



# NSW Public Schools – Audio-visual standards for school learning displays

**Foundations.T4L, Information Technology Directorate**

NSW Department of Education

LEVEL 11, 8 CENTRAL AVENUE, SOUTH EVELEIGH, NSW 2015



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## Document details:

This document specifies the requirements for the provision of Audio Visual (AV) systems for New South Wales Department of Education (NSW DoE) communal hall spaces. These standards shall be applied to current and future NSW DoE facility fit out projects.

This document provides the minimum standard required for key equipment, power and communications required for each NSW DoE learning space. Exact measurements, quantities, equipment locations, and other room aspects such as equipment installation methods will vary from project to project.

## Glossary of terms:

Term	Meaning
"Shall"	The term "SHALL" means that the item is an absolute requirement of the standard. Omission of this item from the deployment would mean that the desired objectives would not be met. Objectives include availability, specific functions or technical requirements, and dependent features.
"Shall Not"	The phrase "SHALL NOT", means that the item is absolutely prohibited in the standard.
"May"	"MAY" means that an item is truly optional. For example, you may choose to include the item because a particular objective or application/protocol requires it or because it enhances the deployment.

## Revision History:

Date	Version	Summary of changes	Author
27/08/2019	0.1	1st Draft presented for feedback.	Ryan O'Hara
06/09/2019	0.2	2nd Draft presented for feedback.	Ryan O'Hara
09/11/2019	0.3	3rd Draft presented for feedback.	Ryan O'Hara
11/09/2019	0.4	4rd Draft presented for feedback.	Ryan O'Hara
13/09/2019	1.0	Final Draft presented for feedback.	Ryan O'Hara
30/09/2019	1.1	Additional Contract information added.	Ryan O'Hara
08/11/2019	1.2	Additional changes made throughout document with specialist AV staff.	Ryan O'Hara
11/02/2020	1.3	Incorporated further feedback from School Network Design Authority (SNDA).	Ryan O'Hara
17/02/2019	1.4	Incorporated further feedback from Architecture Design Authority (ADA).	Ryan O'Hara
23/07/2020	1.5	Added content to new template. Incorporated need to consult Foundations Project Manager before mounting screens, clarified mounting height requirements	Ryan O'Hara
10/11/2020	1.6	Added additional mounting clarifications, including recommendations for height	Ryan O'Hara

Date	Version	Summary of changes	Author
		adjustable mounts.	

### Approvals:

Name	Title	Date
James Quiring	Service Relationship Manager	30/07/2020
School Network Design Authority (SNDA)	N/A – Membership approval	30/07/2020

### Associated International and Australian Standards:

Name
AS/NZS 2017:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors
AS/NZS ISO 717.1:2004 Acoustics – Rating of sound insulation buildings and of building elements. Part 1: Airborne sound insulation
AS/NZS 1680.2.1:2008 (as amended) Interior and workplace lighting – Specific applications – Circulation spaces and other general areas
AS/NZS 1680.2.2:2008 (as amended) Interior and workplace lighting – Specific applications – Office and screen based tasks
AS/NZS 1680.2.3:2008 (as amended) Interior and workplace lighting – Specific applications – educational and training facilities
AS 1428.1:2009 Design for access and mobility – General requirements for access – New building work

### Associated Documents – NSW Department of Education:

Document	Version
NSW DoE Structured Cabling Standard	Latest available in DG 64
NSW DoE Video Collaboration Tools Standard	Latest available in DG 64

# 1. Scope of Works

## 1.1 Roles and responsibilities

Role	Responsibilities
<b>Audio Visual (AV) Contractor</b>	<p>Installing all equipment, software and required cabling (whether or not it is documented in this standard and all accompanying documents).</p> <p>Notifying the Client and Project Manager of any errors, omissions or ambiguities in the standards and accompanying documents.</p> <p>Provide all associated labour.</p> <p>Deliver operational AV systems as per the intended design, documented in this specification and all accompanying documents.</p> <p>Providing the Client with a copy of the Quality Assurance (QA) Procedure to be utilised in each learning space.</p> <p>The AV Contractor shall be present at any scheduled AV User Acceptance Testing (UAT) to witness testing, remediate any uncovered issues and complete the AV hand-over.</p> <p>Ensuring that the installation of the AV systems is of the highest quality and is integrated with other related systems and designs including, but not limited to; electrical (power, communications, lighting), mechanical, architectural, structural, interior design, acoustics, fire, and hydraulics.</p> <p>Providing any non-compiled code and software to the Project Manager and Client for future Disaster Recovery (DR) and upgrade requirements.</p> <p>Ensuring that all aspects of the installation support efficient paths for future expansion or upgrade.</p> <p>Utilising NSW DoE provided and/or endorsed tools for tracking and capturing information.</p>
<b>Project Manager (Foundations.T4L)</b>	<p>Organising and scheduling the procurement, delivery and installation of all equipment, software and required cabling in cooperation with the Audio Visual Contractor, Client and Builder.</p> <p>Ensuring that all supplied equipment is compliant with NSW DoE standards and guidelines, and that equipment has been supplied through NSW DoE contracted suppliers.</p> <p>In cooperation with the Audio Visual Contractor and Builder, ensure that the installation of the AV systems is of the highest quality and is integrated with other related systems and designs including, but not limited to; electrical (power, communications, lighting), mechanical, architectural, structural, interior design, acoustics, fire, and hydraulics.</p> <p>Sign off and approval of all Project Documentation.</p> <p>Final sign-off of fit-out and installation in cooperation with the Client.</p>
<b>Client (Or Client IT Representative)</b>	<p>Identify any additional Audio Visual requirements not specified within this document to the Project Manager.</p> <p>Final sign off of fit-out and installation in cooperation with the</p>

Role	Responsibilities
	Project Manager.
<b>Builder</b>	<p>Supply and fit out of structural reinforcement for AV solutions if required.</p> <p>In cooperation with the Audio Visual Contractor and Project Manager, ensure that the installation of the AV systems is of the highest quality and is integrated with other related systems and designs including, but not limited to; electrical (power, communications, lighting), mechanical, architectural, structural, interior design, acoustics, fire, and hydraulics.</p>

## 1.2 Complete supply and install

- This document does not specify every line item (hardware, software, cabling, connectors, labour etc.) required to complete each system. The AV Contractor shall be responsible for providing all items required to deliver fully working systems, whether or not explicitly specified in this document and whether “Supply and Install” is mentioned or not.
- All required items must be included (or a reasonable allowance made) in the AV Contractor’s tender response price to deliver a Project (excluding AV components to be delivered under a DoE supply contract).
- Failure to include all required items in the AV Contractor’s tender response price shall not be grounds for the AV Contractor to claim for variations to deliver this Project after the tender has been awarded.

## 1.3 Equipment on client LAN

- The AV Contractor shall liaise with the Project Manager and the Client (or Client IT Representative) to inform them of all AV equipment that will require direct connection to any existing NSW DoE ICT network.
- Information supplied shall include as a minimum: brand name, model number, MAC address, serial number and related specifications.
- This information shall be made available to the Client (or Client IT Representative) at least three (3) weeks prior to delivering the equipment to site.

## 1.4 Site works

- The AV Contractor shall take full responsibility for all works on site for the entirety of the project.
- The AV Contractor shall cover, without additional cost to the Client, inclusion of any necessary services and items to effect the safe and timely completion of the project. Services and items shall include, but are not limited to: all freight and delivery costs to and from site for any item unless additional and/or costed separate to this project, scaffolding, rigging, lifting and high-lift equipment, safety barriers and safety equipment, dust covers and protective covers, cleaning equipment, waste and rubbish removal and parking.

## 1.5 Basic warranty statement

- Clear identification of inclusions and any exclusions or conditions affecting warranty of the systems shall, be provided.
- A minimum warranty period of 48 months (4 years), and equivalent to the current contract warranty period shall be required for all items of equipment, parts, labour and programming.
- The warranty statement shall detail all items associated with warranty work including, but not limited to, the initial service call response period, the on-site response period, removal of faulty equipment, replacement or loan equipment (if required), freight charges (for all

segments of the fault period including back-to-base and return-to-manufacturer), parts and labour.

## 1.6 Defects and liability period

- The Defects Liability Period shall apply to all equipment and installation following practical completion as stated above, as well as any period following thereafter for which any nominated defects on site remain incomplete or outstanding.
- At the commencement of the Defects Liability Period the AV Contractor shall warrant all equipment and installation for 48 months (4 years).
- Any deviation from this for equipment, systems or workmanship provided by the AV Contractor shall be clearly indicated in the Tender Submission, including any extended warranty period for any items of equipment. The Defects Liability Period shall not commence until the Project Manager, in consultation with the Client, has specifically authorised the commencement.

## 1.7 Software and programming

- Commissioning and troubleshooting of any software and programming code is still to be included in the scope of the AV Contractor's work.
- For both commercial and non-commercial (custom) software, the AV Contractor shall supply the Client with a complete set of all licences and documentation for all devices, as well as utilities and tools used in the operation and maintenance of the system.
- Any commercial software provided by the AV Contractor shall be procured and transferred in full compliance with the publisher's copyright, licensing and other requirements of ownership. All user licence agreements shall be registered in the name of the Client by the AV Contractor.
- The Client shall also retain full rights to all custom software and programming code developed by the AV Contractor as part of the Project. These rights shall also pertain to any non-compiled code and non-compiled programs developed by the AV Contractor as part of the project.
- The AV Contractor shall supply the first version, and any subsequent versions of any and all custom software and programming code. The AV Contractor shall supply any updated software or code upon release by the manufacturer, especially in instances where software and code updates specifically address security defects.

## 1.8 Documentation

The following technical information shall be provided by the AV Contractor at least three (3) weeks prior to commencement of works on site. All documents on this list below shall be presented in .pdf files, and shall be formally approved by the Project Manager prior to the AV Contractor commencing works on site:

- Technical drawings for each AV system, including all signal paths. The technical drawings shall include audio, video and control signals.
- Technical drawings of all racks that house AV equipment.
- Technical drawings of key items of equipment to be installed such as: loudspeakers, data projectors, projection screens, video conference cameras, LCD screens, table boxes, wall plates/control panels, as well as other relevant equipment.
- Full Bill of Materials (including equipment and labour) containing brand names, model codes, serial numbers and MAC addresses (where applicable).

### 1.8.1 Operations and maintenance manual

- The AV Contractor shall provide one draft electronic copy of the Operation and Maintenance Manual at least two (2) weeks prior to practical completion for approval by the Project

Manager. Within the final two (2) weeks prior to handover, or at handover, the AV Contractor shall provide the final copy to the Client.

- A complete Operational and Maintenance Manual shall be provided in a bound, A4 book (physical copy) and Microsoft Word (.docx, electronic copy).

## 1.9 Associated work by other contractors

- Various works, related to the AV systems may be carried out by contractors other than the AV Contractor.
- The AV Contractor shall liaise with the others on site and coordinate their works to ensure a high quality installation and finish.

## 1.10 Handover

Handover shall be defined as the time when each of the following is completed to the satisfaction of the Client and Project Manager:

- All witness testing and defects inspections completed by both the AV Consultant, and Client. The AV Consultant will provide defects reports post each round of testing and inspection.
- The AV Contractor has rectified any and all defects discovered during the testing and during defects inspections.
- The AV Contractor has provided the final set of Operations and Maintenance Manuals as described in section 1.8.1 of this specification.
- The AV Contractor has provided any remaining items including:
  - all non-compiled code;
  - loose items including remote controls and;
  - any unused items procured by the Client.



## 2. Audio-visual standards for school main learning displays

The school audio-visual (AV) standards for school main learning displays (MLDs) include a single display panel of varying size as specified by the requirements of the learning space in which the Audio Visual equipment is being installed (please see Appendix A: Display Sizing for further information). The school audio-visual standards for school main learning displays takes into account the mobility requirements that are essential for modern, configurable learning spaces. Minimum standard installations are intended to be:

- Mounted on a Mobile Computer on Wheels (MoCoWs) movable trolley or;
- Permanently installed via wall or floor mounts in learning spaces where appropriate.

A minimum standard AV school installation will consist of:

- A touch enabled display.
- A video and audio conferencing camera unit, including microphone and speakers.
- Video conferencing remote control.
- Additional mounts for mounting the video and audio conferencing unit to the display.
- A DoE standard T4L interactive multi-media PC (Please note, the T4L interactive multi-media PC will need to be built to the department's Standard Operating Environment (SoE) by local ICT support personnel).
- VESA Mounting plate (usually 100mm x 100mm to attach mini-PC to rear of display).
- Wireless keyboard, mouse and wireless receiver.

All components are available and shall be purchased from approved DoE suppliers (Please note, some components including the T4L interactive multi-media PC and video/audio conferencing unit will need to be purchased separately) by the Project Manager (a DoE Employee). These components shall then be integrated into a standard Main Learning Display (MLD) by the AV Contractor, in consultation with the Project Manager.

### 2.1 Key operational features

- Present from guest device (Student/Teacher Laptop/Mobile Device) attached to learning display.
- Present from device via screen-cast.

## 2.2. Schematic

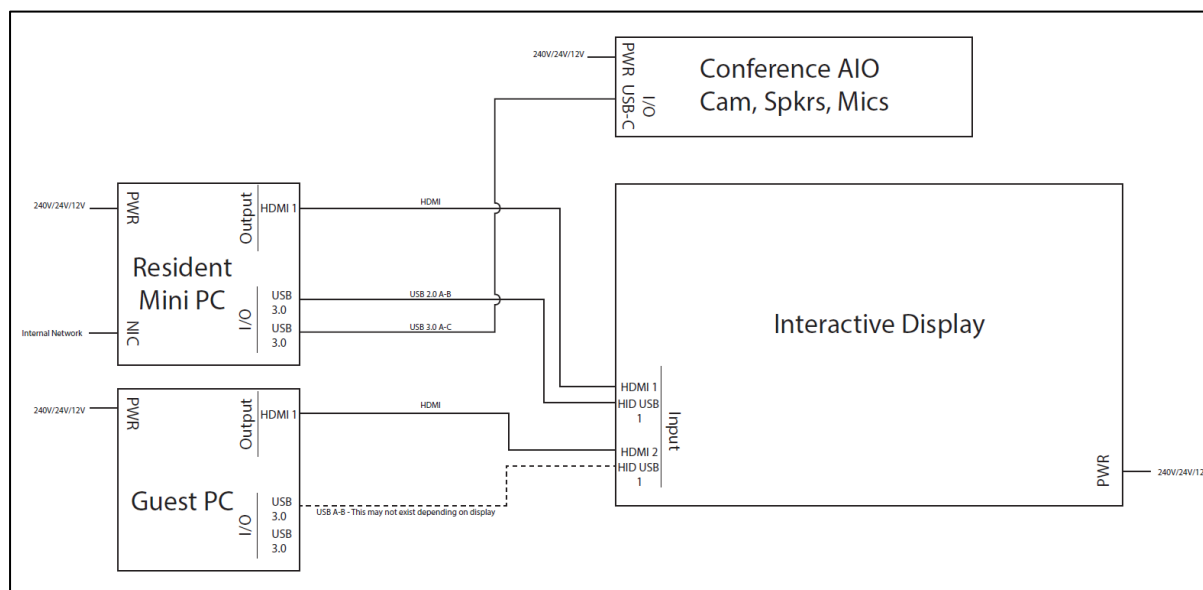


Figure 1 - Main learning display schematic

## 2.3 Other operational characteristics and considerations

### Architectural

- If using a fixed MLD, structural reinforcement is required in wall or floor to support screen mounting.
- If using a fixed MLD, it is recommended that screens be mounted with controllable, height adjustable screen mounts.
- A VESA mounting plate (100mm X 100mm) for a T4L interactive multi-media PC may be conveniently located to the rear of the display.

### Lighting

- Lights shining directly at panel displays create glare and should be avoided. If lights are positioned above screens, they should be individually addressable.
- For optimal camera images, light should be diffused and indirect with an even 400lux coverage.
- A colour temperature of 4100k will produce the best results for attached cameras.
- Flicker and buzz free systems shall be used to avoid distractions caused by the lighting system.
- To avoid camera image flickering, lights require a refresh rate that is an integer multiple of 30Hz.

### Acoustics

- Low ambient noise level of 30-40dBA needs to be ensured to allow clear and prominent speech intelligibility.
- The recommended Reverberation Time is 0.2-0.4 seconds to allow for comfort, speech intelligibility and proper function of conferencing equipment.
- To maintain privacy, consideration should be given to the acoustic rating of walls, doors and glazing.

### Power and communications

- The power and communications requirements listed are only used to support AV devices. Allowances for general power and data outlets have not been included.
- Power and Data requirements are as follows:
  - 5 general power outlets (LCD screen, IR Transmitter, Camera, T4L interactive multi-media PC, Spare), in single or double GPO configuration.
  - 2 single communications/data outlets (Mini PC, Spare)

## 2.4 Detailed functionality and performance

### Modes of use

Mode	Description
Wired Presentation Mode	Present audio and video content from a portable device such as a laptop/tablet/phone via a HDMI fly lead cable.  Each HDMI cable shall be fitted with a Liberty ring adapter for Mini DisplayPort, Lightning & USB-C connections.
Conferencing Mode	The AV solution shall be Skype for Business and Teams capable which includes the functionality of audio calling, Video Conferencing and content sharing.
Screen-Casting Mode	Consistently and reliably present audio and video content from portable device such as a laptop/tablet/phone via screen casting mode.

### Video performance

- Panel Displays shall be set up to operate at a resolution of 1920 x 1080p or 3840 x 2160p with a refresh rate of at least 60Hz.
- The minimum acceptable brightness level (in NITS) for panel displays shall be:

Softly-lit spaces/ No ambient sunlight	Well-lit spaces/ Indirect sunlight	Direct sunlight
350 nits	400 nits	500+ nits

### Audio performance

- The minimum audio performance requirements are:

Parameter	Technical Criteria	Performance
Loudness	Average Sound Pressure Level (SPL) continuous program audio/speech	The default setting shall be: Typical 5 – 10db SPL above normal room SPL level.

Please note that if separate speaker systems have been installed in the learning space, and are connected to the AV solution, ensure that the learning display's built-in speakers have been muted to prevent feedback looping.

### Portable hearing assistance system

To comply with legislation for equal access, a wireless hearing assistance system may be installed in some learning spaces. To ensure that compliance with the current version of the Australian Standard AS 1428.5, as outlined in the Building Code of Australia may be achieved, the AV solution may be built with an attached Infra-red (IR) emitter to allow the use of portable hearing assistance receivers (either headphones or neck-loops).

Design consideration should be made for adjacent rooms to be able to operate simultaneously without interference.

## 2.5 Routing table

**Mode of use: Presentation:**

Mode	MLD	Touch/Pen	Display audio	Audio from video collaboration unit	Camera from video collaboration unit
<b>Resident Mini PC</b>	Yes (HDMI rear)	Yes	No	Yes	Yes
<b>External (Guest) PC</b>	Yes (HDMI front)	Yes*	Yes	No	No
<b>Wireless Screen Sharing</b>	Yes (i.e. Miracast)	No	Yes**	No	No
<b>iPad</b>	Yes (HDMI with adaptor)	No	Yes	No	No

## Appendix A: Display sizing

The tables below detail the relevant screen sizes based on the furthest seated student. The sizes of the screens listed are only applicable to the room types shown above. For bespoke rooms with non-typical use types, the [AETM viewing standards](#) should be referenced. The display may be either Full High Definition (FHD) or Ultra High Definition (UHD) native resolution.

Distance to furthest viewer	Size of display (In diagonal inches)
3-4 Meters	55"
4-5 Meters	65"
5-6 Meters	75"
6-7 Meters	80"
> 7 Meters	> 84"

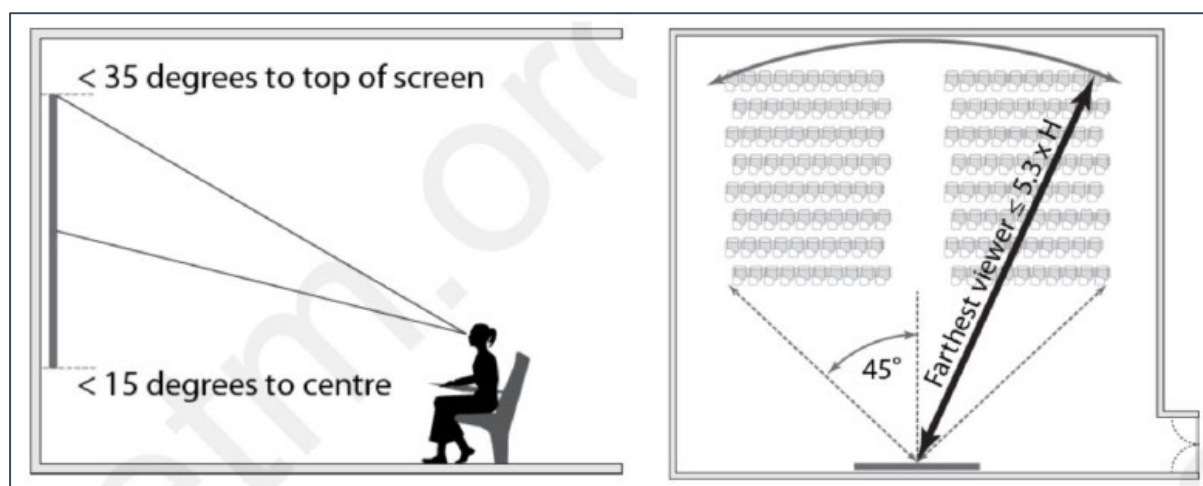


Figure 2 - Screen viewing angle recommendation

Off axis horizontal viewing shall be no greater than 45° from the centre line of the screen. The maximum viewing angle shall be no more than 15° to the centre of the image. This is measured at an average seated eye height of 1270mm or no more than 35° to the top of the screen (whichever is greater).

### A.1 Screen mounting height recommendations

As screen mounting heights can vary according to many different factors, it is recommended that all MLDs be installed with height adjustable mounts.

#### A.1.1 Fixed height installations: Primary and Secondary

Displays shall be mounted to a maximum height of 1800mm (to the **top** of the display) to allow for maximum use of screen area. Please note that fixed height installations are not recommended where a height adjustable installations are available.

#### A.1.2 Height adjustable installations: Primary

- **Low adjustment point:** shall be 300mm or less, from floor to the **bottom** of the display.
- **High adjustment point:** shall be at least 1800mm to the **top** of the display.

#### A.1.3 Height adjustable installations: Secondary

- **Low adjustment point:** the **top** of the display shall be no higher than 1650mm from floor.

- **High adjustment point:** the **top** of the display may be over 2200mm (depending on screen size).

**PLEASE NOTE:**

- The builder shall consult the Project Manager – Foundations.T4L or the school Principal **BEFORE** performing any screen mounting to ensure screens are mounted at appropriate heights.
- These are recommendations only. Individual learning space requirements may dictate higher or lower mounting heights.

## Appendix B: Fixed main learning display

A Fixed main learning display (MLD) is based on a single, touch enabled display permanently mounted to a learning space wall, or supported by a floor mount. The fixed main learning display may be height adjustable. A standard fixed main learning display consists of the following components:

- Touch enabled display.
- T4L interactive multimedia PC (please note, the PC will need to be built to the department's Standard Operating Environment (SoE) by local ICT support personnel).
- Wireless keyboard, mouse and wireless receiver.
- VESA Mounting plate (usually 100mm x 100mm to attach T4L interactive multimedia PC to rear of display).
- A video and audio conferencing camera unit, including microphone and speakers.
- Video conferencing remote control.



*Figure 3 - Example main learning display with conferencing speaker and camera unit.*

### Fixed main learning display requirements:

- Control of input device shall be automatic or on-screen. Input panels shall be provided.
- (If applicable) The controller to adjust height and/or tilt of the display shall be a tethered (not remote) controller that is not permanently attached to the display. The user shall be able to remove and handhold the controller while the display is moving up and down and/or tilting. A magnetic attachment system for the tethered controller may be supplied.
- Storage space may be supplied for a keyboard and mouse (And keyboard, mouse and wireless receiver).
- VESA mounting plate (100mm X 100mm) for a T4L interactive multimedia PC shall be located to the rear of the display to allow for easy cable management, replacement and/or maintenance of the T4L interactive multimedia PC.

### Cable management:

- The use of recognised cable management clips, ties and pathways must adhere to cable management specifications as laid out in the NSW DoE Structured Cabling Standard.
- Attention shall be paid to positioning of the display to ensure that the unit itself, and any cabling does not block points of ingress or egress, and allows for the maximum viewing area supported by the space in which the MLD is installed.

### Further information and installation guide:

- Further information on DoE AV Suppliers and installation guides and checklists can be found on the [DoE NSW Procurement Directorate's Multimedia Solutions intranet site](#).

## Appendix C: Mobile Computer on Wheels (MoCoW)

A MoCoW is based on a touch-enabled display mounted onto a wheeled trolley that should be easy enough for a teacher of any stature, or two stage three students, to move from one location in the school to another.

A MoCoW shall be required to be moved easily, and is facilitated by trolleys as pictured.

A standard MoCoW set up will include:

- Touch enabled display.
- T4L interactive multimedia PC (please note, the PC will need to be built to the department's Standard Operating Environment (SoE) by local ICT support personnel).
- Wireless keyboard, mouse and wireless receiver.
- VESA Mounting plate (usually 100mm x 100mm to attach T4L interactive multimedia PC to rear of display).
- A video and audio conferencing camera unit, including microphone and speakers.
- Video conferencing remote control.



*Figure 4 - Example main learning display mounted on MoCoW trolley.*

### MoCoW requirements

- Input ports for HDMI, USB-B and USB-A shall be located on the front of the display or trolley.
- Control of input device shall be automatic or on-screen.
- Trolley Controller to adjust height and/or tilt of the display shall be a tethered (not remote) controller that is not permanently attached to the display. The user shall be able to remove and handhold the controller while the display is moving up and down and/or tilting. A magnetic attachment system for the tethered controller may be supplied.
- Six Wheels shall be required for stability and ease of mobility. Two of the front wheels may be lockable.
- Two Handles of 32mm or larger diameter that can be mounted vertically or horizontally shall be required.
- Storage space may be supplied for a keyboard, mouse and wireless receiver.
- VESA mounting plate (100mm X 100mm) for a T4L interactive multimedia PC shall be located to the rear of the display to allow for easy cable management, replacement and/or maintenance of the T4L interactive multimedia PC.
- A power panel with at least one free user accessible port shall be supplied.

### Cable management

- Cable management shall be incorporated into the trolley design so that no cables can be loose and become pinched or entangled when moving the MoCoW.
- The use of recognised cable management clips, ties and pathways must adhere to cable management specifications as laid out in the DoE Structured Cabling Standard.
- A power lead and Ethernet cable of 3 metres length shall be the only required leads to power and data connections. These two cables shall be paired by using a suitable braided sleeve.



### **Further information and installation guide**

- Further information on DoE AV Suppliers and installation guides and checklists can be found on the [DoE NSW Procurement Directorate's multi-media solutions site](#).