



Telecommunications Design Guidelines And Performance Standards

**University Information Technology Services
and University Planning, Design and Construction Department**
Established Date: May 2015 - revised

INTRODUCTION

UITS is the service provider for all voice, data, and TV at the University. As such, UITS is the provider of these design guidelines and is the final arbitrator and adjudicator over the performance and functional acceptability of all telecommunication designs and installations. All telecommunication designs and installations for University shall be such that at the completion of the project, there is a complete Structured Cabling System in place and tested for the error free delivery of voice, data, wireless and TV services to the end user; consistent with the guidelines and performance standards 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 as required within the Design Guidelines and Performance Standards shall perform all such designs

This Design Guide is a living document; as such, the criteria contained within are subject to revisions and updates as needed due to technological advances within the telecommunications industry.

1 GENERAL REQUIREMENTS

1.1 PURPOSE

The purpose of this document is to provide the Designer the 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 Design Guidelines and Performance 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.

The University of Connecticut recognizes and adopts for itself the Telecommunication Industry's standards and best practices as defined and/or interpreted by those agencies listed in section 1.5 and the intent of this document is to identify and define those requirements specific to the needs and practices of the University.

1.2 DEFINITIONS

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

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

MAC – An acronym for “Moves, Additions, and Changes” or the post-construction cabling that occurs after the building is occupied.

WAO – An acronym for “Work Area Outlet”; the Telecommunication outlet located at the end user's work area or point of service utilization.

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

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

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

1.3 SCOPE AND DELIVERABLES

As the University's Telecommunication Service Provider, UITS 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 and budget and their designs 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) and cross-connects 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 UITS services shall be borne by the project or requesting department. Coordinate information with UITS to estimate their values.

The Designer shall provide a design for a complete and functional Telecommunication Structured Cabling System; include equipment, materials, labor, tools and 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 samples and submissions

- As-built documentation
- Removing abandoned cable

Close and careful coordination between UITs and the Designer is required to assure the proper design of the Telecommunication pathways and spaces.

The Designer shall provide all responsibilities under the Designer’s contract including the following:

- Plans and Specifications to be consistent with the University’s Design Guidelines and Performance Standards, including all Appendixes, and particularly the appendix regarding Design Document Standards and Plan Submission Requirements, and the latest edition of the BICSI Telecommunications Distribution Methods Manual (TDMM).
- A budgetary cost estimate of the equipment, materials, labor, and services required to complete the installation of the design.
- The Designer shall include a requirement 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.

1.4 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 warranty program
- Optical fiber horizontal and backbone cabling: Corning Cable Systems
- Open frame and enclosed equipment racks, cable management, and cable runway: Chatsworth Products, Inc.
- Surface Metal Raceways: Legrand/Wiremold

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.

1.5 INDUSTRY AND CODE REQUIREMENTS

All telecommunication designs and installations 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

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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 more stringent requirements shall take precedence.

It is required that the Designer be fully trained and experienced in Telecommunications design and have full understanding of current trends and practices within the Telecommunications Industry

1.6 WARRANTY/GUARANTEE

The Designer shall include within the project specifications submittal requirements that the Contractor shall provide copies of the cabling systems installers (subcontractor) certifications endorsed by the cabling connectivity manufacturer that the installer(s) are certified by the manufacturer to install and connect the specified system to support the manufacturer's extended warranty program. In addition, the cable systems installer(s) shall provide by copy of their certifications, technicians and supervisors that have received specialized training in installing Structured Cabling Systems by a vendor-neutral organization such as BICSI. The cable systems installer(s) shall also be properly licensed by the State of Connecticut to install Structured Cabling Systems.

The Designer shall include in the specifications that the Structured Cabling System installer shall provide an unconditional warranty against all defects in materials and workmanship for a period of no less than two years from the date of substantial completion of the project. The Structured Cabling System installer shall also be required to submit from the cabling 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.

1.7 PERFORMANCE REQUIREMENTS

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

- Unshielded Twisted Pair (UTP) Horizontal Permanent Links: Category 6
- UTP Backbone Cabling: Category 3 compatible
- Optical Fiber Backbone Cabling and Permanent Links: ITU-T G.652.D compliant Full Spectrum Singlemode (OS2)
- Coaxial Horizontal Permanent Links: Series 6 (RG6) Quad-shield; tested to 3GHz
- Coaxial Backbone Cabling: .500" Parameter III

1.8 GROUNDING AND BONDING

Provide a low-impedance Telecommunications Grounding System. Bond each equipment rack, cable raceway, cable runway, cable tray, and line protector to the Telecommunication Grounding System. A Telecommunications Main Grounding Busbar (TMGB) shall be required and shall be located in the telecommunications Equipment Room (ER); in close proximity to the Entrance Facility; 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"W 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"W X 2"H X 12"L.

1.9 ADMINISTRATION

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 and Wiring Block with a unique identifier that includes the Equipment Rack or 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:

110-1A (rack-mount patch panel)

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:

110-1A01

All identifiers shall be clearly recorded on the as-built drawings.

As part of the close-out documentation, provide UITS with 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.

2 STRUCTURED CABLING REQUIREMENTS

2.1 TELECOMMUNICATIONS PATHWAYS 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.

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. The doors shall have locks and keyed to UITS specified keys for Telecommunication Spaces. The rooms shall be clearly labeled as a Telecommunications Space on the exterior of the door.

Provide enough space for all equipment located within the Equipment and Telecommunications Rooms 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. The rooms shall be rectangular in shape, all corners are at right angles and opposing walls parallel to each other.

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 back-up power systems are significant components to make the network access operation reliable. The University has deemed that Telecommunications are an “EMERGENCY SERVICE” and that they must be made highly available and in operation during power outages and other crisis. The Designer should include back-up power with an Uninterruptable Power Source (UPS) in the design for powering the Equipment and Telecommunications Rooms. UITS strongly recommends that a centralized UPS and power distribution system be provided for all telecommunication spaces. 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.

The Designer shall include a solution for the room’s environmental needs, utilizing practices and standards set forth by ASHRE. Provide conditioned air and heat such that Equipment and Telecommunications Rooms 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 Equipment Room shall be dedicated units, such as a Liebert Precision Air Cooling unit or approved equal.

Where Equipment and Telecommunication Rooms 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, the Designer shall include a pre-action and/or clean agent fire suppression system.

Provide equipment racks in quantities and types as described below. 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’-0” tall providing 45-RMU of mounting space. Provide cable management troughs with rounded “waterfall” edges at the top of each

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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'-0" 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. EVOLUTION™ series or approved equal). Provide double sided vertical cable managers with two-post racks and single-sided with four-post racks.

Provide 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.

2.1.1 Entrance Facility

For the purposes of this document, the Entrance Facility (EF) is the area where the service lateral conduits, that provide a pathway from the nearest University telecommunications manhole to the building, enter the Equipment Room. Generally, the Designer will specify and show the route of the conduits, but the University, through UITS or its contracted installer, will provide and terminate the service cables or fiber.

Provide a minimum of two (2) trade size 4 conduits from the nearest University telecommunications manhole 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.

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, one on either side.

For terminations and splicing of optical fiber cable(s), provide one four-post Equipment Rack (i.e. Chatsworth Products, Inc. QUADRARACK™ or approved equal).

2.1.2 Equipment Room

The purpose of the Equipment Room (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 MER 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.

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) four-post Equipment Rack (i.e. Chatsworth Products, Inc. QUADRARACK™ or approved equal). Locate this rack 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.

2.1.3 Telecommunications Rooms

The purpose of the Telecommunication Room (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.

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 so as 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) 208/120VAC 30A 3-phase wye branch circuits with NEMA L21-30R receptacles from Telecommunications power supply for each equipment rack with active electronic equipment.

2.1.4 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 reduce labor costs. 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.

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- 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.

2.1.4.1 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.

2.1.4.2 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.

2.1.4.3 Work Area Outlet Boxes

Work Area Outlet (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 plastic 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.

2.1.4.4 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.

2.1.4.5 Modular System Furniture and Paneling

Modular system furniture and paneling shall accommodate the University's specific materials and do not require the use of proprietary cabling components. They shall have integral raceways that conceal telecommunication cables without distorting or damaging them or compromising cable bend radius requirements. System furniture raceways shall have metal barriers to separate telecommunication cables from power cables.

2.2 BACKBONE CABLING

2.2.1 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 so as to provide at least 2.3 pairs for each standard and wall-phone WAO served.

Terminate the cable(s) 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.

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.

As part of the close-out documentation, provide the University Representative and UITS 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.

2.2.2 Optical Fiber Backbone

Provide a singlemode 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 Singlemode (OS2).

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

Terminate fiber cables by fusion-splicing pigtail cable assemblies to the cable ends. The pigtail cable assemblies shall be factory terminated with SC/APC connectors. Protect the fusion-splices with reinforced heat-shrink sleeves and place them in splice trays. Provide rack-mount patch panels with SC-APC couplers and storage for splice trays. Where fiber backbone cables terminate on four-post racks; fiber patch panels shall be mounted on the front side of the rack and splicing cabinets on the rear.

Optical fiber testing shall be performed in accordance with ANSI-TIA/EIA-568 C.0 and C.1. 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. As part of the close-out documentation provide the University Representative and UITS the test results of each fiber 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.

2.2.3 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).

Terminate each cable end with F81 bulkhead connector. All connectors shall be terminated with OEM specified tools. Provide and neatly store 10 feet of additional cable at each location.

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 close-out documentation provide 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.

2.3 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. See below for specific requirements.

2.3.1 UTP Permanent Links

Cables shall be solid copper conductors, 22 AWG to 24 AWG, 100Ω balanced unshielded twisted-pair (UTP) Enhanced Category 6 cables with four individually twisted-pairs, which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA-568-C.2; tested to at least 650 MHz, 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).*

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-C.2. The color of the jacks shall match the color of the mounting frame and the nearby electrical outlets.

Patch Panels shall be category 6; 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-C.2; color BLACK. Each port shall be uniquely and permanently numbered from the manufacturer.

Test each Permanent Link 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-C.1 and ANSI/TIA -568-C.2, including their addenda. UCONN will accept only those permanent links whose field-test results with a PASS. Permanent links with a field-test result of FAIL or *PASS will be rejected. Store and identify test results by the permanent link identification as shown on the contract drawings. As part of the close-out documentation provide the University Representative and UITS 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.

2.3.2 Optical Fiber Permanent Links

Cables shall be of a fan-out type construction with a minimum 2.0mm outer jacket and high-strength reinforcing fibers protecting each fiber. The voice cables shall contain four Singlemode (OS2) fibers which meet or exceed the mechanical and transmission performance specifications in ANSI/TIA-568-C.3. The color of the cable's outer jacket shall

be Yellow. 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 field terminated high performance, no epoxy/no polish small form factor LC connectors which meets or exceeds the mechanical and transmission performance specifications in ANSI/TIA-568-C.3. 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 match the color of the mounting frame.

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-568-C.0, ANSI/TIA-568-C.1 and ANSI/TIA -568-C.3, including their addenda. UCONN will accept only those Permanent Links whose field-test results with a “pass”. Permanent Links with a field-test result of “fail” or “*pass” will be rejected. Store and identify test results by the Permanent Link identification as shown on the contract drawings. As part of the close-out documentation provide the University Representative and UITS 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.

2.3.3 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).*

Terminate each end of the coaxial cable 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 close-out 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.

2.4 WAO DESIGN CONSIDERATIONS

2.4.1 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.

2.4.2 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 shall consist of a one port rectangular frame and faceplate with one Coaxial Permanent Link.

2.4.3 Program Space WAO Requirements:

The WAO layouts should be based on the planned location of furniture. The following are minimal WAO requirements based on typical program space types. 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: Two Standard WAO on opposing walls

Double Faculty/Staff Office: Three Standard WAO

Dean/Director Office: Three 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 and one TV WAO.

Lounge or Break Room: Two Standard WAO 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 each work station 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. If a classroom is identified as “High Technology”, thorough the University Representative additional consultation shall be sought with the University’s Institute for Teaching & Learning (ITL), AV Technology Services Division (AVT) 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 and one UTP permanent link (voice applications) per room. Also provide one TV WAO per room. Provide one Standard WAO and one TV WAO in suite common areas.

2.4.4 Electronic Surveillance and Security (ESS)

Provide one UTP Permanent Link for each door access controller and CCTV camera. ESS permanent links shall terminate to a separate patch panel field in the TR.

2.4.5 Building Automation Systems (BAS)

The following are Building Automation Systems (BAS) services that typically require dial-up or network connectivity. Provide Permanent Links as noted:

- Elevator: Two UTP Permanent Links
- Fire Alarm Control Panel: Four UTP Permanent Links, and one Optical Fiber Permanent Link
- HVAC : One UTP Permanent Link
- Power Metering: One UTP Permanent Link
- Sewage Pumping Station: One UTP Permanent Link

BAS Permanent Links shall terminate to a separate patch panel field in the TR. The BAS patch panel shall be of the modular, multimedia type, 24 or 48 port and the connector and adaptor modules in the TR shall be black.

See University Design Guidelines and Performance Standards under the Section for Electrical for more details.

2.4.6 Wireless Network Access (WLAN)

UITS 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 Designer shall conduct an engineering study to establish the best location for each access point in order to provide optimum wireless coverage. Provide one UTP Permanent Link and a ceiling mounting enclosure for each wireless access point. UITS will provide the wireless access points and Power-over-Ethernet 802.3at Type 2 (PoE+) power sources, but will require the installing contractor to install the access points. The engineering 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

Closeout

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

The installing contractor shall provide UITS with the following as-built information:

- 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

2.5 CODE BLUE EMERGENCY TELEPHONES

The Code Blue Emergency Telephone CB-1s is a freestanding pedestal unit install on a concrete pad used as emergency telephones on campus. Generally standing 9'6" tall, with an 8.75" diameter, the telephone shall have a speaker phone, lighted faceplates with a combination beacon and strobe, with a blue finish. Graphic text shall read "Emergency" in reflective white. Mounted on a concrete pad, the pad will abut a walkway. The emergency telephone apparatus shall be mounted at a height that is ADA compliant. Coordinate to insure new emergency telephones match existing installed equipment.

The Designer shall work with the University Representative and Department of Public Safety to identify the Code Blue Emergency Telephone locations. UITS provides the telephone and cabling for the blue phone system. Foundations, conduit pathways, and electrical power for all Code Blue Emergency Phones shall be included in the design.

Provide each Code Blue Telephone location with the following:

- A concrete foundation no smaller than 24" diameter and 42" deep. Anchor bolts and template for same will be provided by UITS.
- One (1) minimum size 1" Telecommunication conduit terminating in the ER of the building from where the voice circuit is provided. Provide a pull string, tied off at both ends, labeled "Code Blue".
- One (1) minimum size 1" Power conduit to the building from where the voice circuit is provided and one 120VAC 15-amp branch circuit with emergency backup power
- One 5/8" X 8' copper-clad steel ground rod with a #6 AWG copper wire to the base of the Code Blue Phone

The units shall be located adjacent to walkways, not in travel areas where they might interfere with pedestrians or service vehicles. Locate the code blue emergency phone so as to be wheelchair accessible from the sidewalk. Install a concrete pad to extend to the sidewalk if necessary. Access to the phone shall not be impaired by landscaping or curbs. For ease of mowing in grass areas, the Code Blue Telephone shall be located on an eight inch wide concrete mowing strip flush with the surrounding lawn.

The Designer shall provide UITS with record as-built drawings that include conduit locations, electrical panel number and branch circuit information.