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1.2. Introduction and Purpose

This document provides the Yale IT design guidelines to ICT Design professionals for use in preparation of construction documents for new construction and renovation projects. The scope of this document includes requirements for IT project processes, structured cabling systems, security systems, audiovisual systems, and distributed antenna systems. This document is subject to change in form and technical content as warranted by advancements in building construction techniques and IT systems technology. As such, Yale University specifically reserves the right to add to and revise the information contained herein.
These design guidelines shall not be used as the final specification or bid document for any specific new or renovation project. Detailed and specific requirements for a project shall depend on the programmatic use of the space(s) and shall be confirmed during the project formulation and design phases of the project. The ICT Designer shall incorporate existing systems to ensure a seamless co-existence of newly provided infrastructure.

The project ICT Designer shall be a BICSI Registered Communications Distribution Consultant (RCDD) and/ or an AVIXA Certified Technology Specialist (CTS). The ICT Designer shall consult with the Yale Facilities Project Manager; Yale IT and project end users to ensure all IT requirements for the project are met.

Variances and exceptions are to be presented to Yale IT for approval in writing and shall include a written explanation and drawings describing the proposal. The ICT Designer or Contractor submitting the exception request is responsible to ensure that the performance of the system and the requirements of this specification are met within the proposed changes.

Work Not in Scope

Refer to Appendix B – Differential Scope of Work Matrix for complete scope of work descriptions. Items not in the ICT designer design and specification scope of work include:
- The Yale IT active electronic network equipment.

Governance and Compliance

The awareness of these standards and shared practices along with the adherence and adoption of these standards will be governed and administered through a variety of channels.

**ITS-FTS/PS/FAC:** The Information Technology Services (ITS) Foundational Technology Services (FTS) teams, Public Safety (PS) teams, as well as the Office of Facilities (FAC) Capital Program and Facilities Operations teams, are the collaborative governing body for IT infrastructure construction standards at Yale. Together ITS-FTS, PS and FAC will help to ensure visibility and adoption of these standards. Members of these teams will work with ICT designers and contractors to clarify standard requirements and permit exceptions when necessary.

**TAC:** The Technology Architecture Committee (TAC) will help to ensure that there is awareness and visibility of these standards for any future projects and initiatives that come through the ITS Gating Process. They will assist in establishing the connection between the projects and groups like the ICC (see below). Additional information can be found on the confluence site: [https://yaleits.atlassian.net/wiki/spaces/STAN/pages/803668001/TAC](https://yaleits.atlassian.net/wiki/spaces/STAN/pages/803668001/TAC)

**PMO:** The Project Management Office (PMO) will also have an active role in understanding what projects may need to engage the Enterprise Monitoring service during the project portfolio process. They can in turn help to provide awareness and use of services in addition to how they should be engaging with the appropriate governing bodies through the ITS Gating process.

**ISO:** Yale’s ITS Information Security Office (ISO) will continue to be another mechanism to help ensure adherence to predefined standards through processes such as the SDR.

**TAST:** The Technology Architecture Standards Team (TAST) is a committee that has been initiated and formed under the current CIO to look across our technology landscape and to help in identifying areas for standards and shared practices. This document, along with many others, has been discussed and reviewed with this group. Additional information can be found on the confluence site: [https://yaleits.atlassian.net/wiki/spaces/STAN/pages/803700826/TAST](https://yaleits.atlassian.net/wiki/spaces/STAN/pages/803700826/TAST)
Support

Support for the ICT Designer to request additional information or clarifications is available through the project specific Facilities project manager and Yale IT support personnel assigned to the project. Direct all inquiries to the Facilities project manager for distribution to the appropriate Yale IT personnel.

1.3. Codes and Standards

The IT systems design shall adhere to Industry Standards, applicable building codes, and specific user requirements for the building. Relevant codes and standards to be followed are listed below. For a complete list of IT standards, refer to the BICSI TDMM 14th Edition Appendix A: Codes, Standards, Regulations, and Organizations.

TIA:
- TIA-526-7-A, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
- TIA-526-14-C, Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant
- TIA-568.0-E, Generic Telecommunications Cabling for Customer Premises
- TIA-568.1-E, Commercial Building Telecommunications Cabling
- TIA-568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components
- TIA-568.3-D, Optical Fiber Cabling Components
- TIA-568.4-D, Broadband Coaxial Cabling and Components
- TIA-569-E, Telecommunications Pathways and Spaces
- TIA-606-C, Administration Standard for Telecommunications Infrastructure
- TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- TIA-758-B, Customer-Owned Outside Plant Telecommunications Cabling Standard
- TIA-862-B, Structured Cabling Infrastructure Standard for Intelligent Building Systems
- TIA-942-B, Telecommunications Infrastructure Standard for Data Centers
- ANSI/TIA-1152-A: Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- ANSI/TIA-1179-A, Healthcare Facility Telecommunications Infrastructure Standard
- TIA-TSB-162-A, Telecommunications Cabling Guidelines for Wireless Access Points
- TIA TSB-184-A Guidelines for Supporting Power Delivery over Balanced Twisted-Pair Cabling

BICSI:
- BICSI Telecommunications Distribution Methods Manual (TDMM), 14th Edition
- BICSI Telecommunications Project Management Manual (TPMM), 1st Edition
- ANSI/BICSI 002-2019, Data Center Design and Implementation Best Practices
- ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
- ANSI/BICSI 006-2020, Distributed Antenna Systems (DAS) Implementation Best Practices
- ANSI/BICSI N2-17, Practices for the Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications
- ANSI/BICSI N3-20, Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure

AVIXA:
- Audio Coverage Uniformity in Listener Areas
- Standard Guide for Audiovisual Systems Design and Coordination Processes
- Image System Contrast Ratio
- Audiovisual Systems Performance Verification
- Videoconferencing Lighting
- Rack Design for Audiovisual Systems

Codes:
- National Fire Protection Association (NFPA) 70, National Electrical Code
  - Article 110: Requirements for Electrical Installations
  - Chapter 3: Wiring Methods and Materials
  - Chapter 5: Special occupancies, including hazardous locations and health care facilities
  - Article 645: Information Technology Equipment
  - Article 770: Fiber Optics
  - Chapter 8: Communications Systems
- NFPA 72, National Fire Alarm and Signaling Code
- NFPA 75, Standard for the Fire Protection of Information Technology Equipment
- NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
- Connecticut State Building Code
- International Fire Code, Section 510 Emergency Responder Radio Coverage in New Buildings
- ASME A17.1-2016, Safety Code for Elevators and Escalators
- Americans with Disabilities Act (ADA)

1.4. Terms and Abbreviations

For a complete list of relevant ICT industry acronyms, definitions, and abbreviations, refer to BICSI’s ICT Terminology Handbook, Version 3.0. Yale IT specific acronyms, definitions, and abbreviations include, but are not limited to the following:

- **Core Network Room** – A dedicated room containing the Yale IT core network electronics - the public switched telephone network (PSTN) lines - health, life, and safety (HLS) electronics - and, central control equipment for alarms and notification systems, that provide data network and telecommunications services to campus buildings. The Core Network Room is the primary origination point of first-level copper and fiber backbone cables; a cable infrastructure configured in a physical star, that terminates in campus buildings. For the required building services, the core electronics and equipment are interconnected with the campus backbone cable system via main distribution terminal (MDT) cross-connections and/or fiber distribution panels (FDP) patch cord patching.

- **IDT** – Intermediate Distribution Terminal: Located within a floor Telecom Room, the IDT is defined as a group of connectors (e.g., patch panels, punch-down blocks) that allow horizontal cross-connect (HC) of horizontal, backbone, and equipment cabling to be cross-connected with patch cords or jumpers. Also commonly referred to as an intermediate distribution frame (IDF).
● MDT – Main Distribution Terminal: Located within the building main Telecom Room, the MDT is defined as the intermediate cross-connect (IC) connection point between a backbone cable that extends from the campus main connect (MC) and the backbone cable from the horizontal cross-connect (HC). Also commonly referred to as a main distribution frame (MDF).

1.5. References

Office of Facilities Yale University: Refer to the Office of Facilities Yale University Design Standards for Capital Projects for additional project requirement including, but not limited to:

- General Guidelines
- Division 00: Procurement & Contracting Documents
- Division 01: General Requirements
- CAD Standards
- CAD Titleblocks
- Yale University Contractor Health & Safety Guidelines
- Link: [https://facilities.yale.edu/contractor-consultant-resources/design-guidelines/yale-university-design-standards-capital-project](https://facilities.yale.edu/contractor-consultant-resources/design-guidelines/yale-university-design-standards-capital-project)

- Link: [https://yale.box.com/s/c9dq5cyrpworldnkaohx559vqm2ta57](https://yale.box.com/s/c9dq5cyrpworldnkaohx559vqm2ta57)

Yale IT: Minimum Physical Security Standards for Critical IT Spaces
- Link: [https://cybersecurity.yale.edu/protectingcriticalitspaces](https://cybersecurity.yale.edu/protectingcriticalitspaces)

1.6. Project Contractor Requirements and Qualifications

The ICT Designer shall include within the project specifications that the Structured Cabling Contractor shall meet the following requirements and qualifications:

- Contractor Resume: a resume of qualifications shall be submitted with the Contractor’s proposal indicating the following:
  - A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
  - A list of test equipment proposed for use in verifying the installed integrity of copper and fiber optic cable systems on the project.
  - A technical resume of experience for the Contractor’s project manager and on-site installation supervisor assigned to the project.
  - A list of technical product training and manufacturer certifications attained by the Contractor’s personnel installing the system.
  - A list of subcontractors who will assist the Contractor in performance of the work. Subcontractors shall meet the same training and certification requirements as the prime Contractor.

- The Contractor shall provide documentation indicating proper licensing by the State of Connecticut to install structured cabling systems.
The Contractor shall be manufacturer certified, such that the structured cabling plant system will be warranted by the specified manufacturer for parts, labor, and application assurance for a period of no less than 25 years. The Contractor shall submit copies of the manufacturer certifications.

The project security system scope of work, including building access control, security cameras, intrusion detection, and intercom/emergency communications, shall be provided by a prequalified Security Contractor. Contact Yale IT to confirm the current list of prequalified Security Contractors approved to perform projects at Yale. Incorporate the prequalified Security Contractor list into the project bidding requirements.

1.7. Demolition and Temporary Protection of Yale IT Systems

Campus renovation projects may involve work effecting telecommunications infrastructure that is existing to remain. Temporary protection and selective demolition shall be provided by the project or through an associated enabling project. The following provisions shall be included in projects in coordination with project and construction managers:

- Existing Telecom Rooms and infrastructure effected by project demolition and renovation shall remain in operation until successful cutover to replacement Telecom Rooms and infrastructure, or until temporary service is established.
- Prior to demolition of existing Telecom Room walls, ceilings or flooring, construct temporary barriers fully enclosing the existing room equipment. The barriers shall provide physical protection from demolition debris and environmentally seal off the equipment to prevent ingress from dust and contaminates.
- Provide temporary cooling within the barrier spaces to maintain a temperature range between 50-85 degrees Fahrenheit and 10%-90% relative humidity noncondensing. Provide positive pressure within the barrier for dust control. Cooling equipment shall be served by the campus alternate power source if available in the building, or by a standby generator.
- Provide temporary power for the room equipment to maintain operation throughout the duration of construction. Temporary power shall be on alternate power source.
- Yale IT shall have access to all equipment throughout the course of construction. Provide a barrier entrance with sticky clean walk-off floor mats.
- Provide an IP based environmental monitoring system which shall alert the Contractor upon loss of power and when temperature and humidity is outside the acceptable ranges.
- The Contractor shall be held responsible for replacement of Yale IT equipment damaged or for voiding equipment warranties during construction per the general conditions of the contract.
- Temporary short duration planned outages of room equipment shall be preapproved by Yale IT.
- Provide sealed cabling egress ports for existing and new cabling routing through the barriers to the equipment racks. Where existing cabling bundles route through walls scheduled for demolition, provide protection for cabling and re-support cabling from structure. Permanent sleeves shall be provided around existing cabling to be built into new walls.
- Provide selective demolition of cabling back to the patch panels in the equipment racks. Re-terminate and re-label existing to remain cabling infrastructure on patch panels such that gaps do not exist where cabling was demolished. Organize the existing and new patch panel termination per the final permanent renovation layout.
- Relocation of IT active equipment within the room shall be performed by Yale IT.
• The Contractor is responsible to maintain continuity of branch wiring, controls cabling, etc. of existing systems that may extend outside of the scope of the demolition work of the project.

1.8. Project Design and Construction Processes

Proper coordination of IT design and construction requirements are essential throughout the course of the project. Refer to Table 1 below for a summary of required tasks and deliverables organized by project phase. Note that some small projects of short duration shall have a combined Schematic Design and Design Development Phase, also referred to as an Enhanced Schematic Design (ESD).

Table 1 - Project Tasks and Deliverables

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<td>Forward Project Team Directory and Milestone Schedule to Yale IT representative</td>
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<td>Coordinate Project Telecom Rooms with Architect</td>
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<td>Coordinate with Utility Service Providers as Required</td>
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<td>Scope and Design Project Enabling Construction Packages</td>
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<td>Provide Site OSP Plan, Building Riser, and Telecom Room Service Zone Diagrams</td>
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<tr>
<td>Contractor shall provide Yale IT with weekly construction progress reports</td>
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<tr>
<td>Review and Approve Project Submittals (Copy and Discuss Approvals with Yale IT)</td>
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<tr>
<td>Conduct Sitework and Underslab Site Field Report(s)</td>
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<tr>
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<tr>
<td>Schematic Design</td>
<td>Design Development</td>
<td>Construction Documents</td>
<td>Bidding and Procurement</td>
<td>Construction</td>
<td>Close-Out</td>
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<tr>
<td>Conduct Telecom Room and Structured Cabling Field Report(s)</td>
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<tr>
<td>Sign-Off of Completed Turn Over and Acceptance Criteria</td>
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<td>Conduct Punch List(s) (Copy and Discuss Approvals with Yale IT)</td>
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<tr>
<td>Review and Approve Cabling Test Reports (Copy and Discuss Approvals with Yale IT)</td>
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<td>Review and Approve Operations &amp; Maintenance Manuals (Copy and Discuss Approvals with Yale IT)</td>
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<tr>
<td>Review and Approve Product Warranties (Copy and Discuss Approvals with Yale IT)</td>
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<tr>
<td>Review and Approve Record Drawings and BIM Model, Provided by the Contractor to LOD400 Level (Copy and Discuss Approvals with Yale IT)</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 1.9. Construction Drawings and Specifications

Provide a complete set of ICT construction documents detailing the project’s scope of work. The organization and contents of the drawings shall follow the recommendations of the BICSI Telecommunications Project Management Manual (TPMM) and ANSI/INFOCOMM 2M-2010 Standard Guide for Audiovisual Design and Coordination Processes. Indicate ICT design work on T-series (Technology), SE-series (Security), or AV-series (Audiovisual) drawings as required for the project. Refer to Appendix B – Differential Scope of Work Matrix for a system level breakdown of the work included in capital construction projects.

In addition, provide full CSI 3-Part Specifications including Division 27 – Communications and Division 28 – Electronic Safety and Security for each project. Typical Specifications Sections to be included, depending upon specific project requirements, are listed below. Refer to “Appendix G – CSI Outline Specifications” for abbreviated outline sections for reference only. The ICT Designer shall incorporate the content of the outline sections into full length specification sections for inclusion in the project construction documents.

**DIVISION 27 – COMMUNICATIONS**

- 270000 GENERAL COMMUNICATIONS PROVISIONS
- 270500 COMMON WORK RESULTS FOR COMMUNICATIONS
- 270526 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
- 270528 PATHWAYS FOR COMMUNICATIONS SYSTEMS
- 270529 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS
- 270534 FLOOR BOXES FOR ELECTRICAL AND COMMUNICATION SYSTEMS
- 270536 CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
- 270543 UNDERGROUND PATHWAYS AND STRUCTURES FOR COMMUNICATION SYSTEMS
- 270544 SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING
1.10. Project Budgeting and Schedules

Yale IT participates in the budget development and reconciliation process with the Facilities Project Manager during each project enabling, design, and bidding phase. To facilitate this process and properly plan for active systems deployment, the ICT designer shall proactively initiate coordination through the Facilities project manager. The ICT designer shall submit the following Coordination of Service Documentation (COSD) to Yale IT at each phase:

- "Appendix B – Differential Scope of Work Matrix"; Review and edit on a project specific basis. Each ICT system within the scope of work shall be identified.
- Project Summary: project name, project number, location, departments and occupancies, building space program with SF, and 8-1/2” x 11” plan diagrams
- Description of proposed site work and potential for interruption of existing infrastructure, including campus utility service providers
- Demolition and new work floor plans, indicating existing, relocated, and proposed Telecom Rooms
- Project schedule including enabling phases, departmental relocation move dates, certificate of occupancy dates, final occupancy dates
- ICT Basis of Design (BoD) narrative. The BoD shall include security systems device layout plan sketches and audiovisual systems types designations and quantities.
- ICT project drawings and specifications
- Telecommunications Key Connection Schedule: Coordinate and provide a Telecommunications Key Connection Schedule for each project in Microsoft Excel format. This schedule shall provide port take-off information for Yale IT to plan and deploy the network electronics and devices for the project. Refer to Table 2 below for a sample schedule:
### Table 2 – Sample Telecommunications Key Connection Schedule

<table>
<thead>
<tr>
<th>ROOM#</th>
<th>ROOM NAME</th>
<th>LOC.#</th>
<th>C6-V</th>
<th>C6-D</th>
<th>TV</th>
<th>FIB.</th>
<th>ACTIVE-Y/N</th>
<th>STA.ID</th>
<th>PHONE#</th>
<th>LEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X#</td>
<td>X#</td>
<td>X#</td>
<td>X#</td>
<td>X#</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X - FILLED IN BY THE ICT DESIGNER

# - NUMBER OF VOICE/DATA/CATV/FIBER AT EACH LOCATION

ACTIVE - CONNECT TO DATA HUB

The ICT designer shall review the Construction Manager’s project schedule for inclusion of the following milestones critical to Yale IT project deployments:

- Contractor bid review and descoping
- Bid award and Contractor notice to proceed
- ICT submittals review
- Selective demolition of existing ICT systems
- Communications site utility construction
- ICT systems rough-in
- ICT cabling installation
- Subcontractor network access requests
- Telecom Room turn over and acceptance
- Yale IT systems cutover
- Network Go Live
- Certificate of Occupancy Inspections
- End User Building Occupancy

### 1.10. Telecom Room Turn Over and Acceptance Criteria

Prior to Yale IT acceptance of newly constructed or renovated Telecom Rooms, the project Contractors shall complete the following checklist and submit for ICT Designer/Yale IT approval. Incorporate the criteria below as contract requirements in project documentation:

- Provide construction schedule milestones for turnover of Telecom Rooms. Give a minimum of six (6) weeks prior notice to permit network equipment orders such that the permanent equipment may be installed one time.
- The Structured Cabling Plant is installed in a neat and workmanlike manner, meeting the recommendations of the BICSI Information Technology Systems Installation Methods Manual (ITSIMM). All cabling is bundled and managed using required cable management and runways.
- The punch list walkthrough has been performed
- All construction is complete inside the MDT/IDT Telecom Rooms
- Wall and ceiling surfaces are clean with final paint. Plywood backboards are properly installed
- Flooring is deeply cleaned (and waxed if applicable)
- Equipment racks, components, and trays are free of dust
- Packaging, supplies, debris, and wire clippings are removed from the TR interior and exterior vicinity
- Ductwork and vents serving the Telecom Room are cleaned
- Cabling service loops are properly supported
• The Structured Cabling Plant is labeled with machine printed labels and tested
• TR patch cords have been furnished, ready for installation by the Cabling Contractor
• Telecom Room penetrations and openings are sealed and firestopped with room positive air pressure
• Environmental systems are commissioned and operating normally with new air filters or temporary HEPA filters
• Power outlets are operational with correct device types. Prior notifications of planned power outages are provided
• Lighting and controls are installed with fixtures positioned correctly
• Grounding and bonding are provided per TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
• Permanent door is locked with limited key availability and the card reader is activated
• Door dust stopper is installed
• Dirt trapper/sticky mats are placed inside entrance door

1.11. Approved Products and Substitutions

Refer to Appendix A – Approved Components and Manufacturers, for a detailed list of equipment to be specified in capital construction projects. Yale IT primarily utilizes the listed approved products and has adapted language, practices, expectations, and a maintenance inventory based on their use. All ICT designs shall specify the features, quality, and performance of the products offered by these manufacturers. Where a specific manufacturer's product is specified, the Contract shall be based on that product only. Where several manufacturer's products are specified, the Contractor may select any of the listed products.

1.12. Cable Testing and Verification

Each copper horizontal permanent link shall be tested and verified per ANSI/TIA-1152-A and ANSI/TIA-568.2-D standards with Level III field test instruments for Category 6 (250 MHz) and Level IIIe field test instruments for Category 6A (500 MHz) cabling.

Each horizontal and backbone optical fiber permanent link shall be tested and verified per ANSI/TIA 568.3-D, ANSI/TIA-526-7, and ANSI/TIA-526-14. Test parameters shall include optical loss testing, magnified endface inspection, length measurement, and polarity testing. Outside plant interbuilding backbones shall also receive OTDR bidirectional testing at required multimode and Singlemode wavelengths.

Cable television coaxial cable plant shall be tested and verified per TIA-568.4-D with signal level and TDR testing performed to record insertion loss, slope testing, leakage testing. Provide amplifier configuration charts.

Copper multipair backbones shall be tested and verified for continuity, conductor shorts, polarity, effective ground test for shield, ground faults, power fault.

Air blown fiber tube cable testing: pressure and obstruction tests for all tubes and tube cables shall be conducted to manufacturer's recommended procedures. Test reports shall include tube cable ID, tube # (in), tube # (out), test pressure (P.S.I.), time held, and span length.

Test reports shall be generated and submitted to the ICT Designer, Yale IT and the cabling system manufacturer for review in electronic format with the appropriate reader software. All results shall include the cable identification numbers, test date and times, test operator, and the make/model of the testing equipment.
1.13. Record Documents

Upon completion and close out of the project, the ICT Designer shall review, approve, and forward a copy of the final project ICT record documents to Yale IT through the Facilities project manager. Yale IT will integrate the documentation into the cable plant and network system management databases. Electronic file naming shall follow Yale facilities standards requirements. Record documents provided shall consist of the following:

- Electronic drawing files in the following formats
  - Revit BIM Model, Level of Development 400 (LOD400)
  - CADD files in AutoCAD 2019 Format
  - PDF files
- Drawing files containing scale drawings of the complete ICT work set with all Yale IT disciplines. This will include site and building floor layouts depicting outlet locations, equipment plans, device locations, final labeling, telecom rooms, cable pathways, riser diagrams and all other information pertinent to the installation. In addition, include security system devices and equipment including card readers, cameras, panels, and all other devices on record drawings.
- Provide laminated hard copy, black and white, double sided, 11”x17” record drawing floorplans of areas served by each telecom room, and wall mount with hook and loop fasteners in the corresponding telecom room.
- Spreadsheet tables in Microsoft Excel format providing categorized workstation outlet room locations and labels as well as cross-connect field labeling diagrams for each patch panel and 110 block.
- Outside Plant Documentation – Submit the following for Yale IT to incorporate into the campus Langan GIS outside plant database:
  - Record photography of each telecom maintenance hole/handhole wall, as well as ductbank point of entrance close-ups
  - Record photography of OSP excavation indicating uncovered site utilities prior to trench backfilling
  - Butterfly maintenance hole diagrams in Microsoft Excel format listing each backbone and ABF tube cable name, type, size, and conduit routing.
  - Communication site civil utility drawings with ductbank routes and depth profiles
  - ABF system distribution diagrams
- Test reports for various systems as required herein in PDF format and original test data files with reader software.
- Operation and Maintenance manuals in PDF format for each system as required herein.
- Product and systems warranties documentation as required, registered with the Manufacturer.
- Audiovisual control systems source code files and configurations
- Security panel input/output sheets for each node. Print each sheet and place in panel with a PDF sent to Public Safety. Request template from Yale IT.
- Security panels shall be bar coded per naming convention standards provided by Yale IT.
- Outdoor Access Point Installation Data including:
  - A floor plan identifying the exact location of each WAP
  - The identifier of the UTP permanent link supporting each WAP
  - The serial number and MAC address of each WAP in reference to its location
  - The mounting height above finished floor of each WAP
- User and system administrator training course materials and recordings

1.14. Interbuilding Backbone Pathways

Campus outside plant communications ductbanks and subbasement utility tunnels form the pathways for interbuilding backbone cabling serving each building. Yale IT must approve all pathways and building point of entrance designs in writing. Request existing outside plant record documentation from the Langan GIS system campus database for design reference. The recommendations of ANSI-TIA-758-B-2012 - Customer Owner Outside Plant Telecommunications Infrastructure and BICSI Outside Plant Design
Reference Manual, 6th Edition shall be followed for specific design and installation requirements. In addition, observe the following design criteria:

- Interbuilding backbone pathways shall be provided in buried duct structures or building utility tunnels.
- Backbone pathways to each building point of entrance from the designated existing communications maintenance hole shall consist of four (4) 4" schedule 40 rigid nonmetallic conduit in concrete encased reinforced ductbank, unless directed otherwise by Yale IT. Confirm project specific requirements for redundant pathways for physical route diversity.
- Depth to top of ductbank shall be no less than 30" from grade. Follow NESC and NEC requirements for minimum utility line separations.
- Each duct conduit shall be mandrelled and have a pull rope with footage markers installed. Conduit ends shall be reamed and plugged to prevent ingress of water and debris. Ductbanks shall slope away from building point of entrances at 1/8" per foot minimum.
- Tracer wire caution tape shall be installed 12 in. above communications underground ductbanks.
- Ductbank lengths, routing, and bends shall comply with ABF tube cable system installation limits and requirements. In a campus environment, continuous straight ductbank lengths between maintenance holes shall be limited to 350 ft. Ducts shall have no more than 180 degrees of cumulative bends between maintenance holes/handholes. Curvatures shall be long and sweeping with a minimum bend radius of 15 ft.
- Joint Use Maintenance Holes (MHs) are not permitted for communications infrastructure.
- Communications maintenance holes (MH) may either be pre-cast or cast-in-place with at least 24,000 kPa (3500 psi) concrete, typically sized 7'L x 7'W x 6'H. Final size selection is project specific, to be governed by Yale IT.
- MH’s shall have duct knockouts arranged for conduit entrances on all four walls. Conduits shall enter and exit the maintenance hole in a straight-line method. The remaining parallel walls are to remain free of conduit entrances for cable support and splicing operations unless otherwise permitted by Yale IT.
- MH appurtenances shall include ground rod, cable racks, pulling irons, 8” diameter sump hole, bolted entrance collar and frame, permanently installed ladder from top of collar to floor, and cover labeled “Telecommunications”
- MH covers shall be minimum 30” diameter round, cast iron, and centrally located on single-cover MH. Collar
- Handholes (HH’s) may be used in backbone pathways serving small facilities where the communications infrastructure requirements are sparse. HH’s shall be used as pull through points only and not splice points. HH’s shall not be used in conduit runs that have more than three (3) 4” conduits. The maximum HH size shall not exceed 4’L x 4’W x 4’H.
- HH covers shall be 30” round minimum and centrally located for full access to the vault. Frames and covers used in roads or driveways shall be H-20 rated minimum to withstand vehicular traffic.

Utility Service Provider Coordination

Where the project scope of work involves moves, adds, changes, or disruption to existing utility service provider infrastructure, coordinate requirements through Yale IT. Existing campus service providers include:

- Frontier
- Comcast
- Crown Castle
Air Blown Fiber (ABF) Campus Distribution

The ABF system forms the optical fiber pathway infrastructure for distribution of air blown PEF (Polyethylene Extruded Foam) jacketed fiber bundles that contain 2 to 48 strands. The project may provide ABF tube cables through the campus ductbank system to buildings from a Core Network Room, an intermediate fiber distribution hub in another building, or from splices in nearby maintenance holes. Coordinate ABF system designs with Yale IT, beginning in the schematic design phase. The number of required tubes and fiber bundles shall be sized to accommodate the fiber configuration specified by Yale IT. The tube cable pathway may be segments of new tube cables, existing tube cables, or a combination of both. They shall be spliced together at various locations, to provide a continuous tube for air blown fiber bundles from the Core Network Room to the project building destination.

For each fiber span, indicate fiber types, strand counts, fiber distribution panels, tube cables, tube distribution units, and indoor and outdoor tube splices. Fibers may be OM4 50/125 um multimode (MM) and/or OS2 singlemode (SM) in bundles of 2 to 48 fiber. Confirm quantity and types of fiber strands required with Yale IT.

Provide for termination hardware of fiber bundles in building and core network rooms. Specify appropriately sized, high density, MM and SM, rack mounted, fiber distribution panels (FDP) with connector adapters as directed by Yale IT.

Tube cables include capacities of 2, 4, 7, and 19 tube cells. The cable tube capacity shall accommodate immediate fiber requirements plus future spares, as directed by Yale IT. The tube cable may be installed in conduit, exposed in tunnels or plenums, and routed through MH’s. In all cases, the minimum bending radius of the tube cable, in conduit or not, shall be no less than 20 times the tube cable diameter.

Tube Distribution Units (TDU) are inside building enclosures used to transition or branch individual tube cells of tube cables. Tubes are joined together with manufacturer specified connector hardware, to provide the required, continuous, air blown pathways between building and core network rooms. At branch locations provide, unjacketed, black tubes to connect required tubes of one tube cable to another. At the network room locations, transition to unjacketed clear tubes for connection from the TDU to the rack mounted FDP’s. Bending radius of tubes to be no less than 9” radius. All non-used tubes in the tube cables are to be sealed with tube end caps and stored in the TDU

Provide and locate, in the building and core network rooms, and any required intermediate building branch points, appropriately sized wall mounted tube distribution units (TDU) to terminate tube cables. Manage tube cables using Kellems Grips and bushings as recommended by the system manufacturer. Mount no more than three tube cables per TDU enclosure.

Tube cable splices not in TDU’s may be required for long tube cable lengths (in-line) and/or branching in MH’s. Provide appropriately sized, preformed, outdoor splice casings for maintenance hole or tunnel installation. Install tubes cables in conduit in such a manner that one (1) conduit is full prior to using the next conduit. Conduit fill shall not exceed 40% of conduit cross sectional area. A maximum of two (2) 19-tube tube cables may be installed in one (1) 4 in. conduit without exceeding 40% conduit fill limitations. A maximum of five (5) 7-tube tube cables may be installed in one (1) 4” conduit without exceeding 40% conduit fill limitations.

The ABF system Contractor shall be certified by the ABF system Manufacturer to provide a 25-year extended warranty for the installation. The system shall be labeled including all fiber bundles, fiber termination units, terminations, tube cables, tube cells, tube splices, and tube distribution units. The system shall be fully tested, and reports provided as required. Documentation preparation shall include but is not limited to submittals, record drawings, system O&M documents, extended warranty, and manufacturer’s certification of systems.
1.15. Interbuilding Backbone Cabling

Project requirements for interbuilding multipair copper and hard sheath optical fiber backbones shall be provided to the ICT Designer by Yale IT. OSP multipair copper cable shall be gel filled with transition to non-gel filled riser cable or lightning entrance protector stubs prior to termination. OSP rated cabling may be routed exposed from the building point of entrance for no more than 50’ when not routed in IMC or rigid metal conduit. Provide lightning entrance protection for all OSP copper interbuilding backbone pairs, using 5-pin 240v solid state modules with PTC (positive temperature coefficient). Rack mounted lightning entrance protectors are typically provided within core network rooms with wall mounted units provided in building Telecom Room MDT’s. Typically, a 25 pair copper backbone or 25 existing pairs in an existing trunk bundle shall be provided to serve each building (to be confirmed by Yale IT). Copper multipair outside plant splices shall consist of preformed line product stainless steel fillable splice cases with re-enterable encapsulant and 710 modules.

1.16. Telecom Room Requirements

Telecom Rooms (TR’s) shall be designed as dedicated environmentally controlled rooms within buildings to serve as HC’s (IDT’s) or an IC (MDT) as well as contain active network electronics and building system head-end panels. Telecom room locations, sizes, and dimensions shall be designed in the schematic design phase and must be approved in writing by Yale IT.

Location and Adjacencies

- Telecom Rooms shall typically be located near the center of the area/floor served. The area served by the TR and the location of the TR shall be such that no permanent link exceeds 90 m (295 ft.) in total length.
- In a multi-story building, the TR’s shall be located as to stack one directly above another in vertical congruence.
- Consideration shall be given such that the TR location selected may offer expansion into a larger room. Locations that are restricted by building components limiting future expansion shall be avoided (e.g., elevators, building structural elements, kitchens, outside walls, or other fixed building walls, etc.)
- TR’s shall be accessible through common-use corridors that will allow the delivery of large cable reels and equipment, and access for repairs on a 24x7 basis.
- The main Telecom Room housing the building MDT shall be located as close as practical to the building entrance demarc point, and (if possible) to the electrical service room to reduce the length of OSP rated interbuilding backbones and bonding backbone grounding conductors.
- TR’s may not be inside of or be part of a mechanical space, equipment room, washroom, storage area, or janitor closet.
- TR’s shall be located in a dry area not subject to flooding. The TR shall not be located below water level unless preventive measures against water infiltration are employed. The room shall be free of water or drain lines not directly required in support of the equipment within the room. A floor drain shall be provided within the room if risk of water ingress exists.
- There shall be no obstructions in the room such as columns or building structure.
- Plumbing, piping, and fixtures are not permitted within a TR, except for a code required wet sprinkler line/head. The room shall not be located beneath toilets, showers, laboratories, kitchens, sinks, roof drain leaders, or other areas where water/liquid services are provided. No fire protection mains shall be routed through the room.
- The TR shall be located away from transformers, switchgear, motors, x-ray equipment, induction heaters, arc welders, radio and radar systems, or other sources of electromagnetic interference.
- Mechanical lines (e.g., ductwork, pneumatic tubing, electrical conduits), not related to the support of the TR, shall not be routed through it. In addition, the corridor plenum areas adjacent to the TR shall remain accessible and clear for cable pathways exiting the room.

### Architectural Design Criteria

**Room Sizes:** Each building, regardless of size, shall have a minimum of one (1) full size MDT Telecom Room, unless otherwise approved by Yale IT. For renovations and adaptive reuse projects, a Shallow Telecom Room (STR) or Telecom Enclosure (TE) design may be submitted for final approval by Yale IT.

Telecom Room size shall be based on Table 3 below. Final sizes shall be reviewed on project specific basis. All dimensions indicated below are inside room dimensions.

**Table 3 - Telecom Room Minimum Size Requirements**

<table>
<thead>
<tr>
<th>Building Area Served (GSF)</th>
<th>Room Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor Area 25,000+</td>
<td>10’x14’</td>
</tr>
<tr>
<td>Floor Area 10,000-25,000</td>
<td>10’x11’ *</td>
</tr>
<tr>
<td>Floor Area 5000-10000</td>
<td>10’x9’ *</td>
</tr>
<tr>
<td>Floor Area 0-5000</td>
<td>10’x8’ *</td>
</tr>
<tr>
<td>Building Smaller than 5000</td>
<td>4’x8’-6’ (Shallow TR configuration)</td>
</tr>
<tr>
<td>Building Smaller than 1000</td>
<td>Telecom Enclosure (TE)</td>
</tr>
</tbody>
</table>

*Where project programs require extensive audiovisual instruction and collaboration spaces, one or more TR’s shall contain at least one additional equipment rack for network-based IP AV 1 Gbps and SDVoE 10 Gbps systems. To serve this capacity requirement, a 10’x14’ TR room size will be required.

**Walls:** All four (4) walls shall extend from the finished floor to the structural deck (e.g. the slab) and be fire rated if required by NFPA or the Connecticut State Building Code. This requirement is to provide environmental protection (dust) and climate control for electronic equipment. All four (4) walls shall be covered with ¾ in. void free grade A-C FRT plywood. Plywood shall be painted on all six sides with two coats of light gray fire-retardant paint, with FRT stamps left unpainted. Mount plywood 6” above finished floor to a height of 8’-6” on all walls. No windows or door sidelites shall be provided in the room.

**Ceiling Height:** No finished ceiling, open to building structure above, with minimum 10’ clear above floor. Rooms shall not have a lay-in acoustical tile ceiling in order to not obstruct cable pathways. In such cases where fireproofing may be sprayed onto the exposed structural ceiling (deck), the fireproofing shall be treated to mitigate airborne dust.

**Finishes:** Floors, walls, and ceiling shall be treated to eliminate dust. Finishes shall be light in color to enhance room lighting in TR’s. Floor covering shall be a vinyl anti-static or conductive rubber tile material. Color shall be determined on a case-by-case basis. The flooring shall be prepped, leveled, sealed, and cleaned prior to installation of flooring materials.

**Doors/Access Control:** Doors shall be a minimum of 36” wide and 80” high, without doorsill, hinged to open outward (code permitting) and rated as required. Doors for shallow TRs shall be double doors that open out 180 degrees to corridor. Shallow TR doors shall have top and bottom flushbolts that secure the inactive leaf. Door(s) shall be fitted with the University standard wall mounted HID multiCLASS card reader with integral keypad for two-factor authentication. The lock shall be electrified with key override keyed for a Yale IT key code. Door position switch, latch bolt monitoring, and a request to exit switch shall be provided. A campus IP security camera shall be provided in the Telecom Rooms to monitor the room entrance.
Floor Loading: The TR shall be located on floor areas designed with a minimum floor loading of 2.4 kPa (50 lb./ft²). The project structural engineer shall verify that concentrations of proposed equipment do not exceed the floor-loading limit.

Signage: The TR room shall be identified in accordance with the campus and building signage system.

**Table 4 - Telecom Room and AV Projection Room Finish Schedule**

<table>
<thead>
<tr>
<th>TR Surface</th>
<th>Telecom Rooms/ AV Projection Rooms</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor</td>
<td>24” x 24” Electrically Conductive Rubber Tile</td>
<td>Provide product equal to Staticworx Eclipse EC; Static Generation: &lt;20 volts when tested according to ESD STM 97.2.*</td>
</tr>
<tr>
<td>Base</td>
<td>6-Inch High Rubber Wall Base</td>
<td>ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous), Style B (cove)</td>
</tr>
<tr>
<td>Walls</td>
<td>¾ Inch Grade A-C FRT Plywood **</td>
<td>Install plywood 6 inches above finished floor to a height of 8’-6” on all walls. Paint plywood on all 6 sides with 2-coats of fire-retardant paint, (Light gray for Telecom Rooms, flat black for projection rooms). Do not paint over the Grade and FRT stamps.</td>
</tr>
<tr>
<td>Ceiling</td>
<td>Open to underside of deck above.</td>
<td>Where fire-resistive coatings are present on structural steel members, apply a compatible surface sealer to prevent dusting.***</td>
</tr>
</tbody>
</table>

* Prior to finish floor installation, confirm floor levelness meets the requirements for the function of the room. Provide floor leveling as required for room function and finishes. For projection rooms, the floor shall be level and not be sloped such as the audience area of the venue.

** Plywood backboard wall panels are installed on gypsum-board-clad steel stud or masonry walls.

*** Surface sealer shall be a UL classified surface sealer. Apply surface sealer at manufacturer’s recommended spreading rate.

**Electrical Design Criteria**

Power: Each Telecom Room shall contain a 120/208V, 100A Main Circuit Breaker, 42-circuit subpanel dedicated to serve the equipment within the room. The subpanel shall be served from the campus normal and alternative (if available) power source Main Distribution Panel in the building. The subpanel shall be protected from voltage transients and power fluctuations by a Surge Protective Device, IEEE category B3 rated, installed in the subpanel.

UPS Power: Based upon the building use and project design criteria, a building-wide UPS system may be provided. This shall be a project specific decision confirmed by the project management team. If a building-wide UPS system is provided, the Telecom Room electrical subpanel riser shall be served by the UPS. If no building-wide UPS system is provided, local Telecom Room UPS’s may be provided (project specific). Local Telecom Room UPS systems shall only be sized to maintain network systems operation during the outage time before the alternate power source is transferred online. Yale IT may typically size UPS’s at 3KVA or 6KVA, depending upon the load requirement within the Telecom Room. If the building does not have the campus alternate power source available, local UPS units shall not be provided in Telecom Rooms. Note that UPS units, if provided, shall be registered under a multiyear maintenance service agreement (not included in the capital construction project scope).

Electrical circuiting and wiring devices: Provide circuits and receptacles from the TR electrical subpanel.
- Provide one (1) 120V/20A branch circuit with two NEMA 5-20R duplex receptacles in a 4"x4" outlet box mounted on the cable runway above and behind the center equipment rack.
- Based on project specific requirements, provide two (2) 208V/30A or 20A, 1Ø branch circuits each supplying one NEMA L6-30R or NEMA L6-20R twist-lock receptacle, respectively, in 4"x4" outlet box mounted on the cable runway above and on each side of abovementioned outlet box.
- Provide a minimum of two (2) 120V/20A branch circuits to serve security access control system panels and associated power supplies.
- Coordinate with design disciplines to determine locations of additional building systems panels located in the TR. Provide circuits as required for the systems (e.g. BAS, Fire Alarm, DAS, MNS, FAVE)
- Provide two (2) 120V/20A branch circuits serving a minimum of six (6) NEMA 5-20R duplex receptacles spaced evenly along the room perimeter at 18" above the floor, with box extensions through the plywood backboard. Shallow TR’s shall be provided with three (3) NEMA 5-20R duplex receptacles.
- All junction boxes and receptacles shall have laser printed circuit identifiers affixed indicating the panel ID and circuit number.

PDU Units: Two redundant PDU units shall be provided and mounted in the TR equipment racks. The redundant power supplies within the network electronics equipment shall be connected to each PDU. One PDU Unit shall connect directly to the twistlock receptacle (L6-30R or L6-20R) located on the cable runway above the equipment rack, that is circuited to the Telecom Room subpanel (building power). The second PDU shall connect to the local UPS in the room if provided (project specific). The local UPS shall connect to second twist-lock receptacle (L6-30R or L6-20R) located on the cable runway above the equipment rack. If no UPS is provided for the project, both PDU’s shall connect directly to the twistlock receptacles (L6-30R or L6-20R) located on the cable runway above the equipment rack served by the Telecom Room Subpanel.

Lighting: Lighting levels shall be a minimum of 50 foot-candles horizontal and 20 foot-candles vertical measured 3'-0" above the finished floor in equipment rack aisles. Fixtures shall be pendant mounted from structure approximately 8'-6" above the finished floor, suspended between and not from cable runway sections. Light fixtures shall be LED with universal-voltage electronic drivers and protective wire guards. A wall control switch with digital timer control shall be located at the room entrance. Dimmer switches and occupancy sensors shall not be used. Lighting fixtures shall be powered on a dedicated circuit from the TR subpanel, powered from the building alternate source to provide stand-by lighting within the room.

Bonding and Grounding: A telecommunications grounding system shall be provided complying with TIA-607-D. The main TR housing the MDT shall have a Primary Bonding Busbar (PBB) provided to which all Secondary Bonding Busbars (SBB’s) located in STR’s/TR’s/AV Projection Rooms are connected through the Telecommunications Bonding Backbone (TBB). TR equipment, equipment racks, conduits, cable shields, entrance protectors, cable runways, sleeves, structural steel, local electrical panels, etc. shall be bonded to the room PBB or SBB. In addition, provide grounding for roof mounted antennas and equipment. The PBB shall be connected to the normal main electrical service ground of the building with a Telecommunications Bonding Conductor (TBC). Note that Yale buildings may have the alternate service ground separated from the normal service ground, or the normal and alternate systems bonded together. Provide grounding system labeling and testing per standard recommendations.

Environmental Design Criteria
The rooms shall be protected from high temperature, contaminants, dust, moisture, and humidity that could affect operation and material integrity of active equipment within the TR.

HVAC Systems: HVAC shall be available on a 24 hours-per-day, 365 days-per-year basis. A stand-alone unit shall typically be provided for TR’s when the building’s HVAC system cannot ensure continuous operation. HVAC systems shall be powered by the campus alternate power source if available within the
building. Provide a BMS system high temperature alarm point programmed to activate if the cooling setpoint temperature threshold is exceeded for more than 15 minutes.

Equipment Locations: HVAC equipment shall typically be wall mounted at a location that does not obstruct room cable pathways. Do not locate HVAC equipment above equipment racks or wall mounted systems panels. If this is unavoidable due to project circumstances, and a variance is granted by Yale IT, drip pans shall be located under the HVAC equipment. The pans shall be configured with drain lines and integral leak detection sensors that are configured as monitoring and alarm points in the building’s BAS system. Equipment condensate drain lines shall immediately exit the room and not be routed along walls, cable runways, or over equipment racks. Condensate pumps shall not be provided within the TR unless approved by Yale IT.

Room Equipment Loads: Coordinate with Yale IT to develop load assumptions to be provided to the project HVAC Designer. The ICT Designer shall provide Yale IT with the required Coordination of Service Documentation including the Telecom Key Connection Schedule and Differential Scope of Work Matrix. This shall permit an estimate of network port counts and other system equipment to be created, confirming approximate heat rejection and cooling load requirements. Designers shall complete equipment specific load calculations and/or study equivalent TR’s on campus to determine necessary cooling approach. Note that the addition of audiovisual network gear into the TR, if required, shall increase load requirements.

Operational Parameters: The TR HVAC system shall support equipment classes A1-A4 per ASHRAE TC9.9 with the following criteria:

- Heating setpoint: 64.4°F
- Cooling setpoint: 80.6°F
- Humidity Range, Non-Condensing 16°F DP to 59°F DP and 60% RH
- Local room thermostat control with BMS high temperature alarm
- The BICSI TDMM provides a recommendation to “Maintain a positive pressure with a minimum of one air change per hour in the telecommunications space.” In the mechanical system project Basis of Design, provide an evaluation including cost range and increase of system complexity to achieve this. Review with evaluation with facilities project management to determine whether this recommendation should be implemented in the project.

Vibration: Mechanical vibration coupled to equipment or the cabling infrastructure can lead to service failures over time. A common example of this type of failure would be loosened connections. If there is a potential for vibration within the building that will be conveyed to the TR via the building structure, the project structural engineer shall design safeguards mitigating excessive vibration.

Fire Protection: TR fire protection systems shall be provided as required by Code. Typical building TR’s may be fitted with wet sprinklers utilizing wire guards over heads. In some cases, the TR may contain highly mission critical equipment or highly valuable assets that could mandate a dry pipe pre-action system. Campus Core Network Rooms shall require dry pipe pre-action or FM-200 clean agent fire suppression systems. Coordinate fire detection and extinguishing requirements with the Yale Fire Marshal.

Telecommunications Room Fit-Out Requirements

The TR’s shall be fit out to meet the infrastructure requirements of Yale IT. Building end user equipment shall not be permitted in TR’s. Fit-out components shall include:

- Wall plywood backboarding (refer to Architectural Design Criteria above)
- **Overhead cable runway:** Provide black color cable runway in 12", 18", and 24" widths around the TR perimeter and over each equipment rack line. Provide 6" of clearance from the wall to the edge of the cable tray for wall mounted electrical and systems panel clearances. Install the cable runway at 7'-9" above finished floor, leaving 9" clearance above equipment racks. Provide "waterfall" cable radius bend protection over each rack vertical cable manager. Ground each section of cable runway and bonding to the PBB/SBB.

- **Sleeved penetrations:** Provide a minimum of four (4) 4" re-enterable engineered firestop through penetration sleeves with integral intumescent material, installed through the wall into the corridor ceiling plenum above finished accessible ceiling. In addition, provide a minimum of four (4) 4" re-enterable engineered firestop through penetration sleeves in the floor below and deck above into corresponding stacked TR's. Final sleeve quantity required shall be based on cabling amounts, plus 50% spare capacity. Sleeve fill should not be less than the minimum, nor, more than the maximum, specified by the fire stopping material manufacturer. Provide additional vertical wall mounted cable runway sections to transition from floor and wall sleeves. All firestopped penetrations shall be labeled as required.

- **Equipment rack line:** Typically, provide three (3) two-post open 84"H equipment racks in a rack line, bolted to the floor, each bonded with a dedicated #6 AWG TEBC to the PBB/SBB.
  - Provide full height double-sided vertical cable management between each rack and at both ends of the rack line.
  - Upper transition trays shall be provided at the top of each rack, with horizontal cable managers required
  - Rack #1 (left) shall contain interbuilding backbone (MDT only) and riser cabling terminations at the top of rack. These shall consist of optical fiber termination cabinet(s) and 48 port RJ-45 Category 5e copper multipair voice riser cross-connect patch panel(s). Also, Yale IT provided active network electronics, gateways, and PDU's shall reside in the rack.
  - Rack #2 (center) moving left to right, shall contain horizontal cabling cross-connects consisting of angled 48 port RJ-45 Category 6 and Category 6A (for wireless access points) patch panels.
  - Rack #3 (right) shall contain systems including:
    - DAS system singlemode optical fiber system hub(s) and horizontal optical fiber cross-connect serving remote units
    - ScienceNet FTTD 50-micron laser optimized OM4 multimode horizontal optical fiber cross-connect termination cabinet(s), and corresponding fiber network switches, if required
    - Audiovisual systems network infrastructure, including IP AV 1 Gbps and SDVoE 10 Gbps architectures. Based upon the extent of these systems, additional dedicated equipment rack(s) (Rack #4, etc.) may be required in the rack line. SDVoE 10 Gbps systems operate on 50-micron laser optimized OM4 multimode optical fiber horizontal connections and additional fiber termination cross-connect cabinets shall be provided to support them.
    - IP sound masking and paging systems if required
    - Miscellaneous building systems

- **Cable management:** Cabling within the TR shall be expertly installed and managed in equipment racks and cable runways per the BICSI ITSIMM.
  - Category 6/6A cabling shall be organized in neat bundles of 24 cables, trained together from the rear patch panel terminations and routed into the rear section of the rack vertical managers and up to the overhead cable runway.
  - Strain relief bars shall be provided behind each patch panel where cabling will be supported and converge into a bundle.
  - Bundles shall neatly lay adjacent to and in parallel with one another within the cable runways.
  - Each bundle shall be secured with re-enterable hook and loop strap fasteners at the same 2' intervals. Aligned strap positioning shall be used to create air flow gaps between bundles.
Follow the recommendations of the NEC and *TIA TSB-184-A Guidelines for Supporting Power Delivery over Balanced Twisted-Pair Cabling* for design of cable bundles and pathways supporting the *IEEE 802.3bt* standard to source up to 90 watts at the PSE.

- Machine printed cable labels shall be affixed within 2" of the cable termination at the patch panel.
- Service loops shall be configured in figure 8 arrangements and fully supported on wall plywood backboard or empty cable runway.
- Patch cords installed from patch panels into network switches shall utilize switch ports in sequential order. Do not skip or “jump around” to various ports on the network switch.

- **Building Systems Headend Collocation:** Yale IT shall permit the TR to be used by designers to collocate low voltage systems equipment panels and headends. This strategy permits shared use of the secure conditioned environment, cabling plant, building pathways (maintain separations), and IP networking. These low voltage systems shall include:
  - **Security Systems**
    - Access control panel headends shall be wall mounted in building TR’s.
    - Network connectivity for access control panels, security cameras, intercom systems, and emergency phones shall be provided by the campus network. A dedicated security system IP network shall not be provided.
    - Category 6 cabling serving security devices shall be purple color. The cabling shall be fully integrated into the cable plant and not broken out into a separate patch panel.
    - Access control system composite cabling (non-IP) shall be physically separated from Category 6/6A cable bundles within pathways by no less than 6”.
  - **Audiovisual Systems**
    - Each AV device in IP AV systems operating at 1 Gbps (such as the QSC Q-SYS Ecosystem) shall be served with Category 6 cabling plant from the TR with no physical layer distinctions in the cable plant.
    - Dedicated AV LAN network switches shall be provided in the TR by the AV Contractor, and the IP AV devices shall be patched into the AV LAN network switches.
    - Optical fiber riser backbone strands shall uplink the AV LAN network switches.
    - IP AV system Core Processor(s) shall be provided the MDT TR to serve the building-wide system.
    - Each AV device in SDVoE systems operating at 10 Gbps (such as the IDK 4K@60 AV over IP) shall be served with a dedicated 50-micron laser optimized OM4 multimode optical fiber horizontal cable plant.
    - 10 Gbps AV devices shall be connected to dedicated 10 Gbps per port, 100 Gbps or better AV LAN network switches that shall be provided in the TR by the AV Contractor, and patched into the AV LAN network switches.
    - Optical fiber riser backbone strands shall uplink the 10 Gbps per port, 100 Gbps or better AV LAN network switches.
  - **DAS Systems**
    - DAS system secondary hubs in TR’s shall provide 48V power (2C-14AWG) and communications (2 strand OS2 singlemode on LC duplex connectors) to remote units/antenna located throughout the building, using building pathways and open top J-hooks.
    - The DAS system primary hub shall be located in the building main TR MDT.
    - Singlemode OS2 backbone riser strands shall be designated for DAS and cross-connected into the hubs within TR’s.
  - **Building Automation Systems (BAS)**
    - The ICT Designer shall coordinate with the project mechanical engineer for final locations of BAS system panels. The BAS systems shall utilize an independent dedicated control system network provided by the BAS system vendor. Campus network connections shall be provided at main BAS control panel locations, with no distinction in the physical layer cable plant.
  - **Fire Alarm Voice Evacuation (FAVE) System**
1.17. Backbone Riser Cabling

Backbone riser cabling shall be provided for interconnections between the building MDT (IC) and IDT’s (HC’s) in a logical star topology. Backbone riser cabling requirements include the following (to be confirmed by Yale IT for each project).

- **Optical Fiber Backbone Riser Cabling**
  - Twenty-four (24) strand OS2 singlemode optical fiber, OFCP rated with interlocking armor and tightbuffered construction, terminated in rack mounted fiber termination cabinet with duplex LC splice on connectors. The fiber shall be ITU-T G.652.D compliant Full Spectrum.
    - Six (6) strands are reserved for DAS systems. Campus Zinwave deployments shall require APC angled physical contact style singlemode connectors.
    - Six (6) strands are reserved for AV LANs
  - Twenty-four (24) strand 50 Micron Laser Optimized OM4 multimode optical fiber, OFCP rated with interlocking armor and tightbuffered construction, terminated in rack mounted fiber termination cabinet with duplex LC splice on connectors.
    - Provide splice on fiber connectors. Mechanical connectors are not permitted.
    - Provide 50% spare capacity in fiber termination cabinets

- **Copper Multipair Voice Backbone Riser Cabling**
  - One (1) 25 pair, CMP rated 100 Ohm multipair balanced twisted pair, 24 AWG solid conductor Category 3
  - In the MDT, terminate all risers on wall mounted 110 cross-connect blocks with C5 clips and cross-connect into the building entrance cable 110 block.
  - In the IDT’s, terminate on a rack mounted 24 port Category 5e RJ-45 patch panel, with one pair terminated per RJ-45 port. The pair shall terminate on pins 4,5 in AT&T T568A connection.
  - Within the MDT, one (1) 25 pair shall be provided from the 110 wallfield cross-connect block, terminated wit C5 clips, to the rack. On the rack, terminate on a 24 port Category 5e RJ-45 patch panel, with one pair terminated per RJ-45 port. The pair shall terminate on pins 4,5 in AT&T T568A connection.
  - This topology shall permit an analog voice line to be cross-connected to any building workstation outlet using an RJ-45 patch cord.

- **Broadband Coax Cable Television Distribution Backbone Riser**
  - Provide this backbone to support legacy broadband cable television systems only if requested by the project stakeholders and approved by Yale IT
  - The local CATV provider (Comcast) shall design and install the CATV system. This includes backbone coaxial cables and terminals. Designate space for this service in the TR’s. Yale IT shall coordinate design requirements with the service provider.
  - Provide a coaxial riser backbone from the plywood backboard in each TR IDT to the plywood backboard in the TR MDT. The cable shall be a .500” Parameter III coax distribution cable and UL listed to be installed in an environmental return-air plenum space (CATVP).
  - Terminate each cable end with a F81 bulkhead connector. All connectors shall be terminated with OEM specified tools. Provide and neatly store 10 feet of additional cable at each location.

1.18. Backbone Riser Pathways

- Backbone cabling pathways shall be clearly designated and designed to provide routing and protection for backbone riser cables, with 50% future capacity growth.
Provide a minimum of four (4) 4" EMT from the main TR MDT to the IDT TR stack of rooms, or to each TR where they do not stack. In lieu of EMT conduit stubs, re-enterable engineered firestop through penetration sleeves shall be used where TR's directly stack.

Backbone Pathways routed through the building shall be either cable tray or conduit. The installation of a physical separation for the protection of the backbone cables from horizontal cable installation is required. Backbone cables installed in cable trays shall be rated for appropriate use. Yale IT must approve use of cable tray as a backbone distribution system.

Where backbone cables pass through stacked TR's, provide a cable runway vertically mounted from floor to ceiling for cable support.

The conduit pathway shall extend to the roof to accommodate current or future cabling needs. Roof penetrations and seals shall be provided by the roofing contractor and not violate the roof warranty. Extend the building TBB to the roof to permit bonding of equipment.

All pathway through penetrations shall be sealed or firestopped.

1.19. Horizontal Pathways

Horizontal cabling shall be supported from the TR’s to the workstation outlets with an organized system of cable trays, J-hooks, and conduits. Pathways shall be sized to permit 50% spare capacity. According to the TIA Category 6/6A standard cabling distance limitation, the maximum run distance of horizontal pathways, including to floors above or below, shall be less than 295’. All pathway through penetrations shall be sealed or firestopped.

Typical outlet pathway installation shall consist of the following:
- One (1) 1 in. EMT from 4-11/16”x4-11/16”x2-1/8” telecom outlet box with single gang trim ring stubbed above nearest accessible ceiling within the same room
- J-hook open top cable supports above accessible ceilings to main cable tray runs
- Cable tray runs in corridors and densely populated areas, consolidating at the local TR

Cable trays: Single tier overhead wire mesh basket style tray
- Provide 8” clear above tray for cable access
- Utilize ninety-degree sweeps when change in direction is required
- Bond to telecommunications grounding system
- Cable trays shall be continuous with no breaks or sharp cuts
- Methods of support: cantilever, trapeze brackets, or center hanging

J-hooks: J-hooks or equivalent open top cable supports are permitted for use above accessible finished ceilings.
- Supported from building structure
- Spacing shall be three to five ft. apart, with an average separation of four ft.
- Use is permitted from main cable tray runs to workstation outlet conduit stubbed out above accessible finished ceilings
- Provide 50% spare cabling capacity

Conduit: EMT conduit shall be provided for horizontal cable distribution where required. If the conduit route may be subjected to physical damage, provide RMC threaded conduit.
- Conduit runs shall have pull boxes every 80 ft. maximum and/or every two 90-degree bends
- Conduit bends shall sweep, LB fittings are not permitted
- Conduits shall be provided with pull strings
Conduit shall be provided in the following areas:
- Areas exposed without finished ceilings
- Inaccessible ceilings
- Tightly congested areas
- Transition between floors
- Serving floor mounted outlets

1.20. Horizontal Cabling

Horizontal network cabling for data, voice, and IP based video shall conform to the ANSI/TIA-568-C.2, *Balanced Twisted-Pair Telecommunications Cabling and Components for Category 6 and Category 6A Cable*. Cabling shall be NEC CMP plenum rated. Cable jacket color shall be blue per Yale IT standard unless otherwise noted. Terminate using T568B style terminations on rack mounted angled Category 6/6A RJ-45 48 port patch panels. Do not paint installed cabling as it will void the manufacturer warranty.

Broadband television system cabling (legacy system) shall conform to ANSI/TIA-568.4-D, *Broadband Coaxial Cabling and Components*. For cable TV connections, RG-6 Quad shield coaxial cable shall be provided. Coaxial cabling shall be NEC CATVP plenum rated with 18 AWG solid copper covered steel conductor with FEP insulation, foam dielectric, aluminum foil – 60% braid – foil – 40% braid shield, terminated with compression F-connectors.

Optical fiber horizontal and FTTD cabling shall be of a fan-out type construction with a minimum 2.0mm outer jacket and high-strength reinforcing fibers protecting each fiber. The cables shall contain singlemode (OS2) fibers or 50-micron OM4 multimode fibers which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA-568-C.3. The color of the cable’s outer jacket shall be yellow for singlemode and Aqua for OM4 multimode. Cables shall be plenum rated OFNP. The fibers shall be terminated with splice-on LC connectors meeting ANSI/TIA-568-C.3. Adaptor modules shall be flush mount duplex LC. The color of the modules shall match the color of the mounting frame.

Wall mounted workstation outlets shall typically consist of a single gang four-port faceplate, color and material as selected by Architect. The faceplate shall be filled with the quantity of Category 6 or 6A jack modules required at each location with spare positions blanked off, with machine printed labels installed in label windows. Terminations shall be T568B style.

Additional outlet configurations include:
- Security Cameras: Provide one (1) Category 6 cable terminated in a biscuit style surface box.
- Elevator Travelling Cable: Include three (3) Category 6 cables to the elevator machine room for cab devices such as phones, security cameras, or wireless access points. Provide ethernet over coax extenders and include coaxial cabling in the travelling cable connecting the machine room and the cab.
- Building Equipment Panels: Provide two (2) Category 6 cables terminated in a biscuit style surface box at each building systems equipment panel including:
  - Main Building Automation System Panel
  - Security Access Control Panel
  - Fire Alarm Control Panel
  - Elevator Control Panel
  - Lighting Control Gateway Panel
  - Audiovisual Control System Panels
  - Power metering
  - Irrigation Control Panels
- Timeclocks
- Electronic Key boxes
- Chair Lift Telephone

- Floor Boxes and Poke throughs: Provide decora style or 106 adapter plates as required to mount devices where full gang plates do not fit.
- Flat Panel Displays: Provide decora style or 106 adapter plates as required to mount devices in flat panel backbox located behind the display. Provide a minimum of two (2) Category 6 cables. Review with Yale IT whether locations should be provided with OM4 50 micron optical fiber to support SDVoE 10 Gbps connectivity.
- Surface Raceways: Provide decora style or 106 adapter plates as required to mount devices.
- Wall Mounted Telephones: Provide one single jack wall plate.
- Lab Casework: Coordinate actual needs on a per project basis. Historically, providing one (1) Category 6 cable per every two (2) lab bench seats has provided sufficient capacity.
- Elevator telephones: Generally provided under Division 14. Elevator phones are considered emergency telephones, battery operated automatic dialers are not acceptable. These circuits require dedicated conduit point to point. A ¾” conduit will be required for each elevator. This conduit shall be provided from the nearest TR to the box on the elevator controller cabinet where the elevator traveling cable’s telephone pairs are terminated in the elevator machine room. Coordinate the installation and termination with Elevator Vendor and Yale IT.
- Emergency Telephones: The installation and location of emergency telephones must be coordinated with the Yale University Public Safety. Outdoor emergency telephones are hands-free weatherproof and require a 1” rigid conduit. A standard blue light that is illuminated 24 hours per day, 7 days per week shall identify each emergency telephone. Emergency telephones are to be cabled using cable for the intended use (indoor, buried service, aerial). The cable is to be terminated in the appropriate TR on a dedicated voice block as directed in the Telecommunications Key Connection Schedule. These circuits may require dedicated conduit point to point.

- Exterior pole mounted emergency phone requirements:
  - Concrete foundation no smaller than 24” diameter and 42” deep. Anchor bolts and template for same will be provided by Yale IT.
  - One (1) 1” minimum telecom conduit terminating in the TR of the building from where the voice circuit is provided. Provide a pull string, tied off at both ends. Telecom cabling shall be provided in liquid tight flexible steel conduit inside the pole. In addition, provide cabling to serve mass notification speakers where identified.
  - One (1) minimum size 1” power conduit to the building from where the voice circuit is provided and one 120VAC 15-amp branch circuit with emergency backup power
  - One 5/8” x 8’ copper-clad steel ground rod with a #6 AWG copper wire to the base of the phone
  - The units shall be located adjacent to walkways, not in travel areas where they might interfere with pedestrians or service vehicles. Locate the code blue emergency phone so as to be wheelchair accessible from the sidewalk. Install a concrete pad to extend to the sidewalk if necessary. Access to the phone shall not be impaired by landscaping or curbs. For ease of mowing in grass areas, the telephone shall be located on an 8” wide concrete mowing strip flush with the surrounding lawn.
1.21. Wireless Access Points

Wi-Fi shall be ubiquitous throughout the building. It is recommended that horizontal cabling serving wireless access points shall consist of two (2) Category 6A cables, in anticipation of the full future implementation of the IEEE 802.11ax standard supporting multi-Gigabit bandwidth rates. The outlets shall be mounted in a plenum rated biscuit style surface mount box with a 15’ service loop to permit final field location adjustments. The ICT Designer shall plan Wireless access point (WAP) locations on floor plans using the recommendations of TIA-TSB-162-A in the Schematic Design and Design Development Phases. WAP’s shall be a PoE PD. Yale IT shall provide Power-over-Ethernet IEEE 802.3at Type 2 (PoE+) power sources.

In the Design Development phase, the ICT Designer shall conduct an RF predictive wireless study to confirm WAP locations. The study shall be performed by a certified wireless professional approved by Yale utilizing Ekahua Pro Software. Acceptable wireless certifications include but are not limited to ECSE, CWNA, CCNA Wireless, ACDA, or equivalent. The predictive study shall meet the following RF specifications as a minimum requirement for delivery of voice and video quality IEEE 802.11 services as defined by Cisco Systems:

- Radio shall be set on UNII2/3 frequencies at no more than 25mW power/14dBm
- Optimal Cell Boundary of the wireless access point shall be -67db measured by the client adapter in the 5Ghz band
- 20% cell overlap based on the optimal cell boundary to ensure smooth client roaming
- Latency shall be no less than 20 milliseconds
- Packet loss shall be no more than zero within the design coverage
- Packet jitter shall be less than 20ms

The ICT Designer shall review WAP mounting requirements with Yale IT to address various project conditions. A wireless access point enclosure may be recommended by Yale IT or the project Architect to provide physical protection or greater aesthetic appearance. In addition, high gain antennas, remote antennas, or high density WAP’s may be recommended by Yale IT to provide appropriate coverage from acceptable mounting positions. Outdoor site coverage shall be reviewed for each project, served with remote outdoor antenna locations, RF transparent site bollards, or emergency telephone stanchions.

Wireless access points shall be furnished by Yale and installed by the Cabling Contractor. Some locations shall require the wireless access point to be configured for vertical wall mounting. One (1) ceiling grommet shall be provided for each ceiling access point outlet location, installed in the ceiling tile with a patch cable provided from the jack to the wireless access point.

Provide a post-installation study to verify coverage requirements are met. This study shall include allowances for the addition of or re-positioning of WAP as needed.

1.22. Patch Cords

Patch cords shall be furnished for each Category 6/6A link, with one workstation end patch cord, and one telecom room end patch cord. The lengths and colors of patch cords within the TR shall be coordinated to match telecommunications equipment rack layouts and Yale IT standards. Excessive lengths are unacceptable. Reduced diameter (or small diameter) 26 AWG and 28 AWG patch cords shall be provided in the TR. Final lengths and colors of patch cords furnished for workstations and devices shall be coordinated with Yale. In some instances where patch cords to devices such as telephones and wireless access points are exposed, the project Architect may wish to see a specific color patch cord (such as black) so as to not color clash with surrounding finishes and/or to match the device color. The Cabling Contractor

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shall install patch cords within the TR and patch in network devices. The Cabling Contractor shall furnish patch cords to Yale IT and project subcontractors for installation at floor workstation and device locations.

1.23. Labeling and Administration

The structured cabling plant shall be fully labeled and documented. The recommendations of TIA-606-C, Administration Standard Telecommunications Infrastructure shall be used as a guideline with specific requirements dictated by Yale IT.

- Only machine printed laminated labels that are mechanically fastened are acceptable for equipment, panel, cabling, and outlet labeling. Handwritten markings on the cable will not be accepted.
- Uniquely identify and label each permanent link as to reference its source termination patch panel port or wiring block position. The labels shall be durable, machine generated, self-adhering, at least 3/8” wide; the font shall be a minimum of 3/16” high and contrasting the background in color. Affix labels at the end of each cable within 12 inches of termination and to the front of the faceplate near the connector module. All identifiers shall be clearly recorded on the as-built drawings.
- Backbone cables shall be labeled at each end, within 6” from each termination. Additional labeling shall be provided on cables that pass-through locations such as conduit ends, splices, MH’s, and pull boxes.
- Fiber distribution units shall be clearly labeled on the front cover. Racks, patch panels, and interconnect blocks shall be labeled. Label pathways and grounding busbars and wires.
- TR’s shall be labeled WWW01 (for MDT’s), WWW02, WWW03, and so forth (for IDT’s), where “WWW” represents the Yale Building Number. However, in cases where there is a switch in the building, the MDT is designated as WWW00 and all consecutive numbers thereafter are IDTs. An example of this would be Green Hall, where the MDT is labeled 277000, and the IDT’s are 277001, 277002, 277003, etc.
- Each Category 6 telecom outlet shall be labeled XXX-YY DZ, where “XXX” is the room number, “YY” is the outlet in sequential order starting from the door and moving left, and “Z” is the sequential number of the jack in the faceplate. For room scheduling signage, the room number is the corridor with “D” being replaced by “RS”. For FTND applications, “D” is replaced with “F”.
- Individual patch panels are not labeled. Cables and patch panel port labels shall match the faceplate label.
- Fiber interbuilding backbones are labeled FYWWWXX-VVVV, where “FY” is “FM” for multimode fiber, or “FS” for singe-mode, “WWWXX” is the label of the terminating MDT, and “VVVV” is the label for the originating Core Network Room or MDT.
- Wireless Access Points shall be labeled WAP-XX, where “XX” is the sequential number of the WAP in the building.
- Equipment Racks in a rack line shall be labeled sequentially starting at 01, moving from left to right.
- TR patch cords, furnished and installed by the Cabling Contractor, shall be labeled per Yale IT requirements.

1.24. Area of Rescue Two-Way Communications Systems

The ICT Designer shall confirm whether projects require Area of Refuge and/or Area of Rescue two-way communications systems per Connecticut State Building Code. In addition, if not required by Code, the ICT Designer shall discuss with the Facilities Project Manager whether Yale wishes to implement the systems for improved building accessibility. Provide systems that meet code required functionality including call stations, signage, and a central command unit. The central command unit shall be programmed to dial out to the University’s central station in the event there is no direct answer in the building fire command center, utilizing an analog POTS line.
1.25. Design Coordination for Joint Partnership Projects

Yale IT may deploy systems in facilities as a joint partnership with other entities where Yale IT does not directly control the infrastructure design. For these projects, the ICT Designer shall review the facility owner’s standards and determine a methodology for adaptation to these standards. An example is joint projects with Yale New Haven Health System, where differing equipment manufacturers and healthcare standards are implemented.

1.26. Residential Colleges Requirements

The ICT Designer shall anticipate the following design requirements for projects at residential colleges.

- Wi-Fi shall be ubiquitous throughout the building and grounds. Pathways shall be planned for outdoor coverage. DAS coverage shall be provided for specific floors identified to have weak signal strength, in particular dining areas. Some vending and refrigerators utilize Wi-Fi and cellular communications for point of sale.

- Collaborate with the project Architect during end user interviews to uncover special case needs, activities, and events in the colleges that will rely on communications infrastructure.

- Various residential offices utilize service providers such as Comcast for cable television service, that is not billed through Yale IT. Anticipate service provider coordination required for moves, adds, changes to infrastructure in these cases.

- Cabling infrastructure shall be required for the following occupancies:
  - Suite Commons Rooms: two (2) Category 6 cables
  - Office spaces for Deans and Head of Colleges
  - Building common spaces used for guest speakers
  - Audiovisual Booths may require optical fiber connections
  - FAVE and MNS systems and speakers
  - Dining POS cashier stations – two (2) Category 6 cables
  - Laundry Rooms debit card system transaction panel – one (1) Category 6 cable
  - Public computer rooms – one (1) Category 6 cable and one (1) quad 120V/20A receptacle per workstation with two (2) Category 6 cables at multifunction printer stations for printer and card station. Students are now using Window Virtual Desktop more rather than going to the public computer rooms. These areas may be reprogrammed into E-Sports or Collaboration Rooms in the future. The ICT Designer shall assist Yale IT to develop the program for these spaces on a project specific basis.
  - Vending machines – one (1) Category 6 per machine
  - IP surveillance cameras, access control panels, intercom stations
  - Chair lift telephone stations
  - Dining services
    - kitchen timeclocks – one (1) Category 6 cable
    - kitchen wall mounted telephone – one (1) Category 6 cable
    - Employee kiosk – one (1) Category 6 cable
    - Manager’s Office – three (3) Category 6 cables
    - Menu boards – two (2) Category 6 cables
    - Breakroom custodial timeclock - one (1) Category 6 cable
- Digital signage flat panel displays – two (2) Category 6 cables
2.1. Security Baseline Requirements Summary

The following represents a general listing of security requirements for physical and electronic security system installations that typically applies to all projects:

1. All exterior perimeter gates and doors must be fitted with card access systems, to include card readers, exit devices, and door management alarms. Where perimeter gates are two sections, each section will have its own means of electronic locking controlled by a card reader. All exterior perimeter doors designated for exit only shall be fitted with alarm monitoring equipment (door contact, a door management alarm, and a request-to-exit motion detector), and there shall be no exterior hardware or keyway. Where doors are set for emergency exit only (to control egress), these shall be fitted with delay-to-egress hardware tied into the Security and Fire Alarm systems, where permitted by the building code.

2. The following locations shall be fitted with full card access packages:
   a. All rooms/closet entries that house student, staff, employee or patient personal information
   b. All major mechanical/electrical/telecom/server room/utility tunnel entry
   c. All rooms, suites, closets that house high value or high risk equipment
   d. Any room/closet housing an electronic key management system

3. CCTV camera and electronic access control systems are intended for deterrence and forensic purposes only, and not to provide real-time monitoring.

4. All loading docks shall be fitted with access control at the vehicle and perimeter entries to the dock; and every effort shall be made to build access-control separations between the dock interior and the rest of the facility. All perimeter entries shall be fitted with card access, a means of communication (intercom or phone), and a CCTV system for the dock exterior, the dock interior and vehicle entries shall be installed. If there is a local dock receiving office, communication, CCTV and gate/door control shall be wired through there as well (for local system control).

5. CCTV cameras shall be added to all entry/exit door(s) and to areas where high risk material is stored. All cameras shall be wired or networked to Yale Security main server via a secure network circuit on the Yale Public Safety Network. Other locations for CCTV would include all exit/entry points, cash handling areas (tellers, cashiers, convenience store counters, etc.), parking lots....

6. Emergency Blue Phones with blue lights shall be installed at key building perimeter and walkway locations, as designated by Yale Security. On a case-by-case, consideration shall be made for phones/poles to be fitted both with digitally managed CCTV cameras to allow for the monitoring and automatic call-up of emergency use of phones and with public address speakers for broadcasting evacuation notification.

7. The buildings shall be fitted with a DMP alarm communicator, which will serve to centrally transmit all fire alarm signals and intrusion, panic and equipment alarms.

8. Any legacy burglar alarm equipment in the space, including keypads, door contacts, motion detectors and alarm horns shall be removed. Requests for new or reactivated burglar alarm systems will be reviewed on a case-by-case basis.

9. Reception areas shall be fitted with a duress button interfaced to the DMP alarm panel.

10. Where appropriate to the use and security needs of the facility, provisions for a Central Security-Manned Reception Desk at the visitor entrance shall be included, which would be fitted out for local annunciation of building alarms, as well as for local CCTV monitoring.
11. All facility perimeter windows within 10 feet off grade shall either be inoperable or, if operable, fitted with security screens or limiters.

12. Perimeter lighting, courtyard lighting and lighting on exterior perimeter walkways shall be enhanced to ensure clear visibility for after-hour use.

12. The building fire alarm system shall be equipped with voice evacuation capabilities for building-wide emergency broadcasting, as follows:

   a. University owned or leased space where the University operates and maintains the building’s fire alarm system:

      1. All renovations shall include the installation of additional wiring and raceways capable of supporting future speaker/strobes. Any NAC circuit being added to or modified is required to be completely modified (rewired). Wiring shall be installed to support future voice evacuation activation. Initially, horn/strobes shall be installed and set at slow-whoop. All additional voice evacuation wiring shall be clearly marked for future use.

      2. When 20% or more of a building is renovated at one time, the Fire Alarm node covering that portion of the building shall be converted to voice evacuation using Yale Fire Code Compliance Unit and Yale Public Safety approved methods and shall follow all applicable NFPA, State, and Local codes as well as Yale Fire Code Compliance Unit and Yale Public Safety specifications. Voice evacuation coverage shall be throughout renovated area of the building. Equipment/wiring/data shall also be included and installed to communicate on Yale’s network with either the Siemens or FCI/Gamewell Mass Evacuation panels at 57 Lock Street and 101 Ashmun Street.

   b. Commercially-leased space where the University does not operate or maintain the building’s fire alarm system (including YNHH space):

      1. All renovations shall include the installation of additional wiring and raceways capable of supporting future speaker/strobes. Any NAC circuit being added to or modified is required to be completely modified (rewired). Wiring shall be installed to support future voice evacuation activation. Initially, horn/strobes shall be installed and set at slow-whoop. All additional voice evacuation wiring shall be clearly marked for future use.

      2. In those buildings supported by a Siemens or FCI/Gamewell fire alarm system, where 20% or more of the building is renovated at one time, the building’s fire alarm system shall be converted to voice evacuation using Yale Fire Code Compliance Unit and Yale Public Safety approved methods and shall follow all applicable NFPA, State, and Local codes as well as Yale Fire Code Compliance Unit and Yale Security specifications. Voice evacuation coverage shall be throughout the building. Equipment/wiring/data shall also be included and installed to communicate on Yale’s network with either the Siemens or FCI/Gamewell Mass Evacuation panels at 57 Lock Street and 101 Ashmun Street.

      3. In those buildings not supported by a Siemens or FCI/Gamewell fire alarm system, an audio interface from the building fire panel to Siemens or FCI/Gamewell headend Mass Evacuation panels at 57 Lock Street and 101 Ashmun Street shall be implemented. If the building’s fire alarm panel does not support this feature, no additional work is required.

13. Each facility shall be fitted with a Morse-Watchman electronic key management system for use by local Facilities Operations personnel. Additionally, Residential facilities shall be fitted with separate Morse-Watchman systems for use by local residents and residential management personnel.

14. A broadcast speaker shall be installed centrally within the courtyard to facilitate emergency broadcast via the fire alarm voice evacuation system.
15. Where appropriate to the use and security needs of the facility, provisions for a Central Security-Manned Reception Desk at the visitor entrance shall be included, which would be fitted out for local annunciation of building alarms, as well as for local CCTV monitoring.

16. All devices connected to the Yale Next Generation Network (NGN) shall be fully supported by the manufacturer.

17. Security equipment shall be served from the Yale Next Generation Network (NGN) and configured on the appropriate VLAN.

18. Security cameras shall use PoE power from the network switch. Confirm device power requirements and switch power budget available.

19. Yale Cultural properties may have additional and separate requirements. Coordinate with Yale IT to determine requirements.

20. West Campus properties may utilize a LENEL access control system. Coordinate access control design standards for these West Campus properties with Yale IT.

2.2. Security Requirements Summary for Student Residential Facilities

1. The following additional physical and electronic systems shall be installed to secure Student Residential Facilities and environs:

2. All courtyard perimeter primary entry doors to Entryways and shared facilities shall be fitted with card access system packages, including remotely managed/controlled Door Management Alarms.

3. Card access shall be installed at the following locations:
   a. All interior public/residential separations
   b. Entries to Library facilities
   c. Entries to Secure Storage Rooms
   d. Entries to Gallery Areas
   e. Entries to Computer and Media Facilities
   f. Administrative Office Suite
   g. Guest Suites
   h. Any designated room off a common area where privileges are limited to residents of the college (Weight Room, Theatre, etc.)

4. The entries to the Dining Services’ public and staff areas shall be fitted with card access; and when approved by the Associate VP of HR&A delivery entrances/exits shall be fitted with CCTV cameras for Dining Services admitting and event recording.

5. All College entryway card access entry doors shall be fitted with electric strikes or electrified hardware with monitoring capabilities. Gate mag locks will include bonding sensors.

6. The following areas will be fitted with burglar alarm systems: the Head of College’s houses; the Head of College’s/Dean’s administrative offices, and any gallery/exhibit spaces.

7. The Head of College’s Offices shall be fitted with Morse-Watchmans networked electronic key cabinets to house the respective College’s keys for distribution. A Morse Watchmans key system shall be installed as well in the Custodial Manager’s area and the Dining Hall secure staff area. To the greatest extent possible, these Morse-Watchman systems will be shared.
8. All second-means-of-egress pass-through doors—suite-to-suite; bathroom-to-suite/bedroom; bedroom-to-bedroom shall be fitted with remotely managed/controlled Door Management Alarms. The bedroom-to-bedroom pass-through arrangement shall be prevented, if possible.

9. A broadcast speaker shall be installed centrally within the courtyard to facilitate emergency broadcast via the fire alarm voice evacuation system.

10. Intercom systems shall be established for the following areas:
   a. At key entry doors to the Head of College’s living space, wired to locations within the house and to the administrative office suite
   b. At a key delivery entry gate to the administrative office suite
   c. At dining hall delivery entries to within the Dining hall receiving area

2.3. Security Requirements Summary for Clinical Space

The following additional physical and electronic systems shall be installed to secure Clinical Facilities and environs:

1. All electronic systems shall be Yale University Security’s standard security and access control system components and control panels, with all alarm signals transmitted to the Yale University Central Alarm Station.

2. All perimeter entry doors off public corridors shall be fitted with prox card access. Those designated to be able to be left unlocked during certain periods of time shall be fitted with a dedicated “control” card reader with LED mounted on the interior of the door. Those designated for exit only shall be fitted with an alarm contact and a request-to-exit motion detector, with no hardware or keyway on the corridor side of the door.

3. The following clinical spaces shall be fitted with card access:
   a. Medical Records File room
   b. Narcotics closets/rooms
   c. Dedicated staff entry to private/clinical areas not off the main public corridor

4. Clinic entry doors from public waiting areas shall be located at a point visible to the receptionist. This door shall be lockable.

5. Duress buttons shall be installed at any area where large amounts of cash are taken or stored.

6. All perimeter glass to the public corridor shall be fitted with acoustic glass break detectors.

7. Any cash storage safe shall be immovable. A holdup button shall be placed near the cash safe shall large amounts of cash be stored. The safe itself shall be invisible to passers-by.

8. If the clinic will be used for after-hours patients as well, the corridor entry door shall be fitted with a doorbell, and chime speakers shall be distributed throughout the suite.

2.4. Security Requirements Summary for Research Facilities

The following additional physical and electronic systems shall be installed to secure Research Facilities and environs:

1. Windows fronting the exterior in areas with high-value equipment shall be fitted with glass break alarms.
2. High Risk Research and Storage Area entry doors within the facility shall be fitted with card access. When appropriate, CCTV cameras may be installed at key doors.

3. Where appropriate to the use and security needs of the facility, provisions for a Central Security-Manned Reception Desk at the visitor entrance shall be included, which would be fitted out for local annunciation of building alarms, as well as for local CCTV monitoring.

4. There shall be two points of electronic access-control separation between the exterior of a facility and interior lab/lab support areas (including wet bench, dry bench and computer lab areas). This may require card access on some combination of corridors, stairwells, elevators, and/or individual room doors.

2.5. Security Requirements Summary for Child Day Care Space

The following additional physical and electronic systems shall be installed to secure Child Daycare Facilities and environs:

1. There shall be at least two points of electronic access-controlled separation at the public entrance separating the building perimeter envelope from an interior waiting area and that waiting area from the interior Child Care areas. If there is an intermediary vestibule, both the exterior and interior vestibule doors shall be fitted with card access, and the exterior vestibule may remain unlocked during regularly scheduled parent drop-off and pick-up times. To facilitate authorized access, parents may be issued access cards that will allow them no farther than the waiting area.

2. There shall be local intercom communications at all the public entrance doors to several select intercom stations within and around the facility. This shall be interfaced with CCTV cameras, so that visitors can be seen as well as heard. There shall be no remote door release from interior intercom stations.

3. A receptionist area within the public waiting area shall be established, with a desk having the ability to communicate with and identify visitors seeking admittance, and with door release from there only. The desk will be fitted with limited CCTV monitoring capability, and it shall be staffed during drop-off and pick-up times.

4. The interior Child Care Areas shall be restricted to staff access only. Any non-staff person authorized on a temporary basis to be there must be escorted in and out. All perimeter doors to the interior space shall be fitted with alarms that sound locally and throughout the facility when used without authorization. These shall have card access to control entry and a card reader to either allow controlled egress on non-exit doors, delayed egress, or a reader to shunt the alarm upon egress on required exit doors. In sum, there shall be a very limited number of such entry doors to interior space.

5. CCTV cameras may be installed at interior perimeter points of entry and exit; at exterior play areas; and pick-up and drop-off parking areas. CCTV monitors with pan-tilt-zoom camera control may be provided at key interior staff monitoring areas.

6. The building’s environmental system shall be established so that no windows need to be operable. Fixed windows shall be fitted with shock sensors. Any accessible windows that are operable shall be fitted with fixed security screens. Shall any be required to be set for egress, these shall be fitted with safety locks and alarm contacts that sound locally and at key areas of the building.

7. It is recommended that the building be fitted with an interior PA system, with communications in each room. Ideally, the alarm system shall be interfaced with this, so that the exact location of an alarm breach will be broadcasted to staff through the facility’s speakers.
8. All interior activity, classroom and sleep area room entry doors shall be fitted with large vision panels so that staff can assess the interior from the exterior corridors.

9. Any exterior play area shall be physically and visually separated from public pathways with a wall of a minimum of 8’. These shall be as close to the building as possible, separated from driveways or public parking areas. Access into the play area shall be via a gate or opening on card access, with card access to control egress as well. The play area shall be fitted with an emergency telephone with its camera and fixed cameras to cover general play areas.

10. Emergency duress buttons shall be installed in interior and exterior childcare areas. These shall be installed with protective covers and out of general child reach.

2.6. Security Requirements Summary for YARC Space

The following additional physical and electronic systems shall be installed to secure YARC Facilities and environs:

1. There shall be at least three points of electronic access-controlled separation between the building perimeter envelope and YARC Animal Holding rooms. All animal facility use rooms shall be equipped with prox card readers. This includes, but may not be limited to, animal, procedure, wash center, offices, break rooms, locker rooms, surgical suites, storage and waste containment.

2. Any mechanical, electrical, security or telecom rooms that house support infrastructure for this facility shall be fitted with prox card access. These shall be designed to reside within the secure suite.

3. All electric locking hardware on card reader doors shall be fitted with latch bolt monitoring to detect latch taping, and all such locking hardware and catches shall be installed with tamper-proof screws. Pinned hinges shall be used for doors that have exposed hinges on the corridor side.

4. Any access controlled portal or adjacent wall with glass shall be fitted with acoustic glass break detectors.

5. Emergency communications telephones (area of refuge phones), with automatic ring-down to Security, shall be installed in key interior areas, cage wash areas, and other perceived remote areas within the space. Where practical, emergency communication telephones shall be placed at intervals that allow line of sight to at least one emergency communication telephone from all interior corridor location. Each emergency communication telephone will be equipped with a blue lamp.

6. Cellular service shall be provided in all animal facilities.

7. Any exterior windows within YARC space shall be filled in and covered. Where BL3 research is done, these walls-if not 2” thick, shall be fitted with vibration sensors.

8. CCTV cameras shall be installed at each entry point to the YARC facility, and where practical at intervals to allow video monitoring of all interior corridor locations. The video from these cameras will be recorded at a digital video recorder and managed by Yale Public Safety.

9. Biometrics shall be considered for high containment (e.g. BL3) facilities, and other specialized or sensitive areas.
2.7. Security Requirements Summary for Garage Facilities

The following additional physical and electronic systems shall be installed to secure Parking Garage Facilities and environs:

1. All exterior perimeter pedestrian gates and doors must be tied into Yale Public Safety’s card access system only. All vehicle gates/barriers shall be wired primarily into the Yale Parking access system and secondarily into Yale Public Safety’s access control system. All perimeter overhead or other vehicle gates must have alarm contacts wired to Yale Public Safety CAS for status.

2. Card access shall be installed on any Garage offices and Cashier’s booths.

3. As much as is architecturally possible, all garage stairways and elevator backs shall be designed of heavy-duty glass or plexiglass to ensure clear interior visibility from the garage exterior. Doors into stairwells shall have large glass panels, and stairway landings shall be fitted with corner-mount mirrors for added security visibility.

4. The garage shall be designed to be fully enclosed/securable at all accessible points 12’ from grade or below. Landscaping around the perimeter shall be arranged to reduce visual obstructions. Bushes or hedges, especially at entries and exits, shall be avoided.

5. In addition to key exterior perimeter pedestrian entries of the garage, Yale blue phone packages shall be installed at all elevator lobbies and stairwell entries on every floor, as well as on parking ramps and landings.

6. CCTV cameras may be installed at the following locations: at elevator lobbies and stairwells; at roof corners; at perimeter pedestrian entrances; at the interior and exterior of vehicle gates; at the Cashiers booth/office to monitor transactions; at blue phones. These cameras shall be wired back to the Yale Public Safety video servers. The garage office shall be fitted with a CCTV monitor and camera control for local viewing and assessment.

7. Garage Cashiers’ booths and any office, in addition to card access, shall be fitted with glass break detection and emergency hold-up buttons.

8. Interior lighting must be widely distributed, and the lighting must compensate for any architectural obstructions, like closely spaced columns or beams.

2.8. Security Camera Installation Policies

This policy concerns the installation and use of equipment for video surveillance, monitoring, and recording on Yale University-owned, leased or controlled properties; this policy does not apply to the use of video applications for academic, research, or educational purposes of Yale University.

Security cameras are strategically placed throughout the Yale University community to meet the specific needs of departments and to assist the Yale University Department of Public Safety to deter crime, manage emergency response situations, and investigate suspected criminal behavior. No video surveillance cameras may be installed without authorization of the Department of Public Safety.

Video cameras to be used for safety, security or facilities management purposes may be installed in any location, on approval of the Video Review Committed (VRC), except for the following:

- Student dormitory rooms in the residence halls
- Living quarters of other residential facilities
- Bathrooms
- Locker rooms and other changing facilities
- Offices
- Classrooms not used as a lab

Storage and Retention of Recordings

All surveillance records shall be stored in a secure university centralized for a period of 45 days or, if required for specific purposes for certain locations, a set number of days. The video will then promptly be erased or written over, unless retained as part of a criminal investigation or court proceedings (criminal or civil), or other bona fide use as approved by the Director of Public Safety and Chief of Police or designee. Individual departments shall not store video surveillance recordings.

Exceptions

Uses of Public Safety Camera Systems beyond those described in this policy is prohibited. Persons having questions about the use of Public Safety Camera Systems not subject to this policy shall direct those questions to the VRC at VCR@yale.edu.
3.1. Audiovisual Guidelines and Best Practices

Recommended Display Size

Displays shall be sized to allow maximum viewability of content. Displays shall be 16:9 aspect ratio unless specified specifically for Cinema or non-traditional use. In a typical application displays shall be sized so that the Display Height (DH) multiplied by 6 is less than or equal to the Distance to the Farthest Viewer (DFV), DHx6 ≤ DFV. In critical or fine detail viewing the DFV will be half or DHx3 ≤ DFV. The maximum viewing angle cone shall be no more than 30 degrees from center. The closest viewer shall be no less than the height of the display away. In installations where recommended viewing distances and sizes cannot be met supplemental displays shall be included.
Recommended Display Type

Flat panel displays shall have 4K resolution. Projectors shall be LCD or LCOS based imaging and have a laser light source; 3-chip DLP projectors may be used in certain use cases. Projectors will be used in a 16:9 mode. Projection screens shall be tensioned and have a high contrast, 4K capable surface. Ambient light rejecting screen surfaces may be required in certain environments to provide adequate image brightness for the environment. Where architecturally appropriate the elimination of black drop on screens shall be considered. Projection screens shall be motorized with a physical up/down switch located in the room.

Display Installation

All displays must be installed in accordance with local codes and regulations. ADA clearances must be considered in all installations. It is recommended to install displays so the bottom of the image is no lower than 42” above finished floor (aff). Display height will depend on application. Displays shall be installed on articulating mounts to allow for easy access to the back of the display for service. For flat panel installation a Chief PAC526CF style back box is recommended with installed two (2) duplex power outlets and two (2) Category 6 RJ45 network connections, additional conduit may be required per system design. Review with Yale IT whether locations should be provided with OM4 50 micron optical fiber to support SDVoE 10 Gbps connectivity.
Audio Coverage and Uniformity

Program audio and music reinforcement shall reproduce a full range of frequencies while vocal reinforcement shall be tuned for speech intelligibility. Audio coverage shall vary by no more than 3dB across the listening area. Ambient Noise and Reverberation: Unoccupied classroom levels must not exceed 35 dBA; The signal-to-noise ratio (the difference between the teacher's voice and the background noise) shall be at least +15 dB at the listener's ears; Unoccupied classroom reverberation must not surpass 0.6 seconds in smaller classrooms or 0.7 seconds in larger rooms. ADA hearing assist capabilities shall be included in all implementations.

Stereo program audio and music speakers are recommended for the front of the room while ceiling or pendant speakers configured for 70V operation provide speech audio. If one or the other is not possible all audio will be handled by a single speaker type. Line array or specialty speakers may be required by application.

Provide a fire alarm system relay bypass relay connection to amplifiers where required for fire alarm system audibility.

Control Systems

AV control system can serve different purposes depending on application. Typical functions include display power on/off, source selection, audio volume control and can include additional functions as required by the system design. AV control systems and monitoring shall be used in every AV installation.

Extron or QSC’s Q-sys shall be used as AV control systems. YALE IT can provide graphical user interface (GUI) templates for use with control systems to provide consistency with other installations across the University. Use of touchscreen AV controls is recommended.
Infrastructure Requirements

AV systems now follow traditional IT infrastructure architecture. Almost all devices connect over Cat6 cabling for audio, video, data and control, connect to network switches and need to be configured for specific applications and functions. An enterprise deployment of an AV system resembles a server farm or traditional network closet more than a traditional point to point system with AV devices transmitting information with traditional IP protocols and workflows, or AV over IP. As a rule of thumb each AV device requires a network connection. It is recommended centralized AV processing equipment reside in TR’s as power and cooling requirements are the same for both systems. Additional AV infrastructure requirements include:

- AV equipment locations shall typically be served with a minimum 1-¼” conduit or as required by installation. Singular AV devices requiring only one (1) Category 6 cable, speaker wire, control cable, or microphone cable shall be served with a minimum ¾” conduit. Conduit shall terminate in an accessible location, AV equipment closet or TR. Conduit shall have nylon bushings installed on any exposed ends. Conduit shall be left with a nylon pull string for future use.
- Mounting heights for wall mounted control devices shall be mounted at ADA height.
- All physical device installation to be in compliance with local codes and industry best practices.
- Gang style boxes shall be open mud ring (old work) or deep boxes to accommodate AV connections.
- Cables and cords shall not be run across a floor without non-movable cord coverings.
- Large systems shall consider a Video over IP architecture which provides better value and control at scale than traditional systems.
- When utilizing flat panel backboxes, use designated backbox knockouts for mounting receptacles and network outlets. Do not wire into the backbox and mount biscuit style or gang boxes within the usable void of the backbox designated for audiovisual equipment.
- Prior to installation of sensitive audiovisual equipment and projection screens and surfaces within renovation areas, the project Contractors shall complete the following checklist and submit for ICT Designer/Yale IT approval. Incorporate the criteria below as contract requirements in project documentation:
  - All dust generating construction is complete inside the room and room is sealed from exterior construction areas.
  - Wall and ceiling surfaces are clean with final paint.
  - Room surfaces are free of dust
  - Ductwork and vents serving the Telecom Room are cleaned
  - Permanent door is locked with limited key availability
  - Door dust stopper is installed
  - Dirt trapper/sticky mats are placed inside entrance door
- Network cabling serving the audiovisual systems shall be provided by the project cabling contractor and terminated in the project telecom rooms as part of the building structured cabling system. No special designations shall be provided for cabling plant serving the audiovisual systems.

Audiovisual Projection Rooms

Projection room infrastructure requirements shall conform to the architectural, electrical, and environmental design criteria in “Telecom Room Requirements” listed above. Power, cooling, and ventilation requirements demanded by large venue projection systems shall be carefully coordinated. The following design criteria shall be reviewed and coordinated for each project:

- Various sizes of projection rooms may be required for the following venues:
  - Single Projector Small Venue
Based upon the room program and functional requirements, the ICT/AV Designer shall provide a projection room equipment layout plan and room section identifying the following:

- Sight lines into the venue from operator workstations and projector light paths over the audience
- Projection and view port glass windows and framing
- Operator workstations
- Equipment cart and trolley locations
- Equipment racks and rack lines
- Cable runways, room penetrations, and surface raceways
- Grounding busbar
- Lighting control panel
- Electrical subpanel
- Wall light switch(es), control panel(s), and AV panel(s) locations
- Large venue projectors and infrastructure requirements
  - Mounts and structural tie points
  - Mirror systems for rear projection if used
  - Dedicated projection system ventilation or cooling apart from room HVAC system. Provide flexible ducts for final connections to equipment.
  - Power circuiting and device types
- HVAC system loads, ductwork, and equipment locations
- Room lighting
- Wall sound transmission classes and room acoustical treatments
- Door type and card reader access control
- Rear projection screen installation details
- Storage cabinet locations
- Equipment working clearances and circulation paths

- The structured floor shall be 1” below finished floor within the projector room. Apply 1” self-leveling liquid flooring to ensure level floor across room with no more than 1/32” deviation from level. Coordinate final resilient flooring requirements with any trolley racks or rolling projector equipment sub-structure.

- Provide a dedicated electrical subpanel to serve the projection room.

### 3.2. AV Systems Types

#### Digital Signage

Digital Signage can range in size and type from a small table-top display up to a large video wall and can include interactivity or live triggering of content depending on programming. A typical digital signage deployment requires a display, duplex 120V power outlet, 2 Cat6 RJ45 network connections and a content player. Physical installation and content must meet accessibility guidelines and comply with ADA requirements. Digital Signage software or service subscription costs shall be budgeted as a recurring cost and is typically not included in the cost of installation. In addition, recurring service and maintenance costs may apply. System requirements include:

- Display, size and type as needed for the application and design intent
- Media Player, mounted behind the display
- Power: 120V/20A duplex receptacle behind display
- Network: two (2) Category 6 cables behind display
- Control (Power On/Off, Source Selection (if needed), Volume Control) via display or third-party control system
- Recommended: Chief PAC526CFW back box recessed in wall behind display containing the power and network outlets
- Optional enhancements:
  - Touch screen display
  - Supplemental audio reinforcement

**Huddle Room**

Huddle Rooms consist of small gathering spaces intended for less than 10 people and are intended as spaces for collaborative small group work. A typical huddle room requires a display, duplex 120V power outlet, two (2) Category 6 network connections, a laptop connection and optionally a dedicated source like a local computer. Wired HDMI input and wireless display video connection are highly recommended. Optional items include webcam/microphone. An interactive flat panel can be installed to provide additional use cases. Physical installation must meet accessibility guidelines and comply with ADA requirements. Service costs may include periodic maintenance or troubleshooting and are typically not included in the cost of installation. System requirements include:

- Display, typically 55” - 65”
- Power: 120V/20A duplex receptacle behind display
- Network: two (2) Category 6 cables behind display
- Wired HDMI input
- Wireless display video connectivity, recommended
- Control (Power On/Off, Source Selection (if needed), Volume Control) via third party control system. Touchscreen controller recommended.
- Recommended: Chief PAC526CFW back recessed in wall behind display containing the power and network outlets
- Optional:
  - Touch screen display
  - Webcam/microphone, Logitech MeetUp typical
  - Dedicated local computer with wireless keyboard/mouse
  - External room schedule and booking displays
  - Meeting Room Digital Signage display

**Small Conference Room**

A Small Conference Room will have a viewing distance of no more than 18 feet to the farthest viewer and typically utilizes display sizes of 75” or less. A typical small conference room requires a display, duplex 120V power outlet, 2 Cat6 RJ45 network connections, a laptop connection and optionally a dedicated source like a local computer. Wired HDMI input and wireless display video connection are a minimum. Webcam/microphone are included but additional microphones may be required for audio coverage. An interactive flat panel can be installed to provide additional use cases. Physical installation must meet accessibility guidelines and comply with ADA requirements. Service costs may include periodic maintenance or troubleshooting and are typically not included in the cost of installation. System requirements include:

- 65” - 75” display
- 120V duplex power at display
- 2 data at display
- Wired HDMI input
- Wireless display video connectivity
- Control (Power On/Off, Source Selection (if needed), Volume Control) via third party control system and touchscreen controller. Table top control typical.
- Webcam/microphone, Logitech series typical
- Recommended: Chief PAC526CFW back box installed behind display with duplex outlet and 2 data

Optional:
- Touch screen display
- Additional table microphones may be required.
- Dedicated local computer with wireless keyboard/mouse
- External room schedule and booking displays
- Meeting Room Digital Signage display

Large Conference Room

A Large Conference Room will have a viewing distance greater than 18 feet to the farthest viewer and typically utilizes display sizes of 86” or above. For displays above 100” diagonal a projector/screen shall be used. A typical large conference room requires a display, duplex 120V power outlet, 2 Cat6 RJ45 network connections, a laptop connection and optionally a dedicated source like a local computer. Wired HDMI input and wireless display video connection are a minimum. Installed Pan-Tilt-Zoom (PTZ) camera and installed room microphones included. Interactive flat panels not typical to these installations due to room size. Physical installation must meet accessibility guidelines and comply with ADA requirements. Service costs may include periodic maintenance or troubleshooting and are typically not included in the cost of installation. System requirements include:
- 86” - above display, flat panel or screen/projector as required by application and intent
- 120V duplex power at display. Motorized screen will require power and low voltage relay connection with access that allows service of the power and low voltage connections.
- 2 data at display
- Wired HDMI input
- Wireless display video connectivity
- Control (Power On/Off, Source Selection (if needed), Volume Control) via third party control system and touchscreen controller. Table top control typical.
- PTZ camera and installed room microphones, QSC cameras and Shure microphones typical
- Recommended: Chief PAC526CFW back box installed behind display with duplex outlet and 2 data

Optional:
- Dedicated local computer with wireless keyboard/mouse
- External room schedule and booking displays
- Meeting Room Digital Signage display

Movable Display Cart

A Movable Display Cart is used in applications where a fixed installation is not possible or flexibility with display positioning is desired. A Movable Display Cart typically utilizes display sizes of 55” to 86”. A typical movable display cart requires a display, nearby duplex 120V power outlet, 2 Cat6 RJ45 network connections may be needed or the display may be able to operate on the wireless network, a laptop connection and optionally a dedicated source like a local computer mounted on a movable cart. Wired
HDMI input and wireless display video connection are a minimum. Webcam/microphone are optional. An interactive flat panel can be installed to provide additional use cases. Physical installation must meet accessibility guidelines and comply with ADA requirements. Interactive displays require height adjustable carts. Service costs may include periodic maintenance or troubleshooting and are typically not included in the cost of installation. System requirements include:

- **55" - 75" Interactive Flat Panel with integrated Local PC and Wireless Display Gateway, wired HDMI input**
  - Current model includes BenQ RP Series Interactive Displays, other models considered with YALE IT consultation
  - Power and 2 Cat6 to display by others
  - Yale network connection for each

- **Wired HDMI input**

- **Wireless display video connectivity**

- **Control (Power On/Off, Source Selection (if needed), Volume Control) via the display onboard controls.**

- **Optional:**
  - Touch screen display
  - Webcam/microphone
  - Dedicated local computer with wireless keyboard/mouse
  - Soundbar

- **Mobile electric height adjust display cart.**
  - Current model includes Salamander Designs XL Electric Lift Mobile Stand (FPS1XL/EL/GG), Electric Lift Mobile Stand (FPS1/EL/GG) and Fixed Height Display Stand (FPS1/FH/GG)
  - *Height adjustable stand required for interactive displays
  - Accessories included for mounting of webcam or other accessories, power and data connections, storage cover and laptop shelf

**Seminar - Interactive Flat Panel:**

- Interactive Flat Panel with integrated Local PC and Wireless Display Gateway, wired HDMI input
  - Current model includes BenQ RP Series Interactive Displays, other models considered with YALE IT consultation
  - Control directly via the BenQ display
  - Power and 2 Cat6 to display by others required
  - Yale network connection for each
  - Microphone and ALS added as requested

**Seminar - Standard Flat Panel:**

- Standard Flat Panel with integrated Local PC and Wireless Display Gateway, wired HDMI input
  - QSC:
    - QSC NV video encoder, local HDMI output to Primary Display
    - 8” wall or table mounted touch screen control
    - Current models include Samsung and LG Commercial displays, display to be controlled by QSC
  - Extron:
    - IN1084 DO four input DTP out switcher, local HDMI output to Primary Display
    - 7” wall or table mounted touch screen control
○ Power and 2 Cat6 to display by others required
○ Typical Chief PAC526CF series back box installed behind display with standard power/data/conduit
○ Microphone and ALS added as requested

Seminar - Projector and Screen:

● 16:9 aspect, 4K capable motorized screen
● 6000 lumen minimum laser projector
  ○ Current models include Epson (L610U) and Sony
● Local PC, Wireless Display Gateway, Wired HDMI input
  ○ QSC:
    ■ QSC NV video encoder, local HDMI to Preview Monitor
    ■ QSC NV video decoder, local HDMI to Primary Display
    ■ 8” wall or table mounted touch screen control
    ■ QSC Core processor, shared or standalone
  ○ Extron:
    ■ IN1084 DO four input DTP out switcher, local HDMI to controlled 2 input Preview Monitor video switch. Note: Preview Monitor switch will receive content from the IN1804 or the secondary output of the local PC
    ■ HDBaseT output of IN1804 to Projector
    ■ 7” wall or table mounted touch screen control
    ■ Extron control
    ■ Audio Output in addition to ALS to include
  ○ Stereo presentation speakers installed at the display location. Standard models include QSC AD-S8T surface mount speaker. Speakers and amplifiers as required by system design and requirements.
  ○ ALS transmitter locations to be prewired. Single gang box with Cat6

Standard Presentation Classroom - Projector and Screen

Presentation Classroom: Fixed or flexible seating but primary use case is presentation of materials without recording capability. Traditional front of room teaching station with focus toward displays or large writing surfaces. Vocal reinforcement required. System requirements include:

● 16:9 aspect, 4K capable motorized screen
● 6000 lumen minimum laser projector
  ○ Current models include Epson (L610U) and Sony
● Local PC, Wireless Display Gateway, Wired HDMI input, Blu-ray Player
  ○ QSC:
    ■ QSC NV video encoder for local sources
    ■ QSC NV video decoder, local HDMI to Preview Monitor
    ■ QSC NV video decoder, local HDMI to Primary Display
    ■ 8” wall or table mounted touch screen control
    ■ QSC Core processor, shared or standalone
  ○ Extron:
    ■ IN1084 DO four input DTP out switcher, local HDMI to controlled 2 input Preview Monitor video switch. Note: Preview Monitor switch will receive content from the IN1804 or the secondary output of the local PC
- HDBaseT output of IN1804 to Projector
- 7” wall or table mounted touch screen control
- Extron control
- AV Control located at teaching station
- Audio Inputs in addition to Source Audio to include:
  - 2, wireless microphones. Current models include Shure ULXD series.
- Audio Output in addition to ALS to include:
  - Stereo presentation speakers installed at the display location. Standard models include QSC AD-S8T surface mount speaker or as necessary for performance.
  - Mono ceiling speakers recommended for vocal reinforcement. Standard models include QSC AD-C6T ceiling speaker.
  - ALS transmitter preinstalled.

Advanced Presentation Classroom - Projector and Screen

The advanced presentation classroom shall incorporate additional cameras and microphones for streaming and recording. System requirements include:
- 16:9 aspect, 4K capable motorized screen
- 6000 lumen minimum laser projector
  - Current models include Epson (L610U) and Sony
- Local PC, Wireless Display Gateway, Wired HDMI input, Blu-ray Player
  - QSC:
    - QSC NV video encoder for local sources
    - QSC NV video decoder, local HDMI to Preview Monitor
    - QSC NV video decoder, local HDMI to Primary Display. Additional display outputs may be incorporated.
    - 8” wall or table mounted touch screen control
    - QSC Core processor, shared or standalone
  - Extron:
    - Advanced switching or matrix system may be required to meet system functionality requirements. Large Extron systems shall be compared with SDVoE type solutions for cost and flexibility.
    - 7” wall or table mounted touch screen control
  - Software Defined Video over Ethernet (SDVoE):
    - A SDVoE, or Video over IP, system shall be considered for all large and advanced systems designs.
    - Inputs and outputs as required by system use and design
- AV Control located at teaching station
- Audio Inputs in addition to Source Audio to include:
  - 2, wireless microphones for teaching station. Current models include Shure ULXD series
  - 8 additional wireless microphone channels. Current models include Shure ULXD series
- Audio Output in addition to ALS to include:
  - Stereo presentation speakers installed at the display location. Standard models include QSC AD-S8T surface mount speaker. Upgraded audio may include Coda Audio.
  - Mono ceiling speakers recommended for vocal reinforcement. Standard models include QSC AD-C6T ceiling speaker.
  - Dedicated Broadcast audio output
Auditorium - Projector and Screen

Auditorium: Primary use case is presentation of materials to large audiences. Traditional front of room teaching station with focus toward displays or large writing surfaces. AV Booth typical. AV Booth shall be equipped with AV sources and displays to allow production of technician-controlled events. Vocal reinforcement required. Cameras and lecture capture capabilities included. Advanced AV system control and integration. System requirements include:

- 16:9 aspect, 4K capable motorized screen
- 12,000 lumen minimum laser projector
  - Current models include Epson and Sony
- Local PC, Wireless Display Gateway, Wired HDMI input, Blu-ray Player
  - QSC NV video encoder at teaching station
  - QSC NV video decoder, local HDMI to Preview Monitor
  - QSC NV video decoder, local HDMI to Primary Display
    - QSC NV video encoder for local sources
    - QSC NV video decoder, local HDMI to Preview Monitor
    - QSC NV video decoder, local HDMI to Primary Display. Additional display outputs may be incorporated.
    - 11" wall or table mounted touch screen control
    - QSC Core processor, shared or standalone
  - Extron:
    - Advanced switching or matrix system may be required to meet system functionality requirements. Large Extron systems shall be compared with SDVoE type solutions for cost and flexibility.
    - 10" wall or table mounted touchscreen control
  - Software Defined Video over Ethernet (SDVoE):
    - A SDVoE, or Video over IP, system shall be considered for all large and advanced systems designs.
    - Inputs and outputs as required by system use and design
- AV Control located at teaching station and Booth
- Booth AV Sources including Blu-ray and wired HDMI input
  - Integrated into AV system for control from the Booth
  - Video production mixer such as Rolland V-600UHD with appropriate inputs/outputs. Recommended for produced events to enable seamless video preview and switching
- Audio Inputs in addition to Source Audio to include:
  - 2, wireless microphones for teaching station. Current models include Shure ULXD series
  - 8 additional wireless microphone channels. Current models include Shure ULXD series
  - Microphones required for audience capture where necessary
  - Additional microphones as required by system design or functionality
- Audio Output in addition to ALS to include:
  - Stereo presentation speakers installed at the display location. Audio system specified and sized for venue. Coda Audio systems preferred where applicable
○ Mono ceiling speakers recommended for vocal reinforcement. Standard models include QSC AD-C6T ceiling speaker
○ Dedicated Broadcast audio output

● Included Options:
○ Camera and microphones for Lecture Capture or Streaming. Standard models include QSC Cameras and Shure MXA910 microphones
○ Manual audio mixing console enabling full manual control of all audio sources. Must interface digitally with Q-Sys for switching between manual and auto modes.
○ Lecture Capture recording system. Current standard is Panopto.

Active Learning Classroom

Active Learning Classroom: Instructor led, media rich, group collaboration. Typically, multiple displays allowing individual group collaboration and instructor directed media to be displayed and controlled in an interactive and dynamic manner.

● Wolfvision Cynap vSolution Matrix active learning platform shall be installed in all Active Learning spaces
● Teaching/Touchdown station providing dedicated control and local input sources such as Local PC, Wireless Display Gateway, Wired HDMI input
● Audio Inputs in addition to Source Audio to include:
  ○ 2, wireless microphones for teaching station. Current models include Shure ULXD series
  ○ Additional microphones as required for system functionality and performance
● Audio Output in addition to ALS to include sound reinforcement necessary for system functionality and performance
● Note: Due to the custom and complex nature of Active Learning classrooms YALE IT shall be consulted on and approve of all designs and implementations.

3.3. Yale Classroom Minimum Standards

Video Sources

● Local PC with extended display capability to Preview Monitor
  ○ Yale provided classroom managed workstation
  ○ Yale network connection
● Wireless Display Gateway
  ○ Crestron AM-200 (currently under evaluation, Dec 2019)
  ○ Wireless display network connection
● Wired HDMI input
  ○ Adapters provided for Mini DisplayPort and USB-C

Audio Sources

● Audio from input supporting allowable playback formats
● Microphone as needed for ALS
● Shure microphones, UXLD G50 or as needed by application to prevent interference. Frequency survey may be required.

Video Outputs

● Primary Display
   ○ Display shall be sized so that the height of display is equal to or less than the distance to the farthest viewer divided by 6
   ○ 16:9 aspect ratio
   ○ 4K capable projection surface or flat panel display

● Preview Monitor
   ○ Touch monitor with USB connection to Local PC. Current model includes Planar PCT2265 installed on an Ergotron LX mount. Note: In single display systems the Preview Monitor may be omitted.

Audio Outputs

● Stereo program audio speakers, speaker level wiring as required by system, ceiling speakers as necessary
● ALS audio transmitter as needed, infrastructure preinstalled, Cat6 to ALS location
   ○ Listen Technologies IR Assisted Listening system or as required by venue
● Broadcast audio and video output as needed via IP
● No more than 3dB difference in audio level across the listening space

Control

● Acceptable systems include:
   ○ QSC Q-Sys Core, centralized audio, video and control processor
     ■ LAN A for AV, LAN B for Management
     ■ Located in MDF/IDF or locally as necessary
   ○ Extron IPCP Series Control Processor
     ■ LAN A for AV, LAN B for Management
     ■ Located locally to room
● Touch panel control in room of local AV system
   ○ Wall mounted, typical 1” conduit with 1, Cat6, POE+
   ○ Teaching station mounted in table top stand
● AV network connection
● Yale network connection allowing management, internet and remote access to the system

Video Distribution and Switching

● 4K infrastructure and compatibility must be provided
● Acceptable systems include:
   ○ QSC NV network based Video over IP
     ■ 1G Cat6 network devices installed locally in the room and in AV/IT MDF/IDF closets
     ■ AV network connection to each
○ Extron DTP point to point connection
  ■ Shielded Cat6 recommended
  ■ Direct wire devices to display
○ Software Defined Video over Ethernet (SDVoE):
  ■ A SDVoE, or Video over IP, system shall be considered for all large systems designs where a large number of inputs, outputs and signal routing flexibility is required. SDVoE systems support signal management and distribution in ways that make it a better value on large systems.
  ■ SDVoE systems are ideal for new construction and large renovations allowing enterprise management and scalability of deployments and full network integration of devices
  ■ 1G or 10G systems available, Cat6a or Fiber as required by the system, standard network infrastructure and topology, AV specific networking required. IDK is the preferred 10G solution.

Audio Distribution and Switching
● QSC Q-Sys Core audio processing, as part of Control
  ○ Q-LAN, AES-67 and Dante audio over IP
  ○ Mic/Line/Speaker level wiring as needed, IP distribution preferred
  ○ AV network connection
● Assisted listening:
  ○ Listen Technologies IR ALS preferred. Connection or conversion as required by the system.
● Additional audio outputs shall be considered for Broadcast use in each system and must be provided in Standard Presentation room and above.

Network
● AV device locations typically require 2 network connections: Yale data network and Yale AV network
  ○ Devices must be appropriately coordinated and configured with Yale ITS
  ○ Display locations shall receive 2, Cat6
  ○ AV Input locations shall receive 2, Cat6
  ○ Equipment rack locations shall receive 2, Cat6. Additional network switching may be required.
  ○ Touchscreen controllers receive 1, Cat6

Teaching Station
● ADA compliant teaching station, touchdown location or display cart. All devices must meet reach and usability standards.
  ○ Standard and custom furniture available
  ○ Custom millwork provided by Miller's Presentation Furniture
  ○ Power connection required
  ○ 2 Cat6 required or per system design

Wall Mounted Display
● ADA compliant mounting
- Articulating mount preferred for accessibility to connections behind the display
- Typical display to have Chief PAC526 mounted behind the display location.
  - Duplex 15A/120V outlet installed in box by others
  - 2, Cat6 installed by others
  - 1.25” conduit connected to lower wall boxes, floor boxes and/or extended to accessible ceiling
- Acceptable manufacturers include:
  - Samsung commercial
  - LG commercial
  - BenQ Interactive
  - Planar
  - Others as approved by YALE IT

**Movable Display Cart**

- ADA compliant, motorized height adjustable stand
  - Salamander Designs display carts with power, network, storage and accessory mounting options. Custom branding available
4.1. Radio Communication In-Building Coverage Specifications

In building radio coverage systems generally consist of a neutral host DAS that provides cellular service reinforcement and a Public Safety DAS that provides code required Emergency Responder Radio Coverage. These two systems may be separated due to the enhanced infrastructure requirements of the Public Safety DAS as well as the different reinforcement needed based on its frequencies.

Neutral Host Cellular DAS

The neutral host cellular DAS shall meet the following requirements;
- Be neutral, meaning that it should be capable of supporting AT&T, Verizon, and T-Mobile signal sources.
- At a minimum accommodate WSP frequencies LTE700, AMPS850, PCS1900, AWS2100, WCS2300, BRS 2500/2600.
- Use infrastructure (cable, connectors, devices, antennas) that supports wireless systems operating on band widths from 600 MHz to 6 GHz.
- Allow for proactive remote management and end-to-end alarming of active electronics.

Public Safety Emergency Responder Radio Coverage System

Radio communication is the main mean of communications for Facilities Operations and Public Safety. Facilities Operations provides service and maintenance for the University and responds to emergencies that include building mechanical and structural failure. Facilities Operations may also be called upon to support other types of University events and emergencies requiring support in areas of Physical Plant, Custodial, Grounds, and Fire Code Compliance, Power Plants, and Utilities. Additionally, when required, Facilities Operations can communicate with Yale Emergency Management, Yale Public Safety, Yale Hospitality, YARC, and host City/Town first responders.

Provide for inclusion of frequencies serving the municipalities’ first responders in newly constructed buildings, additions to existing buildings, alterations to existing buildings where the geographic scope of work encompasses more than 50% of the building’s gross area, including any additional floor area added and tie them into the fire system.

The ICT Designer shall consult with the Authority Having Jurisdiction (AHJ) of the municipality and Facilities Project Manager. The radio system(s) shall be designed to provide a minimum of 90 - 95% campus coverage and 99% coverage in vital areas. Subterranean spaces present radio signal deficiencies resulting from signal loss due to building penetration. Radio signal in subterranean spaces shall be enhanced through a system design and engineering equipment which are linked to the radio systems through channel configuration (frequencies).

Public Safety System Code Requirements Summary: CT FLSC and IFC

- 2018 Connecticut State Building Code
Systems and Equipment Summary

- DAS
- Multi-band Bi-Directional Amplifiers (BDA)
- Digital signal booster
- RF in-building antennas
- Riser rated coaxial cable
- Riser and Plenum rated fiber
- IP Address
- Emergency backup power
- Backup batteries (24 hours)
- Alarm points
- Equipment Enclosures housed in NEMA-4 compliant spaces.
# Yale IT List of Approved Components and Manufacturers

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<th>Basis of Design Manufacturer</th>
<th>Basis of Design Model</th>
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<td><strong>Telecom Room Fit-Out Components</strong></td>
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<tr>
<td>Telecom Room Cable Runway</td>
<td>Chatsworth Universal Cable Runway, B-Line, Hubbell Premise Wiring, or approved equivalent</td>
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<tr>
<td>Telecom Grounding Busbars (PBB/SBB/RBB)</td>
<td>Erico, Chatsworth, Hubbell Premise Wiring, Panduit, or approved equivalent</td>
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<tr>
<td>Cabling Penetration Sleeves, Floor and Wall, with Firestopping</td>
<td>STI EZ-Path, Hilti SpeedSleeve, Wiremold Flamestopper</td>
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<tr>
<td>Two Post Equipment Racks</td>
<td>Chatsworth</td>
<td>55053-203</td>
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<tr>
<td>Rack Upper Transition Tray, 3.5&quot;D</td>
<td>Chatsworth</td>
<td>12183-X19</td>
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<tr>
<td>Equipment Rack Double Sided Vertical Manager</td>
<td>Chatsworth</td>
<td>Evolution G3 35571-703</td>
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<tr>
<td>Equipment Rack Horizontal Manager, Single Sided, 1RU</td>
<td>Chatsworth</td>
<td>30139-719</td>
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<tr>
<td><strong>Telecom Riser Cabling Distribution</strong></td>
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<tr>
<td>Intrabuilding Multipair Category 3 Copper Backbone</td>
<td>General Cable, Mohawk, Superior Essex</td>
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<tr>
<td>Category 5e Angled 24 Port Voice Crossconnect Patch Panel, 2RU</td>
<td>Ortronics</td>
<td>Clarity OR-PHA5E6U24</td>
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<tr>
<td>Category 5e Rack Mounted 100 Pair 110 Block</td>
<td>Siemon S110D(X)1-300RFT 300 Pair, S110D(X)1-200RFT 200 Pair, S110D(X)1-100RFT, with S110C-5 5-pair connecting clips, or approved equivalent</td>
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<tr>
<td>Category 5e Wall Mounted 100 Pair 110 Block</td>
<td>Siemon S110AW2-XX with S110C-5 5-pair connecting clips or approved equivalent</td>
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<tr>
<td>Interbuilding Copper Voice Backbone</td>
<td>General Cable, Mohawk, Superior Essex</td>
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<tr>
<td>Rack Mounted Telephone Entrance Protector</td>
<td>Circa</td>
<td>1880ENA1/NSC-200</td>
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<tr>
<td>Wall Mounted Telephone Entrance Protector</td>
<td>Circa 110 Connector Series or approved equivalent</td>
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<tr>
<td>Category 6 Entrance Protector</td>
<td>Circa 604-75110 or approved equivalent</td>
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<tr>
<td>Telephone Entrance Protector 5-Pin Surge Protection Modules</td>
<td>Circa 4B1FS-240 or approved equivalent</td>
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<tr>
<td>Intrabuilding Singlemode Optical Fiber Backbone</td>
<td>Corning</td>
<td>MIC Tight-Buffered, Interlocking Armored Cable, OS2 Singlemode</td>
<td>Provide cabling with OFCP Plenum or OFCR Riser rating as required by project conditions</td>
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<tr>
<td>Intrabuilding Multimode Optical Fiber OM4 Backbone</td>
<td>Corning</td>
<td>MIC Tight-Buffered, Interlocking Armored Cable, 50 µm OM4 Multimode</td>
<td>Provide cabling with OFCP Plenum or OFCR Riser rating as required by project conditions</td>
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<tr>
<td>Optical Fiber Rack Mounted Termination Cabinet</td>
<td>Corning</td>
<td>CCH-02U, CCH-03U, CCH-04U with Duplex LC Adapter Panels, 24 F, OS2 SM and OM4 50 µm MM</td>
<td>Size termination cabinet per specific project requirements with 50% spare capacity</td>
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<tr>
<td>Optical Fiber Wall Mounted Termination Cabinet</td>
<td>Corning/Legrand</td>
<td>Minimum 48 strand capacity with Duplex LC Adapter Panels, 24 F, OS2 SM and OM4 50 µm MM</td>
<td>Size termination cabinet per specific project requirements with 50% spare capacity</td>
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<tr>
<td>Optical Fiber SM Connector</td>
<td>Corning</td>
<td>FuseLite Splice-On LC UPC Connector, Singlemode OS2</td>
<td>Zinwave DAS system fiber connections shall be APC in lieu of UPC</td>
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<tr>
<td>Optical Fiber OM4 MM Connector</td>
<td>Corning</td>
<td>FuseLite Splice-On LC Connector, 50 µm Multimode OM4</td>
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<tr>
<td>Air Blown Fiber Tube Cabling, Plenum, riser, OSP rated</td>
<td>Sumitomo Electric Lightwave FutureFlex</td>
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<tr>
<td>Air Blown Fiber, Fiber Bundles</td>
<td>Sumitomo Electric Lightwave FutureFlex</td>
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<td>Air Blown Fiber Tube Distribution Units</td>
<td>Sumitomo Electric Lightwave FutureFlex</td>
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<td>Air Blown Fiber Tube Distribution Splices</td>
<td>Sumitomo Electric Lightwave FutureFlex</td>
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<tr>
<td>Outside Plant Innerduct</td>
<td>Endot, Dura-line, Maxcell, or approved equivalent</td>
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<td>Wire Mesh Basket Cable Tray</td>
<td>Cablofil, Eaton B-Line Flextray, Nvent Caddy WBT, or approved equivalent</td>
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<td>Floor Boxes</td>
<td>Wiremold, Hubbell, FSR</td>
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<tr>
<td>Pokethroughs</td>
<td>Wiremold, Hubbell, FSR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Top J-Hooks for Cabling Supports</td>
<td>B-Line, Chatsworth, Mono-Systems, Nvent Caddy, Panduit, Thomas &amp; Betts, Wiremold, or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 6 Cabling Plenum CMP Rated</td>
<td>Mohawk, Belden</td>
<td>AdvanceNet 4 PAIR #23 AWG UTP CATEGORY 6e+ PLENUM, Blue color, Part Number M57193</td>
<td>Security system devices and cameras shall use Purple color cabling, Part Number M57201</td>
</tr>
<tr>
<td>Category 6 Cabling Riser CMR Rated</td>
<td>Mohawk, Belden</td>
<td>AdvanceNet 4 PAIR #23 AWG UTP CATEGORY 6e+ RISER, Blue color, Part Number M57202</td>
<td>Security system devices and cameras shall use Purple color cabling, Part Number M57210</td>
</tr>
<tr>
<td>Category 6 Cabling Indoor/Outdoor Riser Rated</td>
<td>Mohawk, Belden</td>
<td>VersaLAN INDOOR/OUTDOOR 4 PAIR #23 AWG UTP CAT 6 CMR/CMX, Blue color, Part Number M59200</td>
<td></td>
</tr>
<tr>
<td>Category 6A Cabling Plenum CMP rated</td>
<td>Mohawk, Belden</td>
<td>GigaLAN 10 4 PAIR #23 AWG UTP CATEGORY 6A PLENUM, Blue color, Part Number M58646</td>
<td>Category 6A Cabling for Wireless Access Points</td>
</tr>
<tr>
<td>Category 6 Angled 48 Port Patch Panel, 2RU</td>
<td>Ortronics</td>
<td>Clarity OR-PHA66U48</td>
<td></td>
</tr>
<tr>
<td>Category 6A Angled 48 Port Patch Panel, 2RU</td>
<td>Ortronics</td>
<td>Clarity OR-PHA6AU48</td>
<td>Category 6A Patch Panel for Wireless Access Point Cabling Termination</td>
</tr>
<tr>
<td>Category 6 Reduced Diameter Patch Cords</td>
<td>Ortronics 28 AWG stranded with 8-position modular plug, blue color unless otherwise required</td>
<td>Provide reduced diameter patch cords for cross-connections within Telecom Rooms. Coordinate final lengths and colors required.</td>
<td></td>
</tr>
<tr>
<td>Category 6A Reduced Diameter</td>
<td>Ortronics 28 AWG stranded with 8-position modular</td>
<td>Provide cords for wireless access point cross-connections.</td>
<td></td>
</tr>
<tr>
<td>Equipment Type</td>
<td>Basis of Design Manufacturer</td>
<td>Basis of Design Model</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>------------------------------</td>
<td>----------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Patch Cords</td>
<td>plug, blue color unless otherwise required</td>
<td>Cords installed above ceilings shall be plenum rated as required.</td>
<td></td>
</tr>
<tr>
<td>Category 6 Modular Jack</td>
<td>Ortronics Clarity 6 TracJack OR-TJ600</td>
<td>Provide fog white color unless otherwise directed by Yale IT</td>
<td></td>
</tr>
<tr>
<td>Category 6A Modular Jack</td>
<td>Ortronics Clarity 6a track jack OR-TJ6A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telephone Mounting Faceplate</td>
<td>Ortronics</td>
<td>TracJack OR-403STJ1WP</td>
<td></td>
</tr>
<tr>
<td>Four Port Modular Faceplate – Single Gang Stainless Steel</td>
<td>Ortronics</td>
<td>TracJack OR-403STJ14</td>
<td></td>
</tr>
<tr>
<td>Four Port Modular Faceplate – Single Gang White</td>
<td>Ortronics</td>
<td>TracJack OR-40300546</td>
<td></td>
</tr>
<tr>
<td>Two Port Surface Mount Biscuit Box White</td>
<td>Ortronics</td>
<td>TracJack OR-404TJ2</td>
<td>Boxes installed above finished ceilings shall be plenum rated as required</td>
</tr>
<tr>
<td>Systems Furniture Four Port Faceplate White</td>
<td>Ortronics</td>
<td>TracJack OR-40300633</td>
<td>Coordinate systems furniture plate requirements with furniture provider</td>
</tr>
<tr>
<td>Four Port Decora Adapter Strap White</td>
<td>Ortronics</td>
<td>TracJack OR-41900018</td>
<td></td>
</tr>
<tr>
<td>Four Port 106 Adapter Strap White</td>
<td>Ortronics</td>
<td>TracJack OR-40800019</td>
<td></td>
</tr>
<tr>
<td>ScienceNet 50 micron OM4 Laser Optimized Multimode Duplex LC Module</td>
<td>Ortronics</td>
<td>TracJack OR-63700080</td>
<td></td>
</tr>
<tr>
<td>ScienceNet 50 µm OM4 Laser Optimized Multimode Horizontal Cabling</td>
<td>Corning</td>
<td>MIC Tight-Buffered Cable, Plenum 2 F, 50 µm multimode (OM4)</td>
<td></td>
</tr>
<tr>
<td>Optical Fiber Patch Cords</td>
<td>Corning, or approved equivalent</td>
<td></td>
<td>Coordinate requirements with Yale IT</td>
</tr>
<tr>
<td>Cable Plant Labeling</td>
<td>Brady, Ortronics, Panduit, or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable Plant Tester and Reports</td>
<td>Fluke Networks Versiv test equipment with LinkWare Management Software or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Type</td>
<td>Basis of Design Manufacturer</td>
<td>Basis of Design Model</td>
<td>Notes</td>
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<tr>
<td>---------------------------------------------------------</td>
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<td>-----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Wireless Access Point Enclosures</td>
<td>Oberon or approved equivalent</td>
<td></td>
<td>Coordinate requirements with Yale IT and the Architect</td>
</tr>
<tr>
<td><strong>Distributed Antenna Systems</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head End Equipment</td>
<td>Zinwave or approved equivalent</td>
<td></td>
<td>Coordinate requirements with Facilities Project Management</td>
</tr>
<tr>
<td>Telecom Room Active Hubs</td>
<td>Zinwave or approved equivalent</td>
<td></td>
<td>Coordinate requirements with Facilities Project Management</td>
</tr>
<tr>
<td>Remote Units/Antennas</td>
<td>Zinwave or approved equivalent</td>
<td></td>
<td>Coordinate requirements with Facilities Project Management</td>
</tr>
<tr>
<td><strong>Area of Rescue Two-way Communications System</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area of Rescue Command Unit and Visual Indicator</td>
<td>Talkaphone AOR-XX or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area of Rescue Call Station</td>
<td>Talkaphone ETP-110 or approved equivalent</td>
<td></td>
<td>Coordinate system requirements with project Architect for inclusion in the Building Signage Package</td>
</tr>
<tr>
<td>System Building Signage</td>
<td>Custom Building Signage</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Alarm Voice Evacuation (FAVE) System</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building FAVE Panel</td>
<td>Siemens, Honeywell</td>
<td></td>
<td>Coordinate requirements with Yale IT</td>
</tr>
<tr>
<td>FAVE System Multimode Optical Fiber Patch Cords</td>
<td>Corning, Hubbell Premise Wiring, Ortronics</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mass Notification System (MNS) System</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building MNS Panel and Equipment</td>
<td>SysNova</td>
<td></td>
<td>Coordinate requirements with Yale IT (Yale Emergency Management). The SysNova System is at End of Life and not well supported. Replacement systems are under evaluation and may be implemented for the project.</td>
</tr>
<tr>
<td><strong>Security Systems Infrastructure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door Hardware Power Supplies</td>
<td>Altronix or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor Site Emergency Call</td>
<td>U.S. SNTA 4”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Type</td>
<td>Basis of Design Manufacturer</td>
<td>Basis of Design Model</td>
<td>Notes</td>
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</tr>
<tr>
<td>Station Pole</td>
<td>Architectural Lighting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Call Station 120V Blue Light</td>
<td>Dialight</td>
<td>RTO-0B07-001</td>
<td></td>
</tr>
<tr>
<td>Security Access Control</td>
<td>Belden Inc.; Electronics Division</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banana Cabling</td>
<td>Berk-Tek; a Nexans Company</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mohawk/CDT; a division of Cable Design Technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>West Penn Wire/CDT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custom Entry Card Reader</td>
<td>Refer to photographs of campus installations in Appendix D</td>
<td></td>
<td>Coordinate custom design requirements with project Architect</td>
</tr>
<tr>
<td>Bollards</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Security Systems Equipment**

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>AMAG Technology</th>
<th>Licensing</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Access Control Panel | AMAG Technology | • AMAG ENT-LIC-008-V9 - Symmetry Enterprise 8 Reader License Add-on  
• AMAG ENT-LIC-064-V9 -Symmetry Enterprise 64 Reader License Add-on  
Reader Boards  
• AMAG M2150-4DBC-DL-HSE - Symmetry M2150 4DBC HSE 4 Reader Panel BOARD ONLY - DL, 20K.  
• AMAG M2150-8DBC-DL-HSE - Symmetry M2150 8DBC HSE 8 Reader Panel BOARD ONLY - 20K.  
• AMAG M2150-8DC-DL-HSE - Symmetry M2150 8DC HSE 8 Reader Panel BOARD ONLY - DL Elevator Panels  
• AMAG M2150-ELEV-HSE - | Provide minimum 20% spare I/O point and card reader capacity at each access control headend location in the building. |
## Yale IT List of Approved Components and Manufacturers

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Basis of Design Manufacturer</th>
<th>Basis of Design Model</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Symmetry M2150 HSE Elevator  |                              | Symmetry M2150 HSE Elevator Node with Enclosure - 20K cards.                          | • AMAG M2150-ELEV-EXT-HSE - Symmetry M2150 HSE Elevator Extender with Enclosure - Requires M2150-ELEV & 18VAC trans Interface Module  
  • AMAG WIM4 - Symmetry Wiegand Interface Module (WIM) 4  
  • AMAG WIM8 - Symmetry Wiegand Interface Module (WIM) 8  
  • AMAG M2150-AC8/4  
  • AMAG M2150-OC4/8  
  • AMAG M2150-AC24/4 Board only  
  • AMAG M2150-OC4/24 Board only  
  • AMAG MN-NIC-4 - Symmetry M2150 NIC Module  
  • AMAG FPO150-B100C8D8E4A LifeSafety Power Enclosure  
  • AMAG FPO150/250-2C82D8E8A LifeSafety Power Enclosure  |
<p>| Security Power Supply        | Altronix or approved equivalent | Specify fire alarm system interface where required.                                    |                                                                                                                                                                                                                                |
| Integrated Card Reader       | Sargent                       | SE LP10 multiCLASS SE                                                                 | Coordinate with Yale IT for latest model number. Reader support for Bluetooth shall be provided. Ensure system firmware lights the reader LED red when the door is locked, green when the door is unlocked, and flashing green during momentary unlocking of a door in a normally locked state. |</p>
<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Basis of Design Manufacturer</th>
<th>Basis of Design Model</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall Mounted Card Reader</td>
<td>HID</td>
<td>multiCLASS SE RP40</td>
<td>Coordinate with Yale IT for latest model number. Reader support for Bluetooth shall be provided. Ensure system firmware lights the reader LED red when the door is locked, green when the door is unlocked, and flashing green during momentary unlocking of a door in a normally locked state.</td>
</tr>
<tr>
<td>Mullion Mounted Card Reader</td>
<td>HID</td>
<td>mulitCLASS SE RP15</td>
<td>Coordinate with Yale IT for latest model number. Reader support for Bluetooth shall be provided. Ensure system firmware lights the reader LED red when the door is locked, green when the door is unlocked, and flashing green during momentary unlocking of a door in a normally locked state.</td>
</tr>
<tr>
<td>Keypad Card Reader</td>
<td>HID</td>
<td>multiCLASS SE RPK40</td>
<td>Coordinate with Yale IT for latest model number. Reader support for Bluetooth shall be provided. Ensure system firmware lights the reader LED red when the door is locked, green when the door is unlocked, and flashing green during momentary unlocking of a door in a normally locked state.</td>
</tr>
<tr>
<td>Request to Exist Sensor</td>
<td>Bosch</td>
<td>DS160</td>
<td></td>
</tr>
<tr>
<td>Overhead Door Contact Position Switch</td>
<td>Sentrol 2505A, GRI, Magnasphere, or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recessed Door Position Switch</td>
<td>Sentrol SR-1078W, GRI, Magnasphere, or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door Management Alarm</td>
<td>Designed Security, Inc (DSI)</td>
<td>ES4200-K3-T1</td>
<td></td>
</tr>
<tr>
<td>Security Camera - Exterior, Fixed, Vandal Resistance, Weatherproof</td>
<td>Axis Communications or approved equivalent</td>
<td>P3247-LVE or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Equipment Type</td>
<td>Basis of Design Manufacturer</td>
<td>Basis of Design Model</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>------------------------------</td>
<td>------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Security Camera - Exterior, Fixed, Vandal Resistance, Weatherproof, PTZ Camera</td>
<td>Axis Communications or approved equivalent</td>
<td>Q6155-E or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Exterior, Vandal Resistant, Weatherproof, Wide Dynamic Range (Canopy)</td>
<td>Axis Communications or approved equivalent</td>
<td>P3247-LVE or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Interior, Fixed Camera</td>
<td>Axis Communications or approved equivalent</td>
<td>P3225-LV Mk II or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Interior, Wide Dynamic Range, (facing Exterior Door)</td>
<td>Axis Communications or approved equivalent</td>
<td>P3225-LV Mk II or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Interior, Fixed Camera, Corridors</td>
<td>Axis Communications or approved equivalent</td>
<td>P3225-LV Mk II or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Interior, Fixed Camera, Elevators</td>
<td>Axis Communications or approved equivalent</td>
<td>P9106v Brushed Steel with Axis T8645 PoE+ Over Coax Compact Kit or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Interior, Fixed, 180-degree multi-imager, Wide Dynamic Range</td>
<td>Axis Communications or approved equivalent</td>
<td>P3807-PVE or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Exterior, Fixed, Wide Dynamic Range: 180 Degree</td>
<td>Axis Communications</td>
<td>P3807-PVE or approved equivalent with SD Card edge storage enabled</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
</tbody>
</table>
# Yale IT List of Approved Components and Manufacturers

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Basis of Design Manufacturer</th>
<th>Basis of Design Model</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera</td>
<td>or approved equivalent</td>
<td>and SD card provided.</td>
<td></td>
</tr>
<tr>
<td>Security Camera - Interior, Fixed, Single Imager Panoramic Fisheye Camera</td>
<td>Axis Communications or approved equivalent</td>
<td>M3048-P or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Exterior, Fixed, Wide Dynamic Range: 360 Degree Camera</td>
<td>Axis Communications or approved equivalent</td>
<td>P3717-PLE or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Interior, Fixed, Wide Dynamic Range: 360 Degree Camera</td>
<td>Axis Communications or approved equivalent</td>
<td>P3717-PLE or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Security Camera - Exterior, Fixed, Wide Dynamic Range: 360 Degree/PTZ Camera, Network Camera with pole mounted gooseneck/pendant mount</td>
<td>Axis Communications or approved equivalent</td>
<td>Q6000-E Mk II/Q6125-LE PTZ or approved equivalent with SD Card edge storage enabled and SD card provided.</td>
<td>Coordinate camera specification and final camera submittal approval with Yale IT. Final selection for camera model numbers shall be confirmed in the submittal review process of the project Construction Administration phase.</td>
</tr>
<tr>
<td>Covert Duress Button</td>
<td>United Security US-HUB2SA, DMP, Honeywell, Interlogix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrusion Dual Technology Motion Detector</td>
<td>DMP, Bosch, Honeywell, Interlogix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wireless Intrusion Sensors, Receivers, Repeaters</td>
<td>DMP 1100XH, DMP 1100R, Interlogix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glass Break Detector</td>
<td>Interlogix ShatterPro Acoustic Glassbreak Sensor, Honeywell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laser Scan Detector</td>
<td>Optex RLS 2020I or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock Sensor</td>
<td>GRI Shockgard SG-1 or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Type</td>
<td>Basis of Design Manufacturer</td>
<td>Basis of Design Model</td>
<td>Notes</td>
</tr>
<tr>
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</tr>
<tr>
<td>Plunger Switch</td>
<td>GRI PB2020T or approved equivalent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video Intercom System, IP SIP based</td>
<td>Aiphone, Commend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Call Station</td>
<td>Gai-tronics</td>
<td>293AL-003 in Blue Color</td>
<td>Call Station shall not be specified with a keypad dial</td>
</tr>
<tr>
<td>Building Alarm Panel to Central Station</td>
<td>DMP</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>Alarm System Keypad</td>
<td>DMP</td>
<td>7000 Series Thinline LCD Keypad</td>
<td></td>
</tr>
<tr>
<td>Building Alarm Panel Digital Cellular Communicator</td>
<td>DMP</td>
<td>263/381-2</td>
<td></td>
</tr>
<tr>
<td>Video Management Systems</td>
<td>Milestone</td>
<td>XPCODL Xprotect Corporate Device License, Y5XPCODL 5 Year SUP for Xprotect Corp Device License</td>
<td>Include 5-year license for each camera connected. Provide Pro Support for each camera provided.</td>
</tr>
<tr>
<td>Electronic Keybox</td>
<td>Morse Watchmans</td>
<td>KeyWatcher Touch</td>
<td></td>
</tr>
</tbody>
</table>

**Audiovisual Systems**

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Basis of Design Manufacturer</th>
<th>Basis of Design Model</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Wall Recessed Flat Panel Backboxes</td>
<td>Chief PAC526FCW or Fire Rated FSR PWB-FR-450-XXX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorized Projection Screens</td>
<td>Dalite, Stewart Filmscreen, Screen Innovations</td>
<td></td>
<td>All screen surfaces must be high contrast and, where appropriate, ambient light rejecting. 16:9 aspect ratio format</td>
</tr>
<tr>
<td>AV Network Switches and Configuration</td>
<td>Extreme Networks X440-G2 (1Gbps AV), X465-G2 (1Gbps AV Core Switch), X870 (10Gbps AV), X690 (10Gbps AV), X620 (10Gbps AV), X590 (10Gbps AV)</td>
<td>Coordinate with Yale IT to determine whether Cisco style switches should be provided that may permit integration with the Yale Next Generation Network at a future date.</td>
<td></td>
</tr>
<tr>
<td>Ceiling speakers (with back boxes, transformers, and grilles)</td>
<td>QSC</td>
<td>AcousticDesign Series</td>
<td></td>
</tr>
<tr>
<td>Video Cameras</td>
<td>QSC</td>
<td>PTZ-IP 20x60</td>
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<tr>
<td>Audio Visual consoles and Audio Visual Equipment Cabinets</td>
<td>Millers Presentation Furniture, Middle Atlantic</td>
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## Yale IT List of Approved Components and Manufacturers

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<tr>
<th>Equipment Type</th>
<th>Basis of Design Manufacturer</th>
<th>Basis of Design Model</th>
<th>Notes</th>
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<tr>
<td>Lecterns</td>
<td>Miller’s Presentation Furniture</td>
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<td>Refer to standard details for additional information on Lectern types.</td>
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<tr>
<td>Data / Video projector and ceiling mounting brackets</td>
<td>Chief Manufacturing or approved equivalent</td>
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<tr>
<td>Wall and ceiling mounted flat screen video displays</td>
<td>Samsung, LG, Sony, Planar</td>
<td>Commercial grade minimum models</td>
<td>Displays shall have IP control</td>
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<tr>
<td>Microphones</td>
<td>Shure</td>
<td>MXA-xxx series, ULX-D G50</td>
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<td>Point to Point Audiovisual Systems</td>
<td>Extron Electronics</td>
<td>DTP systems</td>
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<tr>
<td>1 Gigabit AV over IP Systems</td>
<td>QSC</td>
<td>Q-Sys</td>
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<tr>
<td>10 Gigabit SDVoE Systems</td>
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<tr>
<td>Control Interfaces - Touchscreens and physical controls</td>
<td>QSC</td>
<td>Q-SYS TSC-XXX-G2</td>
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<tr>
<td>Room Schedule Panels</td>
<td>Crestron</td>
<td>TSS-7</td>
<td>Coordinate room availability indicators, size, and mounting conditions with Architect</td>
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<tr>
<td>Audio DSP Programming</td>
<td>QSC</td>
<td>Q-Sys Core Processors</td>
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## APPENDIX B1 - SAMPLE PROJECT SPECIFIC SOW MATRIX TEMPLATE

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<thead>
<tr>
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<td><strong>Telecom Room Fit-Out Components</strong></td>
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<td>Cable Runway in Telecom Rooms</td>
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<tr>
<td>Telecom Grounding Busbars</td>
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<tr>
<td>Telecom Grounding Backbones</td>
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<td>Telecom Bonding</td>
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<td>Wall Plywood Backboarding</td>
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<td>Cabling Penetration Sleeves, Floor and Wall, w/ Firestopping</td>
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<tr>
<td>Category 6/6A Patch Panels, Horizontal Managers, and Cable Terminations</td>
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<tr>
<td>Optical Fiber Patch Cords</td>
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<td>Building Riser Conduits</td>
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<td>Copper Voice Termination Patch Panel</td>
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<td>Riser Cabling - Optical Fiber, Singlemode and OM4 Multimode</td>
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<td>Optical Fiber Termination Cabinets</td>
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<tr>
<td>Outside Plant Interbuilding Air Blown Fiber/Copper Backbones</td>
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<tr>
<td>Air Blown Fiber Tube Distribution Units, Tube Cables, Tube Splices</td>
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<td>Outside Plant Communications Ductbank</td>
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<td>Corridor Cable Trays</td>
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<td>Outlet Conduit and Device Backboxes</td>
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<tr>
<td>Floor Boxes and Poke Throughs</td>
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<td>Open Top J-Hooks for Cabling Supports</td>
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<td>Workstation Outlets/Faceplates/Jack</td>
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<td><strong>Network Electronics Equipment</strong></td>
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Questions / Comments
# APPENDIX B1 - SAMPLE PROJECT SPECIFIC SOW MATRIX TEMPLATE

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<th>Design/Specified by</th>
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<td><strong>Area of Rescue Command Unit and Visual Indicator</strong></td>
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<td><strong>Mass Notification System</strong></td>
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**Questions / Comments**
### APPENDIX B1 - SAMPLE PROJECT SPECIFIC SOW MATRIX TEMPLATE

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<thead>
<tr>
<th>Item Description</th>
<th>Design/Specified by</th>
<th>Furnished by</th>
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<tr>
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<td>ICT Designer</td>
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#### Security System Infrastructure
- Security Systems Conduit Rough-in and Device Backboxes
- Electrified Door Hardware (hardware installation)
- Electrified Door Hardware (terminations)
- Door Hardware Power Supplies
- Security System Pathways (Non-IP Network Based)
- Security System Cabling (Non-IP Network Based)
- Security System Device Terminations
- Category 6 Network Cabling and Terminations
- Fire Alarm System Interfaces, Relays, and Programming
- Outdoor Site Emergency Telephone Concrete Base and Pole
- Emergency Telephone 120V Blue Light
- Custom Entry Card Reader Bollards

#### Security System Equipment
- Access Control Panels and Wallfield Elevations
- Card Readers
- Request to Exist Sensor
- Door Position Switches
- Door Management Alarms
- Security Cameras and Mounts
- Intrusion Detection Systems Devices
- Video Intercom System
- Emergency Call Stations
- Building Alarm Panel to Central Station
- Building Alarm Panel Cellular Modem
- Network Video Recording (NVR) Systems
- Electronic Keyboxes
- Security System Programming
- System Testing and Training

#### Audiovisual Infrastructure and Equipment
- Conduit, junction boxes, floor boxes, wireways and other electrical (construction related) rough-in work pertaining to the installation of the AV systems

**Questions / Comments**
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<thead>
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<th>Questions / Comments</th>
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<td>AV Contractor</td>
<td>DAS Contractor</td>
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<td>Microphones</td>
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<tr>
<td>Control Systems - Hardware and Programming</td>
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<td>Electrical Engineer</td>
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<td>Yale</td>
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<td>Control Interfaces - Touchscreens and physical controls</td>
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<td>Audio DSP Programming</td>
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<td>AV System Documentation</td>
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<td>Video System Test Reporting</td>
<td>Yale</td>
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<td>Final Commissioning Report</td>
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<td>AV System User Acceptance Training</td>
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<td>Project Close</td>
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<td>Questions / Comments</td>
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<tr>
<td>Maintenance of AV System</td>
<td>Yale</td>
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<td>Electrical Engineer</td>
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<tr>
<td>AV System Troubleshooting</td>
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<td>Electrical Engineer</td>
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<td>Questions / Comments</td>
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<tr>
<td>Research / Testing Computer Displays / Monitors</td>
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<td>Architect</td>
<td>Electrical Engineer</td>
<td>ICT Designer</td>
<td>Yale</td>
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# Yale IT Systems Differential Scope of Work Matrix

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<tr>
<th>System</th>
<th>Designed By</th>
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<tbody>
<tr>
<td><strong>Telecom Room Fit-Out Components</strong></td>
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<tr>
<td>Cable Runway in Telecom Rooms</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Telecom Grounding Busbars</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>Telecom Grounding Backbones</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>Telecom Bonding</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
</tr>
<tr>
<td>Wall Plywood Backboarding</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Cabling Penetration Sleeves, Floor and Wall, with Firestopping</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Cabling Plant Equipment Racks and Vertical Managers</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<td>Category 6/6A Patch Panels, Horizontal Managers, and Cable Terminations</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Category 6/6A Patch Cords</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<td>Optical Fiber Patch Cords</td>
<td>ICT Designer</td>
<td>Yale IT</td>
<td>Yale IT</td>
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<tr>
<td><strong>Telecom Riser Cabling Distribution</strong></td>
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<td>Installed By</td>
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<tr>
<td>Building Riser Conduits</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>Riser Cabling - Copper Backbone</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Copper Voice Termination Patch Panel</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<td>Riser Cabling - Optical Fiber, Singlemode and OM4 Multimode</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<td>Optical Fiber Termination Cabinets</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Outside Plant Interbuilding Air Blown Fiber/Copper Backbones</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
</tr>
<tr>
<td>Air Blown Fiber Tube Distribution Units, Tube Cables, Tube Splices</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<td>Outside Plant Communications Ductbank</td>
<td>ICT Designer/Site Civil Engineer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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**Horizontal Distribution**

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<tr>
<th>System</th>
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<tbody>
<tr>
<td>Corridor Cable Trays</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>Outlet Conduit and Device Backboxes</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<td>System</td>
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<td>Furnished By</td>
<td>Installed By</td>
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<tr>
<td>Floor Boxes and Poke Throughs</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>Open Top J-Hooks for Cabling Supports</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Category 6/6A Horizontal Cabling</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Workstation Outlets/Faceplates/Jacks</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Workstation Horizontal Category 6/6A and OM4 Fiber Patch Cords</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<td>Cable Plant Labeling</td>
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<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<td>Cable Plant Testing</td>
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<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<td><strong>Network Electronics Equipment</strong></td>
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<td>Network Equipment Racks</td>
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<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Rack Mounted PDU's</td>
<td>ICT Designer</td>
<td>Yale IT</td>
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<td>Funded through Project</td>
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<tr>
<td>Rack Mounted UPS's</td>
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<td>Yale IT</td>
<td>Funded through Project</td>
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<td>Telecom Room Network Switches</td>
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<td>Yale IT</td>
<td>Does not include specialty systems switches such as IP Audiovisual or Sound Masking.</td>
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<tr>
<td>Telecom Room Voice Gateways</td>
<td>Yale IT</td>
<td>Yale IT</td>
<td>Yale IT</td>
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</table>
## Yale IT Systems Differential Scope of Work Matrix

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<tr>
<th>System</th>
<th>Designed By</th>
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<th>Installed By</th>
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<tbody>
<tr>
<td>Core Network Room Core Switching Equipment Upgrades</td>
<td>Yale IT</td>
<td>Yale IT</td>
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<td>Wireless Access Points (Wi-Fi 802.11ac/ax)</td>
<td>Yale IT</td>
<td>Yale IT</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>Wireless Access Points RF Predictive Study</td>
<td>ICT Designer or Yale IT</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Wireless Access Point Enclosures</td>
<td>ICT Designer/Architect</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Coordinate final enclosure selections with Yale IT for WAP compatibility and mounting requirements.</td>
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<tr>
<td>Telephone Handsets (Analog and VoIP)</td>
<td>Yale IT</td>
<td>Yale IT</td>
<td>Yale IT</td>
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<tr>
<td>Building User PC Workstations</td>
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<td>Yale IT</td>
<td>Does not include building systems operations workstations included in the project specifications.</td>
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### Distributed Antenna Systems

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<th>Designed By</th>
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<tbody>
<tr>
<td>Site Assessment</td>
<td>RF ICT Designer</td>
<td>NA</td>
<td>NA</td>
<td>Coordinate requirements with Facilities Project Manager, not Yale IT.</td>
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<tr>
<td>RF Predictive Study</td>
<td>RF ICT Designer</td>
<td>NA</td>
<td>NA</td>
<td>Coordinate requirements with Facilities Project Manager, not Yale IT.</td>
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<tr>
<td>Head End Equipment</td>
<td>RF ICT Designer</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Coordinate requirements with Facilities Project Manager, not Yale IT.</td>
</tr>
<tr>
<td>Carrier Coordination and Sources</td>
<td>RF ICT Designer</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Coordinate requirements with Facilities Project Manager, not Yale IT.</td>
</tr>
<tr>
<td>Telecom Room Active Hubs</td>
<td>RF ICT Designer</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Coordinate requirements with Facilities Project Manager, not Yale IT.</td>
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<tr>
<td>System</td>
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<td>Installed By</td>
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<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Remote Units/Antennas</td>
<td>RF ICT</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Coordinate locations and mounting conditions with the project Architect.</td>
</tr>
<tr>
<td>Optical Fiber/Low Voltage Power Cabling</td>
<td>RF ICT</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Coordinate requirements with Facilities Project Manager, not Yale IT.</td>
</tr>
<tr>
<td>Wireless Coverage and Signal Strength Testing</td>
<td>RF ICT</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Project CM/GC (Recommend assigning to DAS Contractor)</td>
<td>Coordinate requirements with Facilities Project Manager, not Yale IT.</td>
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</table>

**Two-Way Communication System for Area of Rescue**

<table>
<thead>
<tr>
<th>System</th>
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<tr>
<td>Conduit Rough-in and Device Backboxes</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>Area of Rescue Command Unit and Visual Indicator</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>Area of Rescue Call Station</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>System Cabling</td>
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<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
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<tr>
<td>Command Unit Analog Telephone Line</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
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<tr>
<td>System Building Signage</td>
<td>Architect</td>
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**Fire Alarm Voice Evacuation (FAVE) System**

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<tr>
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<tr>
<td>Building FAVE Panel</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Approved FAVE System Vendor)</td>
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</thead>
<tbody>
<tr>
<td>FAVE System Multimode Optical Fiber Patch Cords</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Approved FAVE System Vendor)</td>
<td>Project CM/GC (Recommend assigning to Approved FAVE System Vendor)</td>
<td></td>
</tr>
<tr>
<td>Mass Notification System (MNS) System</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building MNS Panel</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend Assigning to Approved MNS System Vendor)</td>
<td>Project CM/GC (Recommend Assigning to Approved MNS System Vendor)</td>
<td></td>
</tr>
<tr>
<td>MNS System Cabling</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend Assigning to Approved MNS System Vendor)</td>
<td>Project CM/GC (Recommend Assigning to Approved MNS System Vendor)</td>
<td></td>
</tr>
<tr>
<td>MNS System Site Speakers</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend Assigning to Approved MNS System Vendor)</td>
<td>Project CM/GC (Recommend Assigning to Approved MNS System Vendor)</td>
<td></td>
</tr>
<tr>
<td>MNS Central Station and Site Speaker Testing</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend Assigning to Approved MNS System Vendor)</td>
<td>Project CM/GC (Recommend Assigning to Approved MNS System Vendor)</td>
<td></td>
</tr>
<tr>
<td>Security Systems Infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security Systems Conduit Rough-in and Device Backboxes</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td></td>
</tr>
<tr>
<td>Electrified Door Hardware</td>
<td>Architect/Door Hardware Consultant/ICT Designer</td>
<td>General Contractor/Door Hardware Supplier</td>
<td>Installed by General Contractor/Recommend terminations assigned to Security Contractor</td>
<td>Electrified locks and exit devices with integrated card reader, door position switch, and request to exit switch shall be furnished and installed by the manufacturer certified Security Contractor.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>System</th>
<th>Designed By</th>
<th>Furnished By</th>
<th>Installed By</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door Hardware Power Supplies</td>
<td>Door Hardware Consultant/ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Where electrified door hardware is served by manufacturer specific power supplies, the power supplies shall be furnished by the General Contractor and documented in the project door hardware schedules.</td>
</tr>
<tr>
<td>Security System Pathways (Non-IP Network Based)</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Composite cables for access control doors shall be routed in segregated pathways away from Category 6/6A network cabling.</td>
</tr>
<tr>
<td>Security System Cabling (Non-IP Network Based)</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>Security System Device Terminations</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>Category 6 Network Cabling and Terminations</td>
<td>Security/ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>IP-based network connections and analog phone lines shall be provided for equipment and devices including but not limited to access control panels, IP security cameras, IP intercom stations, electronic keyboxes, and emergency call stations.</td>
</tr>
<tr>
<td>Fire Alarm System Interfaces, Relays, and Programming</td>
<td>Security/Electrical Consultant</td>
<td>Project CM/GC (Recommend assigning to Fire Alarm Contractor)</td>
<td>Project CM/GC (Recommend assigning to Fire Alarm Contractor)</td>
<td></td>
</tr>
<tr>
<td>Outdoor Site Emergency Telephone Concrete Base and Pole</td>
<td>Security/Site Civil Consultant</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Designed By</td>
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</tr>
<tr>
<td>Emergency Telephone 120V Blue Light</td>
<td>ICT Designer</td>
<td>Yale Public Safety</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td></td>
</tr>
<tr>
<td>Custom Entry Card Reader Bollards</td>
<td>Architect/ICT Designer</td>
<td>General Contractor</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td></td>
</tr>
<tr>
<td><strong>Security Systems Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access Control Panels and Wallfield Elevations</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Locations shall be coordinated within Telecom Rooms</td>
</tr>
<tr>
<td>Card Readers</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>Request to Exist Sensor</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>Door Position Switches</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>Door Management Alarms</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>Security Cameras and Mounts</td>
<td>ICT Designer/Architect</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Security camera locations shall be coordinated with the project Architect and reviewed by Yale Public Safety during project design phases.</td>
</tr>
<tr>
<td>Intrusion Detection Systems Devices</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>Video Intercom System</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
</tbody>
</table>
# Yale IT Systems Differential Scope of Work Matrix

<table>
<thead>
<tr>
<th>System</th>
<th>Designed By</th>
<th>Furnished By</th>
<th>Installed By</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Call Stations</td>
<td>ICT Designer</td>
<td>Yale Public Safety</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Emergency call station locations shall be coordinated with the project Architect and reviewed by Yale Public Safety during project design phases.</td>
</tr>
<tr>
<td>Building Alarm Panel to Central Station</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>DMP Panel shall be provided at the Fire Alarm Main Panel or Fire Command Center with Cellular modem connection to Central Station</td>
</tr>
<tr>
<td>Building Alarm Panel Cellular Modem</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>Network Video Recording (NVR) Systems</td>
<td>ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Coordinate storage capacity and requirements with Yale Public Safety during project design phases.</td>
</tr>
<tr>
<td>Electronic Keyboxes (Morse Watchman) and Timeclock devices</td>
<td>Architect/ ICT Designer</td>
<td>Yale Facilities</td>
<td>General Contractor</td>
<td>Coordinate quantity and locations with Yale and Architect. Design wall blocking, ADA clearances, power, network, and card reader connections with design team during project design phases.</td>
</tr>
<tr>
<td>Security System Programming</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
<tr>
<td>System Testing and Training</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td>Project CM/GC (Recommend assigning to Security Contractor)</td>
<td></td>
</tr>
</tbody>
</table>
## Audiovisual Infrastructure and Equipment

<table>
<thead>
<tr>
<th>System</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Conduit, junction boxes, floor boxes, wireways and other electrical (construction related) rough-in work pertaining to the installation of the AV systems</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>AV Contractor will provide necessary plans and documentation to be integrated into the appropriate construction sets for coordination and implementation by other trades as necessary.</td>
</tr>
<tr>
<td>Power receptacles and related electrical requirements</td>
<td>Electrical Engineer</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td>Project CM/GC (Recommend assigning to Electrical Contractor)</td>
<td></td>
</tr>
<tr>
<td>Network Connections</td>
<td>ICT Designer/AV Contractor/AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>Project CM/GC (Recommend assigning to Cabling Contractor)</td>
<td>AV Contractor to submit a Network Request spreadsheet of all network attached devices by location including Manufacturer, Model, Serial Numbers, MAC Addresses, Usernames, Passwords via the project to AVSD and Network Engineering.</td>
</tr>
<tr>
<td>AV Network Switches and Configuration</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Port List and Switch Configuration summary shall be provided to Yale IT. Laminated copy of switch port, VLAN and attached device should be kept with all network switches.</td>
</tr>
</tbody>
</table>
## Yale IT Systems Differential Scope of Work Matrix

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Yale Network Integration</td>
<td>Yale Data Network Operations</td>
<td>Yale Data Network Operations</td>
<td>Yale Data Network Operations</td>
<td>If not established, create and document AV VLANs for Control, Audio and Video as separate subnets. Provide IP and Subnet and other related network information to AVSD and AV Contractor. Configuration and connections necessary for Yale Data integration into AV systems.</td>
</tr>
<tr>
<td>Low Voltage Audiovisual Cabling</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Audiovisual Cable Terminations</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Ceiling speakers (with back boxes, transformers, and grilles)</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Video Cameras</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Audio Visual consoles and Audio Visual Equipment Cabinets</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Lectern</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Data / Video projector and ceiling mounting brackets</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Wall and ceiling mounted flat screen video displays</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Designed By</td>
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</tr>
<tr>
<td>Wall mounted fixed projection screens</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Ceiling mounted electric screens (recessed and</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Access hatches as required – GC Power Connection – EC Low Voltage Screen Control – AV Contractor</td>
</tr>
<tr>
<td>surface mount)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microphones</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Control Systems - Hardware and Programming</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>A description of each function of the control system shall be provided describing operation and system performance expectations. Integrate with existing monitoring or server platforms as necessary.</td>
</tr>
<tr>
<td>Control Interfaces - Touchscreens and physical</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>All touch screen graphic user interfaces and physical controls must follow AVSD standards for design and functionality. The programmer will submit a functionality and usage narrative accompanied by screenshots of all User Interface elements.</td>
</tr>
<tr>
<td>controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio DSP Programming</td>
<td>Project CM/GC</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Designed By</td>
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<td>Installed By</td>
<td>Notes</td>
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</tr>
<tr>
<td>AV System Documentation</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>To include final versions of all previously submitted documentation</td>
</tr>
<tr>
<td>Video System Test Reporting</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>A report of video devices tested and devices used to perform the test. All routes tested and validated.</td>
</tr>
<tr>
<td>Audio System Test Reporting</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>A report of audio inputs and outputs tested and devices used to perform the test. All routes tested and validated.</td>
</tr>
<tr>
<td>Control System Test Reporting</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>A report of controls and behaviors tested. All common and detailed activity tested and validated.</td>
</tr>
<tr>
<td>Final Commissioning Report</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>A report of each location and system certifying the systems, performance and practices meet design intentions, functionality requirements and note any exceptions. Distribute accordingly.</td>
</tr>
<tr>
<td>AV System User Acceptance Training</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td></td>
</tr>
<tr>
<td>Project Close</td>
<td>AV ICT Designer</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Attach all project documentation</td>
</tr>
<tr>
<td>Maintenance of AV System</td>
<td>NA</td>
<td>NA</td>
<td>Project CM/GC (Recommend assigning to AV Contractor)</td>
<td>Proactive maintenance, firmware updates, and other regular service of equipment through a Service Level Agreement</td>
</tr>
</tbody>
</table>
## Yale IT Systems Differential Scope of Work Matrix

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>AV System Troubleshooting</td>
<td>Owner</td>
<td></td>
<td>Service Now Ticket</td>
<td>Owner will work with AV Contractor or AVSD to resolve AV System functionality issues. This does not include operational assistance.</td>
</tr>
</tbody>
</table>
Designer Note: The ICT Designer shall provide designs that fully document and incorporate Yale IT Standards and best practices into projects. This Appendix contains photographic documentation, for reference only, that is indicative of final approved installations. It shall be incumbent upon the ICT Designer to provide designs and construction administration to achieve final approved installations as documented in this Appendix. Some photographs are labeled “Incorrect Installation” which depict bad practice to be avoided. Coordinate with Yale IT to confirm the existence of updates and revisions not yet incorporated into this documentation.

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TYPICAL CONSTRUCTION DETAILS

Designer Note: The ICT Designer shall provide construction details for projects that fully document Yale IT Standards and best practices. This Appendix contains sample construction details indicative of the minimum level of documentation expected for typical projects designs. The ICT Designer shall enhance the information shown in the construction details to fully document the specific design requirements of each project.

YALE IT STRUCTURED CABLING SYSTEMS DETAIL LIST

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**AUDIOVISUAL SYSTEMS DETAIL LIST**

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<td>T068</td>
<td>CREDENZA WITH RACK</td>
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<td>T069</td>
<td>FULL SIZE TEACHING STATION</td>
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<tr>
<td>T070</td>
<td>HEIGHT ADJUSTABLE TABLE</td>
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3/8" threaded rod to structure.

2" diameter loop J-hook bolted or screwed to metal studs or partition above ceiling.

Angled hanger bracket

3/8" threaded rod to structure.
Contractor option to provide flange clip, beam clamp, or C and Z purlin clip in lieu of threaded rod where appropriate.

2" diameter loop J-hook

Lay-in ceilings

Note: Cable support assembly shall be provided above all corridor lay-in ceilings to support cabling from outlet conduit stub to cable trays. Contractor shall have option of providing either of the above assemblies where required. Total number of J-hooks (open top cable supports) shall be equal quantity as recommended by manufacturer based on number of cables installed plus 50% spare capacity. Different cable types shall be supported by separate J-hooks. J-hooks spacing shall be 3'-4" intervals.

Open top cable support detail

Not to scale
PROVIDE ONE (1) 1" CONDUIT FROM OUTLET BOX AND STUB OUT ABOVE NEAREST ACCESSIBLE FINISHED CEILING IN SAME ROOM UNLESS OTHERWISE STATED.

PROVIDE PLenum RATED BUSHING ON CONDUIT STUBS

ACCESSIBLE FINISHED CEILING LINE

PROVIDE TRIM RING AND BOX EXTENSIONS ON OUTLET BOX TO MATCH REQUIRED FACEPLATE SIZE AND FIT FLUSH WITH WALL CONSTRUCTION

18" AFF TYP UNLESS OTHERWISE STATED ON THE DRAWINGS

FINISHED FLOOR

TELECOMMUNICATIONS OUTLET CONDUIT AND BACKBOX DETAIL
Not to Scale
CONCEALED TELECOMMUNICATIONS CONDUIT IN WALL

PROVIDE RECESSED 2 1/8" DEEP X 4 11/16" X 4 11/16" (MINIMUM) JUNCTION BOX MOUNTED IN WALL, COORDINATE MOUNTING HEIGHT WITH CASEWORK PROVIDER

PROVIDE FEED-IN TO RACEWAY EVERY 8 FT ALONG LENGTH OF RACEWAY

DETAILED IS FOR GENERAL INFORMATION AND DOES NOT INCORPORATE ALL ACCESSORIES REQUIRED FOR A COMPLETE INSTALLATION.

TYPICAL TELECOMMUNICATIONS OUTLET SMR FEED-IN

Not to Scale
REFER TO ARCHITECTURAL PLANS FOR WALL PARTITION TYPES

PROVIDE ENGINEERED THROUGH PENETRATION. PROVIDE QUANTITY, FIRE RATING, AND SIZE AS SHOWN ON DRAWINGS

ACCESSIBLE FINISHED CEILING LINE

FIRESSTOP RATING LABEL

ENGINEERED THROUGH PENETRATION SLEEVES DETAIL

Not to Scale
1/4" THICK

SECURE TO PLYWOOD BACKBOARDING. SEE DRAWINGS FOR MOUNTING LOCATION.

TWENTY THREE (23) PAIR 5/16"

THREE (3) PAIR 7/16"

INSULATED POLYAMIDE STANDOFFS WITH 2" STANDOFF HEIGHT

COPPER BUSBAR CONFORMING TO TIA-607-D, BICSI, AND NEMA STANDARDS

PBB (PRIMARY BONDING BUSBAR) DETAIL

Not to Scale
INSULATED POLYAMIDE STANDOFFS WITH 2" STANDOFF HEIGHT

THREE (3) PAIR 7/16" HOLES
SECURE TO PLYWOOD BACKBOARDING. SEE DRAWINGS FOR MOUNTING LOCATION.

TEN (10) PAIR 5/16" HOLES
COPPER BUSBAR CONFORMING TO TIA-607-D, BICSI, AND NEMA STANDARDS

INSULATED POLYAMIDE STANDOFFS WITH 2" STANDOFF HEIGHT

1/4" THICK

17 3/4"

SECONDARY BONDING BUSBAR (SBB) DETAIL
Not to Scale
Provide one (1) 1-1/4" conduit for audiovisual cabling and one (1) 2" conduit for audiovisual cabling.

Four (4) gang openings for audiovisual connectors and cabling.

Two (2) single gang openings for telecom.

Two (2) gang openings for power.

Provide one (1) 1-1/4" conduit for telecom.

Conduit for power.

Note: Route conduits and stub out above finished ceiling in same room served by floor box.

Multiservice large floor box detail.

Not to scale.
PROVIDE POWER RECEPTACLES AS REQUIRED

PROVIDE TELECOM OUTLET IN SINGLE GANG DECORA OPENING

PROVIDE AUDIOVISUAL DEVICES

PROVIDE POWER RECEPTACLES AS REQUIRED

PROVIDE MULTISERVICE FLOOR POKETHROUGH

PROVIDE COREDRILLED OR SLEEVED PENETRATION THROUGH ELEVATED SLAB

PROVIDE ONE (1) 1-1/4" CONDUIT FOR TELECOMMUNICATIONS. EXTEND CONDUIT TO STUB OUT ABOVE FINISHED CEILING IN THE ROOM

PROVIDE ONE (1) 2" AND ONE (1) 1 1/4" CONDUIT FOR AUDIOVISUAL CABLING. EXTEND CONDUIT TO STUB OUT ABOVE FINISHED CEILING IN THE ROOM

MULTISERVICE LARGE POKETHROUGH DETAIL

MULTISERVICE LARGE POKETHROUGH SECTION

Not to Scale
PROVIDE ONE (1) 1-1/4" CONDUIT FOR TELECOM / AUDIOVISUAL

ONE (1) GANG OPENING FOR TELECOM / AUDIOVISUAL

ONE (1) GANG OPENING FOR POWER

TWO (2) GANG OPENING FOR TELECOM

NOTE:
ROUTE CONDUITS AND STUB OUT ABOVE FINISHED CEILING IN SAME ROOM SERVED BY FLOOR BOX.

FOUR GANG FLOORBOX DETAIL

Not to Scale
POWER RECEPACLES PROVIDE TELECOM OUTLET IN SINGLE GAND DECORA OPENING

POKETHROUGH DETAIL
Not to Scale

POKETHROUGH SECTION
Not to Scale

PROVIDE ONE (1) 1-1/4" CONDUIT FOR TELECOMMUNICATIONS. EXTEND CONDUIT TO STUB OUT ABOVE FINISHED CEILING IN THE ROOM

PROVIDE MULTISERVICE FLOOR POKE THROUGH
PROVIDE COREDRILLED OR SLEEVED PENETRATION THROUGH ELEVATED SLAB

ELEVATED SLAB SYSTEM

PROVIDE JUNCTION BOX CONDUIT HOUSING ASSEMBLY
PROVIDE POWER CONDUIT

PROVIDE TELECOM OUTLET IN SINGLE GANG DECORA OPENING
WIRE MESH BASKET TRAY, MINIMUM 4" DEPTH

PROVIDE APPROVED CABLE TRAY SYSTEM BOLTED SPLICING CONNECTIONS (TYP)

WIRE MESH CABLE TRAY SPLICE DETAIL

Not to Scale
PROVIDE THREADED ROD ATTACHED TO BUILDING STRUCTURE

PROVIDE MANUFACTURER'S APPROVED TRAY HANGER BRACKET (TYP)

WIRE MESH BASKET TRAY, MINIMUM 4" DEPTH

WIRE MESH CABLE TRAY SUPPORT DETAIL

Not to Scale
WIDTH AS INDICATED ON DRAWINGS

FULL HEIGHT DIVIDERS

HORIZONTAL UTP CABLELING

OPTICAL FIBER HORIZONTAL OR RISER CABLELING

NOTE: PROVIDE LONG RADIUSED HORIZONTAL BEND AT ALL 90 DEGREE BENDS.

WIRE MESH CABLE TRAY SECTION DETAIL

Not to Scale
TYPE "N" SR MOUNTING CONDITION

PROVIDE TELECOM OUTLET
IN 106 STYLE ADAPTER FRAME

JACK LABEL (TYP.)

POSITION 1

POSITION 2

POSITION 3

POSITION 4

SURFACE RACEWAY SYSTEM

SURFACE RACEWAY (SR MOUNTING CONDITIONS) TELECOM OUTLET DETAIL

Not to Scale
NOTES:
1. PROVIDE TWO (2) 4-PAIR CATEGORY 6A UTP PLENUM-RATED CABLE TERMINATED ON AN 8-PIN MODULAR CATEGORY 6A JACK.
2. TERMINATE CABLE WITH TIA/EIA T568B PINNING.
3. TERMINATE CABLE ON DEDICATED WIRELESS ACCESS POINT CATEGORY 6A PATCH PANEL.
4. PROVIDE COMPUTER GENERATED LABELS WITH 1/4" HIGH BLACK TEXT. HANDWRITTEN LABELS ARE UNACCEPTABLE.
5. PROVIDE TEMPORARY, REMOVABLE LABEL ON CEILING TILEGRID TO IDENTIFY OUTLET LOCATION WHEN LOCATED ABOVE FINISHED ACCESSIBLE CEILING.
ONE (1) CATEGORY 6 PURPLE COLOR PLENUM RATED CABLE INSTALLED ABOVE ACCESSIBLE FINISHED CEILING (FROM LOCAL TELECOMMUNICATIONS ROOM)

ONE (1) PURPLE CAT 6 PLENUM RATED PATCH CORD

ACCESSIBLE FINISHED CEILING TYPE (TYP)

PROVIDE 15' SUPPORTED FIGURE 8 SERVICE LOOP

SECURITY CAMERA TELECOM OUTLET DETAIL
Not to Scale

SECURITY CAMERA ACCESSIBLE CEILING INSTALLATION DETAIL
Not to Scale

NOTES:
1. PROVIDE ONE (1) PURPLE COLOR 4-PAIR CATEGORY 6 UTP PLENUM-RATED CABLE TERMINATED ON AN 8-PIN MODULAR CATEGORY 6 JACK.
2. TERMINATE CABLE WITH TIA/EIA T568B PINNING.
3. PROVIDE COMPUTER GENERATED LABELS WITH 1/4" HIGH BLACK TEXT. HANDWRITTEN LABELS ARE UNACCEPTABLE.
BUILDING SYSTEMS TELECOM OUTLET DETAIL (EP EQUIPMENT PANEL MOUNTING CONDITION)

Not to Scale
### TELECOMMUNICATIONS OUTLET TYPE

<table>
<thead>
<tr>
<th>POSITION</th>
<th>CABLE TYPE</th>
<th>TERMINATION</th>
<th>EXTERIOR CABLE JACKET COLOR</th>
<th>JACK MODULE COLOR</th>
<th>TYPE &quot;6N&quot; OUTLET</th>
<th>TYPE &quot;4N&quot; OUTLET</th>
<th>TYPE &quot;3N&quot; OUTLET</th>
<th>TYPE &quot;2N&quot; OUTLET</th>
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### Notes
- **TELECOMMUNICATIONS OUTLET SCHEDULE**
- **YALE UNIVERSITY**
- **ITS INFRASTRUCTURE CONSTRUCTION STANDARDS**

**Client/Project:**
- **YALE UNIVERSITY**
- **ITS INFRASTRUCTURE CONSTRUCTION STANDARDS**

**Revision No.:**
- **1.0**

**Date:**
- **07/31/2020**

**Detail Number:**
- **1022**
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<th>Jack Module Color</th>
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XXX - YY DZ
XXX - ROOM NUMBER
YY - OUTLET NUMBER IN SEQUENTIAL ORDER AT DOOR
AND MOVING TO THE LEFT
D - MEDIA DESIGNATION
  D - DATA
  F - OPTICAL FIBER
RS - ROOM SCHEDULING PANEL OUTLET
Z - SEQUENTIAL NUMBER OF JACK IN FACEPLATE

EXAMPLE LABEL FOR FIRST OUTLET IN ROOM 101
FACEPLATE LABELING DETAIL
Not to Scale
RACK MOUNTED VOICE CATEGORY 5e PATCH PANEL

TERMINATE ONE (1) PAIR OF CATEGORY 3 MULTIPAIR COPPER TRUNK TIE TO EACH RJ-45 PATCH PANEL PORT TO PAIR 1, PINS 4,5.

PROVIDE 25 PAIR CATEGORY 3 MULTIPAIR COPPER INTRABUILDING RISER

TO MDT ROOM XXX RACK MOUNTED MAIN CROSS CONNECT AND VOICE GATEWAY

VOICE BACKBONE PATCH PANEL DETAIL
Not to Scale
FOUR (4) TELECOMMUNICATION TWO POST EQUIPMENT RACKS

PRIMARY OR SECONDARY BONDING BUSBAR

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES STUBBED THROUGH FLOOR INTO CEILING BELOW

3/4" FIRE RETARDANT TREATED GRADE AC PLYWOOD, ALL WALLS FROM +6" TO +8'-6" AFF.

POWER RECEPTACLE (TYP.)

WORKING CLEARANCE ZONES TYPICAL

ACCESS CONTROL PANEL WITH SECURITY POWER SUPPLY

FIRE ALARM INDIVIDUAL ADDRESSABLE MODULE

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE

VERTICAL WALL MOUNTED CABLE RUNWAY

SIX (6) 4" ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES

LIGHT FIXTURE

TWO (2) L6-30R OR L6-20R OUTLETS MOUNTED ABOVE TELECOMMUNICATIONS RACKS

ONE (1) 5-20R OUTLET MOUNTED TO CABLE RUNWAY ABOVE TELECOMMUNICATIONS RACKS

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE

VERTICAL WALL MOUNTED CABLE RUNWAY

TWO (2) L6-30R OR L6-20R OUTLETS MOUNTED ABOVE TELECOMMUNICATIONS RACKS

CABLE RUNWAY

FOUR (4) TELECOMMUNICATION TWO POST EQUIPMENT RACKS

PRIMARY OR SECONDARY BONDING BUSBAR

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES STUBBED THROUGH FLOOR INTO CEILING BELOW

3/4"_FIRE RETARDANT TREATED GRADE AC PLYWOOD, ALL WALLS FROM +6" TO +8'-6" AFF.
3/4" FIRE RETARDANT, TREATED GRADE A C PLYWOOD, ALL WALLS FROM +6" TO 8' 6" AFF

10'X14' TR NORTH WALL ELEVATION
1/4" = 1'-0"

ACCESS CONTROL HEADEND WALLFIELD
FIRE ALARM INDIVIDUAL ADDRESSABLE MODULE
ACCESS CONTROL PANEL
SECURITY POWER SUPPLY
2" x 2" POWER WIREWAY

3/4" FIRE RETARDANT, TREATED GRADE A C PLYWOOD, ALL WALLS FROM +6" TO 8' 6" AFF
DOOR HARDWARE POWER SUPPLY

10'X14' TR SOUTH WALL ELEVATION
1/4" = 1'-0"

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE
LADDER TRAY RUNNING FROM THE OVERHEAD CABLE TRAY TO THE CONDUITS STUBBED IN THE CEILING
OVERHEAD CABLE RUNWAY
VERTICAL CABLE RUNWAY MOUNTED FROM THE FLOOR TO THE OVERHEAD CABLE RUNWAY
MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES STUBBED THROUGH FLOOR INTO CEILING BELOW

10'X14' EAST WALL ELEVATION
1/4" = 1'-0"

MINIMUM OF SIX (6) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES STUBBED THROUGH THE WALL ABOVE CORRIDOR FINISHED CEILING
OVERHEAD CABLE RUNWAY
THERMOSTAT
LIGHT SWITCH WITH DIGITAL TIMER CONTROL

10'X14' TR WEST WALL ELEVATION
1/4" = 1'-0"
10'X11' TR ENLARGED PLAN

1/4" = 1'-0"

THREE (3) TELECOMMUNICATION TWO POST EQUIPMENT RACKS

PRIMARY OR SECONDARY BONDING BUSBAR

3/4" FIRE RETARDANT, TREATED GRADE AC PLYWOOD, ALL WALLS FROM 6'-0" TO 8'-0" AFF.

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP STUBBED THROUGH FLOOR INTO THE CEILING BELOW

POWER RECEPTACLE (TYP.)

WORKING CLEARANCE ZONE TYPICAL

ACCESS CONTROL PANEL WITH SECURITY POWER SUPPLY

FIRE ALARM INDIVIDUAL ADDRESSABLE MODULE

10'X11' TR CEILING ENLARGED PLAN

1/4" = 1'-0"

ONE (1) 5-20R OUTLET MOUNTED TO CABLE RUNWAY ABOVE TELECOMMUNICATIONS RACKS

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE

VERTICAL WALL MOUNTED CABLE RUNWAY

TWO (2) L6-30R OR L6-20R OUTLETS MOUNTED ABOVE TELECOMMUNICATIONS RACKS

ONE (1) 5-20R OUTLET MOUNTED TO CABLE RUNWAY ABOVE

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE

VERTICAL WALL MOUNTED CABLE RUNWAY

TWO (2) L6-30R OR L6-20R OUTLETS MOUNTED ABOVE TELECOMMUNICATIONS RACKS

CABLE RUNWAY

SIX (6) 4" ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES

LIGHT FIXTURE

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE

VERTICAL WALL MOUNTED CABLE RUNWAY

TWO (2) L6-30R OR L6-20R OUTLETS MOUNTED ABOVE TELECOMMUNICATIONS RACKS

CABLE RUNWAY

SIX (6) 4" ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES

LIGHT FIXTURE

MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE

VERTICAL WALL MOUNTED CABLE RUNWAY

TWO (2) L6-30R OR L6-20R OUTLETS MOUNTED ABOVE TELECOMMUNICATIONS RACKS

CABLE RUNWAY

SIX (6) 4" ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES

LIGHT FIXTURE
10'X9' TR ENLARGED PLAN

1/4" = 1'-0"

- HVAC UNIT
- PRIMARY OR SECONDARY GROUNDING BUSBAR
- 3/4" FIRE RETARDANT TREATED GRADE AC PLYWOOD, ALLWALLS FROM +6" TO 8'-6" AFF.
- FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES STUBBED THROUGH FLOOR TWO POST INTO CEILING BELOW
- TWO (2) TELECOMMUNICATION TWO POST EQUIPMENT RACKS
- WORKING CLEARANCE ZONE TYPICAL ACCESS CONTROL PANEL WITH SECURITY POWER SUPPLY
- POWER RECEPTACLE (TYP.)
- FIRE ALARM INDIVIDUAL ADDRESSABLE MODULE
- SIX (6) 4" ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES

10'X9' TR CEILING ENLARGED PLAN

1/4" = 1'-0"

- LIGHT FIXTURE
- VERTICAL WALL MOUNTED CABLE RUNWAY
- ONE (1) 5-20R OUTLET MOUNTED TO CABLE RUNWAY ABOVE TELECOMMUNICATIONS RACKS
- MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE
- TWO (2) L6-30R OR L6-20R OUTLETS MOUNTED ABOVE TELECOMMUNICATIONS RACKS
- ONE (1) 5-20R OUTLET MOUNTED TO CABLE RUNWAY ABOVE TELECOMMUNICATIONS RACKS
- MINIMUM FOUR (4) ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES TO FLOOR ABOVE
- TWO (2) L6-30R OR L6-20R OUTLETS MOUNTED ABOVE TELECOMMUNICATIONS RACKS
- VERTICAL WALL MOUNTED CABLE RUNWAY

- LIGHT FIXTURE
CCH-02U IS CORNING PRODUCT SHOWN UNLOADED/TO BE DETERMINED IN SCOPE

CHATSWORTH PRODUCTS
SET 3 355x1-703

CHATSWORTH PRODUCTS 12183-X19
C9500-24Y4C C9500-24Y4C

CHATSWORTH PRODUCTS 55053-203

CHATSWORTH PRODUCTS 30139-719
C9300-48P

ORTRONICS OR-PHA66U48

YALE UNIVERSITY
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

MDT ROOM TELECOM RACK LINE ELEVATION

Revision No. 1.0
Date 07/31/2020

Detail Number T034
Chatsworth Products 12183-X19
CCH-02U
C9300-48P
Chatworth products 30139-719
C9300-48P
Chatworth products 30139-719
C9300-48P
Chatworth products 30139-719
C9300-48P

Chatworth products - set 3 355x1-703

Chatworth products 12183-X19
Chatworth products 12183-X19
Chatworth products 12183-X19

Ortronics or PHA66U48
Ortronics or PHA66U48
Ortronics or PHA66U48

Third rack required for other equipment - DAS, AV, sound masking, etc.

Chatworth products 55053-203
Chatworth products 55053-203
Chatworth products 55053-203

IDT telecom rack elevation
Not to Scale

Yale
2ND FLOOR

1ST FLOOR

IDT TELECOM ROOM

OPTICAL FIBER CROSSCONNECT

COPPER CROSSCONNECT

MDT TELECOM ROOM

OPTICAL FIBER CROSSCONNECT

COPPER CROSSCONNECT

CORE NETWORK ROOM

OPTICAL FIBER CROSSCONNECT

COPPER CROSSCONNECT

25 PAIR 24 AWG CMP
CATEGORY 3 RATED COPPER
INTRABUILDING RISER CABLE (TYPICAL)

24 STRAND OFCP ARMORED OS2
SINGLEMODE OPTICAL FIBER
INTRABUILDING RISER CABLE

24 STRAND OFCP ARMORED 50
MICRON OM4 MULTIMODE
(TYPICAL)

24 STRAND OS2
SINGLEMODE OPTICAL FIBER
INTERBUILDING BACKBONE

24 STRAND 50 MICRON OM4
MULTIMODE BACKBONE

25 PAIR 24 AWG
CATEGORY 3 RATED COPPER
INTERBUILDING RISER CABLE

24 STRAND OFCP ARMORED OS2
SINGLEMODE OPTICAL FIBER
INTRABUILDING RISER CABLE/ 24
STRAND OFCP ARMORED 50
MICRON OM4 MULTIMODE
(TYPICAL)

YALE UNIVERSITY
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

TELECOMMUNICATIONS RISER DIAGRAM

Not to Scale

Client/Project Title Detail Number Revision No. Date Notes

YALE UNIVERSITY
TELECOMMUNICATIONS RISER DIAGRAM
1.0 07/31/2020

T036
TELECOMMUNICATIONS GROUNDING RISER DIAGRAM

NOTE: PROVIDE TELECOMMUNICATIONS GROUNDING ACCORDING TO THE TIA-607-D GENERIC TELECOMMUNICATIONS BONDING AND GROUNDING (EARTHING) FOR CUSTOMER PREMISES.

PROVIDE TELECOMMUNICATIONS BONDING BACKBONE (TBB) GREEN INSULATED SIZED PER TIA-607-D.

PROVIDE PRIMARY BONDING BUSBAR

PROVIDE SECONDARY BONDING BUSBAR

TO ADDITIONAL IDT TELECOM ROOMS

BOND TO BUILDING STRUCTURAL STEEL (TYP)

LOCAL ELECTRICAL SUB PANEL

PROVIDE SECONDARY BONDING BUSBAR

BOND TO STATIC DISSIPATIVE FLOORING (TYP)

LOCAL ELECTRICAL SUB PANEL

PROVIDE PRIMARY BONDING BUSBAR

EQUIPMENT

EQUIPMENT

ELECTRICAL RM

ELECTRICAL RM

ELECTRICAL GROUNDING ELECTRODE SYSTEM

TELECOMMUNICATIONS BONDING CONDUCTOR (TBC)
AREA OF RESCUE (AOR) COMMUNICATIONS RISER DIAGRAM
Not to Scale
Provide cable bracket and support arms (typ).

Provide warning tape 12" below grade all sides.

Provide slant grade to drain sump pit.

Provide slight grade to drain sump pit.

3/4" x 10' CU rod. Bond metal boxes and components to rod with approved grommetted grounding braid.

Sump pit for owner-provided sump pump in corner (sized per specifications).

Provide cable to drain conduits away from building point of entries.

Provide cap for all unused conduit.

Provide slant grade to drain sump pit.

Typical conduit bank. Maintain depth below frost line. Enter manhole off-center as shown and dress cabling to adjacent wall. Provide cap for all unused conduit.

6" nominal wall thickness.

6" gravel under base to extend 1'-0" beyond on all sides.

24" minimum cover - extend as required to drain conduits away from building point of entries.

Manhole inside dimensions shall be 7' x 7' x 6' deep.

Manhole cover labeled "Telecommunications".

Finished grade.

Pumping ring (typical).

Provide cable bracket and support arms (typ).

Typical telecommunications maintenance hole - section A-A

TYPICAL TELECOMMUNICATIONS MAINTENANCE HOLE
Not to Scale

1. Provide eight (8) unused conduit knockouts for future use on all sides of manholes.
2. Do not route cables side to side in manholes. Dress cables around the perimeter on brackets, leave center area of manholes free of all wire and cabling.

Yale UNIVERSITY
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0 Date 07/31/2020

Design Number: T039
STACK TWO HANDHOLES OR PROVIDE EXTENSIONS TO AQUIRE VERTICAL DEPTH AS REQUIRED.

(EVEN WITH FINISHED GRADE)

POLYMER CONCRETE BOX

PROVIDE CONCRETE ENCASEMENT RING AROUND BOX FOLLOW MANUFACTURER'S GUIDELINES

#2B GRAVEL BASE

NO BASE ON ASSEMBLY

PULL SLOT

TAN COLORATION FOR POLYMER CONCRETE COLORS

STAINLESS STEEL HEAVY DUTY HEX HEAD BOLT (BOTH SIDES OF COVER)

PROVIDE IDENTIFICATION TAG (SEE MANHOLE IDENTIFICATION TAG DETAIL)

FINISHED GRADE

STACK TWO HANDHOLES OR PROVIDE EXTENSIONS TO AQUIRE VERTICAL DEPTH AS REQUIRED. (AS RECOMMENDED BY MANUFACTURER)

EVEN WITH FINISHED GRADE

TYPICAL TELECOMMUNICATIONS HANDHOLE PLAN VIEW

TYPICAL TELECOMMUNICATIONS HANDHOLE - SECTION B-B

TELECOMMUNICATIONS HANDHOLE SCHEDULE

<table>
<thead>
<tr>
<th>TYPE</th>
<th>LOAD RATING</th>
<th>APPLICATION</th>
</tr>
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<tbody>
<tr>
<td>TYPE I</td>
<td>TIER 15</td>
<td>FOR PARKING LOTS AND OFF ROADWAYS WITH OCCASIONALLY NON-DELIBERATE HEAVY VEHICLES</td>
</tr>
<tr>
<td>TYPE II</td>
<td>TIER H-20</td>
<td>ROADWAYS AND AREAS SUBJECT TO DELIBERATE VEHICULAR TRAFFIC</td>
</tr>
</tbody>
</table>

See Manhole Schedule for Load Rating Requirements

TIER 15

24" MINIMUM

TIER 15

36" MINIMUM
4" MINIMUM 2B GRAVEL

WARNING TAPE 12" BELOW GRADE (ORANGE FOR TELECOMMUNICATIONS)

#4 REINFORCEMENT BARS 18" O.C. (TYPICAL)

#4 REINFORCEMENT BARS CONTINUOUS (TYPICAL)

3000 PSI CONCRETE VIBRATED DURING INSTALLATION

(2) 4" SCHEDULE 40 PVC CONDUITS FOR TELECOMMUNICATIONS

4" MINIMUM 2B GRAVEL

TELECOM DUCTBANK DETAILS (TWO CONDUITS)

Not to Scale
TELECOM DUCTBANK DETAILS (THREE CONDUITS)

- Extend Subbase into trench
- Extend top of trench as shown — typical both sides
- Road subbase/base drain
- #2B gravel or equivalent
- Warning tape 12" below grade (orange for telecommunications)
- #4 bar at 18" on center full length of bank and (1) #4 bar at 32" crosswise top and bottom
- 3000 psi concrete vibrated during installation
- Three (3) 4" schedule 40 PVC conduit
- #2B gravel 4" minimum

Not to Scale
4" MINIMUM 2B GRAVEL
3000 PSI CONCRETE VIBRATED DURING INSTALLATION
WARNING TAPE 12" BELOW GRADE (ORANGE FOR TELECOMMUNICATIONS)
#4 REINFORCEMENT BARS 18" O.C. (TYPICAL)
#4 REINFORCEMENT BARS CONTINUOUS (TYPICAL)
3000 PSI CONCRETE VIBRATED DURING INSTALLATION
(4) 4" SCHEDULE 40 PVC CONDUITS FOR TELECOMMUNICATIONS
4" MINIMUM 2B GRAVEL

TELECOM DUCTBANK DETAILS (FOUR CONDUITS)

Not to Scale
GROUND LEVEL

BACKFILL AREA

1" MINIMUM

ADAPTER TO NONMETAL DUCT

RIGID METAL SLEEVE REACHES BEYOND BACKFILL AREA

ELEVATION MUST BE HIGHER THAN THE MAINTENANCE HOLE DUCTBANK POINT OF ENTRANCE TO PREVENT INGRESS OF WATER FROM SITE

BUILDING FOUNDATION

BUILDING POINT OF ENTRANCE SECTION

Not to Scale
### ACCESS CONTROL

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<td>BIOMETRIC READER</td>
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<td>HARDWARE INTEGRATED CARD READER WITH REQUEST TO EXIT AND DOOR POSITION SWITCH</td>
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<td>65</td>
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<td>CARD READER MULLION MOUNT</td>
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### ELECTRONIC VIDEO SURVEILLANCE

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<td>CAMERA POWER SUPPLY</td>
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<tr>
<td>SW</td>
<td>SECURITY WORKSTATION</td>
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<td>SM</td>
<td>SECURITY MONITOR DISPLAY</td>
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<tr>
<td>01</td>
<td>SECURITY CAMERA, TYPE AS DEFINED BY &quot;X&quot;</td>
</tr>
<tr>
<td>A</td>
<td>EXTERIOR, VANDAL RESISTANT WEATHERPROOF FIXED CAMERA</td>
</tr>
<tr>
<td>B</td>
<td>EXTERIOR, VANDAL RESISTANT WEATHERPROOF PTZ CAMERA</td>
</tr>
<tr>
<td>C</td>
<td>EXTERIOR, VANDAL RESISTANT WEATHERPROOF WIDE DYNAMIC RANGE (CANOPY)</td>
</tr>
<tr>
<td>D</td>
<td>INTERIOR, FIXED CAMERA</td>
</tr>
<tr>
<td>E</td>
<td>INTERIOR, WIDE DYNAMIC RANGE (FACING EXTERIOR DOOR) CAMERA</td>
</tr>
<tr>
<td>F</td>
<td>INTERIOR, FIXED CAMERA, CORRIDORS</td>
</tr>
<tr>
<td>G</td>
<td>INTERIOR, FIXED CAMERA, ELEVATORS</td>
</tr>
<tr>
<td>H</td>
<td>INTERIOR, FIXED, 180 DEGREE MULTI-IMAGER, WIDE DYNAMIC RANGE</td>
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<td>I</td>
<td>INTERIOR, FIXED, 180 DEGREE MULTI-IMAGER, WIDE DYNAMIC RANGE</td>
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<tr>
<td>J</td>
<td>INTERIOR FIXED, SINGLE SENSOR PANORAMIC FISH EYE</td>
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<td>K</td>
<td>EXTERIOR, FIXED, 360 DEGREE, WIDE DYNAMIC RANGE</td>
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<tr>
<td>L</td>
<td>INTERIOR, FIXED, 360 DEGREE, WIDE DYNAMIC RANGE</td>
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<tr>
<td>M</td>
<td>EXTERIOR, FIXED, 360 DEGREE/PTZ, WIDE DYNAMIC RANGE, POLE MOUNTED CAMERA</td>
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<td>CLG</td>
<td>CEILING MOUNTED FIXED SECURITY CAMERA</td>
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<tr>
<td>CLG PTZ</td>
<td>WALL MOUNTED SECURITY CAMERA</td>
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<tr>
<td>CLG PTZ 360°</td>
<td>WALL MOUNTED PAN, TILT, ZOOM SECURITY CAMERA</td>
</tr>
<tr>
<td>PTZ</td>
<td>CEILING MOUNTED 360° SECURITY CAMERA</td>
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<tr>
<td>PTZ 360°</td>
<td>WALL MOUNTED 360° SECURITY CAMERA</td>
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<tr>
<td>PTZ 180°</td>
<td>CEILING MOUNTED 180° SECURITY CAMERA</td>
</tr>
<tr>
<td>PTZ 180°</td>
<td>WALL MOUNTED 180° SECURITY CAMERA</td>
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<tr>
<td>EMERGENCY COMMUNICATIONS</td>
<td>INTRUSION DETECTION</td>
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<tr>
<td>--------------------------</td>
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</tr>
<tr>
<td>EMERGENCY ALERT BEACON</td>
<td>KEYPAD FOR INTRUSION DETECTION SYSTEM</td>
</tr>
<tr>
<td>AUDIO INTERCOM SUBSTATION</td>
<td>WINDOW CONTACT SWITCH</td>
</tr>
<tr>
<td>AUDIO INTERCOM MAIN STATION</td>
<td>ROOF HATCH CONTACT SWITCH</td>
</tr>
<tr>
<td>AUDIO/VIDEO INTERCOM SUBSTATION</td>
<td>GLASS BREAK DETECTOR</td>
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<tr>
<td>AUDIO/VIDEO INTERCOM MAIN STATION</td>
<td>CEILING MOUNTED INTRUSION MOTION DETECTOR</td>
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<tr>
<td>PANIC DURESS BUTTON</td>
<td>INTRUSION DETECTION PANEL</td>
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<tr>
<td>REMOTE RELEASE</td>
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<td>DOOR BELL</td>
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<tr>
<td>EMERGENCY TELEPHONE</td>
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<tr>
<td>EMERGENCY TELEPHONE BLUE BEACON</td>
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<tr>
<td>LOCAL ALARM</td>
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<tr>
<td>AREA OF RESCUE TWO-WAY COMMUNICATION REMOTE STATION</td>
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<tr>
<td>AREA OF RESCUE TWO-WAY COMMUNICATIONS COMMAND UNIT</td>
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## ACCESS CONTROL DOOR TYPE ABBREVIATIONS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>C1</td>
<td>CARD READER, SINGLE DOOR</td>
</tr>
<tr>
<td>C2</td>
<td>CARD READER, DOUBLE DOOR</td>
</tr>
<tr>
<td>C1D</td>
<td>CARD READER, SINGLE DOOR, DELAYED EGRESS</td>
</tr>
<tr>
<td>C2D</td>
<td>CARD READER, DOUBLE DOOR, DELAYED EGRESS</td>
</tr>
<tr>
<td>C1F</td>
<td>PREP FOR FUTURE CARD READER SINGLE DOOR</td>
</tr>
<tr>
<td>C2F</td>
<td>PREP FOR FUTURE CARD READER DOUBLE DOOR</td>
</tr>
<tr>
<td>C1I</td>
<td>CARD READER, SINGLE DOOR, INTERCOM SUBSTATION</td>
</tr>
<tr>
<td>C2I</td>
<td>CARD READER, DOUBLE DOOR, INTERCOM SUBSTATION</td>
</tr>
<tr>
<td>C1K</td>
<td>CARD READER WITH KEYPAD, SINGLE DOOR</td>
</tr>
<tr>
<td>C2K</td>
<td>CARD READER WITH KEYPAD, DOUBLE DOOR</td>
</tr>
<tr>
<td>CO</td>
<td>CARD READER, OVERHEAD DOOR</td>
</tr>
<tr>
<td>CP</td>
<td>CARD READER, PARKING GATES</td>
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<tr>
<td>C2AO</td>
<td>CARD READER WITH AUTO OPENER, DOUBLE DOOR</td>
</tr>
<tr>
<td>CSL</td>
<td>CARD READER, SLIDING DOOR</td>
</tr>
<tr>
<td>DE1</td>
<td>DELAYED EGRESS, SINGLE DOOR</td>
</tr>
<tr>
<td>DE2</td>
<td>DELAYED EGRESS, DOUBLE DOOR</td>
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<tr>
<td>EE</td>
<td>ELECTRIFIED EGRESS</td>
</tr>
<tr>
<td>EO</td>
<td>EXIT ONLY</td>
</tr>
<tr>
<td>EEO</td>
<td>EMERGENCY EXIT ONLY</td>
</tr>
<tr>
<td>M1D</td>
<td>MONITORED, SINGLE DOOR, DELAYED EGRESS</td>
</tr>
<tr>
<td>M1R</td>
<td>MONITORED, SINGLE DOOR, REQUEST TO EXIT</td>
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<tr>
<td>M2D</td>
<td>MONITORED, DOUBLE DOOR, REQUEST TO EXIT</td>
</tr>
<tr>
<td>M2RI</td>
<td>MONITORED, DOUBLE DOOR, REQUEST TO EXIT, INTERCOM SUBSTATION</td>
</tr>
<tr>
<td>S1</td>
<td>STAIRWELL CARD READER, SINGLE DOOR</td>
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<td>S2</td>
<td>STAIRWELL CARD READER, DOUBLE DOOR</td>
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<tr>
<td>S1R</td>
<td>STAIRWELL RE-ENTRY SINGLE DOOR</td>
</tr>
<tr>
<td>S2R</td>
<td>STAIRWELL RE-ENTRY DOUBLE DOOR</td>
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<tr>
<td>V1</td>
<td>VESTIBULE, ONE SET OF DOUBLE DOORS</td>
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<tr>
<td>V2</td>
<td>VESTIBULE, TWO SETS OF DOUBLE DOORS</td>
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<tr>
<td>V3</td>
<td>VESTIBULE, THREE SETS OF DOUBLE DOORS</td>
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</table>
TYPICAL ELEVATOR CAB SECURITY RISER DIAGRAM
Not to Scale
VIDEO INTERCOM SYSTEM RISER DIAGRAM (NON - IP BASED)

Not to Scale
PROVIDE PLENUM RATED ACCESS CONTROL SYSTEM CABLING TO HEADEND IN OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED

PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST FINISHED ACCESSIBLE CEILING

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

PROVIDE 1" CONDUIT

FINISHED FLOOR

UNSECURED SIDE

SECURITY DOOR TYPE "C1" - CARD READER, SINGLE DOOR

Not to Scale
PROVIDE PLENUM RATED ACCESS CONTROL SYSTEM CABLEING TO HEADEND IN OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED.

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

PROVIDEוצה BOX MOUNTED ABOVE NEAREST FINISHED ACCESSIBLE CEILING

PROVIDE 3/4" CONDUIT

WALL MOUNTED VIDEO INTERCOM SUBSTATION

FINISHED FLOOR

UNSECURED SIDE

SECURITY DOOR TYPE "C1I" - CARD READER, SINGLE DOOR, INTERCOM SUBSTATION

Not to Scale
Provide plenum rated access control system cabling to headend in open top cable supports or conduit as required.

Provide junction box mounted above nearest finished accessible ceiling.

Provide finished accessible ceiling line (where exists).

Provide 3/4" conduit.

Provide 1" conduit.

Door contact position switch.

Provide wall mounted card reader with integral keypad for two factor authentication.

Frame harness.

Electric power transfer device.

Door harness.

Electrified mortise lock with request to exit.

46" A.F.F.

Secured floor.

Unsecured side.

Security door type "C1K" - Card reader with keypad, single door.

Not to Scale.
Provide junction box mounted above nearest accessible ceiling.

Provide 1" conduit.

Provide hardware integrated card reader on door (unsecure side).

Provide plenum rated access control system cabling to headend in open top cable supports or conduit as required.

Provide finished floor secured side finished accessible ceiling line (where exists).

Provide hardware integrated card reader on door (unsecure side).

Provide hardware integrated card reader on door (unsecure side).

Electrified exit device with integrated card reader, request to exit, and door position switch (secure side).

Electric power transfer device.

Electric power transfer device.

Door harness.

Door harness.

Electric harness.

Security door type "C2" - Card reader, double door

Not to Scale
Provide junction box mounted above nearest accessible ceiling.

Provide 1" conduit.

Provide hardware integrated card reader on door (unsecure side).

Frame harness.

Electric power transfer device.

Door harness.

Electrified exit device with integrated card reader, request to exit, and door position switch (secure side).

 Finished floor secured side (where exists).

Provide plenum rated access control system cabling to headend in open top cable supports or conduit as required.

Security door type "C2" - Card reader, double door, fixed leaf.

Not to scale.
SECURITY DOOR TYPE "C2AO" - CARD READER WITH AUTO OPENER, DOUBLE DOOR

PROVIDE PLenum RATED ACCESS CONTROL SYSTEM CABLE TO HEADEND IN OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED

PROVIDE 3/4" CONDUIT

SECURED SIDE

OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED

PROVIDE 1" CONDUIT

DOOR CONTACT POSITION SWITCH

DOOR MOUNTED CARD READER (UNSECURE SIDE)

OPPOSITE SIDE

46" A.F.F.

PROVIDE 1" CONDUIT

AUTO OPENER (TYP)

FRAME HARNESS (TYP)

ELECTRIC POWER TRANSFER DEVICE (TYP)

ACTUATOR FOR AUTO OPENER (TYP)

DOOR HARNESS (TYP)

ELECTRIC LATCH RETRACTION EXIT DEVICE WITH REQUEST TO EXIT SWITCH

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

FINISHED FLOOR

46" A.F.F.

120V

PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST ACCESSIBLE CEILING

PROVIDE 120V ELECTRIC POWER TRANSFER DEVICE (TYP)

FRONT HARNESS (TYP)
PROVIDE 3/4" CONDUIT

PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST FINISHED ACCESSIBLE CEILING

PROVIDE PLENUM RATED ACCESS CONTROL SYSTEM CABLEING TO HEADEND IN OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED

FINISHED ACCESSIBLE CEILING LINE (WHERE EXIST)

PROVIDE 3/4" CONDUIT

DOOR MANAGEMENT ALARM

SECURED SIDE

DOOR CONTACT POSITION SWITCH

EXIT DEVICE

FINISHED FLOOR

46" A.F.F.

SECURITY DOOR TYPE "EEO" - EMERGENCY EXIT ONLY

Not to Scale
provide plenum rated access control system cabling to headend in open top cable supports or conduit as required

provide junction box mounted above nearest finished accessible ceiling (where exists)

provide 1" conduit

provide 3/4" conduit

doors contact position switch

provide 3/4" conduit

frame harness

electric power transfer device

doors harness

exit device with request to exit switch (secure side)

finished accessible ceiling line
(where exists)

SECURITY DOOR TYPE "EO" - EXIT ONLY

Not to Scale
PROVIDE PLENUM RATED ACCESS CONTROL SYSTEM CABLING TO HEADEND IN OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED

PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST FINISHED ACCESSIBLE CEILING

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

PROVIDE 1" CONDUIT

PROVIDE HARDWARE INTEGRATED CARD READER ON DOOR (UNSECURE SIDE)

FRAME HARNESS

ELECTRIC POWER TRANSFER DEVICE

DOOR HARNESS

ELECTRIFIED EXIT DEVICE WITH INTEGRATED CARD READER, REQUEST TO EXIT, AND DOOR POSITION SWITCH (SECURE SIDE)

FINISHED FLOOR

SECURED SIDE

SECURITY DOOR TYPE "S1R" - STAIRWELL RE-ENTRY DOOR

Not to Scale
PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST ACCESSIBLE CEILING

PROVIDE 1" CONDUIT

CARDB READER

ARCHITECTURAL ENTRY BOLLARD

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

FINISHED FLOOR

SECURITY DOOR TYPE "CSL" - SLIDING CARD READER DOOR

Not to Scale
PROVIDE PLENUM RATED ACCESS CONTROL SYSTEM CABLE TO HEADEND IN OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST FINISHED ACCESSIBLE CEILING

PROVIDE 1" CONDUIT

PROVIDE 3/4" CONDUIT

FRAME HARNESS

ELECTRIC POWER TRANSFER DEVICE

DOOR HARNESS

ELECTRIFIED MORTISE LOCK WITH HARDWARE INTEGRATED AND REQUEST TO EXIT (UNSECURE SIDE)

FINISHED FLOOR

UNSECURED SIDE

MONITORED SINGLE DOOR

Not to Scale
PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST ACCESSIBLE CEILING

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

PROVIDE 1" CONDUIT

FINISHED FLOOR SECURED SIDE

PROVIDE 3/4" CONDUIT

FINISHED ACCESSIBLE CEILING LINE

DOOR HARNESS

FRAME HARNESS

ELECTRIC POWER TRANSFER DEVICE

DOOR CONTACT POSITION SWITCH

FRAME HARNESS

ELECTRIC POWER TRANSFER DEVICE

ELECTRIC POWER TRANSFER DEVICE

DOOR HARNESS

DOOR HARNESS

ELECTRIFIED EXIT DEVICE WITH HARDWARE INTEGRATED, REQUEST TO EXIT SWITCH (SECURE SIDE)

SECURED SIDE

MONITORED DOUBLE DOOR

Not to Scale
PROVIDE PLENUM RATED ACCESS CONTROL SYSTEM CABLING TO HEADEND IN OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED.

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST FINISHED ACCESSIBLE CEILING

LOCAL ALARM SOUNDER +84°

PROVIDE 3/4" CONDUIT

WALL MOUNTED CARD READER

FINISHED FLOOR

PROVIDE 1" CONDUIT

DOOR CONTACT POSITION SWITCH

FRAME HARNESS

ELECTRIC POWER TRANSFER DEVICE

DOOR HARNESS

ELECTRIFIED DELAYED EGRESS EXIT DEVICE

DELAYED EGRESS SINGLE DOOR

Not to Scale
PROVIDE JUNCTION BOX MOUNTED ABOVE NEAREST ACCESSIBLE CEILING

PROVIDE 1" CONDUIT

FINISHED ACCESSIBLE CEILING LINE (WHERE EXISTS)

PROVIDE 3/4" CONDUIT

LOCAL ALARM SOUNDER +84"

DOOR CONTACT POSITION SWITCH

DOOR HARNESS

FRAME HARNESS

ELECTRIC POWER TRANSFER DEVICE

WALL MOUNTED CARD READER

DOOR HARNESS

ELECTRIFIED DELAYED EGRESS EXIT DEVICE

FINISHED FLOOR

PROVIDE PLENUM RATED ACCESS CONTROL SYSTEM CABLING TO HEADEND IN OPEN TOP CABLE SUPPORTS OR CONDUIT AS REQUIRED

FINISHED ACCESSIBLE CEILING LINE

DELAYED EGRESS DOUBLE DOOR

Not to Scale
COMPACT TEACHING STATION

Not to Scale

BOTTOM SECTION
HD CASTERS
PRESENTERS
SIDE LOCKING

CABLE PASS 9" X 14"

PLAN SECTION
CABLE GROMMET

OPEN BASE
NO DOOR

BACK SECTION
SLIDE OUT
KEYBOARD/MOUSE SHELF

FRONT SECTION
SPACE FOR
(MA CFR-16-20) RACK FRAME

FLAT WORK SURFACE OF
FENIX NTM BLACK LAMINATE

HARDWOOD PENCIL LIP

MOUNTING HOLES FOR
SIDE SHELVED ON BOTH
LECTERN SIDES

CUTOUT FOR
CABLE CUBBY

ISOMETRIC SECTION
FLIP UP SHELF OF
MATCHING VENEER
ADA HEIGHT

WORK SURFACE HEIGHT

USEABLE DEPTH IN BASE
CABINET

BOTTOM SECTION
HD CASTERS
PRESENTERS
SIDE LOCKING

CABLE PASS 9" X 14"

PLAN SECTION
CABLE GROMMET

OPEN BASE
NO DOOR

BACK SECTION
SLIDE OUT
KEYBOARD/MOUSE SHELF

FRONT SECTION
SPACE FOR
(MA CFR-16-20) RACK FRAME

FLAT WORK SURFACE OF
FENIX NTM BLACK LAMINATE

HARDWOOD PENCIL LIP

MOUNTING HOLES FOR
SIDE SHELVED ON BOTH
LECTERN SIDES

CUTOUT FOR
CABLE CUBBY

ISOMETRIC SECTION
FLIP UP SHELF OF
MATCHING VENEER
ADA HEIGHT

WORK SURFACE HEIGHT

USEABLE DEPTH IN BASE
CABINET

COMPACT TEACHING STATION

Not to Scale

YALE UNIVERSITY
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No. 1.0
Date 07/31/2020

Client/Project
YALE UNIVERSITY
COMPACT TEACHING STATION
CREDENZA WITH RACK

Not to Scale

BOTTOM SECTION
VENT SLOTS
LOW PROFILE CASTERS
CABLE PASS

BACK SECTION
UTILITY RAIL WITH CABLE GROMMET
VENT SLOTS
LOCKING ACCESS PANEL
OPEN BAY FOR CUSTOMER SUPPLIED RACK FRAME

PLAN SECTION
25 1/4"

FRONT SECTION
29 1/4"
24 1/2"
22"

RIGHT SECTION
USEABLE DEPTH
25"

ISOMETRIC SECTION
FLAT WORK SURFACE OF FENIX NTM BLACK LAMINATE
HINGED LOCKING HARDWOOD FRAMED PLEXIGLASS DOOR

VENT SLOTS

YALE UNIVERSITY
ITS INFRASTRUCTURE CONSTRUCTION STANDARDS

Revision No.: 1.0
Date: 07/31/2020
Detail Number: T068
FULL SIZED TEACHING STATION
Not to Scale

- **HYDRAULIC CASTERS**
- **PRESENTER**
- **SIDE LOCKING**
- **CABLE PASS**
- **CABLE GROMMET**
- **SIDE PANELS WRAPPED IN 1/4" HARDWOOD WITH SOFTENED EDGES**
- **CABLE CADDY**
- **CUTOUT FOR CABLE CADDY**
- **FLIP UP SHELF FLUSH TO SIDE 24" x 20"**
- **FLAT WORKSURFACE OF FENIX NTM P-LAM**
- **ERGOTRON MONITOR ARM**
- **INSTALLER ERGOTRON MONITOR ARM**
- **REMOVABLE ACCESS PANEL**
- **OPEN BASE FOR INTEGRATOR SUPPLIED RACK FRAME**

Dimensions:
- **30"**
- **19 1/2"**
- **20 1/2"**
- **44 1/2"**
- **29 1/2"**
- **32"**
- **30"**

Client/Project Title Detail Number Revision No. Date Notes
- **YALE UNIVERSITY**
- **FULL SIZE TEACHING STATION**
- **ITS INFRASTRUCTURE CONSTRUCTION STANDARDS**
- **07/31/2020**
- **07/31/2020**
- **1.0**
- **07/31/2020**
HEIGHy ADJUSTABLE SEATED TEACHING STATION

Not to Scale
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OUTLINE SECTION 270000 - GENERAL COMMUNICATIONS PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Scope of Work.
2. Intent of Drawings.
3. Pre-Bid Site Visit.
4. Definitions.
5. General Standards of Materials.
6. Products and Substitutions.
7. Applicable Codes.
8. Guarantees and Certificates.
9. Quiet Operation and Vibration Control.
10. Temporary Shutdown of Existing Systems.
11. Coordination.
12. Shop Drawings, Product Data, and Samples.
13. Owner Instruction.

1.3 SCOPE OF WORK

A. The scope of the work included under Division 27 of the specifications shall include complete systems as shown in the Contract Documents and specified herein. Any work reasonably inferable or required to result in a complete installation or the intended operation and performance of the systems, shall be included in the Base Bid except where there is specific reference to exclusion and incorporation in other quotations.

B. A brief written Scope of Work appears in Division 01.

C. Contractor shall be solely responsible for all parts, labor, testing, documentation and all other processes and physical apparatus necessary to turn over the completed cabling system and associated infrastructure fully warranted and operational for acceptance by the Owner.

D. Provide the telecommunication system conduit (with pull string), boxes, cable tray, and raceways in complete accordance with the specifications and the information found on the drawings.

E. This section specifies work to be provided by the network communications contractor, to include furnishing and installation of cabling, jacks, terminal blocks and terminations.
Installation of communications cabling and performing any terminations in the MDF or IDF closets and at all room voice and data jacks will be the responsibility of this cabling contractor.

F. This specification includes structured cabling design considerations, product specifications and installation guidelines for low-voltage network systems and associated infrastructure including, but not limited to:

1. Horizontal Copper
2. Intrabuilding Backbone Cabling
3. Interbuilding Backbone Cabling
4. Telecommunications Pathways
5. Communications Racks and Cable Managers
6. Communications Grounding Systems
7. Cabling Labeling and Administration
8. Audiovisual Systems Infrastructure
9. Security Systems Infrastructure

1.4 QUALITY ASSURANCE
1.5 INTENT OF DRAWINGS
1.6 PRE-BID SITE VISIT
1.7 DEFINITIONS
1.8 GENERAL STANDARDS OF MATERIALS
1.9 PRODUCTS AND SUBSTITUTIONS
1.10 APPLICABLE REGULATORY REFERENCES AND CODES
1.11 GUARANTEES AND CERTIFICATES
1.12 QUIET OPERATION AND VIBRATION CONTROL
1.13 TEMPORARY SHUTDOWN OF EXISTING SYSTEMS
1.14 COORDINATION
1.15 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
1.16 RECORD DRAWING DOCUMENTATION
1.17 OWNER INSTRUCTION
## REVISIONS

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OUTLINE SECTION 270500 - COMMON WORK FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1.3 DEFINITIONS

1.4 SUBMITTALS

1.5 EXCAVATING AND BACKFILLING

1.6 WATERPROOFING

1.7 WEATHERPROOFING LOCATIONS (WP)

1.8 CUTTING AND PATCHING

1.9 ACCESSIBILITY

1.10 PAINTING

1.11 EQUIPMENT FOUNDATIONS, SUPPORTS, PIERS AND ATTACHMENTS

1.12 CLEANING, PROTECTING AND ADJUSTING

1.13 SPECIAL TOOLS
1.14 WELDING

1.15 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

1.16 FIRESTOPPING

1.17 DUST, DIRT AND NOISE

END OF SECTION 270500

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OUTLINE SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Grounding conductors.
   2. Grounding connectors.
   3. Grounding busbars.
   4. Grounding labeling.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

2.2 CONDUCTORS

2.3 CONNECTORS

2.4 GROUNDING BUSBARS

2.5 GROUND RODS

2.6 IDENTIFICATION

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 INSTALLATION

3.3 APPLICATION

3.4 GROUNDING BUSBARS

3.5 CONNECTIONS

3.6 IDENTIFICATION

3.7 FIELD QUALITY CONTROL

END OF SECTION 270526

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OUTLINE SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
7. Nonmetallic surface pathways.
8. Boxes, enclosures, and cabinets.
9. Polymer-concrete handholes and boxes for exterior underground cabling.

B. Provide raceways as required for the following low voltage systems:

1. Data/Voice/Video Premise Wiring System
2. Audiovisual Cabling Systems
3. Security Systems

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

1.5 SUBMITTALS

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS
PATHWAYS FOR COMMUNICATIONS SYSTEMS - OUTLINE

2.2 NONMETALLIC CONDUITS AND FITTINGS

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

2.5 SURFACE METAL PATHWAYS

2.6 SURFACE NONMETALLIC PATHWAYS:

2.7 BOXES, ENCLOSURES, AND CABINETS

2.8 OPEN TOP CABLE SUPPORTS

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: IMC.
3. Underground Conduit: Type EPC-40-PVC.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: IMC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway, EMT.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway, EMT.
8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway, Riser-type, optical-fiber-cable pathway, Plenum-type, optical-fiber-cable pathway, EMT.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in damp or wet locations.

C. Minimum Pathway Size: 1 inch for optical-fiber cables.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

F. Complete pathway installation before starting conductor installation.
G. Contractor shall size conduit large enough to accommodate at least 50% growth. I.e. conduit for 4 cables shall be sized to accommodate 6 cables at less than 40% calculated fill based on cable OD.

H. Interior cable pathways shall utilize 4 inch conduits as connecting points to the communications rooms unless space constraints prevent installation.

I. Additional conduit to the communications rooms shall be installed to provide a 4 to 1 ratio of 40% full conduit to a single empty conduit for future use.

J. Coordinate exact location of backboxes with Architectural drawings prior to installation of raceways and backboxes and before construction of walls and floors.

K. Recessed wall outlet backboxes shall be double ganged, 4 11/16” x 4 11/16” x 2 1/8” minimum size. Provide trim ring on outlet box as required for specific wall construction and size of faceplate.

L. Do not install any Division 27 raceway or conduit below slab on grade unless shown or stated otherwise or approved by the Engineer.

M. Each telecommunication system wall outlet shall have a dedicated outlet box and not be ganged together with power receptacles unless otherwise stated.

N. Do not “daisy-chain” conduit between outlet back boxes for data/voice/video systems unless otherwise stated in specific cases.

O. Coordinate the length and routing of raceway runs to meet cabling length requirements of TIA/EIA 568/569 Standards.

P. Arrange stub-ups so curved portions of bends are not visible above finished slab.

Q. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

R. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

S. Support conduit within 12 inches of enclosures to which attached.

T. Pathways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
   2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
   3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
   4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
   5. Change from nonmetallic conduit and fittings to RNC and fittings before rising above floor.
U. Stub-ups to Above Recessed Ceilings (only where exposed cable installation is permitted):
   1. Use EMT, IMC, or RMC for pathways.
   2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

V. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

W. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

X. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Y. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

Z. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

AA. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

BB. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

CC. Surface Pathways:
   1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
   2. Install surface pathway with a minimum 2-inch radius control at bend points.
   3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

DD. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
   1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
   2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
   3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
EE. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

FF. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

GG. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

HH. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

II. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

JJ. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

KK. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
LL. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

MM. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

NN. Set metal floor boxes level and flush with finished floor surface.

OO. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 OPEN TOP CABLE SUPPORTS

A. Size to allow a minimum of 50 percent future capacity without exceeding design capacity limits.

B. Do not use ceiling grid support wire or support rods.

C. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.

D. Space hooks no more than 4 feet o.c.

E. Provide a hook at each change in direction

3.4 FIRESTOPPING

3.5 PROTECTION

END OF SECTION 270528

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OUTLINE SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Aluminum slotted support systems for communication raceways.
3. Nonmetallic slotted support systems for communication raceways.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

1.5 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES
PART 3 - EXECUTION

3.1 APPLICATION

3.2 SUPPORT INSTALLATION

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

3.4 PAINTING

END OF SECTION 270529

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OUTLINE SECTION 270534 FLOOR BOXES FOR ELECTRICAL AND COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. The floor box provides the interface between power and communication cabling in a concrete floor, and the workstation where both power and communication device outlets are required. The box provides recessed device outlets that will not obstruct the floor area.

B. These poke-thru devices provide the interface between power, communication and audio/visual (A/V) cabling in an above grade concrete floor and the workstation or activation location where power communication and/or A/V device outlets are required. These poke-thru devices provide recessed device outlets that will not obstruct the floor area.

1.3 CLASSIFICATION AND USE

PART 2 - PRODUCTS

2.1 MANUFACTURER

2.2 FLOOR BOXES

A. Classification and Use: Floor boxes shall have been examined and tested by Underwriters Laboratories Inc. to meet UL514A and UL514C. Floor boxes shall also conform to the standards set in Section 300-21 of the National Electrical Code. Floor boxes shall meet UL scrub water requirements, but are not suitable for wet or damp locations, or other areas subject to saturation with water or other liquids. Floor boxes shall also have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, bare concrete, terrazzo, wood, and carpet covered floors. Floor boxes shall be suitable for use in air handling spaces in accordance with Section 300-22 (C) of the National Electrical Code.

2.3 POKE THROUGH

A. Poke-Thru Assembly

B. Activation Cover

C. Communication Modules Mounting Accessories
PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor Boxes

1. The floor box shall contain four leveling legs to provide full pre-concrete pour adjustment. Additionally, the box shall ship with a disposable cover to prevent the entry of debris during the construction phase. Alternate disposable covers to provide terrazzo pour stops is to be available from the manufacturer. The floor box shall be warranted for one year from the date of final acceptance.

2. Provide conduits to the floor box for various services as required.

3. Field verify final location of all floor boxes.

4. Provide lid activation covers of type, finish, and configuration as required. Final configuration shall be approved by the Architect.

5. Provide finished flooring material within recessed areas of the lid activation covers designed to accept finished flooring. The finished flooring shall match the surrounding floor finishes. Coordinate with the flooring contractor.

6. Provide additional supplemental support for the floor box as needed to securely set it at the proper elevation prior to pour.

7. The contractor shall identify the final finished floor type prior to installation. Consult with the manufacturer for directions and elevations for installing the floor box with that type of floor finish. Provide the complete installation as required for that finished floor type.

8. Provide device brackets for mounting power and communications devices and jacks. Coordinate with the Architect for the final configurations and types required for each floor box. The Contractor shall provide any configuration and type required.

9. Provide floor box lids (activation covers) for every floor box. Coordinate with the Architect for the final lid configuration and type required for each floor box. The contractor shall provide any configuration and type required.

B. Poke Throughs

1. The poke through use is defined by the UL Fire Resistance Directory as a minimum spacing of 2 ft. [610mm] on center and not more than one device per each 65 sq. ft. [6m2] of floor area in each span.”

2. Installation shall be completed by pushing unit down into the cored hole. Prior to and during installation, refer to system layout and/or approval drawings. Installer shall comply with detailed manufacturer’s instruction sheet included with each device. The unit shall contain a retainer for securing the device in the slab, as well as the necessary intumescent material to seal the cored-hole under fire conditions.

3. Provide conduits to the poke throughs for various services as required.
4. Field verify final location of all poke throughs.

5. Provide lid activation covers of type, finish, and configuration as required. Final configuration shall be approved by the Architect.

6. Provide additional supplemental support for the poke through as needed to securely set it at the proper elevation.

7. The contractor shall identify the final finished floor type prior to installation. Consult with the manufacturer for directions and elevations for installing the floor box with that type of floor finish. Provide the complete installation as required for that finished floor type.

8. Provide device brackets for mounting power and communications devices and jacks. Coordinate with the Architect for the final configurations and types required for each floor box. The Contractor shall provide any configuration and type required.

9. Provide activation covers for every poke through. Coordinate with the Architect for the final lid configuration and type required for each floor box. The contractor shall provide any configuration and type required.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.

B. Protect boxes until acceptance.

END OF SECTION 270534

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OUTLINE SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wire-mesh cable tray.
2. Cable runway
3. Cable tray accessories.
4. Warning signs.

1.3 REFERENCES

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

1.8 PROJECT CONDITIONS

1.9 COORDINATION

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS
2.2 GENERAL REQUIREMENT FOR CABLE TRAY

2.3 WIRE-MESH CABLE TRAY

A. Cable tray shall consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray acts as Equipment Grounding Conductor (EGC). Wire mesh cable tray will have continuous T-welded top side wire to protect cable insulation and installers.

1. Cable tray systems shall include, but are not limited to, straight sections, supports and accessories.
2. Provide splices, supports, and other fittings necessary for a complete, continuously grounded system.
   a. Mesh: 2 by 4 inches.
   b. Straight Section Lengths: 118 inches.
   c. Wire Diameter: Patented design includes varying wire sizes to meet application load requirements; to optimize tray strength; and to allow tray to remain lightweight.
   d. Fittings: Wire mesh cable tray fittings shall be field-fabricated from straight tray sections, in accordance with manufacturer's instructions.
   e. Tape: Painted wire mesh cable tray to include metallic conductive UL tape.

3. Wire-Basket Depth: 4-inch usable loading depth, unless otherwise indicated on the drawings.
4. Length: Cable tray section length shall be 118.1 inches unless otherwise shown on drawings.
5. Cable Tray Material: Carbon steel wire, ASTM A 510, Grade 1008. Wire welded, bent, and surface treated after manufacture.
6. Load Span Criteria:
   a. Install and support cable management system in accordance with NEMA VE-1, with Safety Factor of 1.5.
7. Fittings/Supports: Wire mesh cable tray fittings are field-fabricated from straight tray sections, in accordance with manufacturer's instructions. Supports shall include the FAS (Fast Assembly System) where possible so that screws, bolts, and additional tools are not required for cable tray mounting to reduce installation time; and tray path can adapt to installation obstacles without the need for additional parts. Place supports so that support span does not exceed that shown on the drawings and is capable of supporting total fill capacity loading.
   a. Ceiling-mounted supports mount to ceiling structure directly or with threaded rod sized for total fill capacity.
   b. Wall-mounted supports.
   c. Splices, including those approved for electrical continuity (bonding), as recommended by cable tray manufacturer.
8. Cable tray shall consist of continuous, rigid, welded steel wire mesh cable management system, to allow continuous ventilation of cables and maximum dissipation of heat, with UL Classified splices where tray acts as Equipment Grounding Conductor (EGC).
   a. Cable tray systems shall include, but are not limited to, straight sections, supports and accessories.
   b. Configuration: Wires are formed into a standard 2 inches by 4 inches (50 by 100 mm) wire mesh pattern with intersecting wires welded together. Mesh sections shall have at least one bottom longitudinal wire along entire length of section.
   e. Straight sections shall be furnished in standard 118.1 inches lengths.

9. Connector Assemblies: Listed Snap in couplers or factory assembled bolted couplers that mechanically join adjacent tray wires to splice sections together or to create horizontal fittings.

10. Hardware and Fasteners:
    a. ASTM F 593 and ASTM F 594 stainless steel, Type 316.
    b. Steel, zinc plated according to ASTM B 633.

11. Steel Material: Straight section and fitting side rails and rungs shall comply with the minimum mechanical properties of ASTM A 1008/A 1008M.

12. Steel Tray Splice Plates: ASTM A 1008/A 1008M.

13. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.

14. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 TELECOMMUNICATIONS ROOM CABLE RUNWAY

A. Size: 1.5 inches high by 0.4 inches wide high tubular steel with 0.065 inch wall thickness.

B. Stringers: 9 feet 11-1/2 inches long.

C. Cross Members: Welded in between stringers on 12 inch intervals/centers beginning 5-3/4 inches with 10 cross members per ladder rack. Open space of 10-1/2 inches between each cross member.

D. Finish and Color: Powder coat paint in black.

E. Provide width as shown on the drawings.

F. Supports shall be positioned as recommended by manufacturer and anchored to the building structure.

G. Cable runway shall be steel and meet ASTM A570.

H. Cable runway shall be finished black.
I. Bond each cable runway joint with a UL listed grounding device and ground tray according to manufacturer’s recommendations to maintain UL and NEC grounding requirements and listings.

J. Cable runway shall have UL listing.

2.5 CABLE TRAY ACCESSORIES

A. Horizontal 90° Turns
B. Vertical-To-Horizontal 90° Turns
C. Horizontal-To-Vertical 90° Turns
D. Corner Brackets
E. Splices
F. Grounding Kit
G. Ladder Rack Supports
H. Foot Kit
I. Threaded Ceiling Kit
J. Center Support Kit
K. Rack-to-Runway Mounting Plate
L. Cable Runway Elevation Kit
M. Vertical Wall Brackets.
N. Tool-less Pathway Dividers
O. Cable Retaining Post.
P. Cable Runway Protective End Caps.

2.6 WARNING SIGNS

2.7 SOURCE QUALITY CONTROL

PART 3 - EXECUTION
3.1 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure.

G. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

I. Support bus assembly to prevent twisting from eccentric loading.

J. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

K. Support wire-basket cable trays with trapeze hangers and wall brackets.

L. Support trapeze hangers for wire-basket trays with 3/8-inch- (10-mm-) diameter rods.

M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

O. Make changes in direction and elevation using manufacturer's recommended fittings.

P. Make cable tray connections using manufacturer's recommended fittings.

Q. Seal penetrations through fire and smoke barriers.

R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

S. Install cable trays with enough workspace to permit access for installing cables.
T. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

3.4 CONNECTIONS

3.5 FIELD QUALITY CONTROL

3.6 PROTECTION

END OF SECTION 270536

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OUTLINE SECTION 270543 - UNDERGROUND PATHWAYS AND STRUCTURES FOR COMMUNICATION SYSTEMS

1.1 STANDARD

A. Comply with TIA-569-C and TIA-758-C.

1.2 COMPONENTS

A. Metal conduits and fittings.
B. Rigid nonmetallic duct.
C. Flexible nonmetallic duct.
D. Duct accessories, including rigid and fabric innerduct.
E. Precast concrete handholes and boxes.
F. Handholes and Boxes Other Than Precast Concrete:
   1. Iron frames and covers.
   2. Chimney components.
   3. Sump frame and grate.
   4. Pulling eyes.
   5. Pulling-in and lifting irons.
   7. Ground rod sleeve.
   8. Expansion anchors.
   9. Cable rack assemblies.
  10. Fixed ladders.

1.3 SOURCE QUALITY CONTROL

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OUTLINE SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLELING

1.1 ROUND SLEEVES

A. Steel Pipe Sleeves Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated steel, plain ends and integral waterstop.

B. Wall Sleeves, Cast Iron:
   1. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. Sheet Metal Sleeves, Galvanized Steel, Round:

1.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1.3 ENGINEERED THROUGH PENETRATION FIRESTOP SLEEVES

A. Classification and Use
   1. The fire-rated pathway shall contain a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to remove or reinstall firestop materials.
   
   2. The firestop device for use in through-penetration firestop systems shall have been examined and tested by Underwriters Laboratories Inc. to UL1479 (ASTM E 814) and bear the U.S. UL Classification Mark.
   
   3. The device shall be classified for use in one-, two-, three-, and four-hour rated gypsum, concrete and block walls. The device shall be classified for use in one-, two-, and three-hour rated concrete floors having a minimum 4 1/2" (114mm) thick reinforced lightweight or normal weight (100-150 pcf) (1600-2400 kg/m3). The devices shall also been tested by Underwriters Laboratories Inc. to UL2043 and determined to be suitable for use in air handling spaces.

   4. For retrofit applications where no conduit is installed in the wall to protect existing cables, split conduit assembly should be used to protect cables. After installing the split conduit within the wall, a wall plate should be installed to cover any irregularly shaped hole cut in the wall. The firestop device is then installed onto the conduit.
1.4 ENGINEERED SMOKE AND ACOUSTICAL SLEEVES

A. The smoke and acoustical sleeve shall be used to maintain an effective barrier against the spread of smoke and hot gases, and to restore the STC rating in through penetrations in non-fire rated wall and floor assemblies.

B. The smoke and acoustical sleeve pathway shall permit cables to penetrate nonrated walls and floors without the need for smoke sealing. Cables shall be easily added or removed at any time without the need to remove or reinstall caulking materials.

1.5 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable or between pathway and cable.

1. Sealing Elements: [EPDM] [Nitrile (Buna N)] rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: [Carbon steel] [Fiber-reinforced plastic] [Stainless steel].

3. Connecting Bolts and Nuts: [Carbon steel, with corrosion-resistant coating,] [Stainless steel] of length required to secure pressure plates to sealing elements.

1.6 GROUT

1.7 POURABLE SEALANTS

1.8 FOAM SEALANTS

1.9 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when raceways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, fire-rated floor, or wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed
      surfaces smooth; protect grout while curing.

H. Interior Penetrations of Non-Fire-Rated Walls and Floors
   1. Provide fabricated steel sleeves of diameter required for penetrations through walls and
      floors. Seal annular space between sleeve and wall, using joint sealant appropriate for
      size, depth, and location of joint.
   2. Provide re-enterable sealant suitable for cabling systems and plenum environments within
      the annular space between the sleeve and cabling bundle.
   3. Where shown on the drawings, provide Engineered Smoke & Acoustic Sleeves in lieu of
      fabricated steel sleeves to serve cable bundle penetrations through walls and floors.

I. Fire-Rated-Assembly Penetrations
   1. Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and
      cable penetrations.
   2. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
   3. Provide non-curing, re-penetrable, intumescent firestop materials around communications
      cable trays or ladder racks penetrating through a fire rated wall.
   4. Where shown on the drawings, provide Engineered Through Penetration Fire Stop
      Sleeves in lieu of fabricated steel sleeves to serve cable bundle penetrations through walls
      and floors.

J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible
   boot-type flashing units applied in coordination with roofing work.

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and
   mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space
   between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow
   for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing
   mechanical sleeve seals.

END OF SECTION 270544
### REVISIONS

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OUTLINE SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

1.1 PRODUCTS

A. Labels:
   1. Vinyl wraparound labels.
   2. Snap-around labels.

B. Bands and Tubes:
   1. Snap-around color-coding bands.

C. Underground-line warning tape.

D. Signs:
   1. Baked-enamel signs.
   2. Metal-backed butyrate signs.
   3. Laminated acrylic or melamine plastic signs.

E. Cable Ties:
   1. General-purpose cable ties.
   2. UV-stabilized cable ties.
   3. Plenum-rated cable ties.

END OF SECTION 270553

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OUTLINE SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Telecommunications mounting elements.
   2. Backboards.
   3. Telecommunications equipment racks.

B. Related Requirements:
   1. Section 270536 "Cable Trays for Communications Systems" for cable trays and accessories.
   2. Section 271513 "Communications Copper Horizontal Cabling" for copper data cabling associated with system panels and devices.

C. The intent of this section is to furnish of all necessary labor, supervision, materials, and equipment to fit out all Telecommunication rooms/spaces as shown on the drawings.

D. Provide cable supports, pull boxes, tube supports, fiber distribution units and accessories in telecommunication room/spaces (as indicated on drawings).

E. Provide plywood backboards as required to support newly installed equipment. Anchors for plywood will be sufficient to support equipment apparatus, with attaching hardware flush or not protruding out from the plywood surface.

F. Provide equipment racks, grounding and all necessary hardware in the room to support the low voltage systems.

G. Contractor shall modify rooms and rack equipment to install new equipment with approval from the Owner or Owners Representative prior to installation.

H. Communication grounding and bonding shall be in accordance with applicable codes and regulations. The requirements of TIA-607D shall be observed throughout the entire cabling system.
1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 QUALITY ASSURANCE

1.7 RECORD DOCUMENTS

PART 2 - PRODUCTS

2.1 BACKBOARDS

2.2 RACKS/CABINETS

2.3 GROUNDING

2.4 LABELING

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

3.2 INSTALLATION

A. Comply with NECA 1.


D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.
1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.

2. Record agreements reached in meetings and distribute them to other participants.

3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.

4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

G. Backboards:
   1. Install from 6 inches to 8 feet, 6 inches above finished floor UON. Ensure that fire-rating stamp is visible after installation. Do not paint plywood backboards.
   2. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.3 GROUNDING

3.4 IDENTIFICATION

3.5 FIRESTOPPING

END OF SECTION 271100

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OUTLINE SECTION 271313 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:
   1. High-count Category 3 twisted pair cable for intrabuilding and interbuilding backbones.
   2. Grounding provisions for twisted pair cable.
   3. Cabling identification.
   4. Source quality control requirements for twisted pair cable.

1.3 DEFINITIONS

1.4 COPPER BACKBONE CABLING DESCRIPTION

A. Copper backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Copper backbones rated for intrabuilding and interbuilding outside plant applications shall be required.

C. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

1.6 INFORMATIONAL SUBMITTALS

1.7 CLOSEOUT SUBMITTALS

1.8 QUALITY ASSURANCE
1.9 DELIVERY, STORAGE, AND HANDLING

1.10 PROJECT CONDITIONS

1.11 COORDINATION

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 GENERAL CABLE CHARACTERISTICS

2.3 INTRABUILDING HIGH-COUNT CATEGORY 3 TWISTED PAIR CABLE

2.4 TWISTED PAIR CABLE HARDWARE

2.5 CABLING IDENTIFICATION

2.6 GROUNDING

2.7 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 WIRING METHODS

3.2 INSTALLATION OF PATHWAYS

3.3 INSTALLATION OF COPPER BACKBONE CABLES

3.4 TERMINATION

3.5 FIRESTOPPING

3.6 GROUNDING
3.7 IDENTIFICATION

3.8 FIELD QUALITY CONTROL

3.9 WARRANTY

END OF SECTION 271313

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OUTLINE SECTION 271323 - OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY
   A. Section Includes:
   1. Optical Fiber Backbone Cabling
   2. Air Blown Fiber Optic System
   3. Optical Fiber Connectors
   4. Optical Fiber Termination Cabinets
   5. Optical Fiber Splices

1.2 DEFINITIONS

1.3 ACTION SUBMITTALS

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

1.8 PROJECT CONDITIONS

1.9 COORDINATION

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 OPTICAL FIBER BACKBONE CABLES
2.3 AIR BLOWN FIBER OPTIC SYSTEM

2.4 OPTICAL FIBER CONNECTORS

2.5 OPTICAL FIBER TERMINATION CABINETS

2.6 OPTICAL FIBER SPLICES

PART 3 - EXECUTION

3.1 GENERAL

3.2 WIRING METHODS

3.3 INSTALLATION OF PATHWAYS

3.4 INSTALLATION OF COPPER BACKBONE CABLES

3.5 TERMINATION

3.6 FIRESTOPPING

3.7 GROUNDING

3.8 IDENTIFICATION

3.9 FIELD QUALITY CONTROL

3.10 WARRANTY

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OPTICAL FIBER BACKBONE CABLING - OUTLINE
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OUTLINE SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:
   1. Category 6 twisted pair cable.
   2. Category 6a twisted pair cable.
   3. Twisted pair cable hardware, including plugs and jacks.
   4. Cable management system.
   5. Cabling identification products.
   7. Source quality control requirements for twisted pair cable.

B. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling. The intent of this section is to define the requirements for the installation of a gigabit copper-cabling infrastructure.

C. This specification describes the actions to be taken, tasks to be performed and responsibilities of the certified Structured Cabling Contractor in order to provide and install a complete Warranted Horizontal Structured Cabling System. Unless otherwise noted all following sections, which describe such actions, tasks and responsibilities refer to the Contractor.

D. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications contractor.

E. The horizontal cabling system shall extend from a Telecommunication room located on the floor, or the floor above/below to the information outlet location.

F. No terms used in this specification are intended to indicate that work or equipment called for shall be less than completely executed or installed or that system shall be less than complete in any respect.

G. Install the cabling plant constructed in a physical star topology. Serve information outlets from Telecommunication Rooms (TR) by means of unshielded twisted pair (UTP) Category 6 & 6A copper, and terminate per 568B pin configuration. Some locations may exceed beyond the standard 90 meter installation, for these locations the Contractor will use the manufacturer warranted cable solution as specified.
H. Outlets shall generally consist of reuse of existing device box/ conduits. All UTP cable, information jacks and the faceplates shall be new. In some locations and where permitted by code the Contractor can install box eliminators and/or surface raceway and boxes.

I. All horizontal cabling will terminate on rack mounted patch panels in the Telecommunication Room.

1.3 DEFINITIONS

1.4 COPPER HORIZONTAL CABLE DESCRIPTION

1.5 ADMINISTRATIVE REQUIREMENTS

1.6 ACTION SUBMITTALS

1.7 INFORMATIONAL SUBMITTALS

1.8 CLOSEOUT SUBMITTALS

1.9 QUALITY ASSURANCE

1.10 WARRANTY

1.11 DELIVERY, STORAGE, AND HANDLING

1.12 PROJECT CONDITIONS

1.13 COORDINATION

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 GENERAL CABLE CHARACTERISTICS

2.3 CATEGORY 6 TWISTED PAIR CABLE
2.4 INDOOR/OUTDOOR RATED CATEGORY 6 TWISTED PAIR CABLE

2.5 CATEGORY 6A TWISTED PAIR CABLE (Wireless Access Points)

2.6 TWISTED PAIR CABLE HARDWARE
   A. Patch Panel
   B. Patch Cords
   C. Plugs and Plug Assemblies
   D. Jacks and Jack Assemblies
   E. Faceplates

2.7 IDENTIFICATION PRODUCTS

2.8 GROUNDING

2.9 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 WIRING METHODS

3.2 INSTALLATION OF PATCH CORDS

3.3 INSTALLATION OF PATHWAYS

3.4 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

3.5 FIRESTOPPING

3.6 GROUNDING

3.7 IDENTIFICATION
3.8 FIELD QUALITY CONTROL

END OF SECTION 271513

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OUTLINE SECTION 271523 - COMMUNICATIONS OPTICAL FIBER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

A. Section Includes:
   1. 62.5/125-micrometer, multimode, optical fiber cable (OM1).
   2. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM3).
   3. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM4).
   4. 9/125 micrometer, single-mode, indoor-outdoor optical fiber cable (OS2).
   5. Optical fiber cable connecting hardware, patch panels, and cross-connects.
   7. Cabling identification products.

1.3 DEFINITIONS

1.4 OPTICAL FIBER HORIZONTAL CABLING DESCRIPTION

A. Optical fiber horizontal cabling system shall provide interconnections between MDT’s/IDT’s, and the equipment outlet in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

   1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the equipment outlet.
   2. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.
1.5 ACTION SUBMITTALS

1.6 INFORMATIONAL SUBMITTALS

1.7 CLOSEOUT SUBMITTALS

1.8 QUALITY ASSURANCE

1.9 DELIVERY, STORAGE, AND HANDLING

1.10 PROJECT CONDITIONS

1.11 COORDINATION

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 62.5/125-MICROMETER, MULTIMODE, OPTICAL FIBER CABLE (OM1)

2.3 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM3)

2.4 850 NANOMETER LASER-OPTIMIZED, 50/125 MICROMETER, MULTIMODE OPTICAL FIBER CABLE (OM4)

2.5 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

2.6 OPTICAL FIBER CABLE HARDWARE
   A. Cross-Connects and Patch Panels
   B. Patch Cords
   C. Connector Type
   D. Plugs and Plug Assemblies
E. Jacks and Jack Assemblies:

F. Faceplate:

2.7 GROUNDING

2.8 IDENTIFICATION PRODUCTS

2.9 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 WIRING METHODS

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

3.3 FIRESTOPPING

3.4 GROUNDING

3.5 IDENTIFICATION

3.6 FIELD QUALITY CONTROL

3.7 WARRANTY

END OF SECTION 271523

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OUTLINE SECTION 272000 – TWO-WAY COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 GENERAL DESCRIPTION

A. "Areas of Rescue Assistance" are mandated by the Americans With Disabilities Act (ADA) as a means of providing greater safety to people with disabilities in case of an emergency. An Area of Rescue Assistance system enables two-way communication between a rescue site, such as a stairwell or foyer, and a central command station, such as a main lobby, fire command station, or security office.

B. The Area of Rescue Assistance (ARA) system shall consist of a microprocessor-based Command Unit ARA Stations. This system shall meet the Federal Government's guidelines as an Areas of Rescue Assistance system under the ADA.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

1.8 DELIVERY, STORAGE, AND HANDLING

1.9 PROJECT CONDITIONS

1.10 COORDINATION

PART 2 - PRODUCTS
2.1 MANUFACTURERS

2.2 OPERATIONAL DESCRIPTION

2.3 FUNCTIONALITY
   A. Local Command Unit Phone
   B. Call Routing
   C. Visual Indicators (Monitoring Panel)
   D. Visual Indicator (Strobe)
   E. Audible Indicator (Sounder)
   F. Call Stations

2.4 INTERFACES

2.5 POWER REQUIREMENTS

2.6 ENVIRONMENTAL

PART 3 - EXECUTION

3.1 INSTALLATION

3.2 WARRANTY

END OF SECTION 272000

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OUTLINE SECTION 275119 - SOUND MASKING SYSTEMS

1.1 QUALITY ASSURANCE
   A. Quality Standards: NFPA 70, UL 813, and ASTM E1374.

1.2 PRODUCTS
   A. Addressable Sound-Masking Systems: Networked with integrated controls, generators, and amplifiers.
      1. Networked control panel with integral sound-masking generator.
      2. Control software.
   B. Zoned Sound-Masking Systems: Zoned sound-masking and paging system. Each zone consists of one loudspeaker control unit.
      1. Loudspeaker control unit with integral sound-masking generator.
      1. Control unit with masking-sound generator and amplifiers.
   E. Wire and Cable:
      1. Category 6 balanced twisted pair cable and hardware.
      2. Loudspeaker cable.
      3. Control-circuit conductors.

1.3 INSTALLATION
   A. Wiring Method: In raceways.
      1. Except in accessible indoor ceiling spaces and attics.
      2. Except in hollow gypsum board partitions.

END OF SECTION 275119
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OUTLINE SECTION 281300 – ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. An access control system (ACS) is an electronic card reader system comprised of controllers, card readers and sensing device that manage the entrance and exit of people through secure areas.

B. The ACS shall be based upon distributed system architecture with local door controllers which communicate with an existing ACS server (AMAG). If there is a failure to the network, the access control decisions may be made locally at the access control panel. Upon the network being restored, the stored alarms on the control panel could then be transmitted to the ACS server for storage and report writing.

C. The ACS shall utilize the campus issued identification (ID) cards.

D. This specification outlines the requirements for an integrated security management/access control system, including integrated subsystems providing VSS. All information herein is intended to present minimum standards of performance, quality and construction.

E. The intent of the ACS is to provide access control for selected portals and monitor the status of selected portals, equipped or not equipped with access control, through the use of electronic equipment.

F. The Security Contractor is responsible for coordinating the selection and installation of the security door hardware. As part of the submittal process, the Security Contractor shall generate a spreadsheet identifying all the doors to receive electronic security devices and validate that the door hardware submittal and doors submittal shall support the required security functions. Should a conflict in function be identified, the security contractor shall alert the Engineer and Architect. The security contractor shall be responsible to ensure that required security functions are met for each door location.

G. The Security Contractor shall be responsible for coordinating the installation with all other trades and shall provide final termination of all conductors, except as provided by the Electrical Contractor.

H. The Security Contractor shall provide complete initialization of the integrated ACS hardware and software. Security Contractor shall consult with Owner to determine Owner's requirements.
prior to initialization. Security Contractor shall transfer and/or enter all data into the system databases, including complete hardware and software configuration, alarm point database, time zone database, employee cardholder database, reports configuration, device database, I/O database, guard tours, and any other required set-up.

I. The Security Contractor shall be responsible for coordinating the security requirements of this Section with all other trades.

J. The access control system (ACS) outlined in this section shall be an expansion of the existing operational ACS. The Security Contractor shall provide sufficient license needs to support the card readers added under this project.

K. Certain cameras associated with Access Controlled Doors shall automatically cue-up upon alarm or manually.

1.3 WORK INCLUDED

1.4 SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. Any proposed alternative must meet, or exceed, the product data of the devices identified, and approval must be received by the Engineer and the Owner before supplying.

B. Final approval of security devices and equipment is to occur at the last most reasonable moment to ensure the most current and appropriate technology is installed.

2.2 ACCEPTABLE MANUFACTURERS

2.3 ACCESS CONTROL SYSTEM

A. Access Control Panels

B. Card Readers

C. Request to Exit Devices

D. Power Supplies

E. Door Position Switches

F. Cables
PART 3 – EXECUTION

3.1 GENERAL
3.2 PREPARATION
3.3 LABELING AND IDENTIFICATION
3.4 FIELD QUALITY CONTROL
3.5 TESTING
3.6 FINAL ACCEPTANCE
3.7 ON SITE COMMISSIONING AND TRAINING

END OF SECTION 281300

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OUTLINE SECTION 281600 – INTRUSION DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes a description of access control devices, intrusion detection devices, security access devices, relay control, alarm monitoring controllers, credential creation, and credential holder database and management.

B. The intrusion detection system (IDS) is an electronic system comprised of sensors and process to detect unauthorized entry into, or occupancy of, a space that is restricted to a level pre-defined or time based.

C. The intrusion detection system components will be continuously monitored for normal, alarm, supervisory, and trouble conditions:

1. Normal: Reports the system is, and sensing devices, are in proper working order and that no alarm conditions are active.

2. Alarm: Reports that a sensing device has changed state from “normal” to “alarm” due to a breach or attempted breach.

3. Supervisory: Reports a condition that a device or controller is not functioning as specified.

4. Trouble: Reports a condition that the system is not fully functional. The “trouble” alarm will be used to indicate problems with system component alarms, such as battery failure, open or shorted transmission wiring or a controller failure.

D. The security contractor is responsible to review the design of the intrusion detection system, utilizing DMP as the selected system, and note any proposed modifications and configurations to the head-end layout and wiring configuration during the bid process.
1.3 WORK INCLUDED

1.4 SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. Any proposed alternative must meet, or exceed, the product data of the devices identified, and approval must be received by the Engineer and the Owner before supplying.

B. Final approval of security devices and equipment is to occur at the last most reasonable moment to ensure the most current and appropriate technology is installed.

2.2 ACCEPTABLE MANUFACTURERS

2.3 INTRUSION DETECTION DEVICES

A. Door Position Switch

B. Ceiling Mounted Passive Infrared Motion Detector

C. Wall Mounted Motion Detector

D. Panic/Duress Device

E. Glass Break Detector

F. Laser Detector

G. Shock Sensor

H. Plunger Switch

I. Power Supplies
PART 3 – EXECUTION

3.1 GENERAL
3.2 PREPARATION
3.3 LABELING AND IDENTIFICATION
3.4 FIELD QUALITY CONTROL
3.5 TESTING
3.6 FINAL ACCEPTANCE
3.7 ON SITE COMMISSIONING AND TRAINING

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OUTLINE SECTION 282300 – VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This specification outlines the requirements for a video surveillance system (VSS). All information herein is intended to present minimum standards of performance, quality and construction.

B. The VSS system shall be able to be displayed on any Owner workstation connected to the Owner’s network with the appropriate permissions. The cameras added under this project will connect to the Owner's existing operational video surveillance system. The Security Integrator shall provide the required number of licenses to support the cameras added under this project.

C. The new network video recorders associated with this project are to be installed at the Yale Central Command.

D. Pan/Tilt/Zoom (PTZ) camera shall be utilized for the Help Point Intercom / Blue Light Phone. Upon activation of the help point intercom, the PTZ shall be automatically be called to a preset position to allow an operator to assess the emergency.

E. The primary functions of the VSS shall be for alarm assessment, access control verification purposes and general surveillance.

F. The VSS system shall be based upon the use of IP cameras control and managed from a network video management system. The IP cameras shall utilize the structured cabling system (SCS) and the Owner’s data network for the transmission and management of the VSS video.

G. The VSS shall be calculated based on the following parameters:

1. Camera Resolution
   a. Fixed (standard): 3MP
   b. Fixed (elevator): 10809
   c. 180° Panoramic: 15MP (SMP/imager)
   d. 360° Fisheye: 12MP
e. PTZ: 1080p

2. FPS: 15

3. Video Retention: 30 days

H. The electrical contractor shall provide a data outlet adjacent to the VSS camera. The SCS shall run to the nearest IT closet and terminate into a patch panel. The electrical contractor shall provide a patch connection from the security patch panel to the Owner identified network switch port. The network port will provide IEEE compliant PoE to the IP cameras. The Security Integrator is responsible to coordinate with the electrical contractor as to the locations required for data outlets. Two (2) data outlets shall be provided for each camera. The data outlets, where possible, shall be located in an accessible location.

I. The cameras shall be configured to record per the Owner’s standard record rates.

J. The system shall begin real-time recording of designated pre-set alarm positions under an alarm condition. Under the alarm condition, the VSS shall automatically flag the alarm event for easy retrieval. For calculating storage requirements, the security contractor shall assume 60 alarm conditions within a 30 day time frame (video storage requirement).

1.3 WORK INCLUDED

1.4 SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. Any proposed alternative must meet, or exceed, the product data of the devices identified, and approval must be received by the Engineer and the Owner before supplying.

B. Final approval of security devices and equipment is to occur at the last most reasonable moment to ensure the most current and appropriate technology is installed.

2.2 ACCEPTABLE MANUFACTURERS

2.3 VIDEO SURVEILLANCE DEVICES

A. Video Surveillance Camera

B. Network Video Recorder

C. Cables
D. Power Supplies

PART 3 – EXECUTION

3.1 GENERAL
3.2 PREPARATION
3.3 LABELING AND IDENTIFICATION
3.4 FIELD QUALITY CONTROL
3.5 TESTING
3.6 FINAL ACCEPTANCE
3.7 ON SITE COMMISSIONING AND TRAINING

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OUTLINE SECTION 285100 – SECURITY INTERCOMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Project Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes a description of access control devices, intrusion detection devices, security access devices, relay control, alarm monitoring controllers, credential creation, and credential holder database and management.

B. 2-way voice communication system between a control point (door station) and a control room (main station).

C. 1-way video to allow operator to visually assess individual initiating the call and the surrounding area.

D. Ability to remote release an electronically access controlled door associated with the door station from the main station through an interface with the AMAG access control system.

E. Ability to call an outside line, Yale Central Command.

F. Health Point Intercom System (HPI) to be connected to the existing Yale University emergency phone system.

G. 2-way emergency voice communication between an individual (help point intercom) and a control room (main station).

H. 1-way video through the use of separately mounted PTZ camera attached to the same pole which will allow the operator to visually assess the individual initiating the call and the surrounding area.

I. Ability for an individual to easily identify the location of a help point intercom through the use a steady blue light illuminates directly above the unit.

J. Ability for attention to be drawn to the help point intercom when an emergency call is initiated.

K. Ability to make a mass notification announcement through a separate speaker unit mounted to HPI.
1.3 WORK INCLUDED

1.4 SUBMITTALS

1.5 DELIVERY, STORAGE, AND HANDLING

1.6 WARRANTY

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. Any proposed alternative must meet, or exceed, the product data of the devices identified, and approval must be received by the Engineer and the Owner before supplying.

B. Final approval of security devices and equipment is to occur at the last most reasonable moment to ensure the most current and appropriate technology is installed.

2.2 ACCEPTABLE MANUFACTURERS

2.3 SECURITY INTERCOMMUNICATION SYSTEM DEVICES

A. Door Station

1. Door station to be equipped with a single button for initiation of a call.

2. Device shall allow for 2-way audio communication.

3. Device shall equipped with a camera to capture and stream video to the operator receiving the call.

4. Device shall be IP-based.

B. Main Station

1. 2-way audio communication, monitoring of video captured by door station and door release shall be performed by a computer workstation or mobile device with appropriate app installed.

PART 3 – EXECUTION

3.1 GENERAL

3.2 PREPARATION

3.3 LABELING AND IDENTIFICATION

3.4 FIELD QUALITY CONTROL
3.5 TESTING

3.6 FINAL ACCEPTANCE

3.7 ON SITE COMMISSIONING AND TRAINING

END OF SECTION 285100

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Bold Underline = Latest Revision
Underline = Previous Revision(s)