UVA RFP #HH080514
UNIVERSITY OF VIRGINIA
BUILDING WIRING STANDARDS
INFRASTRUCTURE SPECIFICATION
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1 Introduction

This document establishes the standard for the installation of telecommunications facilities in University buildings and supersedes all previous Information Technology Services (ITS) and Office of the Chief Information Officer (OCIO) wiring and cabling standards. While this standard is meant to apply particularly to new construction and major renovation projects, it should also be followed when wiring or rewiring existing buildings.

ITS will act as telecommunications consultant and/or University cabling project manager and review the plans for all university construction and renovation projects.

It is recognized that the design process and the allocation of space in all construction and renovation projects is actually a negotiation between all interested parties. These standards provide information for the initial project design. Once the initial phase is complete, ITS and the other consultants will work with the building committee to perform the detailed work and ensure that a modern network infrastructure can be installed. ITS and the other reviewers will always be flexible and make sure that the needs of the building occupants are met at the minimum possible cost.
2 Industry Standards

All work that a Consultant performs and all fiber, hardware, and material that the Consultant purchases for a piece of work must be compliant with applicable State, national, and international standards and codes such as, but not limited to, the following:

- Alliance for Telecommunications Industry Solutions (ATIS)
- American Association of State and Highway Transportation Officials (AASHTO)
- American National Standards Institute (ANSI) / Telecommunications Industry Association (TIA) / Electronics Industries Association (EIA)
  - ANSI/TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard
  - ANSI/EIA/TIA-TSB75 “Additional Horizontal Cabling Practices for Open Offices”
  - ANSI/TIA/EIA-455-6 “FOTB-61, Measurement of Fiber or Cable Attenuation Using an OTDR”
  - ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard
  - ANSI/EIA/TIA-569, Commercial Building Telecommunications Pathways and Spaces
  - ANSI/EIA/TIA-570, Residential and Light Commercial Telecommunications Cabling Standard
  - ANSI/EIA/TIA-606, Administration Standard for the Telecommunications Infrastructure for Commercial Buildings
  - ANSI/EIA/TIA-607, Commercial Building Grounding and Bonding Requirements for Telecommunications
- ANSI/ICEA S-90-661
- American Society for Testing and Materials (ASTM)
- Electronic Industries Alliance (EIA)
- Institute of Electrical and Electronics Standards Association (IEEE-SA)
• IEEE 383 “Vertical Flame Test”
• International Code Council, aka Building Officials and Code Administrators International (BOCA), National Codes and International Standards
• Virginia Department of Transportation (VDOT)
• National Electrical Code (NEC)
• National Electrical Safety Code (NESC)
• National Electrical Manufacturers Association (NEMA)
• National Fire Protection Association (NFPA)
  • NFPA-70E “Standard for Electrical Safety Requirements for Employee Workspaces”
  • NFPA-75 “Protection of Electronic Computer Data Processing Equipment”
  • NFPA-297 “Guide on Practices for Communications Systems”
  • NFPA-780 “Standard for the Installation of Lightning Protection Systems”
• Occupational Safety and Health Act of 1970 (OSHA)
• Underwriters Laboratories (UL)
  • UL 444 “Communications Cables”
• Applicable local standards, codes, and ordinances of the particular legal jurisdiction where construction is taking place
• Other standards and codes that may be applicable to acceptable standards of the industry for equipment, materials, and installation under contract

Penetration and Fire Barrier Specific

• ASTM E814, Standard Method of Fire Tests of Through-Penetration Fire Stops.
• UL 1479, Fire Tests of Through-Penetration Firestops.
• UL Fire Resistance Directory: Through Penetration Firestop Devices (XHCR) and Through Penetration Firestop Systems (XNEZ).
• 2008 NFPA National Electrical Code, Section 300-21, Spread of Fire and Products of Combustion.
• ANSI/NECA/BICSI-568-2006, Standard for Installing Commercial Building Telecommunications Cabling, Section 5, Clause 5.1 through 5.2.3, Firestopping
• 2006 edition of the BICSI Telecommunications Distribution Methods Manual, Chapter 7, Firestopping
• Factory Mutual Approval Guide.
• ULC List of Equipment and Materials, VOL. II.
• Installed firestopping systems shall meet approval of authorities having jurisdiction
Where there is a conflict between standards the Contractor must receive clarity from the University Project Manager before moving forward. If the Contractor desires to offer a solution that is not in compliance with this standards document or those mentioned above, they may do so, as long as the preparation of the alternative solution proposal does not require any resources from the University and does not change the delivery time or delivery duration of the assigned piece of work. The University Project Manager is the final judge of the acceptance or denial of alternative solutions.
### 3 Definitions and Abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWG</td>
<td>American Wire Gage</td>
</tr>
<tr>
<td>Backbone Pathway</td>
<td>The Backbone Pathway consists of a series of conduits or chases which connect the MCC to TCs. It generally houses the vertical or backbone system.</td>
</tr>
<tr>
<td>Backboard</td>
<td>Backboard generally refers to the plywood sheeting lining the walls of telecommunications facilities. Backboard may also refer to the entire wall-mounted assembly, including wire management, wiring blocks, and equipment racks.</td>
</tr>
<tr>
<td>BISCI</td>
<td>Building Industry Consulting Service International</td>
</tr>
<tr>
<td>dB</td>
<td>Decibel</td>
</tr>
<tr>
<td>DEMARC</td>
<td>Demarcation Point</td>
</tr>
<tr>
<td>MC or MCC</td>
<td>The MC is the location, within a building or complex of buildings, where the entire telecommunications system originates. It may include: the physical location, enclosure, wire and cable management hardware, termination hardware, distribution hardware, and patching and equipment racks. EIA/TIA-569 refers to the room housing the MC as the &quot;Equipment Room.&quot;</td>
</tr>
<tr>
<td>MDF</td>
<td>Main Cross Connect (MDF). MDFs are the cabling frame within the MCC.</td>
</tr>
<tr>
<td>RCDD</td>
<td>Registered Communications Distribution Designer</td>
</tr>
<tr>
<td>TC</td>
<td>Telecommunications Closet</td>
</tr>
<tr>
<td>UPS</td>
<td>Uninterruptable Power Supply</td>
</tr>
</tbody>
</table>
4 Contractor Specifications

The University requires only qualified and experienced Telecommunications Contractors to perform design, project management, and installation services in the construction of the University structured cabling infrastructure. Pursuant to this, the University wants to ensure that successful contractors have the manufacturer certifications, authorizations, capabilities, qualifications, financial stability, and experience to complete Telecommunications installations using common industry practices (i.e. BICSI TDMM, ANSI/TIA/EIA, NEMA, NFPA, etc) while meeting all of the University standards.

A Contractor, by responding to a bid, represents that their company possesses the manufacturer authorizations, qualifications, certifications, capabilities, test equipment, expertise, and personnel necessary to provide an efficient and successful installation of properly operating components, as specified.

Bidder must meet the requirement of having continuously performed telecommunications installation work for a period of at least five (5) years. The Telecommunications contractor must be an approved Commscope Systimax certified installer. A copy of certification documents must be submitted with the bid in order for such bid to be valid. The Telecommunications Contractor is responsible for workmanship and installation practices in accordance with the Commscope Systimax warranty. It is preferred that, with respect to project submitted for bidding, at least 30 percent of the copper installation and termination crew must be certified by BICSI, with a BICSI Technician Certification.

Prior to submitting bid, Contractor is required to carefully consider the amount and character of the work to be done, as well as the difficulties involved in its proper execution. Bidder should include in their bid all costs deemed necessary to cover contingencies essential to successfully installing the specified system. Any cost not specifically itemized in the proposal shall not be incurred unless specifically agreed upon by all parties and documented in writing. No claims for compensation will be considered or allowed for extra work resulting from lack of knowledge of any existing conditions on the part of the bidder.

The University requires references from projects of a similar size and nature. Names of the officers of the company and resumes of those to be assigned to the project, including subcontractors, must be provided. Telecommunications contractor shall, at all times during performance of work, and until work is completed and accepted, have on the premises a competent supervisor satisfactory to the University and with authority to act for the Telecommunications contractor regarding work schedules and any changes to the scope of work. It is preferred that the supervisor must be a BICSI certified Technician and a BICSI member in good standing.
Telecommunications Contractor must provide at least one project manager or lead technician on site at all times during a new construction project whom is a BICSI trained, certified, and registered Technician and a BICSI member in good standing. A copy of certificate and BICSI member number must be provided with bidding documents.

After an installation is complete, in addition to any other required testing, and at such times as the University directs, the Contractor shall be present while the University conducts operational tests of the transport electronics connected to the cabling system. The installation shall be demonstrated to be in accordance with the requirements of this cabling standard. The Contractor shall be notified in writing of any defective items and must repair or replace such items within twenty-four (24) hours of written notice, without cost to the University.

Contractor shall provide a single written SYSTIMAX Performance Warranty (“SYSTIMAX structural cabling systems twenty (20) year extended product warranty and application assurance”) which guarantees all work against faulty and improper material and workmanship for a minimum period of twenty (20) years from date of final written acceptance by the University. Other cable manufactures such as Berk-Tek/Panduit, Corning and CommScope also apply. Within twenty-four (24) hours of written notice, Contractor shall correct any deficiencies which occur during the guarantee period at no additional cost to the University, all to the satisfaction of the University.
# 5 Approved Materials List and Installation

## 5.1 General

Only the materials identified in this section may be used University cabling infrastructures. Additions and substitutions may only be used, only with the pre-approval of the University of Virginia ITS Project Manager.

## 5.2 Cabling

### 5.2.1 Accepted Materials Listing

#### 5.2.1.1 Category 5e

The University has selected the CommScope PowerSum suite for copper Ethernet solution 1Gbps or less. This product suite will comprise the entire solution. There will not be any substitutions of other product lines or vendors.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Part #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CommScope</td>
<td>110AW2-100</td>
<td>100 PR BLOCK 110 WITH LEGS</td>
</tr>
<tr>
<td>CommScope</td>
<td>110A-3</td>
<td>110 Jumper Trough With Legs</td>
</tr>
<tr>
<td>CommScope</td>
<td>110C-4</td>
<td>110 Connecting Trough With Legs, 4 pair count</td>
</tr>
<tr>
<td>CommScope</td>
<td>110C-5</td>
<td>110 Connecting Block, 5 pair count</td>
</tr>
<tr>
<td>CommScope</td>
<td>MPS100E-YYY</td>
<td>PowerSUM MPS100E Category 5e U/UTP Information Outlet</td>
</tr>
<tr>
<td></td>
<td>YYY = Color</td>
<td></td>
</tr>
<tr>
<td>CommScope</td>
<td>188UT1-50</td>
<td>110 Transparent Label Holder</td>
</tr>
<tr>
<td>CommScope</td>
<td>M20AP-YYY</td>
<td>M20 Dust Cover for M-Series Faceplates and Outlets</td>
</tr>
<tr>
<td></td>
<td>YYY = Color</td>
<td></td>
</tr>
<tr>
<td>CommScope</td>
<td>1061C BL 4/24 W1000</td>
<td>PowerSUM 1061C ETL Verified Category 5e U/UTP Cable, non-</td>
</tr>
</tbody>
</table>
### 5.2.1.2 Category 6A

The University has selected the CommScope GigaSPEED X10D suite for its 10 Gbps copper Ethernet solution. This product suite will comprise the entire solution. There will not be any substitutions of other product lines or vendors.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Part #</th>
<th>Description</th>
</tr>
</thead>
</table>
| CommScope | 1291B BL 4/23 R1000  
BL = Blue  
R = Reel | Category 6A F/UTP Non-Plenum Cable, blue jacket, 4 pair count, 1000 ft (305 m) length, reel |
| CommScope | 2291B BL 4/23 R1000  
BL = Blue  
R = Reel | Category 6A F/UTP Plenum Cable, blue jacket, 4 pair count, 1000 ft (305 m) length, reel |
| CommScope | 360-IPR-MFTP-E-HD6B-1U-24  
SYSTIMAX 360 GigaSPEED X10D Evolve High Density F/UTP Modular Panel, 24-port | |
| CommScope | 360-IPR-MFTP-E-HD6B-2U-48  
SYSTIMAX 360 GigaSPEED X10D Evolve High Density F/UTP Modular Panel, 48-port | |
| CommScope | 360-MFTP-LKB  
SYSTIMAX 360 GigaSPEED X10D Evolve High Density F/UTP Modular Panel Label Kit | |
<table>
<thead>
<tr>
<th>CommScope</th>
<th>See Catalog</th>
<th>CommScope M2000 Modular Panel System</th>
</tr>
</thead>
<tbody>
<tr>
<td>CommScope</td>
<td>See Catalog</td>
<td>SYSTIMAX 360 GigaSPEED X10D 360GS10E Patch Cords</td>
</tr>
<tr>
<td>CommScope</td>
<td>See Catalog</td>
<td>GIGASPEED X10D 360GS10E MODULAR PATCH CORD</td>
</tr>
<tr>
<td>CommScope</td>
<td>See Catalog</td>
<td>GIGASPEED X10D 360GS10E ZONE EXTENSION CORD</td>
</tr>
</tbody>
</table>

5.2.1.3 **Single Mode Fiber**

To be identified as needed.
5.2.2 110 Block Installation

110 blocks (110AW2-100) are to be mounted on the plywood wall within the wiring closet. Each column of 110 blocks should be started at the top and added to directly underneath. The column should start at six (6) feet off the floor. Each 110 block should be surrounded by cable management (110A-C) on both sides. There should be no more than six (6) 110 blocks in a column. The following diagram depicts an example 110 block wall build-out.

Figure 5.2.2.1 – Example 110 Block Wall Build-out
5.2.3 **Standard Network Drops**

The standard network drop consists of a user accessible connector, such as a wall box with a wall plate (often referred to as an outlet), a custom box in a modular office system or another like box type. It is standard that a network drop have at a minimum two ports be installed and that these two ports be the next two ports on the 110 block or 48 port panel in the wiring closet.

The following diagrams depict the installation of two wall boxes and show how each new one takes the next two ports on the infrastructure within the wiring closet (110 block or 48 port panel).

At the wall jack the two connections should be terminated 568B.

*Figure 5.2.3.1 – Wall Plates Connected to a 110 Block*

![First Installed](image1) ![Second Installed](image2)

*Figure 5.2.3.2 – Wall Plates Connected to a 48-Port Panel*

![First Installed](image3) ![Second Installed](image4)

In non-residential spaces, within the ceiling before the cables drop within the wall to reach the wall boxes, 20 foot of slack for each cable be left coiled and tie wrapped in the ceiling, if overall channel length permits.

*Figure 5.2.3.3 – Coiled Cabling*
5.3 Labling

5.3.1 Closet

Closets are identified by two characters. The first character represents the floor and the second character represents a closet from the others on that floor. For example, if the closet is on the 5th floor and it is the second or “B” closet, then it will be known as closet [5B]. All closet identifiers must be unique within a building.

5.3.2 Outlet

Outlets are identified with a permanently affixed label. The label contains two character strings separated by a dash, as follows [closet#-outlet#]. For example, the 618th outlet that is fed from the wiring closet “3A” will be labeled [3A-618]. All outlet numbers must be unique within a building.
5.3.3 110 Block

110 block positions must be labeled to indicate room, outlet and jack numbers separated with dashes, such as [room#-outlet#-jack#] or [W359-018-1]. The font should be the largest Courier font that will fit within the space provided.

Figure 5.3.3.1 – 110 Block Labels
There are a large number of legacy three port wall plates / outlets where the first port is for an analog connection and the other two are for data. This style of outlet is no longer an approved standard and should be replace if any work is applied to it.

*Figure 5.3.3.1.1 – Legacy Three Port Outlet*

In these cases the first port is only using the brown cable pair (brown strip / brown) from the first cable. The second port is using the other three pairs. The last port is using all four of its pairs from the second cable.

As you can see in the above picture, the first position is labeled with the room (116A), the wall plate (002) and then both the single pair analog port and the three pair data port (1,2). The second
position has all four pair and is labeled without any modification, (116A-002-3).

5.3.4 Category 5 & 6 48 Port Panel (48 Block)

Category 5 & 6 48 port panels (48 blocks) must be labeled as seen in the following figure. Each port must be labeled to indicate room, outlet and jack numbers separated with dashes, such as [room#-outlet#-jack#] or [W359-018-1]. The font should be the largest Courier font that will fit within the space provided. The labels should be printed with a label printer that will enable the labels to be permanently affixed.

*Figure 5.3.4.1 – 48 Block Labels*

5.4 Testing

5.4.1 Category 5 and 6

All UTP cabling installed by internal or external resources (contractors) must be tested for polarity (tip and ring signals in the appropriate pin location), continuity (opens or shorts in the cable) and cables terminated in the correct
order. The Contractor must perform tests and provide detailed
documentation, in spreadsheet and/or database format, which measure, at
minimum cable length, attenuation, near-end cross-talk, and mutual
capacitance against EIA/TIA Category 5 or Category 6 specifications, where
applicable. The documentation must also indicate by jack, that the materials
and installation is in compliance to Category 5 or Category 6 specifications.
If during testing, any cable runs are found which do not meet these
specifications, the Contractor must take the necessary actions to bring the
run(s) within specifications prior to submitting the testing results. The
Contractor shall visually inspect all terminations after they are made to assure
that the termination is complete and clear of loose wires. An official written
certification of this inspection and testing shall be turned over to the
University Project Manager. All of the materials manufactures’ certifications
and warrantees must also be turn over to the University Project Manager.

5.4.2 Fiber

Perform optical time domain reflectometer (OTDR) testing on each fiber optic
conductor. Measured results shall be plus/minus 1 dB of submitted loss
budget calculations.

5.4.3 Others

Other cabling types will have the testing requirements identified in the work
order.

5.5 Grounding

Establishing a suitable telecommunications ground is critical in protecting and
equalizing telecommunications equipment. A proper grounding and bonding
infrastructure is essential for the reliable operation of today’s sensitive
telecommunications equipment and systems. Telecommunications cabling and
electrical power cabling must be effectively equalized.

The grounding and bonding infrastructure is to originate at the service entrance
(electrical power) ground and extend throughout the building to each
telecommunications room.

Building steel, neither water pipes, nor electrical service sub-panels are acceptable
grounding points.
Grounding and Bonding shall conform to NEC Article 250 and TIA/EIA-607-A using a minimum conductor size of 6 AWG.

- Install a contiguous Intra-building grounding and bonding system in compliance with NEC Article 250 and TIA/EIA-607-A.
- Use a minimum conductor size of 6 AWG
- Install a grounding busbar on each plywood backboard in each telecommunications room as directed.
- The grounding and bonding system shall originate at the service entrance (electrical power) ground and be a contiguous intra-building bus as shown in the example drawings.
- Bond all telecommunications equipment racks, backboards, conduits, and cable trays as specified in TIA/EIA-607 as shown in example drawings.
5.5.1 Telecommunications Grounding Busbar

The Telecommunications Grounding Busbar (TGB) provides the interface from the equipment / frame grounding to the building grounding. The TGB should be placed on the plywood wall directly behind the UPS and about six (6) feet off the ground. This will provide an optimal location for grounding the frames, ladder rack and other items.

*Figure 5.5.1.1 – Telecommunications Closet Grounding (Horizontal View)*
5.5.2 Frame Grounding

With respect to frame grounding all three examples below are approved, but “Example C” is the preferred. The vertically mounted frame grounding bar is the preferred method.

Figure 5.5.2.1 – Frame Grounding Options
5.6 Cabling Infrastructure Support

These materials will be approved by the University before work begins on a project.
5.7 Wireless Access Point Installation

This section provides not only the physical installation of access points, but also provides the cabling options.

5.7.1 General Access Point Installation

Access points are approved to be install in one of two ways.

5.7.1.1 Suspended Ceiling

In the case of a suspended ceiling the Ceiling Rail Adapter can be used for both open rail or flanged rail, as seen in the following figures. It should be noted that one of the ceiling tiles directly above an access point will have to have a small indentation made to pass the Ethernet cable without pinching the cable and while allowing the tile to rest completely on the rail.

*Figure 5.7.1.1.1 – Attaching the Ceiling Rail Adapter to the AP*

*Figure 5.7.1.2 – Attaching the Ceiling Rail Adapter to the Ceiling*
In the case of a finished or sealed ceiling, a mounting bracket is used as seen in the following figures. It should be noted that another hole must be made that aligns with the window in the ceiling mounting bracket to pass the Ethernet cable into the ceiling space above.

**Figure 5.7.1.2.1 – Mounting the Ceiling Mounting Bracket**

**Figure 5.7.1.2.2 – Connecting the AP to the Ceiling Mounting Bracket**
5.7.2 **RJ45 Cat5e Direct Access Point**

In this configuration the access point is connected directly to the horizontal infrastructure cabling that is terminated with an RJ45. Please note the square end of the blue line that represents an RJ45. This horizontal infrastructure cable terminates at the other side into a 110 block in the wiring closet.

*Figure 5.7.2.1 – RJ45 Cat5e Direct Access Point*

This is the least preferred method and is only permitted if a single remaining horizontal infrastructure cable is already ran to a location.

If there are two horizontal infrastructure cables ran to that location, then it should be converted into a Cat5e Box Access Point, as seen in the next section.

If there are two horizontal infrastructure cables ran to a location and there is already one access point installed, then the two should be converted into a Cat5e Box Access Point and the existing access point should take the first port, while the new access point should take the second.
5.7.3 Cat5e Box Access Point

In this configuration the access point is connected via a Cat5e patch cable to a standard wall box with a face plate within the ceiling. The wall box has two Cat5e horizontal infrastructure cables terminated on one side within the box and the other side on the 110 block in the wiring closet. The box must be securely attached within the ceiling supports.

*Figure 5.7.3.1 – Single Cat5e Box Access Point*

This configuration supports a clean labeling scheme and the flexibility of moving the access point beyond its current length limitation, by simply changing the patch cable.

If a second access point is added, it will take the second port in the wall box assuming it is within the same distance to the wall box as the original access point, as seen in the following diagram

*Figure 5.7.3.2 – Two Cat5e Box Access Points on a Single Wall Box*
If one or more of the access ports need a secondary connection, then both of its connections should be on the same two port box. In cases where there are two access points on a single wall box, this will entail taking one completely off of that wall box and putting it on its own, as can be seen in the following diagram.

*Figure 5.7.3.3 – Two Cat5e Box Access Points on Two Wall Boxes*

This configuration is permitted in legacy non-Cat 6A facilities.
5.7.4 Cat6A Box Access Point

In this configuration the access point is connected via a Cat6A patch cable to a standard wall box with a face plate within the ceiling. The wall box has two Cat6A horizontal infrastructure cables terminated on one side within the box and the other side on the 48-port panel in the wiring closet. The wall box must be securely attached within the ceiling supports.

Figure 5.7.4.1 – Cat6A Box Access Point

This configuration is approved for all new construction.

It should be noted that the use of wall boxes when adding additional access points or secondary connections will be the same as in the Cat5e Box Access Point, as seen in the above example.

5.7.5 New Dorms / Concrete Ceilings Example

New dorms are being constructed with concrete ceilings and ¾ to 1 inch conduit ran from each network drop back to a closet. At the time of installation, the two cable runs to an access point will have both cables terminated with RJ45 heads.

Figure 5.7.5.1 – Cat6A Concrete Ceiling
5.8 Telephony Component Installation

5.8.1 Supported VoIP Phone

The University currently only supports the following VoIP phone models.

*Figure 3.5.1.1 – Polycom VVX 310*

*Figure 3.5.1.2 – Polycom VVX 410*

*Figure 3.5.1.3 – Polycom VVX 500*

*Figure 3.5.1.4 – Polycom VVX 600*
5.8.2 VoIP Phone Mounting

The supported Polycom models support being placed on the desktop or being wall mounted, as seen in the PDF file found by following this link; http://supportdocs.polycom.com/PolycomService/support/global/documents/support/setup_maintenance/products/voice/VVX300_400_500_600_WallmountInstructions_UCS_4_1_4.pdf.
5.8.3 VoIP Phone Networking

Each VoIP phone has multiple connections on the back side of the unit, as can be seen in the figure below. Each VoIP phone has a built in two port 1 Gbps Ethernet switch. The green port provides connectivity from the VoIP phone to the network. The blue port provides connectivity for another device, which in the vast majority of the cases will be the end user’s PC.

It should be noted that in the case of the University VoIP phones the green connection to the closet LAN switch will not only provide network connectivity, but low voltage power to the phone.

*Figure 5.8.3.1 – Ports on the Back of the VoIP Phones*
5.8.4 VoIP Desktop Phone Installation

In a standard desktop VoIP phone installation, the new phone will be placed on the desk. The phone will either take the port in the wall plate that was used by the existing PC or take the first available port. In the case of there being an existing PC, after the phone has been placed in the PC’s port, the PC will be connected to the PC port on the back of the phone, which is basically a switch port enabling the phone to forward the PC’s LAN traffic.

*Figure 5.8.4.1 – Standard VoIP Desktop Phone Installation*

It is critical to note that the VoIP phones selected by the University require Power Over Ethernet (POE). That said, when a new phone it added is must be confirmed that it is on a POE switch in the closet. If it is on a POE switch the phone should start the boot process when it is plugged into the outlet.

5.8.5 VoIP Courtesy Phone Installation

These materials will be approved by the University before work begins on a project.

5.8.6 Analog Devices

Analog devices are patched through to an analog service at the core switching site, not in the local building. The two options in this case is an analog service provided internally via the University’s Zhone analog to SIP bridges or the local carrier provider’s B1 line service.

In the figure below the standard two port wall plate is used to terminate two Cat5e runs from the closet. One port is taken by the VoIP phone; that with its two port switch is providing the port needed for the PC. The fax machine in the office is connecting with an RJ11 cable to the wall plate. This cable is typically a two-pair silver satin cable and analog devices only uses the center
pair of the cable and wall port. In the closet the center pair of this analog connection is patched from the office outlet 110 block to the inter-building copper 110 block that connects into the copper trunk that runs back to the core site.

In the core site the center pair terminates into a B1 line provided by the local carrier or the Zhone analog-to-SIP bridge that will then convert the analog into IP traffic and send it to the core site router, which in turn will route the traffic over the UVa core network.

*Figure 5.8.6.1 – Analog Option 110 Block*

Another option that must be contended with is a Category 6 48 port panel in the closet instead of a 110 block. In this case a full four pair port will be used for the analog connection. The analog end device (in this case a fax machine) will connect to the network outlet with an RJ11 connector, just as in the example above. The difference in this example is that a whip will have to be
created in the closet to connect from the 48 block to the 11 block. One end of the whip should have a pair crimped into position 4 and 5 in an RJ45 connector. The other end will be punched-down on the 110 block.

**Figure 5.8.6.2 – Analog Option 48 Block**

![Diagram of Analog Option 48 Block](image)

### 5.8.6.1 In-Building Analog Gateway

In some instances the building will have an analog to SIP gateway installed locally. In this case there will be no need to patch through the outside plant to get to the core site. Instead a patch would be added between the 110 block or 48 port panel feeding the office outlets and the 110 block feeding the local analog to sip gateway.
6 Telecom Closet Specifications

6.1 General

Telecommunications closets house the wiring and electronic equipment that are used to connect end-user devices and ITS wireless network access points (APs) to the University communications network. These closets are designed for and intended for the intra-building distribution of centrally managed telephone, data communications, and video services and *in no instance shall they be used to support other building utilities*. Telecommunications closets *must* be located so they can be accessed from hallways.

The following closet depicted in Figure 6.1.1 and 6.1.2 shows the smallest “over 100-port closet” supported. These closets are based on the Category 5e 110 block design. Figure 6.1.3 and 6.1.4 show the Category 6A 48 block design.
Figure 6.1.1 – Top-Down View of the 110 Block Telecom Closet

- EATON UPS
- 110 Block
- V Cable Management
- Telecom Frame
- ¾ Inch Plywood Wall Covering
- Patch Cable Paths
- 6 Ft.
- 8 Ft.
- 36 In.
Figure 6.1.2 – Horizontal View of the 110 Block Telecom Closet
Figure 6.1.3 – Top-Down View of the 48 Block Telecom Closet

Figure 6.1.4 – Horizontal View of the 48 Block Telecom Closet
6.2 Dimensions

Closets serving up to 100 outlet locations shall be 6x8 ft. minimum. In areas where greater than 100 outlet locations are anticipated the closet shall be sized on a case-by-case basis. The maximum number of ports a 6x8 ft. closet should support is approximately 576, assuming all of the end-points are within cable length standards.
Ceilings shall be 9 ft. minimum in height; no false ceilings will be allowed. The door shall be a minimum of 36" wide and 80" high, open outward, and be fitted with a keyed lock. Lock keying should meet ITS specifications as appropriate. A magnetic card system may be requested in some cases in order to meet a particular requirement.

### 6.3 Interior Furnishings

Floors, walls, and ceilings shall be treated to minimize dust. Paint or other surface finishes shall be of a texture and color such that room lighting is enhanced. Three walls, preferably without a door, shall be fitted floor to ceiling with BC grade 3/4" fire rated plywood.

### 6.4 Lighting

Lighting shall be a minimum of 50-foot candles measured 3 feet above the finished floor, mounted 8.5 ft. above the finished floor. No wall-mounted lighting will be allowed.

### 6.5 AC Power

A minimum of two (2) dedicated 20 amp, 120 volt circuits and one (1) dedicated 30 amp 208/220 volt circuit, outlet NEMA size L14-30-R30A 125/250V shall be provided. Quad service outlets shall be placed at four (4) ft. intervals along the length of the four walls and 18 inches above the finished floor, as seen in Figure 4.5.1.

Service panel location and breaker positions shall be clearly marked. Access shall be available to the main building-grounding electrode. Power for communications wiring closets should always be supplied from building emergency power systems whenever emergency power is available in a building. Some wiring closets in some buildings will need additional electrical power depending on special needs. These extra needs will be specified by ITS during the review process.

*Figure 4.5.1 – Telecom Closet Power View*
It should be noted that it is required that there are two Power Distribution Units (PDUs) (also known as power strips) in a telecom closet. One PDU should receive its power from the UPS, while the other should receive its power from the building service. All critical electronics in the room must be dual homed to both power strips. Items with only a single power connection must be connected to the UPS.

### 6.6 Environment

Temperature and humidity control shall be continuous over the range 50 to 85 degrees F with 30% to 75% relative humidity non-condensing. The cooling system should maintain the ambient room temperature of below 75 degrees F. A positive
pressure shall be maintained with an air exchange sufficient to dissipate the heat generated by electronic/electrical equipment. Dissipated power will typically be less than 6,000 watts. The cooling system for the wiring closet must operate on a 24x7 basis, 365 days per year. Wiring closet cooling cannot be controlled by energy management systems that cut off cooling when the building is not occupied. When additional power is specified per Section 2.5 above, a corresponding increase in cooling capacity is required.

6.7 Closet Penetrations

Floor penetrations for vertically stacked closets shall be a minimum of two 4" penetrations per closet. It is recommended that all penetrations be in clusters at a location in the closet stack specified by ITS. Penetrations for horizontal conduit or cable tray runs which use ceiling pathways should be near the 8 ft. level. Additional penetrations may be needed depending on the density of network devices needed in a particular area.

**Figure 6.7.1 – Floor Cross Section**

6.7.1 Sleeves

New sleeves for conduit and cable penetrations of building construction must be galvanized rigid conduit/intermediate metallic conduit/electrical metallic tubing/schedule 40 PVC (select one) sleeves for penetrations through exterior masonry/concrete walls and foundations, concrete floor slabs on grade and above grade, and concrete-filled decks. Use only fire-rated listed assemblies for the type of sleeve being installed through (Concrete Masonry Unit) CMU walls or gypsum walls for communications penetrations.
Sleeve type shall be galvanized rigid conduit/intermediate metallic conduit/electrical metallic tubing/schedule 40 PVC (select one). Where conduits are installed before building construction being penetrated, install sleeves loose around conduits. Secure sleeves firmly in place using filling and patching materials (grout) that match with surrounding construction.

In floor penetrations, extend sleeve 4" above finished floor unless noted otherwise.

In wall penetrations, cut sleeves flush with wall surface and use metal escutcheon plates in finished interior areas.

Seal voids between sleeves and building construction with joint sealants. Make allowances for and coordinate the work with installation of firestopping, conduit insulation, and waterproofing, as applicable.

6.8 Closet Linkage

When multiple closets exist on a single floor, these closets must be interconnected via horizontal cable pathways. If drop ceilings are used, the closets should be interconnected using cable ladder that is 12 inches wide and 4 inches deep. In locations without drop ceilings a minimum of two four (4) inch conduits should be provided to implement the closet interconnection. A conduit system must include pull boxes at 100 foot intervals and after every pair of 90-degree bends. Conduits entering the closet through a 90-degree bend, whether from floor or ceiling, shall do so with a bend radius of 18 inches for 2' Inner Diameter (ID) or less. Conduits with greater than a 2" ID shall have a radius ten times conduit ID. Pull cords shall be provided in all conduits.

6.9 Closet-to-Wall Outlet Distance

The closet-to-wall outlet distance shall be a maximum of 290 cable-feet. Multiple closets shall be provided where necessary to meet this requirement. Remember to include the vertical components of a cable path when calculating distances. The 290 foot limit is cable length and not simply floor path length.

6.10 Fire Suppression

Wiring closets should not include fire sprinkler heads. If sprinkler heads must be accommodated, a dry-pipe system is preferred.
6.11 Cable Management

Between the two diagrams (Figure 5.1.1 through 5.1.4) it is clear that cable management is key to the room.

From the top-down view it is clear to see the ladder racking, hanging horizontally from the ceiling, providing patch cable management from the 110 blocks on the wall to the LAN switches in the telecom frame. In the Horizontal view the path of the patch cables is continued; traveling through the 6” vertical cable management, into the 2 RU horizontal cable management and finally to the switches.

From the Horizontal view, the infrastructure cable is depicted entering the room via sleeved cutouts. This infrastructure cabling is supported via 6” D-Rings every 18” along the wall, until finally delivering this cabling to the 110 blocks.

6.12 Building Entrance Termination Space

The building entrance room houses the facilities necessary to terminate the inter-building cable plant and to transition to the intra-building communications backbone cabling. Along with cable splice facilities, this room will also hold the lightening surge suppressors needed for the telephone system cable plant. The intra-building backbone cables run from this room via the vertical riser and horizontal pathways to the communications wiring closets throughout the building. In some cases this room may also serve as a wiring closet for the lower level of the building.

It is very likely that the building entrance termination space will act as the main closet for the building and act as the hub for the typical hub and spoke topology of the University’s telecommunications closets.

The differences between the building entrance termination space and a standard telecommunications closet are detailed below.

6.12.1 Entrance pathway sizing

The size of the pathways, if any, between the building entrance point and the Building Entrance room shall be the same as the actual facilities that enter the building. This is generally two 4” conduits.

Conduits from the Outside Plant must be firestopped and sealed to prevent water entering from outside of the building.
7 Horizontal Wiring Pathways

7.1 Overview

The term "horizontal wiring" refers to a number of cable types that run from a communications closet on a particular floor of a building to workstations on that floor. Where there are multiple closets on a floor, it can also include wiring-hub interconnection cables. These interconnection cables are typically some combination of copper and fiber optic cables. Careful design work on the horizontal cable pathways to minimize total cable length will help to lower wiring costs and in some cases might decrease the total number of wiring closets needed to serve a building.

7.2 Ceiling Cable Pathways

Ceilings used as distribution pathways for horizontal cabling shall meet the following conditions:

If a fixed ceiling has to be used as a cable route, properly sized conduit must be installed as a pass through.

**Cat5e Conduit Capacity:**

<table>
<thead>
<tr>
<th>Conduit Size</th>
<th>Number of Network Drops</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inch</td>
<td>100</td>
</tr>
<tr>
<td>3 inch</td>
<td>50</td>
</tr>
<tr>
<td>2 inch</td>
<td>20</td>
</tr>
<tr>
<td>1 inch</td>
<td>6</td>
</tr>
</tbody>
</table>

**Cat 6A Conduit Capacity**

<table>
<thead>
<tr>
<th>Conduit Size</th>
<th>Number of Network Drops</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inch</td>
<td>40</td>
</tr>
<tr>
<td>3 inch</td>
<td>20</td>
</tr>
<tr>
<td>2 inch</td>
<td>12</td>
</tr>
<tr>
<td>1 inch</td>
<td>2</td>
</tr>
</tbody>
</table>

Ceilings of lay-in tiles which allow easy access to a suitable space above are recommended. Suitable space is defined as that which supports the installation and
ready use of a 12" open-frame center spine cable ladder. These cable ladders should be installed in all hallways. Solid bottom cable trays are not to be used.

Height of the cable ladder/raceway above the finished floor shall be no more than 11’. Metal cable ladders/raceways shall be bonded to the building ground per applicable code. Plenum ceilings add to the cost of wiring a building since special type of cable must be used to meet fire codes.

### 7.3 Raceway-to-Outlet Cable Path

A 1" conduit shall be provided from the cable raceway area above the ceiling to a quad wall box, or quad boxes if specifically requested, for each workstation location. The quad box should be fitted with a mud ring to size it down to use a duplex outlet faceplate. The conduit should be installed from the outlet box to the cable ladder in main corridor. When no cable ladder exists, a simple stub termination of the in-wall outlet conduit extending several inches into the ceiling space is preferred. A cable ladder should be installed for all addition and renovation projects. Enclosed raceways should not be installed as this restricts access. Pull ropes shall be installed in all conduits as part of the conduit installation work. Daisy-chained systems that originate in the wiring closet and serve multiple outlets via a single conduit are not allowed.
8 Building Backbone Cabling

8.1 General

Building backbone cabling refers to the intra-building communication trunk system. The system consists of multi-pair telephone riser cable, coaxial trunk cable, optical fiber cable, and in some cases Category 5E or Category 6 twisted pair cabling. These cables bring the various communications services from the building entrance facility to the telecommunications closets on each floor from whence they are distributed via the horizontal wiring systems to the individual user outlets.

8.2 Topology

Building backbone cabling shall have a star topology unless otherwise specified.

8.3 Intra-building Data Backbone

The data network backbone cable installed shall be a combination of 50 micron multi-mode and 9 micron single-mode optical cable. No in-building distance limitations apply.

8.4 Intra-building Video Trunk

The building video backbone shall be 75 ohm semi-rigid coax. No distance limitations apply.

8.5 Intra-building Telephone Riser

Telephone risers shall be unshielded twisted pair CMR rated cable. Two pairs per 100 sq. ft. of assignable space shall be provided to each floor if the exact number of telephones required is unknown. If the number of telephones required is known, allow for 100% growth.
9 Miscellaneous Topics

9.1 General

This section contains comments on a variety of topics pertaining to building wiring that do not fit exclusively (at this time) under one of the main headings.

9.2 Documentation

Documentation shall be computer based and include both schematic and table forms. Elements of the building infrastructure to be documented shall be chosen based on local requirements and with reference to the TIA/EIA-606 infrastructure administration standard. A documentation maintenance program shall be developed and put into effect.

9.3 Proximity to EMI sources

Telecommunications closets and wiring pathways shall not be located in close proximity to sources of electromagnetic interference. Special attention shall be given to potential EMI sources such as large electric motors, welding equipment, etc. Wiring pathways shall be at least 12 from unshielded power lines of <480 volts and at least 5 from fluorescent lighting fixtures.

9.4 Conduit Capacity

Conduits should not be filled to more than 50% of capacity, without specific permission of the University Project Manager. If a conduit is found to be at or over the 50%, inform the University Project Manager for additional instructions.