

Colorado State University Smart Classroom Standards

Version 9, 4-24-17

Background: Colorado State University currently has 165 General Assignment (GA) Classrooms, all of which are designated as Smart Classrooms.

Classroom Support Services (CSS), a division of Academic Computing and Network Services (ACNS), maintains and supports these rooms, and designs and installs equipment. CSS constantly evolves technology in the Smart Classrooms to achieve effective teaching for the benefit of CSU faculty and staff.

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1 - Classroom Design & Equipment Overview:

All technology-equipped CSU classrooms are referred to as Smart Classrooms.

1.1 Large classroom, 100+ seats:

One or more motorized 16:10 powered projection screens, laser projector(s), ceiling PA speakers, lectern, touch screen control, LED monitors where appropriate.

- Projectors shall be laser type, capable of 1920 x 1200 resolution. Projectors must be capable of receiving control and video signals via CAT6AA cable.
- Scaler must provide the matching projector resolution – HDMI for HDBaseT at the projector and displays.
- Larger rooms typically have 2 (two) projectors with ability for the user to put different content on each; where whiteboards are located behind screens, programming will allow user to power off each projector and screen individually in order to use the whiteboard; and to raise and lower each screen individually while leaving the projector on to illuminate the whiteboard.
- Projection screens are electrically powered with the housings recessed into the ceiling.
- A large lectern built by CSU Facilities houses the A/V equipment unless an A/V closet is used; in that case, user-accessible A/V controls, PC, DVD player and document camera must still be user-accessible on the lectern.
- A wall-mounted graphics monitor or electronic whiteboard is provided for annotation over the PC display, with the output displayed on the data projector; **Sharp Aquos touch screen monitors such as the PNL303A and PNL703A** are preferred.
- One touch-screen monitor shall be mounted on the desktop: **Sharp LL-S201A 20" LED touch screen**, and shall be mounted on an **Ergotron LX Desk Mount LCD arm, #ERG45241026**. The mount shall be located centrally on the lectern desktop to allow full range of motion across the desktop left to right.
- When needed, two to four video monitor locations will be located around the room for breakout collaboration sessions, with ability to share the content from any monitor with the whole room. This installation is determined on a room by room basis, as needed.
- Each video monitor shall be fed by a **Creston Airmedia**; wall plate connections shall be provided adjacent to each monitor; monitor output and input shall be routed back to the room matrix switcher to allow display of any source on any monitor or projector screen.
- Display sources to be located in or on the lectern:
 - PC (network and HDMI connections needed)
 - Laptop (HDMI & VGA outputs, network connection needed)
 - Wolfvision VZ-3 document camera
 - Blu-ray player and
 - Sharp LL-S201A touch screen display for computer.
- **Each room shall be pre-cabled with at least one camera mount** on the wall opposite the lectern to allow installation of a future camera for lecture capture;

there shall be two CAT6A cables run between the camera mount and the interior of the lectern.

- Wireless microphone receiver, **Shure QLXD4 frequency G50**. Output is to be fed to room PA and any recording or lecture capture system.
- Microphone docking charger **Shure SBC200-US**
- Shure wireless rechargeable transmitter **Shure QLXD1-G50** with cardioid lavalier microphone **WL185** and battery pack **SB900**.
- If handheld mics are needed in addition to belt pack transmitters, they shall be **Shure QLXD2/B58, frequency G50**.
- **Crestron DMPS** unit with appropriate switching capacity for the equipment installed, with **TSW 760** touch panel mounted in lectern top, is standard for control.
- **Preference will be given to Crestron Certified Designs, although this is not mandatory.**
- Extron switching / scaling may be added if needed, subject to CSU approval.

Auditorium installations often use additional matrix switchers and audio equipment. These installations require additional A/V rack spaces which are normally provided in an AV closet location.

1.2 Medium Classroom: 50 - 100 seats

16:10 powered projection screen, projector, touchscreen control on lectern, ceiling speakers for playback

- Projection screen shall be recessed in ceiling and electrically powered.
- The room may include one or more flat panel monitors as collaboration locations with the ability to share or work in a separate small group – fed by a wall plate adjacent to the monitor and a **Crestron AirMedia** unit at the monitor.
- A small lectern houses the AV equipment.
- **Crestron DMPS** unit with appropriate switching capacity for the equipment installed and **TSW 760** touch panel mounted in lectern top, are used for control.
- **Preference will be given to Crestron Certified control designs, although this is not mandatory.**
- **Crestron Airmedia** output shall be connected to the DMPS control unit or matrix switcher for classroom display.
- Wireless microphone as specified above is installed.
- PA speakers may be wall or ceiling mounted depending on room design.

1.3 Small Classroom: Fewer than 50 seats

- Specifications are same as medium classroom.
- Lecterns may not be used in some rooms that are small enough to double as conference rooms; in those cases, the Crestron touch panel will normally be placed on a table.
- No wireless microphone is needed in small classrooms unless lecture capture is to be installed. If lecture capture is to be used in the room, a wireless QLX series microphone (belt pack and lavalier mic) and charger as specified above are required.

1.4 Conference Room

- Most conference rooms seat 6-20 people.
- Lecterns are not used in conference rooms.
- Crestron controls may be used if the amount of equipment to be installed justifies it; this decision is made on an individual room basis.
- Standard video display is a wall-mounted video monitor, 65" or larger.
- Connections to the monitor are generally cabled directly via one HDMI cable from the conference table area to the monitor, or by providing a wall plate provided adjacent to the monitor.
- If not routed through a floor box, at least two HDMI connections to the monitor shall be enclosed in a sturdy floor trough, or shall be provided on a wall plate adjacent to the monitor.
- No wireless microphone is normally needed in conference rooms unless lecture capture or web conferencing functions are specified for them.111111

1.5 Lecture Capture Room (any size)

- A room of any size can be used for lecture capture.
- Every lecture capture room will include certain design and equipment characteristics
- Each room will have a PTZ camera mounted on the wall opposite the lectern and presentation screen; the current approved model is the PTZ Optics PT12X-USB-GY-G2 (12X) or PT20X-USB-GY-G2 (20X) in 12X or 20X zoom depending on room size.
- A network port shall be located next to the camera.
- There shall be two CAT6A cables run between the camera mount and the interior of the lectern, with HDMI transmitter/receiver units on one cable for the camera signal.
- HDMI connections for the camera and for the video feed sent to the room projector shall be provided inside the lectern.
- Program audio out from the DMPS unit to a 1/8" jack shall be provided for the lecture capture device.
- The audio for the classroom microphone must be programmed as a constant level output and programmed not to mute to the lecture capture recorder when the mic is muted in the room PA system.
- Lights in the room shall be mounted so as not to obstruct the camera view of the presentation area.
- Ceiling mounted whiteboard lights are strongly discouraged. If they are used, they must not hang down from the ceiling far enough to intrude into the camera view or the projector image path.

2 - Standard Lectern Design:

Fixed lecterns are preferred – movable lecterns with detachable connections are considered in certain circumstances.

Classroom Lecterns –

CSU - Smart Classrooms are designed with either a large or small wooden lectern; size depends on the room. Each room is configured to be a user friendly teaching station

with an intuitive touch panel control system designed with ease of control over media teaching sources. Current lectern suppliers: CSU Facilities or Growling Bear Company of Greeley CO: 1-970-353-6964.

The lecterns house one or two prebuilt equipment rack(s), depending on whether they are large or small size. All equipment racks shall be roll-out and rotate design for ease of access and service. Large lecterns will have a document camera mounted on the lectern top surface on the right side; on small lecterns, there will normally be a side shelf to mount a document camera. All lecterns will have removable panels (normally on the back side) to provide full access for service and maintenance.

3 - Lectern power and data requirements

- **Power controllers** are not used in CSU lecterns or classrooms.
- **Surge protection** appropriate to the number of devices in the lectern should be provided in each lectern or equipment rack/closet.
- **Two 4-Plex 120V A/C boxes** per side (on the inner walls of the lectern) coming up through the rear of the lectern on flex from a combined 20 amp circuit.
- **Minimum of 8 - 100Mbps Ethernet jacks** or directly terminated data cables: this includes one VOIP telephone connection, also serving a laptop on a loop-through as per the standard CSU VOIP telephone. The laptop connection shall be available via a cable run out to the desktop from the lectern cable cubby
- **Locks:** lectern doors shall be equipped with CompX brand lock sets, part # C8053-C415A-14A, using key C415A.

4 - Equipment Specifications:

4.1 - Display Input Sources - source switching specifications: the Input signal path must handle a wide range of input resolutions up to 1920x1200.

Analog VGA sources (VGA up to WUXGA, 1920x1200 = 1080p, with the ability to accept the following type of inputs: RGBHV, RGBS, RGSB, RGSBs, HDTV component video (Y, R-Y, B-Y).)

- **One laptop** interface on the lectern with additional 1/8" stereo audio connection.
- Each cable run to the desktop must be replaceable independently of the cable runs to the displays.

HDMI / Digital Video Sources:

- **Blu-ray** at 1080p resolution.
- **Laptop HDMI** input on lectern.
- **PC** or spare – HDMI/DVI connection inside lectern.
- **Document Camera** installed on lectern.

Video Outputs:

- Four HDMI outputs to serve room display, lecture capture, Sharp monitor on lectern, and one spare. All shall be HDMI Scaled outputs.

- Large classroom (100+ capacity) should have matrix output to mix and match outputs to displays.

Audio Outputs:

- **One line-level**, variable stereo program output from analog and HDMI sources, to power amp.
- **Microphone** –two outputs, wireless mixed and level controlled.
- **One additional** fixed stereo program (mic plus all other devices) output for lecture capture.
- **Program and room PA mute function** must not mute the program or mic audio feed to the lecture capture device.

5 – Video, Data Projector and Lighting Specifications:

Display Design Specifications:

We install displays at wide screen (16:10) resolution. Panasonic projectors are the current standard in all classrooms, but other brands will be considered. Laser projectors are required for new installations and remodels.

- HDMI input must comply with the latest HDCP specifications.
- Ethernet connection is required on all projectors.
- Crestron Fusion-ready capability is required on all projectors.
- Maintenance: access is required to change projector lamp and clean the filter (if any) without removing the projector from its ceiling mounted location.
- Low maintenance filter (10,000 hrs.) is preferred in lamp projectors; longer lamp hours (3,000 hours or better) is preferred.
- Displays shall use the latest LCD or DLP technologies available on the market, capable of 1920 x 1200 resolution. (Lower resolution at 1280 x 800 may be set in classrooms depending on the project.)
- **Panasonic or Sony laser projectors are preferred**, with brightness in lumens:
 - 3500 ANSI lumens or higher for small size classrooms.
 - 6000 ANSI lumens or higher for medium classrooms.
 - 10,000 ANSI (**minimum**) lumens for large or auditorium sized classrooms (DLP projector).

Lighting:

- Ceiling mounted whiteboard lights are strongly discouraged. If they are used, they must not hang down from the ceiling far enough to intrude into the camera view or the projector image path.
- No suspended lighting in any classroom shall hang down from the ceiling far enough to intrude into the camera view or the projector image path. Rooms may be retrofitted to install a camera at a later time.
- Light controls shall be configured so that the row of lights closest to the display screen can be controlled separately from the rest of the room lighting. Using the 50/50 model of light control to enable 50% lighting or no light is appropriate.

6 - Control System Specifications

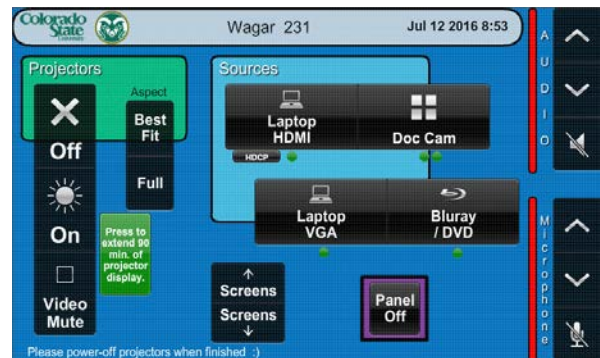
6.1 - Control Graphics

CSU Classroom Support Services programs and supports classroom control systems. Crestron products are required for all new installations and upgrades. Control graphics shall conform to CSU design and visual practice.

The basic system in each lectern is comprised of:

- Controller – Crestron DMPS series with network port. If additional controllers are needed, CP3 units or switchers similar to Extron 1608 may be added.
- Touch Panel – TPW-760 – color touch panel.
- Integration capability with Crestron Roomview and Fusion must be included.
- Crestron program and Xpanel software are to be supplied to Classroom Support for each room.
- CSU Crestron shut down scheme code is available from Classroom Support and shall be included in the code for each room.

Touch Screen Design Samples (examples only, design changes periodically)



Current graphics and layout are available from CSU Classroom Support Services.

6.2 - Control Design Specifications:

- Programming files, Xpanel files and as-built diagrams for all installations become property of CSU and shall be provided to CSU Classroom Support.
- All graphics, control screen layout and design, controls and functions in each classroom must be reviewed and approved by CSU Classroom Support Services before project signoff.
- Final control and touch panel files are to be given to CSU as part the project signoff.
- Intuitive designs following CSU graphics practices are required, with user-friendly ability to control the room without prior instruction.
- All classrooms should have the ability to dim the lights nearest to the projection screens, with that control separate from the classroom lighting.
- All electric powered screens are to be controlled via the touch panel.

- Projectors are controlled via RS232 or Ethernet – with run hours, filter hours and reset for both provided in the programming and on the touch panel service page.
- Source / switcher selections shall be controlled either by RS232 or Ethernet.
- Program audio shall be volume controlled and muted separately from microphone audio.
- Audio controls and indicators for both program and microphone audio shall be easily accessible on all touch panel screens, including mute control.
- Blu-ray control pages are to be included with control via IR or RS232.
- A maintenance / service page shall be provided, with these features:
 - Panel setup access
 - Lift controls in rooms with projector lifts
 - Executive modes with executive mode on/off toggles for switcher control

6.3 - Audio System Specification:

Design Consideration - Evenly distributed and clearly audible sound is required for both audio program material and wireless microphone audio.

- Audio source selection – separate controls for program out and microphone volume, with mute button for each.
- Audio source and mic volume control – if not DMPS unit, A/V switcher via RS232 commands.
- Audio source amplification shall be a stereo power amp.
- Speakers shall be wall speakers or multiple ceiling speakers; speakers are not to be located immediately behind or above the lectern to minimize audio feedback.
- Microphone – Shure QLXD wireless system noted in section 1.1 above; for medium or large classrooms, two microphone systems (with one each belt pack and handheld transmitters) shall be provided.

6.4 Network Design

Design Consideration - No private networks will be created or used for A/V functions and controls. Network connections for all systems, wired and wireless, must use the CSU campus network.

7 - Build Specifications:

7.1 - Lectern Equipment Locations

- Standard Equipment rack is **Middle Atlantic SRSR Series Rack, SRSR-2-14** providing 14 RU of rack space. There will be two (2) racks in a large Lectern, one (1) rack for a small lectern.
- Equipment racks are to be prewired and tested before being installed at the installation site.
- **Crestron Connect It TT-100** cable holder shall be built into lectern top to provide AC power, VGA and HDMI connectors, and a network Ethernet cable for laptops.
- User interface equipment (PC and Blu-Ray Players) is to be located at or near the top left side of the lectern rack mount.

- All other equipment including the A/V controllers: switchers, and audio amps, receivers and equalizers (if any) are to be located below the user access area and placed behind a hinged, lockable plexiglass enclosure which uses the standard CSU key set.
- This cover may enclose only the part of the rack containing A/V equipment, leaving the PC and DVD player user-accessible.
- At least one rack unit (1 RU) of space shall be provided between equipment located in the rack to provide for proper heat ventilation and dissipation.
- Lectern back side main access panel shall not be located closer than thirty-six inches (36") from any fixed furniture or object to provide maintenance access.
- The document camera is to be located on the top of the lectern centered in the right half (flat area) of the lectern surface.
- **Any open rack space** in lecterns is to be blocked off by either blank rack panels or smoked plexiglass.

7.2 - Wiring / Cable Specifications:

- Shielded CAT6A Crestron DM or Extron XTP or equivalent
- RS 232 control: Belden 9451- 2 conductor, 22 AWG, stranded, shielded
- Speaker: Belden 5200U or equivalent (audio), minimum 18 gauge.
- Quality Extron cables or equivalent for all HDMI and VGA lectern cabling

7.3 - Terminations and Connectors:

- **RS232** –soldered DB-9 connectors with proper hoods are used for RS232 connections
- **CAT6A** cables are to be terminated with the EIA/TIA - T568B standard; connections are to be tested and verified for proper termination.
- In rooms with camera signals run to the lectern, the cable termination shall be an **HDMI connector**.
- In rooms with lecture capture, the program video sent to the projector must also be available via an **HDMI connector** in the lectern.

7.4 - Lectern Wiring

- All video, data and control wires are to be labeled and numbered in correspondence with the system diagram
- An as-built wiring diagram is to be placed inside the Lectern on the rear equipment side door, and the computer file with that wiring diagram is to be provided to Classroom Support Services; a Microsoft Visio file is preferred.
- Proper wiring dress, maintenance loops, and cable separations are to be employed.
- Lectern is to be secured and bolted to the floor, normally using L-brackets.
- All wires connected from the lectern to ancillary equipment or connections are to be secured under a bolted down cable threshold or through provided conduits with cable sheathing.
- Wiring that is routed to above the ceiling from the lectern shall be inside an installed cable raceway; the portion traversing the wall shall resemble the color of the wall or be painted to match.

- Conduit cable pulls should not exceed 50% of the permissible conduit size.
- Nylon pull strings should be left in place after cables are pulled.
- Each lectern shall have eight (8) network jacks (see earlier specification) installed on an internal block.
- Each data projector location shall have 1 (one) network jack installed next to the projector for network connectivity.
- A/V closets shall have a number of network jacks installed; the number to be determined in consultation with Classroom Support and ACNS.

7.5 - Projector Mounting

CSU recognizes and adheres to the ICIA / Infocomm Video Systems Installations Handbook standards and recognizes installers certified with the CTS and CTS-I certifications from this organization. A copy of this book is available from CSU Classroom Support Services.

- Projectors shall be mounted as high as practical in each room to reduce the potential for vandalism and unauthorized personnel tampering with the connections. Typical mounting height is level with the top of the projection screen.
- Ceiling tile replacement type mounts are typically used in rooms with drop ceilings - **Premier PFFCMA Ceiling Tile replacement – secured to ceiling structure**. Standard 1.5” piping is used to drop the projector down to the proper mounting position to minimize any Keystone effect and subsequent electronic keystone adjustments.
- All cables are routed through the 1.5” pipe – including power; a power outlet mounted on projector mounting plate is standard.
- Projector mount is to be a universal mount by Chief manufacturing model **RPM-U Projector Mount (Key Code "A")**
- All projector HDMI Receivers are to be located either in the plenum or above the projector on the ceiling tile replacement unit.
- All cables not routed through conduit are to be above the ceiling grid on J-hooks.
- Plenum cable is to be used on all and any plenum air space ceiling or raised floors installations.
- A sonic alarm is to be properly attached to the projector - **Sonic Shock Projector Alarm (Key Code #527)**

7.6 - Projector screen specifications: 16:10 Screen by Dalite are standard in all new installations – model varies depending on the size of the room. Recessed electric screens are preferred in new installations.

Manual screens are sometimes used in smart classrooms. Examples:

- Projection screens shall be mounted high enough to prevent line of sight problems for students sitting in the back of the classroom; in most cases, this means the top of the projector screen image area should be as close to the ceiling as possible.
- Projectors shall be mounted so that the placement of room lighting systems does not interfere with the projected image.

- Da-Lite screen, Model C w/CSR, 69" x 110", matte white, white case - #34734
 - Da-Lite screen, Model B w/CSR, 57.5" x 92", matte white, white case - #36457
- Screens are to be installed according to manufacturer specifications for model type and weight.*

7.7 - Equipment Security Specifications:

Lectern:

- Each lectern will have access panels allowing A/V maintenance and repair, secured by key locks using a CSU standard key set.
- As noted earlier, lectern access panels will be located no closer than 36 inches to permanently mounted objects such as tables and walls.

Video Projector:

- ¼" aircraft type cable securely connected to the projector and fastened in the ceiling with a padlock.
- Sonic Shock audio alarm also adhered to the projector and looped into the ceiling

Document Camera:

- Camera base shall be bolted through the top of the lectern or fastened to lectern with security cable.

8 – Networks

- No private control network shall be installed within the classroom(s) installed. All equipment will be connected to a CSU building or campus network and must be accessible to control access via the CSU network.
- All wireless equipment installed in a classroom (if any) shall connect to and use the CSU wireless system already in place; no new wireless network shall be created or set up in the classroom.

9 - Final System Checks and Testing:

- **Copies of receipts or purchase orders** for all Crestron equipment installed must be provided to the CSU Classroom Support Supervisor for CSU to obtain credit with Crestron for equipment purchased.
- All systems must be checked out fully for functionality, installation integrity and build documentation. **All controls and functions in each classroom must be reviewed and approved by CSU Classroom Support Services before signoff.**

Functionality Tests

Touch Panel External Buttons Labeled
 Power On Projector
 Select Laptop - Check Video and Audio
 Select Doc Cam - Test Video and Controls
 Select Video Mute and test
 Audio up / down and mute work properly

Switcher / Scaler is set to the Projectors' native resolution

Projector Alignment

Screen Functional and properly positioned
Image Properly fills the screen on all images
Brightness and Contrast check
Image Keystone set
Image is sharp and in Focus
Fan is set to High Altitude mode

Lectern Tests / Checks

Little Light Functionality
Check A/C Power in Cable Nook
User Network Cable active at Cable Nook
Plexi / Lexan or Rack Blanks installed in blank spaces
Inside the Lectern: wired neatly and clear of extra parts
Lectern Top Clean and void of leftover parts
Wires Labeled and Block Diagram provided inside the Lectern

Other Diagrams and Specifications:

Sample System Block Diagrams (PDFs)

- Small Smart Class Room (Attachment 1)
- Larger Collaborative Smart Classroom (Attachment 2)
- Matrix Switching Multi Display Classroom (Attachment 3)

A/V Contractor

- RFQ for AV Contractors (Att. 9)

Lectern Specification Diagrams:

Large1 (Att 4) – Large2 (Att 5) – Large3 (Att 6) – Large4 (Att 7) – Large5 (Att 8)

10 - Classroom Support Services Primary Contact:

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Classroom Support Services is a part of Academic Computing & Networking Services:

<http://www.acns.colostate.edu/Services/CSS>

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Please contact Albert Powell with questions concerning the information provided.

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