UC Davis Health IT Facilities Design Standards



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Introduction and Purpose

This document defines the design standards and minimum requirements for all construction and renovation projects within UC Davis Health. It provides authoritative guidance for UC Davis Health Facilities Design and Construction Consultants, Project Managers, and Low Voltage Design Professionals, ensuring consistency, code compliance, and alignment with organizational goals throughout project execution.

These standards and guidelines establish standardized Low Voltage system configurations and layouts for all UC Davis Health projects. They also serve as a critical resource for consultants, project managers, and low voltage design professionals involved in bidding on Design and Design-Assist projects.

IT Facilities acts as the liaison between Facilities Design and Construction and space occupants. The team works closely with project managers, architects, and engineers to design communication infrastructure that meets the IT service needs of the occupants.

The following guide is specific to UC Davis Health and not UC Davis campus services.

Included within this document are items regarding Information and Communications Technology (ICT) infrastructure including but not limited to:

- IT Timeline and Process Requirements
- IT Facilities Space allocation and management
- IT Facilities Space Environmental conditions
- IT Facilities Space Electrical Requirements
- Structured cabling systems, pathways and low voltage space requirements
- Nurse call system requirements
- Synchronized master clock system requirements
- MATV and IPTV requirements
- Emergency 2-way communications (ERRCS) requirements
- Building security – access control, video surveillance and intrusion detection, and intercom system requirements.
- DAS and radio system requirements
- Wireless system requirements
- Real Time Location Services (RLTS), infant protection, and patient elopement requirements
- Public address and sound masking requirements
- Audio visual (AV) requirements

1 INFORMATION TECHNOLOGIES STANDARD IMPLEMENTATION PROCESS

Cabling installation is not merely a task to be completed—it is a comprehensive process that requires careful planning and execution. As the ultimate owner of the finished product, IT expects to be actively involved throughout the entire process. Successful installations depend on several critical factors, including but not limited to:

- (FP&D) or project representative submits an IT service request.
- Floor plans shall be used to determine IT Telecommunications Room layouts. Architects and engineers shall consider specifications and standards when determining location, spacing and number of IT Telecommunications Rooms.
- Horizontal cabling quantities shall be assessed following the completion of an initial device drawing.
- Accessible pathways shall be derived using architectural plans and device placement plans.
- Horizontal cabling volume shall be estimated using cabling quantities and accessible pathway plans to complete a cable pathway design.
- Cable drawings shall be converted to shop drawings using the final room numbers and assigned cable numbers.
- IT representatives shall initiate an assessment and prepare a plan for deployment.

2 INFORMATION TECHNOLOGIES PROJECT IMPLEMENTATION SCHEDULE

IT Facilities coordinates services that are essential to multiple project phases, with specific needs varying based on project scale and technical requirements. While IT strives to support flexible scheduling, minimum lead times are necessary to meet the rigorous standards required for clinical network installations. For further information or implementation support, please contact an IT Facilities Project Manager.

3 REFERENCES, STANDARDS AND CODES

3.1 REGULATORY REFERENCES

The following industry standards are the basis for the Structured Cabling System (SCS) described in this document.

The Consultant and/or Design Professional is responsible for understanding and applying the current versions of all applicable standards and codes. In the event of updates, the Consultant must comply with the most recent revisions—including any applicable changes or addenda—in effect at the time of installation.

1. ANSI/TIA:
    a. ANSI/TIA-526-7-A (July 2022) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

b. ANSI/TIA-526-14-D (January 2023) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
c. ANSI/TIA-568.0-E-1 (July 2022) Generic Telecommunications Cabling for Customer Premises
d. ANSI/TIA-568.2-E (2024) Balance Twisted Pair Communications and Components Standards
e. ANSI/TIA-568.4-E (2022) Broadband Coaxial Cabling Components Standard
f. ANSI/TIA-568.1-E (2023) Commercial Building Telecommunications Infrastructure Standard
g. ANSI/TIA-569-E-1 (2022) Telecommunications Pathways and Spaces
h. ANSI/TIA-598-E (July 2020) Optical Fiber Cable Color Coding
i. ANSI/TIA-606-D (2021) Administration Standard for Telecommunications Infrastructure
j. ANSI/TIA-607-E (2024) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
k. ANSI/TIA-758-C (2024) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
l. ANSI/TIA-862-C (2022) Building Automation Systems Cabling Standard
m. ANSI/TIA-942-C (2024) Telecommunications Infrastructure Standard for Data Centers
n. ANSI/TIA-1005-A (2020) Telecommunications Infrastructure Standard for Industrial Premises
o. ANSI/TIA-1183-B (2023) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183
p. ANSI/TIA-1152-A (2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
q. ANSI/TIA-1179-B (2023) Healthcare Facility Telecommunications Infrastructure Standard
r. ANSI/TIA-4966-A-1 (2023) Telecommunications Infrastructure Standard for Educational Facilities
s. TIA-TSB-184 (2017) Guidelines for Supporting Power Delivery OverBalanced Twisted-Pair Cabling
t. TIA-TSB-190-A (2024) Guidelines on Shared Pathways and Shared Sheaths
u. TIA-TSB-162-B (2021) Telecommunications Cabling Guidelines for Wireless Access Points
v. TIA-568-C.3-E (2022) Optical Fiber Cabling Components Standard
w. TIA-568-C.3-1 (2011) Optical Fiber Cabling Component Standard- Addendum 1, Addition of OM4 Cabled Optical Fiber and array connectors

2. ISO/IEC:

a. ISO/IEC 11801-5 (2022): Information Technology – Generic Cabling for Customer Premises
b. ISO/IEC TR 11801-99-1 (2017) Balanced cabling for 40Gbps channels

c. ISO/IEC 14763-3 (2024): Implementation and Operation of CustomerPremises Cabling – Part 2: Planning and Installation
d. ISO/IEC TS 29125 (2024) Information technology -- Telecommunications cabling requirements for remote powering of terminal equipment

3. CALIFORNIA CODE OF REGULATIONS TITLE 24

a. California Electrical Code
b. California Building Code
c. California Fire Code
d. ANSI/NFPA 70-2023, National Electrical Code© (NEC©)
e. ANSI/IEEE C2-2023, National Electrical Safety Code®
f. National Electrical Code (NEC) (NFPA 70 2023)

4. OTHER STANDARDS, REGULATIONS, CODES

a. Department of Health Care Association and Information (HCAI formerly OSHPD) Standards and Regulations
b. Local Codes and Standards as determined by the AHJ.

5. BICSI – BUILDING INDUSTRY CONSULTING SERVICES INTERNATIONAL:

a. BICSI 004-2018, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
b. ANSI/BICSI 007-2024: Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
c. Information Transport Systems Installation Methods Manual (ITSIMM), 8th Edition
d. ANSI/BICSI 002-2024, Data Center Design and Implementation Best Practices
e. ANSI/BICSI 001-2017, Information Transport Systems Design Standard for K-12 Educational Institutions
f. BICSI-003-2024 Building Information Modeling (BIM) Practices forInformation Technology Systems
g. Telecommunications Distribution Methods Manual, 15th Edition
h. Outside Plant Design Reference Manual, 6th Edition
i. ANSI/BICSI 008-2024 Wireless Local Area network Systems Design and Implementation Best Practices
j. Telecommunications Project Management Reference Manual (TPMRM) reference, 2nd Edition

In cases where cabling standards conflict with one another or with electrical or safety codes, the Consultant shall defer to the National Electrical Code (NEC), California Electrical Code (CEC), California Building Code (CBC), California Fire Code **(CFC)**, and any applicable local codes or ordinances. If conflicts remain, the Consultant shall adopt the most stringent requirement from the applicable standards.

The Consultant is solely responsible for understanding, interpreting, and complying with all applicable standards and codes.

Any violations of applicable standards or codes by the Consultant or Contractor shall be corrected at the Consultant's or Contractor's sole expense.

4 TELECOMMUNICATIONS SPACES

Telecommunications Room (TR) is a general term used to describe any space within a building assigned to Information Technology (IT) infrastructure. Industry terms such as IDF, BDF, and MDF are not applicable to UC Davis Health. The term TR serves as the standard reference in place of the aforementioned acronyms.

This space may or may not house the main point of entry (MPOE) cabling and electronic equipment.

Telecommunications Spaces are dedicated areas designed to provide a secure and controlled environment for telecommunications network equipment, building security systems, and other specialized electronic communications devices.

On the UC Davis Health Campus, the term **TR** is widely used and accepted to designate the connection point between equipment, backbone fiber or copper, and horizontal cabling infrastructure.

The space may or may not contain network distribution equipment.

The space shall accommodate network equipment and infrastructure as required by the customer.\

4.1 TELECOMMUNICATIONS ROOM (TR) – **ARCHITECTURAL**

The size of a Telecommunications Room (TR) is determined by the area it serves and the equipment it will house. The TR must provide adequate space for all planned terminations, electronic equipment, cabling, and supporting systems, including environmental controls, power distribution, power conditioning, and uninterruptible power supplies (UPS). Sufficient clearance for equipment access and maintenance is required, and the room should accommodate future expansion. Industry guidelines, including BICSI and TIA-569-C, recommend careful consideration of these factors to ensure the TR is properly sized for both current and future needs.

At least one Telecommunications Room (TR) shall be provided on each floor of a building and located within 275 feet (including slack) of all telecommunications outlet locations. If a floor's usable space exceeds 10,000 square feet, or if the distance limitation cannot be met, additional TRs shall be provided to ensure adequate coverage in accordance with CBC 1224. TRs shall be designed to accommodate a maximum of 960 horizontal CAT-6A cables. If more than 960 cables are required within the 10,000-square-foot area served by a TR, an additional TR shall be provided. The design and placement of TRs shall follow industry standards, including BICSI's Telecommunications Distribution Methods Manual (TDMM) and TIA-569-C, to ensure sufficient capacity and accessibility for all telecommunications infrastructure.

Telecommunications Rooms (TRs) that do not meet the size requirements specified in this document shall undergo a review and redesign process by the IT facilities team. This process ensures that the TR provides adequate space and infrastructure to support both current and future telecommunications needs while complying with all relevant standards and guidelines.

TR Physical Characteristics:

- The Telecommunications Room (TR) should be located as close as possible to the center of the area it serves, preferably within the building core. The TR must be easily accessible, with direct access from public hallways rather than through offices or other utility spaces. Proper placement ensures efficient serviceability and compliance with industry standards. For specific layout guidance, refer to the Enlarged Plan in Section 5.2 of this document.
- When multiple Telecommunications Rooms (TRs) are required within a building, the design shall include physically diverse and redundant fiber pathways. Buildings with multiple TRs shall provide two separate and redundant telecommunications entrance pathways: one at the ground level with a minimum four 4-inch entrance conduits, and another at the opposite end of the building on a different floor, also with a minimum four 4-inch entrance conduits. The minimum separation between these entrance pathways shall be 67 feet (20 meters) to ensure redundancy and reliability. These pathways are essential for minimizing service disruptions and maintaining continuous connectivity.
- TR walls shall extend from floor to ceiling in a single, continuous plane.
- Telecommunications Rooms (TRs) shall be vertically aligned (stacked) in multistory buildings, with each TR positioned directly above the TR on the floor below. For efficient connectivity between floors, TRs shall utilize EZ-Path penetration systems for both vertical and horizontal pathways. If vertical alignment is not feasible, TRs shall be connected with a minimum of four 4-inch conduits, sized to accommodate both initial cabling and 100% future growth at 40% fill. Conduits shall follow diverse and redundant distribution paths to ensure reliability and minimize potential downtime.
- Non-patient care areas serving up to 10,000 sq. ft., shall comply with the 4-rack standard model (12 feet X 16 feet; see example in section 5.2).
- Patient care areas serving up to 10,000 sq. ft., shall comply with the 5-rack standard model (12 feet X 19 feet; see example in section 5.2).
- Doors for all Telecommunications Rooms (TRs) shall provide a minimum clear opening of 36 inches wide and 84 inches high. Doors shall swing outward unless restricted by local building codes. If a TR door opens to an exterior environment, it shall be rated for exterior use and equipped with a weatherproof gasket to prevent the entry of vermin, water, dirt, and dust. These requirements ensure both accessibility and protection of sensitive equipment within the TR.
- Ceilings shall be open to the underside of the floor above and have treated, sealed fireproofing (e.g., Monokote or equivalent) to minimize airborne dust.
- Walls in Telecommunications Rooms (TRs) shall be covered with fire-rated ¾-inch A/C grade plywood, void-free, kiln-dried, and mounted between 6 inches and 144 inches above finished floor (AFF) with the "A" side exposed. The plywood shall be painted with white fire-rated paint, ensuring that all grading and certification stamps remain visible and unpainted to maintain compliance. *Note: Fire-rated plywood may need to be custom ordered with grading and certification stamps on the "A" side.*
- Space should be allocated on the walls for Intrusion Detection systems, Access Control systems, DAS, ERRCS, and TV where applicable.
- Lighting in Telecommunications Rooms (TRs) shall provide a minimum of 500 lux (50 foot-candles) at any point within the room. Photometric planning shall account for the placement of racks and equipment to

ensure uniform illumination throughout the space. Light fixtures shall be positioned to eliminate shadows between rows of equipment racks, providing adequate visibility for maintenance and operation.

- TR floors shall be covered with Electrostatic Discharge (ESD) Composition Tile or ESD Epoxy. Sealed concrete is not acceptable. ESD tiles shall be electrostatically dissipative and rated for forklift traffic; approved products include Nora Norament 928 Grano ed, #5301, or equivalent as approved by UC Davis Health IT. ESD epoxy shall be anti-static and suitable for forklift traffic.

Design restrictions for TR's are as follows:

- The TR **shall not** be shared with electrical equipment, building services, or any equipment other than that required to directly support telecommunications systems and services.
- TRs **shall not** occupy or share space in boiler rooms, washrooms, janitorial closets, or storage rooms.
- TRs **shall not** be located in areas that restrict expansion, such as within structural steel, stairwells, elevator shafts, along exterior walls, or adjacent to other fixed structural elements.
- TRs **shall not** be located near electrical power transformers, elevator or pump motors, generators, x-ray equipment, radio transmitters, induction heating devices, or other potential sources of electromagnetic interference (EMI) or radio frequency interference (RFI).
- TRs **Shall not** be located near sources of mechanical vibration.
- TRs **shall not** be located in areas subject to steam infiltration, excessive humidity, heat, corrosive atmospheres, or other adverse environmental conditions.
- TRs **shall not** contain any piping or ductwork (e.g., sprinkler systems, steam lines, chilled water pipes, supply and waste piping, pneumatic tubing, etc.), nor shall such systems pass overhead or enter the room, unless they specifically serve the TR. In retrofit projects where existing services are present, drip pans or containment systems with proper drainage must be installed beneath or around each pipe to prevent water damage. Sprinkler heads within the room must not be positioned directly above electronic equipment racks or cabinets to minimize the risk of water-related damage.
- TRs **shall not** have sinks, drains, toilets, or any plumbing installed on or within walls shared with other spaces.
- TRs **shall not** contain structural supports that obstruct usable space (e.g., columns, K-braces, or other building components that restrict the installation of telecommunications equipment).

4.2 TELECOMMUNICATIONS ROOM (TR) – **LAYOUT AND ENLARGED PLAN**

Telecommunications spaces shall be designed in accordance with the guidelines presented in this IT standards document, with input from the intended users and all relevant service providers. This document is intended to support coordination efforts but does not replace the need for direct collaboration with UC Davis Health IT. Final designs must be reviewed and approved by UC Davis Health IT Low Voltage Engineering to ensure compliance with all applicable standards and operational requirements.

A typical Telecommunications Room (TR) requires four (4) or five (5) 19-inch, two-post seismic equipment racks to accommodate IT, clinical, AV, and network equipment, as well as Structured Cabling System (SCS) patch panels for copper and fiber backbones and horizontal cabling to Work Area Outlets (WAOs). During planning and evaluation, IT must assess device and cable counts to determine the final TR size and the total number of rooms required. The

design-builder must coordinate all TR design parameters with IT Facilities Low Voltage Engineering to ensure proper alignment with IT requirements and infrastructure standards.

Four (4) rack configurations are sized for up to 672 horizontal copper cables and 384 Plug Pack cables plus patch cords. Cable will be laid out according to UC Davis Health IT direction.

Five (5) rack configurations are sized for up to 960 Horizontal copper cables and 768Plug Pack cables plus patch cords.

Final TR layouts shall be coordinated with UC Davis Health IT.

Provide 36” of working clearance surrounding racks and electronic equipment.

Typical 19” racks shall be 8’ in height. Where space is contested 7’ racks shall be considered.

All access control, intrusion detection, power distribution, DAS, ERRCS, TV, and other wall-mounted panels shall be installed on the wall in front of the equipment racks. Wall-mounted equipment may only be installed on the wall behind the racks when deemed necessary and with prior approval from UC Davis Health IT Low Voltage Engineering. In all cases, a minimum of 36 inches of working clearance must be maintained, regardless of the mounting location.

The typical width for vertical wire managers used in design is 10 inches. However, vertical wire managers ranging from 8 to 12 inches in width may be specified in UC-provided elevations, depending on equipment requirements. Vertical wire management must maintain a fill ratio of 80% or less when all cables are patched.

Horizontal cabling and pathways shall terminate in the TR located on the same floor as the area they serve.

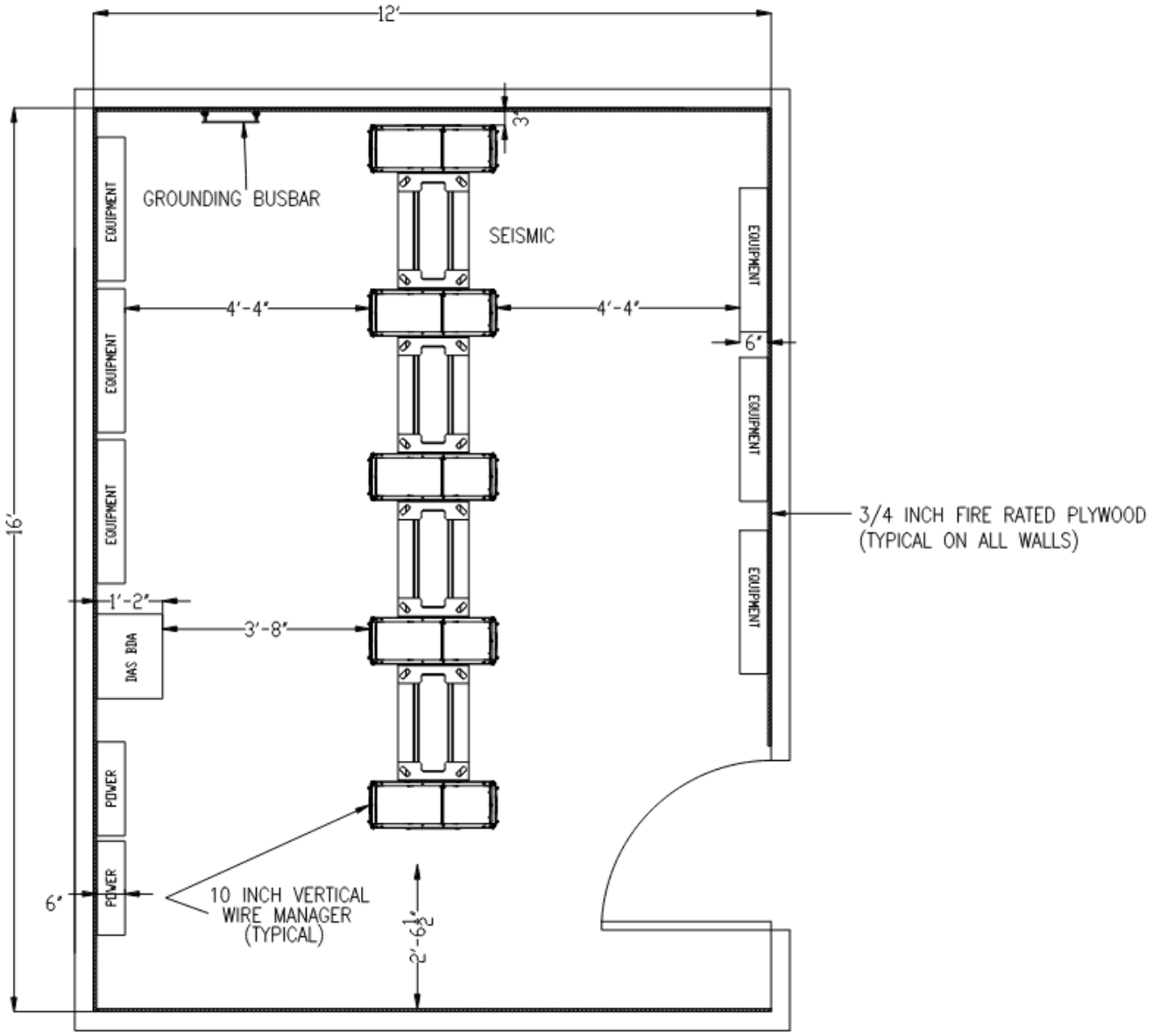
All horizontal cabling shall terminate on 8P8C module inserts within rack-mounted 48-port steel modular patch panels.

A dedicated pathway shall be provided from the highest Telecommunications Room (TR) to the roof to accommodate the installation of radio systems, Distributed Antenna System (DAS) donor antennas, or point-to-point communication systems. All pathways must be properly sealed to prevent water intrusion into the building.

Campus Outside Plant (OSP) and riser single-mode fiber optic cabling shall terminate in rack-mounted Fiber Termination Units (FTUs).

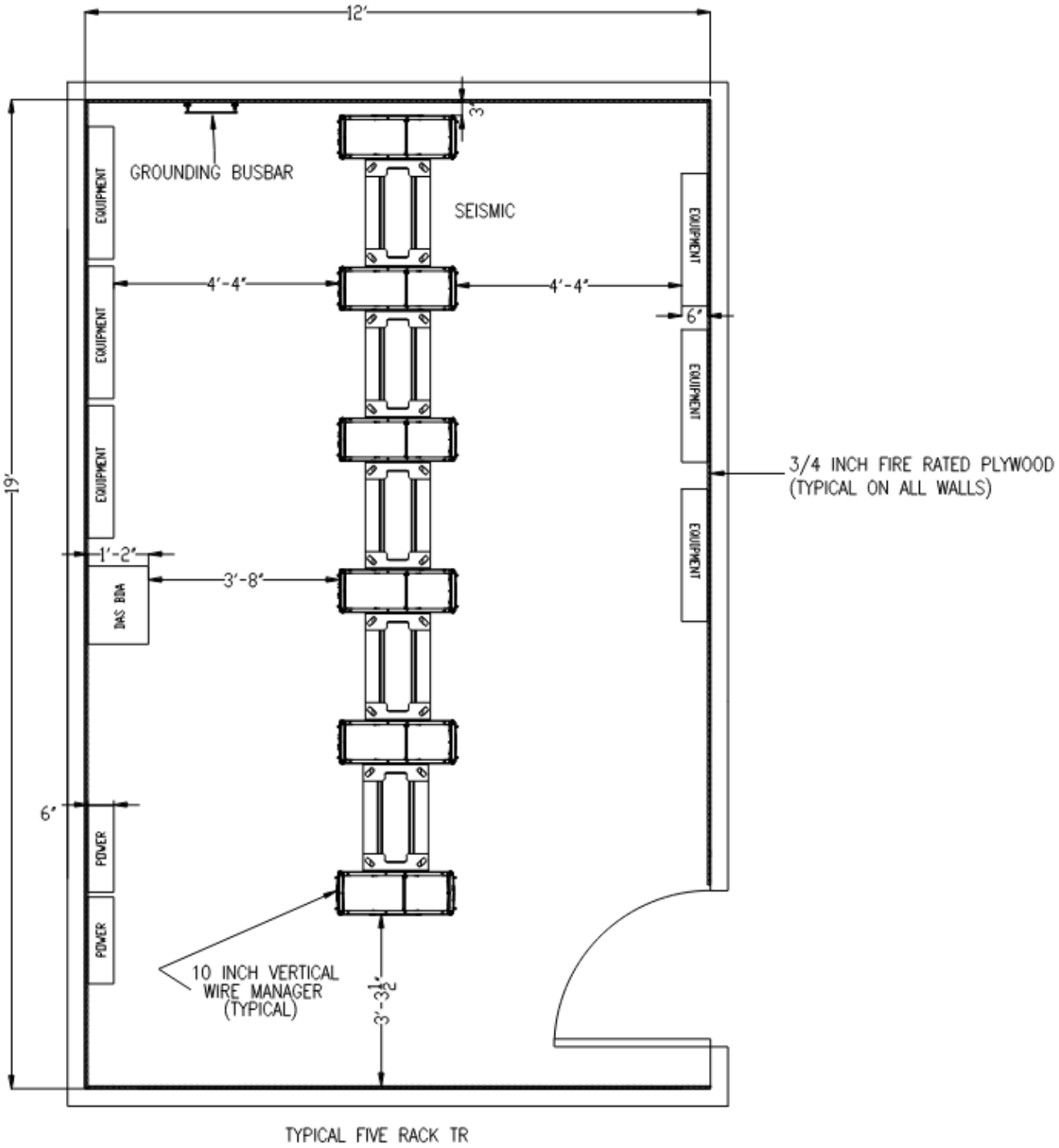
Campus Outside Plant (OSP) and Main Point of Entry (MPOE) copper cabling shall terminate on wall-mounted lightning arrestors. From the lightning arrestors, the cabling shall be cross-connected via 110 blocks to 19-inch racks, terminating on 8P8C connectors within high density modular patch panels.

TELECOMMUNICATIONS ROOM (TR) – **typical Rack layouts**



TYPICAL FOUR RACK TR

TELECOMMUNICATIONS ROOM (TR) – **typical Rack layouts**



TYPICAL FIVE RACK TR

4.2.1.1 TELECOMMUNICATIONS ROOM (TR) – **TYPICAL LADDER RACK LAYOUTS**

TRs shall have 18-inch wide ladder racking wrapping the room, or be coordinated with IT Facilities for alternate configurations.

Ladder rack shall be used only in Telecommunications Rooms (TRs) and shall be constructed of steel with a black finish.

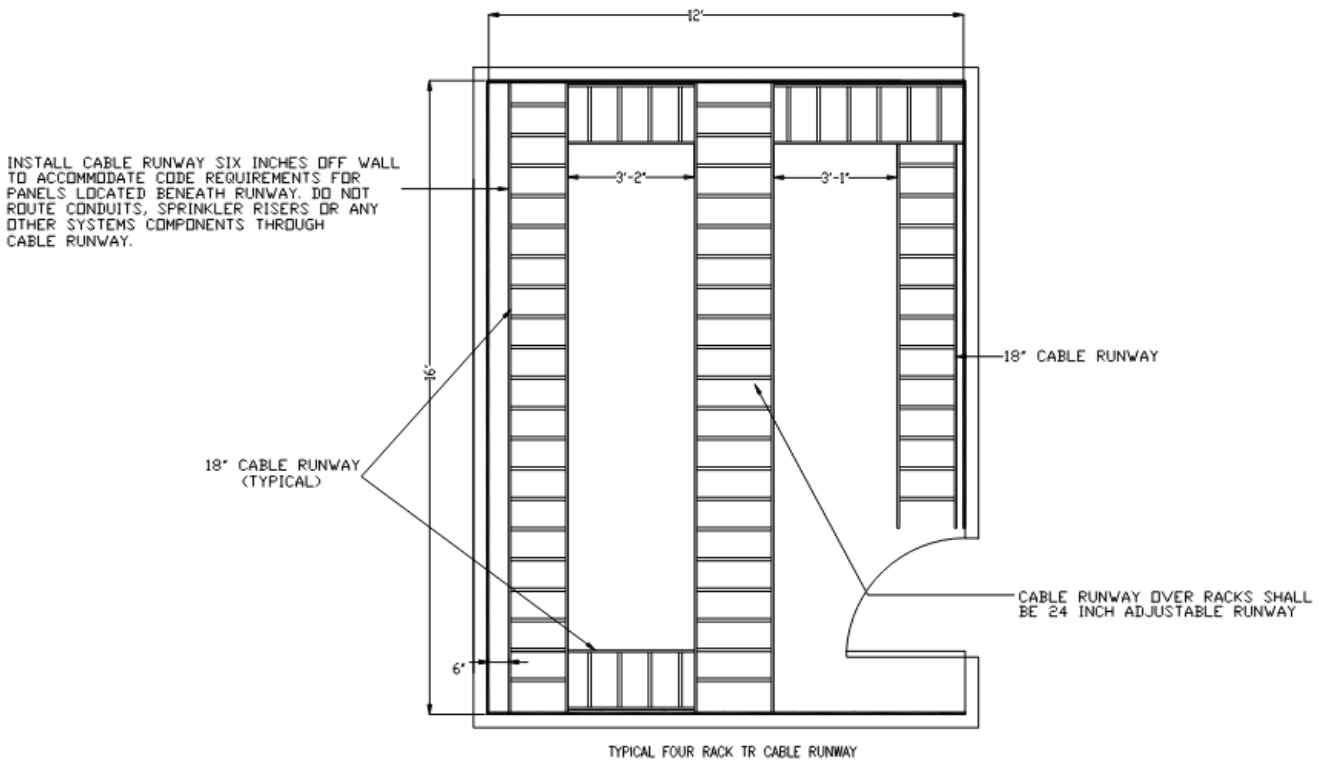
24" "adjustable cable runway" style Ladder Rack shall span across each row of racks.

Ladder Rack shall be grounded and bonded to the PBB or SBB within the TR.

Cables installed on Ladder Rack **shall not** be fastened with plastic tape or cable ties (tie-wraps).

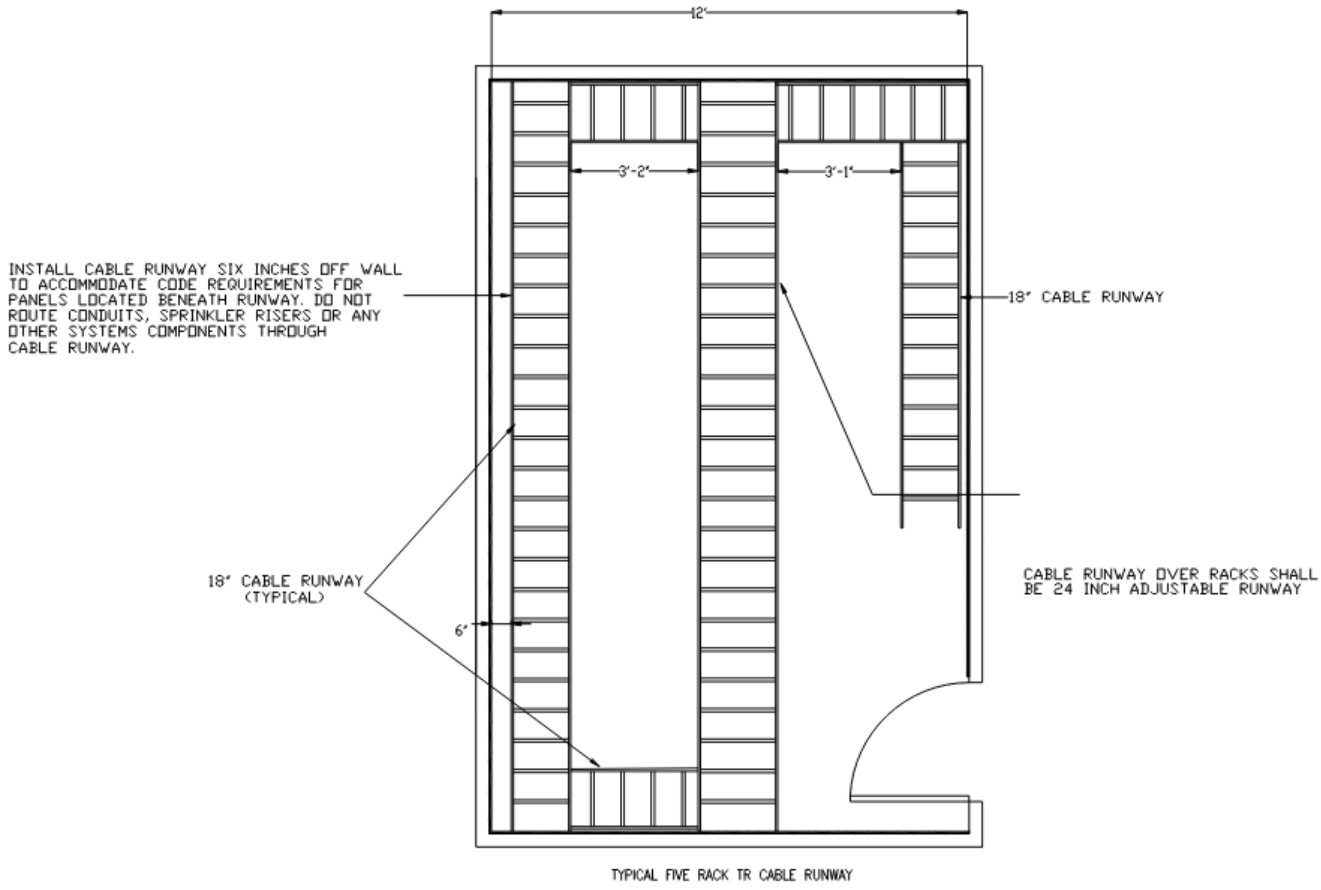
Ladder Rack is contractor furnished contractor installed.

In multistory buildings, brackets and/or cable racking shall be used to support the weight of riser cables as they pass between or through TRs.



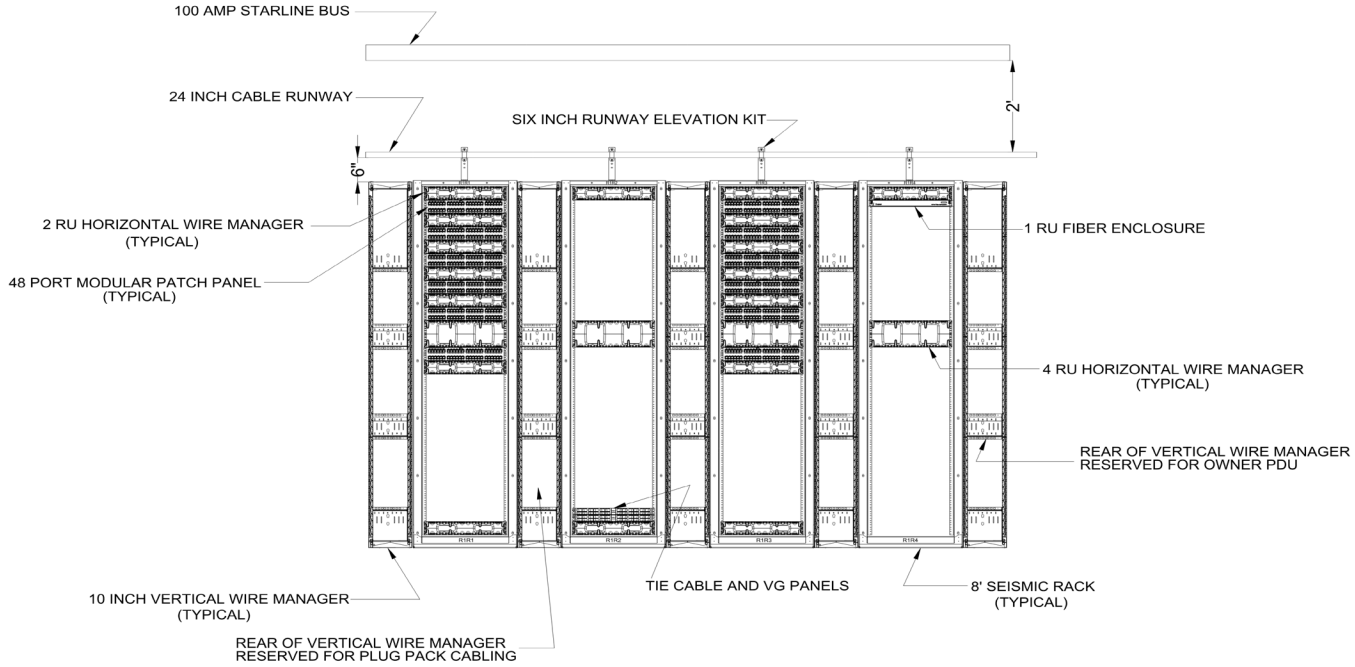
TYPICAL FOUR RACK TR CABLE RUNWAY

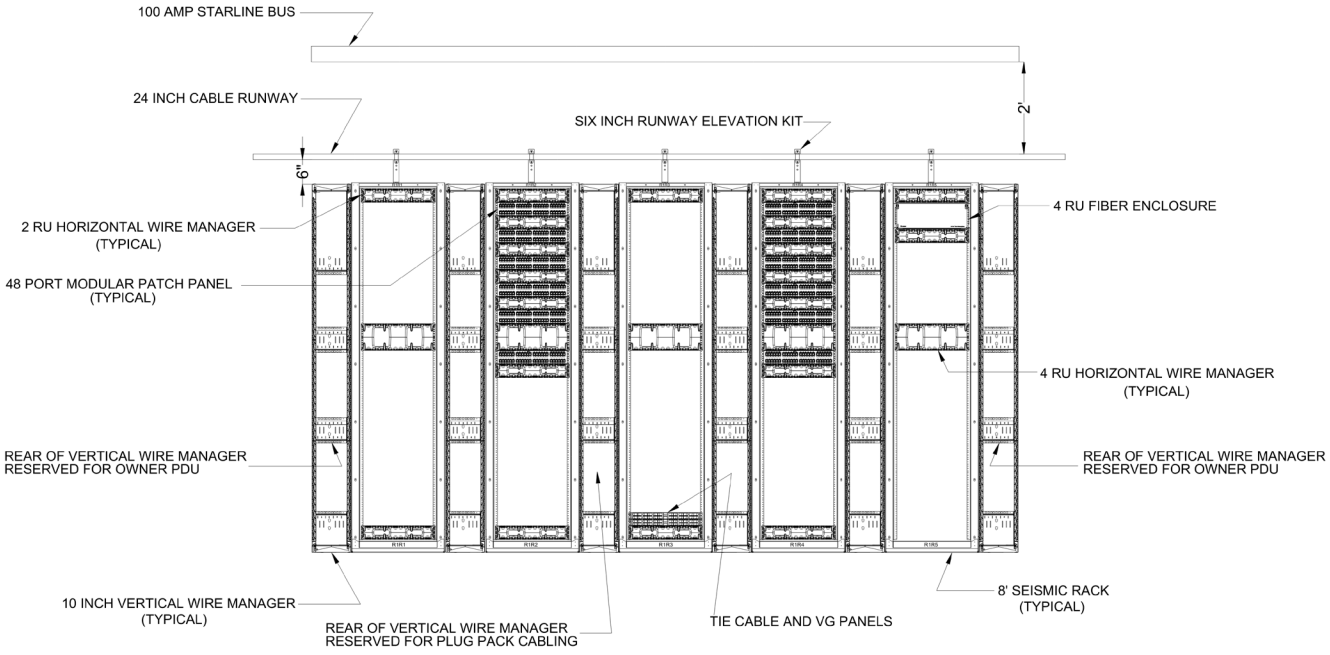
TELECOMMUNICATIONS ROOM (TR) – **typical Rack layouts**



TYPICAL FIVE RACK TR CABLE RUNWAY

4.2.1.2 TELECOMMUNICATIONS ROOM (TR) – TYPICAL RACK ELEVATIONS





TELECOMMUNICATIONS ROOM (TR) – typical Rack elevations (Example only. Final elevations shall be provided by the university).

4.3 TELECOMMUNICATIONS ROOM (TR) – MECHANICAL/ELECTRICAL/PLUMING

4.3.1 MECHANICAL

A positive pressure HVAC system shall be provided for all TR's.

Hot and cold aisles shall be coordinated with IT during the design phase and, as applicable, during construction. Dedicated HVAC service shall be provided for all TRs 24 hours per day, 365 days per year, supported by emergency power if available.

The HVAC system shall be appropriately sized to maintain an ambient room temperature between 64°F and 75°F under normal operating conditions with all equipment installed and functioning. Historically, a capacity of 2 to 3 tons has been sufficient. Heat load calculations must be reviewed and adjusted as necessary to ensure adequate cooling capacity based on the equipment load.

4.3.2 ELECTRICAL

All Telecommunications Rooms (TRs) shall be provided with dedicated electrical service from two separate sources: a primary (normal) source and a backup source from a centralized Uninterruptible Power Supply (UPS) powered from the critical branch. Both sources shall have isolated and dedicated power circuits. Each source shall be served by a dedicated electrical panel located within the TR. These panels shall exclusively service circuits within the TR and shall not provide power to any circuits outside the TR.

The backup source shall be a dedicated three-phase 120/208-volt UPS supplying power to one of the equipment inputs. Building UPS systems are required for all new building designs.

Power in telecommunications rooms shall be distributed via a power busway, such as Starline, Vertiv™ Powerbar iMPB, or approved equivalent. The busway shall be mounted above the rack rows and configured to provide both UPS and normal power. Busways shall be securely mounted to the structure above, as detailed by the SEOR.

All ancillary equipment (C13, C19, and 5-15 outlets) within racks and on the external walls of Telecommunications Rooms (TRs), shall be controlled by intelligent Power Distribution Units (PDUs). PDUs will be Owner-Furnished, Owner-Installed (OFOI). Receptacle requirements for the PDUs shall align with IT-provided equipment elevations specific to the project under design.

Telecommunications Rooms (TRs) shall include 5-20 convenience receptacles installed every six feet around the room's perimeter at a height of 18 inches above finished floor (AFF). No more than four outlets shall be connected to a single circuit. Electrical circuits shall be alternated around the room to ensure balanced load distribution.

UC Davis Health requires a centralized Uninterruptible Power Supply (UPS) to support all telecommunications equipment. The UPS shall be a three-phase 120/208-volt unit, appropriately sized to accommodate the total

equipment load in the TRs. This includes telecommunications systems, building security systems, card key access, Aiphone intercoms, and nurse call systems.

UC Davis Health IT will collaborate with designers to determine the appropriate size of the Uninterruptible Power Supply (UPS). UC Davis Health IT will also provide guidance on the recommended model and input power requirements to ensure compatibility with the project's needs.

If UC Davis Health IT determines the need for individual (distributed) Uninterruptible Power Supply (UPS) systems within each Telecommunications Room (TR), the sizing criteria shall be established in coordination with UC Davis Health IT. A 10 KVA UPS unit must be supplied with a 60A service disconnect switch and connected to a generator or emergency power branch, if available. For UPS units smaller than 10 KVA, the service power feeds must comply with the manufacturer's specifications.

Both 120-volt and 208-volt receptacles shall be provided and distributed through a Power Distribution Unit (PDU) power strip. UC Davis Health IT will specify the UPS Point of Distribution (POD) as required for the project under design.

4.3.3 SPRINKLER HEAD PROTECTION

Protective measures, such as wire cages, shall be installed to prevent accidental activation of all wet pipe fire sprinkler systems within the Telecommunications Room (TR). Fire sprinkler pipes or sprinkler heads shall not be installed directly above equipment racks or cabinets that house electronic equipment.

4.1 TELECOMMUNICATIONS ROOM (TR) – **GROUNDING & BONDING**

The Primary Bonding Busbar (PBB) for each building shall be located where the copper cabling enters the building.

All Telecommunications Rooms (TRs) within a building shall be interconnected using a Telecommunications Bonding Backbone (TBB) and, where applicable, a Grounding Equalizer (GE) to ensure proper bonding and grounding.

Telecommunications Bonding Backbone (TBB) and Grounding Equalizer (GE) conductors shall be sized per the chart below:

Sizing of the TBB	
TBB length linear m (ft.)	TBB Size (AWG)
less than 4 (13)	6
4 – 6 (14 – 20)	4
6 – 8 (21 – 26)	3
8 – 10 (27 – 33)	2
10 – 13 (34 – 41)	1
13 – 16 (42 – 52)	1/0
16 – 20 (53 – 66)	2/0

greater than 20 (66)	3/0

Grounding shall be contractor provided and contractor installed.

5 PATHWAYS FOR COMMUNICATIONS SYSTEMS

5.1 CABLE SUPPORT AND DESIGN

The main routing and support systems for communication cables on the UC Davis Health System campus are:

- Cable tray system (corridor's) (Primary Support Pathways.)
- J-hooks installed above accessible false ceiling areas. (Secondary Supports)
- Conduit runs (hard ceiling areas, inaccessible ceiling areas, in-floor boxes, masonry walls)
- Conduit riser and backbox.

UC Davis Health standards specify the use of an overhead distribution method, utilizing cable trays for primary pathways and J-hooks for secondary pathways. Installation shall begin with a cable tray from the Telecommunications Room (TR), followed by J-hooks and a conduit riser leading to a backbox at the Work Area Outlet (WAO). EMT conduit shall be used where accessibility is restricted or when required by code.

Building cabling systems unrelated to voice or data—such as 800 MHz radio, access control, intrusion detection, nurse call, Distributed Antenna Systems (DAS), building automation, and similar systems—must be routed through dedicated, independent pathways separate from network cabling (e.g., sidecars or J-hook pathways attached to cable trays). RCDD certification is required for the design of these systems. UC Davis Health IT should be consulted in the event of any issues.

5.2 CABLE TRAYS

The preferred cable tray system is a steel wire basket tray. Its use is primarily intended for corridors and areas outside of Telecommunications Rooms (TRs).

Cable trays shall be a minimum of 18 inches wide and 4 inches deep. Tray sizing must account for full occupancy and the anticipated full building lifecycle fill ratio. Cable trays shall be sized to accommodate a maximum fill of 25% at the end of the project.

Cable trays shall be mounted no higher than 12 feet above finished floor (AFF) and shall not extend more than 4 feet above a fixed ceiling.

Cable trays shall be grounded and bonded in accordance with current BICSI, ANSI, and TIA standards.

Cable trays shall terminate before fire-rated walls and transition to E-Z Paths, ensuring equal capacity at the point of penetration.

Cables installed in cable trays shall not contain, nor be secured with, Velcro, tape, or plastic cable ties (tie-wraps).

Location of cable tray pathways shall be indicated on the Telecommunications Drawings.

5.3 COMMUNICATIONS J-HOOKS

J-hooks shall be spaced no more than 60 inches apart and positioned within 24 inches of a conduit riser at the Work Area Outlet (WAO).

J-hook cable pathways shall be designed to accommodate up to a maximum 50 communication cables.

Plastic J-hooks are not allowed.

Location of the J-Hook pathways shall be indicated on the Telecommunications Drawings.

5.4 INDOOR COMMUNICATIONS CONDUITS

Conduits shall:

- Be a minimum of 1¼ inches in diameter for each workstation or device, as required.
- Be installed along the most direct and accessible route possible, ensuring compliance with Data Cabling distance limitations.
- Be installed through inaccessible areas, such as hard ceilings, inaccessible ceiling spaces, in-floor boxes, or masonry walls.
- Be installed in areas where flammable materials are stored or where cabling may be exposed to adverse environmental conditions.

5.5 COMMUNICATIONS FLOOR POKE THROUGH

Floor poke-through devices shall be indicated on the electrical and/or telecommunications drawings with the size of conduit to be installed.

Floor-mounted poke-throughs shall be fed with a minimum 1¼-inch conduit for communications cabling.

Floor-mounted poke-throughs located in a shared enclosure with network cabling shall include a second conduit, minimum 1½ inches in diameter, for A/V cabling.

6 TELECOMMUNICATIONS FIRE STOPPING

The purpose of this section is to establish requirements for the selection and maintenance of firestop systems used to maintain or restore the fire-resistance and smoke containment of rated walls, floors, shafts, and joints where communications pathways, conduits, cable trays, cable, and equipment penetrate or cross fire or smoke rated barriers. In a healthcare facility, these systems protect life safety egress, compartmentation and separation of hazardous or critical systems per applicable health and building codes.

EZ-Path fire-rated pathway systems shall be used for cable penetrations wherever required. These assemblies shall be provided for both horizontal and riser (vertical) penetrations.

6.1 UL LISTED IT APPROVED TR PRODUCTS

STI EZD22: EZ-Path Series 22 Fire-Rated Pathway Kit

STI EZDP133CWK: EZ-Path Series 33 Fire-Rated Pathway Circular Wall Plate Kit.

STI EZDP33FWS: EZ-Path Series 33 Fire-Rated Pathway Device Kit.

STI EZDP33WR: EZ-Path Series 33 Fire-Rated Pathway Retro-Fit Kit.

STI EZDP233GK: EZ-Path Series 33 Fire-Rated Pathway 2-gang kit.

STI EZDP333GK: EZ-Path Series 33 Fire-Rated Pathway 3-gang kit.

STI EZDP433GK: EZ-Path Series 33 Fire-Rated Pathway 4-gang kit.

STI EZDP733GK: EZ-Path Series 33 Fire-Rated Pathway 7-gang kit.

STI EZDP44S2: EZ-Path Series 44+ Fire-Rated Pathway Device Kit

STI EZDG444S2: EZ-Path Series 44+ Fire-Rated Pathway Single Slot 4-Grid Kit

STI EZDG844S2: EZ-Path Series 44+ Fire-Rated Pathway Single Slot 8-Grid Kit

STI EZDR200: EZ-Path Retrofit Device for 2”

STI EZDR400: EZ-Path Retrofit Device for 4”

STI EZ-Path Cable Tray Retrofit Devices: EZCTR612, EZCTR614, EZCTR616, EZCTR618, EZCTR624.

Or approved equals

All fire stopping installations shall be labeled in accordance with ANSI/TIA 606-D.

7 WORK AREA OUTLET (WAO)

All Work Area Outlets shall be provided and installed by the contractor.

7.1 WORK AREA OUTLET (WAO) PLACEMENT

Typical WAO mounting height shall be 18 inches above finished floor (AFF), or aligned with adjacent new or existing power receptacles where appropriate.

Cabling for ceiling-mounted devices shall terminate in a 5-inch square by 2-7/8-inch deep device box for standard installations. Where the mounting or hardware requirements of the device differ from typical conditions, the device manufacturer's mounting requirements shall take precedence.

For Modular Furniture, manufacturer integrated furniture faceplates capable of accepting UC Davis Health standard modular jacks shall be provided.

7.2 WORK AREA OUTLET (WAO) ELECTRICAL OUTLET BOX

WAOs shall be provided with a 5-inch square, 2-7/8-inch deep device box and finished with a single-gang device ring. Each box shall be served by a 1-1/4-inch conduit and installed flush within the wall, unless otherwise indicated on the drawings or specified by the Architect of Record.

Wall-mounted courtesy and public telephone device boxes shall comply with all applicable ADA accessibility requirements. The typical mounting height shall be 44 inches above finished floor (AFF), unless otherwise directed by the Architect of Record. Provide a dedicated electrical outlet at 18 inches AFF to accommodate TTY/TDD equipment.

Outlets required for specific functions—such as patient headwalls, audiovisual equipment, and patient exam rooms—shall be located according to the needs of the associated service. All such outlet locations shall be coordinated with IT Facilities prior to installation.

Conduits serving WAO devices shall be individually routed and shall not be daisy-chained.

7.3 WORK AREA OUTLET (WAO) CABLE FACEPLATES, CABLE SURFACE MOUNT BOXES

Surface-mounted WAOs shall use surface-mount boxes that are black in color and permanently secured to the mounting surface.

WAO faceplates shall be stainless steel, flush-mounted, and have a smooth surface without plastic lenses. Faceplates matching the color of surrounding surfaces shall only be provided with UC Davis Health IT approval and upon specific request. Cabling contractors shall coordinate with furniture installations to ensure that outlets remain accessible and are not covered by furniture.

Work Area Outlets (WAOs) installed in the ceiling for wireless access points shall include a 5-inch square by 2-7/8-inch deep device box, finished with a double-gang mud ring. If the backbox is installed in a hard cap or otherwise inaccessible location, a 1-1/4-inch conduit shall be provided to the nearest accessible location, within 2 feet of a cable pathway.

Work Area Outlets (WAOs) installed in the ceiling for cameras shall include a 5-inch square by 2-7/8-inch deep device box, finished with a single-gang mud ring. If the backbox is installed in a hard cap or otherwise inaccessible location, a 1-1/4-inch conduit shall be provided to the nearest accessible location, within 2 feet of a cable pathway.

7.4 WORK AREA OUTLET (WAO) POWER REQUIREMENTS

Field A/C power receptacles shall be installed near each WAO location, within 3 feet, for devices that require local power.

Dedicated power for printers shall be provided by the design professional based on locations identified by UC Davis Health IT.

Power is not required for access points, cameras, or time clocks that are within horizontal cabling limits. Power for devices located more than 275 feet from the nearest telecommunications room shall be coordinated with UC Davis Health IT.

7.5 CABLING CONTRACTOR CERTIFICATION REQUIREMENT

The cabling contractor shall be certified and trained in Panduit cabling products to ensure the maximum available warranty. The contractor shall comply with all UC Davis Health and FD&C policies and specifications. In addition, the cabling contractor must be a Panduit ONE Certified Installation Partner.

7.6 OFFICE WORK AREA CABLING REQUIREMENT

Typical workstation locations in offices, cubicles, or service counters shall have a minimum of one Work Area Outlet (WAO), typically consisting of two data cables. User requirements shall be considered when determining the number of cables, which may require three or more data cables in a single faceplate. Final requirements shall be coordinated with UC Davis Health IT.

Typical workstation locations at nurse stations shall consist of three cables per seat. Other workstations, such as printers and downtime computers, shall have dedicated Work Area Outlets (WAOs) and shall not share a faceplate with other locations within the nurse station area.

A typical Work Area Outlet (WAO) shall consist of a single-gang, 4-port stainless steel faceplate or a 4-port furniture-integrated faceplate.

All cable colors shall correspond to matching jack colors and indicate the category of service. The standard color scheme shall be as follows:

- CAT-6A cables and jacks: violet
- CAT-6 cables and jacks: white
- CAT-5E cables and jacks: blue.

All colors shall be consistent throughout the installation.

Work Area Outlets (WAOs) shall be terminated with 8P8C modules using the T568B termination scheme.

7.7 PATIENT CARE WORK AREA CABLING REQUIREMENT

A typical configuration of six cables per patient bed shall be provided, with three cables on each side of the headwall. Final configuration shall be coordinated with UC Davis Health.

Work Area Outlets may vary based on the service requirements of each care unit in a patient care facility. IT Facilities shall be consulted to define requirements prior to finalizing decisions on the cabling infrastructure.

Coaxial cabling remains the preferred medium for TV service in patient rooms. A minimum of one quad-shield RG-6 coaxial cable and one CAT-6A cable shall be provided at each cable TV location in patient rooms.

Clinical Engineering systems require specialized cabling that may not conform to UC Davis Health IT standards. Refer to Clinical Engineering for guidance on items not covered in this document.

7.8 UNIQUE WORK AREA CABLING REQUIREMENTS

Two strands of Singlemode OS2 fiber and 2 data cables shall be installed at a Fire Alarm Control Panel (FACP).

One data jack shall be installed at the control panel of the Elevator Control Room for each elevator car. An additional data jack shall be installed in the Elevator Control Room to support the two-way communication system.

Two Data jacks shall be installed at the Building Management System (BMS) Control Panel.

Two Data jacks shall be installed at the Lighting Control Panel (LCP).

Two Data jacks shall be installed at the Power Monitoring (PML) Control Panel.

Three Data jacks shall be installed at the Building Intrusion Detection System control panel.

Two data jacks shall be provided at the Building Access Control Panel.

One Data jack shall be installed for each Courtesy, Pay, Text, Area of refuge Telephone.

Two Data jacks shall be installed at each Emergency Phone location.

Standard AP locations shall have two CAT 6A cables.

A standard Camera location shall have one CAT6A cable, installed by the same C-7 contractor installing all other Data Cabling to prevent overlapping work.

A standard Nurse Station shall have three data cables per chair.

7.9 ELEVATOR TELEPHONE

Each elevator bay, including elevator chair lifts, shall be provided with a dedicated phone line. An analog dial tone suitable for typical elevator car use shall be supplied. UC Davis Health typically provides a ring-down answering location to meet code requirements for buildings on campus.

Elevator phones and code-required two-way communication systems shall be contractor-provided and contractor-installed. These systems shall be capable of integration with the UC DAVIS HEALTH PO&M legacy system.

Answering locations for leased facilities shall be coordinated with UC DAVIS HEALTH.

7.10 SECURITY COMMUNICATION SYSTEM

The Security Communication System (SCS) at UC Davis Health is operated and maintained by UC Davis Health Innovation Technologies, Facilities Technologies (ITFT), and programmed and configured by the Designer/Contractor. The following system, devices, and components shall be utilized at all UC Davis Health facilities, new and existing, owned and leased.

- SCS Intercom Platform: **Aiphone**
- Intercom Master Station: **Aiphone IX-MV7 Series**, model suited to application
- Intercom Video Door Station: **Aiphone IX-EA Series**, model suited to application
- Emergency Phone Platform: **Gai-troincs**
- Emergency Blue Light Tower: **Gai-troincs 294 Series**, model suited to application, with or without camera mast
- Emergency Blue Light Wall Mount: **Gai-troincs 294 SeriesWM**, model suited to application, with or without camera mast
- Emergency Flush Mount Compact Phone: **Gai-troincs 379 Series**, model suited to application
- Emergency Surface Mount Phone: **Gai-troincs 393 Series**, model suited to application

DESIGN AND INSTALLATION REQUIREMENTS

ITFT has jurisdiction over the SCS design, installation, testing, and commissioning requirements on all projects and at all buildings owned or leased by UC Davis Health.

The project SCS design shall include SCS locations, as identified by ITFT and building/area users. Typical locations may be some or all the following:

- Exterior building entrances for intercoms
- Sensitive interior area/room entrance for intercoms
- Exterior and site locations for emergency phones and blue light stations
- Parking lots and structures for emergency phones and blue light stations
- Other locations as directed by the University

Each SCS intercom location shall include all infrastructure, conduits, cabling, and mounts required by the project.

Each SCS emergency phone location shall include all infrastructure, conduits, cabling, and mounts required by the project.

SCS design configuration shall be ethernet network based and shall terminate to the nearest PoE+ network switch or powered fiber switch in the nearest TR room, unless specifically approved by ITFT.

Each intercom and emergency phone shall be connected to the network switch via an intermediate ethernet patch cable and via an ethernet jack installed at the device. CAT6A ethernet cabling, fiberoptic network cabling, patch panels, and network jacks shall be provided per Division 27 specifications.

Designer/Contractor shall complete a SCS Termination Schedule for the devices included in the project. This termination schedule shall include device configuration data, including the IP information provided by ITFT, as well as specific MAC address, username and password. The termination schedules shall also include areas to document testing and commissioning of the NVR and associated camera.

SCS Termination Schedules shall be completed by the Designer/Contractor and included in the project submittals and approved by ITFT prior to beginning device installation and termination. Final "as-built" termination schedules shall be submitted and approved by ITFT at least 10 working days prior to system testing and commissioning. The final "as-built" termination schedules will be used by the Designer/Contractor, ITFT, and the project commissioning agent to verify all SCS devices are installed and programmed correctly, and that the operation of each devices meets the design intent and the specifications.

All SCS cabling and termination requirements shall meet or exceed device manufacturer's written specifications and installation instructions, and Division 27 requirements for ethernet and fiberoptic network communications. Horizontal cabling may be "free run" in accessible plenum if supported by suitable hangers or trays as specified in Division 27. Horizontal cabling shall be installed in EMT through non-accessible, hard-lid, and exposed ceilings. Exposed vertical cabling shall be installed in EMT. As required by N.E.C. Vertical cabling in walls shall be installed in EMT. All conduit, regardless of type or installation location shall be sized to accommodate no more than 40% fill, per N.E.C. and UC DAVIS HEALTH Division-27 specifications.

SCS cable labels shall be keyed to the drawings using ITFT device identification schema such that at each cable end, origination and destination can be quickly and clearly ascertained. Labels shall be custom printed on sleeve or flag type laminated labels. Labels shall be positioned so that they can be easily read without needing to adjust or reposition label or surrounding cabling.

SCS intercom device labels shall be installed in the lower right-hand corner of the device faceplate. The label shall use the ITFT device identification schema.

All SCS device locations, device wiring requirements, installation details, and network switch rack locations and elevations shall be shown on the project drawings and keyed to the programming and labeling standards as provided by ITFT.

PROGRAMMING AND CONFIGURATION

Designer/Contractor has responsibility for configuration and programming all SCS devices, which shall include IP information, as provided by ITFT, necessary to bring the online and make it discoverable by on the network.

TESTING AND COMMISSIONING

After SCS installation and programming are complete, the Designer/Contractor shall perform a pre-commissioning test to verify all devices are installed, terminated, and configured correctly. Ten (10) days prior to the scheduled commissioning date, the Designer/Contractor shall provide printed pre-test documentation indicating each device has been successfully tested and is in conformance with the operational intent of the project. Failure to provide pre-testing documentation will prevent commissioning from being conducted.

SCS Commissioning shall be performed by the Designer/Design-Build Contractor, shall be witnessed in the field by ITFT, and shall be monitored and recorded by ITFT. Commissioning shall include a complete observational inspection to ensure all devices are installed per manufacturer's instructions and per industry standards (straight/level/plumb/secure) as designed and specified. Commissioning shall also include verification of audibility and volume level. During commissioning the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After the conclusion of commissioning, the ITFT representative shall document the unsatisfactory items on a punch list of deficiencies and distribute to the Designer/ Contractor. Follow-up commissioning shall occur after all deficiencies have been rectified.

8 FIRE DETECTION AND ALARM

Design is provided based on NFPA and local Authority Having Jurisdiction.

All Hospital Campus Buildings report to UC Davis Campus dispatch center as a proprietary supervising station. All UC DAVIS HEALTH leased buildings report to their local jurisdiction based on the building owners' preferences. The Fire Marshal's office will work with Fire dispatch (including UC Fire dispatch) to coordinate the addition of buildings.

On the UC DAVIS HEALTH Campus fiber and network connectivity (local area connection) is required at the Notifier Fire Panel in addition to the analog phone lines for alarm reporting.

All fire alarm systems are wholly owned and installed by the construction group. UC DAVIS HEALTH will receive the system following fire marshal acceptance (OSHPD where applicable) for maintenance responsibilities.

9 NURSE CALL / CODE BLUE SYSTEMS

The Nurse Call System (NCS) at UC Davis Health is operated and maintained by UC Davis Health Innovation Technologies, Facilities Technologies (ITFT), and programmed and configured by the Contractor. The following system, devices, and components shall be utilized at all UC Davis Health facilities, new and existing, owned and leased.

- NCS Platform: **West-Com Novus Connect**
- System and Device Components include the following:
    - Nurse Call Consoles
    - Nurse Call Novis SIP-Controllers
    - Patient Stations
    - Staff Stations

  - Emergency Stations
  - Corridor Lights
  - Smart Dome Lights
  - Staff Presence Stations
  - Entertainment And Environmental Interface Units
  - Vocera Integration
- NCS Integration: **Vocera**

9.1 DESIGN AND INSTALLATION REQUIREMENTS

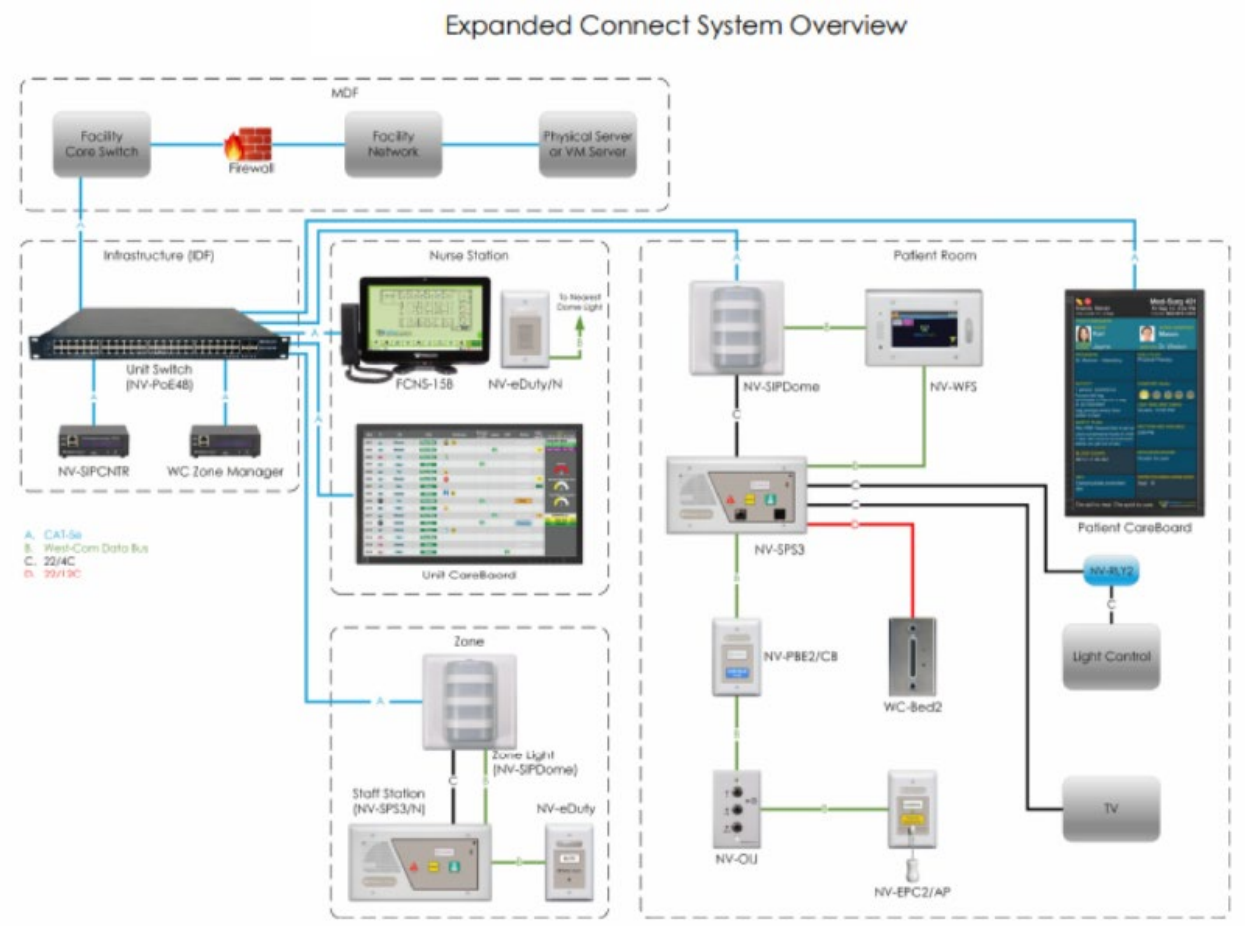
ITFT, in coordination with building/area users, has jurisdiction over the NCS and Code Blue design, installation, testing, and commissioning requirements on all projects and at all buildings owned or leased by UC Davis Health. The NCS and Code Blue system shall comply with NFPA 70, NFPA 99, Joint Commission Environment of Care standards, and HCAI requirements governing emergency signaling systems.

The project NCS design shall include nurse call system devices at locations identified by ITFT in coordination building/area users. Typical locations may be some or all the following:

- Nurse Stations
- Staff Rooms
- Patient Rooms
- Patient Lavatories
- Examine Rooms
- Emergency Rooms
- Critical Care Areas
- Operating Rooms
- And other areas as defined by ITFT

The Code Blue system shall be designed, installed, and programmed as part of the Nurse Call system in accordance with UC Davis Health IT and Facilities standards.

NCS design shall include some or all the system and device components listed previously and shown on the Expanded Connect System Over Diagram below.



The NCS may include Careboards. These systems are designed to present real-time, patient-specific information to patients, families, and staff, reducing reliance on dry-erase boards and manual updates.

Designer/Design-Build Contractor shall complete an NCS Loading Schedule for each system area included in the project. This loading schedule shall include devices, configuration data, including the IP information provided by ITFT, as well as device specific MAC address, username and password as applicable. The loading schedule shall include specific addressing and point-to-point termination information for all system devices and shall include designating information for each device or component in the system, as keyed to the project drawings.

NCS Loading Schedules shall be completed by the Designer/Design-Build Contractor and included in the project submittals and approved by ITFT prior to beginning device installation and termination. Final "as-built" loading schedules shall be submitted and approved by ITFT at least 30 working days prior to system testing and commissioning. The final "as-built" loading schedules will be used by ITFT to program the system and by the Designer/Design-Build Contractor, ITFT, and the project commissioning agent to verify all NCS devices are installed and programmed correctly and that the operation of each device meets the design intent and the specifications.

The NCS AND Code Blue systems shall be powered by both normal (house) power and the facility's emergency/UPS/back-up power sources to ensure continuous operation under all conditions. All Nurse Call head-end equipment, servers, and network components shall be connected to emergency power circuits with UPS backup. Nurse Call devices shall maintain functionality during power transfer and network failover conditions.

Network connectivity between Nurse Call devices, servers, and monitoring stations shall utilize redundant communication paths to ensure continuous operation in the event of component or network failure. All NCS cabling, wiring, and termination requirements shall meet or exceed device manufacturer's written specifications and installation instructions. Horizontal cabling may be "free run" in accessible plenum if supported by suit hangers or trays as specified in Division 27. Horizontal cabling shall be installed in EMT through non-accessible, hard-lid, and exposed ceilings. Exposed vertical cabling shall be installed in EMT or rigid conduit, as required by N.E.C. Vertical cabling in walls shall be EMT or flexible metal conduit. All conduit, regardless of type or installation location shall be sized to accommodate no more than 40% fill, per N.E.C.

NCS cable labels shall be keyed to the drawings using ITFT device identification schema such that at each cable end, origination and destination can be quickly and clearly ascertained. Labels shall be custom printed on sleeve or flag type laminated labels. Labels shall be positioned so that it can be easily read without needing to adjust or reposition label or surrounding cabling.

All NCS system components, device components, and installation details shall be shown on the project drawings and keyed to the programming and labeling standards provided by ITFT. These drawings shall be submitted to ITFT for review and record keeping.

9.2 SYSTEM INTEGRATION REQUIREMENTS

Where applicable, the system shall support integration with the UC Davis Health Vocera wireless communication platform and/or HL7 interfaces with the Epic electronic medical record (EMR) to enable data exchange, clinical notifications, and workflow synchronization with associated subsystems.

The Designer and Contractor shall coordinate with IT Facilities Technologies (ITFT) and the respective user departments to define integration parameters, testing procedures, and acceptance criteria.

9.3 PROGRAMMING AND CONFIGURATION

Designer/Contractor has responsibility for all NCS programming, including IP addressing, as provided by ITFT, necessary to bring all system and device components online and operational.

9.4 TESTING AND COMMISSIONING

Integration with the Nurse Call head-end, Vocera, or other clinical-communication platforms shall be coordinated with IT Facilities Technologies (ITFT) to ensure compatibility, alarm-routing integrity, and compliance with UC Davis Health IT security standards.

After NCS installation and programming are complete, the Designer/Design-Build Contractor shall perform a pre-commissioning functional test to verify all devices are installed, terminated, and configured correctly. Ten (10) days prior to the scheduled commissioning date, the Designer/Design-Build Contractor shall provide printed pre-test documentation indicating each device has been successfully tested and is in conformance with the operational intent of the project. Failure to provide pre-testing documentation will prevent commissioning from being conducted.

Formal commissioning shall include complete end-to-end testing of call initiation, annunciation, escalation, and integration with ancillary systems (e.g., Vocera, Code Blue) as applicable. Commissioning shall be witnessed by HCAI and documented by ITFT. NCS Commissioning shall be performed by the Designer/Design-Build Contractor, shall be witnessed in the field by ITFT and building/area representatives, and shall be monitored and recorded by ITFT. Commissioning shall include complete testing and operational verification of all NCS devices installed and/or utilized as part of the project. Commissioning shall also include complete observational inspection to ensure devices are installed per manufacturer's instructions and per industry standards (straight/level/plumb/secure) as designed and specified. During commissioning the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After the conclusion of commissioning, the ITFT representative shall document the unsatisfactory items on a punch list of deficiencies and distribute them to the Designer/Design-Build Contractor. Follow-up commissioning shall occur after all deficiencies have been rectified.

The Code Blue system shall undergo full functional testing during Nurse Call commissioning, including verification of alarm initiation, annunciation, escalation, and cancellation sequences. Testing shall be witnessed by HCAI and documented by ITFT as part of system acceptance.

10 ACCESS CONTROL

The Access Control System (ACS) at UC Davis Health is programmed, operated, and maintained by UC Davis Health Innovation Technologies, Facilities Technologies (ITFT). The following system, devices, and components shall be utilized at all UC Davis Health facilities, new and existing, owned and leased.

- Access Control System Platform: **Lenel OnGuard Professional**
- ID Badge/Card Technology: **HID Seos** (part number to be provided by ITFT if necessary)
- Standard Card Reader: **HID Signo 40** series (part number to be confirmed by ITFT during design)
- Standard Card Reader w/ Keypad: **HID Signo 40K** series (part number to be confirmed by ITFT during design)
- Mullion Card Reader: **HID Signo 20** series (part number to be confirmed by ITFT during design)
- Mullion Card Reader w/ Keypad: **HID Signo 20K** series (part number to be confirmed by ITFT during design)
- Intelligent Controller: manufactured by Mercury Security - Series 3, branded Lenel **LNL-X3300**
- Two-Door Controller: manufactured by Mercury Security - Series 3, branded Lenel **LNL-1320-S3**
- Single-Door Controller: manufactured by Mercury Security - Series 3, branded Lenel **LNL-1300-S3**
- Output Board: manufactured by Mercury Security - Series 3, branded Lenel **LNL-1200-S3**
- 12VDC Power Supplies: **Altronix AL** Series (amperage to meet application requirement)
- 24VDC Power Supplies: **Altronix AL** Series (amperage to meet application requirement)
- Power Distribution: **Altronix PD** Series (port count to meet or exceed application requirement)
- Isolation Relay Modules **and ACM** Series (port count to meet or exceed the application requirement)

- ACS Panel Enclosures: **Altronix Trove** Series (sized to meet application)

Per UCOP Information Security Policy 3 requirements, all ACS data shall be encrypted.

- Card readers shall be wired to Door Controllers utilizing Open Supervised Device Protocol (OSDP), version 2 with Secure Channel mode to provide AES-128 data encryption and CMAC chaining.
- Door Controllers shall be wired to Intelligent Controllers utilizing OSDP version 2 with Secure Channel mode to provide AES-128 data encryption and CMAC chaining.
- Intelligent controllers shall be configured to utilize AES-256 encrypted Ethernet communication on UC Davis networks, as provided and provisioned by the ITFT.

DESIGN AND INSTALLATION REQUIREMENTS

ITFT, in coordination with the UC Davis Police Department, has jurisdiction over the ACS design, installation, testing, and commissioning requirements on all projects and at all buildings owned or leased by UC Davis Health.

The project ACS design shall include card reader-controlled access at locations, as identified by ITFT in coordination with UC Daivs PD and building/area users. Typical locations may be some or all the following:

- Exterior Building Entrances
- Departmental doors separating public from staff spaces
- TR, TER, EF, BDF, MPOE, Radio and IDF Rooms
- OR Integration Rooms
- EVS Rooms
- Stair Doors Leading into Floors
- Within Staff Elevator Cabs
- Med Rooms
- Nourishment Rooms
- Clean Supply Rooms
- Soiled Utility Rooms
- Staff break, locker, and sleep rooms (if within a public space)
- Pharmacy (Lenel equipment for pharmacy serves only pharmacy, separate from the rest of the building installation)
- Pharmacy ACS panels shall be installed within the controlled Pharmacy area they support.

Card reader doors shall include card readers, door position switches, electric locking devices, request-to-exit switches, and interface to automatic door operators where applicable. Card readers, door position switches, and independent request-to-exit devices (when request-to-exit devices are not provided integral with door hardware) will be specified and provided under Division 28. Electric locking devices with integral request-to-exit switches (included whenever available) will be specified and provided under Division 8. Additionally, some access control doors may be equipped with power assisted operators, which will be specified and provided under Division 8. At these locations, the operator shall be interfaced to the ACS to provide security override and automated operation of the devices. Additionally, the exterior actuator shall be configured to only function immediately following a valid card read

(remaining operational with the programmed unlock time of the door), and during any scheduled unlock times for the door.

All door position switches, and request-to-exit switches/devices shall be installed with 1K Ohm/2K Ohm end-of-line supervision resistors, installed at the switch/device, to provide 4-state monitoring of the input to the ACS. Unless otherwise noted, all electronic locks on exterior access-controlled stairwell doors shall be 24VDC fail-safe and configured to unlock on a signal from the fire alarm control panel (FACP). All other electronic door locks shall be 24VDC fail-secure. All electronic locks shall be powered from the ACS panel, except for electronic door locks that are powered locally by automatic door operators or that require local boosted power for operation. In these cases, the ACS panel will be configured to provide "dry" triggers to the applicable power source to control the lock.

Design coordination between Division 8 and Division 28 is required to provide a fully integrated design package. The demarcation between Division 28 and Division 8 shall be the door frame side of the electronic wire transfer or hinge, as provided in Division 8.

ACS design configuration shall be based on a centralized model where all field devices terminate to controllers located at ACS panel location. ACS field devices shall terminate to an ACS panel on the same floor as the device, unless approved by ITFT.

ACS panel design shall include a panel enclosure with the required 12VDC and 24VDC power supplies, power distribution modules, isolation relay modules, intelligent controller, door controllers, output modules. All modules, controllers, boards, card readers, and independent request-to-exit devices shall be powered via 12VDC service from the ACS panel 12VDC power supply. All electronic door locks shall be powered via 24VDC service from the ACS panel 24VDC power supply or be triggered by a "dry" isolation relay from the ACS panel.

One independent 120V 20Amp circuit shall be provided, per Division 26, to service each ACS panel. ACS power supplies shall be hard wired to this circuit.

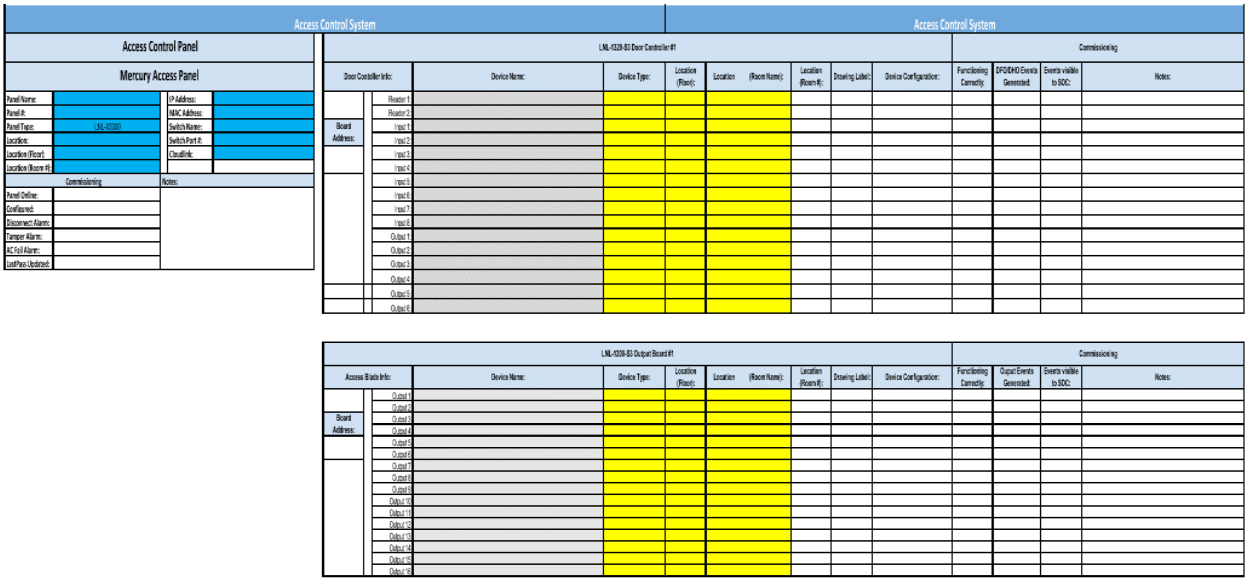
One fire alarm interface relay shall be provided in each ACS panel for interface between the FACP and the isolation relay modules so that associated electronic locks can be configured to unlock on a general fire alarm condition.

Designer/Design-Build Contractor shall complete an ACS Loading Schedule for each intelligent controller included in the project. This loading schedule shall include intelligent controller configuration data, including the IP information provided by ITFT, as well as panel specific MAC address, username and password. The loading schedule shall also include specific addressing and point-to-point termination information for all door controllers, input boards, and output boards and shall include designating information for each device or component attached to the panel, as keyed to the project drawings. The termination schedules shall also include areas to document testing and commissioning of the panel and associated boards and devices.

ACS Loading Schedules shall be completed by the Designer/Design-Build Contractor and included in the project submittals and approved by ITFT prior to beginning device installation and termination. Final "as-built" loading schedules shall be submitted and approved by ITFT at least 30 working days prior to system testing and commissioning. Once submitted to ITFT, any changes from the Contractor shall be reflected on a revised load schedule. The final "as-built" loading schedules will be used by ITFT to program the system and by the

Designer/Design-Build Contractor, ITFT, and the project commissioning agent to verify all ACS devices are installed and programmed correctly and that the operation of each devices meets the design intent and the specifications.

Sample ACS Loading Schedule:



In conjunction with each ACS Loading Schedule, the Designer/Design-Build Contractor shall create and submit for approval by ITFT an ACS voltage calculation sheet. Each sheet shall show each device type connected to the 12VDC power supply(s) associated with the panel, each device type connected to the 24VDC power supply(s) associated with the panel, the quantity of each device, the maximum current draw of each device type, the calculated total maximum current draw for each device type, and the calculated total maximum current draw for the panel. This final calculation shall be used to size the 12VDC and 24VDC panel power supplies. Power supplies shall be sized at 80% or less of the maximum total available current draw.

All ACS cabling, wiring, and termination requirements shall meet or exceed device manufacturer's written specifications and installation instructions. Horizontal cabling shall be Installed, labeled, and tested per this document and UC DAVIS HEALTH Division-27 specifications.

ACS cable labels shall be keyed to the drawings using ITFT device identification schema such that at each cable end, origination, and destination can be quickly and clearly ascertained. Labels shall be custom printed on sleeve type laminated labels. Labels shall be positioned so that it can be easily read without needing to adjust or reposition label or surrounding cabling.

Card reader labels shall be installed on the right-hand exterior side of the card reader bracket (or left-hand side if the right-hand side is not readily visible). The label shall use the ITFT device identification schema, typically the panel designation followed by the reader port assignment, as shown in the example below.



All ACS system devices, components, associated electronic locks, device wiring requirements, door elevations, device installation details, and ACS panel locations and elevations shall be shown on the project drawings and keyed to the programming and labeling standards as provided by ITFT.

INTRUSION ALARM SYSTEM INTEGRATION

All exterior perimeter access-controlled doors and select interior access-controlled doors may require interface to the Intrusion Detection System (IDS). A hardwired, local, unidirectional, input/output topology shall be utilized when an interface is required. The interface shall utilize the LNL-1200-S3 output module(s) connected to the LNL-X3300 installed in the same location as the associated Bosch alarm panel. Two relays on the output module(s) shall be assigned to each access-controlled door to provide independent monitoring of the Door Forced Alarm (associated to the first relay) and Door Held Alarm (associated to the second relay).

The ACS/IDS interface shall be wired and programmed as a Local interface (the door controller and the associated output board are wired and configured to the same intelligent controller). A Global ACS/IDS interface is not permissible.

PROGRAMMING AND CONFIGURATION

Designer/Contractor has responsibility for access control panel base configuration programming, which shall include IP information, as provided by ITFT, necessary to bring it online and make it discoverable by the access control system.

Project specific ACS programming shall be performed by ITFT, based on the "as-built" version of the ACS loading schedules, as provided by the Designer/Design-Build Contractor.

● TESTING AND COMMISSIONING

After ACS installation and programming are complete, the Designer/Design-Build Contractor shall perform a pre-commissioning test to verify all devices are installed, terminated, and configured correctly. Ten (10) days prior to the scheduled commissioning date, the Designer/Design-Build Contractor shall provide printed pre-test documentation indicating each device has been successfully tested and is in conformance with the operational intent of the project. Failure to provide pre-testing documentation will prevent commissioning from being conducted. The Designer/Design-Build Contractor shall provide a drawing with all reader locations clearly labeled and identified.

ACS Commissioning shall be performed by the Designer/Design-Build Contractor, shall be witnessed in the field by ITFT and UC Davis PD representatives, and shall be monitored and recorded by ITFT. Commissioning shall include complete testing and operational verification of all ACS devices installed and/or utilized as part of the project. Commissioning shall also include complete observational inspection to ensure devices are installed per manufacturer's instructions and per industry standards (straight/level/plumb/secure) as designed and specified. During commissioning the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After the conclusion of commissioning, the ITFT representative shall document the unsatisfactory items on a punch list of deficiencies and distribute to the Designer/Design-Build Contractor. Follow-up commissioning shall occur after all deficiencies have been rectified.

11 VIDEO SURVEILLANCE

The Video Surveillance System (VSS) at UC Davis Health is programmed, operated, and maintained by UC Davis Health Innovation Technologies, Facilities Technologies (ITFT). The following system, devices, and components shall be utilized at all UC Davis Health facilities, new and existing, owned and leased.

- Video Surveillance System Platform: **OnSSI Ocularis** - Existing
- Network Video Recorders: **Razberri** (project specific part number to be provided by ITFT) - Owner Furnished, Contractor Installed
- Fixed Interior and Exterior Video Cameras: **AXIS Communications P32 Series** - Owner Furnished, Contractor Installed
- Interior Panoramic (Fisheye) Cameras: **AXIS Communications M30/M43 Series** - Owner Furnished, Contractor Installed
- Exterior Panoramic (multi-imager) Cameras: **AXIS Communications P37/P47 Series** - Owner Furnished, Contractor Installed
- Video Camera Accessories and Mounts: **AXIS Communications** (as required per location)

DESIGN AND INSTALLATION REQUIREMENTS

ITFT, in coordination with the UC Davis Police Department, has jurisdiction over the VSS design, installation, testing, and commissioning requirements on all projects and at all buildings owned or leased by UC Davis Health.

The project VSS design shall include VSS camera coverage locations, as identified by ITFT in coordination with UC Daivs PD and building/area users. Typical locations may be some or all the following:

- Exterior view of building entries/exits
- Interior view of building entries/exits
- Exterior view of building perimeter (multi-imagers)
- Helipad
- Elevator lobbies
- Interior and exterior of all stairwell entries/exits
- Interior of elevator cabs
- Entry door for IDF/BDF/EF/MPOE and Radio Rooms if on building exterior

- Lobby areas
- Reception areas
- Point of sale locations
- Med rooms
- Pyxis machines
- Duress button locations
- Emergency Blue Light Phones
- Other locations as directed by the University

Each camera location shall include all infrastructure, conduits, cabling, and mounts required by the project.

VSS design configuration shall be based on a distributed network model where all cameras terminate on a patch panel in a TR on the same floor as the device, unless specifically approved by ITFT.

VSS NVR performance and storage requirements shall be coordinated with ITFT to meet policy requirements for field of view, focus, pixels-on-target, and video retention. All cameras shall be configured for 24/7 recording at frame and bit rates defined in policy.

The NVR shall be connected to the network switch via an intermediate ethernet patch cable. Cameras shall connect to the NVR via an intermediate patch panel at the switch and via an ethernet jack installed at the camera.

The NVR shall be powered by both normal (house) power and the facility's emergency/UPS/back-up power sources to ensure continuous operation under all conditions.

Designer/Contractor shall complete a VSS Loading Schedule for each NVR included in the project. This loading schedule shall include NVR configuration data, including the IP information provided by ITFT, as well as specific MAC address, username, and password (user name and password shall be provided by ITFT). The loading schedule shall also include specific IP addressing and point-to-point termination information for all cameras connected to the associated NVR, as keyed to the project drawings. The termination schedules shall also include areas to document testing and commissioning of the NVR and associated camera.

VSS Loading Schedules shall be completed by the Designer/Contractor and included in the project submittals and approved by ITFT prior to beginning camera installation and termination. Final "as-built" loading schedules shall be submitted and approved by ITFT at least 30 working days prior to system testing and commissioning. The final "as-built" loading schedules will be used by ITFT to program the system and by the Designer/Contractor, ITFT, and the project commissioning agent to verify all VSS devices are installed and programmed correctly and that the operation of each devices meets the design intent and specifications.

All VSS cabling and termination requirements shall meet or exceed device manufacturer's written specifications and installation instructions. Horizontal cabling may be "free run" in accessible plenum if supported by suitable hangers or trays as specified in UC DAVIS HEALTH Division-27 specifications. Horizontal cabling shall be installed in EMT through non-accessible, hard-lid, and exposed ceilings. Exposed vertical cabling shall be installed in EMT. As required by N.E.C. Vertical cabling in walls shall be installed in EMT. All conduit, regardless of type or installation

location shall be sized to accommodate no more than 40% fill, per N.E.C. and UC DAVIS HEALTH Division-27 specifications.

VSS cable labels shall be keyed to the drawings using ITFT device identification schema such that at each cable end, origination and destination can be quickly and clearly ascertained. Labels shall be custom printed on sleeve type laminated labels. Labels shall be positioned so that they can be easily read without needing to adjust or reposition label or surrounding cabling.

Camera labels shall be installed on the outer side of the camera trim ring or housing so that it can be seen and read from the ground. The label shall use the ITFT device identification schema.

All VSS cameras and NVRs, device wiring requirements, installation details, and NVR and network switch rack locations and elevations shall be shown on the project drawings and keyed to the programming and labeling standards as provided by ITFT.

PROGRAMMING AND CONFIGURATION

ITFT has responsibility for configuration and programming all cameras, which shall include IP information necessary to bring it online and make it discoverable by the VSS.

The Designer/Contractor shall install, position, and orient all cameras and associated infrastructure in accordance with the project drawings and ITFT standards. IT Facilities Technologies (ITFT) shall perform all NVR configuration and programming in alignment with UC Davis Health IT security and performance requirements, based on the approved “as-built” VSS loading schedules.

TESTING AND COMMISSIONING

After VSS installation and programming are complete, the Designer/Contractor shall perform a pre-commissioning test to verify all cameras and NVRs are installed, terminated, and configured correctly. Ten (10) days prior to the scheduled commissioning date, the Designer/Contractor shall provide printed pre-test documentation indicating each camera and NVR has been successfully tested and is in conformance with the operational intent of the project. Failure to provide pre-testing documentation will prevent commissioning from being conducted.

VSS Commissioning shall be performed by the Designer/Design-Build Contractor, shall be witnessed in the field by ITFT and UC Davis PD representatives, and shall be monitored and recorded by ITFT. Commissioning shall include a complete observational inspection to ensure all cameras are installed per manufacturer's instructions and per industry standards (straight/level/plumb/secure) as designed and specified. Commissioning shall also include verification of all live and recorded camera views, and verification that all camera recording parameters are set and functioning to meet the guidelines and specifications. During commissioning the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After the conclusion of commissioning, the ITFT representative shall document the unsatisfactory items on a punch list of deficiencies and distribute to the Designer/Design-Build Contractor. Follow-up commissioning shall occur after all deficiencies have been rectified.

12 INTRUSION

The Intrusion Detection System (IDS) at UC Davis Health is operated and maintained by UC Davis Health Innovation Technologies, Facilities Technologies (ITFT), and programmed and configured by the Designer/Contractor. The following system, devices, and components shall be utilized at all UC Davis Health facilities, new and existing, owned and leased.

- Central Station: **Surgard System III Receiver** - existing - Operated by UC Davis PD 911 Dispatch
- Alarm Panel: **Bosch B9512G**
- Alarm Panel Power Supply: **Bosch D1640**
- Alarm Panel Expansion Module: **Bosch B208** Octo-Input Module
- Alarm Keypad: **Bosch B930**
- Glass Break Detector: **Honeywell FG-730**, or equal based on performance and application
- Motion Detector: **Bosch ISC-BPQ2-W12**, or equal based on performance and application
- Panic/Robbery Button: **Honeywell 270R**, or equal based on performance and application
- Alarm Contact/Door Position Switch: **Interlogix (GE/Sentrol)**, model suited to application, or equal based on performance

DESIGN AND INSTALLATION REQUIREMENTS

ITFT, in coordination with the UC Davis Police Department, has jurisdiction over the IDS design, installation, testing, and commissioning requirements on all projects and at all buildings owned or leased by UC Davis Health.

The project IDS design shall include IDS intrusion devices and panic/robbery button locations, as identified by ITFT in coordination with UC Daivs PD and building/area users. Typical locations by device type, may be some or all the following:

Alarm Contact/Door Position Switch

- Exterior building entrances/exits when equipped with a card reader, via hardwired input/output (I/O) interface with the ACS
- Exterior building exits and emergency exits when not equipped with a card reader
- Exterior building doors, typically electrical rooms, mechanical rooms, and storage areas when not equipped with a card reader
- Sensitive interior area/room entrance/exit when equipped with a card reader, via hardwired I/O interface with the ACS
- Sensitive interior area/room entrance/exit when not equipped with a card reader
- Interior electrical rooms and storage areas when not equipped with a card reader
- Roof access hatches
- Other locations as directed by the University

Glass Break Detectors and Motion Sensors

- Glass break detectors to monitor ground floor perimeter windows and storefronts
- Glass break detectors to monitor perimeter windows and storefronts of sensitive interior areas, excluding laboratories
- Motion detectors to monitor perimeter windows and storefronts of sensitive interior areas, where glassware commonly used, such as laboratories
- Other locations as directed by the University

Panic/Robbery Buttons

- Cash handling registers and areas
- Patient interview rooms
- Pharmaceutical areas
- Select nursing stations
- Other locations as directed by the University

IDS design configuration shall be based on an account area model where all field devices covering areas in a specific departmental or administrative area terminate to a panel in the area.

IDS panel design shall include a panel enclosure with the required 12VDC power supplies, power distribution modules, expansion modules, and an alarm keypad for programming and control. The alarm panel and expansion modules, keypads, and field devices that require power shall be powered via 12VDC service from the IDS panel 12VDC power supply.

One independent 120V 20Amp UPS circuit shall be provided, per Division 26, to service each IDS panel. IDS power supplies shall be hard wired to this circuit.

Designer/Contractor shall complete an IDS Loading Schedule for each alarm panel included in the project. This loading schedule shall include alarm panel configuration data, including the analog (POTS) phone line and IP information provided by ITFT, as well as panel specific MAC address, username and password. The loading schedule shall also include specific addressing and point-to-point termination and designation information for all expansion modules, keypads, and field devices, as keyed to the project drawings. The termination schedules shall also include areas to document testing and commissioning of the alarm panel and associated devices.

IDS Loading Schedules shall be completed by the Designer/Contractor and included in the project submittals and approved by ITFT prior to beginning device installation and termination. Final "as-built" loading schedules shall be submitted and approved by ITFT at least 30 working days prior to system testing and commissioning. The final "as-built" loading schedules will document the contractor programming, as coordinated with ITFT, and be used by the Designer/Contractor, ITFT, and the project commissioning agent to verify all IDS devices are installed and programmed correctly and that the operation of each devices meets the design intent and the specifications.

All IDS cabling, wiring, and termination requirements shall meet or exceed device manufacturer’s written specifications and installation instructions. Horizontal cabling may be "free run" in accessible plenum if supported by suitable hangers or trays as specified in UC DAVIS HEALTH Division-27 specifications. Horizontal cabling shall be installed in EMT through non-accessible, hard-lid, and exposed ceilings. Exposed vertical cabling shall be installed in

EMT. As required by N.E.C. Vertical cabling in walls shall be EMT. All conduit, regardless of type or installation location shall be sized to accommodate no more than 40% fill, per N.E.C. and UC DAVIS HEALTH Division-27 specifications.

IDS cable labels shall be keyed to the drawings using ITFT device identification schema such that at each cable end, origination and destination can be quickly and clearly ascertained. Labels shall be custom printed on sleeve or flag type laminated labels. Labels shall be positioned so that they can be easily read without needing to adjust or reposition label or surrounding cabling.

All IDS system panels, modules, keypads, and field devices shall be shown on the project drawings and keyed to the programming and labeling standards as provided by ITFT. IDS specific "as-builts" shall be submitted by the Designer/Contractor in conjunction with the "as-built" loading schedules for review and approval by ITFT prior to Testing and Commissioning.

PROGRAMMING AND CONFIGURATION

Designer/Contractor has responsibility for all IDS programming, coordination of analog (POTS) phone line connection and IP information, as provided by ITFT, necessary to bring the panel online and make it discoverable by the Surgard System III receiver in the UC Davis PD Dispatch Center.

ACCESS CONTROL SYSTEM INTEGRATION

All exterior perimeter access-controlled doors and select interior access-controlled doors may require interface to the Intrusion Detection System (IDS). A hardwired, local, unidirectional, input/output topology shall be utilized when an interface is required. The interface shall utilize outputs from the ACS panel, installed in the same location as the associated IDS alarm panel. Two relays from the output module(s) shall be assigned to each access-controlled door. Each of these outputs shall be wired to individual inputs on the IDS alarm panel or expansion module to provide independent monitoring of the Door Forced Alarm and Door Held Alarm from each associated door in the ACS.

TESTING AND COMMISSIONING

After IDS installation and programming are complete, the Designer/Contractor shall perform a pre-commissioning test to verify all devices are installed, terminated, and configured correctly. Ten (10) days prior to the scheduled commissioning date, the Designer/Contractor shall provide printed pre-test documentation indicating each device has been successfully tested and is in conformance with the operational intent of the project. Failure to provide pre-testing documentation will prevent commissioning from being conducted. The Contractor shall provide a zone list of all devices and a corresponding map clearly indicating the locations of all zones.

IDS Commissioning shall be performed by the Designer/Design-Build Contractor, shall be witnessed in the field by ITFT and UC Davis PD representatives, and shall be monitored and recorded by ITFT. Commissioning shall include complete testing and operational verification of all IDS devices installed and/or utilized as part of the project. Commissioning shall also include complete observational inspection to ensure devices are installed per manufacturer's instructions and per industry standards (straight/level/plumb/secure) as designed and specified. During commissioning the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After the conclusion of commissioning, the ITFT representative shall document the

unsatisfactory items on a punch list of deficiencies and distribute to the Designer/Contractor. Follow-up commissioning shall occur after all deficiencies have been rectified.

13 PATIENT SECURITY (HUGS PATIENT ELOPEMENT SYSTEM)

The HUGS-Patient Elopement System (HUGS-PES) at UC Davis Health is programmed, operated and maintained by UC Davis Health Innovation Technologies, Facilities Technologies (ITFT), through the sole-source vendor, Securitas Healthcare. The following system, devices, and components shall be utilized at all UC Davis Health facilities, new and existing, owned and leased.

- Software:
  - **AeroScout Location Engine for Cisco Environment (ENG-8500)**
  - **MobileView Hugs Enterprise Infant Protection Software License (MVINFS-1000-L300)**
  - **License for MobileView High Availability (MVHA-2200)**
- Indoor Exciter: **EX-3220**
- Long Range Exciter: **EX5200**
- Controller: **EX5500**
- External LF Antenna: **ANT4210**
- Hugs Wi-Fi Tag: **TAG-HGS-1000-C**
- Hugs Wi-Fi Tag Charger: **CGS-HGS-1000-U**
- Standard Exciter Mounting Kit: **EXAC-STD-1000**
- Heavy Duty, Off-Grid, Exciter Mounting Kit: **EXAC-HDUTY-1000**
- Wall Mount Bracket for EX5500 and EX5200 Exciters: **EXAC-143**
- Low Voltage Power Supplies: **per project requirements**
- Hugs - Patient Protection Band, 100 Pack: **per project requirements**
- Project Based Professional Services: **as required and detailed by vendor**

13.1 DESIGN AND INSTALLATION REQUIREMENTS

ITFT, in coordination with Securitas Healthcare and the Department of Health Care Access and Information (HCAI), has jurisdiction over the HUGS-PES design, installation, testing, and commissioning requirements on all projects and at all buildings owned or leased by UC Davis Health.

The project HUGS-PES design shall include project specific software, field hardware, infant/patient tags and professional and construction services provided on a per project basis through Securitas Healthcare. In general, HUGS-PES devices will be installed to secure the perimeter area where risk of infant abduction or patient elopement are present. Excited and antennae will be installed at portals on the perimeter of the space. These devices activate infant/patient tags when an individual with one of these tags approaches or passes through the portal. Interface with the access control system (ACS) door position switches may be required as well. At these locations, the ACS will utilize double-pole, double throw door contacts with one pole connected to the ACS and the other connected to HUGS-PES.

Dedicated workstations shall be provided on the clinical units for HUGS monitoring, and a dedicated PC shall be provided in the TR to manage audio volume levels for the HUGS system on the unit.

Power and Redundancy Requirements:

All HUGS-PES controllers, servers, and associated network components shall be connected to emergency power circuits with UPS backup in accordance with UC Davis Health IT and Facilities standards. Workstations and monitoring PCs shall maintain continuous operation during transfer to generator power through uninterruptible power supplies. The HUGS-PES software server shall reside on redundant or virtualized infrastructure that supports automatic failover and data recovery, and network connectivity between HUGS-PES devices, servers, and monitoring stations shall be designed with redundant communication paths to ensure continuous operation in the event of component failure.

Regulatory and Compliance Requirements

The HUGS-PES infant protection system shall comply with all applicable codes and standards governing healthcare safety and electrical systems, including but not limited to NFPA 70 (National Electrical Code), NFPA 99 (Health Care Facilities Code), Joint Commission Environment of Care standards, and HCAI (Health Care Access and Information) requirements for essential electrical systems. All equipment, installation, and testing shall conform to UC Davis Health IT and Facilities standards and any other regulatory agency requirements applicable to patient-protection and life-safety systems.

During commissioning, the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After commissioning is concluded, the ITFT representative shall document these items on a punch list of deficiencies. Follow-up commissioning shall be performed at the request of HCAI.

All HUGS-PES cabling, wiring, and termination requirements shall meet or exceed device manufacturer’s written specifications and installation instructions. Horizontal cabling may be "free run" in accessible plenum if supported by suit hangers or trays as specified in Division 27. Horizontal cabling shall be installed in EMT through non-accessible, hard-lid, and exposed ceilings. Exposed vertical cabling shall be installed in EMT or rigid conduit, as required by N.E.C. Vertical cabling in walls shall be EMT or flexible metal conduit. All conducts, regardless of type or installation location, shall be sized to accommodate no more than 40% fill, per N.E.C.

HUGS-PES cable labels shall be keyed to the drawings using ITFT device identification schema such that at each cable end, origination and destination can be quickly and clearly ascertained. Labels shall be custom printed on sleeve or flag type laminated labels. Labels shall be positioned so that it can be easily read without needing to adjust or reposition labels or surrounding cabling.

All HUGS-PES system devices and components, device wiring requirements, and device installation details, shall be shown on the project drawings and keyed to the programming and labeling standards as provided by ITFT.

13.2 PROGRAMMING AND CONFIGURATION

Project-specific programming and configuration of the HUGS-PES infant protection system shall be performed by an authorized system vendor in coordination with IT Facilities Technologies (ITFT). Final programming shall reflect the

as-built locations of all exciters, workstations, and associated equipment, as well as the approved loading schedules and any authorized integration or configuration requirements. ITFT shall review and validate the final programming prior to system acceptance.

13.3 TESTING AND COMMISSIONING

After HUGS-PES installation and programming are complete, Securitas Healthcare and TSI, in coordination with IT Facilities Technologies (ITFT), shall perform a pre-commissioning site survey to verify that all exciters, tags, and associated devices are installed, communicating, and functioning as intended. Following the site survey, a pre-commissioning test shall be conducted to confirm that all devices are installed, terminated, and configured correctly. Ten (10) days prior to the scheduled commissioning date, the Designer/Design-Build Contractor shall provide printed pre-test documentation indicating that each device has been successfully tested and is in conformance with the operational intent of the project.

HUGS-PES commissioning shall be performed by Securitas Healthcare, TSI, and ITFT, and shall be witnessed in the field by a representative from HCAI. Commissioning shall include complete testing and operational verification of all HUGS-PES devices installed and/or utilized as part of the project, as well as a comprehensive observational inspection to ensure all devices are installed in accordance with manufacturer instructions and industry standards (straight, level, plumb, and secure) as designed and specified.

14 MATV

The Master Antenna Television System (MATV) at UC Davis Health is operated and maintained by UC Davis Health Innovation Technologies, Facilities Technologies (ITFT). The following system, devices, and components are owner furnished, contractor installed (OFCI), and shall be utilized at UC Davis Health facilities, new and existing, owned and leased.

- MATV Platform: **Dish SmartBox**
- System and Device Components include the following:
    - Dish SmartBox
    - Satellite Distribution Amplifiers
    - Quadrature Amplitude Modulators (QAM) - single, quad, and 48-channel
    - Digital to analog converters
    - HMMS CATV mini modulators
    - ENSEO set back boxes
    - HDMI to RCA converters
    - Output mixers
    - BT AMCM analog modulators
    - COAX splitters
    - Fiber-Optic splitters
    - Optical amplifiers
    - Optical receivers
    - Television wall mount brackets

- Television displays

Contractor support and installation requirements include conduit and cabling as defined by the project documents to support the installation and connection of the above OFCI devices and components.

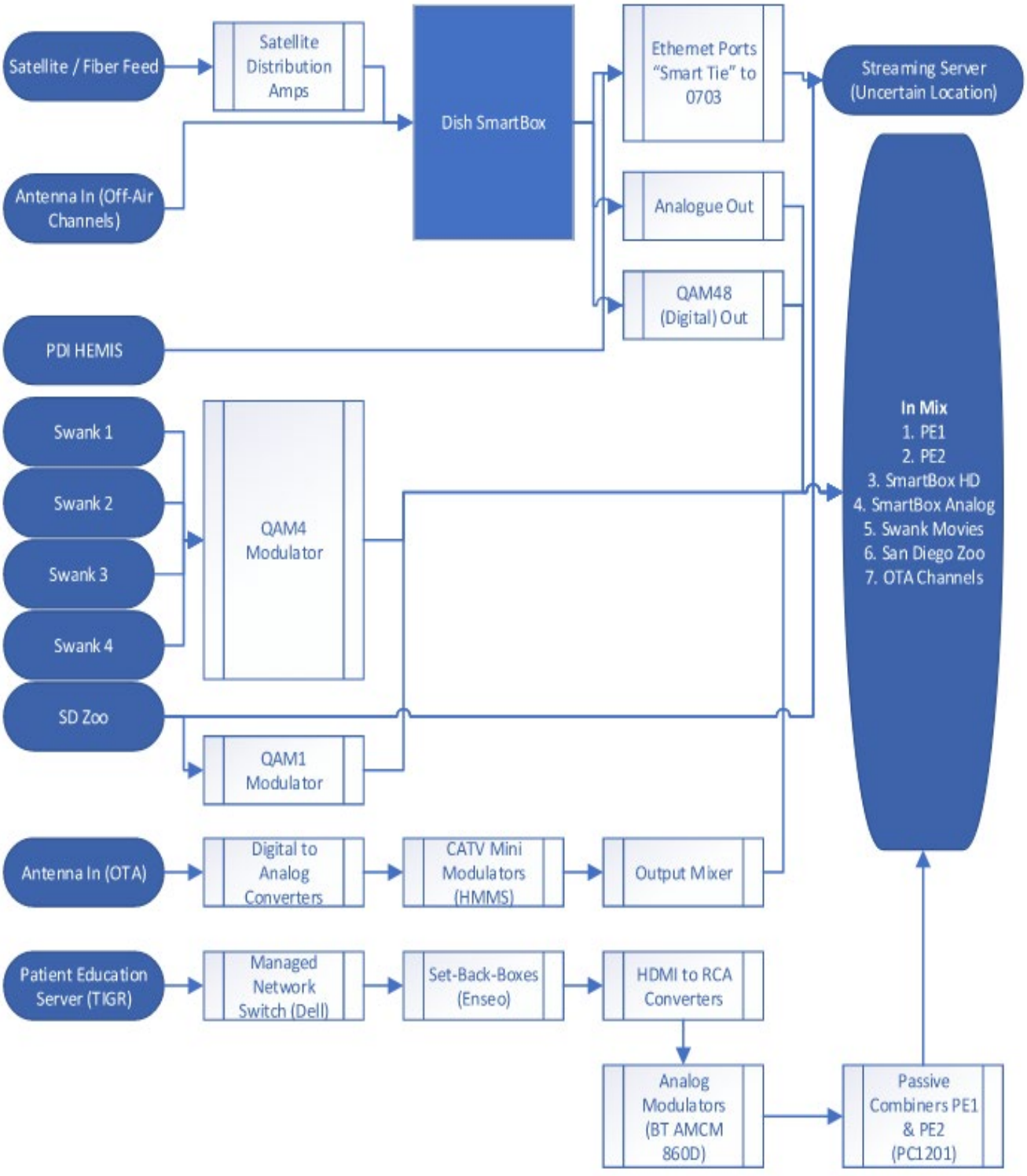
14.1 DESIGN AND INSTALLATION REQUIREMENTS

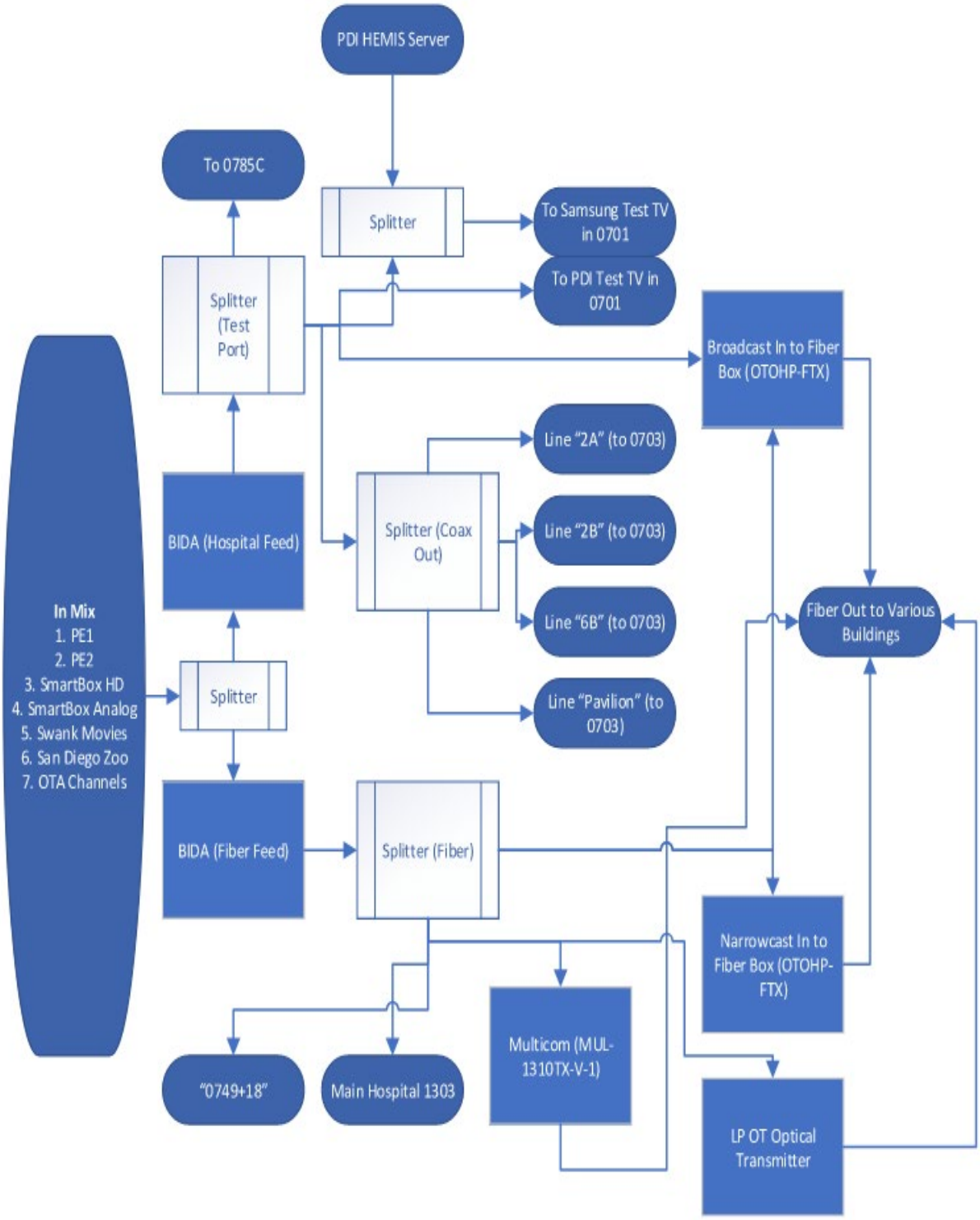
ITFT, in coordination with building/area users, has jurisdiction over the MATV design, installation, testing, and commissioning requirements on all projects and at all buildings owned or leased by UC Davis Health.

The project MATV design shall include television and supporting devices at locations identified by ITFT in coordination building/area users. Typical locations may be some or all the following:

- Patient Rooms
- Waiting Areas
- Dining Areas
- Staff Lounges
- And other areas as defined by ITFT

MATV design shall include some or all the system and device components listed previously and shown on the Expanded Connect System Over Diagrams below.


Satellite / Fiber Feed
Satellite Distribution Amps
Dish SmartBox
Ethernet Ports "Smart Tie" to 0703
Streaming Server (Uncertain Location)
Antenna In (Off-Air Channels)
Analogue Out
QAM48 (Digital) Out
PDI HEMIS
Swank 1
Swank 2
Swank 3
Swank 4
QAM4 Modulator
SD Zoo
QAM1 Modulator
In Mix
1. PE1
2. PE2
3. SmartBox HD
4. SmartBox Analog
5. Swank Movies
6. San Diego Zoo
7. OTA Channels
Antenna In (OTA)
Digital to Analog Converters
CATV Mini Modulators (HMMS)
Output Mixer
Patient Education Server (TIGR)
Managed Network Switch (Dell)
Set-Back-Boxes (Enseo)
HDMI to RCA Converters
Analog Modulators (BT AMCM 860D)
Passive Combiners PE1 & PE2 (PC1201)


PDI HEMIS Server
To 0785C
Splitter
To Samsung Test TV in 0701
To PDI Test TV in 0701
Splitter (Test Port)
Broadcast In to Fiber Box (OTOHP-FTX)
Line "2A" (to 0703)
BIDA (Hospital Feed)
Splitter (Coax Out)
Line "2B" (to 0703)
Line "6B" (to 0703)
Fiber Out to Various Buildings
In Mix
1. PE1
2. PE2
3. SmartBox HD
4. SmartBox Analog
5. Swank Movies
6. San Diego Zoo
7. OTA Channels
Splitter
Line "Pavilion" (to 0703)
BIDA (Fiber Feed)
Splitter (Fiber)
Narrowcast In to Fiber Box (OTOHP-FTX)
Multicom (MUL-1310TX-V-1)
"0749+18"
Main Hospital 1303
LP OT Optical Transmitter

MATV cabling shall include, but not be limited to, RG-6 coax (for runs less than 100'), RG-11 coax (for runs greater than 100'), SM and MM fiber, various interconnection cables, as defined by the project documents. All MATV cabling, wiring, and termination requirements shall meet or exceed device manufacturer's written specifications and installation instructions. Horizontal cabling may be "free run" in accessible plenum if supported by suit hangers or trays as specified in Division 27. Horizontal cabling shall be installed in EMT through non-accessible, hard-lid, and exposed ceilings. Exposed vertical cabling shall be installed in EMT or rigid conduit, as required by N.E.C. Vertical cabling in walls shall be EMT or flexible metal conduit. All conduit, regardless of type or installation location shall be sized to accommodate no more than 40% fill, per N.E.C.

MATV cable labels shall be keyed to the drawings using ITFT device identification schema such that at each cable end, origination and destination can be quickly and clearly ascertained. Labels shall be custom printed on sleeve or flag type laminated labels. Labels shall be positioned so that it can be easily read without needing to adjust or reposition label or surrounding cabling.

All MATV system and device components and device installation details shall be shown on the project drawings and keyed to the programming and labeling standards provided by ITFT.

14.2 PROGRAMMING AND CONFIGURATION

ITFT has responsibility for all MATV programming and configuration necessary to bring all system and device components online and operational.

14.3 TESTING AND COMMISSIONING

MATV Commissioning shall be performed by the Designer/Design-Build Contractor and ITFT and shall be witnessed in the field by ITFT and building/area representatives. Commissioning shall include complete testing and operational verification of all MATV devices installed and/or utilized as part of the project. Commissioning shall also include complete observational inspection to ensure devices are installed per manufacturer's instructions and per industry standards (straight/level/plumb/secure) as designed and specified. During commissioning the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After the conclusion of commissioning, the ITFT representative shall document the unsatisfactory items on a punch list of deficiencies and distribute them to the Designer/Design-Build Contractor. Follow-up commissioning shall occur after all deficiencies have been rectified.

15 PUBLIC ADDRESS

15.1 INTRODUCTION

This section defines the design and performance criteria for the Overhead Paging (OHP) System implemented across University of California Davis Health facilities where public address or emergency paging are required. The OHP system shall be deployed as a standardized IP-based platform integrated within the UC DAVIS HEALTH network architecture and managed by IT Facilities Infrastructure Cabling Services, Unified Coms Voice Engineering and Voice Services.

The system shall utilize Power over Ethernet Plus (PoE+) IP speakers as the primary endpoint devices. Each speaker shall incorporate ambient noise sensing to dynamically adjust output levels for consistent audibility across varying environmental conditions. The OHP infrastructure shall support zone-based announcements, emergency code calls, and streaming content through integration with Informacast and compatible paging adapters.

Each IP speaker shall support the cascading of up to three (3) satellite speakers, where such configurations are required to ensure full acoustic coverage in large or distributed spaces. Speakers shall be self-amplified and individually addressable via the network, eliminating the need for traditional analog amplifiers or separate 70-volt distribution systems.

The system design shall also incorporate fire alarm shunt functionality for life safety integration, device management via the ALGO ADMP (Algo Device Management Platform) for centralized configuration and mass firmware updates, and standardized 8301 paging adapters per floor (one per building for facilities three floors or less). All devices and associated infrastructure shall comply with NFPA 72/99, ANSI/TIA-1179, BICSI 007, and UC DAVIS HEALTH IT Facilities Division 27 specifications.

15.2 SYSTEM OVERVIEW

The Overhead Paging (OHP) system is built on the Informacast platform, which integrates with Cisco Call Manager through a SIP (Session Initiation Protocol) trunk. This integration enables seamless communication between the VoIP infrastructure and paging endpoints.

The system utilizes IP speakers to deliver clear and intelligible announcements throughout the facility, providing the flexibility to support both clinical and non-clinical environments within the hospital.

All endpoints connect to the ALGO ADMP server, which is managed by UC DAVIS HEALTH IT. The ADMP server provides centralized management, allowing IT staff to deploy configurations, push firmware updates, and monitor device performance across the network in real time.

- Speakers: High-quality speakers designed for IP PoE+ operation shall be strategically placed throughout the facility to ensure even coverage and optimal audio quality. All speakers shall include ambient noise detection to automatically adjust volume based on surrounding sound levels.

- Paging Controller (Informacast): Centralized control platform for initiating announcements, managing volume levels, and monitoring system status.

- Audio Sources: The system shall be capable of integrating with multiple audio sources, including telephony systems, background music sources, pre-recorded announcements, and emergency alert systems. Control shall be provided through Informacast and integrated with Cisco Call Manager to support voice announcements and code calls. The system shall also support streaming content. Emergency systems (fire) shall not use the paging platform.

- Wiring and Cabling: Network cabling shall be properly routed, supported, and terminated on modular patch panels in the nearest Telecommunications Room (TR). Cabling infrastructure shall be designed and installed to ensure optimal performance and support PoE+ power delivery.

- Network Connectivity:
    - The Overhead Paging System shall integrate with the UC DAVIS HEALTH network through Cisco Call Manager using SIP (Session Initiation Protocol) to support IP-based paging and announcements.
    - All paging endpoints, including IP speakers, adapters, and controllers, shall reside on the designated Voice VLAN as defined by UC DAVIS HEALTH Unified Comms.
    - Endpoints shall receive DHCP reservations as directed by Voice Engineers standards to ensure stable communication and device traceability.
    - All network-connected endpoints shall be powered using PoE+ compliant network switches, ensuring sufficient power delivery for IP speakers and associated peripherals.
    - Network configuration, switch port settings, and VLAN tagging shall comply with UC DAVIS HEALTH network security and segmentation policies.

15.3 SYSTEM ARCHITECTURE

The Overhead Paging (OHP) system follows a distributed IP-based architecture, designed to ensure reliability, scalability, and seamless integration across all UC Davis Health facilities. The architecture leverages enterprise-grade network infrastructure, redundant paging controllers, and managed IP endpoints to deliver consistent coverage and intelligibility in all clinical and non-clinical areas.

System Topology and Core Components:

- Paging Controllers (Informacast): Primary and secondary Informacast servers are hosted in the ASB and Quincy data centers, communicating through the Cisco Unified Communications Manager (CUCM) core in ASB and Davis Tower. These controllers manage all multicast paging traffic and coordinate announcements by zone.
- Network Distribution: Within hospital facilities, paging traffic traverses the existing UC DAVIS HEALTH network backbone through core switches located in TR 2P609 and TR 0P715, extending to user access switches in each Telecommunications Room (TR). Each TR serves as the network demarcation point for OHP zones and endpoints.
- ALGO 8301 Paging Adapters: One adapter shall be installed per floor (or one per building for facilities three floors or fewer). These devices connected to a fire alarm relay enable fire alarm shunt integration per CFC and NFPA 72, providing an automatic mute signal to OHP zones when a fire alarm is active on that floor and adjacent levels.
- Speakers and Satellite Runs: ALGO 8198-IC IP speakers shall serve as main paging endpoints. Each main speaker may cascade up to three (3) satellite speakers via daisy-chained patch cables, with a termination dongle required at the end of each satellite run to maintain impedance and signal balance.
- Cable Infrastructure: Horizontal cabling between speakers and network switches shall be routed through approved J-hook pathways or cable trays per UC DAVIS HEALTH Division 27 specifications. Cabling shall terminate on modular patch panels in the serving TR.
- Management and Monitoring: All paging adapters and speakers shall register with the ALGO ADMP (Algo Device Management Platform) for centralized control. UC DAVIS HEALTH IT shall use the ADMP to manage configurations, deploy firmware updates, monitor device status, and perform remote troubleshooting.

- Power and Redundancy:
  - All paging endpoints, adapters, and controllers shall receive PoE+ power from managed network switches. Telecommunications Rooms (TRs) housing paging equipment shall be supported by both Uninterruptible Power Supply (UPS) and Emergency Power (E-Power) sources to maintain operation during utility loss.
  - The Overhead Paging (OHP) system is classified as a critical communication system under NFPA 99 and NFPA 72 and shall maintain a minimum operational uptime of 99.99%. Power backup design shall ensure the system remains functional for at least 24 hours of standby and 15 minutes of full-load operation during an emergency event or power interruption, in compliance with NFPA 72.
  - All power systems supporting the OHP infrastructure shall be verified during commissioning to confirm redundancy, automatic transfer operation, and alarm supervision per UC DAVIS HEALTH IT Facilities standards.
- Network and VLAN Configuration:
  - All OHP devices shall reside on the Voice VLAN assigned by UC DAVIS HEALTH Unified Communications (UC).
  - Multicast traffic for Informacast paging shall be properly segmented and permitted within the paging VLAN.
  - All devices shall use DHCP reservations as defined by UC Voice Engineering.
  - Network switches supporting OHP devices shall follow UC DAVIS HEALTH network security hardening and segmentation policies, including port control and storm suppression.

15.4 ADDITIONAL DESIGN AND INSTALLATION REQUIREMENTS

The Public Address (PA) system shall include the following additional design and installation provisions to ensure coverage, reliability, and operational integration:

- All workrooms shall be equipped with main overhead paging speakers to ensure consistent paging audibility throughout the area.
- Speaker placement and volume levels shall allow for proper sound adjustment specific to each workroom, maintaining clear and intelligible paging without interfering with normal operations.
- Each main IP speaker may support up to three (3) satellite speakers in a cascaded configuration. However, the use of satellite extensions shall be limited by the physical separation of spaces and variations in ambient sound conditions. Satellite connections shall not extend across acoustically isolated areas, such as elevator lobbies, corridors divided by normally closed doors, or zones with differing ambient noise levels or foot traffic patterns. This restriction exists because satellite speakers replicate the configuration, output level, and ambient noise response of the main speaker to which they are connected. Therefore, satellite speakers shall only be installed in contiguous areas sharing similar acoustic and environmental characteristics to ensure consistent paging volume, clarity, and automatic volume adjustment accuracy.
- All ceiling-mounted speakers installed in suspended ceiling tiles shall utilize ceiling tiles brackets to distribute the speaker load across the T-bar grid and prevent tile deflection, cracking, or sagging, in

accordance with CBC Title 24 non-structural seismic restraint requirements and NFPA 99/HCAI (OSHPD) guidelines for ceiling-mounted equipment in healthcare facilities.

- All speakers shall be securely mounted to the ceiling grid or structural ceiling using approved hardware, with a secondary safety wire anchored to building structure, in accordance with CBC Title 24.
- Fire alarm shunt integration shall be provided where applicable to mute overhead paging during emergency events, in compliance with NFPA 72.
- Paging audibility shall be calibrated to maintain a minimum of 15 dB above ambient noise, as required by NFPA 72. Ambient noise readings shall be taken and recorded during commissioning.
- Speakers and associated cabling shall be labeled per UC DAVIS HEALTH Division 27 specifications.
- Final testing shall verify tone clarity, message intelligibility (STI ≥ 0.7), and proper zone association directed by UC DAVIS HEALTH IT.
- All test results shall be documented and submitted to UC DAVIS HEALTH IT for review and approval prior to project closeout.
- Any deficiencies identified during testing shall be corrected and re-tested to confirm compliance with UC DAVIS HEALTH standards and manufacturer recommendations.
- Provide one ALGO 8199 Surface Mount IP PoE+ Speaker in every Telecommunications Room (TR).
- In large open or wide areas, use main vs. satellite speaker configurations to optimize acoustic coverage and minimize echo.

15.5 INTERACTIONS AND WORKFLOWS

The typical interactions and workflows within the Overhead Paging (OHP) system are outlined below. These workflows define how announcements are initiated, routed, managed, and maintained across the UC DAVIS HEALTH network.

- Authorized personnel shall access the Informacast paging interface or dial assigned SIP extensions from authorized IP phones to initiate live or pre-recorded announcements.
- The Informacast paging controller shall route audio through the Cisco Call Manager using SIP (Session Initiation Protocol) and multicast streams to deliver announcements to the designated paging zones or departments via the UC DAVIS HEALTH LAN.
- ALGO IP speakers shall broadcast audio announcements and code calls within their defined coverage areas, automatically adjusting output levels using integrated ambient-noise sensing to maintain speech intelligibility in all acoustic conditions.
- UC DAVIS HEALTH IT shall access the ALGO ADMP (Algo Device Management Platform) to centrally monitor, manage, and troubleshoot all IP speakers and paging adapters. The ADMP shall be used to push firmware updates, deploy device configurations, and perform remote diagnostics to ensure system reliability and consistency across all networked endpoints.
- UC DAVIS HEALTH Voice Engineers shall configure ALGO 8301 Paging Adapters to enable Overhead Paging (OHP) shunt capabilities, ensuring proper interaction with the building Fire Alarm Control Panel (FACP) in compliance with NFPA 72 and UC DAVIS HEALTH life-safety standards. When an active fire alarm is triggered, the OHP system shall automatically mute paging audio on the affected floor and adjacent floors.

- All paging traffic shall traverse the designated Voice VLAN managed by UC DAVIS HEALTH Unified Communications (UC). Each endpoint shall receive DHCP reservations as defined by UC standards, maintaining traceability and secure device authentication within the UC DAVIS HEALTH network.
- Routine verification, firmware alignment, and endpoint synchronization shall be performed through the ADMP interface in coordination with UC DAVIS HEALTH IT Facilities ICS. Field technicians shall verify tone clarity, zone mapping, and message intelligibility (STI ≥ 0.7) during commissioning and maintenance cycles.

16 MASTER CLOCK

The Master Clock System (MCS) at UC Davis Health is operated and maintained by UC Davis Health Innovation Technologies, Facilities Technologies (ITFT). The following system, devices, and components shall be utilized at UC Davis Health facilities, new and existing, owned and leased.

- MCS Platform: **Primex OneVue**
- System and Device Components include the following:
    - PoE Analog Clocks - Traditional Series
    - PoE Analog Clocks - Slim Metal Series

Contractor support and installation requirements include providing and installing new clocks and conduit and cabling to support clock connectivity as defined by the project documents.

16.1 DESIGN AND INSTALLATION REQUIREMENTS

ITFT, in coordination with building/area users, has jurisdiction over the MCS design, installation, testing, and commissioning requirements on all projects and at all buildings owned or leased by UC Davis Health.

MCS cabling shall include ethernet network cabling as specification in Division 27.

All MCS clock installation details shall be shown on the project drawings and keyed to the programming and labeling standards provided by ITFT.

Each clock location shall include all infrastructure, conduits, cabling, and mounts required by the project.

MCS design configuration shall be based on a distributed network model where all clocks terminate to the nearest PoE+ network switch in the TR room on the same floor as the device, unless specifically approved by ITFT.

All MCS clocks terminating in a TR shall be on UPS power.

All MCS cabling and termination requirements shall meet or exceed device manufacturer’s written specifications and installation instructions. Horizontal cabling may be "free run" in accessible plenum if supported by suitable hangers or trays as specified in Division 27. Horizontal cabling shall be installed in EMT through non-accessible, hard-lid, and exposed ceilings. Exposed vertical cabling shall be installed in EMT or rigid conduit, as required by N.E.C. Vertical cabling in walls shall be EMT or flexible metal conduit. All conduit, regardless of type or installation location shall be sized to accommodate no more than 40% fill, per N.E.C.

Designer/Contractor shall complete a MCS Loading Schedule for the project. This loading schedule shall include clock configuration data, including the IP information provided by ITFT, as well as specific MAC address, username and password. The loading schedule shall also include specific IP addressing and point-to-point termination information for all clocks connected to the associated network switch, as keyed to the project drawings. The termination schedules shall also include areas to document testing and commissioning of the MCS clocks.

MCS cable labels shall be keyed to the drawings using ITFT device identification schema such that at each cable end, origination and destination can be quickly and clearly ascertained. Labels shall be custom printed on sleeve or flag type laminated labels. Labels shall be positioned so that they can be easily read without needing to adjust or reposition label or surrounding cabling.

16.2 PROGRAMMING AND CONFIGURATION

Designer/Contractor has responsibility for configuring all clocks, which shall include IP information, as provided by ITFT, necessary to bring the clock online and make it discoverable by the MCS.

16.3 TESTING AND COMMISSIONING

MCS Commissioning shall be performed by the Designer/Design-Build Contractor and shall be witnessed In the field by ITFT. Commissioning shall include a complete observational inspection to ensure all cameras are installed per manufacturer's instructions and per industry standards as designed and specified. During commissioning the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After the conclusion of commissioning, the ITFT representative shall document the unsatisfactory items on a punch list of deficiencies and distribute to the Designer/Contractor. Follow-up commissioning shall occur after all deficiencies have been rectified.

16.4 PROGRAMMING AND CONFIGURATION

ITFT has responsibility for all MCS programming and configuration necessary to bring all system and device components online and operational.

16.5 TESTING AND COMMISSIONING

MCS Commissioning shall be performed by the Designer/Design-Build Contractor and ITFT and shall be witnessed in the field by ITFT and building/area representatives. Commissioning shall include complete testing and operational verification of all MCS devices installed and/or utilized as part of the project. Commissioning shall also include complete observational inspection to ensure devices are installed per manufacturer's instructions and per industry standards (straight/level/plumb/secure) as designed and specified. During commissioning the ITFT representative shall record all items found to be in an unsatisfactory state, either functionally or aesthetically. After the conclusion of commissioning, the ITFT representative shall document the unsatisfactory items on a punch list of deficiencies and distribute them to the Designer/Design-Build Contractor. Follow-up commissioning shall occur after all deficiencies have been rectified.

17 AUDIO VISUAL STANDARDS

17.1 PURPOSE

This document describes the system-wide official Audiovisual (AV) Standard. Its purpose is to ensure that all AV systems are designed according to the specifications and policies set by UC Davis Health IT. This document also references additional guidance and supporting standards necessary to align and conform with industry standards, best practices, and regulations. These guidelines will be used as a framework for future projects (both renovations and new construction initiatives) to maximize efficiency in each project phase while delivering consistent solutions that effectively meet the needs of the end user. The conventions outlined in this document apply to all employees and contract personnel involved in the development, delivery, support, or use of AV technology.

This document summarizes the basic technical requirements for audiovisual systems and associated processes in UC Davis Health System's Business, Administrative, and Clinical spaces. While this document is intended to be a comprehensive resource in those areas, it does not necessarily pertain to all individual environments or projects throughout the organization. Notably, the standards described herein are not applicable to the UC Davis Health School of Medicine. If for any reason these standards cannot be met, consultation with the IT Facilities Implementation team is mandatory prior to any AV project commission. To ensure that project parameters conform to current standards, all planned design elements and specifications must receive approval from the IT Facilities Implementation team before finalizing for execution. Where required, contractors and consultants must coordinate with the assigned UC Davis Health Project Manager in formalizing any new plans or proposals.

Compliance and References:

Authority	Title	Document
AVIXA[1]	AV Implementation Handbook	
AVIXA	Audiovisual Systems Performance Verification	10:2013
AVIXA	Cable Labeling for Audiovisual Systems	F501.01:2015
AVIXA	Audio Coverage Uniformity in Listener Areas	A102.01:2017
AVIXA	Standard Guide for Audiovisual Design and Coordination Processes	D401.01:2010
AVIXA	Projected Image System Contrast Ratio	V102.01:2021
AVIXA	Audiovisual Systems Energy Management	S601.01:2012
AVIXA	Display Image Size for 2D Content in Audiovisual Systems	V202.01:2016
AVIXA	Rack Building for Audiovisual Systems	F502.01:2018
AVIXA	Recommended Practice for Lighting Performance for Small to Medium Sized Videoconferencing Rooms	RP-38-17
AVIXA	Recommended Practices for Security in Networked AV Systems	RP-C303.01:2018
Cisco	Guidelines for Video Conferencing Room Acoustics	D14377.01
ANSI[2]	Audio, Video and Control Architectural Drawing Symbols Standard	ANSI-J-STD-710
USDOJ[3]	2010 ADA Standards for Accessible Design	
UC DAVIS HEALTHS IT[4]	UC DAVIS HEALTHS TELECOMMUNICATIONS STANDARDS	09202019Rev9

[1] AVIXA™ and InfoComm International® are a trademark and a registered trademark, respectively, of AVIXA, Inc., also known as

Audiovisual and Integrated Experience Association.

[2] United States Department of Justice

[3] Documentation available from UC DAVIS HEALTHS IT Facilities team

17.2 TECHNOLOGY STANDARDS

17.2.1 DISPLAY SYSTEMS

17.2.1.1 TYPES OF PROJECTION

Laser projection technology has developed rapidly in recent years, quickly becoming a viable alternative to lamp-based systems typically used in the past. Laser projectors may be specified as a low maintenance and relatively cost-effective option for very large spaces where 120" or greater image size is needed. Minimum lumen rating for projector-based display solutions shall be 5500 for smaller enclosed spaces or 10k lumens for large room deployments and/or environments with a high degree of ambient light. For custom engineering applications, throw distance and brightness requirements are determined using standardized ANSI measurement ratings in consultation with a qualified system designer or AV integrator.

17.2.1.2 LCD AND LED PANEL DISPLAYSK

As large-format LCD and LED panels have become more affordable, they have rapidly evolved into the preferred solution for most display systems. LCD and LED panel displays have a lower total cost of ownership over time and may also reduce requirements related to support, maintenance, control integration, and installation logistics. All display panels intended for general conference room use shall be commercial grade (24/7 rated) and of high material build quality to withstand the strain of daily use. Common control protocols (e.g. HDMI CEC, IR, RS232/serial) often play a crucial role in successful system integration and control interface compatibility requirements should be identified early on during the design phase. LCD and LED display availability can be particularly susceptible to supply chain constraints with procurement delays and long lead times becoming commonplace. Many AV dealers have started stockpiling surplus panels for mark up to capitalize on high client demand. It is recommended that models subject to limited availability are sourced sufficiently far in advance to minimize potential disruptions to the project schedule. When selecting a display panel for a specific use case, form factor, viewing distance and angle, and brightness ratings are all important considerations. Direct view LED technology has evolved into a viable option for very large screen sizes, offering a bezel-free aesthetic and flexible scalability at a premium cost. Per TEECOM specifications on developing project plans, Samsung QxC Series is a standard offering. The Samsung QxC line has become a flexible and increasingly ubiquitous commercial panel well suited for both conference room and digital signage use cases. Changes to the QxC line up are anticipated in the coming year, so newer variants may differ slightly in terms of I/O and included cables (and a slightly slimmer bezel) but otherwise maintains technical specifications and feature parity with the current QxC iteration.

17.2.1.3 VIDEO WALLS

No current standards are specified for video wall installations. Hardware standards for display technologies, mounting systems, video processors, matrix switchers, scalers, and/or accompanied audio solutions may be established as needs arise for future projects. Specifications related to deployment, installation, and content delivery processes may similarly develop over time. All video wall design must factor in compatibility with both BrightSign hardware (local player component) and the AppSpace content delivery platform. Specifications related to deployment, installation, and content delivery processes may similarly develop over time. Industry offerings for DVLED technologies are rapidly evolving from a manageability and affordability standpoint and may be a viable option for large format display use-cases previously served by lamp-based projection. Several older UC DAVIS HEALTH facilities feature NEC “video cube” systems, while more recently, Samsung video wall solutions have been successfully deployed.

17.2.1.4 RESOLUTION AND ASPECT RATIO

. In general, new display systems should be designed as 4K (3840x2160) capable with a native aspect ratio of 16:9. Minimum supported display resolution shall be 1080p (1920x1080) with a native aspect ratio of 16:9. Any projection screens, processors, or video scalers present in the signal chain must conform to these standards. Some possible exceptions may include matrix-tiled, multi-display LCD video walls with irregular aspect ratios, ultrawide displays in newer video conferencing systems or specialized monitors for medical imaging. Please refer to the individual project specifications for detailed display system design requirements.

17.2.1.5 OPTIMAL VIEWING METRICS

17.2.1.5.1 SCREEN SIZE CALCULATIONS

The AVIXA DISCAS standard (Display Image Size for 2D Content in Audiovisual Systems V202.01:2016) is the authoritative metric used for screen size calculations. DISCAS was devised as a comprehensive and scientific framework for optimizing display sizes in any proposed AV system. DISCAS offers scalable and adaptable guidelines for determining optimal display image size based human vision and audience viewing distance, ensuring that all viewers have a clear and comfortable viewing experience. BDM (Basic Decision Making) should be the primary metric for most use cases and is commonly employed for display size calculations in the standard meeting room setting. ADM (Advanced Decision Making) should be utilized where a higher-level of detail is required to resolve every element of the displayed image. Limited viewing modalities that may qualify as ADM, include medical imaging, design and construction plans, electrical schematics, collaborative image editing and graphic design work, and forensic evidence inspection. Please see the chart below for additional details on DISCAS.

	Basic Decision Making (BDM)	Analytical Decision Making (ADM)
Definition	15:1 Minimum Contrast Ratio The viewer can make basic decisions from the displayed image. Images and text are legible to the extent that basic decisions can be made Decisions based on content itself, not resolution of detail Non-analytical viewing The viewer is actively engaged with the content (e.g., information displays, presentations containing text and images, classrooms, boardrooms, multi-purpose rooms, product illustrations).	50:1 Minimum Contrast Ratio The viewer can make critical decisions with the ability to analyze details within the displayed image. The viewer is analytical and fully engaged with the content's details. This category requires that the finest detail available in an image is evident down to one line pair (e.g., art history classrooms, medical imaging, architectural/engineering drawings, forensic evidence, image inspection).
Communication Level	Basic information is retained Line-pair level detail in image not required	Analyze (fine) detail to make critical decisions Line-pair detail in image is required
Description	Ability to discern elements that are a certain percentage of the overall image height, relative to viewing distance· Ability to absorb information within time constraints	Based on visual acuity to discern a line pair Placing as much information on the screen as possible and be able to discern all of the intended detail Ability to view analytical material for extended period of time Ability to view analytical material for extended period of time Comfort not a significant factor
Environment	Typical office environment, meeting rooms, classrooms Unpredictable ambient light Possible task lighting	Highly controlled environment Controlled ambient light Focused task lighting No ambient light directly affecting screen, black-out window treatments

For more information on how to apply DISCAS for your design, please refer to the published standard by AVIXA and review the online resources linked below:

https://www.avixa.org/standards/display-image-size-for-2d-content-in-audiovisual-system

https://www.avixa.org/standards/discas-calculators/discas/learn-more-about-display-size

https://www.avixa.org/standards/discas-calculators/discas/dontknow

https://www.avixa.org/standards/discas-calculators/discas/bdm

https://www.avixa.org/standards/discas-calculators/discas/adm

17.2.1.5.2 CONTRAST RATIO

Contrast ratio can be an important consideration for display systems, particularly where high-definition video or detailed text and graphics are presented. Contrast ratio quantifies the range of luminance between the brightest shade (white) and the darkest shade (black) visible in a display system. A greater contrast ratio will generally result in sharper image quality with better defined blacks and more natural visual characteristics. Dynamic contrast ratio values are manufacturer specified and not standardized. As such, *static contrast ratio* should be the primary design criteria used to specify a display system. For most purposes, a static contrast ratio of 3000:1 is sufficient. For further information, please refer to the recently updated ANSI/AVIXA standard on this topic (Projected Image System Contrast Ratio V102.01:2021).

17.2.1.6 CONNECTIVITY AND I/O

All display systems shall feature source connectivity to present content from users' personal devices. This may be provided through HDMI inputs in accessible locations or an approved wireless screen sharing protocol such as Webex cloud video or Miracast. VGA is a largely obsolete video interface standard and is no longer recommended. Where non-standard connector types other than HDMI are required (and wireless sharing cannot be utilized as a functional alternative) user issued, personal HDMI-compatible adapters are suggested. Please see AV Networking section below for information on network policy. Please refer to the cabling installations section (and UC DAVIS HEALTHS Telecommunications Standards document) for additional guidance on conformation with official connectivity and cabling standards.

17.2.1.7 PERFORMANCE VERIFICATION

Post-design phase, unique project specifications packages are prepared for each new system commission. This documentation acts as a comprehensive checklist for display system performance verification. In essence, all cabling and display system components in the signal flow path must be tested and verified by the AV installer at the time of commission. All display-side control integration, video switching/matrix routing, and programming elements must operate as specified in the basis of design and should be thoroughly tested to rule out stability concerns. Common performance factors to be verified in display systems include resolution, aspect ratio, frame rate, video sync, switching response times, brightness/color properties, EDID management, potential pixel failures, HDCP conflicts, and any perceived image quality issues. Signal reproduction must be free of all visual artifacts, warping, distortion, signal attenuation, interference, etc. A uniform and consistent viewing experience is expected in larger installations where replicated signal is distributed across multiple displays. For projection-based systems, the displayed image and screen should be aligned via grid pattern. While many performance aspects of a display system are validated through simple visual inspection, certain tests warrant use of some specialized equipment such as video signal generators, multimeters, colorimeters, or spot photometers. The installer is expected to furnish and proficiently utilize tools and testing equipment in compliance with all processes outlined in the respective project specifications package. Please refer to the Video System Performance section of AVIXA's Audiovisual Systems Performance Verification (10:2013) for detailed technical information on the metrics employed to measure display system performance parameters.

17.2.2 AUDIO SYSTEMS

17.2.2.1 TYPES OF INSTALLED AUDIO SYSTEMS

Audio reproduction is an essential aspect of AV systems and all AV-equipped meeting rooms shall feature functional audio systems. This may vary between basic PC audio through display speakers in huddle rooms to more advanced, DSP-based systems enabling integrated conferencing in some larger spaces. Below are some brief descriptions of audio systems deployed in common room types.

Huddle Rooms and Small Conference Rooms
HDMI (or wireless screen sharing) program audio output through built-in display speakers. For systems where existing displays do not feature on-board speaker capabilities, a sound bar may be placed as a workaround. Room-integrated conferencing not supported in this model.

Medium to Large Conference Rooms and Training Rooms
HDMI (or wireless screen sharing) program audio output through a structurally integrated sound system. To accommodate conferencing, these systems may incorporate rack mounted DSP units to process incoming and outgoing audio signals, optimizing signal reproduction for human speech. Microphones and speakers may be ceiling embedded or surface mounted.

17.2.2.2 MICROPHONES

Large rooms with integrated conferencing require microphones to pick up in-room participants. The standard is the Sennheiser Team Connect Ceiling 2, which is recess mounted in the dropped ceiling. Each TCC2 unit replaces a standard 2 x 2 ft (600 x 600 mm) tile, installed flush with adjacent ceiling tiles. For spaces larger than 600 sq. ft, a second unit may be added. In spaces with prohibitive structural elements or inaccessible dropped ceilings, the Shure MXA710 Linear Array Microphone may be specified as a wall or soffit mounted alternative. Each Shure array module captures a 30 sq. ft area, requiring multiple units for coverage of larger spaces. Room integrated conferencing microphones, whether installed in the ceiling or surface mounted, must be positioned for maximum exclusion of technical noise (e.g., airflow from diffusers, mechanical/HVAC noise, projection equipment hum, etc.). Microphone systems placed in direct proximity to such noise sources may result in poor outgoing audio quality and may significantly impact frequency response if noise suppression algorithms are engaged in the signal chain. Audinate Dante is the standard signal protocol for transmitting audio over the network. For Conference Services managed systems (and where otherwise indicated), integrated microphone systems shall be networked for access to configuration, control, and management features All necessary microphone configurations and adjustments are to

be performed at the point of commission by the contracted AV installer in accordance with the system verification check list outlined in the project specifications package.

17.2.2.3 SPEAKERS

Large rooms with integrated AV systems require speakers to reproduce program and conferencing audio. The standard is QSC AD-series ceiling tube speakers installed flush in the dropped ceiling. In spaces with prohibitive structural elements or inaccessible dropped ceilings, the QSC AD-S402T Column Surface-Mount Loudspeaker may be specified as a wall or soffit mounted alternative. The project specifications package shall indicate the appropriate speaker count and placement pattern for optimized coverage in a given area. In systems with passive speaker systems, the AV installer shall verify loudspeaker transformer tap settings in constant voltage systems is as defined in the project specifications. All loudspeaker configurations and adjustments are to be performed at the point of commission by the contracted AV installer in accordance with the system verification check list outlined in the project specifications package.

17.2.2.4 DIGITAL SIGNAL PROCESSING

Large rooms with integrated AV systems require DSP (digital signal processing) hardware to act as an I/O interface for audio components, route signals, and manage audio processing functions like echo cancellation and EQ. Since most gain staging in room-integrated digital audio applications occurs within the DSP, a qualified engineer and/or programmer is required to set operating levels across all connected audio components, chiefly microphones and speakers. As sound properties of a system are dynamic and can vary based on conditional factors, most DSPs are specially programmed with an “Auto Mixer” to intelligently adjust signal parameters without requiring active user input. Noise suppression algorithms are often enabled through the DSP and should be individually assessed to rule out any undesired filtering of natural human speech frequencies. Careful consideration is required when enabling any DSP functions (particularly AEC and EQ) as this requires a high degree of programming proficiency. Verification of all DSP functions is crucial in the successful commission of an audio system. DSP units shall be mounted in a locally secured AV rack and custom programmed for each project by the contracted AV installer. Post-commission, all DSP-specific program or source code must be submitted to the project team during owner hand off. Standard DSP hardware is the QSC Q-SYS Core Nano (per recent project precedent).

17.2.2.5 REINFORCEMENT/VOICE LIFT

Outside of the main campus Conference Services domain, traditional public address systems (whether room-based or portable) are not widely utilized. Local reinforcement of in-room participant speech, or voice lift, is not currently implemented or specified for future proposals. Adoption of related technologies may be revisited should needs develop over time.

17.2.2.6 ALS IMPLEMENTATION

ALS compatibility is subject to ADA regulation in publicly accessible spaces. UC Davis Health does not currently specify a standard ALS solution and supplemental design considerations for ALS integration are addressed on a case-by-case basis. . ListenTalk solutions have been deployed in several new commission and retrofit additions.

17.2.2.7 VOIP/INTEGRATED DIALING

Implementing phone functions for new conference room projects (containing standard Cisco conferencing hardware) should attempt to utilize the RoomOS integrated dialing feature. A button for the dialer component is prominently featured in the control GUI for quick access to phone functions. Each Cisco system has an associated phone number provisioned in Call Manager and activated in the workspace control hub. Cisco Call Manager settings are assigned and administered by the Unified Communications team. VOIP dialing is not delivered through DSP systems. Traditional table-top speaker phones are not generally specified for new conference room builds.

17.2.2.8 SYSTEM VERIFICATION

All cabling and audio components in the signal flow path must be tested and verified by the contracted AV installer. The audio section of AVIXA's Audiovisual Systems Performance Verification (10:2013) outlines the industry standard procedures used to assess performance parameters and is the primary reference for verification of all commissioned audio systems. Industry best practice methods should be followed with careful consideration of all technical conditions related to gain staging, phase and time alignments, signal to noise ratios, and overall fidelity. The system must be free of all undesirable noise including distortion, hiss, hum, buzz, clicks and pops, EMI and RF interference, cable crosstalk, digital artifacts, and comb filtering. The AV installer is expected to furnish and proficiently utilize all tools and testing equipment for system verification. System variables may require a range of specialized equipment such as voltmeters, SPL meters, signal generators, spectrum RTA/spectrum analyzers, and oscilloscope systems. Proper gain staging is a key component in the correct alignment of input source gain levels and should be configured so that the system produces no more than 1 dB variance in program source levels. Signal to noise ratios shall be calculated to account for ambient noise levels, which includes any undesired sounds heard or measured. This includes noise from HVAC, building mechanical systems (e.g. elevators), technical noise (e.g. projectors, lighting control systems, etc.), and sounds from outside the room (such as vehicle traffic, weather, or noise originating from adjacent spaces). The generally accepted rule for the absolute minimum signal to noise metric in a conference room environment is 20 dB. For best results, spaces with active conferencing systems should be designed for a signal to noise metric of at least 25 dB. Lower ambient noise levels are always better. Some example scenarios:

- Example 1 - the noise floor in a room measures 55 dB SPL A weighted (slow). If normal speech is assumed to be 70 dB SPL A weighted (slow), then the signal to noise metric of the room is 70-55 or 15 dB. This room will be challenging for conference use.
- Example 2 - the noise floor in a room measures 42 dB SPL A weighted (slow). If normal speech is assumed to be 70 dB SPL A weighted (slow), then the signal to noise metric of the room is 70-42 or 28 dB. This room is an excellent candidate for conferencing.
  Source: Shure Audio Systems Guide for Meetings and Conferences

AV installers or system integrators typically require that certain prerequisite conditions are met before commencing the audio system performance verification process. These are often contractual stipulations and may include

completion of peripheral trade dependencies and resolving architectural or infrastructure conflicts with the project team. A specified window of uninterrupted silence is a general requirement for commission and system verification. Other environmental factors may necessitate additional coordination. Project-specific shop drawings and related documentation delivered by the AV designer during the program phase is used to generate a system verification punch list utilized at the point of commission. A finalized verification punch list (in addition to system user guides and O&M documentation) shall be submitted by the AV installer or integrator upon successful commission of any new audio system. Any resulting concerns shall be clearly conveyed to the project team so that proper remediation of any identified issues occurs with minimum impact on delivery timeframe. Upon successful verification, the owner hand off process may involve system training, creation of instructional documentation and/or recorded video guides for end-user reference.

17.2.2.9 ACOUSTICAL GUIDELINES

Acoustics are an important consideration in the successful commission and operation of audio systems. Dynamic and unique acoustical properties of each space must be assessed and, in some cases, physically modified to optimize reproduced audio quality. Boundary reflection and reverberation factors are important to the perceived quality of an audio system. Proper acoustical design will yield a room that minimizes adverse reflections but isn't perceptibly "dead-sounding." Conversely, certain construction materials are prone to compounding reverberation which can significantly detract from the listening experience. Some building materials and room shapes that can negatively impact acoustical properties in a space include:

- Large glass surfaces - walls or windows
- Large drywall surfaces
- Large white boards
- Non-sound-absorptive ceiling material
- Concave wall or ceiling shapes

To compensate for acoustical challenges caused by reflections (especially in spaces with flat, hard surfaces), acoustical treatment in the form of diffusion or absorption panels may be added. Audio output coverage shall be evenly distributed and clearly heard at nominal operating levels (65 dBA for conference speech and 70 dBA for program audio) throughout all designated listener areas. Localized sound level meter readings are required to confirm acceptable noise floor level prior to commission of a new audio system. The resting ambient noise floor shall not exceed 35 dBA (Noise Criterion curve of 25-30). The relative difference between the measured noise floor and originating source(s), typically in-room speech, is referred to as the signal-to-noise ratio. This ratio should measure around 25 dB for optimal speech intelligibility in a conferencing system. Spectrum analysis or other specialized testing is often required to determine acoustical attributes of a room so that the system may be tuned or adjusted for optimal performance. In addition to the standards described in AVIXA's AV Implementation Handbook (A102.01:2017), the Cisco Guidelines for Video Conferencing Room Acoustics (D14377.01) should be consulted during installation of Cisco conferencing systems.

17.2.2.10TECHNICAL NOISE

Technical noise in a conference room can impair audio system performance. HVAC systems in particular produce broad-spectrum noise with the potential to negatively impact audio clarity and speech intelligibility. Besides the introduction of undesirable noise levels in an enclosed area, diffusers or vents generating airflow around a microphone may seriously compromise microphone function and pick up patterns. As such, sensitive audio equipment should not be positioned within the circulation path of any airflow sources. Wherever possible, all building mechanical systems should be carefully engineered to minimize technical noise in proximity to installed AV systems. Efforts may include structural isolation of adjacent air handlers/ductwork and plumbing systems, or relocation of proposed AV systems where technical noise cannot be reasonably suppressed. Coordinated planning with the larger project team can help identify such concerns early in the timeline. If integrated AV system requirements are not factored into architectural and mechanical plans during the design phase, interventional changes to existing construction can be expensive and difficult or may not be possible at all.

17.2.3 CONTROL SYSTEMS

AV installations with more complex integration profiles may require a control system. Formal needs analysis will determine whether the components and applications of a proposed system necessitate inclusion of a custom control program. This consists of a central processor unit executing a purpose-built program for control and automation of integrated room functions (including, but not limited to the examples listed below).

- Lutron lighting control
- Automatic shades and blinds
- Mechanical screens
- Advanced signal routing
- Multi-source matrix switching
- Divisible spaces and breakout or spillover functions

While control systems have historically been considered a standard part of the meeting room model, there are considerable engineering, programming, and support efforts involved in executing a custom control program. End user learning curve and reliability concerns should also have a role in weighing the inclusion of a custom control program. With fewer projectors and improved ready-use control protocols available (i.e., CEC), simpler solutions which avoid control system implementation may be preferrable. Where feasible, an alternative for larger conference spaces with integrated AV systems may be a Webex Room Kit deployment, wherein the Cisco codec controls basic room functions like powering display systems on and off or managing video calls. If control system integration is unavoidable, the approved solutions are QSYS or Crestron (as utilized in main campus and education zone installations). IT policy dictates that all program source code, software, and associated use licenses are wholly owned by UC Davis Health IT. Digital copies of all files and software resources accompanying newly commissioned systems shall be obtained from the programmer during hand off and centrally stored for operational continuity. This includes all source code, program upload/configuration files, management software, licensing information, and any other associated digital resources

17.2.4 VIDEO CONFERENCING STANDARDS

17.2.4.1 CONFERENCING AND COLLABORATION EQUIPMENT

While universal standards are still being determined, the current VTC footprint is largely Cisco-centric. Cisco offers a variety of endpoint conferencing devices and codecs. The Webex Board Pro is an all-in-one touch screen conferencing and collaboration system available in 55" and 75" models. The Board Pro can be deployed in a standalone configuration (as seen in small conference rooms) or paired with an external Webex codec and placed in companion mode (as seen in large conference rooms and training rooms). Webex Room Kit packages are an option for larger room-based configurations with external AV components. The Room Kit Plus features a mid-range I/O profile and a Quad Cam video bar system with an onboard loudspeaker (suitable for medium room types). The Room Kit Pro variant consists of advanced codec hardware with expanded I/O for integrating external AV components in larger spaces and training rooms. There are several package variants that may or may not include an accompanying Room Navigator for control. The Unified Communications team shall specify, procure, and furnish the correct Cisco equipment for a project. If there are concerns around cabling interconnectivity or compatibility with other constituent AV components, the AV designer shall consult the Unified Communications team (or assigned UC Davis Health project manager) to confirm before incorporating Cisco Systems in shop drawings or as-built designs.

17.2.4.2 CONFERENCING AND COLLABORATION APPLICATIONS

UC Davis Health conferencing and collaboration systems are compatible with Cisco Webex, Microsoft Teams, and Zoom meeting platforms. Cisco video endpoints are currently configured as Webex-native with interoperability for Teams and Zoom as standard. The advanced interoperability solution requires two license types: CVI (Cloud Video Interop) for Teams and CRC (Conference Room Connector) for Zoom. There are costs associated with procurement of either license type. CVI endpoint licenses are purchased annually, and Microsoft offers Basic (free) or Pro (paid) versions. If more than 25 endpoints are registered, Pro licensing is required, and all Basic licenses are automatically transitioned to Pro and invoiced accordingly. Zoom CRC licenses are also renewed annually and are dynamically applied across compatible endpoints in a shared pool. This license pool should be provisioned to accommodate the maximum expected concurrent usage of Zoom CRC sessions. With Hybrid Calendar engaged, OBTP (one button to push) allows Cisco conferencing devices to easily launch Webex, Teams, or Zoom meetings. When a system is reserved through Outlook with a compatible embedded meeting ID, a green "JOIN" button appears in the UI home page and calendar sections of the connected Room Navigator controller. This allows non-technical users to simply invite the room as they would a meeting participant, which both reserves the space and automatically displays the associated meeting through a single convenient process. App-switching functionality recently implemented on newer model Cisco video endpoints allows for MTR (Microsoft Teams Room) configuration. MTR is a combination of approved third-party hardware running a dedicated Teams application developed exclusively for room-based conferencing hardware). This is a Teams-native solution adding an extra layer of flexibility in spaces where only Teams and Webex are prominently utilized (but Zoom compatibility is a low-priority). This option is being considered to fully leverage UC Davis Health Cisco hardware investments. Teams-certified MTR systems from other manufacturers are also being evaluated internally.

17.2.4.3 PC CONFERENCING CONFIGURATION

For Conference Services supported conference rooms located within clinical facilities, host device bridging must be configured for the locally installed mini PC to utilize the room integrated camera, microphones, and speakers. This allows the mini PC to operate as soft codec by utilizing integrated conferencing capabilities through the codec

(camera interface) and DSP (audio interface). A wireless keyboard and track pad is deployed for input control to the PC. The North Addition-based Conference Services team administers and maintains these PCs, and can provide additional details respective to their local configuration and operation. There are two distinct set up considerations to factor in based on the room type (where standard equipment specifications apply): Small room models with an all-in-one video bar-type system and Medium/Large room models with integrated audio programs (i.e., DSP-based systems with external mics/speakers).

Small room systems: for small rooms and huddle spaces with the all-in-one Room Bar Pro, PC host bridging is achieved through a single USB-C (BYOD Pass-thru) connection between the mini PC and the Room Bar Pro USB-C input (with the HDMI input reserved for the separate laptop source connection). Please note that the mini PC hosting the conference bridge must have a compatible DisplayPort Alt Mode USB-C port. Alt Mode-enabled USB-C ports offer expanded bandwidth over traditional USB-C connections, which is needed to transmit data and video over a single interface connection. Currently, USB-C Alt Mode is not included with the UC DAVIS HEALTH standard model HP mini desktop, so a specialized module must be purchased and installed separately for host device bridging in small room systems with Room Bar Pro. Updated I/O options for newer HP mini desktop variants may feature on-board Alt Mode capable USB-C port. Please check for AV contractor advisories related to PC conferencing integration in future standards revisions.

Medium/Large room systems: for room systems classified as medium, large, and above, additional equipment may be required to accomplish PC host bridging integration with the larger conference system. For systems with Room Kit Pro systems, a network capable USB media encoder (e.g., Extron Media Port 300) is utilized as a soft codec interface. This component converts camera signal (from a dedicated HDMI output on the codec) to USB video for camera ingest to the PC. Additionally, the USB media bridge connects the mini PC to a room's integrated audio program (i.e., DSP), with IP audio channels routed via AES67. For configuration and programming guidelines related to a specific system commission, please consult the AV specifications package for the respective project. If the outlined process or described methods seem unclear, please contact the IT Facilities team for further coordination. Please note: this design scheme is currently evolving and is subject to change in future revisions. Expect updated AV contractor advisories related to PC conferencing integration in future standards revisions.

17.2.5 DIGITAL SIGNAGE

17.2.5.1 TYPES OF DIGITAL SIGNAGE

Based on current state precedent, UC Davis Health IT utilizes BrightSign player hardware in combination with the AppSpace content delivery platform. Devices are not domain joined and may need NAC profiling. Digital signage must support 24/7 operation, HD content and acceptable visual/auditory quality. Some aspects of the digital signage platform may be incorporated into future patient room AV integration models. Digital signage is not specified for clinical applications, such as contact-center dashboards or central tracking boards. Coordinate with UC DAVIS HEALTH IT for project specific digital signage requirements.

17.2.5.2 INSTALLATIONS

Digital Signage installations shall allow for convenient access to wiring and component I/O without requiring removal of the display. Digital signage installations shall comply with all pertaining regulatory code. ADA compliance shall be factored into any planned installations in public areas including display protrusion limits to maintain adequate egress, mounting height, and wheelchair accessibility to interactive/touch screen signage systems. In clinical environments, OSHPD regulations may apply. OSHPD compliant mounts must be utilized where seismic certification requirements exist. Sufficiently reinforced backing shall be specified by the architect in coordination with the design team. UC Davis Health currently contracts with an external AV installer for new digital signage projects.

17.2.5.3 NETWORK CONNECTIVITY

- All digital signage endpoint components (including displays) are to be hardwired on the general-purpose network. Dual data drops shall be the minimum for all new installations. BrightSign players are not domain joined devices and may require NAC profiling on the network side. All endpoints today are using Wifi. However, they can use hardware on the general-purpose network with a minimum of two data drops.

17.2.5.4 STANDARD HARDWARE

BrightSign manufactures the proprietary hardware player installed at each display location. Content deployments are locally cached on the BrightSign device at full HD/1080p resolution. BrightSign players feature HDMI source output. No current standard for commercial display manufacturer/models, although Samsung QxC panels are a possible candidate. Any potential standard should be rated for 24/7 operation, offer a range of screen sizes in the model series, and provide adequate performance (brightness, contrast, color reproduction, refresh rate, etc.) for the intended environment. CMS capabilities and SOC are other potential considerations in selecting a display standard. Metrics employed for size selection to optimize viewing parameters will also factor in. Audio output, if available, will be supported through the display's built-in/integrated speakers.

17.2.5.5 CONTENT DELIVERY

AppSpace is the content management and delivery platform for UC Davis Health digital signage. It is a cloud-based solution that provides direct content management functionality to non-IT entities, e.g., Public Affairs and Marketing. UC Davis Health IT does not administer or manage processes related to content creation or graphic design.

17.2.5.6 MANAGEMENT, MAINTENANCE AND SUPPORT

Maintenance and support processes vary across UC Davis Health facilities. Some segmented AV eco-systems (such as the education zone) support their own signage operations. Specific processes related to centralized management, remote monitoring, and support may evolve as the digital signage footprint expands. Maintenance and lifecycle expectations shall be determined based on manufacturer specs and industry standard recommendations for each respective component.

17.2.6 WAYFINDING

Cardigram has been identified as a wayfinding solution for future new construction projects. Coordinate with UC DAVIS HEALTH IT for project specific wayfinding requirements.

17.2.7 SCHEDULING PANELS

17.2.7.1 SCHEDULING PANEL USE CASE

Located just outside the meeting room entrance, scheduling panels display the room name and number, meeting title and duration, and current room use status. While the touch screen UI can be configured to allow for walk-up reservations booked directly on the panel, this functionality is not currently enabled. Please note that, due to disparities in scheduling process, there are significant differences in Conference Services supported facilities and the following information pertains primarily to the UC Davis Health IT environment.

17.2.7.2 STANDARD HARDWARE

The standard is the Cisco Room Navigator. Cisco offers a Navigator model variant specifically designed for scheduling panel applications which includes wall mounting hardware. Please see the Recommended Hardware List section for model and SKU details.

17.2.7.3 SCHEDULER PANEL INSTALLATIONS

Cisco offers a Navigator model variant specifically designed for scheduling panel applications. This package includes a mounting bracket for attaching the Navigator panel to a wall or glass surface. Data drops at the mounting location must be terminated with male RJ45 connectors and excess cabling must not extend more than two inches beyond the pass through. Failure to follow these indications may result in cable strain inside the bracket assembly and require cabling correction and/or re-termination. Standard mounting height for scheduler panels is 44” above the floor to the lower edge of the panel. Standard placement for room control Navigator panels is at the rear of the table or on a credenza directly underneath the Cisco codec.

17.2.7.4 SCHEDULER PANEL CONFIGURATION

Cisco Room Navigator panels can be configured for room control or as a room status indicator with a walk-up scheduling feature for impromptu reservations. The desired operating mode is selected when the unit first initializes. Panels are paired with the Webex conferencing devices in a managed workspace. Please note that *Hybrid calendar* must be enabled to interface with mailbox accounts in M365/Exchange. With the release of RoomOS 11.3, there is a standalone set up option for scenarios where a scheduler-designated Navigator panel is deployed *without* an associated Webex board or Room Kit installed in the space.

17.2.8 SOUND MASKING

17.2.8.1 SOUND MASKING USE CASES

Sound masking is the process of adding background sound to reduce noise distractions, protect speech privacy and increase workplace comfort. Sound masking is typically deployed in office environments with various specialized speakers staged throughout open areas and corridors. Signal is distributed through head-end hardware located in the TR's. Line level audio input can be routed through the system for auxiliary source connections at the head end. If music or paging capabilities are required, additional engineering support must be engaged to affect an implementation strategy as there are complex hardware and programming processes involved.

17.2.8.2 STANDARD HARDWARE

Lencore is the standard systems manufacturer for structurally integrated sound masking systems.

17.2.8.3 SOUND MASKING SYSTEM INSTALLATIONS

The Lencore i.Net head end unit is installed in a dedicated rack space inside the main TR. Distributed signal is fed to separate zones through a series of data controllers and routers (OP units) in each area's local TR. These zones are proximally located clusters of 4-10 speakers per channel. Cabling is installed independent of the enterprise network and all control parameters must be accessed through a local network interface connection at the head end.

17.2.8.4 SOUND MASKING SYSTEM CONFIGURATION

Zone designations, channel routing assignments, and per-channel parameters (such as output gain and EQ) are predetermined by the engineering contingent contracted for system design and physical installation. Adjustments of any parameters within a zone's channel affect all speakers in the signal chain of the selected zone. The i.Net Head-End unit is the point of access for all adjustment and control functions.

17.2.9 AV ENDPOINT NETWORKING AND CYBER SECURITY POLICY

17.2.9.1 AV NETWORKING

Historically, AV network implementation has varied depending on the environment. Due to infrastructure limitations and security concerns, many projects have employed the closed loop model, wherein all IP traffic is routed through an isolated switch. While this topology is often preferred from the network administrator's perspective, data connectivity needs should be closely analyzed to identify whether networked AV endpoints must incorporate centralized control, management, and/or monitoring platforms. Some tech teams may rely on these control access capabilities for operational support and critical maintenance. Counts for local data drops should be specified during the design process to accommodate all network integrated video and display components. Networked endpoints may be partitioned on a VLAN to segment AV IP traffic through enterprise managed switches, which may include a tie-

back or VLAN trunk from a dedicated in-room AV switch. Network configuration for all AV systems shall be compliant with UC DAVIS HEALTHS network and cyber security policies and must be planned in close coordination with the appropriate network administrators and IT security personnel. New AV hardware solutions which aren't strictly isolated from the enterprise network may require a formal IT evaluation. Additionally, a firewall rule change request may be needed if any AV system traffic must be routed to or from the internet.

17.2.9.2AV OVER IP

Recent advances in compression efficiency and codec capabilities have allowed for transmission of full frame video via compatible switch infrastructure on the enterprise network. Due to the considerable engineering and logistics efforts involved, AV over IP (AVoIP) is not yet a prominent feature in many AV/IT ecosystems, and as such, AV over IP is not currently implemented or supported on the UC Davis Health enterprise network. As this technology develops, protocols improve, and costs are reduced, AV over IP solutions may be considered. The AV designer is responsible for clearly communicating network requirements and receiving formal approval for AVoIP implementation through the UC Davis Health project team or assigned project manager. It should be noted that there are significant added challenges when highly synchronous signal distribution across multiple endpoints is a requirement. To accommodate precise timing of large payloads, bandwidth allocation for AVoIP platforms must be coordinated closely with network administrators. Network segmentation and QoS are often necessary Audinate Dante is the standard protocol for transport of audio over the network. Dante is a low latency solution and generally doesn't require dedicated segmentation for optimized packet delivery. Please refer to Audinate's Dante controller documentation for additional details on the Dante protocol and supported hardware.

17.2.9.3CYBER SECURITY POLICY AND COMPLIANCE

As AV systems are designed and commissioned, compliance with all published UC Davis Health IT Telecommunications Standards (as outlined in the UC DAVIS HEALTHS TELECOMMUNICATIONS STANDARDS documentation) is required. Unauthorized access to endpoint devices, whether with malicious intent or otherwise, can wreak havoc on an AV system and disrupt regular operations. Networking of integrated AV systems requires calculated logistical planning and execution to prevent vulnerability risks or footholds when connected to the enterprise network. This is especially true of newly adopted solutions, where potential security concerns must be thoroughly vetted. Wireless display sharing protocols should be closely scrutinized to rule out potential network bridges. The serial number and MAC address of each installed device are to be documented by the installing integrator and provided to the UC Davis Health IT Facilities Implementation team (or assigned UC DAVIS HEALTHS project manager) as early as reasonably possible. All networked AV components are to be classified and registered according to standard network policies. At the time of deployment, all AV devices must be updated with the most current firmware and/or software releases.

17.3 PHYSICAL REQUIREMENTS FOR AV SYSTEMS

17.3.1 AV CABLING AND WIRING

17.3.1.1 CABLE TERMINATION

All cable terminations should follow best practices or processes set by industry recognized standards organizations such as TIA/EIA wiring standards, BICSI, AVIXA, and/or UC DAVIS HEALTH Division-27 standards. Typically, the AV drawings for each individual system indicate connector types and termination requirements.

17.3.1.2 CABLE MANAGEMENT

Elements of proper cable management include cable handling, serviceability, and signal separation. Careful attention should be paid to correct placement and support of individual cables and cable looms in horizontal and vertical runs. Use only the cable type and/or variant indicated, e.g., Plenum rated cable only in overhead installations ran through the plenum space. Planned cabling installations must comply with all applicable building code and NEC requirements.

17.3.1.3 RECOMMENDED SIGNAL SEPARATION

RECOMMENDED MINIMUM SEPARATION BETWEEN CABLES

Signal Type	Common Level(s)	Audio Micro-Phone Level	Audio Line Level	Video Cable	Data Twisted Pair Cable	RF Coax Cable	Speaker Cable	AC Power Cable
Audio Micro-Phone Level	-60 dBV (0.001 volt) to -40 dBV (0.010 volt)	No Spacing Required	Separate Bundles	Separate Bundles	100 mm (≈4 in) minimum	100 mm (≈4 in) minimum	100 mm (≈4 in) minimum	300 mm (≈12 in) minimum
Audio Line Level	0 dBV (1.000 volt)	Separate Bundles	No Spacing Required	Separate Bundles	Separate Bundles	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	100 mm (≈4 in) minimum
Video Cable	0.8 volts	Separate Bundles	Separate Bundles	No Spacing Required	Separate Bundles	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum
Data Twisted Pair Cable	max 125 VDC, 30 watts (add signal level)	100 mm (≈4 in) minimum	Separate Bundles	Separate Bundles	No Spacing Required	Separate Bundles	Separate Bundles	50 mm (≈2 in) minimum
RF Coax Cable	0 dBmv to 50 dBmv	100 mm (≈4 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	Separate Bundles	No Spacing Required	Separate Bundles	50 mm (≈2 in) minimum
Speaker Cable	1 watt to 1,000 watts, max 100 VRMS	100 mm (≈4 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	Separate Bundles	Separate Bundles	No Spacing Required	50 mm (≈2 in) minimum
AC Power Cable	120/240 volts 50/60 Hz	300 mm (≈12 in) minimum	100 mm (≈4 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	50 mm (≈2 in) minimum	No Spacing Required

Source: AVIXA F502.01:2018

Refer to UC DAVIS HEALTH Division-27 Specifications for additional cabling specifications.

17.3.2 EQUIPMENT MOUNTING

All equipment mounting is expected comply with pertaining regulatory code. In clinical environments, OSHPD requirements may apply and OSHPD compliant mounts may be specified where seismic certification requirements exist. Sufficiently reinforced backing which supports at least five times the aggregate equipment load shall be specified by the architect in coordination with the design team. All equipment mounting shall adhere to serviceability, electrical interference, cable, and thermal management requirements as indicated in the project specifications prior to installation. All mounting hardware and fixed attachments must be fully tightened. Fixing, fastening, or attachment of AV components to one another is not advised unless specifically called for in manufacturer documentation. The use of fastening methods relying on adhesives is not acceptable. Where possible, mounting bracket assemblies should allow for convenient technician access to wiring and component I/O without requiring removal of equipment.

17.3.3 RACK ASSEMBLY

Rack design must allow for only a maximum of 75% fill to accommodate future growth. All racks should be enclosed and secured. Racks installed in cabinetry should have a rear access, in the form of a lockable door. All racks will be assembled per the manufacturer's instructions.

In some cases, accessories such as doors and side panels will be installed and checked for proper fit, but then temporarily removed to aid in the subsequent loading/populating and cabling of the rack. Once all rack parts and accessories are fully assembled, final adjustments will be made before the loading/populating of AV equipment. This includes the final adjustment and location for the front, mid, and rear rack rails, and all vertically mounted accessories such as vertical cable management.

17.3.4 VENTILATION

All AV gear generates heat, which can quickly compound in an enclosed area. Regardless of the location, there must be adequate air flow to prevent unacceptable temperature rise and all racks and enclosures holding AV components must have sufficient ventilation. Cooling and ventilation requirements will vary according to component types and amounts. The AV designer will determine the thermal units produced by a system and calculate the needed ventilation factor based on manufacturer specifications. Localized ventilation solutions containing mechanical devices with moving parts, such as fans, should have minimal noise ratings to prevent distractions in the meeting space.

17.3.5 ROOM LAYOUT

Room dimensions, furniture layout and equipment orientation all affect AV design. Careful placement of equipment and furniture is essential for optimal performance and to ensure ADA requirements are met. Room layout will be

considered in consultation with the UC Davis Health IT Implementations team during the design process. Conduit, raceways, cable trays, cable paths and electrical power must be located and sized correctly. Ceiling layout and material, location of lights and sprinkler heads must be coordinated with installation of ceiling-mounted AV systems such as loudspeakers, projectors, cameras, and projection screens. Lighting fixture placement and illumination properties should be checked for impact on AV systems, particularly projected images. Acoustic treatments, which can significantly affect the performance of audio systems, must be considered. Wall, floor, ceiling, window, furniture/upholstery, and other treatments all affect the acoustic behavior of a space. While many spaces have unique characteristics, AVIXA's AV/IT Infrastructure Guidelines offers detailed guidance related to sightlines, viewing angles, image heights and other critical room design considerations. These best practice suggestions can provide a strong foundation for layout planning and help inform individual specifications on a per-project basis.

17.4 AV PROJECTS

17.4.1 DESIGN PROCESS

UC Davis Health may employ AV design consultants, especially for larger or more complex projects. Processes may differ slightly from project to project. Design consulting services may be subcontracted through the architect or GC in a progressive design-build framework. Often a single contingency remains engaged from the program phase through commission. In such cases, UC Davis Health standards (in combination with use-case considerations identified during stakeholder needs analysis) shall drive design decisions and provide basis for all per-project specifications. Consultant cooperation with internal IT resources is crucial for conformance with all applicable Unified Communications, network, and cyber security policies.

17.4.1.1 INFRASTRUCTURE COORDINATION

Successful AV project outcomes rely heavily on close coordination throughout the design and construction phases. Careful planning of infrastructure provisions and logistics between project team counterparts is needed to effectively sequence AV work with other building trades. Much of the responsibility for AV-specific infrastructure considerations falls upon the AV designer and project manager, who may be relied upon to drive critical alignment efforts. All parties involved should be aware of the potential impact coordination issues may have on the project dynamic and, ultimately, the resulting product. The project team may devise project specific WBS (work breakdown structure) documentation as part of this coordination process.

Examples of areas that require particularly close coordination include:

- Millwork that integrates with AV systems must be built to spec and tolerance.
- Conduit, raceways, cable trays, cable paths and electrical power must be located and sized correctly. The schedule of this work is also critical to the AV integrator.
- The scheduling of walls and ceiling installations must be monitored to dovetail the installation of wiring, structural mounts, and AV devices. Lighting dimming systems and any interface(s) must be confirmed.
- Installation of HVAC ductwork and terminal devices must be monitored for conflicts with the AV installation.
- Existing facility use must be considered, including any spaces that might be affected by

work on the project. For instance, drilling or cutting may create noise on other floors or equipment deliveries may only be allowed during off-hours.

- Dimensions of loading docks, elevators, doorways, corridors and passageways must be large enough to allow delivery of equipment, particularly large rear projection screens and millwork that is fabricated off-site.
- Other work and treatments that may create a hazardous environment for AV equipment must be complete before equipment is delivered to the site. This work includes carpentry, sanding, painting, concrete work and ceiling installation in areas where AV equipment is to be stored or installed.
- Data drops must be installed, activated, and labeled before functional testing of AV systems. PoE requirements must be factored in per manufacturer specifications.

For a more complete overview of industry standard best practices related to project coordination, please reference AVIXA's AV Implementation Handbook and Standard Guide for AV Design and Coordination Processes (D401.01:2010).

17.4.1.2 COORDINATION CHECKLIST

As noted above, there are several coordination issues to be addressed between AV design and base building design teams. All major items of note should be identified early and incorporated into an *Infrastructure Coordination Checklist*. Below is an example plan.

Architectural Construction, Space Planning and Interiors

❑ Develop seating layouts and room orientations

❑ Develop furniture layouts

❑ Provide display types, sizes and locations

❑ Recommend room finishes

❑ Perform sight line studies

❑ Provide acoustics and noise control recommendations

❑ Develop AV-related millwork details

❑ Provide assistance with anticipated AV-related infrastructure costs

Provide architectural integration details for:

❑ Projection screen installation

❑ Loudspeaker mounting

❑ Structural mounts for displays and other devices including loads

❑ AV integration into furniture

❑ Wall-mounted racks, monitors and other devices

HVAC

❑ Provide head loads from AV equipment

❑ Coordinate duct runs and terminal device locations

❑ Provide noise criteria for AV spaces

Electrical, Lighting and Data/Telecom

❑ Convey conduit and backbox type, quantity and locations

❑ Provide power requirements and power grounding details

❑ Provide lighting layouts and/or criteria for AV spaces

❑ Provide data/telecom requirements for AV

Administrative Coordination

❑ Develop anticipated AV system costs

❑ Provide AV design and installation schedule

17.4.1.3 AV DRAWINGS AND DESIGN DOCUMENTATION

UC Davis Health typically engages consultants to drive design efforts in larger, more complex AV and telecom projects. Design consultants usually remain throughout the process, leading design efforts and assuming an advisory role in the later stages. Design consultants will draft and submit shop drawings and schematics for proposed systems. These may include single line schematics, RCP diagrams, section detail plans, or elevation drawings. In addition to guiding the design process, consultants can help identify compatibility or coordination concerns and recommend non-standard solutions for unique use-cases. Alternatively, design duties may be performed in-house or as part of a direct design-build model with a single integrator partner.

17.4.1.4 AV SYSTEM SPECIFICATIONS

Contracted design consultants typically author per-project specifications as a part of the project documentation. This is the primary reference for technical details pertaining to AV systems. Individual project specifications are used extensively by the contracted AV integrator during installation and commission. Specifications for all proposed projects shall be closely internally vetted by UC DAVIS HEALTH IT prior to finalized approval and distribution.

17.4.2 SERVICE PROCUREMENT

No standard process currently defined for service procurement. Should relevant standards develop, they will be outlined in future updates to this documentation.

17.4.3 EXECUTION AND DELIVERY

The contracted AV installer shall install and configure all equipment as specified in the approved scope of work. Installation procedure shall reflect a high quality of workmanship with the product being a complete and functional AV system achieving all stated program objectives. System installation (and subsequent operation) must adhere to all applicable regulatory policy, including federal, state, and local life safety standards, and/or building codes. Contractors should have experience equivalent to or exceeding the project requirements and exhibit proficiency in their respective trades. This should include expectations that contracted integration partners be fully trained and/or certified for all aspects of AV equipment installation, testing and system verification (e.g., field wiring methods and techniques such as separation of signals). Industry standards and best practice policies must be followed to ensure a successful installation, which may include fabrication, assembly and/or programming.

17.4.4 SYSTEM PROGRAMMING

It is UC DAVIS HEALTHS policy that all programming elements and associated software are owned by the end user. Hard copies of all files accompanying newly commissioned systems should be obtained from the integrator at the point of owner hand off and stored securely for operational continuity. This includes all source code, program upload/configuration files, management software, licensing information, and any other associated digital resources.

17.4.5 PERFORMANCE VERIFICATION

System performance must be verified for all installed AV systems post-commission. The integrator must thoroughly test signal reproduction and verify system performance based on the provided project specifications. A checklist is generated as a part of the specifications package and should be followed item-by-item to ensure system performance optimization, rule out any prospective issues, and document commission process.

17.4.6 ACCEPTANCE TESTING AND OWNER HAND-OFF

Immediately post-commission, AV integrator partners must provide UC DAVIS HEALTHS with a fully completed performance verification checklist, as-built plans, and instructional documentation where applicable. All system source code and associated software will be submitted directly to UC DAVIS HEALTHS as a part of the hand-off process. Occasionally, hand-offs may need to be staged through the GC if required as part of the sub-contract. In these instances, there should still be accountability on the part of the subbed integrator partner should UC DAVIS HEALTHS (as the owner and end-user) identify technical issues which require remediation or a there is failure to deliver on the contracted scope of work.

17.5 REGULATORY REQUIREMENTS

17.5.1 ADA COMPLIANCE

The ADA (Americans with Disabilities Act) was enacted in 1992 for the purpose of eliminating discrimination against people with disabilities. ADA building compliance is important for legal reasons, but it's also crucial for the safety and experience of UC DAVIS HEALTH staff and patients. ADA compliance must be a consideration when specifying placement of LED displays, touchscreens, and Assistive Listening Systems.

Display Placement
The ADA requires any display attached to walls in hallways, corridors, and other walkways to protrude no more than 4 inches from the wall and into the space. There are a couple of exceptions and workarounds. Displays with leading edges that are within the sweep of a cane (27 inches high maximum) or that are at least 80 inches above the finished floor can protrude any amount. Recessing the wall mount location so that the face of the display is sufficiently inset or flush with the wall is also an acceptable solution. If recess mounting, architectural designs must specify dimensions based on the exact form factor of the display enclosure and embedding structure within a custom wall cavity and particular attention must also be paid to ventilation and cooling requirements for display panels or AV components. Another quick fix is to install furniture (or kick rails) underneath the display location.

Touchscreen Placement
ADA requirements for touch screens are primarily focused on the physical placement and accessibility of such devices. For example, the maximum for ADA touch screen mounting height is 48", keeping all touch components within easy reach of someone in a wheelchair. There should also be ample space around the touch screen in which a wheelchair can easily be maneuvered. Mounting orientation may change this dynamic and interactive content should be focused in the lower section if there are potential accessibility concerns around non-standard placement or mounting height.

Assistive Listening Systems
The ADA contains specific requirements for assistive listening systems in public assembly areas “where audible communication is integral to the use of the space.” In public spaces that must comply with ASL regulations, clearly visible signage must be posted alerting patrons to the availability of hearing assistance devices. Conference services maintains ALS packages which are provided for the hard of hearing upon request.

17.5.2 OSHPD COMPLIANCE

The Office of Statewide Health Planning and Development (OSHPD) is responsible for overseeing all aspects of construction for general acute care and psychiatric hospitals, as well as multi-story skilled nursing homes and intermediate care facilities in California. AV-specific considerations are primarily related to seismic safety code requirements. All non-structurally integrated equipment must be mounted on certified brackets in areas subject to OSHPD regulations. A certified mounting brackets' support and attachments are pre-approved by OSHPD through OSHPD OPM Certification.

17.6 RECOMMENDED HARDWARE LIST

Display			
Manufacturer	**Model**	**Description**	**Specified for**
Samsung	QM55B 55” LH55QMBEBGCXGO	55” LED display for conference rooms and digital signage -4K60	Huddle/Small Room and Digital Signage
Samsung	QM65B 65” LH65QMBEBGCXGO	65” LED display for conference rooms and digital signage -4K60	Small Conference Room and Digital Signage
Samsung	QM75B 75” LH75QMBEBGCXGO	75” LED display for conference rooms and digital signage -4K60	Medium/Large Conference Room and Digital Signage

Samsung	QM85R-B 85” LH85QMRBBGCXGO	85” LED display for conference rooms and digital signage -4K60	Large Conference Rooms/Training Room and Digital Signage
Samsung	QM98T-B 98” LH98QMTBPGCXZA	98” LED display for conference rooms and digital signage -4K60	Large Conference Rooms/Training Room and Digital Signage
NEC	ME551	55” LED display deployed in HAS Huddle Rooms	Huddle Room
NEC	V554	55” LED display (replaced by ME551 model above)	Huddle Room

Audio			
Manufacturer	**Model**	**Description**	**Specified for**
Sennheiser	TCC2	Microphone array; ceiling tile embedded	Training Rooms
Shure	MXA710	Microphone array; wall or column mounted	Large/Medium Rooms
QSC	AD-C6T-LP	Speaker; ceiling tile embedded sound tube speaker (passive)	Training Rooms
QSC	AD-S402T	Speaker; surface mounted satellite speaker (passive)	Large/Medium Rooms
QSC	SPA2-60	Amplifier; rack mountable, 2 channel	Large/Medium Rooms and Training Rooms

QSC	Core Nano	Q-SYS digital signal processor	Large/Medium Rooms and Training Rooms

Conferencing and Collaboration			
Manufacturer	**Model**	**Description**	**Specified for**
Cisco	CS-CODEC-PRO	Webex Codec Pro conferencing system	Large Conference Rooms and Training Rooms
Cisco	CS-CODEC-PLUS	Webex Codec Plus conferencing system	Medium Conference Rooms and Project Team Rooms
Cisco	CS-BRD75P-K9	All-in-one, touch screen collaboration device	Large/Medium Rooms and Training Rooms
Cisco	CS-BRD55P-K9	All-in-one, touch screen collaboration device	Small Conference Rooms and some Huddle Rooms
Cisco	CS-T10-TS	Webex Room Navigator touch screen controller or scheduler panel	All Conference Rooms, **not** specified for Huddle Rooms
Cisco	CS-CAM-PTZ4K	Conferencing camera for Cisco Room Kits	Training Rooms
Cisco	CS-QUADCAM	Cisco video bar system	Large/Medium Rooms

Mounting Brackets

Manufacturer	Model	Description	Specified for
Peerless	SA761PU	Articulating Wall Mount for 39" to 75" Displays	Huddle Rooms
Peerless	ST680	Universal Tilt Wall Mount for 60" to 98" Displays	Large/Medium Rooms and Training Rooms
Cisco	CS-BRD75P-WMK	Cisco Webex Board Pro 75 wall mount kit	Large/Medium Rooms and Training Rooms
Cisco	CS-BRD55P-WMK	Cisco Webex Board Pro 55 wall mount kit	Small Conference Rooms and some Huddle Rooms
Cisco	CS-T10-WM-BR	Webex Room Navigator wall mount bracket	All Conference Rooms, **not** specified for Huddle Rooms
Cisco	CS-CPRO-WMK	Cisco Codec Pro wall mount bracket	Large Conference Rooms and Training Rooms
Cisco	CS-KITPLUS-WMK	Cisco Codec Plus wall mount bracket	Medium Conference Rooms and Project Team Rooms
Cisco	CS-PTZ4K-BRKT	Webex PTZ 4K Camera wall mount bracket	Training Rooms
Cisco	BRKT-QCAM-WMK	Cisco Quad Camera wall mount bracket	Large/Medium Rooms

17.7 DEFINITIONS

- **ADA:** The Americans with Disabilities Act is federal regulation policy prohibiting discrimination against people with disabilities in several areas, including employment, transportation, public accommodations, communications and access to state and local government' programs and services.
- **ANSI:** The American National Standards Institute (ANSI), a private, not-for-profit organization that develops and supports U.S. voluntary consensus standards.

- **Audiovisual Integrator:** External entity commissioned by UC DAVIS HEALTH for equipment installations, technical support, or other work related to AV systems and processes.
- **AVIXA:** Audio Visual and Integrated Experience Association, a prominent trade association representing the professional audiovisual and information communication industries worldwide. Formerly known as InfoComm.
- **Codec:** "Coder/Decoder". In a conferencing system context, Codec refers to the endpoint device that receives and transmits communications signals.
- **CRC: "**Cloud Room Connector", license required for Zoom interoperability with Webex-native Cisco video conferencing endpoints.
- **CVI: "**Cloud Video Interop", license required for Teams interoperability with Webex-native Cisco video conferencing endpoints.
- **DSP**: Digital Signal Processor, a hardware I/O interface for audio components, which routes signals and manages audio processing functions like EQ and automixing.
- **EDID:** Extended display identification data. Digital handshake between a source device and external display initiated each time a new video connection is detected.
- **HDCP:** High-bandwidth Digital Content Protection (HDCP) is a form of digital copy protection developed by Intel Corporation to prevent copying of digital audio and video content as it travels across connections.
- **HDMI:** High-Definition Multimedia Interface, a proprietary audio/video interface for transmitting uncompressed video and audio data from an HDMI-compliant source device, such as a laptop, to a compatible digital display or audio device.
- **MTR:** Microsoft Teams Room, combines room-based conferencing hardware running a dedicated, Microsoft developed conferencing application. Multiple manufacturers offer Microsoft-certified MTR systems.
- **NEC:** National Electrical Code standard administered by the National Electrical Manufacturers Association (NEMA).
- **OBTP:** One Button To Press, dedicated button for Webex-native conferencing systems to directly launch meetings from the Cisco Room OS home screen.
- **POE:** Power over Ethernet, supplies discrete electrical power over network cabling.
- **Rack:** A cabinet enclosure with mounting rails to securely house AV/IT equipment.
- **RU:** Rack unit, a spacing measurement (1 rack unit = 44.45 mm (1.75 inch) height).
- **Shall:** Denotes a mandatory requirement.
- **Should:** Denotes an advisory statement.
- **SPL:** Sound pressure level.
- **System:** All combined AV components, cabling, and programming, as defined in project specifications.
- **TR:** Telecom room, common term for network closet or data frame installation.
- **UC DAVIS HEALTH:** University of California, Davis Health System
- **VLAN:** Virtual Local Area Network, a custom network configuration which subdivides and re-partitions host objects at the data link layer, effectively isolating network traffic for a specified subset of endpoint devices.
- **VTC:** "Videotelephony" or Video teleconferencing. Commonly referred to as simply video conferencing, consists of multipoint reception and transmission of audio and video signals by people in different locations for real-time communication.
- **Will:** Denotes an informative statement.

17.8 EXCEPTIONS TO THE STANDARD

Any exceptions, deviations or amendments to this Standard must be documented and submitted to the Enterprise Architecture Steering Committee as part of its normal design review. If approved, it is a one-time exception for the requesting project or work group only, and the exception and its approval must be maintained as part of the project, work group or contract documentation, including (and especially) any operational runbook artifacts produced by the project. If not approved, the full requirements of this Standard must be followed.

17.9 CONSEQUENCES

Failure to fulfill the requirements of this Standard, in the case of an IT system, shall result in rejection of the request and denial of the system for production use.

18 CELLULAR DAS TELECOMMUNICATIONS RADIO UNITS/ACESS POINTS

The cellular DAS system shall provide coverage that meets industry standards, ensuring consistent connectivity throughout the building. Signal strength and reliability must be maintained across the entire space. The system must not interfere with other building components or elements. It should have a low life-cycle cost, offering excellent signal quality to enhance productivity for both patients and occupants while minimizing maintenance. The DAS system must also support future reconfiguration of locations, allowing the organization to adapt to changes with minimal modifications needed to preserve connectivity and signal quality.

UC Davis has standardized on a coaxial-based DAS system, recognizing its ability to provide reliable cellular DAS coverage that meets industry standards. This decision is based on the system's proven performance in supporting the required frequency range of 600 MHz to 4.2 GHz while maintaining flexibility for future upgrades.

The DAS system must also accommodate future reconfigurations with minimal modifications.

18.1 CELLULAR DAS TELECOMUNICATIONS WIRELESS PROVIDERS TO BE INCLUDED

The System shall be able to simultaneously support the following wireless carriers and services.

a. AT&T Wireless and (FirstNet)

b. T-Mobile

c. Verizon

d. Include 5G services for each carrier

e. C-Band Capable, coax and antennas to be able to cover those frequencies

f. mmWave band should be considered for Future Deployment (above C-band freqs.)

g.

18.2 CELLULAR DAS TELECOMUNICATIONS WIRELESS FREQUENCIES TO BE INCLUDED

Service	(MHz) Technology	Reference Technology	Frequency Reference *Alternate*
600 MHz Some equipment may not support this fq.	DL: 663 – 698 MHz UL: 617 – 652 MHz	FDD LTE	TDD 5G
700 MHz	DL: 728 – 798 MHz UL: 698 – 798 MHz	FDD LTE	TDD 5G
Cellular or 800 MHz	DL: 869 - 894 MHz UL: 824 – 850 MHz	FDD LTE	TDD 5G
PCS	DL: 1930 – 1995 MHz UL: 1850 – 1915 MHz	FDD LTE	TDD 5G
AWS	DL: 2110 – 2155 MHz UL: 1710 – 1755 MHz	FDD LTE	TDD 5G
AWS-3	DL: 2175 – 2180 MHz UL: 1755 – 1780 MHz	FDD LTE	TDD 5G
BRS/EBS	UL/DL shared 2496 – 2690 MHz	TDD 5G	none at this time
CBRS	UL/DL shared 3400 – 3650 MHz	TDD 5G	none at this time
C-Band	UL/DL shared 3700 – 4200 MHz	TDD 5G	none at this time

18.3 CELLULAR DAS DESIGN REQUIREMENTS

1. Do not combine the Cellular DAS with other radio systems such as:
    - Wi-Fi systems.
    - Pager systems.
    - Medical telemetry systems.
    - ERRCS (Emergency Responder Radio Communication System)
    - Provide at least a -95 dBm signal strength over 95% of the area for public safety

18.4 CELLULAR DAS PERFORMANCE CRITERIA

The DAS shall provide seamless, high-quality cellular coverage throughout the facility, ensuring reliable connectivity for all users.

1. Coverage & Signal Strength
    - Maintain ≥ -95 dBm signal strength across all designated areas.
    - Minimum Received Signal Strength Indicator (RSSI) of -70 dBm with a Signal-to-Noise Ratio (SNR) of 20 dB or higher for 5G
2. Interference & Network Integrity
    - Prevent interference with macro networks and adjacent RF systems.
    - Maintain signal quality through proper isolation, filtering, and power balancing.
3. Public Safety & Reliability
    - Ensure compliance with FirstNet/Public Safety DAS requirements.
4. Testing & Validation
    - Perform RF validation testing, including coverage mapping and carrier acceptance.
    - Pre and post scanner data from all carriers to include all floors and exterior first floor collection.
    - Provide comprehensive signal performance reports and compliance documentation.

18.5 CELLULAR DAS AS-BUILTS

1. Cover Page & Project Overview
    - Project Name & Location

- Client Information (UC Davis, hospital, venue, etc.)
- DAS Integrator/Contractor (e.g., Metropolitan Electric)
- Wireless Carrier(s) & Frequency Bands (AT&T, Verizon, T-Mobile)
- Date of Completion

2. System Design & Layouts

- Floor Plans & RF Design Maps – Finalized layouts showing antenna placements, fiber/coax routes, and IDF/Head-End locations
- Equipment Locations – Head-End, Remote Units (RUs), Antennas, POE locations
  Cable Pathways & Risers – Conduit, fiber, and coax runs with labeling

3. Bill of Materials (BOM)

Equipment List – Breakdown of all installed components, including:

- DAS Head-End (OEM: JMA, Corning, CommScope, SOLiD, etc.)
- Remote Units (RUs) and Nodes
- Antennas (Omni, Directional, Panel)
- Coaxial Cables, Fiber, and Splitters
- Power Systems (UPS, Rectifiers)
- Network Components (Switches, Routers, Firewalls)

5. Pre-Installation Survey and Post-Installation Coverage Testing:

- Original measurements of the macro signal strength (e.g., RSRP, RSSI) both inside and outside the building (or building site in the case of greenfield construction), which serve as a baseline.
- comprehensive test results and reports verifying signal saturation and quality throughout the entire building, demonstrating the system meets the specified coverage and capacity goals:

4. Commissioning & Optimization Reports

System Performance Data:

- Signal Strength (RSRP, RSSI, SINR, RSRQ)
- Downlink/Uplink Throughput

- E911 Call Testing Results (Ray Baum's Act Compliance)
- PIM & VSWR Reports (Passive Intermodulation & Cable Line Sweep)
- Pre and post scanner data from all carriers to include all floors and exterior first floor collection.
- Propagation Maps & Heatmaps (Before & After)

5. Equipment Labeling & ID Convention

Labeling Scheme – Includes all antennas, cables, and head-end components with logical naming (e.g., ANTENNA: NAOB2-2322-ANT.1)

6. Test Results & Acceptance Criteria

- Carrier Acceptance Test Results (AT&T, Verizon, T-Mobile approvals)
- Noise Floor & Interference Analysis
- Call Testing & Handovers (VoLTE, 5G NR, LTE)

7. Maintenance & Troubleshooting Guide

- System Diagrams & Troubleshooting Steps

a. Contact Info for Support & Vendor Warranties

19 EMERGENCY RESPONDER RADIO COVERAGE TELECOMMUNICATIONS RADIO UNITS/ACCESS POINT

The ERRCS DAS system shall provide code required signal propagation as defined in NFPA 1221 and Article 510 of the California Fire Code, ensuring consistent connectivity throughout the building. Signal strength and reliability must be maintained across the entire space. The system must not interfere with other building components or elements. The ERRC DAS system must also support future reconfiguration of locations, allowing the organization to adapt to changes with minimal modifications needed to preserve connectivity and signal quality.

20.1 EMERGENCY RESPONDER RADIO COVERAGE SYSTEM DESIGN AND COMPLIANCE:

- Provide detailed drawings showing the general system architecture, equipment locations, and cable routing for all areas of the building.
- The system design must include signal amplification on every floor of the building, with infrastructure (equipment space, electrical power, and cable pathways) installed throughout.
- For floors that do not meet the pre-installation signal strength or coverage requirements, signal amplification should be installed. However, reserve spare capacity for floors that pass pre-installation testing but may experience signal degradation after construction and furniture installation.

- The design and installation of the ERRC system must comply with the California Fire Code, Title 24, part 9 and NFPA 72 as applicable.
- Pre-construction surveys by the contractor shall determine if signal amplification is needed, ensuring that all requirements are met before system installation.
- Ensure that the system is registered and compliant with the most current rulings of the Federal Communications Commission (FCC). Additionally, ensure the system complies with the California Public Safety Communications Network and obtains necessary licenses or consents from local authorities and or the AHJ.
- All equipment must be Underwriters' Laboratories (UL) listed and labeled per applicable standards, including UL 2524 compliance.

EMERGENCY RESPONDER RADIO COVERAGE system must provide comprehensive, code-compliant coverage in all critical areas of UC Davis facilities, ensuring emergency responders can communicate effectively during critical situations.

20.2 EMERGENCY RESPONDER RADIO COVERAGE TELECOMMUNICATIONS FREQUENCIES TO BE INCLUDED

Service	(MHz) Technology
700/800 Public Safety	UL : 793-805, 806-824 DL : 763-775, 851-869
SMR 800 (iDEN 800)	UL : 806 – 824 DL : 851 - 869
SMR 900 (iDEN 900)	UL : 896 – 902 DL : 929 - 941
Commercial Paging	DL : 929.6125

20.3 EMERGENCY RESPONDER RADIO COVERAGE DESIGN REQUIREMENTS

- Do not combine the ERRCS DAS with other radio systems such as:
  - Wi-Fi systems.
  - Pager systems.
  - Medical telemetry systems.
  - Cellular DAS

20.4 EMERGENCY RESPONDER RADIO COVERAGE PERFORMANCE CRITERIA

The DAS shall provide seamless, high-quality cellular coverage throughout the facility, ensuring reliable connectivity for all users.

1. Coverage Requirements:
    - General Areas: The IFC mandates that 95% of all areas within a building must have adequate radio coverage.
2. Critical Areas:
    - The NFPA requires 99% coverage in critical areas such as emergency command centers, fire pump rooms, stairwells, and other designated critical locations.
3. Signal Strength:
    - The radio signal strength inside the building should match that of the exterior to ensure seamless communication for emergency responders.
4. System Testing and Maintenance:
    - Both the IFC and NFP require regular testing to ensure system reliability. The NFPA 1225 outlines annual testing requirements for any building with a Public Safety DAS installed.
5. System Supervision:
    - The radio system's integrity must be supervised by the building's fire alarm system to alert to malfunctions, such as antenna failure, signal booster failure, or low battery capacity.

20.5 EMERGENCY RESPONDER RADIO COVERAGE PERFORMANCE CRITERIA: California-Specific Guidelines:

In California, the 2022 California Fire Code (CFC) has specific provisions for ERRC systems:

1. New Buildings:
    - All new buildings must meet minimum performance requirements for in-building emergency responder communication system coverage. Upon completion, a radio coverage test is required, and if the building fails, an ERRCS must be installed.
2. Existing Buildings:
    - Buildings undergoing changes in use or occupancy, or those without existing wired fire department communication systems, are required to conduct radio tests. If they fail, an ERRCS must be installed within three years of the test date.

20.6 EMERGENCY RESPONDER RADIO COVERAGE AS-BUILTS

Cover Page & Project Overview

- Project Name & Location
- Client Information (UC Davis, hospital, venue, etc.)
- DAS Integrator/Contractor (e.g., Metropolitan Electric)
- Wireless Carrier(s) & Frequency Bands (AT&T, Verizon, T-Mobile)
- Date of Completion

1. Antenna Placement:
    - Provide detailed drawings showing the exact location, height, and angles of all antennas (donor and distributed, with named labels).
2. RF Coverage Map:
    - Show signal coverage throughout the building, highlighting weak spots and ensuring compliance with coverage requirements.
3. Equipment List:
    - Include all system components (make, model, serial numbers) and their power requirements.
4. Cable Routing & Specs:
    - Show cable paths and provide details on cable type, length, gauge, and signal loss.
5. Signal Strength Testing:
    - Document signal strength readings and any adjustments made to meet coverage standards.
6. Power & Equipment Locations:
    - Identify power sources, backup systems, circuit numbers, grounding, and surge protection.
7. System Configuration:
    - Record final system settings, including frequencies, power levels, and gain adjustments.
8. Regulatory Compliance:
    - Provide proof of compliance with NFPA 1221, local fire codes, and other standards, along with final inspection approval.
9. Maintenance Access:
    - Clearly mark locations for future maintenance, including headend equipment and amplifiers.
10. Final Testing & Inspection:
    - Document test results for signal strength, equipment function, and backup systems, along with any corrective actions taken.