

1. Introduction

The purpose of these Telecommunications Standards is to establish a strategic direction for the physical connection of communications devices at the University of Connecticut (UCONN). This document will serve as both a design guide for architects and engineers, as well as an installation guide for contractors, and as an infrastructure standards guide for university staff. A properly designed and constructed telecommunications system will be adaptable to change over the life of the building. This standard is a living document and as such, the criteria contained within are subject to revisions and updates as needed due to technological advances within telecommunications.

Telecommunications has an impact on most areas within and between UCONN's buildings. It is expensive and time-consuming to continually change cabling systems to support different network configurations, computer systems and the relocation of employees. Therefore, it is very important that the design and construction of new or renovated buildings are such to avoid obsolescence. That is why in recent years, national and international standards organizations have been developing standards for the various elements of telecommunications cabling systems. UCONN's implementation of these standards will ensure a flexible, uniform telecommunications environment and:

- Provide an architecture based on documented standards to support efficient, long-lasting, cost-effective telecommunications operations.
- Improve the service levels from departments and/or vendors providing telecommunications-based services to end users thereby reducing the amount of time required to install and implement new systems or to relocate workstation and server devices within and between departments.
- Reduce the amount of time required installing new networks or reconfiguring existing local area networks.
- Provide the flexibility to operate many different technologies on a common cable system.
- Eliminate the cost of installing non-standard, vendor-unique cabling by providing industry standard cabling systems that support a wide variety of equipment from different manufacturers.
- Improve network manageability through uniformity in cable systems, networks, network interconnectivity and workstation connectivity making problem determination easier and less time consuming.
- Facilitate automated cable system management through the use of uniform and industry standard identification and numbering schemes.
- Allow for the growth of anticipated high speed, high bandwidth LANs and WANs required by specialized applications.

1.1. Definition of UCONN and University Information Technology Services

UCONN is the University of Connecticut and the owner of all property and completed projects, unless otherwise specified in the project.

University Information Technology Services (UNIVERSITY ITS) is the department that is responsible for all of UCONN's Telecommunications Systems.

UNIVERSITY ITS reserves the right to send a representative to attend weekly job meetings with the GC and the trade representatives.

UNIVERSITY ITS reserves the right to send a representative to inspect the job site.

UNIVERSITY ITS will be the focal point for all telecommunications matters for projects.

1.2. Turn-key Solution

In instances where UNIVERSITY ITS will not be performing the inside wiring and installation directly, a turn-key solution must be provided. For turn-key projects UNIVERSITY ITS must be provided with the following information at least two weeks prior to commencing telephone moves: station cable information, jack numbers, IDF room numbers, riser counts, testing, and end user information including server and IP addresses. Also, telecommunication closets must be completed including grounding, power, equipment installation and lockable doors.

Adherence to these Standards for Installation and related standards and codes established by the agencies listed in section 2.4 shall be required.

1.2.1. UNIVERSITY ITS Representation

A University Information Technology Services representative shall be included in all phases of the project from the first preliminary meeting to the final walk-through, including each architectural, engineering, and construction phase.

UNIVERSITY ITS will provide input to the design and implementation of the telecommunications infrastructure.

UNIVERSITY ITS will have final approval of the details of the specifications for the voice, data, and video cabling requirements at each phase and milestone of the project.

UNIVERSITY ITS reserves the right to send a representative to attend the weekly construction meetings and have final resolution of all RFI's that concern the telecommunications infrastructure during design and construction.

1.2.2. Budget

The Telecommunications Systems budget for this project must include all items required for a complete "turn-key" solution.

There is a three-part cost associated with the Telecommunications Systems – Engineering, Installation, Testing and Documentation.

The engineering cost includes design, engineering, supervisory, and project management functions.

The installation cost includes the actual installation labor and materials costs for both the passive cableplant components and active electronic equipment.

The testing and documentation cost includes electronic documentation of all testing, electronic and hard copies of all as-builts, noting all changes, and, if necessary, providing University ITS with the software used to document testing and as-builts.

The overall budget must include the following items:

- The inter-building cabling and infrastructure for voice, data and video.

- The intra-building cabling and infrastructure for voice, data and video.

- Any telephone switch growth costs.

- All active and passive devices for all data network connections (i.e. switches, routers, fiber optic devices, patch cables, etc.).

- All active devices for all SMATV connections.

- All interconnecting devices and cables.

Additionally, all planning, design, testing and documentation costs, and all consulting, project management, and supervisory costs including staff from University Information Technology Services must be included in the project budget.

2. Definitions and Acronyms

2.1. Document Definitions

For purposes of this document, the following definitions apply.

Owner – UCONN, the State of Connecticut

GC – The General Contractor or Project Management Company designated to run this project.

EC – The Electrical Contractor

CV – The Telecommunications Provider or the Cabling Vendor or Electrical contractor designated to install the cable plant.

2.2. Industry and Standard Definitions

The following are industry standard definitions.

EF – Entrance Facility – The place where Telecommunications cables and inter-building backbone cables enter the building.

ER – Equipment Room – The primary room in the building that houses the main voice, data, and video equipment for the building. This room may also be referred to as the MC – Main Cross Connect – since it connects the equipment to the backbone and feeds all other Telecommunications Closets in the building.

TC – Telecommunications Closet – The secondary room that feeds a section of the building and houses distribution cable and equipment. This room is the transition point between backbone and horizontal cabling.

BB – Backbone Cabling – Vertical or riser cabling which feeds TCs from the ER

HC – Horizontal Cabling – Horizontal or station cabling which feeds individual Work Area Outlets.

WAO – Work Area Outlets – Individual stations or drops set up for a user.

2.3. Adherence to Reference Documentation

This document does not exclude any part of the EIA/TIA standards. It is the responsibility of the reader to be familiar with the most current revision of EIA/TIA standards. Additionally, the reader is responsible to know and comply with all code requirements. Code requirements and standards shall be enforced, however, where they differ, enforce the more stringent rules.

2.4. Regulatory Requirements/ Codes and Standards

American National Standards Institute (ANSI)

American Society for Testing and Materials (ASTM)

Institute of Electrical and Electronic Engineers (IEEE)

National Electrical Manufacturers Association (NEMA)

Underwriters Laboratories (UL)
American Society of Mechanical Engineers (ASME)
National Fire Protection Association (NFPA)
Telecommunications Industry Association (TIA)
Electronic Industry Association (EIA)
1999 National Electrical Code (NEC)
Business Industry Consulting Services International (BICSI)
State of Connecticut and Local Building Codes

3. Construction Specifications

3.1. Industry Standards

Telecommunications/data drawings shall be identified by T series numbers in the approved Construction Drawings or included as part of the electrical drawings. The telecommunications/data section of the specifications manual shall be numbered separately and distinctly from other sections.

All vendors working on the design and implementation of the telecommunications infrastructure must have certifiable industry knowledge.

A BICSI certified RCDD will approve and stamp all prints relating to the telecommunications infrastructure including all rooms, closets, riser diagrams, Work Area Outlet locations, and logical designs. If the architect or engineer does not have an RCDD on staff, UNIVERSITY ITS will provide a list of consultants who can contract for the project.

UNIVERSITY ITS will approve the RCDD used on the project. For locations with SMATV installations, the installer will use a SCTE (Society of Cable Television Engineers) certified engineer and installation crew.

3.2. Local Code and Regulatory Requirements

All pertaining statutes, ordinances, rules, codes, regulations, standards, and the lawful orders of all public authorities having jurisdiction over the construction of telecommunications cable systems shall be followed in the design and installation of new cable systems. These include, without limitation, applicable building codes, handicapped regulations, municipal codes, fire codes, State Statutes and the regulations of the Occupational Safety and Health Administration (OSHA) unless superseded by State Statute or local law.

3.3. EIA/TIA Standards

UCONN's telecommunications infrastructure standards generally follow the applicable standards and technical service bulletins published by the Electronic Industry Association/Telecommunications Industry Association (EIA/TIA). The specific EIA/TIA standards are indicated in sections within this document. While the EIA/TIA standards are considered the primary standards, standards from other organizations such as Underwriter's Laboratory and the American National Standards Institute may also apply.

It is the responsibility of the reader to be familiar with the most recent revision of the EIA/TIA standards in their entirety.

4. Telecommunications Rooms

4.1. Types and Uses

All rooms used for Telecommunications, including but not limited to Entrance Facilities (EF), Equipment Rooms (ER), and Telecommunication Closets (TC), are for the sole use of Telecommunications. No other building facility equipment will be housed in any telecommunication rooms including, but not limited to, fire alarm systems, monitoring systems, security systems, janitorial services, supply storage, departmental storage, etc. There shall never be an exception to these restrictions.

4.1.1. Entrance Facility

The Entrance Facility (EF) is where all the cabling enters the building. It is acceptable for the EF and the ER to be one and the same room. In this instance, use the design specifications for the ER and increase the size of the room accordingly to accommodate all the required equipment.

The EF should be located on the ground floor and have one wall adjacent to the outside.

The minimum size for this room is 10' x 12', however there must be enough room to house all of the grounding and bonding equipment for the cables.

Typically, outdoor cables need to enter the building, terminate onto a grounded device for lightning protection, and cross connect onto terminated indoor cables that will pass onto the Equipment Room.

There shall be 6 ft between lightning conductors and communications cables and wires per NFPA 70 Article 800-13.

The facilities will enter the room from the side on the outside wall closest to manhole, pole, or other service entrance.

The point of entry for telecommunications wiring and cables shall be within 20 ft of the electrical service entry point per NFPA 70 Article 800-11(c).

All entrance cables that need to transition from outdoor cable to indoor cable must do so within 50' of entering the building.

All outdoor innerduct must transition immediately upon entering the building.

Specify to have a minimum of three (3) 4" conduits and one (1) multi-cell conduit installed on the outside wall from the building to the manhole or tunnel.

All conduits must run directly to a Telecommunications manhole or a tunnel.

No aerial cable is acceptable.

No direct-buried cable is acceptable.

4.1.2. Equipment Room

The Equipment Room (ER), also called the Main Distribution Frame (MDF), Main Cross-connect (MC) or Building Distribution Frame (BDF), we will use BDF, houses all of the equipment that supports the building and that ties it back to the main hub of the campus.

Typically, the BDF additionally serves as the Telecommunications Closet for that section of the building, and therefore should be the largest of the three types of rooms used for telecommunications in the building.

This room must be centrally located on the ground floor.

The minimum size for this room is 10' x 12'. This size should accommodate two racks and appropriate backboard space for voice and video.

The BDF must increase in size .75 square feet for every 100 square feet of workspace and/or as needed to accommodate additional equipment necessary to accommodate high density or demand of voice, data or video services.

Specify a large capacity 4800 – 6000 watts UPS for this room and the electrical service provided to support it.

Specify to have a by-pass switch placed in-line with the UPS to service the batteries of the UPS.

Most equipment used in this room contains switching power supplies so many manufacturers are now recommending to oversize the neutral conductor in the AC distribution panel.

A 3' service area is required around all UPS equipment, equipment racks, and electrical panels. Refer to NFPA 70 Article 110-26.

UCONN uses American Power Conversion (APC) UPS equipment with an Ethernet SNMP management card for remote monitoring.

If generator backup power is available to the building, a transfer switch must be included to power the UPS.

Most equipment manufacturers require the electrical receptacles specified to be dedicated 20 amp IG duplex outlets.

Specify to have the outlets evenly distributed throughout the room and within a 6' reach from all equipment racks and cabinets.

Specify to have the outlets overhead in order to reach the racks and cabinets.

UCONN requires buildings that have more than 500 data jacks to have one 30-amp dedicated IG outlet with a NEMA N5R twist lock receptacle.

4.1.3. Telecommunication Rooms

Telecommunication Rooms (TR), also called Intermediate Distribution Frame (IDF), houses the cabling that runs horizontally to each Work Area Outlet and the electronic devices that support them.

Each room should serve a surrounding area of 225'.

There is a minimum of one TR per floor.

Telecommunication Rooms are designed for voice, data, and video equipment and NOTHING ELSE.

Telecommunication Rooms are to be rectangular in shape with a minimum size of 10' x 12'. This size should accommodate two racks and appropriate backboard space for voice and video. Larger rooms may be needed to accommodate additional equipment necessary to accommodate high density or demand of voice, data or video services.

Telecommunication Rooms shall not be located near or under bathrooms, laundry rooms, kitchens, or janitorial sinks.

All Telecommunication Rooms should be vertically congruent, located near the middle of each floor and within 90 meters of each other and all work area outlets.

No horizontal cable can exceed a length of 90 meters or 295 feet from patch panel to station jack. This distance allows for a service loop at each end of the station cable, wall traversal distance, and allowing cables to run parallel and perpendicular with the joists. Cable pathways run parallel and perpendicular to the building walls. Running cables diagonally through the building or "as-the-crow-flies" will not be accepted.

Specify at least 32 square feet of contiguous plywood backboard space for every 400 voice jacks served from the closet.

For residence hall buildings with SMATV interdiction units, specify at least 4 square feet of backboard space for every 16 room locations served.

If Telecommunication Rooms and Equipment Rooms do not stack, install a minimum of four 4" conduits for a pathway between the rooms.

Specify to have a small 2400 – 3000 watt UPS for this room.

The electrical service provided to the room should accommodate at least three dedicated 20-amp IG duplex outlets. At locations where a power supply is located to power SMATV interdiction units, an additional dedicated 20-amp circuit with a service disconnect for the transformer shall be installed.

UCONN uses American Power Conversion (APC) UPS equipment with an Ethernet SNMP management card for remote monitoring.

4.2. General Requirements

Telecommunication rooms are special purpose rooms that house telecommunications equipment and wiring. These rooms have specific requirements due to the nature, size and complexity of the equipment and wiring housed in the room.

Telecommunications rooms must be able to accommodate workstation wire terminations, riser or distribution cable terminations necessary to cross-connect workstations to network or telephone equipment, as well as video equipment. Telecommunication rooms must have the space and environmental facilities required by the electronic equipment used in today's networks, including hubs, switches, terminal concentrators, backbone multiplexing systems, fiber optic distribution panels, workstation patch panels and other devices.

4.2.1. Room Shape and Size

All Telecommunication Rooms should be rectangular in shape. Do not designate rooms with curved walls or odd shapes for Telecommunication rooms.

In general, each room must be large enough to accommodate the wiring and equipment, which will be located within them, plus additional space for growth.

UNIVERSITY ITS shall be contacted for approval of final dimensions and locations of all Telecommunication Rooms.

4.2.2. Plywood Backboards

Specify to have $\frac{3}{4}$ " AC plywood installed on all walls. Mount the plywood 2' AFF at the bottom to a height of 8' AFF.

4.2.3. Lighting

There should be adequate lighting from the ceiling.

Specify to have lights mounted higher than 8'6" AFF with a minimum of 540lux measured three feet above the floor. Special consideration will be made regarding the placement of lighting fixtures to avoid equipment racks and loaded cable trays from blocking much of the lighting.

UNIVERSITY ITS will have final approval over placement of the lights.

Illumination shall not be controlled by automatic means only per NFPA 70 Article 110-26-(3)(d).

4.2.4. Conduit and Sleeves

Specify to have a minimum of 4-4" sleeves installed on the inside wall near the ceiling adjacent to the hallway for horizontal pathways.

Specify to have a minimum of 4-4" sleeves installed in the floor and in the ceiling for riser cabling to telecommunications closets that are located on the floors above or below the equipment room.

4.2.5. HVAC Requirements

Specify to have all Telecommunication Rooms provided with adequate HVAC equipment to maintain a constant temperature and humidity level throughout the day, evening, and weekend timeframes.

Most equipment manufacturers recommend a temperature range of 60 to 80 degrees Fahrenheit and a 40-60% non-condensing humidity level.

The ambient temperature should not change more than 12 degrees in an hour.

Each room must not contain any water or drain pipes except to support the HVAC equipment.

4.2.6. Cable Tray

Specify to have a continuous pathway of cable tray placed from all the conduits or sleeves up the wall and along the ceiling around the perimeter of the walls and over all equipment racks and cabinets.

The pathway must be strong enough and well secured to support the weight of the cables and any possible splice enclosures.

All Equipment Rooms, Telecommunications Closets, and Entrance Facility rooms must have cable tray also known as runway or ladder rack line the perimeter of the room.

A minimum of 12" wide cable tray must be used for the pathway to the racks.

4.2.7. Doors

Specify that all doors for Telecommunication Rooms be a minimum of 36" x 80" with an outward swing.

The door should have no center posts or doorsills.

4.2.8. Ceilings

Do not specify suspended ceilings in any Telecommunication Rooms.

The minimum clear height of all Telecommunication Rooms must be 8 feet without obstructions.

4.2.9. Flooring

Specify to have the floor covered with light colored VCT.

Schedule the VCT installation at least one week before the rack installation.

The minimum distributed floor loading for Telecommunication Rooms or IDFs is 50 lbf/sqft.

The minimum distributed floor loading for Equipment Rooms and/or BDFs is 100 lbf/sqft.

The concentrated loading in Equipment Rooms or BDFs must be 2000 lbf over the area supporting the communications equipment.

These are minimum guidelines. The designer is responsible to determine the floor loading requirements for the equipment.

4.2.10. Convenience Power Outlets

Specify to have convenience power outlets placed at six foot intervals in the room for support and test equipment.

4.2.11. Work Area Outlets

Specify to have a minimum of 4 data and 4 voice communication outlets provided to each active equipment rack and cabinet, not co-located with the passive rack, with spare capacity available within the room.

Specify to have at least one wall mounted analog telephone with a long handset cord provided near the equipment racks.

4.2.12. Other space

Reserve space to service equipment around the racks and cabinets. See sections for specific equipment for proper space allowance.

Equipment cabinets and racks should not block pathways to evacuate the room in case of an emergency.

Refer to NFPA 70 Article 110-26.

4.2.13. Fire Protection

Specify fire protection to meet state and local building codes.

Specify at least one fire extinguisher rated for electrical fires placed near the entry to the ER.

Any wet sprinkler heads installed within these rooms must be provided with caged protection.

Alternate fire-suppression systems should be used.

4.3. Closet Layout

Detailed Layouts for the footprint of termination fields and racks must be approved by UNIVERSITY ITS before the release of the bid package.

UNIVERSITY ITS will give recommendations on the design criteria based on information about the building use and occupancy.

5. Outside Plant

5.1. Overview

The Outside Plant is the pathway for the cables to enter the building to provide service for voice, data, and video. The preferred pathway is a conduit system installed below the surface of the ground from the closest manhole.

UNIVERSITY ITS will make final approval on the Outside Plant.

5.2. Conduits

The design from each building to manhole must include a minimum of three 4" poly vinyl chloride (PVC) conduits and one 4" multi-cell conduit in every run.

Each conduit run will not exceed a maximum length of 400 feet between any two pulling spaces.

Each conduit run will not exceed a combined bend radius of 180 degrees between any two pulling spaces.

All pulling spaces including but not limited to manholes, pull-boxes, and hand-holes will be specifically designed for Telecommunications.

The design must include at least one spare conduit in every run.

5.3. Confined Spaces

All manholes are confined spaces.

Manhole size shall be minimum 6 feet wide by 12 feet long by 7 feet high.

The site drawings shall show the approximate locations. Actual locations will be determined at the job site. Locations will be determined by length and pulling capability.

Maximum distances between manholes shall not be greater than 600 feet for a run containing an aggregate of 45-degree bend, and 400 feet for runs having an aggregate of 90-degree bend.

Joint boxes are only permitted in routes having less than four (4) ducts where no branches are required, or in other areas where manhole construction is not feasible, upon approval by UNIVERSITY ITS.

5.4. Code Blue Emergency Phones

UNIVERSITY ITS and UCONN Police Department will review and approve location and installation of all Code Blue Emergency Phone foundations.

6. Building Infrastructure

6.1. Conduits

A conduit system must be part of the design of the infrastructure.

The design of the conduit support system must include the estimate of the size and weight of conduits - both empty and filled.

The design must include the pulling stress of the conduit.

One conduit in all new conduits runs must be for fiber optic cable and it must be a multi-channel conduit.

The design must include enough conduits so that none are more than 40% full and there is a spare remaining.

Refer to NFPA 70 Appendix C

The design must include pull boxes every 100 feet.

The design must include no more than two- ninety-degree bends between pull boxes.

UCONN requires that a minimum size of 1" used for EMT conduits inside buildings.

Specify no more than five station cables run through any one section of 1" EMT.

All prints, diagrams, and drawings will note specific conduits as "Used for Telecommunications."

All conduits will be identified and labeled on the prints with a unique "from - to" designation.

Pathways must not be located near sources of electrical noise.

Riser pathways should extend to the roof.

Pathways must not be located in elevator shafts.

Pathways must be installed in dry locations.

Pathways must be sized for quantity and size of cables, bend radius, and growth.

6.2. Horizontal Pathways

A center rail cable support with a minimum of one rung must be installed to run continuously from the Equipment Room to each Telecommunications Closet and to the Entrance Facility.

Additional center rail cable supports will be required from each TC out to the main corridors to form a pathway for station cabling to the Work Area Outlets.

All cable tray and center-rail systems will be identified and labeled on the prints with a unique “from – to” designation.

6.3. Sleeved Cores

A minimum of four 4” cores must be installed in Entrance Facilities, Equipment Rooms, and Telecommunications Closets.

In rooms or areas that are heavily populated with Work Area Outlets, an additional two 4” cores must be installed.

All cores must be identified and labeled with Building number, floor, and TC “from,” and the Building number, floor, and TC “to” on the print set.

UNIVERSITY ITS must approve the design of all cores before the release of the bid package.

6.4. Surface Mounted Raceway

All surface mounted raceway must be identified and labeled on the print set with the contents and the from-to locations.

6.4.1. Cable Routes

Cable routing should follow the structure of the building.

Communication cables cross the path of electrical cables at a perpendicular to minimize field effects.

The minimum configuration to each WAO is one Category 5e cable for voice and one Category 5e cable for data or one coaxial RG6 with an F connector for video.

6.5. Design Requirements for Wireless Systems

UNIVERSITY ITS must be contacted before designing any wireless systems.

UNIVERSITY ITS will perform a wireless site survey for coverage and frequency considerations before determining the wireless access point.

Typically one access point is needed for every 30 wireless users.

One data outlet shall be provided for the access point.

7. Work Area Outlets

7.1. Standard Configurations, Locations and Quantities

The standard Work Area Outlet (WAO) includes two cables to each location one for voice and one for data.

WAO shall be provided in the following locations as indicated.

Faculty/Staff Offices

Two standard WAO to be installed on opposite walls.

Additional WAO may be required depending on size of room and needs of intended occupant(s).

Dean/Director Offices

Two standard WAO to be installed on opposite walls.

One WAO shall include a coax connection.

Additional WAO may be required depending on size of room and needs of intended occupant(s).

Clerical Staff/Graduate Student Offices or Work Areas

One standard WAO to be provided for each desk or workspace.

Additional WAO may be required for additional devices (printers, fax machines, etc.).

Conference Rooms

Two standard WAO to be installed on opposite walls.

One WAO shall include a coax connection.

Additional WAO may be required depending on size or special needs of room.

Lounges/Break Rooms

A minimum of one WAO containing a coax connection.

Computer Labs

A minimum of one WAO containing dual data connections for each computer.

A minimum of one WAO containing a coax connection.

One standard wall phone to be placed near the door.

Classrooms

One standard wall mounted phone to be placed near the door.

A minimum of one WAO containing a coax connection.

Hi-Tech Classrooms

One standard WAO for a wall phone to be placed near the teaching station.

Conduit for cameras at the front and rear of the room.

Where applicable, one WAO containing two data connections placed so that there is one data connection for every seat.

One WAO containing two data and one coax connections to be located inside the cabinet of the teaching station for the classroom computer and AV Systems.

One standard WAO to be located near an electrical outlet in the knee well or other easily accessible location on the teaching station for the use of a laptop.

One 6-strand multi-mode fiber-optic cable shall be terminated in the cabinet of the teaching station with ST connectors and shall be home-run to the nearest building TC closet.

Power receptacle on front of station for laptop power and in the rear of the computer well for computer power. The power for the computer shall not be switched.

Where there is a rear projection booth in the classroom, one standard WAO shall be provided for a wall phone as well as one WAO for voice, data and coax connections.

Where there are ceiling mounted projectors or TVs, one WAO for a coax connection should be mounted in the ceiling near the location for the TV or projector.

Wall Phones (standard)

One WAO containing a voice connection per location, 48" AFF.

Campus Phones

One WAO containing a voice connection per location.

Ride Phones

One WAO containing a voice connection per location.

Area of Refuge Phones

One WAO containing a voice connection per location.

Pay Phones

Follow to ADA guidelines.

Elevator Phones

One WAO containing a voice connection per location.

Emergency Phones

One WAO containing a voice connection per location.

Intercom Phones

One WAO containing a voice connection per location.

Access Phones

One WAO containing a voice connection per location.

SmartCard

One WAO containing two data connections per location.

Monitoring Systems

One standard WAO per location.

Residence Hall/Apartment Rooms

Two standard WAO to be installed on opposite walls.

One WAO shall include a coax connection outlet served by an addressable interdiction port.

Other Systems

A minimum of one standard WAO to be installed at the location of any equipment requiring a telephone or data network connection.

Arrange with UNIVERSITY ITS in advance for any services that are required at this location for activation of building systems including Fire Alarm and EMS systems.

8. Construction Specifications

8.1. UCONN Specific Material

UCONN has standardized on specific brands for many of their telecommunications requirements. These items are included in [Appendix A](#).

All bids submitted should contain these specific brands.

Any substitutions recommended by the vendor must be reviewed and approved by UNIVERSITY ITS in writing prior to installation, including all positive and negative cost adjustments

8.2. Materials

All materials, equipment, hardware, and components to be used in the project must be new and free from defects in materials, composition, and installed workmanship.

All materials and equipment must be installed, placed, terminated, tested, handled, and processed in a manner consistent with manufacturer's instructions or prevailing codes, ordinances, and regulations whichever is more stringent.

All material will be installed in a neat and workmanlike manner per NFPA 70 Article 800-6.

The materials listed in [Appendix A](#) should not be considered a complete list.

UNIVERSITY ITS must approve any item added to the list.

No item may be substituted from the list without the express written consent of UNIVERSITY ITS.

8.3. Industry Standards

All communications design and implementation will comply with TIA/EIA 568B, 569B, 606, and 607.

These standards are known in the industry as "Category 5e standards," although they encompass more than "Category 5e" cable.

All vendors working on the design and implementation of the telecommunications infrastructure must have certifiable industry knowledge.

A BICSI certified RCDD will approve and stamp all prints relating to the telecommunications infrastructure including all rooms, closets, riser diagrams, Work Area Outlet locations, and logical designs. If the architect or engineer does not have an RCDD on staff, UNIVERSITY ITS will provide a

list of consultants who can contract for the project.

UNIVERSITY ITS will approve the RCDD used on the project. For locations with SMATV installations, the installer will use a SCTE (Society of Cable Television Engineers) certified engineer and installation crew.

9. Telecommunications Rooms

9.1.1. Entrance Facility

There shall be 6 ft between lightning conductors and communications cables and wires per NFPA 70 Article 800-13.

The facilities will enter the room from the side on the outside wall closest to manhole, pole, or other service entrance.

The point of entry for telecommunications wiring and cables shall be within 20 ft of the electrical service entry point per NFPA 70 Article 800-11(c).

All entrance cables that need to transition from outdoor cable to indoor cable must do so within 50' of entering the building.

All outdoor innerduct must transition immediately upon entering the building.

Specify to have a minimum of three (3) 4" conduits and one (1) multi-cell conduit installed on the outside wall from the building to the manhole or tunnel.

All conduits must run directly to a Telecommunications manhole or a tunnel.

No aerial cable is acceptable.

No direct-buried cable is acceptable.

All conduits that enter the room should slope towards the outside and shall be sealed on both sides at each end to prevent leaks.

All cables should have drip loops installed wherever practical.

Refer to NFPA 70 Article 800-12 (c).

9.1.2. Equipment Room

Most equipment used in this room contains switching power supplies so many manufacturers are now recommending to oversize the neutral conductor in the AC distribution panel.

A 3' service area is required around all UPS equipment, equipment racks, and electrical panels. Refer to NFPA 70 Article 110-26.

UCONN uses American Power Conversion (APC) UPS equipment with an Ethernet SNMP management card for remote monitoring.

If generator backup power is available to the building, a transfer switch must be included to power the UPS.

9.1.3. Telecommunications Closets

Telecommunication Closets (TC), also called Intermediate Distribution Frame (IDF), are to be used exclusively for Telecommunications Systems.

No horizontal cable can exceed a length of 90 meters or 295 feet from patch panel to station jack. This distance allows for a service loop at each end of the station cable, wall traversal distance, and allowing cables to run parallel and perpendicular with the joists. Cable pathways run parallel and perpendicular to the building walls. Running cables diagonally through the building or “as-the-crow-flies” will not be accepted.

If Telecommunications Closets and Equipment Rooms do not stack, install a minimum of four 4” conduits for a pathway between the rooms.

9.2. General Requirements

9.2.1. Grounding and Bonding Requirements

The Electrical Contractor (EC) must provide a good grounding conductor and busbar at this location for the equipment in this room.

All grounding and bonding must be installed to protect personnel and equipment from dangerous voltages and to reduce EMI.

The busbar must be mounted using minimum two-inch insulated standoffs.

All connections to the busbar must be made with two hole, crimp, or weld-on lugs.

Each busbar must be assigned a unique identifier and be permanently labeled.

The busbar must be electroplated for reduced contact resistance.

The busbars in the TC must be bonded to building steel using a minimum #6 AWG wire and crimp or weld-on lugs.

All TC busbars are connected to the main busbar in the EF or ER with a bonding backbone, minimum size #6 AWG, that allows no more than 25 ohms resistance between any two points in the grounding system. Refer to NFPA 70 Article 800-11

All bonding backbone cables run vertically in a multi-story building must be bonded together at every third floor intervals per ANSI/TIA/EIA-607.

Any metallic conduit used to protect grounding or bonding conductors must be bonded to the bonding backbone.

All racks and cable tray must be bonded to the bus bar.

UCONN requires a minimum of #4AWG grounding wire attached to the building electrical ground and attached to a 4” x 1/4” x 24” grounding bus-bar for all equipment grounds and cable shields. This busbar is to be located at the EF.

Grounding conductors must be individual runs to devices.

A pathway must be provided through all telecommunications rooms for the telecom ground conductor.

Grounding and Bonding must be installed to meet TIA/EIA 607.

Grounding and Bonding must be installed to meet National Electrical Code NFPA 70.

9.2.2. Plywood Backboards

Specify to have 3/4" AC plywood installed on all walls. Mount the plywood 2' AFF at the bottom to a height of 8' AFF. The plywood is to be held off the wall 6" to allow cables to pass behind.

Specify to have the plywood painted on both sides with an intumescent additive contained in the paint. A light tint or white color will reflect the maximum light.

UNIVERSITY ITS will approve the color of the paint.

9.2.3. Lighting

There should be adequate lighting from the ceiling.

Specify to have lights mounted higher than 8'6" AFF with a minimum of 540lux measured three feet above the floor. Special consideration will be made regarding the placement of lighting fixtures to avoid equipment racks and loaded cable trays from blocking much of the lighting.

UNIVERSITY ITS will have final approval over placement of the lights.

Illumination shall not be controlled by automatic means only per NFPA 70 Article 110-26-(3)(d).

9.2.4. Conduit and Sleeves

Specify to have a minimum of 4-4" sleeves installed on the inside wall near the ceiling adjacent to the hallway for horizontal pathways.

Specify to have a minimum of 4-4" sleeves installed in the floor and in the ceiling for riser cabling to telecommunications closets that are located on the floors above or below the equipment room.

Specify to have a protective bushing installed on each end of each sleeve.

Specify to have a cover placed on each end of all spare and empty sleeves.

Specify to have a pull string placed in each sleeve.

Specify to have all conduit and sleeves protrude 4" beyond the wall or floor.

9.2.5. HVAC Requirements

Specify to have all Telecommunication Rooms provided with adequate HVAC equipment to maintain a constant temperature and humidity level throughout the day, evening, and weekend timeframes.

Most equipment manufacturers recommend a temperature range of 60 to 80 degrees Fahrenheit and a

40-60% non-condensing humidity level.

The ambient temperature should not change more than 12 degrees in an hour.

Each room must not contain any water or drain pipes except to support the HVAC equipment.

9.2.6. Cable Tray

Specify to have a continuous pathway of cable tray placed from all the conduits or sleeves up the wall and along the ceiling around the perimeter of the walls and over all equipment racks and cabinets.

The pathway must be strong enough and well secured to support the weight of the cables and any possible splice enclosures.

All Equipment Rooms, Telecommunications Closets, and Entrance Facility rooms must have cable tray also known as runway or ladder rack line the perimeter of the room.

All cable tray must be secured to the plywood using proper supports.

All cable tray must run parallel and perpendicular to the top of each equipment rack.

Cable tray must be provided to a reserved area to house the cable service loops above the equipment racks.

The size of the loop will vary with the use of the rooms.

A minimum of 12" wide cable tray must be used for the pathway to the racks.

A minimum of 12" wide cable tray must be used for racks with station cabling patch panels.

A proper installation must form a brace for the equipment racks that is earthquake-proof.

All cable tray must be installed contiguously using proper sweeps and offsets to maintain proper a proper bend radius and prevent cable damage.

9.2.7. Doors

Specify that all doors for Telecommunication Rooms be a minimum of 36" x 80" with an outward swing.

The door should have no center posts or doorsills.

9.2.8. Room Security

All Telecommunication Rooms will be locked and keyed with a University core key for access by University Information Technology Services staff.

9.2.9. Ceilings

Do not specify suspended ceilings in any Telecommunication Rooms.

The minimum clear height of all Telecommunication Rooms must be 8 feet without obstructions.

9.2.10. Flooring

Specify to have the floor covered with light colored VCT.

Schedule the VCT installation at least one week before the rack installation.

9.2.11. Use of Listed Devices

All material used within the building will be listed per NEC.

9.2.12. Convenience Power Outlets

Specify to have convenience power outlets placed at six foot intervals in the room for support and test equipment.

9.2.13. Work Area Outlets

Specify to have a minimum of 4 data and 4 voice communication outlets provided to each active equipment rack and cabinet, not co-located with the passive rack, with spare capacity available within the room.

Specify to have at least one wall mounted analog telephone with a long handset cord provided near the equipment racks.

9.2.14. Other space

Reserve space to service equipment around the racks and cabinets. See sections for specific equipment for proper space allowance.

Equipment cabinets and racks should not block pathways to evacuate the room in case of an emergency.

Refer to NFPA 70 Article 110-26.

9.2.15. Fire Protection

Specify fire protection to meet state and local building codes.

Specify at least one fire extinguisher rated for electrical fires placed near the entry to the ER.

Any wet sprinkler heads installed within these rooms must be provided with caged protection.

Alternate fire-suppression systems should be used.

9.2.16. Equipment Racks

All racks must be open relay racks with vertical wire managers installed on each side.

All closets must contain a minimum of two racks, one active rack and one passive rack. The active rack is for equipment and the passive rack is for cabling.

One active rack contains equipment for 240 data jacks. One additional rack will be required for

every additional 240 data jacks served from the closet.

Each active rack must have a minimum of one 20-amp power strip permanently installed on the top of the rack with no less than six (6) outlets available for use. If it is not possible to mount the power strip on the rack, then the power strip can be mounted on the ceiling above the rack.

One 20-amp circuit can accommodate a maximum of ten (10) switches. At no time will the number of switches exceed the capacity of the electrical outlet.

All racks must be 19" wide by 84" high and have holes that comply with the 1.75U TIA/EIA standard.

Schedule the racks for installation during the first week of the cabling contractor task list as a milestone.

All racks should be installed side by side and have a dual channel vertical cable manager installed on each side and between each rack.

Bolt each rack to the floor and brace it to the walls above the racks with cable tray. Anchor racks to the floor using the appropriate kit from the OEM. The cable tray will have a minimum of two points of attachment to the walls.

Racks should be installed 3' away from the wall and have 3' of space in front of and behind them.

9.3. Closet Layout

Each TC must have a unique number to identify it using an automated cable management system. The number should include a building number, floor number, and Closet identifier.

One wall must be used for voice terminations.

One wall must be used for video terminations and equipment.

Data cabling including copper UTP and Fiber Optic cables must be terminated onto patch panels mounted onto open relay racks.

9.4. Requirements for Voice

9.4.1. Termination Fields

Specify to have 110 punch down blocks with jumper troughs and distribution rings for cable management for voice cabling.

The voice backbone punch down blocks must be placed together on backboard in the left-most position to allow room for expansion.

The voice station punch down blocks must be placed in the right-most position with room for expansion.

The two fields must be cross-connected together with wire through a cable management system including distribution rings and jumper troughs.

The exact number of blocks and management devices will be determined as design criteria.

All special circuits terminated on a separate field of punch down blocks.

Every row on the 110 blocks must be labeled with Designation Strips including a printed label with the identification number of distribution cable or station cable.

UCONN uses 110 blocks manufactured by Siemon.

All 110 blocks must have legs.

All 110 blocks must be sized for 100 or 300 pairs.

All voice station cables must terminate onto the blocks with 110-C4 block connectors.

All voice distribution cables must terminate onto the blocks 110-C5 block connectors.

UNIVERSITY ITS must approve the color of the designation strips used to differentiate the voice cables.

All voice cables must be run behind the plywood backboard before termination onto the 110 blocks.

9.5. Requirements for Data

9.5.1. General Specifications

There shall be one (1) Ethernet switch port supporting 10/100 Mb service for every data jack in every closet.

The GC and the GC's selected installer of data communications equipment shall provide a list of all equipment, procedures, and product specifications to be used to provide networked data services at this site to UNIVERSITY ITS six (6) months before targeted completion date of that installation.

UNIVERSITY ITS must review and approve all equipment and procedures used.

UCONN uses Ortronics patch panels and cable managers for the data cabling.

All patch panels must be panels that are 48 port, high density, Category 5e or higher, 110 to MJ 568B wired for data cabling. All patch panels must have rear wire management.

UNIVERSITY ITS will establish specific Network Core attachment requirements.

UNIVERSITY ITS and the University occupant of the building will provide any special networking requirements.

UNIVERSITY ITS will provide all Networking address information used for LAN device installation for the project.

GC and GCs installer must comply with all standards and guidelines established by UCONN and UNIVERSITY ITS.

NO external links or gateways to other networking resources may be installed on the UCONN network with out express consent from UNIVERSITY ITS.

9.5.2. Switch Specifications

9.5.3. Edge Specifications

Refer to [Appendix A](#) for approved switch manufacturer and model.

Switches are to be interconnected using approved modules and multimode fiber listed in [Appendix A](#).

Any Ethernet switch used must meet or exceed all specifications for the approved Switch.

If ANY alternative switch is used the GC is required to provide monitoring, and support software, hardware and documentation that would allow UNIVERSITY ITS to provide data support for these devices.

Switch stacks are NOT to exceed six (6) switches.

Variance can be granted by UNIVERSITY ITS if closet data jack count would exceed six-switch capacity by less than ten (10) ports for a given closet.

Each switch stack is to be connected to an aggregate distribution node or the core network using two (2) GB full duplex Ethernet links over fiber-optic cabling.

Vendor must provide approved fiber-optic connection cables and any fiber optic patch cables needed to connect each stack to the network core device identified in process

9.5.4. Aggregate Specifications

When there are more than 2 closets in any one building, an aggregate switch needs to be installed in the MDF/BDF.

Depending on the number of users and/or uplink ports needed will determine which model switch will be used. Please confer with UNIVERSITY ITS as to what aggregate product needs to be used.

The aggregate switch used will be required to be connected to two (2) different core sites at 1000Base-X speeds.

9.5.5. Switch Installation

Each Switch stack will require one (1) 20 amp, double-duplex dedicated power circuit.

Each power circuit will have isolated grounding.

Use one (1) Waber 72193 (or equivalent) power-strip with surge suppression per stack.

Each switch will be securely mounted, using switch vendor supplied mounting hardware, in racks provided vendor.

Switch ports will be connected to data jacks in closet patch panels using category-5e grade RJ45 Booted patch cables.

All patch cables are to be green in color.

Any TX Crossover cables (Crossed pairs) must be Yellow in color

Horizontal cable management must be installed in between every-other switch to allow neat and orderly patch cable installation. Refer to [Appendix A](#) for preferred Cable Manager.

9.5.6. Active Equipment

This equipment shall be purchased by the contractor and delivered to UNIVERSITY ITS for configuration at a point approximately six (6) weeks before building occupancy. The contractor shall retrieve and install the switches prior to building occupancy.

The contractor shall provide, at a minimum, data network switches, patch cables, fiber optic cables, station cables and ancillary materials necessary for the activation of the data network.

All data communication equipment provided by the contractor must match prevailing data equipment as specified by UNIVERSITY ITS. Submittals for all equipment shall be provided to UNIVERSITY ITS for approval approximately three (3) months prior to building occupancy.

9.5.7. Labeling and Documentation

A detailed list must be provided to UNIVERSITY ITS showing by closet, which data jack is connected to which switch by switch port number.

Documentation detailing setup information and configuration information for each device used must be provided to UNIVERSITY ITS.

Vendor/Manufacturers documentation for every device used must be provided to UNIVERSITY ITS.

All fiber optic cable jumpers and connection cables must be labeled as specified by UNIVERSITY ITS.

A complete diagram of installed equipment must be provided to UNIVERSITY ITS.

9.6. Requirements for Video

9.6.1. Active Equipment

Substitutions are not allowable.

The contractor shall provide the fiber optic receivers and transmitters to feed each building from the campus SMATV system, including all the necessary equipment which includes, but is not limited to, power supplies, intermediary splitters, and intermediary patch cables for each building location

The existing plant is standardized on highly technical interrelated frequency allocations, computer control system and configuration parameters.

Alternative vendors and materials will not be allowable in any instance without the prior written authorization of UNIVERSITY ITS.

In residence hall locations, one Blonder Tongue Interdiction Distribution Unit (VMIU) port shall be provided for each residence hall student room location. A minimum of 5% spare ports will be installed in each building for future drop installations. At least two spare test ports non-interdicted

must be installed in each wiring distribution closet. These spare ports shall have 12 dB minimum on their output ports. The vendor shall be responsible for coordination of activation and testing of the VMIU units with the University's existing Blonder Tongue Video Central Control package.

Refer to [Appendix A](#) for part numbers.

No manufacturer or part substitutions will be acceptable.

The system shall be installed to meet all manufacturer, federal communications commission and other regulatory requirements as if the system were a cable television system. These requirements include at minimum Carrier-to-Noise, Signal-to-Noise, composite Triple Beat, Composite Second Order, Hum, Cross Modulation, RF video level and RF Aural level requirements. UNIVERSITY ITS will conduct a cumulative leakage sweep of the system upon activation and before sign-off. The contractor will be expected to repair all leaks in excess of 20 dBmV measured at 3 feet from the installed equipment and cables.

ADC Homeworx 750Mhz fiber optic receiver - AC powered with FC/APC connectors. Power supply and installation cage to be provided and installed at the Homer Babbage Library if allowance is not chosen.

ADC Homeworx 750Mhz fiber optic transmitter - Minimum of 16 dB of power at 1300nm terminated into an angle-polished FC/APC connector mounting into a Homeworx transmission shelf.

Optical Splitter to provide power dividing between the buildings in the project plus one spare port on the splitter. Each splitter shall have FC/APC connectors and be rack-mountable in a single 19" EIA/TIA 1.75" rack-unit. Splitters shall be designed to allow no less than -3dB at 1310nm measured at the location of the receiver in the served buildings. If multiple transmitters are required to meet this level, the contractor will be expected to provide them.

Optical Jumper Cables shall be provided with FC/APC connectors for the University Siecor patch panels and SC/UPC connectors for the ADC receivers.

Power Supply- Where Blonder Tongue interdiction taps are installed, a power supply will be provided to power the units. It shall be a UL Listed 60 Volt AC power supply with 15 Amp rating and circuit-breaker load protection. Each power supply shall not be loaded to more than 80% load at initial installation, which is defined as no more than 18 4-port interdiction units per power supply. Power supplies shall be served with a dedicated 20 Amp circuit. A service disconnect shall be installed at the power supply location to service the power supply.

Amplifiers- 750 Mhz amplifiers with a minimum of 30 dB of gain shall be provided. Each amplifier shall have a gain and slope adjustment with a 20 dB down test port for both the input and output of the amplifier. Design calls for no less than 10 dB flat on the input to the amplifier and no more than 20 dB flat on the output. Output levels at UCONN are standardized at 49 dB on Channel 80 and 42 dB on channel 2.

Blonder Tongue Amplifier, Part Number BIDA 750-30, pad input to specification as required.

Passive Test Taps - Each location equipped with Blonder Tongue interdiction taps will have a two-port "hot tap" installed for testing and diagnostic purposes. This tap shall be secured with locking terminators approved by submittal to the University and shall provide a minimum of 15 dB on Channels 2 and 70 of the standard channel plan.

The entire system shall be installed and balanced to provide manufacturer recommended and FCC

required signal levels at the drops.

The entire system shall meet FCC requirements for Carrier to Noise, Signal to Noise, Composite Second Order, Composite Triple Beat, Audio to Video Carrier Ratio, subscriber signal level, cumulative signal leakage and all other FCC requirements.

After activation by the contractor, UNIVERSITY ITS will conduct an FCC sweep and detail any required remedies to the contractor.

10. Outside Plant

10.1. Conduits

Each conduit run from building to manhole must include a minimum of three 4" poly vinyl chloride (PVC) conduits and one 4" multi-cell conduit in every run.

PVC conduits shall be "Carlon" or equivalent, Type "C", 4" diameter, rated 50 PSI, furnished in twenty foot lengths, suitable for encasement in concrete, and complying with NEMA standard TC-10.

Multi-cell conduits shall be "Carlon" PVC/Rigid Multi-Gard Type "MX" complete "MX-4 way" innerducts. The contractor shall provide necessary accessories including but not limited to, couplings, bends, universal terminator at manhole and each building, slip couplings, and adapters fitting PVC to rigid duct.

Rigid Galvanized steel (R.G.S.) shall be used where a minimum required depth of 30" is not feasible. In this instance, the duct shall extend into the manhole and/or building for good support before concrete is poured.

Each conduit run will not exceed a maximum length of 400 feet between any two pulling spaces.

Each conduit run will not exceed a combined bend radius of 180 degrees between any two pulling spaces.

Entrance conduit must be kept as straight as possible.

A positive drain slope must be maintained at all points to prevent water accumulation.

All pulling spaces including but not limited to manholes, pull-boxes, and hand-holes will be specifically designed for Telecommunications.

No electrical pulling spaces are acceptable to UCONN.

All unused conduits must be capped.

10.2. Duct Bank

The conduit duct bank must be encased in concrete. Concrete for conduit encasement shall have a minimum compression strength of 2500 PSI at 28 days of curing. Each batch is to be slump tested before pouring concrete, with slump being a maximum of eight inches, and a minimum of six inches. Aggregated in concrete shall be no larger than ½ inch crushed stone or washed gravel

The vendor will remove ledge and/or rock boulders (less than 1 cubic yard in size) using standard construction equipment and construction personnel on the job site. During the course of construction of

the University's underground conduit system, wherever possible, the vendor will use excavation equipment such as a backhoe with a single point bucket, jack hammer, wedge, or rock/ earth saws.

Wherever ledge and/or rock boulder conditions or non-utility underground obstructions exceed standard construction, removal and/or excavation capabilities, and/or extraordinary measures will be required to proceed, UNIVERSITY ITS and the vendor Project Manager will consult to review the most cost effective alternatives available, such as:

- Re-routing of the path of the structure to circumvent the underground obstruction(s)
- A shallow trench placement using steel conduits
- Use of specialized construction equipment (not already on the job site) and personnel to perform the removal

The vendor will notify all owners of utilities on the campus that may be affected by the planned underground construction. The vendor shall contact "Call Before You Dig" to determine locations for all known utility service and/or underground structures prior to the start of construction.

All duct-banks shall have spare ducts after installation of new cable. Spare duct quantity requirements are:

- Three (3) spare four-inch (4") ducts in main and feeder routes.
- Two (2) spare four-inch (4") ducts in entrance routes to buildings.

Install exterior duct banks with no more than 2-90 degree bends. All duct bend radiuses are to be 10 times the duct I.D. minimum for the bend radius. Where sharp bends or turns are required, prefabricated fittings shall be used unless such bends or turns prohibit the pulling of large cables and the broadband cable required for data communications. In such cases, joint boxes/pull boxes shall be installed.

Where long turns or bends are required in the duct formations, the straight duct sections shall be formed, only wherever large radius turns can be safely made without deformation of the duct cross-section. Watertight joints between sections of ducts shall be made using PVC solvent cement.

In constructing the duct bank and before pouring concrete removable PVC duct separators (separating conduits 2 inches apart) shall be placed at intervals of approximately six (6) feet and fastened securely. All ducts and conduits shall be securely fastened in place during construction. Each end of a duct or conduit shall be supported with "Carlton Snap-Loc" spacers and shall be plugged to prevent seepage of grout, water, or dirt into them during construction. Any section having a defective joint is not acceptable.

An iron-shod mandrel, not more than ¼ inch smaller than the bore of the duct and/or conduit shall be passed through each duct. The mandrel shall have a leather or rubber gasket slightly larger than the duct hole, to remove all accumulated moisture or obstructions before the installation of conductors.

Where possible, the duct and structure systems shall slope at a minimum 3 inch drop per 100 foot run to permit penetrating water to drain towards the manhole(s). If not possible, the duct and/or structure system shall maintain a slope that will permit penetrating water to drain towards the manhole(s). Should such sloping not be possible, the vendor shall submit a request to UNIVERSITY ITS for a variation; for which approval will not be unreasonably withheld. Where contour prevents the required slope, lines shall slope from high point to pull box in both directions. Avoid pockets or traps where moisture may accumulate.

Steel and PVC ducts shall be encased in a concrete envelope. Trenches for concrete encased duct shall be opened the complete length before concrete is poured so that if any obstructions are encountered,

proper provisions can be made to avoid them. Where two or more ducts are encased in concrete, a space of not less than 1 inch (measured from outside wall to outside wall) shall be maintained using spacers applicable to the type of duct. As the duct laying progresses, concrete not less than 2" inches thick shall be placed around the sides and top of the duct bank. End bells or couplings shall be installed flush with the concrete encasement where required.

When specified and wherever concrete encased ducts cross other utilities, reinforce the bottom and top of encasement with steel reinforcing fabric mesh, or other approved metal reinforcement. Additional supports shall be installed where the ground is soft and boggy, where ducts cross under roadways, or whenever otherwise shown on the plans. Wherever soft or boggy soil is encountered, the complete duct structure shall be supported on reinforced concrete footings or piles as required.

The following minimum clearances shall be maintained unless otherwise noted:

<i>Utility</i>	<i>Crossing</i>	<i>Parallel</i>
Gas Main	12"	30"
Gas Service	12"	12"
Water Main	12"	18"
Steam Main	18"	48"
Electric Facilities	12"	12"
Storm & Sanitary Sewers	12"	12"

All concrete shall be poured onto the duct bank using a chute and evenly distributed by hand to provide minimum encasement.

The vendor shall not use any prefabricated conduit sections of ducts embedded in pre-cast concrete. Concrete shall be poured in place to encase all ducts.

All new ducts shall be provided with a minimum 3/8" diameter 200lb strength nylon pull cord. Sufficient length shall be left in pull boxes/manholes bending the drag cord back to prevent it from slipping back into the duct.

The open ends of all spare installed ducts shall be plugged with readily removable "Carlson" made Terminator Type I kit to prevent water from entering the ducts.

The duct back must have a warning ribbon at least 12 in. above the underground installation. Refer to NFPA 70 Article 300-5 (d).

The installed outside plant including but not limited to conduits, manholes, hand-holes, and pull-boxes will become property of UCONN upon completion of the project.

The installation contractor will perform a walk-thru with UNIVERSITY ITS of the outside cable plant construction during all phases including a final walk-through noting measurements and landmarks as references.

10.3. Confined Spaces

All manholes are confined spaces. Certification and training is required for all individuals entering manholes.

Contractors must adhere to appropriate OSHA safety procedures at all times. This includes ventilating the manhole and using proper safety gear to raise and lower individuals into the space.

New manholes shall be of the pre-cast or cast in place telephone manhole type Splay Entrance with Teraducts and inserts. Please see [Appendix A](#) for approved manufacturer and model number. Equivalent substitutions may only be made with the approval of UNIVERSITY ITS.

Manhole size shall be minimum 6 feet wide by 12 feet long by 7 feet high.

Minimum depth from ground surface to top of manhole roof shall be one foot (1'-0").

Minimum strength in compression requirement shall be 5000 PSI in 28 days and shall meet State Highway specifications for H-20 wheel loading.

All reinforcement bars shall be of intermediate Grade steel, which conform to manufacturing requirements and State Highway requirements for H-20 wheel loading.

All conduits shall enter and exit on two opposite pre-cored end walls only. Conduits should enter manholes in a splayed vertically stacked design 9 inches from the corner of the side walls and be terminated with bell ends. At no time should conduits enter on the sidewall of the manholes. Conduits should be neatly stacked into the pre-cored Rotundo knockouts starting on the bottom to allow for future expansion from the top.

The location of manhole cover, Teraduct layout and other details shall be shown on drawings and shall be clear of reinforcement bars.

Pulling eyes or iron opening shall be included in the manholes as per manufacturer specifications.

The manhole shall be fitted with a metal frame and lettering "Telephone" or "Communications."

The manhole shall be equipped with cable racks, pulling irons, sump hole, frame, and cover. The frame nominal opening shall be 27"(inches).

A PVC water barrier shall be installed at each construction joint.

Standard hardware required for construction and utilization of manholes shall be provided. This includes rocking bolt assemblies, vertical support brackets, pulling irons, ladder support hooks, etc.

Maximum distances between manholes shall not be greater than 600 feet for a run containing an aggregate of 45-degree bend, and 400 feet for runs having an aggregate of 90-degree bend.

UNIVERSITY ITS reserves the right to require the vendor to install additional manholes if, during the construction phase, rerouting of new underground structures is required. The manholes shall be sealed per industry standards. The vendor shall be responsible for the pumping of all manholes.

Joint boxes are only permitted in routes having less than four (4) ducts where no branches are required, or in other areas where manhole construction is not feasible, upon approval by UNIVERSITY ITS.

All holes required in concrete structures (except manholes) for installation of outside plant and inside plant shall be mechanical cored and sleeve installed. The exception being existing manholes where several options may be incorporated for creating entrance into the structure. Regardless of the method used the vendor will patch and seal to restore the manhole to acceptable condition.

10.4. Wiring and Terminators

Secure all cable entering a manhole to rack supports on the sides of the encasement.

Leave a service loop of cable whenever possible.

Do not block unused ducts with cable as it passes through the manhole.

Splices are not preferred in manholes. If a splice is required in the manhole, an appropriate preformed waterproof enclosure must contain the splice. Secure the splice boot to the racking system in a manner that does not block ducts or prohibits movement within the encasement.

Outside non-rated cables will be terminated within 50' of building entrance or will be required to be placed in approved metallic conduit to termination location per NEC Regulations.

The vendor shall be prudent in the OSP design and installation using all available industry techniques to fully utilize individual ducts and avoid using existing spare ducts where feasible.

The vendor shall use all industry available techniques to pull out cable, and take every possible precaution to leave the duct in a usable condition.

Existing conduits full or otherwise not usable can fulfill the requirements for spare capacity. The vendor shall clear such conduits by pulling out existing wire immediately after cut-over, cleaning and rodding the ducts, and installing pull wires. This duct clearing process shall be substituted for new construction where spare capacity specifications can be met.

Where the existing ductbank does not have sufficient capacity for installation of the new cable and spare capacity as required the vendor shall install new ducts.

The vendor shall notify University ITS when conduit spares do not exist after cut-over. The conduit is not an adequate spare if the vendor uses the existing conduit and the abandoned cable cannot be removed. It is at this point, UNIVERSITY ITS shall decide whether the contractor should open the ground for the installation of spare conduit.

All ducts including those that contain cable shall be sealed according to industry standards to provide a watertight seal.

10.4.1. Copper

All copper cable used in outside plant shall be gel filled bonded ASP using 24AWG twisted pair copper cable. All cable shall be waterproof type ANMW.

All splice connections in manholes and in aerial runs shall be placed in waterproof enclosures and sealed according to industry standards. However, all splice enclosures shall be able to be re-entered.

All copper cable which enters or exits a building shall be minimally "gas tube" protected at both ends by using Lucent Type 188 blocks and pigtails at the buildings and Lucent Type 311 blocks and pigtails at the EF.

All outside plant shall be properly grounded according to industry standards and local requirements with #6 AWG copper grade wire connected to electrical grounding system.

10.4.2. Coax

All OSP coax shall include a .750" parameter III coaxial cable gel filled between each distribution building and end-point buildings.

Splices to ISP shall include heat shrink and sealant.

Each cable shall be grounded using an approved block.

10.4.3. Fiber

UCONN uses multi-mode and single-mode fiber.

All fiber will be tested and test results will be provided in paper and electronic formats to UNIVERSITY ITS before project completion.

Splicing shall only be allowed when approved by UNIVERSITY ITS.

See [Appendix A](#) for approved racks and patch panels.

10.4.3.1. Multi-mode

Outdoor fiber optic cable will be multi-mode FDDI grade, loose tube construction, 62.5/125um multi-mode all dielectric. It will be terminated using ceramic tipped ST connectors and shall be installed in its own duct or in its own flexible innerduct within the 4" PVC duct. In each building EF, a 50' service loop is required before attaching fiber to the Fiber Patch Panel.

The multi-mode fibers will be tested at 850nm, 1300nm in one direction.

Any installation requiring splicing other than to pigtails will require an OTDR trace at 850nm.

10.4.3.2. Single-mode

Single-mode fiber, 9/125um can be placed in the same duct/innerduct as the multi-mode fiber. The single-mode is to be terminated by fusing FC/APC pigtails at both ends. In each building EF a 50' service loop is required before attaching fiber to the Fiber Patch Panel.

The single-mode fibers at 1310nm, 1550nm in one direction.

Any installation requiring splicing other than to pigtails will require an OTDR trace at 1310nm.

10.5. Code Blue Emergency Phones

10.5.1. Overview

UNIVERSITY ITS will provide and install all Code Blue Emergency Phones.

The GC will provide and install foundations for all Code Blue Emergency Phones.

UNIVERSITY ITS and UCONN Police Department will review and approve location and installation of all Code Blue Emergency Phone foundations.

10.5.2. Installation Requirements

A 2' circular concrete foundation shall be poured at a minimum depth of 42" for each Code Blue Emergency Phone.

The top of the base shall be crowned to allow for drainage and the base will be a maximum of 1" – 2" above ground level.

The foundation shall be installed so that the phone is wheelchair accessible and include a concrete pad at the base if necessary.

The foundation will not be installed in landscaped areas unless it is directly against and facing a sidewalk.

The foundation will not be installed behind curbing.

Four j-bolts will be installed in the concrete base in an 8" circle; two bolts shall be parallel with the sidewalk.

A minimum 6" of thread shall be exposed on the end of each j-bolt. Nuts and washers are to be left on the threads.

Code Blue Emergency Phone bases shall be covered to protect against weather.

UNIVERSITY ITS will provide j-bolts and a template upon request.

Each foundation shall have two 1" conduits stubbed up in the center of the foundation and trenched into the building specified by the project.

One conduit shall terminate in the BDF. This conduit will have a pull string installed, tied off at both ends, and will be labeled in the closet as "Code Blue".

The other conduit shall terminate in the electrical panel and will provide 110VAC power on a dedicated 15-amp circuit with emergency power backup for each Code Blue phone.

The electric feed shall include 3' of looped THHN at the foundation.

The panel breaker number shall be clearly identified as "Code Blue".

The breaker shall be left in the OFF position.

Conduits shall comply with proper bending radii.

Each base shall have dedicated conduits and electric service installed. No looping of multiple bases is allowed.

UNIVERSITY ITS shall be provided with as-built drawings immediately upon completion.

As-built drawings must include conduit locations, electrical panel number and breaker information.

10.6. Trenching, Back-Filling and Restoration of Grounds

Identify and label all manholes, pull-boxes, hand-holes, and junction boxes.

Trenching shall be done using trenching machines or backhoes and supplemented by hand excavation where required.

All excavated material shall be marked and placed in such a manner to protect pedestrians and control

traffic flow.

Sheathing shall be placed on excavated material and trenches to protect pedestrians and other traffic from injury. Safe, temporary passage shall be provided for all vehicles and pedestrians at existing sidewalks and roadways cut by trenches. A minimum cover of twelve (12) inches on non-clay granular fill above conduits shall be provided. All debris, large rocks, and large vegetation shall be removed from any excavated soil to be used as remaining backfill. A continuous plastic marking strip labeled "telephone" or "communications" shall be embed twelve (12) inches below finished grade. This tape should include a metal strip for location from surface by detector.

After installation of concrete, the trench shall be filled in several layers with each layer properly tamped before installation of next layer.

The depth to the top of the concrete level shall be maintained at a minimum of thirty (30) inches.

The vendor shall be responsible for all damage caused to the University, public, and private property from the construction of the outside plant.

The vendor shall repair and restore University grounds and property to its original condition using materials of same or better type/quality. This includes but is not limited to, re-paving, reseeding, walls, fences, landscaping, utilities, signs, painting, and curbing. Bituminous for roads, parking areas and footpaths shall be provided in two (2) courses (2 1/2" binder and 1" surface course) for all pavement areas. All existing paths and roadways of greater depth shall be repaired to match existing materials and depths. UNIVERSITY ITS reserves the right to inspect all materials to be used and to demand changes in type and quality to attain University standards. These standards will be supplied to the vendor at a timely point during the implementation process. Such changes shall be at the vendor's expense unless the University requires materials of a higher quality than originally installed.

In all cases concerning determination of "original condition," UCONN shall be the judge and has final approval.

The vendor shall maintain, preserve, and adequately protect all utilities and services traversing and located within the vicinity. The vendor shall be responsible for interruptions of all services to existing buildings.

Disruptions shall be restored immediately to original condition with continuous effort. Work shall be performed on an emergency round-the-clock basis, using sufficient number of personnel and equipment to restore the services in the shortest possible time.

The vendor shall be responsible for any substandard damages caused by interruption of services, such as freeze-ups, electrical or mechanical failures stopping equipment where such interruption is caused by the performance of work requested.

10.7. Documentation

Identify and label all manholes, pull-boxes, hand-holes, and junction boxes on the print set.

Labeling must be performed in all phases of installation and each final label must be permanent and fixed.

Use butterfly diagrams to show all manholes, pull-boxes, hand-holes, and junction boxes including cables paths and racking requirements.

11. Building Infrastructure

11.1. Conduits

All conduits must be supported with independent suspension, such as unistrut.

One conduit in all new conduits runs must be for fiber optic cable and it must be a multi-channel conduit.

A pull rope is required in every conduit.

Proper joints are required between all conduit sections to insure good bonding.

Cap unused conduits and seal with a fire-stop pillow for easy removal.

UCONN requires that a minimum size of 1" used for EMT conduits inside buildings.

Specify no more than five station cables run through any one section of 1" EMT.

UNIVERSITY ITS must approve any greater number of station cables run in 1" EMT.

Specifications to UNIVERSITY ITS must include the exact cable types, including manufacturer, cable jacket type, and outside diameter.

EMT must be UL approved and stamped

EMT must be zinc coated with a factory applied interior lining or coating.

Electrical PVC conduits will not be used inside a building.

UCONN uses set-screw or compression type couplers and does not allow crimp-type connectors.

Box-connectors and plastic bushings must be installed on all conduit stub-outs above the ceiling.

All EMT used for Work Area Outlets should stub into a 4 11/16"sq x 2 1/8" Grade Standard back-box with a single gang plaster ring installed on the front of it.

All conduits for the use of fiber optic cable to maintain a minimum bend radius of 20 times the outside diameter of the cable.

All pull boxes used for fiber optic cables will have spindles installed for bends and will take the biggest sweeps available in the boxes.

Proper pull-boxes will be installed wherever required, since "L" fittings are not usable with fiber optic cable.

Pull boxes used for fiber should be over-sized, have a hinged cover, and large enough to store a service loop of cable.

UNIVERSITY ITS must approve any use of "L" fittings on exposed work for UTP cabling.

UNIVERSITY ITS only accepts the use of Crouse-Hinds fittings.

All pull boxes and each 10' section of conduit that contains fiber optic cable will have a fixed secure

bright bold label specifying “Danger – Fiber Optic Cable” and “Danger - Laser Light in Use.”

UNIVERSITY ITS will approve all labels before installation.

All prints, diagrams, and drawings will note specific conduits as “Used for Telecommunications.”

All conduits will be identified and labeled on the prints with a unique “from - to” designation.

UCONN uses heavy stamped steel boxes with covers attached by screws and knockouts sized for connecting conduits at opposite ends.

The size of the box must be matched to the conduit used. Two- inch conduit requires a minimum sized box of 8” wide by 36” long by 4” deep. Four-inch conduit requires a minimum sized box of 15” wide by 60” long by 5” deep.

All boxes in finished areas must have a finished neat look.

UNIVERSITY ITS must approve all pull boxes and junction boxes in the design.

Pathways must not be located near sources of electrical noise.

Riser pathways should extend to the roof.

Pathways must not be located in elevator shafts.

Pathways must be installed in dry locations.

Pathways must be sized for quantity and size of cables, bend radius, and growth.

11.2. Horizontal Pathways

A center rail cable support with a minimum of one rung must be installed to run continuously from the Equipment Room to each Telecommunications Closet and to the Entrance Facility.

Additional center rail cable supports will be required from each TC out to the main corridors to form a pathway for station cabling to the Work Area Outlets.

UNIVERSITY ITS must approve the use of basket tray.

All cable supports must be independently suspended.

Refer to NFPA 70 Article 800-6

Refer to NFPA 70 Article 800-52 (2) (e)

All firewalls penetrated by cable trays or supports must be resealed with firestopping devices, using pillows wherever possible.

Refer to NFPA 70 Article 800-52 (2) (b).

11.3. Sleeved Cores

All wall and floor penetrations for Building Facility Rooms must be made with sleeved cores.

A minimum of four 4” cores must be installed in Entrance Facilities, Equipment Rooms, and Telecommunications Closets.

In rooms or areas that are heavily populated with Work Area Outlets, an additional two 4” cores must be installed.

All cores must be lined with sections of 4” EMT.

All EMT sleeves must be reamed and have a plastic bushing installed on each end.

All sleeves must extend 4” beyond the wall or floor.

A section of vertical ladder rack must be installed as a pathway from floor to ceiling behind areas where cores stack between floors to secure pass-through cables and service loops.

During construction all sleeves must have a firestopping pillow installed in it.

All firestopping pillows must be reinstalled daily during cable installation and at no time will sleeves be left unprotected.

All sleeves must have a firestopping caulk applied to the outside circumference of the sleeve on each side of the wall penetration and from the top of a floor penetration.

Wherever it is not feasible to use a pillow or caulk, use firestopping putty.

All other firestopping methods need prior approval by UCONN Facilities.

All cores must be identified and labeled with Building number, floor, and TC “from,” and the Building number, floor, and TC “to”.

11.4. Surface Mounted Raceway

Surface mounted raceway will be used only when necessary.

UCONN uses Wiremold products and Square D wireways with hinged covers.

11.5. Firestopping Penetrations

All attempts shall be made to prevent the spread of fire, smoke, or water.

Firestopping methods include mechanical systems, putty, caulk, pillows, intumescent sheets and wrap strips.

Firestopping materials must be prepared and installed using established quality control procedures.

All products used inside a building shall have the highest UL ratings available and will bear the UL stamp.

All copper cabling used in plenum areas must be stamped CMP.

All fiber optic cabling used indoors must be stamped OFNP.

All plenum rated innerduct used must be stamped “plenum.”

Plenum-rated innerduct shall be used in all indoor locations except where EMT is used.

Plenum rated fiber and innerduct must be used indoors to prevent possible future disruptions from later renovations that may add plenum air returns.

UNIVERSITY ITS will make the final decision on whether to purchase the upgrade to the cable.

All paint used in Building Facility Rooms should contain an intumescent additive.

All floor mount penetrations for work area outlets will have a firestopping device contained within the monument.

12. Backbone Cabling

12.1. Overview

There are two types of backbone distribution cable – outdoor which is used for building to building connections, and indoor which is used for connections between Entrance Facilities, Equipment Rooms, and Telecommunications Closets.

12.2. General Requirements for Fiber

12.2.1. Outdoor

The minimum strand count of outdoor fiber optic backbone cable must be 12 strands of multi-mode and 12 strands of single-mode fiber optical cable for buildings with less than 200 jacks.

The minimum strand count of outdoor fiber optic backbone cable must be 24 strands of multi-mode and 24 strands of single-mode fiber optical cable for buildings with 200 or more jacks.

Where multiple new buildings are included in the project scope, a single location will serve as the hub site for fiber optic cable and will include 24 multimode and 24 single-mode cables from the hub site to two other hub sites on campus.

The minimum pair count of outdoor copper backbone cable for voice must be 200 pair. In certain applications a smaller cable maybe used, but must be approved by UNIVERSITY ITS.

The video backbone between buildings will use the single-mode fiber optical cable and optical 750 Mhz laser transmitters and receivers.

12.2.2. Indoor

The minimum strand count of indoor backbone cable includes 12 strands of single-mode and 12 strands of multi-mode fiber optical cable.

The minimum pair count of indoor backbone copper voice cable is 100 pair.

Specify to have two pairs for every WAO plus 40% growth capacity for that Telecommunications Closet for the indoor backbone copper voice cable size for design purposes.

In risers, the minimum SMATV video cable will be .500 Parameter III CATV-R cable. RG-11 risers are not acceptable.

UNIVERSITY ITS must approve all counts and sizes of all intra-building cables before the release of the bid package.

All cable must be new.

Used cable is not acceptable.

All distribution cables must have a unique identification number including Building and TC or ER "from," and Building and TC or ER "to."

Each pair or strand must have a unique number for tracking on an automated cabling system.

Each cable must have an appropriately sized plastic adhesive label on each end with its identification number printed on it.

UNIVERSITY ITS must approve the numbering scheme before the release of the bid package.

The prints and riser diagrams must have the identification labels on them.

There must be a spreadsheet prepared with all cable numbers recorded for cross-connect identification purposes.

The form of this spreadsheet must be in a format that is easily imported to an automated cable management system.

Backbone cabling must be installed in a star topology with the ER as the central hub.

12.3. Design Requirements for Data

12.3.1. Outdoor

Data services must be provided to each building over fiber optical cable.

Both single-mode and multi-mode fiber must be installed.

UNIVERSITY ITS will determine the exact counts of fiber required above the minimum based on the usage and population of the building.

The fiber optic cable must be installed into the multi-ducted conduit.

Outdoor fiber optic cable must be loose-tube gel-filled with an UV rated jacket.

All outdoor fiber optical cable must transition immediately upon entering the building unless it is rated as indoor/outdoor cable and is properly UL-rated.

If outdoor innerduct is used, it must transition to plenum rated innerduct immediately upon entering the building.

The 50' rule does not apply to fiber since a minimum of 50' is required for the service loop to

transition the cable.

A minimum of 50' of fiber optical cable must be left in a service loop at all fiber optic splice and termination locations, and in all pull boxes and manholes to provide enough cable for splices.

A significant amount of cable length is required to make a splice in an indoor fiber optical cable and this length increases ten times for outdoor cable because of the manufacturing differences in the cables.

12.3.2. Indoor

Indoor fiber optic cables must be tight-buffered plenum rated cables installed in a plenum rated innerduct.

A significant amount of cable length is required to make a splice in an indoor fiber optical cable.

A furcation break-out buffer tube kit must be installed on all loose-tube gel-filled fiber cables.

All splices to fiber optic cables must be performed using a fusion splice.

Mechanical splices are not allowable.

A maximum of .05db loss measured at 1310nm is allowable in a splice.

Refer to TIA/EIA 455-34 or TIA/EIA 455-59

Single-mode fiber must be 9/125micron size.

Multi-mode fiber must be 62.5/125micron size.

UNIVERSITY ITS must approve size of the multi-mode and single-mode fiber optic cable counts before the release of the bid package.

All patch panels containing single-mode fiber must be marked in green.

Refer to [Appendix A](#) for appropriate manufacturer and part numbers.

UCONN will accept no substitutions on the fiber optic components. No alternates are acceptable on fiber connectors.

All patch panels must be securely fastened and have protective covers.

A minimum of 1m of fiber shall be left accessible and spare in the fiber storage cabinet behind the termination panel between any splices and termination pigtails, or on any direct terminations for future re-termination or splicing purposes.

12.4. Design Requirements for Voice

12.4.1. Outdoor

Voice services must be provided to each building with high count UTP 24AWG copper cable with individual color-coded insulated copper conductors.

The minimum count of outdoor cable for voice between buildings is 200 pair.

Each 100 pair cable contains four 25 pair binders.

If the design includes two or more cables in one duct, the sum of the outside diameters of all the cables should not exceed a 40% fill-rate of the inside diameter of the duct.

The 40% rule does not apply to one duct that contains one high pair-count cable.

For inter- building cables, provide for a pull-box every 400' below grade and no more than two ninety-degree bends in the pathway.

If the pair count exceeds 600, the bends must sweep very gradually and must not exceed a forty-five degree bend.

Outdoor voice cable must be transitioned to indoor cable within 50' of entering the building.

Leave a service loop for any future splices or terminations.

The shields on outdoor voice cables must be properly grounded on each end.

Refer to TIA/EIA 606 as a reference for this item.

Lightning protection is required for each pair of the copper voice cables.

The cable must be terminated onto a block specifically designed to have a lightning protection resistor installed in-line with each pair that is cut-down onto the block.

The minimum protection device allowable is a solid state relay that automatically resets after small surges and transient spikes.

UCONN uses 110 style termination blocks for voice service.

12.4.2. Indoor

For intra-building cables, provide for a pull-box every 100' and no more than two ninety-degree bends in the pathway.

Specify indoor voice backbone cables with a minimal rating of CMR and installed in conduits.

Specify to have bidders submit a price for CMP rated cables instead of CMR rated cables.

UNIVERSITY ITS will make the final decision on the type of cable to install.

12.5. Design requirements for Video

12.5.1. Outdoor

Provide video services to each building over a single mode fiber optical cable.

The contractor will install a fiber optic transmitter and at the Homer Babbidge Library and provide all patch cables between the library and the buildings as required. Optical splitters may be used to serve multiple buildings, but signal levels at each receiver must be no less than -3 dB at 1310 nm.

Where spare transmitter shelf capacity is not available at the library location, the contractor will supply a transmitter shelf and dual power supply.

Transmitters should be specified to be 16 mW power.

Trunk levels entering any amplifier will be no lower than 10 db on any analog channel between 2 and 80.

The output of each amplifier shall be designed for 49 db at channel 80 and 42 db at channel 2.

No more than 2 amplifiers may be used in any cascade.

Each amplifier will have all electronics for 5-50 Mhz return capability installed.

12.5.2. Indoor

Specify to have the video distribution cable from the ER to the TC provided as ½" .500 hard-line coaxial CATV-R cable to serve the SMATV system.

See [Appendix A](#) for approved cable.

No substitutions are allowable except as specifically authorized by UNIVERSITY ITS

No kinks or nicks are allowable in this cable and damaged cable must be re-pulled.

Specify to have installers certified by the manufacturer for the termination of this cable.

SCTE certified installers are required for the SMATV system.

All installers must use tools specified by the OEM for the termination of this cable.

At each video outlet location 15 db at channel 80 and 12 dB at channel 2 will be the maximum allowed output. The minimum level at any output is 4 dB at channel 80 and 1 dB at channel 2.

For residence hall locations with interdiction taps, splitters may be installed after the interdiction distribution tap for multiple outlets in the same suite of student rooms. Any location with a separate doorway to a common hallway must have a separately addressable interdiction port.

All coaxial cable must meet or exceed CATV-R ratings.

UCONN will accept no substitutions on video components.

13. Horizontal Cabling

13.1. Overview

Horizontal cabling is the station cabling that runs from the Telecommunications Closet to the Work Area Outlet (WAO).

The cabling vendor is required to attend a certification class from the OEM on the materials before installation begins.

Copies of the certificates must be given to UNIVERSITY ITS prior to installation.

The technicians performing the installation must be certified technicians.

13.2. General Requirements

All horizontal cable must be new.

Used cable is not allowable.

Install horizontal station cabling in a star topology with each cable individually homerun back to the TC serving that area.

Label each end of the cable with a plastic adhesive label with the station number printed on it.

All station cabling must be homerun from the TC to the WAO.

No splits, splices, taps, or bridges can be in station runs.

A 10' service loop for each station cable must be left in the TC.

A 10" service loop left at the WAO.

A maximum of 25 lbs of pulling force per cable can be used to pull.

The station numbers for each location must match the station numbers on the prints.

UNIVERSITY ITS must approve the numbering scheme before the release of the bid package.

13.2.1. Cable Routes

Cable routing should follow the structure of the building.

Communication cables cross the path of electrical cables at a perpendicular to minimize field effects.

Install communication cables at a minimum of 12 inches from conduit and cables of 2kVA and fluorescent lights, and 48 inches from 5kVA lines, transformers, and motors.

Avoid any heat sources in the pathway of the cables

Cable pathways will run parallel and perpendicular to the building walls. Running cables diagonally through the building or "as-the-crow-flies" will not be accepted.

Install horizontal station cables in a continuous pathway independently supported every 36 inches to the building structure.

The minimum configuration to each WAO is one Category 5e cable for voice and one Category 5e cable for data or one coaxial RG6 with an F connector for video.

All wall and floor penetrations require a metal conduit sleeve with plastic bushings installed on each end.

All openings in fire barriers shall be resealed to meet local and state fire codes and the NEC.

13.2.2. Outlet Boxes

All outlet boxes must be securely fastened to the building structure.

Recessed outlet boxes or extension covers must be set flush with the face of the finished wall and no more than 1/4" behind the finished face of the wall.

All workboxes must be 4-11/16" x 4-11/16" x 2-1/8" workboxes with a minimum size of 1" EMT stubbed into the ceiling area or raceway system.

All conduits and outlet boxes must be grounded.

All EMT must have plastic bushings installed on each end.

Single gang plaster rings must be fitted over the outlet boxes.

13.2.3. Faceplates

The jacks must be inserted onto a flush-mounted single gang stainless steel faceplate or other to match electrical faceplate or as preferred by owner/occupant.

The faceplate top position for voice jacks, the middle position for data jacks, and the bottom position for video jacks.

Each faceplate must be labeled with a printed adhesive label with the complete station number and jack designation.

13.2.4. Hangers and Supports

Supports for conduits must be malleable hangars supported for pulling force, placed per NEC regulations.

Groups of conduit must be supported using horizontal metal supports below the conduits with vertical hangar rods on each end.

UCONN uses Unistrut.

All supports attach to walls with metal expansion shields.

At NO time are explosive shields and inserts allowable at a UCONN facility.

All support devices and accessories must be UL approved.

13.3. Requirements for Voice

The voice station cable is green colored jacket, 100 ohm, four pair, 24AWG, with pull-back string, Unshielded Twisted Pair or UTP, Category 5e or better.

UCONN uses Berk-Tek or Mohawk cable.

If a different grade of cable is used it must be a different color than green. UCONN exclusively uses

green for Category 5e, blue for Category 5 and gray or ivory for Category 3.

The voice cable on the station side must terminate with a Category 5e or better jack, wired for 568B, eight positions, MJ, high density, and colored “office white”.

Splitting of cable pairs is not allowable.

Jack color should match the faceplate color provided throughout the job.

The closet end of the voice cable must terminate onto 110 blocks.

Wall telephones must terminate with a wall mounted non-flush voice/data jack.

13.4. Requirements for Data

The data station cable is green colored jacket, 100 ohm, four pair, 24 AWG UTP, Category 5e.

UCONN uses Berk-Tek or Mohawk cable.

Cables must be installed to Category 5e specifications.

The data cable on the station side must terminate with a Category 5e jack, wired for 568B, eight position, eight conductor, MJ, high density, non-keyed, and colored “office white”.

Splitting of cable pairs is NOT allowable.

Specify the closet end of the cable for termination onto Category 5e, eight position, eight conductor, MJ to 110, high density, 48 port patch panels, wired for 568B.

Each port of the patch panel must be labeled on the front and back with printed adhesive labels of the complete station number before cable termination.

The jack and patch panel must be the same level as the cable if a better grade of cable is used.

Both the jack and the patch panel must be configured for “568B” wiring.

UCONN uses Ortronics patch panels.

13.5. Requirements for Video

The video cable is 75 ohm, coaxial RG6, quad shielded, CATV rated minimum.

Each end of the video cable must be terminated with an F connector.

UCONN specifically uses Augat Brand Snap-N-Seal connectors.

No other connectors are allowable.

Positive compression type connectors with minimal signal leakage characteristics must be installed with OEM installation tool.

UNIVERSITY ITS will conduct a cumulative signal leakage sweep of the RF plant after installation and will provide a list of leaks exceeding 20dBmV to the contractor after installation but before sign-off. The

contractor shall be responsible for repairing any signal leak beyond 20 dBmv in compliance with FCC regulations.

UCONN will accept no substitutions for SMATV components.

13.6. Requirements for Wireless Systems

UNIVERSITY ITS must be contacted before performing any wireless installations.

UNIVERSITY ITS will perform a wireless site survey for coverage and frequency considerations before determining the wireless access point.

The wireless access point must be registered with UNIVERSITY ITS wireless authentication and network system.

Wireless access points must be Lucent Orinoco AP-1000 with a Lucent Orinoco Silver PC Card.

A Lucent Orinoco Range Extender antenna may or may not be used depending on the building materials within the access point's coverage.

Typically one access point is needed for every 30 wireless users.

The wireless access point must be mounted in a secure area, in classrooms the preferred area would be the teaching station or a closet adjacent to the room.

One data outlet shall be provided for the access point.

The AP-1000 power requirements are 110VAC, 0.2A.

13.7. Category 5e Installation Procedures

Refer to TIA/EIA standard 568A for these procedures in detail.

Pulling tension shall not exceed 25lb force per cable during installation.

Bend radius will not be less than four times the outside diameter for four pair copper cable and ten times the outside diameter for fiber optic, coaxial, and copper cables containing more than four pair.

No horizontal cable shall exceed 295 feet or 90 meters in length from jack to patch panel or block.

Category 5e standards include proper installation of voice, data, and video systems.

Cables must be bundled at approximate five-foot intervals.

Cable runs must be free of tension at each end and throughout the entire run.

Cables should not cross electrical pathways, however if required, they must cross perpendicular to the electrical pathway.

13.7.1. Color Code - 4 Pair

Use the following color code for voice and data.

Pair 1 is White/Blue and Blue/White

Pair 2 is White/Orange and Orange/White
Pair 3 is White/Green and Green/White
Pair 4 is White/Brown and Brown/White.

13.7.2. Color Code - Groups of 25 Pair

Use the following color code or voice and data.

Pair 1 is White/Blue and Blue/White
Pair 2 is White/Orange and Orange/White
Pair 3 is White/Green and Green/White
Pair 4 is White/Brown and Brown/White
Pair 5 is White/Slate and Slate/White
Pair 6 is Red/Blue and Blue/Red
Pair 7 is Red/Orange and Orange/Red
Pair 8 is Red/Green and Green/Red
Pair 9 is Red/Brown and Brown/Red
Pair 10 is Red/Slate and Slate/Red
Pair 11 is Black/Blue and Blue/Black
Pair 12 is Black/Orange and Orange/Black
Pair 13 is Black/Green and Green/Black
Pair 14 is Black/Brown and Brown/Black
Pair 15 is Black/Slate and Slate/Black
Pair 16 is Yellow/Blue and Blue/Yellow
Pair 17 is Yellow/Orange and Orange/Yellow
Pair 18 is Yellow/Green and Green/Yellow
Pair 19 is Yellow/Brown and Brown/Yellow
Pair 20 is Yellow/Slate and Slate/Yellow
Pair 21 is Violet/Blue and Blue/Violet
Pair 22 is Violet/Orange and Orange/Violet
Pair 23 is Violet/Green and Green/Violet
Pair 24 is Violet/Brown and Brown/Violet
Pair 25 is Violet/Slate and Slate/Violet

14. Work Area Outlets

14.1. Overview

Each Work Area Outlet (WAO) must have a unique identification number recorded using an automated cable management system.

WAO numbers must identify their application with appropriated colored icon.

Refer to Section 16.2. for faceplate labeling.

14.2. Standard Configurations, Locations and Quantities

The standard Work Area Outlet (WAO) includes two cables to each location one for voice and one for data.

WAO shall be provided in the following locations as indicated.

Faculty/Staff Offices

Two standard WAO to be installed on opposite walls.

Additional WAO may be required depending on size of room and needs of intended occupant(s).

Dean/Director Offices

Two standard WAO to be installed on opposite walls.

One WAO shall include a coax connection.

Additional WAO may be required depending on size of room and needs of intended occupant(s).

Clerical Staff/Graduate Student Offices or Work Areas

One standard WAO to be provided for each desk or workspace.

Additional WAO may be required for additional devices (printers, fax machines, etc.).

Conference Rooms

Two standard WAO to be installed on opposite walls.

One WAO shall include a coax connection.

Additional WAO may be required depending on size or special needs of room.

Lounges/Break Rooms

A minimum of one WAO containing a coax connection.

Computer Labs

A minimum of one WAO containing dual data connections for each computer.

A minimum of one WAO containing a coax connection.

One standard wall phone to be placed near the door.

Classrooms

One standard wall mounted phone to be placed near the door.

A minimum of one WAO containing a coax connection.

Hi-Tech Classrooms

One standard WAO for a wall phone to be placed near the teaching station.

Conduit for cameras at the front and rear of the room.

Where applicable, one WAO containing two data connections placed so that there is one data connection for every seat.

One WAO containing two data and one coax connections to be located inside the cabinet of the teaching

station for the classroom computer and AV Systems.

One standard WAO to be located near an electrical outlet in the knee well or other easily accessible location on the teaching station for the use of a laptop.

One 6-strand multi-mode fiber-optic cable shall be terminated in the cabinet of the teaching station with ST connectors and shall be home-run to the nearest building TC closet.

Power receptacle on front of station for laptop power and in the rear of the computer well for computer power. The power for the computer shall not be switched.

Where there is a rear projection booth in the classroom, one standard WAO shall be provided for a wall phone as well as one WAO for voice, data and coax connections.

Where there are ceiling mounted projectors or TVs, one WAO for a coax connection should be mounted in the ceiling near the location for the TV or projector.

Wall Phones (standard)

One WAO containing a voice connection per location, 48" AFF.

Campus Phones

One WAO containing a voice connection per location.

Ride Phones

One WAO containing a voice connection per location.

Area of Refuge Phones

One WAO containing a voice connection per location.

Pay Phones

Follow to ADA guidelines.

Elevator Phones

One WAO containing a voice connection per location.

Emergency Phones

One WAO containing a voice connection per location.

Intercom Phones

One WAO containing a voice connection per location.

Access Phones

One WAO containing a voice connection per location.

SmartCard

One WAO containing two data connections per location.

Monitoring Systems

One standard WAO per location.

Residence Hall/Apartment Rooms

Two standard WAO to be installed on opposite walls.

One WAO shall include a coax connection outlet served by an addressable interdiction port.

Other Systems

A minimum of one standard WAO to be installed at the location of any equipment requiring a telephone or data network connection.

Arrange with UNIVERSITY ITS in advance for any services that are required at this location for activation of building systems including Fire Alarm and EMS systems.

15. Testing

15.1. Specifications for Testing Fiber

All fiber optic cables tested with light meters and records taken of the readings.

Newer test equipment can store the readings for printing later.

Power meters must be used to test multi-mode fiber at both 850nm and 1300nm in one direction.

Power meters must be used to test single-mode fiber at both 1310nm and 1550nm in one direction.

If there is a splice in the cable, each strand of fiber must be tested with an OTDR in one direction.

An OTDR must be used to test multi-mode fiber at 850nm.

An OTDR must be used to test single-mode fiber at 1310nm.

Each test result must have a printout of the test result labeled by strand with the from-to information, and the test speed, the test date and time, and the operator performing the tests.

All fiber strands should have a maximum of 0.5db loss per mated pair.

Multi-mode fiber shall not exceed 3db loss/km at 850nm.

Single-mode fiber shall not exceed 1db loss/km at 1310nm.

All strands with losses greater than 0.5db must be cleaned and re-tested.

Any strand with greater than 1.0db loss must be re-terminated.

No more than .03db loss at 1300nm through any fusion splice point is allowable.

The fiber optic patch cables will be provided and installed by the contractor on inter and intra-building fiber.

All fiber optic jumpers must be cleaned before installation.

All fiber optic jumpers must be a duplex or two strand cable of the same type as the backbone and of an indoor construction.

All fiber optic jumpers must be premanufactured.

All extended links must be tested from end to end.

All fiber optic losses must meet the link-loss budget of the design specification.

References

TIA/EIA 455-34 Attenuation
TIA/EIA 455-107 Return Loss
TIA/EIA 455-21 Durability

15.2. Specifications for Testing Copper

All copper pairs must be tested for a minimum of polarity, continuity, shorts, opens, crossed pairs, and reversals.

All Category 3 riser cables must be tested using a hand-held tester designated to test Category 3 components.

Category 3 tests include polarity, continuity, pair mappings, and length.

All Category 5e cables tested using a hand-held tester that meets Category 5e testing requirements in TSB-67.

All Category 5e cables tested using a hand-held tester that meets Category 5e testing requirements.

Category 5e testing must include length, attenuation, dc resistance, NEXT, FEXT, ACR, and signal-to-noise ratio, ELFEXT, PSNEXT, PSELFEXT, and PSACR.

The contractor must perform a Basic Link Test on all cables from jack to patch panel.

Combined lengths of patch cables must not exceed 10m.

All patch cables must be tested and labeled before installation.

All patch cables must be premanufactured.

UCONN requires Category 5e testing performed with a Microtest Omni Scanner Test Set.

All problems found on UTP during testing must be corrected and re-tested.

References

TIA/EIA 568A section 4
TIA/EIA 569A section 4
TIA/EIA 568 A1
TSB-67

15.3. Specifications for Testing Video

All coaxial cable tested with a TDR for length and continuity.

UNIVERSITY ITS will submit the exact and final testing specifications before the release of the bid package.

UCONN requires that all coaxial cables tested to assure compliance with FCC standards for broadband CATV systems.

In units served by Interdiction, a visual inspection of each output port tested with a cable ready television on channel 54 must be conducted with the port in the on and off mode.

The contractor is expected to provide a computer file copy of the serial numbers, interdiction tap numbers, building name and room numbers in Microsoft Excel prior to testing and sign-off.

15.4. Testing Documentation

All test results must be submitted in an electronic format, if UNIVERSITY ITS does not have a program capable of reading the format, then the contractor must provide the software or all test results must be printed out and placed in a binder.

All results must include the cable identification numbers, test date and times, the operator performing the test, the make and model of the testers used.

All results must include the setting used to test, and the from-to locations of the cable.

Testing documentation is the certification of the cable plant.

The Warranty period does not begin until the testing documentation is given to UNIVERSITY ITS.

16. Documentation

16.1. As-Built Documentation

UNIVERSITY ITS must be provided with a clean copy of the bid package plus all changes from the original scope.

All Changes must be highlighted, noted, or written in red.

UNIVERSITY ITS must be provided with a clean copy of the print set plus a copy red-lined with changes.

All floor plans must document all WAO location and number.

All floor plans must document all TC, ER, and EF locations and numbers.

All floor plans must document all horizontal pathway locations and numbers.

All floor plans must distinguish between UTP and fiber locations.

UNIVERSITY ITS must be provided with a clean copy of all butterfly diagrams plus all changes will be required.

UNIVERSITY ITS must be provided with the electronic media of all documentation as well as a hard copy.

All test results must be included with the package.

All cross-connects installed by the cabling contractor will be printed out in a spreadsheet or in an automated cable management system.

A spreadsheet identifying all faceplate locations by room and identifying the outlet numbers for each faceplate location.

UCONN reserves the right to withhold final payment until receiving all As-Built documentation.

UCONN may withhold partial final payment until approving documentation.

UCONN may take up to three weeks to review and approve documentation sets.

16.2. Faceplate Labeling Standard

All faceplates must have printed, adhesive labels. Hand written labels are not acceptable.

The label format shall identify the floor and room plus the outlet location within the room. A typical location would require no more than five characters (three to identify the floor and room, two to identify the location within the room). For Example: 10120 would be first floor, room 1 (room 101,) jack number 20.

UCONN uses colored icons inserted above the jack opening to identify the jack application. Where applicable the top most position of the faceplate shall be used for voice, the bottom or middle position for data and the bottom most position for video. The following is the standard color identifiers for icons.

	<i>Application</i>	<i>Color</i>
	Voice 1	White
	Voice 2	Gray
	Voice 3	Yellow
	Data 1	Green
	Data 2	Blue
	Data 3	Purple
	Video 1	Red
	Video 2	Orange
	Video 3	Brown

A faceplate example and a faceplate numbering submittal on a print set, and a summary of all WAO faceplates on a spreadsheet shall be submitted to UNIVERSITY ITS and approved by UNIVERSITY ITS before installation.

17. Warranty

A minimum of fifteen years is required for warranty on the installed cableplant.

If a manufacturer or team of manufacturers offer a free extended warranty, then that warranty must be included also.

The warranty should cover defects in materials and workmanship.

The contractor must cover any and all of the OEM extended warranties.

All active equipment manufacturers must be able to replace any defective materials overnight.

The Active Equipment manufacturer must be onsite to assist the cabling contractor with installation.

UNIVERSITY ITS must be provided with the copies of the OEM certificates of training included with the warranty information.

18. Walk-Thru

UNIVERSITY ITS requires a full walk-through with the cabling contractor project manager to review every closet, ERs, EFs, and TCs, and all manholes, hand-holes, and significant pull-boxes and junction boxes.

The walk-thru may include a full demonstration of termination and testing on the various media.