CAL POLY
SAN LUIS OBISPO

Telecommunications Standards Document
February - 2014

Introduction & Overview

ITS Telecommunications

Introduction

California Polytechnic State University, San Luis Obispo relies heavily on its technology infrastructure to support learning, research, and the business operations of the University. The Cal Poly Information Technology Services (ITS) - Telecommunications Group is committed to the growth, management and long-term viability of this infrastructure that includes telephone, data, cable television and radio communications operations, infrastructure and maintenance.

The Telecommunications Standards Document establishes the criteria by which the technology infrastructure shall be designed, installed, managed and maintained. The technical material incorporated in this document is intended for use by facility planners, architects, information technology managers, designers as well as construction planners, project managers and inspectors for the design and technical integration of the telecommunications system, pathways, and spaces. Nothing in this document is intended to relieve design and construction consultants of their basic professional and contractual obligations for careful project analysis, strict adherence to sound design principles, building codes and best practices as well as their responsibilities regarding the oversight of construction and installation activities.

As technology evolves and the University's needs change, the Telecommunications Standards Document will be updated to reflect the best practices for Cal Poly. The most current version of this document is available online and can be found on our WEB site: http://www.telecommunications.calpoly.edu

Telecommunications Standards Document Objectives:

1. Provide a universal framework for intra- and inter-building infrastructure design, development and deployment at Cal Poly.

2. Define minimum standards for spaces, pathways and telecommunications-related infrastructure that must be programmed into either new building construction or remodeling projects.

3. Outline specific media selection and design criteria.

4. Establish technical standards that shall be incorporated into campus design, procurement, construction scheduling and system/product testing processes.

5. Delineate methods and procedures for installing, testing and documenting cable and related infrastructure.

6. Provide direction and support to project management and inspectors of record when overseeing, approving for payment and accepting telecommunications work product.

The content in this document is based on national standards and guidelines for telecommunications systems, including those developed by the California State University Telecommunications Infrastructure Planning Standards (TIP), the Electronic Industry Association (EIA), Telecommunications Industry

Association (TIA), Institute of Electrical and Electronic Engineers (IEEE) and Building Industry Consulting Services International (BICSI). Great emphasis is placed herein on the idea that taking guidance from such sources is generally more desirable than using specific manufacturer's proprietary designs which may quickly become outdated or may be incompatible with other needed equipment.

To better clarify guidance, should a conflict between documents arise, the order of precedence shall be as follows:

1. Cal Poly ITS Telecomm Group, "Telecommunications Standards Document" (TSD)

2. CSU's "Telecommunications Infrastructure Planning Standards" document (TIP)

3. Electronic Industry Association (EIA), Telecommunications Industry Association (TIA), Institute of Electrical and Electronic Engineers (IEEE) and Building Industry Consulting Services International (BICSI)

The precedence can be overridden in the case where an item is disallowed by an applicable building code and/or with the approval in writing of the Cal Poly ITS Telecomm Group.

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Telecommunications Spaces – Specific Facility Definitions

There are primarily three types of telecommunications spaces in a building. Each building has an Equipment Room (ER), a Building Entrance Facility (EF) and potentially one or more Telecommunications Rooms (TR). A single room can serve as the ER or TR and EF but must comply with the requirements for each type of room. *All telecommunications spaces shall have either a sealed concrete floor and/or the floor shall be tiled or covered to provide project appropriate dust, dirt and moisture protection. Further, these spaces shall be used for telecommunications purposes only. No Fire Alarm, Elevator or other non-telecomm systems shall be located within these spaces.*

Equipment Rooms (ER, MPER, MCER)

The ER is (typically) centrally located in a building. The equipment in the ER connects the Building-supporting backbone to either the Main Project-supporting (MPER) or Main Campus-supporting (MCER) ER backbone. An ER can also serve as the TR for the floor on which it is located. If the ER is also to be used for telecommunications equipment for the floor on which it is located, it must also meet the entire list of requirements for Telecommunications Rooms (TRs). The ER can also serve as the EF but must have its size increased adequately to perform both functions.

The ER generally houses telecommunications equipment, cabling, environmental control equipment (for the room only), power distribution/conditioners, and uninterruptible power supply (UPS) systems. *The ER, MPER and MCER shall be large enough for equipment installation and/or replacement without interfering with other systems in the same room. All ERs shall be large enough to mount equipment racks in straight rows. (see Fig. 129 & 132 in Appendix B) All ERs shall have interior dimensions no less than 10' x 15'.*

Building Entrance Facility (EF)

The EF is where the outside plant (OSP) cables connect (through protection devices and distribution cross-connects) to the building backbone.

The EF must be large enough for the plywood backboards with 36 inches of clearance in front of the entrance cross-connects and the same door and lighting requirements as a TR. *Entry conduits must be installed within 3" of the 66 block-field wall. (see Fig. 136 & 137 in Appendix B)*

Telecommunications Rooms (TR)

Telecommunication rooms (TRs) differ from Equipment Rooms (ERs) and Building Entrance Facilities (EFs) in that they are generally considered to be *floor* serving (as opposed to *building* or *campus* serving).

Square Footage Served	Minimum TR Room Size	Minimum EF Room Size

Under 5000 sq. ft.	10' x 10'	4' x 5'
5,000 to 10,000 sq. ft.	10' x 12'	5' x 8'
10,000 + sq. ft.	10' x 15'	8' x 10'
If the EF is in a TR	*add 3' to TR width*	

Requirements for Telecommunications Spaces

Access Control

Each telecommunications room (TR) shall have a Campus lock with the proper and unique tumbler number to allow only Telecommunications and other authorized Personnel to enter.

Backboards

Each telecommunications space shall have all walls covered from one foot above finished floor to the deck above with ¾ inch x 4-foot x 8-foot plywood panels securely fastened to the wall framing members. The screw heads must be flush with the plywood face. The plywood is to be sanded smooth (not rough), void-free and both fire-rated and painted with a light colored intumescent paint, two coats on all sides (front, back and edges*). The Fire Rating Stamp shall remain visible on all plywood backboards at all times. (See Fig. 146 in Appendix B)*

Cable routing inside the TR

Cables that are to be terminated on a backboard shall be routed on the ladder rack around the perimeter (creating the slack loop) to a point directly above the termination hardware.

Cable will not be run along the floor or across a workspace in the ER/TR. All cable, including grounding wire, will approach the equipment rack from above via cable pathway or conduit.

Ceiling

The minimum ceiling height shall be 9-feet above the finished floor.   The ceiling shall be open (No false/suspended ceiling) so that there is easy access to the conduit, raceways, cables, etc. entering the ER/TR/EF.

Conduit

Conduits that protrude through the floor of the ER/TR/EF shall extend a minimum of 3-inches above the sealed or tiled floor surface. The minimum size conduit installed for telecommunications purposes shall be 1 ¼". *(See Fig. 136 &137 in Appendix B)*

One 4" trade size conduit is required (specifically for riser cable) per 50,000 sq. ft. of usable floor space served by that backbone/riser system, plus two spares for a minimum of three conduits per ER/TR/EF.

Install mule tape or pull cord in all conduits. (See Fig. #138 in Appendix B)

Conduits shall not be routed across the backboards.

Doors

The door to the telecommunications space shall be 3 feet wide (minimum), opening fully (180 degrees on flat wall, 90 degrees in the corner) and be lockable/openable with a standard campus telecom key. Doors shall be fitted with a sweep when not opening into an interior public space to insulate the room from contaminants typically found in outside public spaces.

The telecomm space door shall open outward into a public space. (see Fig. 148 in Appendix B)

Duct Sealing

Any conduits that enter a telecommunications space from outside must be sealed at both ends with a re-enterable product specifically listed for that application. ***Any conduits that allow or cause water to enter a telecommunications space shall be immediately repaired or replaced.***

Environmental Service

Any telecommunications space housing active communications equipment shall have dedicated refrigerated air conditioning providing positive air flow. Temperature control shall be maintained independently for each space and run continuously, 24 hours a day, 365 days a year.

Equipment Racks

Floor Mount

Use standard 19-inch by 7-foot, two post racks separated by and flanked with vertical cable management on both sides. ***There shall be a 3-foot working clearance in front and behind the furthest extending equipment in a rack to allow technicians the ability to work on the communications equipment mounted in the racks (National Electrical Code, Section 110-26***). ***Racks shall always be installed in straight rows***. ***(See Fig. 129 in Appendix B) Each rack shall always include a minimum of three (2U or 3 1/2") horizontal wire managers. One horizontal wire manager shall be installed at the top of each rack and one under each installed patch bay.***

Approved Manufacturers: Hubbell, Panduit, Chatsworth or Cal Poly ITS Telecomm group approved equal

Vertical Wire Management

Each ER/TR rack shall be provided with vertical wire management on both sides of every rack. There shall be 6" vertical wire management on the outside rail of the first and last rack in a row and 12" vertical wire management between each rack. Example: ER/TRs with four racks shall have two 6" vertical wire managers (outer side rails), and three 12" vertical wire managers (one between each rack). ***(See Fig 145 & 148 in Appendix B)***

Approved Manufacturers: Hubbell, Panduit, Chatsworth or Cal Poly ITS Telecomm group approved equal

Horizontal Wire Management

A minimum of three horizontal wire managers per rack shall be provided. Additional wire management shall be provided as the rack becomes more populated. *(See Fig. 104 in Appendix B)*

Approved Manufacturers: Hubbell, Panduit, Chatsworth or Cal Poly ITS Telecomm group approved equal

Equipment position

Generally, coax and copper, unless it is structured cable terminating in patch bays (CAT 6), are not terminated on patch panels in telecom racks. Telephone copper cable shall be terminated on the plywood back-board on 66 (punch) blocks. CATV shall also terminate, via appropriate connector, to a node, tap or splitter mounted on the plywood back-board attached to the wall. Fiber optic cable (both intra-building and inter-building) shall terminate inside splice trays housed in fiber shelves mounted in equipment racks.

Attachment

The bottom of the rack shall be attached (bolted) to the floor meeting Seismic Zone 4 requirements. The top of the rack shall be attached to an adequately sized cable path (18" ladder rack) that shall run from the ER/TR/EF ladder racking attached to all walls, across the top of the rack(s), and securely attached to the ladder racking at both ends.

Fire Protection

All Telecommunications spaces shall be provided with a portable CO_2 fire extinguisher with current certification.

All Telecommunications spaces shall be provided with a smoke detector tied into the building's fire alarm system.

Firestopping

All firewall penetrations into a telecommunications space shall be metal sleeved and firestopped. All firestopping shall match the specific fire rating of the wall that is penetrated. Products used to seal conduits shall be reusable/re-enterable to allow for additional cabling and maintenance.

Grounding

All Telecommunications facilities shall be provided with a Telecommunication Main Grounding Busbar (TMGB) in accordance with NEC Article 250, ANSI/EIA/TIA-607, as well as any other grounding protection codes or specifications.

All equipment, racks, metal conduit, cable tray and cable shields shall be properly bonded to the TMGB or a Telecommunications Grounding Busbar (TGB) as appropriate. (See Fig 140 & 141 in Appendix B)

The electrical panel serving a telecommunications space shall be grounded to that facility's TMGB or TGB. The TMGB shall also be directly and substantially grounded to the building main electrical grounding busbar assembly.

Approved Manufacturers: Hubbell, Panduit, Chatsworth or Cal Poly ITS Telecomm group approved equal

Labeling

A. Inside structured cables (including all ground wires) must be labeled on each end using machine generated 1" white with black lettering cable labels. (See Fig. 107 in Appendix B) Hand written labels shall not be allowed.

Approved Manufacturers: DYMO, Brother or Cal Poly ITS Telecomm group approved equal

B. Backbone and riser cables (including all ground wires) must be labeled on each end using 1" white nylon labels with black lettering.

Approved Manufacturers: DYMO or Cal Poly ITS Telecomm approved equal

C. Faceplates shall be labeled using machine printed "window inserts".

D. Outdoor cables must be labeled using outdoor rated 1" wide nylon labels with black lettering at each endpoint and in each manhole or pull box.

Approved Manufacturers: DYMO or Cal Poly ITS Telecomm approved equal

E. Inside and outside of all pull boxes, manholes, terminating cabinets, and telecommunications facilities shall: be labeled inside by using an appropriate stencil with black or white paint depending on background; be appropriate for the surface type; and utilize letters and numbers ranging in size from 2" to 6" high as approved by the Cal Poly ITS Telecomm group. Outside labeling shall conform to the Project Labeling Standards used for all other project labels.

Submit a Proposal for Approval to the Cal Poly ITS Telecomm group

F. All interior racks, cabinets and panels must be labeled using 1" white permanent material with black lettering. (See Fig. 147 in Appendix B)

Approved Manufacturers: DYMO Rhino or Cal Poly ITS Telecomm approved equal

Lighting

Fluorescent lighting shall be installed; a minimum equivalent of 500 lux (50 foot-candles) measured 1 m (3-feet) above the finished floor, at both the front and rear of the populated rack(s) and mounted above the rack(s), off-set from the rack centerline, to avoid shadowing.

Light switches shall be located for easy access upon entry.

Locate light fixtures a minimum of 9-feet above the finished floor. All light fixtures or lamps shall be caged or sleeved to provide shatter protection.

At least one light shall be on emergency power or battery backed-up.

Light ballasts shall not be installed within 1' of telecommunications cable, and the light fixture itself shall not be mounted within 5". *This is typically an issue around the telecom ladder and cable trays used to route telecom cable.*

A typical ER/TR shall include at least two 8' light fixture rows, placed parallel to the racks to illuminate the wall wiring as well as the front and rear of all equipment in the racks. (See Fig. 148 in Appendix B)

Location (EF)

The EF shall be nearest the point of entry for conduits entering a building from the underground.

Entrance cabling shall be terminated on a bearing wall (whenever possible) to reduce the possibility of having to relocate the termination space if the building is expanded or altered in the future.

Location (ER/TR)

Locate the TR/ER such that the majority of the cable runs are 150 feet long or less.

ERs/TRs shall be accessible from a hallway or other common public area. In multi-floor buildings the EFs/ERs/TRs shall be stacked vertically in a fire rated shaft.

If any of the CAT 6 cable runs will be longer than 290 feet, a second TR shall be built on the floor and located so that they can, in an evenly divided and balanced manner, *service each floor without exceeding the 290 foot limit*.

Telecommunications facilities shall be located such that infrastructure can enter the space from all four sides. Telecommunications facilities shall not be directly adjacent to elevator shafts, electrical or mechanical spaces, stairs, kitchens, or restroom facilities. Locations that are specifically unsatisfactory include those with sources of excessive electromagnetic interference, hydraulic equipment or other heavy machinery that causes vibration or voltage spikes.

Power

ERs/TRs shall be equipped with adequate electrical power: (See Fig. 149 in Appendix B)

Communications Equipment circuits (minimum):

A minimum of four dedicated, protected, non-switched 3-wire 120 volt, 20 amp, NEMA 20R double duplex electrical outlets, located as directed and approved by the ITS Telecomm group, on separate branch circuits shall be provided, along with one dedicated, protected, non-switched 4-wire 120/250 volt, 30 amp, NEMA L14-30R electrical outlet, in each telecommunications space not initially populated with equipment. *Provide a separate power panel in all communications facilities with planned equipment installations per the CSU, TIP Standards. All AC power outlets shall be identified and marked by use of machine generated labels, both on the faceplate and in the electrical breaker panel. (See Fig. 149 in Appendix B) Any TR/ER without its own power panel shall have a minimum of one 1¼" conduit installed (with pull rope) between that room and the power panel in the closest populated TR/ER.*

Convenience outlets (for tools, test sets, etc.)

Install duplex, protected 3-wire, 120 volt, 20 amp, NEMA 20R non-switched circuits, embedded and recessed in the plywood back panel mounted to each wall at standard outlet height AFF and placed at 6-ft intervals around the perimeter walls. Convenience outlets shall be identified and marked as such by machine generated labels, both on the faceplate and in the electrical breaker panel.

No conduit for electrical circuits shall be mounted on top of plywood backboards; it shall be routed around or behind the backboard (inside the wall).

Distribution Panels

Distribution panels that serve telecommunications rooms shall be dedicated for that purpose only and located in that room. (See Fig. 148 & 149 in Appendix B)

The electrical panel serving a telecommunications space shall be grounded to that facility's TMGB or TGB as well as directly to the main building electrical grounding busbar. *Electrical panels serving ERs/TRs shall be included in all generator power back-up schemes and shall be connected to emergency power via an auto transfer-switch.*

Safety

Telecommunications spaces shall be safely accessible to technicians, free of storage material or other obstructions that could block access to equipment and shall have an exposed "hard" ceiling at a standard working height of 9' AFF. ***The ER/TR/EF shall be free from moisture, severe temperature conditions, and/or possible submersion in case of flooding.***

Shared Use

Shared use of any telecommunications space and/or pathways with other building facilities shall not be allowed.

Telecommunications spaces shall be dedicated to the telecommunications function and their related support facilities, and shall not contain equipment unrelated to the support of the other systems such as piping, duct work, distribution of building power, HVAC, Building Management Systems, Access Controls, CCTV equipment and fire life safety systems. ***Non-telecommunications supporting materials shall not be located in, or pass through, the TR/ER/EF.***

The telecommunications space shall not be shared with building or custodial services as they may interfere with the telecommunications systems and the telecommunications spaces shall be keyed to prohibit general access.

Testing & Inspection

All installed equipment and/or materials, be they copper wire, coax, fiber optic cable, jacks, plugs, connectors, splices, cable tray, conduits, equipment racks, consolidations, taps, splitters, WAPs, phones, and **complete systems require Inspection and acceptance by an ITS Telecomm group representative**. After inspection of an item has been completed by the ITS Telecomm group representative, the Cal Poly Project Manager and/or Contractor shall be advised in writing as to the acceptability of the item(s) inspected. If approved, the Contractor shall proceed with testing the item and/or system in accordance with all the Standards listed or referred to as part of this document. In all cases, if testing requirements are not fully understood by the Contractor, it shall be the Contractor's responsibility to submit an RFI (Request for Information), through the proper channels, requesting additional information and clarification. If the Contractor does not make any requests, the ITS Telecomm group shall assume that the Contractor fully understands what test data is expected and the format and number of copies that constitutes full compliance.

Interior Communication Pathways

Ceiling Cable Pathways (cable trays, conduit, etc.)

Horizontal pathways shall follow building lines as much as possible. Horizontal cables shall feed from rooms/offices via individual conduits to a hallway or other common space where they shall transit to the cable tray and then proceed to the ER/TR. ***Structured Cabling and associated***

pathways shall be separated/protected from all water, waste, fire sprinklers, hung ceiling and other threats to the greatest extent possible.

Cable Hangers

No cable hangers (J-Hooks, Bridle Rings, Bat Wings, Etc.) shall be allowed. (Unless specifically designed for the cable type and quantity and approved by the Cal Poly ITS Telecomm group) If structured cable receives approval to be supported using hangers, the cable shall not touch hung ceiling cables and/or ceiling tiles.

Cable Tray

Cable tray shall be aluminum with solid corrugated flooring. Minimum width for cable tray is 18". Minimum load rating should be 100 lb./ft.

Approved Manufacturers: Cope Trof or Cal Poly ITS Telecomm group approved equal

Conduit

All conduits shall be home run back to a cable tray or the ER/TR.

All conduits shall be continuously bonded back to the TGBB in the ER/TR/EF. All conduit terminations shall be equipped with bushings or grounding bushings as necessary . *(See Fig. 141 in Appendix B)*

Horizontal cabling conduit runs shall not be installed below slab in any building. They may, however, be installed within the slab.

Cable Pull Force

The maximum allowable pulling force on a 4-pair (CAT 6) cable or bundle of cables is 25 lbs. *Over-filled conduit, long conduit runs and bends increase the pulling force required to pull the cable.*

Conduit Bends

There shall be no more than two 90-degree bends (or combination of bends equaling 180 degrees) between pull points or pull boxes.

For reverse bends (between 100 and 180 degree), Insert a pull box at each bend. The recommended 90-degree bend radius for conduit is 6 times the internal diameter of the conduit (10 times the internal diameter if conduit larger than 2 inches).

Conduit Fill (4 pair UTP, plenum rated)

Recommended conduit sizes are based CAT 6 Plenum cable which is approximately .26" in diameter.

Conduit Size	Sleeve Less than 2'	Straight Less than 100'	2x 90 Degree Bends Greater than 100'
3/4"	Not Allowed	Not Allowed	Not Allowed

1 1/4"	12	8	6
2"	30	20	14
4"	120	80	56

Conduit length

Conduit runs shall contain no continuous sections longer than 100 ft. without a pull box.

Firestopping

All firewall penetrations shall be adequate in number, metal sleeved and firestopped. ***When cable tray meets a penetrated wall, the number and size of the penetrations shall approximate the capacity of the tray feeding them.***

All conduits (empty, partly filled or full) terminating in a telecommunications space shall be firestopped or sealed. *(See Fig. #136 & #137 in Appendix B)*

Pull Boxes

Pull boxes shall not be used in lieu of a 90 degree bend, and conduits shall be aligned (whenever possible) such that pulls are straight through with no jogs.

Pull boxes shall be located such that conduit runs do not exceed 100 feet. Minimum size for pull boxes; length shall be 8x diameter of the largest entering conduit; width shall be 4x the diameter of the largest entering conduit.

Walls

All conduits shall be placed within the interior of a wall.

Ladder Racking

Ladder racking shall be made of 3/8" x 1- 1/2 " x .065" wall rectangular steel tubing with cross members welded at 12" intervals. Minimum width required shall be 18". Finish shall be grey powder coated. Ladder racking shall only be used within telecommunications spaces.

Approved Manufacturers: Chatsworth Universal Cable Runway or Cal Poly ITS Telecomm group approved equal

Faceplates (sometimes called outlets)

Each work area (electrical, mechanical janitorial, etc.) shall be provided with a minimum of one faceplate location with a minimum of three CAT 6 station cables. (See Fig. #108 & 113 in Appendix B)

In-Wall Mounted Faceplates

The "standard" wall faceplate shall consist of a 4 11/16 inch square back box, 2 ¼ inch deep, equipped with a single gang mud ring. Each faceplate shall be served by a dedicated 1¼-inch conduit (minimum) with no more than a total of 180 degrees of bend between boxes.

Telecommunications faceplate back boxes shall never be daisy-chained or mounted back-to-back using a common feeder conduit. (See Fig. #158 in Appendix B)

Floor Mounted Modular Jacks

If flush-mounted floor boxes are required, the designer shall place a dual use (signal & power) preset floor box in the floor surface and feed the conduits (1¼" for signal only) through the floor slab to the nearest wall and immediately into a pull box before continuing to a cable tray or telecommunications space. Flush- mount units shall provide a space for telecommunications connections comparable to the standard NEMA back box.

Approved Manufacturer: TBD (submittal required to Cal Poly ITS Telecomm group)

If a large number of such modular jacks are required, cast-in-place floor boxes with feeder duct shall be used. They shall be served by multiple two-inch conduits back to an ER/TR or cable tray.

Approved Manufacturer: TBD (submittal to Cal Poly ITS Telecomm group required)

Single Surface Mount Faceplate

When a single surface mount faceplate is specified, it shall be a steel raceway 7/8" x 1 29/32". Back boxes should be 2¾" deep, and all surface mount pathways shall have fiber rated fittings.

Approved Manufacturers: Wiremold 2400 Series or Cal Poly ITS Telecomm approved equal

Multiple Surface Mount Modular Jacks

In some laboratories, work areas, and/or counter spaces, wall-mounted Wiremold may be utilized to distribute power and signal to a variety of user locations. This raceway shall be metal, grounded, and at a minimum be 4.75" wide by 3.56" high. The communications portion of the raceway shall be fitted with standard single gang knockouts for mounting the communications jacks. The designer shall provide for multiple access points into the raceway, and *place a minimum of two 1¼" feeder conduits into every eight feet of raceway section.*

All surface mount pathways shall use fiber rated fittings.

Approved Manufacturers: Wiremold 4000 Series or Cal Poly ITS Telecomm group approved equal.

Distributed Power Outlets for Rack Mounted Equipment

In populated TRs/ERs with multiple racks that will house active equipment requiring 120 volt AC power, mount conduit and outlet boxes across the top, front of the rack. Provide double duplex boxes between each rack, each containing 2 – 20 amp dedicated circuits, mounted in such a way as to not block any product or equipment functionality.

Exterior Communication Pathways

Underground Conduit

All ducts and conduits shall be installed with a minimum pitch of 4" per 100 ft. and shall drain away from the building towards manholes.

Only manufactured elbows shall be used for stub ups at building entrances or equipment. Manufactured long sweep bends with a minimum radius of 6 feet both vertically and horizontally shall be used at all other locations

All conduits need to be sealed at their endpoints and at any other open points underground. (See Fig. 136, 137 & 138 in Appendix B)

Entrance Conduit, Size and Number for UTP Copper

Underground entrance conduits size and quantity requirements based on the number of telephone pairs to the building.

Telephone Entrance Pairs	Required Size & Number
1-300	Three 4" Conduits (1 is spare)
301-600	Four 4" Conduits (1 is spare)

Entrance Conduit, Size and Number for Fiber

Underground entrance conduits size and quantity requirements based on the number of telephone pairs to the building.

Fiber Optic Cable Size	Required Size and Number
6 SM or 6 MM	One 4" Conduit w/ 4x 1 1/4" Innerduct
48 SM or 48 MM	One 4" Conduit w/ 4x 1 1/4" Innerduct
96 SM or 96 MM	Two 4" Conduits w/ 4x 1 1/4" Innerduct

Entrance Conduit for Telecom Ground

All underground entrance conduits shall be accompanied by a common ground system.

This ground shall be bare 2/0 copper conductor in a dedicated 1-¼" conduit. The ground shall attach to the TMGB in the ER, and connect to the reinforcing bar of the duct bank and, to the existing grounding infrastructure in the vault system.

Pull Cord/Tape

Install pull cord/tape in all conduit runs. When pulling cable in conduit a pull cord shall be installed with the cable so additional cable can be installed later if necessary. ***(see Fig. 138 in Appendix B)***

Innerduct

For one 4" conduit provide four 1-1/4" Corrugated HDPE innerduct in the designated fiber conduit only (1 - 4" conduit per duct bank). Each of the four 1-¼" innerduct runs shall be a different color, pulled at one time and include pull tape in each.

Approved Manufacturers: Endot Endocor1050 Series or Cal Poly ITS Telecomm group approved equal

For fiber optic carrying conduits between 2" and 4" provide innerduct specific to that size conduit, always providing a minimum of three runs in different colors.

Approved Manufacturers: Endot Endocor1050 Series or Cal Poly ITS Telecomm group approved equal

Manholes

Only precast interlocking mating sections complete with cover shall be used. Cast in openings shall be included for known requirements. Knockouts to equal 25% spare capacity shall be provided.

Manhole cover shall be labeled "COMMUNICATIONS"

Approved Manufacturers: Jensen Precast Product or Cal Poly ITS Telecomm group approved equal

Pull Boxes

Pull boxes rather than manholes may be used only when the maximum number of conduits in that run is never expected to exceed 2- 4" conduits.

Pull box covers shall be labeled "COMMUNICATIONS"

Approved Manufacturers: Jensen Precast Product or Cal Poly ITS Telecomm group approved equal

Hand Holes

Hand holes shall be used only when the maximum number of conduits in that run is never expected to exceed a single 2" conduit. Hand holes shall only be used to serve isolated endpoints, and shall never be used for backbone cabling.

Hand hole covers shall be labeled "COMMUNICATIONS"

Approved Manufacturers: Jensen Precast Product with a Lid or Cal Poly ITS Telecomm group approved equal

Interbuilding Backbone Cabling

Application: *Outside plant cable shall be pulled in conduit for runs between buildings. (See Fig. 136 in Appendix B)*

Fiber Backbone

Install one OSP, gel filled, dielectric, loose tube, 96 Strand Single-Mode and one 96 Strand 50µ Laser Optimized Multi-Mode fiber from the nearest Main Campus ER/MCER Facility to the ER or MPER in the building or project.

Terminate the 50µm OM4 fiber inside fiber termination bays using duplex LC connectors.

Terminate the single mode fiber inside fiber termination bays using duplex SC connectors.

Mount fiber bay in top position in the 19" rack. *(See Fig. 103 & 145 in Appendix B)*

Approved Manufacturers: Commscope, Corning, or Cal Poly ITS-Telecomm group approved equal

Service Loops

Service loops shall be provided for all copper and fiber runs for the purpose of possible relocation or for splicing if necessary. A minimum cable service loop of 30 feet shall be required at each end of a cable. Fiber cable slack shall be coiled and mounted to backboard and copper cable slack routed around the room using ladder racking. Inside all pull boxes and manholes the slack loop should be "once around the walls of the manhole/box" before exiting.

Copper Backbone

Copper tie cables shall be installed from the nearest campus MCER to the MPER in a multi-building project or ER of an individual building.

Cables shall specifically be gel filled, ALPETH sheathed with aluminum shield, 22 gauge, multi-pair in multiples of 25 pair.

Approved Manufacturers: Superior Essex Sealpic or Cal Poly ITS Telecomm group approved equal

Building Entrance Protector Panel

Building entrance protector panels shall be 489A type, 100 pair with input pig tail and 66 block style output.

Approved Manufacturers: Commscope or Cal Poly ITS Telecomm group approved equal

Building Entrance Protectors

Building entrance protectors shall be gas discharge type with heat coils and gold plated connectors, type 4B1EW.

Intrabuilding Backbone Cabling

Fiber Riser

One riser rated, 24 Strand Single-Mode and one 24 Strand 50μ Laser Optimized Multi-Mode fiber shall be installed from the ER to all other TR spaces in the building.

Terminate the OM4, 50μm multi-mode fiber inside fiber termination bays using duplex LC connectors.

Terminate the single-mode fiber inside fiber termination bays using duplex SC connectors. Mount fiber bay in top position in the 19" rack. *(See the Cal Poly ITS Labeling, Design & Syntax Standard)*

Approved Manufacturers: Commscope, Corning or Cal Poly ITS Telecomm group approved equal

Fiber Service Loop

All fiber runs shall require a service loop so that they can be relocated or spliced in the future if necessary. A minimum of 30 feet of cable, forming the service loop, shall be provided at each end of a fiber riser cable. Fiber cable slack shall be coiled and mounted to backboard or routed around the ER/TR using ladder racking. *(See Fig. 139 in Appendix B)*

Copper Riser

Copper riser cables shall be installed from the ER to all other telecommunications spaces in the building.

Cables shall be ARMM, aluminum shielded, 22 gauge, multi-pair cables in multiples of 25 pair.

Approved Manufacturers: Superior Essex, General Cable or Cal Poly ITS Telecomm group approved equal

Copper Service Loop

All copper runs shall require a service loop so that they can be relocated or spliced in the future if necessary. The service loop shall consist of one lap around the telecomm room in the ladder racking or coiled and mounted to all walls. Any deviation from this standard must be approved in writing by the Cal Poly ITS Telecomm group. *(See Fig. 134 in Appendix B)*

Horizontal Cabling

Each horizontal cable run shall be continuous, between the telecommunications space and the station faceplates, without any joints or splices. In areas where temporary or modular office systems are used, horizontal cabling can be installed using a MUTOA (multi-user telecommunications outlet assembly) or CP (consolidation point).

Cable Types

Horizontal UTP Station Cable

All UTP Station Cable shall be white (or project specific color coded) CAT 6, and Plenum Rated.

Approved Manufacturers: Commscope Systimax or Cal Poly ITS Telecomm group approved equal

Horizontal Station Coaxial Cable

Cable shall be white (or project specific color coded) RG 6QS, Plenum Rated, Quad Shielded cable.

Approved Manufacturers: Commscope Systimax or Cal Poly ITS Telecomm group approved equal

Horizontal Multi-Mode Station Fiber

Cable shall be plenum rated, OFNP/FT6, laser optimized, 50µm, OM4 multi-mode, strippable jacket and include either a central strength member or high tensile strength yarn for mechanical protection.

Jacket color shall be **aqua** for all applications

Approved Manufacturers: Commscope Systimax or Cal Poly ITS Telecomm group approved equal

Horizontal Copper UTP OSP Station Cable

Cable shall be Category 6 UTP Cable, outdoor, flooded gel, black jacket, 4 pair count.

Approved Manufacturers: Commscope Systimax or Cal Poly ITS Telecomm group approved equal

Horizontal Fiber OSP Station Cable

Cable shall be 6 strand, laser optimized, 50µm, OM4 multimode, Single Jacket, All-Dielectric Outdoor Cable, Arid-Core Construction, Stranded and Loose Tube

Approved Manufacturers: Commscope Systimax or Cal Poly ITS Telecomm group approved equal

Copper Cable Length

The cabling between, including the horizontal cross-connect (in the ER/TR) and the interconnect cable going to the voice/data/video equipment/patch panels, shall not to exceed 290 feet in length. This includes not only the horizontal distance between the ER/TR and associated work area, but also the service loop, routing of the cable along the walls, inside the pathways, and vertical distances (up the wall inside conduit, etc.).

Horizontal UTP Cables

Copper horizontal cables are not to exceed 290 feet in length from the patch-bay termination in the telecommunications space to the faceplate on the wall and ***shall always remain a minimum of 12" from any surface in excess of 104 F degrees.***

Multi-User Telecommunications Outlet Assembly (MUTOA)

If a MUTOA is used, the combined length of the horizontal cable between the TR and the MUTOA and the patch cord between the MUTOA to the user workstation shall not exceed 290 feet.

User Space Fiber Cable

Provide a minimum 36 inch service loop for stripped fiber at work area locations. Provide a minimum 10 foot long fiber loop for sheathed fiber that shall be located in the telecommunications room on the backboard, or on the ladder racking in a lap around the room. ***(See Fig. #139 in Appendix B)***

Station Faceplates & Jacks (Copper)

Faceplates and jacks shall be ivory or white in color and coordinated with finished color of electrical outlets. Faceplates shall be flush mount with windowed insets and clear covers to protect the labels.

Blank module inserts shall be installed in all unused module locations.

Approved Manufacturer: AMP, Inc. or Cal Poly ITS Telecomm group approved equal

Telecommunications Space Cable Termination

Telecommunications space shall provide adequate 19" equipment racking to house the necessary number of 48 port CAT 6 patch panels, to ***terminate/land the cables in the racks to the EIA/TIA <u>568A</u> Wiring Standard.***

Approved Manufacturer: AMP, Inc. or Cal Poly ITS Telecomm group approved equal

Entrance protectors for Horizontal Copper UTP OSP Station Cable

A single cable entrance protector module shall be provided for each OSP cable end that extends beyond the drip line of the building.

Approved Manufacturers for data: Commscope Systimax or Cal Poly ITS Telecomm group approved equal

Approved Manufacturers for voice: Commscope Systimax or Cal Poly ITS Telecomm group approved equal

Specific End Device/Location Requirements (IP Based Ethernet Only)

All spaces within a building (including support areas, electrical rooms, mechanical rooms, etc.) shall contain at minimum one standard faceplate location (with three cables/jacks). The following areas contain specific scenarios, rooms or systems that require additional/alternate style connectivity.

Access Control Box (Key Box) (IP based only)

A single 1¼" conduit, homerun directly to a telecommunications space or cable tray shall be provided to each Access Control Box. At minimum a single CAT 6 cable/jack shall be provided in this pathway.

Building Automation System Control Station (BMS/EMS) (IP based only)

A single 1¼" conduit, homerun directly to a telecommunications space or cable tray shall be provided to each Building Automation Control Box. At minimum a single CAT 6 cable/jack shall be provided in this pathway.

Building Generator (IP based only)

A single 1 ¼" conduit per building, homerun directly to a telecommunications space shall be provided for building backup generators. At minimum a single CAT 6 cable/jack shall be provided in this pathway.

Card Access Control Panel (Card Swipe) (IP based only)

A single 1¼" conduit, homerun directly to a telecommunications space or cable tray shall be provided to each Card Access Control Panel. At minimum a single CAT 6 cable/jack shall be provided in this pathway.

Electrical Room (not for direct connection of electrical equipment)

A minimum of a single 1 ¼" conduit, homerun directly to a telecommunications space or cable tray shall be provided to each electrical room. At minimum a three CAT 6 cable/jack faceplate shall be provided in this pathway.

Elevator Control Room (IP based only)

A minimum of a single 1 ¼" conduit, homerun directly to a telecommunications space or cable tray shall be provided to each elevator control room. At minimum a three CAT 6 cable/jack faceplate shall be provided in this pathway.

Emergency Telephones

Emergency telephones require a minimum of one 1¼" conduit homerun directly to a telecommunications space or cable tray. At minimum a single CAT6 cable shall be provided in this pathway. CAT 6 cable will punch down on 66 blocks. Emergency telephones shall also be provided with a dedicated 120v circuit.

All emergency phone housings shall be "safety blue" in color with white lettering "EMERGENCY". ***Placement of all emergency phones is to be coordinated with University Police.***

Wall Mount Emergency Telephone

Approved Manufacturer/Product: Talk-A-Phone Model ETP-WM w/ ETP-400V or Cal Poly ITS Telecomm group approved equal

Standalone Tower Emergency Telephone

Approved Manufacturer/Product: Talk-A-Phone Model ETP-MT/R w/ ETP-400V or Cal Poly ITS Telecomm group approved equal

Fire Alarm Control Panel

A single 1¼" conduit, homerun directly to a telecommunications space is required to a building's main Fire Alarm Control Panel. Two (2) CAT 6 (non-Ethernet) cables/jacks shall be provided in this pathway, specific details to be provided during the project. (SOME PANELS MAY REQUIRE FIBER OPTIC CABLE AS PHONE LINES, NOT CAT 6)

Gate Controller (IP based only)

A single 1¼" conduit, homerun directly to a telecommunications space or cable tray is required to a building's exterior gate controller. Each gate location must have its own dedicated conduit. At minimum a single CAT 6 cable/jack shall be provided in this pathway.

HVAC Systems

HVAC Control Panel (IP based only)

A single 1¼" conduit, homerun directly to a telecommunications space or cable tray is required to a building's HVAC Control Panel. At minimum a three CAT 6 cable/jack faceplate shall be provided in this pathway.

HVAC Devices (IP based only)

A single 1 ¼" conduit, homerun directly to a telecommunications space or cable tray is required to each networkable component in a building's HVAC System. At minimum a single CAT 6 cable/jack shall be provided in this pathway.

Intrusion Alarm Control Panel (IP based only)

A single 1¼" conduit, homerun directly to a telecommunications space or cable tray is required to a building's main Intrusion Alarm Control Panel. At minimum a three CAT 6 cable/jack faceplate shall be provided in this pathway.

Irrigation Control Panel (IP based only)

A single 1¼" conduit, homerun directly to a telecommunications space or cable tray is required to a building's Irrigation Control Panel. At minimum a single CAT 6 cable/jack shall be provided in this pathway.

Parking Permit Dispenser (IP based only)

A single 1¼" conduit, homerun directly to a telecommunications space or cable tray is required to any parking ticket dispensers. At minimum a single CAT 6 cable/jack shall be provided in this pathway.

Safety Cameras

Indoor Camera Locations (IP based only)

A single 1 ¼" conduit, homerun directly to a telecommunications space or cable tray is required for each safety camera location. Each location shall have a 2 gang, 4 11/16" deep box terminating the conduit. At minimum a single CAT 6 cable/jack shall be provided in this pathway and terminated in the box. A patch cable will extend to the camera.

Outdoor Camera Locations (IP based only)

A single 1 ¼" conduit, homerun directly to a telecommunications space or cable tray is required for each IP based safety camera location. Each location shall have a 4 11/16" deep, 4 gang box on the inside of the building terminating the conduit, and then a separate conduit connecting through the wall to the camera. At minimum a single CAT 6 cable/jack shall be provided in this pathway and terminated in the box. A patch cable will extend to the camera.

Wireless Access Points

A single 1 ¼"conduit, homerun directly to a telecommunications space or cable tray is required for each wireless access point location. ***At minimum, two (2) CAT 6 cables/jacks shall be provided at each location***. Connection methodology of wireless access points (WAP) to the campus IT infrastructure can vary based on location and other circumstances. A detailed drawing/plan indicating the specific location of each WAP shall be submitted to the Cal poly ITS Telecomm group for approval prior to purchasing or installing any WAP.

Any IP Based Controller

A single 1 ¼" conduit, homerun directly to a telecommunications space or cable tray is required for each IP based controller. At each location a standard 3-port faceplate shall be installed. Connection methodology of each controller shall be as shown in the Cal Poly ITS Telecomm Labeling, Design and Syntax Standards in Appendix B. The Cal Poly ITS Telecomm group shall approve the drawing showing each installation of an IP based controller prior to purchasing or installing any equipment.

Codes & Standards – Specific References

Design, manufacture, test, and install telecommunications cabling networks per manufacturer's SCS requirements and in accordance with NFPA-70 (National Electrical Code®), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following standards:

- ANSI/TIA/EIA-526   Standard Test Procedures For Fiber Optic Systems
- ANSI/TIA/EIA-568-C   Standard for Installing Commercial Building Telecommunications Cabling
- ANSI/TIA/EIA-569-B   Commercial Building Standards for Telecommunications Pathways and Spaces
- ANSI/TIA/EIA-570-B   Residential and Light Commercial Telecommunications Wiring Standard
- ANSI/TIA/EIA-598-C   Optical Fiber Cable Color Coding
- ANSI/TIA/EIA-604   Fiber Optic Connector Intermateability Standard
- ANSI/TIA/EIA-606-A   The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- ANSI/TIA/EIA-607-A   Commercial Building Grounding and Bonding Requirements for Telecommunications
- ANSI/TIA/EIA-758-A   Customer-owned Outside Plant Telecommunications Cabling Standard
- ANSI/TIA/EIA-854   Full Duplex Ethernet Specification for 1000Mbis/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling
- ANSI/TIA/EIA-862   Building Automation Cabling Standard for Commercial Buildings
- NFPA 70   National Electrical Code – 2010
- NFPA 72   National Fire Alarm & Signaling Code - 2010
- ANSI/IEEE C2   IEEE's National Electrical Safety Code
- CEC 2010   California Electrical Code (Title 24, Part3) - 2010
- *CSU TIP STANDARDS*   California State University's Telecommunications Standards Infrastructure Planning Standards (3rd Edition) – May 2007

Codes & Standards - Organizations

- ADA   Americans with Disabilities Act
- ANSI   American National Standards Institute
- ASCII   American Standard Code for Information Interchange
- ASTM   American Society for Testing Materials
- BICSI   Telecommunications Distribution Methods Manual 11th Edition
- CEC   California Electrical Code
- ISO   International Standards Organization
- IEC   International Electrotechnical Commission
- UL   Underwriters Laboratories Cable Certification and
-     Follow Up Program, UL Testing Bulletin
- NEMA   National Electrical Manufacturers Association
- IEEE   Institute of Electrical and Electronic Engineers
- TSD   *Cal Poly ITS Telecomm group - Telecommunications Standard Document*
- NFPA   National Fire Protection Association
- ASIS   American Society for Industrial Security
- Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached

If the contractor should note items on the drawings or the specifications, construction of which would be a code violation, they shall be promptly brought to the attention of the owner's representative in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the most restrictive specifications shall apply.

Warranty

Guarantee in writing the Structured Cabling System (SCS) (materials, equipment, and workmanship) for a period of not less than fifteen (15) years from date of acceptance by the owner.

Complete documentation and a copy of the manufacturer's warranty shall be submitted as part of the proposal. This shall include, but is not limited to: a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.

A systems application assurance manual documenting the vendor supported applications and application guidelines shall be provided as part of the submittals.

Field Quality Control

Employ a job superintendent and a project manager during the course of the installation to provide coordination of work of this specification and of other trades, and provide technical information when requested by other trades. These persons shall have substantial IT/Telecomm/CATV infrastructure installation experience and shall be responsible for quality control during installation, equipment set-up, and testing and provide the Cal Poly ITS Telecomm group with AS-BUILT drawings at project conclusion.

DOCUMENT REVISION CONTROL

DATE	AUTHOR	REASON
02/20/2013	R. Volk	DOCUMENT DEVELOPMENT – Revision 0
02/20/2013	DW & MH	DOCUMENT REVIEW