and to minimize training, productivity and opportunity costs.

- **Ease-of-use**
  - A single familiar intuitive user interface device to cover all functions;
  - subject to formal usability testing;
  - all controls co-located in the one place and of the same format;
  - no handheld remote controllers;
  - no multiplicity of (in particular handheld) controllers for different components;
  - no controls scattered around in different parts of the room;
  - in particular a user shall never need to go to another room to set a room feature (important for splittable/joinable rooms).

- **User driven design & function based specification**
  Functional requirements are defined in formal Standards approved so as to meet the business needs of the University (refer ICT Volume 2.1 Audio Visual Room Standards and other standards and documents referenced from Volume 2.1) while layers of consequential technical and implementation details are specified in subsidiary Standards and their associated technical Resources available at [https://blogs.deakin.edu.au/avn-docs/](https://blogs.deakin.edu.au/avn-docs/)

  For example: not functionality that:
  - must be inferred (reverse-engineered) from a parts list
  - nor driven by low-level technical issues, such as a specific cabling system – cabling is a means to an end not an end in itself.

- **Total solution quality – includes venue**
  Standards and implementation do not focus solely on the AV technologies in the space but also ensure a holistic, quality, and usable result considering all aspects of the space, for example including interior design and general amenity.

- **High audio and video image quality**
  Includes HD, digital, wide-screen and stereo requirements.
• **Simplicity**  
Avoid complexity in all things so as to reduce design cost, system cost, support cost, training cost, documentation cost, while improving reliability, performance, fault rates and repair times. Including preference for:
  
  o **‘Single-box’ solutions**  
    Fewer components are better, e.g. an all-in-one Audio/Video switcher/controller (e.g. AMX DVX/DGX family) that reduces the box count, where multiple devices would otherwise be required.
  
  o **‘Out-of-the-box’ solutions**  
    Complete solutions delivered ‘as supplied’ by single supplier, with no or minimal 3rd party accessories (e.g. Cisco C20).  
    Similarly preference for factory manufactured cables and leads wherever practicable, instead of hand-made cables on-site.
  
  o **Get more value out of the components**  
    For example: Make use of Cisco codec’s inbuilt AEC, vision switching and vision compositor functions rather than replicating this functionality by introducing unnecessary 3rd party boxes; Use the one camera for multiple functions (for example videoconference, lecture capture and remote support).
  
  o **Integrate and customize only to the extent necessary**  
    While complex rooms (AV6-AV9) require integration, others do not (AV1-AV4), or only require minimal integration (AV3-AV5). In all cases ways to minimize integration and customization shall be sought.

• **Fit-for-purpose and Value-for-money**  
Solutions are fit-for-purpose, neither ‘gold-plated’ nor ‘prehistoric’, and of a consistent quality level across the whole University.

• **TCO**  
Reduced Total Cost of Ownership through all these design principles including having regard to:
  
  o Scalability
  o Adaptability
  o Supportability
  o Maintainability
  o Energy efficiency and sustainability

• **Standard designs**  
Each standard room type (AVxx) and sub-type (AVxx-y) has an exact detailed design which shall always be implemented exactly as detailed. Please refer to the system designs which are published at [https://blogs.deakin.edu.au/avn-docs/](https://blogs.deakin.edu.au/avn-docs/) As per the flexibility principle:
  
  o **Unusual physical layouts**  
    These standard designs can be installed ‘as is’ equally into conventional and unusual physical configurations;
  
  o **Adaptations**  
    These standard designs can be adapted for non-standard applications, generally by removing components from the standard design. Each standard design nominates specific optional components that can be removed. In some cases, adaptations can be by substitution or addition of components to the standard design.
• Hybridization
  In some cases non-standard applications can be satisfied by combining multiple instances of a standard design, or by combining aspects of multiple standard designs. Examples are given in the text.

• Custom solutions
  Custom solutions shall always be based on the nearest standard room sub-type and nearest standard detailed design. The custom solution shall be expressed solely in terms of exactly enumerated differences with respect to the nearest standard design, and not as a complete recital from scratch disconnected from a standard solution.

• Non-standard solutions to be approved on a case-by-case basis
  All non-standard solutions must be approved by the Des AV and Network Services Manager strictly on a case-by-case basis, before either procurement or work commences, and by using the approved form ICT Resource 2.7.1 Custom Solution Approval and Waiver Form. The approved form is published at https://blogs.deakin.edu.au/avn-docs/standards-documents/additional-resources/

• Reduced standard parts-list
  Following careful and formal product evaluation, the University selects a reduced set of suppliers (usually one) for each range of products, and selects a reduced sub-set of components from each of those suppliers’ ranges as the Deakin standard components.

• No component substitution
  No component substitution without approval of the Des AV and Network Manager. The list of approved hardware is amended from time to time. For the currently approved hardware, please refer to https://blogs.deakin.edu.au/avn-docs/approved-hardware/. Up-to-date components must always be employed.

• Quantitative not qualitative / rational not opinionated
  Precise, testable, quantitative specifications in all regards wherever possible, not vague motherhood statements. Avoidance of words like ‘satisfactory’. Rational, objective decision making.

  This quantitative approach parallels the current migration from ‘best-effort’ analog to the deterministic performance of digital systems.

• Within manufacturers’ specifications / not by experiment
  Design constrained for operation within manufacturers’ published Specifications in all regards, and not reliant on something that has been observed to apparently work by local experiment. Otherwise no recourse to suppliers when things don’t work or stop working (including as a result of software upgrade) or not working consistently, reliably, predictably or to required performance quality levels.

  For example: HDBaseT along with 10GbaseT require more than 250 MHz of bandwidth, therefore the minimum cable grade that shall be used is Cat6A. Similarly, shielded cable shall be used if a manufacturer recommends it.

• Cabling – horses-for courses
  Cabling is a major cost component and therefore optimization of physical design is important. This is covered in Section 4 below, including consideration of:
  
  o in-room vs centralized AV as appropriate
• Remote management – simple and effective
  Centralized remote monitoring, control, adjustment, upgrade, fault diagnosis and management
  (e.g. reporting and statistics) capabilities to be provided for all systems.

• Ethernet management and control
  All devices that have any level of Ethernet monitoring, control or management capability shall
  be connected to the University’s (wired) Ethernet network, even if current AMX control is via
  some other form (e.g. RS-232) of communications.

• Future-proofed
  All standards, designs, product choices, implementations and installations shall be future-proofed
  to the extent practicable. For example:
  o refer Ethernet management above;
  o refer VGA phase-out below;
  o at time of installation, install additional cables (N+1) to cater for changed usage.

• Cyclic refresh
  Solutions shall be provided in the context of formal continuous cyclic technology refresh
  arrangements. In this regard, most AV technologies are expected to have a service life of at
  least 6 years, thus an approximate 6~7 year refresh cycle should be accommodated. Of
  particular note in this regard during the current refresh cycle period: Analog video.
  o VGA and other related analog video technologies (DVI-A, Component, YC/S-Video,
    Composite) have reached end of serviceable life.
  o As of 1 Jan 2018 analog video (including VGA) shall not be installed in new installations.
  o As of 1 Jan 2019 analog video (including VGA) shall be retrospectively removed from
    existing installations.
4 Physical design – constraints and optimization

A major cost component in a typical AV deployment is the installation costs, including the costs of cabling and small components, in particular cable transceivers and adaptors. Deciding on a suitable physical layout is therefore important to optimize the overall system cost. As is controlling the number of transceivers and small components, each of which typically adds cabling, power provisioning, installation, documentation, support and reliability costs.

In all this, selecting an optimum physical design is important.

This type of optimization, common in various professional engineering disciplines, is formally known as a ‘Mesh Relaxation’ problem – think of a multiply-interconnected network of springs – release the nodes and see where they end up. They come to rest where the overall average spring length is shortest, i.e. least extended (hence most ‘relaxed’). In our case the ‘springs’ represent the cables and the ‘nodes’ are the equipment items. For example, if all the AV equipment items serve just one room then by this method they all end up in the centre of the room. Of course, there are various constraints that prevent the nodes from moving to their perfect optimal locations – such as: projectors need to remain on the ceiling, and equipment needs to be in convenient yet out-of-the-way locations.

Below are the various requirements, constraints and other considerations that need to be balanced in making the right decision:

4.1 Considerations

4.1.1 Requirements

Requirements include:

- **Cost optimization**
  The overall design must be cost-optimized.

- **Aesthetics**
  There shall be no ugly exposed equipment racks in the rooms. Instead the following options are available: install equipment in credenza (meeting rooms) or presentation desk (teaching spaces); and/or install equipment in a co-located or nearby AV equipment room. And for very specific cases as set out in the text: behind LCD display panels; on the underside of tables; and attached to (above) video projectors. But not: within floor-boxes; within ceilings; within walls.

- **Serviceability**
  Includes:
  - *Easy access to all equipment.*
  - *Easy access to front and rear of all racked equipment,*
    without introducing OH&S hazards (e.g. where a small rack must be rolled for rear access: the rolling space must be flat – no slope or step; max height 24RU; easy rolling with easy stopping/brake/lock).
  - *Where an audio mixer or processor (DSP) is located remotely,* i.e. outside the room: an audio service loop must be fitted from the DSP to a suitable location within the room so that a technician in the room can hear via headphones relevant audio signals while tuning the remote DSP. In turn this means that the DSP must be remotely manageable via the Deakin Ethernet network.
• **Flexibility**
  By using TP wiring wherever practicable, AV equipment in rooms can be upgraded/refreshed over time without significant re-cabling.

### 4.1.2 Constraints

Constraints include:

- **Some equipment types must be installed within the room**
  Refer list at Figure 1 below.

- **Some signal types cannot run over TP**
  A key objective is for all out-of-room cabling to be standardized UTP:

  The concept of centralized AV is predicated on the desirability of using standardized (low-cost, structured) UTP cabling for all (non-power) fixture wiring throughout the building and the consequent benefits of co-location of AV equipment with other electronic systems, that also use this same common UTP cable plant, in dedicated controlled spaces (‘comms rooms’).

  This objective is undermined by:

  o  some AV signal types cannot be adapted to run over TP: cases in point include cabling between power amplifiers and speakers; between power amplifiers and hearing loops; RF cables between antennae and radio mic receivers;

  o  many AV suppliers recommend the use of STP not UTP, hence differentiating AV cables from the common structured UTP plant used by other electronic systems.

- **Cable length limits**
  Each transmission technology has defined maximum lengths (refer Figure 11), beyond which transceivers must be used or equipment must be constrained to lie within.

- **Heat dissipation**
  The solution must provide necessary air-flow / cooling so that equipment remains within manufacturers’ specified temperature limits. Particular care is required for Cisco codecs so as not to create a closed-loop air-path in constrained spaces. For details refer to [https://blogs.deakin.edu.au/avn-docs/standards-documents/vc-standards/](https://blogs.deakin.edu.au/avn-docs/standards-documents/vc-standards/)

- **Noise isolation**
  Noise from the equipment and/or fans must remain within the acceptable limits set-out in Section 8.9 of these Standards.

### 4.1.3 Other considerations / observations

Other considerations and observations that impinge on the optimization include:

- **Heat and Noise**
  Removal of AV equipment into a separate controlled environment external to the room neatly addresses both the heat and noise constraints (above).

  Similarly the use of high-efficiency fanless digital power amplifiers can assist in all these regards: by retaining equipment in the room, and hence addressing the speaker cabling requirement, while reducing noise and heat load, and also improving energy efficiency and environmental impact objectives.
• **Shorter cable runs are cheaper**
  While being less at risk of interference (hence improved reliability and consistency and reduced support costs) and also reducing the need for expensive transceivers. Also improves sustainability objective through reduced consumption of copper.

• **Expensive cable vs transceivers**
  The use of expensive cable (e.g. HDMI) must be balanced against the need for expensive transceivers when using cheaper TP wiring.

• **Cable installation much cheaper at build-time than at retro-fit**
  Therefore any room that might need AV should be wired for such at initial build-time.

• **Additional cable runs much cheaper at the same time**
  Therefore additional cables (at least N+1) should be run whenever cables are being installed (either at initial-build or during a retro-install).

• **Re-use of AV TP cables for other purposes unlikely**
  The promise of re-use of AV TP cables for different purposes later, or conversely the re-use of other TP cables for future AV use, is unlikely to realise in practice – due to the unusual locations and large quantities of cables required for an AV system. Thus we should always expect to need to retro-fit for-purpose cables whenever AV is added to an existing room.

• **Initial build vs Retro-fit**
  Initial build provides greater opportunity for achieving optimum layout, and at lower cost. When retro-fitting there are several cases:
  
  o Major refit where the interior is being gutted and completely rebuilt, in which case the flexibility to deliver an optimal outcome, and the cost-point, is equivalent to that of new builds and hence equipment can go wherever it optimally should.
  
  o Minor refit where the designer has to live within the constraints of the existing building, which can lead to either: more equipment needing to be installed within the room than ideal; or equipment being installed further away in nearest available equipment room (e.g. BDR); or equipment being located in less than ideal accommodation, e.g. small rooms retro-added in or near the rooms serviced.

• **No Floor Distribution tier**
  Due to the generally low-profile structure of most Deakin buildings (small number of floors), the Deakin network architecture deliberately does not have explicitly separate Building and Floor distribution tiers. This is a good thing because it prevents proliferation of large numbers of poorly utilized Floor Distribution Rooms that can result from a formal FDR/BDR tiered structure, which is more suitable for high-rise buildings. Hence the Deakin network architecture defines only a Building Distribution Room (BDR), and hence many floors of many buildings do not have a comms room on their own floor and are instead serviced from a BDR on another floor. At Deakin, where there is a need for more than one BDR in a building, either due to the building’s breadth, or its height, additional BDRs are provisioned, not a Floor Distribution Room (FDR) downstream of the BDR.

  Hence, in general at Deakin the local BDR is further away from the areas serviced at (e.g. on another floor) than for organizations that have FDRs on every floor of every building.

• **Audio DSP/mixer**
  Due to the large number of audio sources and sinks within the room, and the issues of speaker and RF cabling (refer Constraint #2 in previous section above) there is in turn an optimizing motivation for the audio DSP to also be within or near the room serviced. Otherwise, where the DSP is remote, there becomes a need for either a large number of audio-over-TP transceivers, or
equivalently multi-channel audio multiplexer between room and remote DSP. Also, as stated at Requirement #2 above, where the DSP is remote an audio service loop must be provisioned back into the room for technician use when commissioning or subsequently tuning the DSP.

- **AV-quality power**
  Given that some AV components must be within the room (projectors, etc. – refer Constraint #1 above and Figure 1), in turn these require AV-quality power (Section 8.1) to be reticulated into the room. Thus with AV-quality power necessarily in the room, this makes it easy (low cost) to extend AV-quality power to any/all other AV items that the optimization elects to place in the room.

Taken together these requirements, constraints and considerations lead to the general conclusion that AV components should optimally be located within or in close proximity to the room/s serviced, and generally closer to the room than the location of the nearest Building Distribution Room.

### 4.2 Cases

Firstly, there are various unambiguous cases:

- **Simple stand-alone rooms**
  All AV1-AV5 spaces: The amount of AV equipment is small and can easily and optimally always be all located within the room, either: behind an LCD panel or in credenza or presentation desk.

  Some AV6-AV8 spaces: Where larger amounts of AV equipment are required to be located in the room, this can sometimes be accommodated within the larger (2 rack) standard presentation desk.

- **Splittable/joinable spaces**
  Where a pair (or more) of spaces can be split or combined, they must all be operated from a single integrated AV and Control system, which can be located in one of the rooms or co-located in a single location nearby.

- **Clusters**
  Similarly clusters of AV spaces can easily be serviced from a single common co-located AV equipment room. Hence building design should give strong consideration to clustering AV spaces.

There are also some less-clear-cut cases:

- **Larger AV6-AV8 spaces**
  In circumstances where all the equipment cannot easily fit within the room, in which case a nearby equipment room needs to be used or provisioned.

- **Retro-fits**
  In circumstances where there is no nearby equipment room, and hence either one needs to be provisioned, or alternatively a further away BDR might need to be used, or more equipment than ideal may need to be located within the room itself.
**Figure 1 – AV Equipment Locations**

<table>
<thead>
<tr>
<th>Equipment Type / Location</th>
<th>may be in Equipment Room</th>
<th>must be in Local Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Processors (e.g. AMX NetLinx)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Auto Switchers</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Video Switchers, integrated</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Codecs, stand-alone</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Codecs, integrated</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Digital Signal Processors</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Audio Mixers</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Content Recorders (inc. EchoSystem capture devices)</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Amplifiers* (inc. Induction Loop)</td>
<td>if cable distance to FCR meets requirements at Figure 11</td>
<td>if cable distance to FCR exceeds requirements at Figure 11</td>
</tr>
<tr>
<td>Speakers</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Microphones</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Wireless Microphone Receivers</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Digital Signage STB</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>IP-TV STB</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>AV-TP transceiver</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>AMX TPI</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>PIR motion detectors</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Projectors</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>LCD panels</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Document Camera</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Cameras</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Controller UI devices</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>VoIP Phone</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>House PC</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

* Amplifiers should be installed as indicated in the table below.

**Figure 2 – Preferred Amplifier Mounting Locations**

<table>
<thead>
<tr>
<th></th>
<th>AV enabled room with local AV rack</th>
<th>AV enabled room without a local AV rack</th>
</tr>
</thead>
<tbody>
<tr>
<td>if cable distance to FCR meets requirements at Figure 11</td>
<td>FCR</td>
<td>FCR</td>
</tr>
<tr>
<td>if cable distance to FCR exceeds requirements at Figure 11</td>
<td>Local rack</td>
<td>Located within joinery, credenza or presentation desk out of sight.</td>
</tr>
</tbody>
</table>
5 Detailed Technical designs

Detailed technical designs are available at https://blogs.deakin.edu.au/avn-docs/ Including schematics, approved hardware, companion standards and additional resources. Please refer to Bill of Materials for specific hardware requirements on a per installation basis.

6 Standard Equipment & Components

The equipment listed in this section, and summarized in Appendix B, forms the current Deakin University standard for audio visual devices accepted for use within the University. Anything installed other than the equipment listed within this section requires written approval from the DeS AV and Network Manager.

Any deviations from this standard to equipment types and installation methods, without prior approval from DeS will not be accepted and replacement will be at the expense of the contractor.

6.1 Projectors

Unless specified in writing by DeS, projectors shall be Epson models. This is to maintain continuity and compatibility with Deakin’s ongoing operations and deployment. Specific projector modes shall be noted in Scope Of Works and/or accompanying BOM documents on a per-job basis.

Projectors should be powered from dedicated AV UPS power circuit (refer section 8.1). Projectors require controlled cooldown and startup cycles. Where UPS circuit not available, projector shall be fitted with an approved power-line filter. For approved models refer to https://blogs.deakin.edu.au/avn-docs/approved-hardware/

Light output capability of the projector must not be less than 4000 ANSI lumens. Where deemed appropriate by DeS (e.g. in small teaching spaces) the projector may be set into the “Economy” mode to reduce unnecessary brightness. The lens ratio should be close to 2:1, (i.e. 4 metres back to obtain a 2 metre wide image), unless the particular venue dictates otherwise. Regardless, when the installation of the projector is undertaken, correct measurement and checking using the projector’s own raster to confirm location and image size is essential.

Data projectors must be installed with an Ultra-lift Spider 1200. Where the projectors are mounted too high for safe servicing from a ladder a service lift arrangement shall be provided. Projector data information must be available in the engineering page on the AMX Touch screen, i.e. Lamp hrs.

The Projector shall be connected to the Deakin network via wired Ethernet. Control and monitoring of the projector shall be via IP over wired Ethernet.

Projector stacking shall not be employed.

**FIGURE 3 – MINIMUM PROJECTOR SPECIFICATIONS**
<table>
<thead>
<tr>
<th>Projector Attribute</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brightness:</td>
<td>Minimum 4000 ANSI Lumens</td>
</tr>
<tr>
<td>Native Aspect Ratio:</td>
<td>16:10</td>
</tr>
<tr>
<td>Resolution:</td>
<td>1920x1200</td>
</tr>
<tr>
<td>Contrast:</td>
<td>Minimum 2000:1</td>
</tr>
<tr>
<td>Picture Size (diagonal):</td>
<td>40” – 300”</td>
</tr>
<tr>
<td>Compatibility aspect ratio:</td>
<td>4:3, 16:9, 16:10</td>
</tr>
<tr>
<td>Compatibility resolution:</td>
<td>640 x 480 – 1900 x 1200</td>
</tr>
<tr>
<td>Digital Video Input Terminals:</td>
<td>HDBaseT, HDMI</td>
</tr>
<tr>
<td>Control Inputs</td>
<td>Wired Ethernet (RJ45)</td>
</tr>
<tr>
<td>Fan Noise:</td>
<td>Less than 35 dBA</td>
</tr>
<tr>
<td>Zoom/Focus:</td>
<td>Motorised Focus and Zoom Lens</td>
</tr>
<tr>
<td>Power Requirements:</td>
<td>240 V AC +/- 10% 50 Hz</td>
</tr>
</tbody>
</table>

### 6.2 Projection surfaces & screens

Deakin has strong preference for unframed projection direct onto painted white wall. Zero-gloss matte pure white paint shall always be used (Dulux Ceiling White is recommended). No colour tints are acceptable. A high-quality plaster finish including paintwork should be used to ensure the best surface finish possible. The wall must be vertical and flat with no bows.

Drop-down screen (whether manual or motorised) is to be used as a means of last resort only. Where provided, screens shall always have a 16:10 aspect ratio and shall provide approximately uniform reflectance out to beyond 60° off-axis. The size of the screen is to be determined appropriate for the size of the space. Screens shall have screen printed masking (not the stick on type).

Where recessed projector screens are required, the contractors shall also supply a matching pelmet enclosure as part of the screen.

The motorised screens shall have a motor mounted inside the roller with noise silencer, oiled for life, automatic thermal overload cut-out, integral gears, capacitor and an electric brake to prevent castings. It shall have pre-set but adjustable limit switches to automatically stop the picture surface in the “up” and “down” positions. The roller is to be of rigid metal, and mounted on vibration and noise absorbing supports.

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

In automated spaces, screens should be controlled via a Somfy CD4 screen controller or similar. This controller must only be located in a position that allows easy access from floor level, such as in a wall mounted enclosure usually with the lighting dimmer. In the case of multiple screen controllers, these should all be mounted together.
In automated spaces a two-gang wall plate containing momentary push mechanisms, representing up and down, should be installed. This should be parallel wired to the input side of the screen controller to allow control of the screen in case of automation failure.

Where screens are installed under existing FoH lighting fixtures, the lighting fixtures should be disconnected, relocated or disabled by the AMX processor when required.

Motorised screens shall connect to relays on the master NetLinx Controller.

All Projection Screens shall be made by Screen Technics.

All screens shall have a gain of 1.0.

### 6.3 LCD panel/s

Wall-mounted LCD displays shall be installed using suitable wall mounting hardware meeting ISO9001:2000 standards. LCD panels greater than 38" shall be mounted using Vogels Popout Module mounts.

Desk-mounted LCD panels 38" and smaller shall be mounted using CBS Flow Monitor Arm.

All LCD displays must be able to be controlled via IP over wired Ethernet. All devices with Ethernet management capability shall be connected to the Deakin Ethernet network.

LCD displays shall be commercial grade only and at *minimum* shall conform to the following specification:

**FIGURE 4 – MINIMUM LCD DISPLAY SPECIFICATIONS**

<table>
<thead>
<tr>
<th>LCD Display Attribute</th>
<th>Minimum Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brightness</td>
<td>Minimum 400 cd/m²</td>
</tr>
<tr>
<td>Resolution</td>
<td>1920 x 1080 minimum</td>
</tr>
<tr>
<td>Digital Video Input Terminals</td>
<td>DVI-D or HDMI</td>
</tr>
<tr>
<td>Communication Terminals</td>
<td>Wired Ethernet (RJ45)</td>
</tr>
<tr>
<td>Audio</td>
<td>Attachable Stereo Speakers; line level stereo RCA connectors</td>
</tr>
</tbody>
</table>

### 6.4 Document Camera

A high resolution (minimum 1920x1080) document camera shall be provided in all AV5 – AV9 teaching spaces and lecture theatres.

For all spaces controlled by NetLinx (i.e. AV6 – AV9), the Document Camera shall connect to RS-232 Device port on the Master NetLinx controller and the control software shall be able to revert the device into a working state regardless of which controls the user adjusts. As a minimum, the NetLinx system shall power-on and power-off the DocCam as required by user source selection.

The unit must be secured to the presentation desk.
6.5 **Presentation PC**

The presentation PC shall conform to current DeS DUEWS standards. The presentation PC **MUST** be set to display resolution and aspect ratio that matches the native resolution and aspect ratio of the main displays in the venue, e.g. so that circles are circular on all displays and sharp edges are sharp with no pixel interpolation or rescaling through the vision system.

6.6 **Wireless keyboard/Mouse**

Where wireless keyboard/mouse is required, it is preferred to use the Logitech model as specified in the relevant Scope Of Works.

6.7 **DVD unit – not to be provided**

DVD playback functionality shall be provided by the room’s Presentation PC. Discrete DVD players will no longer be provided.

6.8 **VCR unit – not to be provided**

VCR/VHS is no longer a supported technology.

6.9 **Set Top Boxes**

6.9.1 **Digital Signage (AV1-S)**

For AV1-S the set-top box to be used is as specified in Appendix B.

6.9.2 **IP-TV (AV1-T only)**

IP-TV set-top boxes are provided **only** for AV1-T spaces. Otherwise the room’s Presentation PC is used to display IP-TV content.

For AV1-T the set-top box to be used is as specified in Appendix B.

6.10 **Interactive Projector**

Interactive projectors shall be from the Epson Interactive Education range. Interactive whiteboards shall not be specified for new installations.

Where USB extenders are required, iCron extenders shall be used. The USB extending pair shall be powered at the rack end only, with the remote (projector) end receiving power via the Cat cable. Cable restraint must be observed to prevent any mechanical load/strain on USB/RJ45 connectors.

6.11 **Electronic whiteboard**

Where provided, electronic whiteboards can either be wall mounted or supplied with a floor stand as appropriate for the area. Refer to the relevant Scope Of Works for specific models.

6.12 **Interactive tablet**

Where identified as required, only makes and models approved by DeS shall be used. Refer to the relevant Scope of Works for specific models.
6.13 Microphones
Microphones are required as below, types as specified in the relevant Scope Of Works:

- **AV1**: None
- **AV3**: None
  
  *Wireless microphones are not to be used.*
- **AV5**: None
- **AV6, AV7, AV8**: All lecture theatres and larger classrooms, including all spaces that require Automated Capture, are to be equipped with a wired horizontal array microphone on the standard presentation desk, as well as both handheld and lapel wireless microphones (one of each).
- **AV9**: DAYD-style spaces are to be provided with wired cardioid boundary microphone on each student desk, instead of wireless handheld microphone. Wired horizontal array and wireless lapel are provided for the presenter.

*Wireless microphones shall use the manufacturer’s recommended battery type/s.*

6.14 Cameras

6.14.1 Cameras – Videoconferencing
Refer ICT 2.3 Videoconferencing standards.

6.14.2 Cameras – Automated Recording
Cameras are currently not required for Automated Recording.

6.15 Time-of-day clock
A PoE powered NTP clock should be provisioned: at the rear of the space (for AV5-AV8); or at the front or side of the space (for AV3-AV4).

6.16 Automated Recording
Where capture hardware is installed, all video signals to be recorded are to be scaled to HDMI. The recording status, ability to pause and stop as well as video preview and countdown timer shall be available on the AMX touch panel.

6.17 Videoconference units
6.18 Audio

Meeting rooms and teaching areas with video based displays shall typically be provided with audio playback capabilities. Source or content playback known as program audio shall typically be provided via a set of stereo front of house speakers. Areas requiring voice reinforcement shall be provisioned with ceiling speakers. Where deemed appropriate, AV4 spaces may utilise a soundbar as specified in https://blogs.deakin.edu.au/avn-docs/approved-hardware/av-hardware/

6.18.1 Program audio

Program audio must be delivered by stereo speaker enclosures that are wall mounted. They are to be located on either side of the screen, at least half way between screen edge and the side wall, i.e. closer to the side wall than to the screen, so as to leave the viewing area and its surrounds uncluttered. The dispersion pattern and power output must be chosen to suit each space. Speaker enclosures are to be focused to the centre of the venue. Types to be as listed at https://blogs.deakin.edu.au/avn-docs/approved-hardware/av-hardware/

6.18.2 Voice reinforced audio

Low level distributed audio systems are the preferred option for speech reinforcement. A well-designed ceiling array using quality drivers must be used wherever possible with partial overlap of speaker coverage. Edge to edge speaker coverage is acceptable. High quality white flush mount speaker and grill assemblies are preferred; types as listed at https://blogs.deakin.edu.au/avn-docs/approved-hardware/av-hardware/

The system must be capable of producing a suitable acoustic gain so that even quietly spoken presenters can be heard clearly in all parts of the space.

6.19 Audio processing

All video conference locations shall include automatic echo cancellation capabilities.

Teaching spaces provisioned for lecture recording shall also contain a Digital Signal Processor (DSP) providing a clear audio stream for recording and allowing the system the possibility of easy future upgrade to video conferencing.

Where an Audio DSP is required, the preferred DSP platform is ClearOne. Refer to the relevant Scope of Works for model-specific details.

Audio processing systems are required as follows:

- **AV1, AV3**: None required
- **AV2, AV4**: Codec’s system integral audio processing system
- **AV6, AV7**: ClearOne
- **AV8, AV9**: ClearOne Converge

6.20 Hearing augmentation

Hearing augmentation shall be provided in all teaching spaces with audio visual systems, all publicly accessible rooms with audio reinforcement larger than 100 square metres and any other areas as identified by Deakin University or as required by the BCA.
Hearing augmentation shall deliver coverage as required by the BCA.

All rooms with hearing augmentation shall be clearly labelled in accordance with current DDA requirements.

The Disability Discrimination Act (DDA) makes it illegal to discriminate against people with disabilities in terms of access to education. Hearing augmentation must be provided in all places where sound amplification is provided (e.g. microphones are being used) or public announcements are being made.

A sign indicating that an assistive listening system is installed shall be placed at each of the doors into the space as required by BCA/DDA.

If the coverage is less than the entire room then the coverage area must be marked on the sign.

Hearing augmentation hardware is not to interfere with surrounding audio visual equipment. Approved hearing augmentation hardware is listed at https://blogs.deakin.edu.au/avn-docs/approved-hardware/av-hardware/

### 6.21 Laptop input

All AV equipped teaching spaces and meeting rooms shall be equipped with a laptop input point. This input shall be via HDMI.

An Ethernet network connection shall also be required alongside the Laptop input.

Leads for these connections are to be made available. These shall be via AMX HydraPort tabletop box to allow neat retraction of leads and to prevent unwanted removal.

### 6.22 Video switching and transmission

Video switching and transmission shall be via the equipment shown in the relevant Scope Of Works.

In the cases where an autoswitcher is utilised, it shall be setup so as to automatically select a connected Laptop with priority over the room’s in-built PC.

#### 6.22.1 Digital

All TP-based vision switching shall utilize the approved digital TP vision switching and HDBaseT transmission equipment as listed in https://blogs.deakin.edu.au/avn-docs/approved-hardware/av-hardware/

#### 6.22.2 Analog

Analog twisted pair-based vision switching is not part of the Standard.

Analog video is legacy technology. All video switching shall be done in the digital domain. Where analog sources are required, conversion to the digital domain shall be required prior to switching.

#### 6.22.3 Video adaptors

BYOD users are responsible for providing their own adaptors for connecting to the Deakin standard AV connectors. The standard connector for video at Deakin is HDMI Type A.
6.23 Telephone
A Deakin standard VoIP phone shall be provisioned in each space as set out below.

- **AV1-S**: No
- **AV1-T**: Not part of this standard but often found nearby (e.g. Student Residences require phones)
- **AV2**: No
- **AV3**: Either VoIP phone or VoIP VoicePoint, located either on meeting table or credenza.
- **AV4**: No
- **AV5-AV8**: Yes – on wall next presentation desk, secured using Polycom wall-mount bracket or on desk if unable to mount to wall.

Telephones shall be provided with single dedicated network outlet in each room. In the case of AV3, the phone is NOT to provide downstream Ethernet services (e.g. for user-supplied laptops). Instead, separate Ethernet points shall always be provided in table-box/es for user-supplied equipment.

6.24 Equipment racks

Cables in racks shall be managed using Velcro straps, vertical cable tray and lacing bars, as specified in the relevant Scope of Works.

- Cable trays shall be mounted to the sides of the rack.
- Lacing bars shall only be located at vertical boundaries between equipment.
- Lacing bars shall be located such that they:
  - Provide unimpeded service access to hot-swappable components, including power supplies, chassis cards, etc.
  - Do not obstruct serviceability of cables to fixed or hot-swappable equipment.
  - Do not cause cables to be bent beyond the requirements as specified in Minimum bending radius

6.24.1 Small (in desk) racks

Desk designs shall provide lockable doors and shall enclose the rack to prevent unauthorized access to the rack and rack equipment. Locks shall be keyed to the standard Deakin desk key.

Racks shall have caster wheels for easy removal and servicing of the rack. All cables shall be loomed appropriately to allow unimpeded rack movement. Cables shall be managed to provide a minimum of 50mm clearance above floor level at all times while moving the rack.

Top and side rack panels impede equipment ventilation and rack serviceability. Top and side panels shall not be used.
Blanking panels (vented and non-vented) impede equipment ventilation and rack serviceability. Blanking panels shall not be used.

RU shelving for additional equipment shall be provided at the time of installing the additional equipment, due to the changing availability of hardware.

6.24.2 Large racks
Large racks shall be fully welded with vented top panel, meeting International standard IEC297.

Racks shall include metal front and rear doors. Equipment rack door locks will be keyed to the standard Deakin rack key.

Rack side panels shall be made secure to prevent unauthorized access.

The front and rear of the rack must be accessible with a 900 mm minimum clearance.

All rack cable looms to be long enough to allow the rack to be moved out for servicing access. Cables shall be covered in Halogen sleeving.

All equipment rack mounting screws are to be M6 Phillips cage nut and washers. Regardless of equipment location, there must be sufficient ventilation (air flow) to prevent temperature rise beyond equipment manufactures’ specifications.

Rack builds should be performed as indicated in the Rack Layout page of the relevant schematic document. Schematics are located at https://blogs.deakin.edu.au/avn-docs/schematics/

Equipment shall be located in the rack as per the relevant Scope of Works.

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

6.25 Rack power and UPS
Where a centralised UPS system is unavailable the audio visual contractor will provide dedicated UPSs for audio visual equipment.

A network accessible power switcher will be monitored by our preferred APC UPS. The model shall meet the following minimum requirements: 3000VA, 230V, SNMP monitoring, rack mounted, C13 outlets x8
All equipment will be powered from an APC Rack PDU, Metered, 1U, 12A/208V, 10A/230V, (8) C13. Device is to be configured by Deakin University once commissioned.

These power rails use C13 IEC outlets so to run plug packs and DVD figure 8 power leads a suitable adaptor lead or C13 power board will be required.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Plug Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controllers</td>
<td>1</td>
</tr>
<tr>
<td>Video Switching</td>
<td>2</td>
</tr>
<tr>
<td>Audio DSP</td>
<td>3</td>
</tr>
<tr>
<td>Video Conferencing</td>
<td>4</td>
</tr>
<tr>
<td>Automated Capture</td>
<td>5</td>
</tr>
<tr>
<td>Scaling</td>
<td>6</td>
</tr>
<tr>
<td>Spare</td>
<td>7</td>
</tr>
<tr>
<td>Spare</td>
<td>8</td>
</tr>
</tbody>
</table>

*Under no circumstances will Deakin allow the use of double adaptors or domestic grade power boards.*

### 6.26 Fittings and consumables

All fittings and consumables are to be detailed in quotes and provided by the audio visual contractor.
7 Control systems

Control systems, using standard components as listed at [https://blogs.deakin.edu.au/avn-docs/approved-hardware/av-hardware/](https://blogs.deakin.edu.au/avn-docs/approved-hardware/av-hardware/) are required as follows:

- **AV1**: None required
- **AV2**: Codec’s system-integral controller and user-interface device
- **AV3-A**: None required (LCD autosenses power on/off from vision source)
- **AV5**: AMX DVX presentation controller and keypad
- **AV6**: AMX DVX presentation controller and touch-screen
- **AV7, AV8 & AV9**: AMX DGX Controller, AMX TPI-PRO and touch screen monitor

The control system shall typically be interfaced to the following items of equipment:

- Projectors and Projector Lifts;
- Motorised projector screens;
- LCD screens;
- Video Conferencing systems;
- Sound reinforcement systems;
- Touch screen control panel;
- Lighting dimmers;
- Motorised Blinds;
- Fire Control System; and
- Floor boxes.

The control system shall be interfaced to the above equipment to allow equipment control from a touch screen controller.

7.1 Automation System

The AMX NetLinx® system is the standard control system utilized throughout Deakin University. The audiovisual contractor shall provide suitably sized AMX Control Systems® to enable the central control audio visual equipment for specified rooms. Refer to the relevant Scope of Works per job.

Optional controllers may be utilised in certain circumstances as per DeS design. The contractor shall ensure that all necessary control accessories are provided for correct system operation.

7.2 Touch screens

Touch screens shall be provided and interfaced to the equipment control system.
Touch screens in premium teaching areas shall utilise the AMX TPI-PRO-DVI touch screen interface integrated with an appropriately-sized touch screen monitor. Refer to Scope of Works for specific model.

An AMX 10” touch screen is standard for smaller teaching spaces. Refer to Scope of Works for specific model.

The touch screen shall provide facilities to fully control all audio, data and video functions via customised icons from within the room.

The touch screen control panel shall be capable of controlling all equipment specified.

7.3 Graphical user interface

Deakin’s GUI standard is specified in ICT 2.5 AMX Programming Standards.

7.4 Control Signalling

Order of preference, and further limited for use as specified in Figure 11:

1. Ethernet / HDBaseT
2. RS-232
3. RS-422 / RS-485
4. Contact closure
5. System integral IR
6. Self-adhesive IR
   (last resort only and to be approved by DeS AV and Networks Unit leader on case-by-case basis)

7.4.1 Ethernet

Ethernet is the preferred method of connection and must be delivered to all panels using standard patch leads from the DeS installed infrastructure.

Only Deakin approved Ethernet switches may be used. These may be installed in AV racks as required – refer to https://blogs.deakin.edu.au/avn-docs/approved-hardware/network-hardware/ for details.

Connection to the Deakin University network shall be via the patch panels located within the audio visual racks and cross patched into the Deakin network switches via the wall mounted patch frame provided by the communications contractor.

Outlets must be connected using the DeS network standard outlet configuration. Outlets made live must be indicated by the use of suitable labelling to indicate as such on the outlet itself. Suitable label wording shall be obtained from DeS.

7.4.2 DXLink

AMX DXLink is built on HDBaseT and encapsulates a number of stream, one of which is Ethernet. DXLink transmitters and receivers provide Ethernet pass-through. To avoid creating network loops, DXLink transmitter/receiver Ethernet jacks may only be patched into end-point devices. Unless clearly stated by DeS, DXLink Ethernet jack MUST NEVER be patched into Deakin network outlets.
7.4.3 **AxLink**

Only to be used where required. The relevant Scope of Works will indicate whether AxLink products are required.

AXM and AXP must be carried on one pair of a Deakin data network standard CATx UTP cable (using 1st Blue/Blue-White pair). The power and ground should be carried on a separate fig 8 DC power cable which is sized suitably for the current draw of the attached panel.

7.4.4 **ICSNet**

*Obsolete.* Not to be used. Use ICSLan over Ethernet instead.

Where an existing system is being repaired, it shall be wired with a Deakin data network standard CATx UTP cable using the AMX recommended pin out. Any socket carrying ICSNet that is accessible to the user must be labelled to indicate that it is not a network socket.

7.4.5 **Wireless**

Wireless shall *not* be used for control signalling, except where an iPad is used as a UI device.

7.4.6 **RS-422, RS-232 and RS-485**

Shall be installed using Deakin data network standard CATx UTP cable as shown below.

**Figure 7 – Serial Cable TP Conductor Assignment**

<table>
<thead>
<tr>
<th>Conductor</th>
<th>RS-422</th>
<th>RS-232</th>
<th>AxLink</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue/White</td>
<td>TxD+</td>
<td>TxD</td>
<td>AXP</td>
</tr>
<tr>
<td>Blue</td>
<td>TxD-</td>
<td>Gnd</td>
<td>AXP</td>
</tr>
<tr>
<td>Brown/White</td>
<td>RxD+</td>
<td>RxD</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>RxD-</td>
<td>Gnd</td>
<td></td>
</tr>
</tbody>
</table>

7.4.7 **Infrared**

For local rack equipment the emitter can be wired directly to the NetLinx. If it is required to extend beyond the rack it should be run in Belden 8723.

7.4.8 **Input / output**

For I/O communications, from motion detectors, user devices, PC’s Belden 8723 must be used.

7.5 **Motion detection**

A suitable motion detector(s) shall be installed into every automated space. The motion detector should be able to reliably detect the smallest amount of motion in any part of the room, for example the amount of motion caused by a few people sitting still watching a movie. Multiple detectors can be used if this is not achievable with a single detector and these should cover entry/exits, lecturers and front/middle audience. These detectors should be wired back to AMX controller I/O port 1 (and port 2 if 2nd sensor is used) using Belden 8723.
Upon entry to the space the system should be programmed to turn on the lighting and to wake the touch panel. After 35mins of no activity the system is to shut down the audio visual system. This “Shut Down” routine will return all working equipment back into a standby mode and turn off all lighting within the venue with the exception of the local PC, Automated Recording capture device and AMX NetLinx controller which must remain powered on at all times.

In a videoconference equipped space, the 35 minute countdown timer WILL be disabled while in a conference call and re-enabled when a call is ended.

7.6 Interface to and control of lighting

Lighting shall be interfaced into the audio visual controller and be the responsibility of the audio visual installer to ensure co-ordination takes place.

The lighting mechanisms shall be provided and installed as part of the electrical and building works.

The audio visual installer shall provide all necessary control wiring, control equipment and interface equipment as required. It shall be the audio visual installer’s responsibility to fully coordinate the interface requirements to ensure complete functioning of these controls.

Defects will be expected to be resolved within two (2) weeks or as documented and agreed on by DeS and FSD during any FSD managed projects.
8 In-room services and environment

8.1 System AC power

There are a number of risks to consider regarding the quality of available mains power:

- Power loss – Blackout
- Undersupply – Brownout
- Oversupply – Surge for a short duration
- Hash – Cleanliness of power as compared to a sine wave
- Lightning – Excessive oversupply for an almost instantiations duration

Mitigating each issue involves varying levels of complexity/cost. In view of the likelihood of each potential issue, the cost of mitigation, and the anticipated impact should any issue arise, the current DeS strategy is:

- Smaller venues should be protected against Oversupply only.
- Large capacity venues should be protected against: power loss, undersupply, oversupply and hash.

Power loss is mitigated via UPS. UPS hardware must be specified to meet the following criteria:

- Seamless changeover from mains supply to battery-backed supply.
- Sufficient capacity to power all AV related equipment for a minimum of 15 minutes.
- Sufficient overcapacity for anticipated future equipment growth.
- Notification to the AV system to indicate: power failure, power restore.

In the event of a UPS-mitigated power failure, the AV system shall begin a graceful shutdown if power has not been restored within 10 minutes.
In summary:

- **NO** double adaptors or domestic-grade power boards to be used.
- **ALL** equipment that is part of the AV installation (e.g. including LCD panels, projectors, house PC, etc.) to be protected.
- New buildings to provide building-wide wired-in UPS-protected dedicated AV circuits, to which all AV equipment including table-boxes and floor-boxes shall be connected.
- Where wired-in UPS AV circuit not available:
  - Stand-alone items (e.g. AV2, AV3 and all ceiling-mounted projectors): to be protected by approved in-line power line filter
  - Non-rack-mounted AV systems (AV1, AV4): to be protected by approved power distribution unit with inbuilt power line filter
  - Rack-mounted systems: to be powered from approved in-rack UPS and/or PDU system
    - AV4-AV5: Requires at least PDU with inbuilt power line filter
    - AV6-AV9: Requires UPS with remotely manageable PDU
  - Table-boxes and floor-boxes: to be re/wired to UPS in AV rack where available
- Projectors:
  - Any projectors that are not powered from UPS circuit: to be protected by approved in-line power line filter
  - At time of original installation or refresh: to be re/wired to wired-in UPS circuit (either building-wide or at AV rack)

All audio visual designated circuits within an installation shall all be derived from the same load centre and maintain the same neutral and earth relationship throughout the installation. Where a centralised UPS is utilised to power communications within the building, the UPS should be sized to accommodate all audio visual equipment throughout the building, including centralised equipment and display devices.

Rack mount power distribution units (PDUs) manufactured by APC shall be utilised within audio visual racks and sized appropriately for each rack. Installation and use of power boards or double-adaptors within the racks shall not be accepted.

Audio visual cabling must be segregated from power circuits. All equipment must be electrically tested and tagged prior to handover.
In all new building installations, a separate centralized UPS protected circuit or circuits shall power all AV equipment. These circuit/s will be dedicated to providing power to AV and network equipment only and user power in table-boxes and presenter desks only. These circuits shall not power any other equipment or other general purpose outlets. Dedicated AV circuit/s with wired-in UPS is necessary for the following reasons:

- **Protection**
  UPS circuit is the only practical method of providing UPS power to projectors, which are most important to protect.

- **Cost efficiency**
  UPS circuit is the most efficient method of provisioning UPS power to multiple pieces of AV equipment in a building area.

- **Interference**
  UPS circuit is the only effective method of minimizing power-line interference to nearby AV signal cables, e.g. in cable routes to table-boxes, and for demanding applications such as digital AV over UTP (e.g. HDBaseT).

- **Accommodation**
  It is often not practical to install UPS co-located with small AV equipment installations (e.g. in presentation desks, credenzas) due to heat load, noise or space (e.g. depth) constraints.

### 8.2 AC power for user devices

With the growing number of user devices such as laptops, iPads, smart phones etc. additional GPOs for charging these devices shall be provided. Placement of outlets should be designed so as not to create trip hazards.

GPOs in meeting rooms for users shall be placed within central table boxes rather than around the perimeter walls.

GPOs in teaching spaces and lecture theatres shall be either fixed to the seat / desk or recessed in a suitable floor box if the room furniture is not secured to appropriate electrical safety standards.

While some examples of ‘soft power’ options are available, use of these must be approved prior to selection and purchase by both DeS and FSD for standards compliance and to ensure the product is fit for intended purpose.

### 8.3 BYOD power

240 V AC GPOs and 5 V DC USB charging points shall be provided in table boxes and convenient locations in class-rooms. Such locations must not cause tripping hazards.

USB power must provide a mechanism to deliver 2000 mA at 5 V (i.e. 10 W) as required by iPads. There should be no differentiation between outlet types, i.e. end-users shall not be expected to read labels to indicate which outlets are suitable for iPads (otherwise spurious fault reports and assistance requests will result).
8.4 Eduroam WiFi – wireless network access

Deakin 'Eduroam' wireless network coverage shall be provided into all spaces as per Deakin ICT Standards.

- **AV1-AV4**: normal coverage level, generally does not require a dedicated WAP in the room.
- **AV5**: high density coverage level, generally requires 1 WAP in the room.
- **AV6-AV9**: high density coverage level, generally requires multiple WAPS in the room.

Wireless Access Points (WAPs) shall be installed as part of the IT fitout in accordance with current Deakin University network standards.

Devices (such as iPads) used to provide AV content or Control functions that require WiFi to operate shall be configured onto the normal 'Eduroam' WiFi SSID. The audio visual contractor shall be responsible for coordinating with DeS to obtain the necessary network and security details to effectively configure these devices.

8.5 Artificial Lighting

8.5.1 Lighting – Type

Lighting should be high efficiency (i.e. neither incandescent nor halogen) and of uniform colour temperature throughout the space.

8.5.2 Lighting – Circuits and Control

With the exception of AV1 and AV2, all spaces must provide as an absolute minimum a 2-way split system for separate switching of FoH and audience area lighting. In addition, some types of room will have additional circuits and/or dimming capability as follows. Minimum requirements by room type are as follows:

- **AV1-AV2**: not specified
- **AV3-AV4**: 2-way split system for separate ON-OFF switching of FoH and audience areas
- **AV5-AV6**: as for AV4 plus: either (2 circuit) dimming capability or checkerboard-pattern half-lighting for audience area (total 3 circuits); optional integration for AV6.
- **AV7-AV9**: as for AV4 plus: at least (2 circuit) dimming capability, with integrated control.

8.5.3 Lighting – Control panels

Manual control panels shall be fitted within easy reach of entrance doors within the room; shall be suitably labelled (suitable for visually impaired users); at suitable heights (as required by BCA/DDA) with the main (audience) switch consistently at the first (top or left) switch position; switches shall not be mislabelled (e.g. a switch labelled ‘fan’ shall not operate lights); non-functioning switches shall not be provided (i.e. unused switches shall be removed).

Where the manual door-entry panels control an integrated dimming system, brightest setting button shall be at the top-left progressively through to blackout at the bottom-right. Ideally buttons should form a single row or single column. Buttons shall be illuminated.

In addition to the mandatory door-entry panels, for all AV7-AV9 and optionally for other rooms that have AMX NetLinx and integrated lighting controller, lighting controls shall also be presented in the AMX touch-panel. All instances of the same button (on touch-panel and at door-entries) shall function in unison.
8.6 Natural light ingress & windows

Windows are not recommended for any teaching space or meeting room – external windows due to the uncontrolled ingress of bright light; and internal and external windows due to external movement distracting participants. Instead there should be a small viewing port in doors so people can see whether rooms are occupied.

There must be no direct sunlight, at any time of day or year, onto any walls/surfaces in-shot in a videoconference space or other space with cameras.

Given Deakin’s temperate latitude, these requirements (above and below) are very hard to meet because the Sun is both low in the North during winter and goes a long way into the South during summer mornings and evenings. Deakin operates three trimesters (including over Summer) and operates early morning and late evening classes.

Therefore external windows should be avoided. Where present they need to be covered, either by permanently closed or motorized drapes, particularly in FoH areas.

8.6.1 No glare from behind presentation surfaces

There must be no glare from behind presentation surfaces, neither direct sunlight nor indirect skylight. Mounting LCD panels or drop-down presentation screens in front of windows is strongly not recommended. Where this occurs brightness from windows must be less than brightness of the images. There must be no direct sunlight entry from behind presentation surfaces at any time of day or year.

8.7 Light bleed onto presentation surfaces

There must be no direct light (either natural or artificial) upon presentation surfaces. Sunlight must NOT shine directly onto presentation surfaces at any time of day or year.

The positioning of luminaires and their grilles, directional diffusers and/or barn-doors (blinders) shall be chosen and adjusted so that NO light shines directly onto presentation surfaces.

Total (i.e. indirect) light impinging on presentation surfaces must be limited as given in the following table.

Also, the variation of indirect light bleed across the image area must be gradual and uniform with no sharp steps.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>LCD maximum</th>
<th>LCD preferred</th>
<th>Projector maximum</th>
<th>Projector preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity (% of image brightness)</td>
<td>100%</td>
<td>10%</td>
<td>10%</td>
<td>1%</td>
</tr>
<tr>
<td>Variation across image area (% variation of light bleed intensity)</td>
<td>40%</td>
<td>10%</td>
<td>20%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Preliminary guidance – if you seek to exceed these values please contact DeS AV and Networks Unit Leader for approval, as for any other non-standard implementation.

It is pointless spending money on high quality, high brightness, high contrast projectors and LCD panels and then flooding the presentation area with light.
8.8 Heating, ventilation and air conditioning

HVAC systems must be designed so as not to exceed acoustic noise requirements (refer next section). Particular care is required in flexible-furniture videoconference / teleteaching spaces due to the tighter acoustic noise limits required to accommodate ceiling microphone arrays.

**No voids:**

Air-flow voids must not allow noise ingress into the room. Ideally there should be no such voids so that a controlled acoustic environment can be guaranteed.

In particular there must be no openable windows, nor gaps, air-flow holes, grilles, etc. to corridors or externally, nor to adjacent rooms.

Similarly, air-flow fans for AV equipment within the room must not exceed the following acoustic noise requirements.

8.9 Acoustics & noise

The overall acoustic design shall provide a minimum 40dB attenuation of ambient noise. 35dB is considered sufficient when doors are closed.

Ambient sound in the room shall not contain any distinctive characteristics such as tones or fluctuations.

Air conditioning, external noise and other plant noise should not exceed NR35 as defined by AS2107 1987.

The construction of any space must ensure that it is not excessively reverberant, for clear intelligible speech as required by AS2107 1987. Acoustic dampening is required if the room is too live.

Operable walls must seal so as to not allow sound bleed between the rooms when closed.

9 Installation

All new audio visual installations shall utilise a centralised approach where non user interactive equipment is centrally located in audio visual racks within local FCRs.

Audio visual signal distribution shall be via the twisted pair structured cabling system installed as part of the telecommunications services.

Note: joiners must not be used in any cable.

9.1 Sight lines and viewing angles

All AV Spaces shall be designed as per Sight Lines standards, detailed at https://blogs.deakin.edu.au/avn-docs/standards-documents/additional-resources/

9.1.1 Viewing distance

The distance to the most distant seat ideally must be no more than 6 times the height of the image and ideally no seat should be closer than twice the image height:

\[
\text{Maximum Viewing Distance} = 6 \times \text{Image Height} \\
\text{Closest Viewing Distance} = 2 \times \text{Image Height}
\]

All room seating arrangements and screen selections shall be designed in accordance with these parameters. Areas where an adequately large screen size is prohibitive and/or an optimal seating arrangement is not achievable, require additional relay screens towards the rear or the rooms and should be considered on a case-by-case basis.

9.2 Ceiling height

For new installations, once the required screen size is calculated, the minimum ceiling height can be calculated, being the screen height and its minimum height above floor level.

\[
\text{Minimum Ceiling Height} > \\
\text{Height of Lower Edge of Image AFFL} \\
+ \text{Image Height} \\
+ \text{Clearance for projector and/or other fixtures (e.g. lighting, fans) suspended from ceiling}
\]

Where Height of Lower Edge of Image AFFL depends on sight lines, generally as given in the following table:
Figure 9 – Height of Lower Edge of Displayed Images AFFL

<table>
<thead>
<tr>
<th>Room type</th>
<th>Sight lines obstructed by audience seated closer to screen (AV3,4,5,6) or by standing presenter or presenter desk (AV5,6,7,8)</th>
<th>Height of Lower Edge of Displayed Image AFFL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV1</td>
<td>n/a</td>
<td>&lt; 1.6 m</td>
</tr>
<tr>
<td>AV2</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>AV3, AV4</td>
<td>NO</td>
<td>0.8 ± 0.1 m</td>
</tr>
<tr>
<td></td>
<td>YES (audience)</td>
<td>1.4 m</td>
</tr>
<tr>
<td>AV5, AV6, AV7, AV8, AV9</td>
<td>NO</td>
<td>0.8 ± 0.1 m</td>
</tr>
<tr>
<td></td>
<td>YES (desk)</td>
<td>&gt; 1.2 m</td>
</tr>
<tr>
<td></td>
<td>YES (audience)</td>
<td>&gt; 1.4 m as required by sight lines</td>
</tr>
<tr>
<td></td>
<td>YES (presenter)</td>
<td>&gt; 1.9 m</td>
</tr>
</tbody>
</table>

Note: Top edge of Interactive Whiteboard image must be no higher than 1.9 m AFFL, i.e. lower edge of Interactive Whiteboard must be installed at 0.7 m AFFL.

9.3 Thermal protection of equipment

For the protection and safe operation of audio visual equipment, the maximum allowable operating temperature for any audio visual rack, cabinet or credenza fitted to house equipment must not exceed 35°C. It is the contractor’s responsibility to ensure sufficient air flow and ambient temperature will maintain the equipment within this limit.

Use of low-noise or low revolution in-rack fans is permitted.

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

9.4 Twisted pair cabling

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

UTP cabling for data shall be blue, UTP cabling for AV shall be green and STP cabling for AV shall be white.

9.5 Twisted pair transmitters/receivers (signal conversion)

Where required, audio, video and control signals shall be distributed to/from local FCRs via the use of twisted pair transmitters/receivers (signal converters), as outlined in the relevant Scope of Works.
9.6 Housing small components

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

- in or behind floor-boxes
- within walls (e.g. behind wall-plates)
- in ceilings

Exception – the only exception is:
- Transceivers as necessary for ceiling microphones

9.6.1 Mounting small components

The preferred methods for mounting small components are via the manufacturers supplied rack-mount kit, under-table mounting kit, or suitable 3rd party custom mount kit.

The use of self-adhesive Velcro and similar glue-based adhesives is prohibited.

9.6.2 Table microphones

Mounting of table-top microphones are an exception to the above clause. Microphones must be fixed to the table in their correct mounting locations (as per the relevant Scope of Works) using small self-adhesive Velcro pads.

9.7 Equipment racks in credenzas

Must be mounted at floor-level, on casters, so that it can easily be pulled out for servicing – i.e. credenza joinery plinth and base must be cut away so there is no step down to floor level.

There must be adequate airflow for the installed equipment.

9.8 Equipment racks

Equipment racks located within FCRs shall typically be provided by the Communications Contractors as part of the cabling installation works.

*Note the thermal protection requirements – operating rack temperatures must not exceed 35°C.*

Where these are not provided and for standalone audio visual projects, all racks shall be provisioned as described in this document and be in accordance with the relevant DeS Network Standards.

9.9 Displays

All flat panel displays and projection surfaces and screens shall have a widescreen format (16:9 for panels, 16:10 for projectors) and be sized so as to be suitable for the required 2H-6H viewing distance formula.

9.9.1 Flat panel displays

Flat panel displays shall be LCD type, either wall or ceiling mounted. Considerations should be taken for adequate cooling, in particular where screen is to be located within a dedicated wall cavity.

Panels shall be mounted on pop-out brackets to facilitate ease of servicing.
9.9.2 Projectors

Lecture theatres and class rooms (AV6 – AV9) are to be equipped with two side-by-side projectors as standard. This provides for dual display presentations of various types and provides a fall-back safety-net should one projector fail. Images must be adjusted to exactly the same height and size as each other.

AV1-S generally use an LCD panel, although a projector may be used in unusual situations. AV1-T always uses an LCD panel. AV2 rooms may have an accessory interactive Whiteboard. Meeting rooms (AV3) may be equipped with either a single projector or single LCD panel. Videoconference rooms (AV4) are generally equipped with LCD panels (dual), projectors are generally not recommended. Small teaching rooms (AV5) are to be equipped with a single projector.

9.10 IP-TV Set Top Box (AV1-T)

The LCD panel for AV1-T is mounted on a flexible arm. The IP-TV Set-Top Box (STB) is to be mounted immediately below or behind the LCD panel, attached via the same VESA mount as the LCD so that it swivels with it. When mounted behind the LCD panel, the STB’s provided IR extender accessory is added.

9.11 Presentation desk

Presentation desk dimensions and clearances shall be as follows:

- Desktop surface: 850H ±20 above finished floor level (ref. AS1428.2-1992, Clause 24.1.1(a), p.33)
- Space under desk (for wheelchair access): min 820H ±20 x min 800W (ref. AS1428.2-1992, Clause 24.1.1(b), p.33 & 24.1.3, p.34)
- Clearance from desk to (presentation) wall: min 1540 mm (ref. AS1428.2-1992, Clause 6.2, p.6)

Where this is not achievable in smaller existing spaces: a minimum clearance of 1200 mm wide is required and exemption must be approved by Facilities Services Division, Disability Services and DeS AV and Networks Unit Leader.

Where the presenter’s area has obstructions on all four sides (e.g. in a recording studio booth; or in an unusual teaching space with obstructions in the vicinity of the presenter’s area) then the minimum area to allow wheelchair U-turn manoeuvre is 1540 mm wide by 2070 mm in the direction of travel.

- Height of equipment on desk (e.g. top of monitors): max 1200H above floor level [to accommodate Sight Line from presenter (in wheelchair) to audience: The average eye line of a seated wheelchair is 1220 mm, as is the average eye line of the front row of audience, front row being worst case for a raked theatre; Note also that unavoidably on any flat-floored teaching space students' heads in the rows towards the front will obscure site line from wheelchair presenter to students in rows towards the rear] (ref. AS1428.2-1992, Figure 30, p.37)
- End-user accessible equipment (e.g. PC) in desk rack: min 230H above finished floor level (ref. AS1428.2-1992, Figure 28, p.35)
- Clear labelling (for example, black lettering on white background) and illumination for all end-user accessible equipment in desk rack (e.g. PC: “PC”)
Desks are available in three models: left swing, right swing, and fixed. The appropriate model for the room layout shall be specified in the relevant Scope of Works. The desk shall house one 12 RU rack underneath the bench, and optionally a second rack. A lockable door must be provided to allow service access to the rack. The rack houses infrastructure equipment only - no end user equipment shall reside in the rack. End user equipment shall be located on the top desk surface, other than the PC which shall reside in an accessible shelf on the presenter side of the desk.

An unused surge protected 4-way power board must be provided on top of the desk to power auxiliary devices such as laptop computers and cameras etc.

Non-retractable cables are to be covered in neat tubular braided sleeving.

Where required, specific desk designs shall be supplied in the relevant Scope of Works document.

9.12 Lighting

Deakin University will ensure that all spaces will be provided with fluorescent luminaries using directional diffusers. All lighting fixtures will be dimmable.

The preferred option for dimmable ballasts is DALI, this provides the most flexibility in configuration of lighting states. If DALI is not possible then DSI should be the second preference and it will be wired so at least every row is on a dedicated channel. 0-10V analog control may be used but only after the first two options have been exhausted. The lighting control system must be Dynalite.

A wall plate will be provided at each entry door position. The dimmer unit or DALI gateway must be installed in a location that is easily serviceable from floor height. Profile spots should be provided to illuminate the presentation area. These are to be installed at an angle between 45 and 60 degrees from horizontal to minimize shadowing and spill onto the projection screen. These spots are to be controlled by a Dynalite dimmer. Aisle lighting and exit sign luminaries must be designed in a way that prevents light from spilling onto the screen.

In video conference meeting rooms the lighting will be configured to give an even illumination across all participants without any bright or dark areas. Care should be taken not to introduce shadowing of the participants. It is mandatory that the lighting not introduce any glare on the camera lens which may cause the auto iris to close up.

The Dynalite DyNet network will connect to the Master NetLinx controller via a DyNet-to-IP gateway.

Any contractors working for the University will need to provide an optically isolated PC node (RS232 interface) for connection into the control system.

*If C-bus lighting is used a C-bus 5500PC RS232 interface is to be used.

Legacy control (RS-232, RS-485, contact-closure, relay, I/O, or other low-voltage controls, etc.) of lighting controllers must be via an AMX EXB breakout box, which converts to Ethernet. The EXB must be co-located with the lighting controller. The legacy controls must not be wired back to the AV rack or the master NetLinx controller.
The caption regarding C-bus is only relevant for non-standard situations – Deakin standard lighting controller is Dynalite.

The lighting levels must be set as per the recommended levels below. In addition minimum 2-way split system providing separate control of FoH and auditorium lighting (all room types except AV1, AV2) **must** be provided and must be brought out as separate end-user control buttons. Additional lighting circuits (greater than 2-way) may be provisioned as required by the circumstances.

**FIGURE 10 – LIGHTING LEVELS**

<table>
<thead>
<tr>
<th>Action</th>
<th>Lighting Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Off</td>
<td>Aisle lighting on only - 0%</td>
</tr>
<tr>
<td>Projection Mode</td>
<td>70 lux + Aisle Lighting On – 40%</td>
</tr>
<tr>
<td>Lecture Mode</td>
<td>300 lux + Aisle Lighting On – 70%</td>
</tr>
<tr>
<td>All On</td>
<td>400 lux + Aisle Lighting Off – 100%</td>
</tr>
</tbody>
</table>

The audio visual contractor will utilise UTP converters to transport the signal to the FCR and into the audio visual processor.

**9.12.1 LED lighting**

If LED lighting is considered for inclusion in **any** space of any type, it **must** conform to the interim guidelines at *ICT 2.3 Videoconferencing Standards* – even if videoconferencing is not initially envisaged, so as to cater for other future video camera applications, including:

- future addition of videoconferencing;
- future Automated Recording dual capture presenter camera;
- future remote monitoring cameras;
- ad-hoc and portable video camera use by end-users and/or for recording/relay.

**9.13 Floor boxes**

Floor boxes are to be fitted out with the appropriate standard wall plates and fitting as required per job. Signal extenders shall not be located in floor boxes. Where required, signal extenders shall be located in the desk or rack.

**9.13.1 Presentation Desk**

A floor box beneath the presentation desk should be provided wherever possible to remove the tripping hazard of cables across the floor. The floor boxes are to be a minimum 300 mm x 300 mm sized to be able to house all the services required for the desk. Minimum provision shall be two empty 32mm conduits with draw wires between this floor box and the system rack location to enable future expansion. All floor ducts are to have removable lids.
10 Cabling

The following cabling specifications describe the current University standards. Audio visual cabling that extends outside the room shall be delivered over structured TP cabling, or as described below.

Anything installed other than the standard listed here, must be signed off by DeS AV and Networks Unit Leader before procurement or installation commences. Any deviation from this standard without prior approval from DeS AV and Networks Unit Leader will not be accepted.

Where existing cabling is to be reused, suitability can be determined by the contractor upon initial site visit. If deemed that existing cabling is to be pulled out and rerun the contractor will first need to have sign off from DeS AV and Networks Unit Leader.

Joiners must not be used in any cable.

10.1 Maximum cable lengths

All copper cabling must remain within the one earthing zone of the one building – no exceptions. Only optical fibre may be run between buildings or (where a physical building is comprised of multiple electrically independent ‘buildings’) between power system earthing zones. Maximum cable lengths differ depending on technology and shall not exceed the following.

**Figure 11 – Maximum cable lengths**

<table>
<thead>
<tr>
<th>Type</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touch-8 umbilical to EX90/proprietary PoE injector</td>
<td>7.5 m</td>
</tr>
<tr>
<td>Mic-20 integrated cable</td>
<td>7.5 m [2]</td>
</tr>
<tr>
<td>VGA</td>
<td>refer cable manufacturer’s specifications</td>
</tr>
<tr>
<td>RS-232 over any CATx TP</td>
<td>15 m end-to-end</td>
</tr>
<tr>
<td>HDMI</td>
<td>10 m end-to-end [3]</td>
</tr>
<tr>
<td>line level audio, unbalanced (coax)</td>
<td>&lt;1 dB attenuation at 10 kHz end-to-end [4]</td>
</tr>
<tr>
<td>line level audio, balanced (STP)</td>
<td>&lt;1 dB attenuation at 10 kHz end-to-end [4]</td>
</tr>
<tr>
<td>speaker figure 8</td>
<td>round-trip impedance &lt;10% of speaker impedance [5]</td>
</tr>
<tr>
<td>analog AV over CATx TP</td>
<td>refer transceiver manufacturer’s specifications</td>
</tr>
<tr>
<td>HDBaseT over CAT6a UTP or better</td>
<td>100 m end-to-end</td>
</tr>
<tr>
<td>10/100/1000 Mbit/s Ethernet over CAT5e UTP or better</td>
<td>100 m end-to-end, maximum of two patch leads.</td>
</tr>
<tr>
<td>RS-485 over any CATx TP</td>
<td>&gt;200 m end-to-end between furthest devices</td>
</tr>
<tr>
<td>RS-422 over any CATx TP</td>
<td>&gt;200 m end-to-end</td>
</tr>
</tbody>
</table>

Notes:

1. ‘end-to-end’ means device-to-device including allowance for all fly-leads, patch-leads etc.
2. may be extended via fixture wiring from floor-box by a further 7.5 m
3. regardless of length must meet or exceed HDMI “High Speed” (Category 2) Standard i.e. certified to 340 MHz and 10.2 Gbit/s end-to-end
4. with matched (low-Z ~100Ω) drive; high-Z (>1kΩ) termination
both resistive impedance (measured at DC) and inductive impedance measured at 1kHz, e.g. if speaker resistance is 8Ω over 0Hz to 1kHz then cable AWG must deliver less than 0.8Ω round-trip impedance, i.e. single conductor end-to-end 0.4Ω

[6] refer Deakin Network Cabling Standards for actual minimum required CATx cable type

10.2 Strain relief
All cables shall be provided with strain-relief slack and tether. Slack shall be sufficient to allow equipment disconnection without dismantling the tether. Tether shall not crush cable – this is most important for all cable types.

Velcro is preferred for strain-relief. Cable ties shall not be accepted.

Loose bundled Velcro is mandatory for all CATx (UTP and STP) and other shielded (e.g. coax) cable types.

10.3 Network cabling
All network cabling shall be in accordance with the Deakin University Information and Communication Technologies (ICT) Volume 6 – Network Standards.

10.4 Signal delivery
Audio visual signals between the FCR and audio visual enabled areas, shall be via the twisted pair structured cabling installed in accordance with Deakin University Structured Cabling Standards directly terminated into the AV equipment rack, not via intermediate Krone frame.

Approved twisted pair transceivers shall be used to convert the native audio, video and control signals for twisted pair delivery.

10.5 Audio visual cabling
Where possible, all audio visual signals shall be distributed over the same TP structured cabling system in use by the IT network, with the exception of powered audio cabling between amplifiers and speakers and inter-device cabling co-located within the audio visual rack. All cabling shall be neat and tidy.

Approved cable fasteners shall be used at 300mm (min) for all audio visual cables.

Audio visual cabling should be supported on cable tray or catenaries in ceiling spaces. Cables attached to catenaries should be attached at 200mm intervals ensuring Velcro ties are firm but do not distort or apply undue pressure to the cables in any way.

Additionally, a service loop is required for audio visual cabling within the rack, projector and speakers (this will allow for future re-termination). A gentle drip loop (observing bend radius restrictions for the given cable type) is required at each termination for strain relief of the cable, between the termination point and where secured to the threaded rod in the rack.

Where AV racks are movable/on wheels, drip loops should be managed such that they clear the floor by at least 50mm, and do not foul with the rack movement during servicing.

10.5.1 System Cables
Apart from twisted pair cables, all other cabling, including inter-device cables, shall comply with the requirements outlined below.
10.5.1.1 VGA
Until VGA sunset time is reached, provide VGA cabling for initial laptop connections only, prior to switching/scaling/conversion.

VGA cables shall typically be AMX HydraPort retractable VGA cables with 15 pin D-Sub connector and integrated 3.5mm analog audio. Soldering of VGA cables shall not be accepted.

10.5.1.2 System control cabling subsystems (RS-232)
Provide system control cabling for control of lighting from the audio visual systems.

Control cabling shall be either Belden 1421A or CATx UTP. Terminate the cabling on DB-9 connectors at both ends.

10.5.1.3 USB subsystems
Provide USB 2.0 cabling for control lectern equipment. Terminate the cabling on USB 2.0 compliant connectors at both ends.

10.5.1.4 Relay cabling
Provide cabling for relay control. Relay cabling to be Belden 1421A or Cat6 UTP.

10.5.1.5 Front of house speaker cabling
Provide front of house speaker cabling to all front of house speakers. Speaker cabling shall consist of Belden figure 8 min. 16 AWG with bare copper conductors. Cabling shall be terminated with Speakon connectors at both ends.

10.5.1.6 Ceiling speaker cabling
Provide 100 volt line cabling to all ceiling speaker outlet locations. Supply and install speaker cabling to all speaker outlets locations. Speaker cabling shall be high quality OLEX JSF 2.6. The ceiling end of the cable shall be left terminated and coiled within the ceiling void with the location clearly identified on the as-build drawings allowing future relocation to the first ceiling speaker position. A service loop for each speaker in ceiling will be provided for maintenance/repair. This should allow for the speaker to be lowered to ground level for servicing.

10.5.1.7 Microphone cabling
Supply and install microphone cabling to all microphone connection locations. Microphone cabling shall be Belden 1192-A Four Conductor Star Quad 24AWG. Terminate the cabling as per device input outputs.

10.5.1.8 Line level cabling
Supply and install line level cabling to all audio input connection locations. Line level cabling shall be Belden 8723. Terminate the cabling as per device input outputs.
10.5.1.9 **HDMI**

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

- Maximum end-to-end length **10m**
- No joins
- Category 2 “**High Speed**” compliant cable (i.e. certified to 340 MHz and 10.2 Gbit/s)
- **Type A** (19 pin) connectors
- Where wall-plates are employed overall end-to-end length must still fit within the 20 m limit and maintain “High Speed” performance

Otherwise for digital video HDBaseT over TP shall be used (see below).

10.5.1.10 **HDBaseT**

HDBaseT and related signalling (e.g. DXLink) shall always use multistrand **Cat6a** or better TP and shall follow manufacturer’s recommendations regarding use of UTP or F/UTP (or other forms of STP).

10.5.1.11 **DVI**

DVI cabling shall be Extron DVI-D Dual Link (cable length dependent on application).

10.5.1.12 **DXLink**

DXLink cabling shall be multistrand Shielded Cat6a. It shall be routed and terminated in accordance with the AMX White Paper publication: Cabling for Success with DXLink.

10.5.2 **Fly leads**

Provide fly leads in lengths suitable for equipment to the wall plate.

Provide a fly lead for each audio visual outlet.

10.5.3 **Audio visual plates**

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

All plates to be mounted in cupboards for connection of equipment are to be Clipsal 2000 series. Plates to be mounted in the field or in floor boxes shall match power and communications plates. Samples of each mounting plate type, including proposed engraved labelling, size and layout is to be submitted for approval prior to manufacture.

The layout of connectors and labelling is to be in a logical concise format. Terminal strips to be screw with crimp mechanism.

Shop drawings reflecting all appropriate cables and terminations shall be submitted for approval prior to any orders being placed.

10.6 **Labelling**

*Note: DeS are currently developing a new labelling standard for audio visual installations. Please refer to the DeS AV and Network Manager for further directions.*
All cables, data outlets, video and audio outlets shall be labelled with a label conforming to Deakin University requirements for each application. All audio visual cables should be labelled at both ends in a plain text format indicating the source and destination.

10.6.1 Data sockets

All data sockets shall be labelled with a printed label conforming to Deakin University requirements.

Each socket will be affixed with the label that can be clearly read from above or head-on. It is preferable that labels are not placed in such a position that drooping patch leads will obscure their reading.

The information contained on the label shall be identical to the information on the corresponding distribution frame label network and must match the convention used elsewhere within the premises.

10.6.2 Video cabling

The contractor must label video cables at both ends in line with Deakin University standards.

_Exception: Do not affix labels to the retractable end of cables within a HydraPort module._

10.6.3 Audio cabling

The contractor must label audio cables at both ends in line with Deakin University standards.

_Exception: Do not affix labels to the retractable end of cables within a HydraPort module._

10.7 Segregation from other services

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

*FIGURE 12 – SEGREGATION OF SERVICES*

<table>
<thead>
<tr>
<th>Circuit Rating kVA @ ≤ 415V AC</th>
<th>Unshielded Power Cables mm</th>
<th>Shielded Power Cables mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1</td>
<td>300</td>
<td>25*</td>
</tr>
<tr>
<td>&gt; 1 ≤ 2</td>
<td>450</td>
<td>50</td>
</tr>
<tr>
<td>&gt; 2 ≤ 5</td>
<td>600</td>
<td>150</td>
</tr>
<tr>
<td>&gt; 5</td>
<td>1500</td>
<td>300</td>
</tr>
</tbody>
</table>

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

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

10.8 Minimum bending radius

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 which is applicable to the largest minimum radius of bend of any cable in the group, typically the largest cable.

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

10.9 Tray support systems

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

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

All external cabling is to be covered using tubular braided sleeving, matching the immediately surrounding architectural colour scheme. Joints in the tray shall be butted and present a smooth finish to the cable bearing surface.

10.10 Joints in cables

Mid-run joints in cables are not permitted.

10.11 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.

10.12 Removal of redundant and de-commissioned cabling

All redundant or disused cabling and wall plates must be completely removed, unless such cable is correctly installed and terminated at both ends in a manner that complies with this Standard.
11 Network services

11.1 Audio visual components

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

**Figure 13 – Audio visual device – cabling requirements**

<table>
<thead>
<tr>
<th>Device\Cabling Requirements</th>
<th>UTP Outlets (RJ45)</th>
<th>Power Outlet (GPO)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive White Board</td>
<td>3</td>
<td>2</td>
<td>1 – USB, 1 – Audio, 1 – Spare</td>
</tr>
<tr>
<td>Projector</td>
<td>3</td>
<td>1</td>
<td>1 – Video &amp; Control, 1 – LAN/Spare</td>
</tr>
<tr>
<td>LCD Screen</td>
<td>2</td>
<td>1</td>
<td>1 – Video &amp; Control, 1 – LAN/Spare</td>
</tr>
<tr>
<td>Plasma Panel</td>
<td>2</td>
<td>1</td>
<td>1 – Video &amp; Control, 1 – LAN/Spare</td>
</tr>
<tr>
<td>Document Camera</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Interactive Tablet</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Local PC</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Laptop Connection</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Table Microphones</td>
<td>1</td>
<td>0</td>
<td>1 RJ45 per 2 microphones</td>
</tr>
<tr>
<td>Wireless Microphones and receivers</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Speakers Ceiling Mounted</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Ceiling Speaker Amplifier</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>DVD Player</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>VGA Laptop Switcher</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Video Conferencing Camera</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Projector Lifter</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Motorised Projection Screen</td>
<td>No</td>
<td>1</td>
<td>Use control cable instead</td>
</tr>
<tr>
<td>Field Rack</td>
<td>12</td>
<td>2</td>
<td>1No. 24 port patch panel (1/2 terminated)</td>
</tr>
<tr>
<td>AV Rack located in Communications Room</td>
<td>48</td>
<td>1 x 15Amp</td>
<td>2No. 24 port patch panels</td>
</tr>
</tbody>
</table>
11.2 Audio visual racks

All audio visual racks located in FCRs, shall be provisioned with RJ45 patch panels presented onto the patching frame below network switch allocations as detailed within the ICT Network Standards and the table below.

**Figure 14 – AV Rack Patch Panel Details**

<table>
<thead>
<tr>
<th>AV Room</th>
<th>Rack Type</th>
<th>RJ45 Patch Panels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor Communications Room</td>
<td>48 ports – 2x 24 port patch panels</td>
<td>2x 24 port patch panels (48 Ports terminated)</td>
</tr>
<tr>
<td>Teaching Space</td>
<td>Lectern / Desk – 12 RU</td>
<td>1x 24 Port patch panel (12 ports terminated)</td>
</tr>
<tr>
<td>Lecture Theatre AV Room</td>
<td>18RU</td>
<td>1x 24 Port patch panel (24 ports terminated)</td>
</tr>
</tbody>
</table>

11.3 Network devices

Audio visual devices requiring network connectivity shall be provisioned and centrally configured by DeS, prior to being attached onto the Deakin University network.

A list of all devices intended for IP communication shall be given to Deakin DeS by the installer prior to any connections being made. Installers shall provide MAC addresses for all such devices to DeS, no later than two (2) weeks prior to installation, to allow enough time to for Deakin to assign appropriate DHCP Reserve IPs and DNS names for each device.

Deakin DeS shall provide IP addresses and a patching schedule to the audio visual contractor for connection.

11.4 Video conferencing systems

Video conference codecs shall be configured to communicate over IP. Codecs shall use DHCP Reserved IP addresses and be provided an appropriate DNS name as per DeS DNS naming practices.

Network connections to the video conferencing codec shall include full channel testing to DeS Network Standards and that the installed unit is configured to Deakin standards.

Prior to connection onto the network, the audio visual contractor shall confirm all IP addresses, MAC addresses and patching details with DeS.

12 Commissioning and handover

12.1 Commissioning

Appropriate commissioning of equipment and systems will be carried out by the contractor to ensure that the as-designed performance, functionality and reliability of equipment and systems is proven and documented prior to project handover.

Three sign-off stages by DeS staff are needed to be carried out prior to handover.

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

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

12.2 Documentation requirements

Where documentation has been requested, the contractor must provide the following in editable form before handover and sign off:

- Professional Shop drawings (MS Visio preferred)
- As built diagrams (MS Visio preferred)
- Operations manual (MS Word preferred)

12.3 Handover and signoff

Final handover and signoff of work will be tracked via SafetyCulture iAuditor using Deakin audit templates. Any installation that does not meet the standards presented in this document will need a signed off exemption from DeS before it is completed.

Scope of works and check lists must be signed off by all parties.
13 Appendices

13.1 Appendix A: Definitions
<table>
<thead>
<tr>
<th>Word or Short-form</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV</td>
<td>Audiovisual</td>
</tr>
<tr>
<td>AMX</td>
<td>A control system used by most universities, which is manufactured by AMX Corp.</td>
</tr>
<tr>
<td>ANSI</td>
<td>The American National Standards Institute – a standards organisation. Commonly used in conjunction with brightness or light output of projectors.</td>
</tr>
<tr>
<td>Audio</td>
<td>Any audio signal in either analog or digital format</td>
</tr>
<tr>
<td>AV1-AV8</td>
<td>Audiovisual Room standards (refer ICT Volume 2.1 for definitions)</td>
</tr>
<tr>
<td>Balanced</td>
<td>A signal of opposite polarity to each other typically used to carry microphone signals.</td>
</tr>
<tr>
<td>BCA</td>
<td>Building Code of Australia</td>
</tr>
<tr>
<td>BDR</td>
<td>Building Distribution Room</td>
</tr>
<tr>
<td>Biobox</td>
<td>A separate projection booth or control room at the rear of a theatre</td>
</tr>
<tr>
<td>Cat6 (Category 6)</td>
<td>Balanced twisted-pair copper cabling specifications characterized in a frequency range from 1 to 250 MHz.</td>
</tr>
<tr>
<td>Cat6a (Category 6a)</td>
<td>Balanced twisted-pair copper cabling specifications characterized in a frequency range from 1 to 500 MHz.</td>
</tr>
<tr>
<td>Composite video</td>
<td>A method of delivering video using a single cable to carry a composite video signal</td>
</tr>
<tr>
<td>CD</td>
<td>The common Compact Disc audio format</td>
</tr>
<tr>
<td>CDROM</td>
<td>The common Compact Disc Read only memory data disc format</td>
</tr>
<tr>
<td>Codec</td>
<td>A device capable of encoding and decoding a digital data stream or signal</td>
</tr>
<tr>
<td>Data Projector</td>
<td>An electronic device capable of projecting an image from a computer or video source (eg VCR) onto a large display screen. (The terms ‘data projector’ and ‘video projector’ are normally interchangeable.)</td>
</tr>
<tr>
<td>DDA</td>
<td>Disability Discrimination Act</td>
</tr>
<tr>
<td>DeS</td>
<td>Deakin eSolutions (Deakin University's information technology services division, previously ITSD)</td>
</tr>
<tr>
<td>DMP</td>
<td>Digital Media Player</td>
</tr>
<tr>
<td>Drapes</td>
<td>In this document ‘drapes’ means all window coverings including curtains and blinds of all types</td>
</tr>
<tr>
<td>DSP</td>
<td>Digital Signal Processor (usually audio)</td>
</tr>
<tr>
<td>DVD</td>
<td>The common Digital Versatile Disc format for video, audio or data storage and playback</td>
</tr>
<tr>
<td>DVI</td>
<td>Digital Visual Interface – a video connection capable of delivering analog and/or digital video with resolutions up to 2048x1536</td>
</tr>
<tr>
<td>DVI-A</td>
<td>A DVI cable similar to RGBHV used to deliver high quality analog video signals</td>
</tr>
<tr>
<td>DVI-D</td>
<td>A DVI cable used for delivery of digital video signals</td>
</tr>
<tr>
<td>DVI-I</td>
<td>A DVI output capable of sending both analog (DVI-A) and digital (DVI-D) signals.</td>
</tr>
<tr>
<td>FCR</td>
<td>Floor Communications Room</td>
</tr>
<tr>
<td>FDR</td>
<td>Floor Distribution Room</td>
</tr>
<tr>
<td>FOH</td>
<td>‘Front of House’ – the front of the space</td>
</tr>
<tr>
<td>F/UTP</td>
<td>shielded Twisted Pair cable, with overall Foil shield; and no individual pair shields</td>
</tr>
<tr>
<td>GPO</td>
<td>General Purpose Outlet for distributing 240V power</td>
</tr>
<tr>
<td>HD</td>
<td>High Definition – a display image resolution typically of 1080x720 (720p) or 1920x1080 (1080p)</td>
</tr>
<tr>
<td>Word or Short-form</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------</td>
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</tr>
<tr>
<td>HDBaseT</td>
<td>Multi-vendor industry standard for combined digital transmission of HDMI video, audio, control, 100 Mbit/s Ethernet and DC power over a standard single 4-pair twisted pair (TP) cable. Aggregate bit rate 10.2 Gbit/s.</td>
</tr>
<tr>
<td>HDMI</td>
<td>High Definition Multimedia Interface -- a proprietary connection used for the delivery of high definition uncompressed digital data at short distances.</td>
</tr>
<tr>
<td>iLecture</td>
<td>Deakin University’s lecture capture and online media delivery system utilizing Echo360 SafeCapture-HD digitizers.</td>
</tr>
<tr>
<td>ITSD</td>
<td>refer DeS</td>
</tr>
<tr>
<td>NetLinx</td>
<td>An AMX proprietary language that when compiled can be sent to NetLinx controllers</td>
</tr>
<tr>
<td>NTSC</td>
<td>The ‘National Television Standards Committee’ system of broadcasting analog television in the USA.</td>
</tr>
<tr>
<td>NTP</td>
<td>Network Time Protocol</td>
</tr>
<tr>
<td>OHP</td>
<td>Overhead projector – An optical device for projecting transparencies onto a screen</td>
</tr>
<tr>
<td>PAL</td>
<td>The ‘Phase Alternate Line’ system of broadcasting analog television signals in Europe and Australia</td>
</tr>
<tr>
<td>PC</td>
<td>A personal computer running under a Microsoft windows platform</td>
</tr>
<tr>
<td>PDU</td>
<td>Power Distribution Unit</td>
</tr>
<tr>
<td>PIR</td>
<td>Passive Infra Red motion detector</td>
</tr>
<tr>
<td>PLF</td>
<td>Power Line Filter</td>
</tr>
<tr>
<td>PoE</td>
<td>Power over Ethernet</td>
</tr>
<tr>
<td>RGBHV</td>
<td>A method of delivering video using five cables to carry red, green, blue, horizontal and vertical signals</td>
</tr>
<tr>
<td>RS232</td>
<td>A standard for 2-way serial device communications</td>
</tr>
<tr>
<td>RS485</td>
<td>A standard for multipoint communications</td>
</tr>
<tr>
<td>S/FTP</td>
<td>shielded Twisted Pair cable, with both overall Shield and individual pair Foil shields</td>
</tr>
<tr>
<td>STB</td>
<td>Set Top Box</td>
</tr>
<tr>
<td>STP</td>
<td>Shielded Twisted Pair cable, includes variants: Overall shield; individual pair shield; and both overall and individual pair shields; potentially ambiguous – prefer use of F/UTP, U/FTP, and S/FTP respectively</td>
</tr>
<tr>
<td>SVGA</td>
<td>A display image resolution of 800 x 600</td>
</tr>
<tr>
<td>S-Video</td>
<td>Also known as Y/C is an analog video interface that carries the video data as two separate signals, luma (luminance) and chroma (colour)</td>
</tr>
<tr>
<td>SXGA</td>
<td>A display image resolution of 1280 x 1024</td>
</tr>
<tr>
<td>TP</td>
<td>Twisted Pair – 4-pair standard CATx cable including Unshielded (UTP) and various Shielded (STP) variants.</td>
</tr>
<tr>
<td>U/FTP</td>
<td>shielded Twisted Pair cable, with individual pair Foil shields; and no overall shield</td>
</tr>
<tr>
<td>UI</td>
<td>User Interface</td>
</tr>
<tr>
<td>Unbalanced</td>
<td>A signal being carried in a single centre conductor surrounded by a shield</td>
</tr>
<tr>
<td>UPS</td>
<td>Uninterruptable Power Supply</td>
</tr>
<tr>
<td>UTP (or U/UTP)</td>
<td>Unshielded Twisted Pair cable – structured cable used by communications networks consisting of 4 pairs of wire twisted together to varying twist ratios</td>
</tr>
<tr>
<td>UXGA</td>
<td>A display image resolution of 1600 x 1280</td>
</tr>
<tr>
<td>VCR</td>
<td>The common Video Cassette Recorder videotape format</td>
</tr>
<tr>
<td>Word or Short-form</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------</td>
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</tr>
<tr>
<td>VGA</td>
<td>A computer image resolution of 640 x 480 pixels. In respect to cables VGA means a multi-core carrying RGBHV signals from one device to another</td>
</tr>
<tr>
<td>VHF</td>
<td>The ‘Very High Frequency’ radio spectrum between 30Mhz and 300Mhz</td>
</tr>
<tr>
<td>Video</td>
<td>Any video signal in either analog or digital format</td>
</tr>
<tr>
<td>WSXGA</td>
<td>A display image resolution of 1680 x 1050 (widescreen format)</td>
</tr>
<tr>
<td>WUXGA</td>
<td>A display image resolution of 1920 x 1200 (widescreen format)</td>
</tr>
<tr>
<td>WXGA</td>
<td>A display image resolution of 1366 x 768 (widescreen format)</td>
</tr>
<tr>
<td>XGA</td>
<td>A display image resolution of 1024 x 768</td>
</tr>
</tbody>
</table>