UCONN
UNIVERSITY OF CONNECTICUT

# Telecommunications Design Guidelines and Performance Standards

**University Planning, Design and Construction**
**and Information Technology Services**

**Established Date: May 2015**

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# 1 Introduction

Information Technology Services (ITS) is the service provider for all voice, data, and TV at the University. The Designer shall adhere to all standards outlined, unless otherwise directed by the University Representative in conjunction with ITS. All telecommunication designs and installations for the University shall be a complete Structured Cabling System, tested for error free delivery of voice, data, wireless and TV services to the end user; consistent with the guidelines and performance standards as set forth in this document.

The Designer shall incorporate existing systems to ensure a seamless co-existence of newly installed and existing systems. Only certified personnel shall perform all such designs, required certifications are identified farther into this document.

These Standards are a living set of documents. As such, the criteria contained within are subject to updates due to technological advances within the telecommunications industry. The Designer is responsible to adhere to the most current University Design Standards including all appendixes.

# 2 General Requirements

## 2.1 Purpose

The purpose of this document is to provide the Designer general information necessary for the proper design and constructability of a Telecommunication's Structured Cabling System at the University.
A properly designed and constructed Structured Cabling System, based on industry and University standards, will provide a flexible, efficient, long-lasting, and cost-effective transportation solution for our present and future communication needs.
The implementation of these Telecommunications Standards will ensure a flexible, uniform telecommunications environment that will allow for the growth of high speed, high bandwidth communication services required by the specialized applications used in a higher education environment.

## 2.2 Certification Requirements

It is required that the Designer have a sub-consultant who is fully trained and experienced in Telecommunications design and have full understanding of current trends and practices within the Telecommunications Industry. When the design involves Data Centers, Server Rooms or Outside Plant Cabling the Designer shall be trained and demonstrate an understanding of those specific systems. The designer shall also have a current BISCI RCDD, CT TLT, or CNet CNIDP Certification.

All telecommunication shall comply with all Connecticut building codes and follow the Telecommunication's Industry standards and best practices as defined and/or interpreted by the following agencies and organizations:

- The American National Standards Institute (ANSI)
- The Institute of Electrical and Electronic Engineers (IEEE)
- The Telecommunications Industry Association (TIA)
- Building Industry Consulting Services International (BICSI)
- Telcordia

All codes, industry standard practices, and the University specific requirements shall be adhered to. Should there be conflict between University requirements and code or industry standard, the higher quality and/or requirements that are more stringent shall take precedence.

The Designer shall include as a condition to prequalifying and approving submittals of the structured cable contractor, the following:

- Copies of the structured cable (inside and outside plant cabling) installer's certifications (minimum 3), endorsed by the approved connectivity manufacturer. This is required to register the project under the extended warranty program.
- Copies of the certifications held by technicians and supervisors who will be assigned to perform the installations that have received specialized training in installing Structured Cabling Systems by a vendor-neutral organization such as BICSI or CNet.

## 2.3 Definitions

In addition to the definitions described within the University's Design Guidelines & Performance Standards, below are definitions specific to this document.

**DATA** – Equipment and services associated with connectivity to the local and wide area networks and the internet.

**EF –** Entrance Facility

**Emergency Services** – Fire or Security Alarms

**ER –** Equipment Room

**ETP-MTE-ECO** - Emergency Telephone

**ITS-PIP –** University's Information Technologies Services – Physical Infrastructure and Planning

**MAC** –Moves, Additions, and Changes post-construction cabling.

**OEM –** Original Equipment Manufacturer

**OSP -** Outside Plant Cabling

**TELECOMMUNICATIONS** – Term used to describe voice, data, and TV services and the infrastructure to deliver them.

**TR –** Telecommunications Rooms

**TV** – Equipment and services associated with the delivery of HUSKYvision broadband cable television solutions.

**UPDC –** University Planning Design and Construction

**UTP** – Unshielded Twisted Pair

**VOICE** – Equipment and services associated with the delivery of analog, digital, IP, or wireless telephony

**WAO** –Work Area Outlet. The Telecommunication outlet located at the end user's work area or point of service utilization.

**WAP** – Wireless Access Point

# 3 Scope and Deliverables

Close and careful coordination between the Designer and ITS is required to assure the proper design of the Telecommunication pathways and spaces. Project size does not dictate compliance with this requirement. Comply with Appendix II Electronic Document Submission for design review submission for telecommunications and other standards.

The Designer shall provide a design for a complete and functional Telecommunication Structured Cabling System; include equipment, materials, labor, tools and installation services. System components include, but are not limited to:

- Outside Plant pathway infrastructure
- Raceways, boxes, cable tray, and cable supports
- Wall and floor penetrations and sleeves
- Fire-stopping
- Inside and outside plant cabling
- Line protection
- Splice enclosures
- Balanced twisted-pair cabling, terminations, and splicing
- Optical fiber cabling, terminations, and splicing
- Coaxial cabling, terminations, and splicing
- Work area communication outlets
- Consolidation points
- Cross-connect systems (wiring blocks, patch panels)
- Equipment racks, frames, and cabinets
- Wireless Access Point Enclosures
- Grounding and bonding
- Cable management
- Testing and labeling
- Pre-construction submittals
- As-built Record Documents – incorporate the Contractor's as-built documentation into the record documents a format outlined within these standards and provide them as a separate attachment document when turning over the record and as-built documentation.
- Existing cabling that is being affected by the design, shall not be reused and shall be required to be removed in its entirety back to the IDF or MDF. Abandonment is not acceptable

The University is its own Telecommunication Service Provider, ITS will provide the following:

- All design and installation of the transportation media (i.e. copper, fiber, wireless) necessary to deliver telecommunication services to a demarcation point established at the building's Entrance Facility (EF). However, the pathways for the media (i.e. underground conduits, manholes, pole lines, masts) shall be included in the project's scope, budget, and their designs as part of the Designer's scope of work.
- All telephone sets, equipment (i.e. NT1 cards, power supplies), and cross-connects to deliver voice services to the end user.
- All network equipment (i.e. routers, switches, wireless access points) to deliver network

services to the end user.

- All fiber receivers, amplifiers, taps, splitters, and cross-connects to deliver TV services to the end user.
- The non-reoccurring installation and equipment costs associated with delivering these ITS services shall be borne by the project or requesting department. Coordinate information with ITS to estimate their values.

### 3.1 Project Management

Projects managed by ITS, Designer shall include in the specifications that the telecommunication's trade contractor provide a schedule of events in the form of a Gantt chart that graphically identifies task durations and dependencies and a Network Diagram that identifies the project's critical path. The trade contractor shall also be responsible for providing progress updates.

Projects managed under the Capital Projects Program under UPDC, schedule requirements are defined in the Division One of the specifications.

The Designer shall include the following requirements in the specifications:

- 6 weeks prior to move in ALL TR's including the MDF shall be fully assembled cleaned and dust free. This includes permanent power, permanent cooling, a permanent lockable door, racks/wire management all cable terminations and labeling. This time is required for equipment burn in, programing, testing and to bring building systems on to the UConn Network.
- 6 weeks prior to move in the installer shall provide a cut sheet in excel format with the following cable information: Floor, Station Room Number, Jack Number, MAC Addresses, TR Number and Jack Description (Voice, Data, CAM, WAP, BMS, Meter, Elevator, AOR/emergency phone). This is required so we can build our databases, assign phone numbers and create host reservations.

## 4 Design Requirements

All Design documents shall be in accordance with the contract requirements, University's Design Standards and the latest edition of the BICSI Telecommunications Distribution Methods Manual (TDMM).

### 4.1 Entrance Facility

For the purposes of this document, the Entrance Facility (EF) is the area within the ER where the service lateral conduits terminate. Refer to University Design Standards Volume 1 for details on Telecommunications Duct Banks.

Provide a minimum of two (2) trade size 4" conduits from the nearest University telecommunications vault to the building's main Equipment Room. Where the purpose of the building, either in whole or in part, is to serve the telecommunications needs of other buildings (i.e. SLC site, Network Distribution Layer Node, Wiring Center, etc.) provide a minimum of six (6) trade size 4" conduits. When the EF is below grade provide a drain in the telecomm vault directly connected to the building.

For line-protection and splicing of copper cable(s), provide on the wall two 4' X 8' X ¾" fire-retardant

plywood sheets adjacent to the Entrance Facility conduits.

For terminations and splicing of optical fiber cable(s), provide one two-post Equipment Rack.

## 4.2 Telecommunications Spaces

Telecommunication Spaces (ER, TR) shall be directly accessible from main corridors; technicians shall not have to pass through other spaces, such as offices or mechanical rooms, to access Telecommunication Spaces.

### 4.2.1 Function of the Space

The rooms shall be rectangular in shape; all corners are at right angles and opposing walls parallel to each other. The doors shall have locks and keyed to ITS specified keys for Telecommunication Spaces. The rooms shall be clearly labeled as a Telecommunications Space on the exterior of the door. If the building has a card access system, all TR's shall have electronic access control.

Provide enough space for all equipment located within the TRs and offer a safe working environment for technicians. Code and standards establish minimum working clearances, but considerations shall be given to the layout and additional space that allows a technician with a tool belt to work safely around active equipment without having to step around or over cords, cables and equipment.

Designer shall include ¾" fire-retardant plywood backboard on all telecommunication space walls that do not have doors. 4' by 8' sheets should be specified with the long side vertical and mounted with the bottom of the sheet 6" from the floor.

### 4.2.2 Environmental Needs

The Designer shall include a solution for the room's environmental needs for conditioned air and heat to maintain temperatures and humidity levels within the recommended limits of the telecommunication equipment manufacturers, as well as the ventilation of any accumulated fumes and gasses. Heating and cooling to the rooms shall be available 24x7x365. Monitoring of the environment within the space shall be included through the building automation system, reporting to Facilities Operations.

As buildings become "smarter", more and more services are becoming dependent on the local area network for their communication needs. As a result, it has become a critical function of the University to keep the network running on a 24/7 basis. Power availability, quality and in some cases back-up power systems are significant components to make the network access operation reliable. The University has built the network core and fiber backbone for high availability.

With new construction or major renovations where TRs contain a significant volume of data equipment (i.e. Data Center, Server Farm, Network Distribution Layer Node, etc.) or service a large portion of the building needs, these rooms shall be designed to include a pre-action and/or clean agent fire suppression system.

### 4.2.3 Uninterrupted Power

Prior to designing for uninterrupted power, the design team shall consult with public safety, facilities, ITS and the building management to determine what network / telecommunication

services fall into the “EMERGENCY SERVICES” category. If it is determined the TRs will support “EMERGENCY SERVICES”, the Designer should include back-up power with an Uninterruptable Power Source (UPS) in the design. The UPS shall only be in place to bridge the gap of Emergency Power coming online. The design of the UPS shall include centralized monitoring compatible with existing University systems. Integration shall be included with system start-up. Provide branch circuits for telecommunications equipment as noted below. In addition, provide at least one 120VAC 20A outlet in each room from normal building power for maintenance operations.

#### 4.2.4 Equipment Needs

Provide equipment racks in quantities and types as described. Racks shall be of a high strength extruded aluminum construction with a black powder-coat finish; standard TIA 19” design with #12-24 threaded holes spaced according to the EIA-310-D Universal Hole pattern on both the front and rear of the rails. The rails shall be labeled along the front to identify the Rack Mount Unit (RMU, 1.75”) spaces. Racks shall be 7-foot tall providing 45-RMU of mounting space. Provide cable management troughs with rounded “waterfall” edges at the top of each rack. The racks shall be securely fastened to the floor and to the ladder racking above. Mount racks side-by-side in continuous row with 10” wide vertical cable management in between each pairing of racks and 6” wide vertical cable management at the outside of the row. Vertical cable managers shall be double-sided, 7 foot tall with deep “T” shaped rigid cable guides spaced at 1-RMU increments. They shall have hinged covers that open to the left or right by a single control action (i.e. Chatsworth Products, Inc. EVOLUTIONTM series or approved equal). Provide double sided vertical cable managers with two-post racks and single-sided with four-post racks.

### 4.3 Equipment Room (ER)

The purpose of the ER is to serve as the building distributor for Telecommunication services. It shall be located as close as practicable to the main electrical service. Located within the ER shall be the EF; the TMGB; terminations for all Telecommunication Backbones; Telecommunications Equipment that serve the building (i.e. ISDN NT1’s, telephone power supplies, routers, switches, servers, broadband amplifiers, etc.). Where the size of the building is such that it only requires one Telecommunications space, the ER may also serve as the TR.

#### 4.3.1 Equipment Needs

Provide overhead ladder racking around the perimeter of the ER and over each Equipment Rack. This ladder rack shall be sized to accommodate the orderly distribution of cable within the room, but shall not be less than 12” wide. Install the ladder rack approximately 7’-6” AFF. Provide “waterfall” cable guides over each vertical cable manager and vertical cable route to protect the cables’ bend radius.

Locate the UTP copper and P-III coaxial backbone terminations on a ¾” plywood backboard near the OSP line-protection.

For terminations and splicing of the building backbone optical fiber cable(s):

- Provide one (1), two-post Equipment Rack, location shall be adjacent to the EF rack.
- Provide two (2) 120VAC 20A branch circuits with two NEMA 5-20R duplex receptacles each from the Telecommunications power supply, one circuit at the plywood backboard and the other at the equipment rack.

## 4.4 Telecommunications Rooms (TR)

The purpose of the TR is to serve as an area or floor distributor for Telecommunication services; it shall be located near the center of the area/floor served. In a multi-story building, the TR's should be located as to stack one directly above the other. 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. Located within the TR shall be the termination fields for the Permanent Links and backbone cables, the TGB, active and passive equipment racks, and the Telecommunications equipment to serve the area.

### 4.4.1 Equipment Needs

Provide overhead ladder racking around the perimeter of the TR and over each Equipment Rack. This ladder rack shall be sized to accommodate the orderly distribution of cable within the room, but shall not be less than 12" wide. Install the ladder rack approximately 7'-6" AFF. Provide "waterfall" cable radius bend protection over each vertical cable manager and vertical cable route to protect the cables' bend radius.

Provide a minimum of two (2) two-post equipment racks in each TR to house all cable terminations and Telecommunications equipment. The rack loading shall be designed so as not to exceed 80% (32-RMU) usage of the available space. Note: A typical TR should be provisioned with three (3) racks with space allocated for a future fourth rack.

Provide an intra-TR backbone in each TR. An intra-TR backbone is a category 3 UTP backbone from the plywood backboard, near the UTP backbone, to the equipment rack. This backbone should terminate to a 110-type wiring block mounted on the plywood backboard and to 48-port T568B patch panel(s) on the equipment rack. Equip the 110- type wiring block with 110-C4 connector blocks. This backbone shall be sized in 48 port increments to provide 1.1 patch panel ports (4-pairs per port) for each standard and wall-phone WAO served from the TR.

Provide one (1) 120VAC 20A branch circuit with two NEMA 5-20R duplex receptacles from Telecommunications power supply at the plywood backboard near the intra-TR backbone termination field in each TR. Provide two-(2) 208VAC 30A 3-phase wye branch circuits with NEMA L21-30R receptacles from Telecommunications power supply for each equipment rack with active electronic equipment. Install 2 owner provided vertical PDU's for each active equipment rack.

## 4.5 Grounding and Bonding

Include in the design for a low-impedance Telecommunications Grounding System. Each equipment rack, cable raceway, cable runway, cable tray, and line protector shall be bonded to the Telecommunication Grounding System. A Telecommunications Main Grounding Busbar (TMGB) shall be required and shall be located in the TR in close proximity to the entrance into the space; and bonded in accordance to NEC Art. 800.100. Size the TMGB to provide enough points of attachment for each bonding connection plus 20% growth. The minimum size for the TMGB is ¼" D X 4"H X 12"L. Provide a telecommunications grounding busbar (TGB) in each Telecommunication Room (TR). The TGB shall be located high on the wall just below the overhead ladder racking. Size the TGB to provide enough points of attachment for each bonding connection plus 20% growth. The minimum size for the TGB is ¼" D X 2"H X 12"L.

## 4.6 Testing and Labeling

Provide a schedule of each permanent link with the following fields: floor #, room #, jack #,TR #, patch panel port #, x-conn switch port and cable use (Voice, Data, CAM, WAP, BMS, Meter, Elevator, AOR/emergency phone, Fire).

Include permanent link ID's (labeling) above each outlet location on the T drawings. Utilize ITS- PIP provided CAD drawing template and CAD blocks for planned work area outlet (WAO) modifications (Add, Remove, Existing to Remain). The Designer shall work with ITS-PIP representative to clarify T-Series CAD requirements. Baseline layers to be filled out may include:

T-Anno-Path (Junction box locations)
T-Comm-D (Existing WAOs being demolished)
T-Comm-E (Existing end user WAOs that will be remaining)
T-Comm-E-Security Cameras (Existing security camera that will be remaining)
T-Comm-E-Wireless (Existing Wireless AP WAOs that will be remaining)
T-Comm-N (New WAOs that will be installed)
T-Comm-Path (The main pathway feeding into rooms)
T-Comm-Penetrations (penetrations through fire-rated walls)
T-Comm-TR (the location of the Telecommunications rooms)

The Designer shall include in the specifications the following requirements for testing out and labeling of devices:

- Identify and label each Equipment Room and Telecommunication Room with a unique identifier derived from the University's Design Document Standards. The labels shall be permanent and consistent with the labeling style established for the building. Along with the room number, the label shall include "TEL/DATA" as the use describer. Example:

  110
  TEL/DATA

- Identify and label each Equipment Rack with a unique identifier that includes the Telecommunication Space room number followed by a hyphen then a single numeric character. The labels shall be engraved plastic; the font shall be at least 1 inch high and contrasting the background in color. Securely attach the label to the front of the ladder rack, directly above the equipment rack. Example:

  110-1

- Identify and label each Wall with a Plywood Backboard with a unique identifier that includes the Telecommunication Space room number followed by a hyphen then a single alpha character. The labels shall be engraved plastic; the font shall be at least 1 inch high and contrasting the background in color. Securely attach the label to the front of the ladder rack directly, above the plywood backboard. Example:

  110-A

- Identify and label each Patch Panel with a single alpha character. 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 the labels to the front of the patch panel or wiring block so that they will remain clearly visible once cross-connects or

patching is completed. Example:

A (rack-mount patch panel 1)

- Identify and label each Wiring Block with a unique identifier that includes the Plywood Backboard identifier followed by a single alpha character. 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 the labels to the front of the patch panel or wiring block so that they will remain clearly visible once cross-connects or patching is completed. Example:

  110-AA (wall-mount wiring block)

- Uniquely identify and label each Backbone Cable as to reference its source and destination termination patch panel or wiring block, the cable's type and size. 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 the cable within 12 inches of termination and on each patch panel or wiring block. Example:

  001-AA/110-AA 100-3-UTP (UTP copper backbone)
  001-1A/110-0A 12-SMF (fiber backbone)
  001-AB/110-AB P3-500 (coaxial backbone)

- Uniquely identify and label each Permanent Link as to reference its source termination patch panel port or wiring block position. The identifier shall include the patch panel or wiring block identifier followed by a two-digit port or position number. 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. Example:

  1. Patch panel: WAO room number first line →**126-A01**←
  then patch panel port……..second line → **BMS, CAM, or WAP**←

  2. WAO: Top Window→**A01, A02, A03**←
  then patch panel ports, bottom window → **TR-110**← TR room number

Include as part of the close-out documentation specifications to provide a table that shows the relationship of each permanent link, by its identifier, to the room number of the TR and the room number where the WAO is installed. All identifiers shall be clearly recorded on the as-built drawings.

## 4.7 Specific Materials

The University primarily utilizes products from the following manufacturers and has adapted language, practices, expectations, and a maintenance inventory based on their use. All telecommunication designs shall specify the features, quality, and performance of the products offered by these manufacturers. Substitutions are allowed; however, they shall meet or exceed these

requirements and integrate seamlessly with any existing cable plant.

- Unshielded Twisted Pair (UTP) copper, horizontal and backbone cabling: Hubbell Premise Wiring and all cable manufacturers allied with their 25 year warranty program
- Optical fiber outside plant cabling: Corning Cable Systems only
- Inside fiber horizontal or backbone cabling: Corning Cable System or same as the selected connectivity manufacturer
- Open frame and enclosed equipment racks, cable management, and cable runway: Chatsworth Products, Inc.
- Surface Metal Raceways: Legrand/Wiremold
- Emergency Phones: Talk-A-Phone, see University Design Standards for acceptable manufacturers

All materials, equipment, hardware, and components shall be new and free from defects in materials and composition. Materials and equipment shall be installed, placed, terminated, tested, handled and processed in a manner consistent with manufacturer's instructions.

### 4.7.1 Structured Cabling Requirements

Design the Structured Cabling System to meet the following minimum requirements:

- Unshielded Twisted Pair (UTP) Horizontal Permanent Links: Category 6 with guaranteed minimum headroom for (NEXT, PSNEXT, ACRF, PSACRF) of +5dB over the ANSI/TIA/EIA standards for Category 6 cable @ 250 MHz.
- UTP Backbone Cabling: Category 3 compatible
- Optical Fiber Backbone Cabling and Permanent Links: ITU-T G.652.D compliant Full Spectrum Single-mode (OS2)
- Coaxial Horizontal Permanent Links: Series 6 (RG6) Quad-shield; tested to 3GHz
- Coaxial Backbone Cabling: .500" Parameter III

### 4.7.2 UTP Copper Backbone

Provide a UTP copper backbone cable from each TR back to the ER. The cable shall be, at a minimum, category 3 compatible and UL listed to be installed in an environmental return-air plenum space (CMP).
Size the UTP copper backbone in 100 pair increments to provide at least 2.3 pairs for each standard and wall-phone WAO served.
Ensure in the specifications that the terminations are to wall-mount 300-pair 110-type wiring block(s) in the ER and TR. The 110-type wiring blocks shall be equipped with 110-C5 connector blocks. Provide cross-connect wire management above and below each 110 wiring block.

And include each cable pair shall be tested for point-to-point continuity. This includes testing to certify correct wire mapping and to insure there are no opens, shorts, crosses, or grounds.

### 4.7.3 Optical Fiber Backbone

Provide a single-mode optical fiber backbone from each TR back to the ER. The cable shall be of a tight-buffer construction with an aluminum interlocking armor jacket and UL listed to be installed in an environmental return-air plenum space (OFCP). The fiber shall be ITU-T G.652.D compliant Full Spectrum Single-mode (OS2).

Size the optical fiber backbone in 12-fiber increments to provide at least 8 fibers per application (ITS typically has one application per TR).

Ensure in the specifications that the terminations are by fusion-splicing pigtail cable assemblies to the cable ends. The pigtail cable assemblies shall be factory terminated with SC/APC connectors and contained within a cassette designed to protect the splice. SC/APC splice on connectors are also acceptable. Protect the fusion-splices with reinforced heat-shrink sleeves. Specify rack-mount patch panels with the ability to accept splice cassettes or SC-APC adapter panels. Mechanical splices or field-terminated connectors are never acceptable.

Specify optical fiber testing shall be performed in accordance with ANSI-TIA/EIA-568.1-D and .3-D Perform a Tier 1 (LS/PM) test on each optical fiber. Fibers that are spliced, with other than pigtail splicing, shall also undergo a Tier 2 (OTDR) test.

#### 4.7.4 Coaxial Backbone

Provide a Coaxial Backbone from the plywood backboard in each TR back to the plywood backboard in the ER. 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). Ensure in the specifications the following:

- terminations are for each cable end with F81 bulkhead connector. All connectors shall be terminated with OEM specified tools.
- require parameters for testing of each cable: Continuity, length and insertion loss. Testing shall be done in accordance to OEM requirements for warranty.
- require an additional 10 feet of cable be neatly stored at each location.

### 4.8 Pathways, Raceways and Spaces

Pathways and spaces identified for Telecommunication use shall be dedicated solely for that purpose. Concerns for network security, complexity of the systems, sensitivity to alien interferences (i.e. static electricity, RF or EMI), power quality, and special environmental requirements make it necessary that telecommunications equipment and cabling to be the sole occupant of these pathways and spaces.

#### 4.8.1 Telecommunication Pathways

Information technology is constantly evolving. As such, the media infrastructure for new technologies must adapt and expand to keep pace and transport these services to the user. Because of the dynamic nature of this industry, the telecommunications pathway must be well designed and should provide ease of access for the installer, to minimize damage to the building and operational cost associated with post construction adoptions of new technologies. The Pathway should be of sufficient size to accommodate future cabling needs such as MAC cabling for staffing changes or wholesale media upgrades. With this in mind, include the following points in designing the Telecommunications Pathways.

- Cable supports shall be wide-based and close enough together to prevent distortion to the cables' geometry from the weight of other cables piled on top and excessive cable drooping.
- Provide oversized or additional sleeves through common pathway walls and floors or along the major cable paths.
- Provide additional conduits through non-accessible spaces like fixed or gypsum ceilings.

- In areas where horizontal cables aggregate into the TR, provide cable tray.
- Design the telecommunications Pathways to run parallel with and perpendicular to the lines of the building and other construction. Cables shall not be run through ceiling spaces in an "as-the-crow-flies" manor.
- All through-wall and through-floor penetrations for the Telecommunications Pathway shall be sleeved and properly fire-stopped. All Fire-stopping solutions shall be re-enterable.
- Provide pull-strings in empty conduits and cable tray for future cable installations.
- No exposed cabling allowed when passing through electrical and mechanical spaces.

#### 4.8.2 Backbone Pathways

Backbone cabling pathways shall be clearly identified as such, designed to provide adequate space and protection for the backbone cables, and to allow room for future growth. Backbone Pathways shall be either cable tray or conduit. Where backbone cables pass vertically through stacked TR's, provide a ladder rack vertically mounted from floor to ceiling for cable support. Where possible, the pathway should extend to the roof to accommodate future cabling needs.

#### 4.8.3 Horizontal Pathways

Cable pathways shall be accessible and should be mounted in the corridors of the building. Where cable tray or conduit is not specified, a continuous pathway of independent cable supports shall be provided.

#### 4.8.4 Work Area Outlet Boxes

WAO boxes shall be a minimum of 4-11/16"H x 4-11/16"W x 2- 1/8"D with a single gang plaster ring. Each WAO box shall have a minimum trade Size 1 conduit stubbed to an accessible ceiling space or cable tray. Conduit openings shall be bushed to protect cables from damage.

#### 4.8.5 Surface Mounted Raceway

Raceways shall be metallic and sized to accommodate the number of cables specified for installation. They shall maintain proper cable bend radii and provide room for additional cables. Provide split or dual channel raceway for installations that require both power and telecommunication services to share the raceway. Shall be a minimum size of 21/32" x ¾" 700 series (or equivalent) raceway.

## 5 Horizontal Cabling (permanent links)

All horizontal cabling, including video cabling, shall be distributed in a star configuration running from the WAO back to the serving TR.

Include in the specifications acceptance is only those Permanent Links whose field-test results with a "pass". Permanent Links with a field-test result of "fail" or "*pass" will not be accepted. Results are to be stored by the Permanent Link identification as shown on the design documents.

Include as part of the close-out requirements documentation of the test results and the testing equipment's make, model, serial number, and most recent certification of calibration by the manufacturer. List the setting(s) used, as well as, cable identification, from/to locations of each cable, test date and the

names of the testing technicians.

## 5.1 UTP Permanent Links

Cables shall be solid copper conductors, 22 AWG to 23 AWG, 100 OHM balanced unshielded twisted-pair (UTP) Enhanced Category 6 cables; with four individually twisted-pairs, which meet or exceed the mechanical specifications in ANSI/TIA- 568.2-D. Additionally, these cables shall exceed the (NEXT, PSNEXT, ACRF, PSACRF) transmission performance specifications @ 250MHz by +5dB, minimally compliant category 6 cables shall not be accepted. The color of the cable's outer jacket shall be WHITE. Data cables shall be UL listed for the application and environment for which they are installed, with the following modification: cables installed in residence buildings and places of public assembly shall be, at a minimum, UL listed to be installed in an environmental return-air plenum space (CMP). All cables in slab on grade conduit MUST be rated for wet locations and be suitable for the ceiling environments they may pass through.

**Category 6A cables** (for wireless) – have the following additional requirements:

- Shall be a reduced diameter cable.
- Shall have a continuous noise barrier.
- Color of outer jacket shall be yellow.

Modular Connectors (Jacks) shall be category 6; "Keystone" in design; wired T568B; and meet or exceed the mechanical and transmission performance specifications in ANSI/TIA- 568.2-D. The color of the jacks shall match the color of the mounting frame and the nearby electrical outlets.
Patch Panels shall be "jack type panels" with white category 6 jacks and yellow category 6A jacks (for wireless); wired T568B; 48 port; 2-RMU; designed to mount on a standard TIA 19" frame; and shall meet or exceed the mechanical and transmission performance specifications in ANSI/TIA-568.2-D; color BLACK. Each port shall be uniquely and permanently numbered from the manufacturer. Panels shall also have integrated label windows for in field labeling.

Patch and Work Area Outlet Cords shall be factory made, low diameter, 4-pair cables; terminated with an 8-position plug at each end. The patch / WAO cord brand shall be the same as the connectivity manufacturer to allow for a complete channel warranty. Patch / WAO cord shall be the same category as the permanent link. Provide one 5' blue patch cord for each cable terminated at the patch panel. Furnish one blue WAO cord for each cable terminated at the WAO (50% 7' and 50% 10'). Install the patch cords at the patch panels in the TR's at the owner's direction.

Specify that each Permanent Link be tested as a complete horizontal cabling system, with jacks and faceplates completely assembled and properly mounted in their final position. Perform permanent link field tests with a Level III field tester; in accordance to test unit manufacturer instructions. Field-test each category 6 permanent link in accordance with ANSI/TIA-568-C.0, ANSI/TIA-568.1-D and ANSI/TIA -568.2-D.

Store and identify test results by the permanent link identification as shown on the contract documents.

## 5.2 Optical Fiber Permanent Links

Specify that the cables shall be of a fan-out type construction with a minimum 2.0mm outer jack and high- strength reinforcing fibers protecting each fiber. And shall contain four Single mode (OS2) fibers, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA-568.3-D. The color of the cable's outer jacket shall be Yellow. Cables shall be UL listed for the application and environment for which they are installed with the following modification: cables installed in residence buildings and places of public assembly shall be, at a minimum, UL listed to be installed in an environmental return-air plenum space (OFNP).

The fibers shall be splice on small form factor LC connectors which meets or exceeds the mechanical and transmission performance specifications in ANSI/TIA-568.3-D. Adaptor modules shall be flush mount duplex LC and produced by the same manufacturer of the UTP modular connectors. The color of the modules shall be green. Mechanical splices or field-terminated connectors are never acceptable.

Require a test with each permanent link as a complete horizontal cabling system, with connectors, adaptors, and faceplates completely assembled and properly mounted. Perform permanent link field tests with a Level III field tester, in accordance to test unit manufacturer instructions. Field-test each fiber Permanent Link in accordance with ANSI/TIA

### 5.3 Coaxial Permanent Links

Cables shall be Series 6 (RG6) Quad-shield coaxial construction; 75Ω unbalanced video cable; 18 AWG copper-clad steel center conductor; Foam dielectric; Aluminum foil - 60% braid – foil – 40% braid shield; factory tested to 3GHz cables shall be UL listed for the application and environment for which they are installed with the following modification: cables installed in residence buildings and places of public assembly shall be, at a minimum, UL listed to be installed in an environmental return-air plenum space (CATVP, CMP).

Specify each end of the coaxial cable will be terminated with an F-type compression connector. Positive compression type connectors with minimal signal leakage characteristics shall be installed with OEM installation tool. Hex crimp connectors are not acceptable. At the TR, the cable shall be connected to an F-81 ground block orderly and securely mounted to the plywood backboard. At the WAO the cable shall be connected to an F-81 adapter module. . The color of the modules shall match the color of the mounting frame.

Test each Permanent Link as a complete horizontal cabling system, with connectors, adaptors, and faceplates completely assembled and properly mounted. Test the following parameters of each cable: Continuity, length and insertion loss. Testing shall be done in accordance to OEM requirements for warranty. As part of the closeout documentation, provide to the University Representative and UITS the test results of each coaxial cable along with the testing equipment's make, model, serial number, and most recent certification of calibration by the manufacturer. List the setting(s) used, as well as, cable identification, from/to locations of each cable, test date and the names of the testing technicians.

## 6 WAO Design Considerations

### 6.1 Mounting Frames and Faceplates

Connector modules and adapters shall be installed in a NEMA standard rectangular (Style- Line®, GFCI) shaped plastic mounting frame. The frame shall be the rear-loading type and shall be made by the

same manufacturer as the connector and adaptor modules. The connector and adaptor modules shall mount flush with the frame's front surface. The color of the frames should match the color of the nearby electrical outlets. Each frame shall have no more than three ports. If more than three ports are required at a location, than consider using multiple-gang faceplates.

Faceplates shall accommodate the rectangular mounting frames and shall match the nearby electrical outlet faceplates in appearance. The faceplates shall have provisions to affix and display labeling for the connector or adaptor modules.

## 6.2 Commonly Used WAO's:

- Standard WAO – Standard WAO shall have a two-port rectangular frame and
- faceplate with two UTP Permanent Links. The topmost/leftmost port is typically reserved for voice applications and the remaining port(s) for data.
- Wall-phone WAO – Wall-phone WAO shall have one UTP Permanent Link. The
- wall-phone faceplate shall be made of stainless steel with a brushed finish and shall have two mounting posts that accommodate a standard wall-phone. The faceplate shall be rear loading with a recessed port opening.
- TV WAO – TV WAO in residence halls shall consist of a one port rectangular
- frame and faceplate with one Coaxial Permanent Link.
- TV WAO – TV WAO in office, academic and common spaces shall consist of a three
- port rectangular frame and faceplate, one Coaxial and two UTP Permanent links.

## 6.3 Program Space WAO Requirements:

The WAO layouts should be based on the planned location of furniture or specialty requirements. The following are minimal WAO requirements. Additional WAO may be required for ancillary devices (printers, fax machines, charging areas, etc.), specific needs of the occupant(s), and the size or intended use of the room. Each WAO should be located near an electrical power outlet.

- Single Faculty/Staff Office: One Standard WAO next to the workstation.
- Double Faculty/Staff Office: Two Standard WAO
- Dean/Director Office: Two Standard WAO on opposing walls and one TV WAO.
- Clerical Staff and Graduate Student Work Area: One Standard WAO for each desk or workspace.
- Conference Room: Two Standard WAO on opposing walls with one positioned to service the AV cabinet and one TV WAO.
- Lounge or Break Room: One Wall Phone and one TV WAO. Considerations should be given to mount the TV WAO high on the wall or in the ceiling for wall-mounted televisions.
- Computer Lab: One Standard WAO for every two computers, one TV WAO, and one Wall-phone WAO located near the door.
- Research / Laboratory: One Standard WAO for every two workstations and one Wall-phone WAO located near the door.
- Classrooms: Two Standard WAO; one near the teaching station and one on an opposing wall;

one TV WAO at the front of the room; and one Wall-phone WAO located near the door. Through the University Representative, additional consultation shall be sought with the University's AV Technology Services Division (Academic IT) for additional WAO and AV requirements.

- Student Housing: Provide enough WAO as to satisfy the minimum ratio of one UTP permanent link (data applications) per bed. In RA Rooms, add one UTP permanent link for voice applications. Also, provide one TV WAO per room. Provide one Standard WAO and one TV WAO in suite common areas.
- Electronic Room Schedule Signs: One UTP cable in a single port faceplate, mounted at 52" AFF outside of each conference room and classroom.
- Electronic Surveillance and Security (ESS): One UTP Permanent Link for each door access controller and CCTV camera. These cables shall be installed by the awarded cabling contractor (not the security or electrical contractor)
- Building Automation Systems (BAS): Requires dial-up or network connectivity and Permanent Links as noted:
    - HVAC : One UTP Permanent Link (Per Controller)
    - Power Metering: One UTP Permanent Link
    - Steam Metering: One UTP Permanent Link
    - Chilled Water: One UTP Permanent Link
    - Reclaimed Water: One UTP Permanent Link
    - Domestic Water: One UTP Permanent Link
    - Lighting controls: One UTP Permanent Link (per Controller)
    - Sewage Pumping Station: One UTP Permanent Link
- Emergency Circuits: Requires dial-up or network connectivity and Permanent Links as noted:
    - Elevator: Two UTP Permanent Links
    - Fire Alarm Control Panel: Two UTP Permanent Links.
    - Emergency Site Phone: One outdoor rated UTP permanent link, terminated on a 110 in/out primary protector before landing on the 66 block.

Emergency Circuit Permanent Links shall terminate to a 66 block next to the voice wall field in the TR. This includes elevator, fire alarm, AOR and emergency site phones. Fire Alarm, elevator, intrusion detection and alarm system installers are to coordinate dial plans with University representative.

## 6.4 Wireless Network Access (WLAN)

The University provides wireless network access (IEEE 802.11a/b/g/n) via a Cisco Unified Wireless Network consisting of WLAN controllers and CAPWAP access points. The Design Firm must have a current Certified Wireless Network Professional CWDP or Cisco CCNA Wireless Certification and proof of training from the manufacture of the wireless design software utilized.

The Designer shall conduct an engineered study to establish the best location for each access point in order to provide optimum wireless coverage (predictive model for construction). The 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
- Confirm centralized infrastructure settings and WAP standards with the University

When specifying, include one (1) Category 6A UTP Permanent Link, terminated with channel compliant field termination plugs for each wireless access point (crimp on rj-45 plugs are not acceptable). The University will provide the wireless access point equipment, however ensure that it is specified the contractor shall install the access points. The Designer shall perform a post-installation survey (as close as possible to actual move in conditions) to verify coverage requirements are achieved. Include in the specifications an allowance for additional contractor time to reposition the equipment as required and/or add wireless access points based on the findings of the survey.

### 6.5 As-Built Documentation

- 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

## 7 Emergency Site Telephones

The Emergency Telephone (ETP-MTE-ECO) is a freestanding pedestal unit, installed on a concrete pad, and used as emergency telephones on campus. Generally standing 9’6” tall, the telephone shall have a speakerphone, lighted faceplate, and a combination beacon and strobe light. The paint finish will be Midnight Blue. Graphic text shall read “Emergency” in reflective white. The emergency telephone apparatus shall be mounted at a height and in a location, which meets ADA requirements. Verify that new emergency blue phone equipment matches current university standards.

The Designer shall work with the University Representative and Department of Public Safety to identify the Emergency Site Phone locations. ITS will provide the phone number and final programming of the system. Foundations, conduit pathways, grounding, lightning protection, outdoor rated telecomm cabling, and electrical power (single gang, GFI outlet) for all Emergency Site Phones shall be included in the design. Each EPB shall have dedicated power and telephone conduits (daisy-chaining conduits through EBP stations is prohibited).
Provide each Emergency Site Phone location with the following:

- A concrete foundation no smaller than 24” diameter and 42” deep. Anchor bolts and template for it are part of the stanchion order. Delivery of the necessary anchor bolts

and template should be planned for early, before delivery of the stanchion, in order to facilitate creation of and proper placement of the foundation.

- One (1) minimum size 1" Telecommunication conduit terminating in the TR of the building from where the voice circuit is provided.
- One outdoor rated UTP permanent link, terminated on a 110 in/out primary protector before landing on the 66 block.
- One (1) minimum size 1" Power conduit to the building from where the voice circuit is provided and one dedicated, 120VAC, 15-amp branch circuit, on emergency backup power
- One 5/8" X 8' copper-clad steel ground rod with a #6 AWG copper wire to the base of the Code Blue Phone

# 8 Closeout

As part of the close-out documentation require the Contractor document and certify the test results of each fiber/cable along with the testing equipment's make, model, serial number, and most recent certification of calibration by the manufacturer. List the setting(s) used, as well as, cable identification, from/to locations of each cable, test date and the names of the testing technicians.

The Designer shall include in the specifications that the Contractor shall provide an unconditional warranty against all defects in materials and workmanship for a period of no less than one year from the date of substantial completion of the project. The Contractor shall also be required to submit from the connectivity component manufacturer(s) an extended warranty with a representation that all materials and cabling shall be free from defects and function as intended for a period of no less than twenty-five years. All materials, labor, and expenses to correct a breach of the warranty shall be included.

The Contractor will perform a final as-built of the systems and provide the following documentation:

- Emergency Blue Phone - Routing conduit locations, electrical panel number and branch circuit information.
- WAP – See requirements under wireless
- A detailed report generated by Air Magnet (Netscout) or Ekahau.