# University of New Mexico
# Information Technology Services
# Design Guidelines for
# Information Technology Infrastructure & Facilities
# Vantage Report: April 30, 2003 Edited March 21, 2006, Edited February 27, 2008

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# UNIVERSITY OF NEW MEXICO DESIGN GUIDELINES FOR INFORMATION TECHNOLOGY INFRASTRUCTURE FACILITIES

## 1. General

The University of New Mexico has identified the need to incorporate a structured approach to the integration of Information Technology Infrastructure facilities within the planning and programming of new construction projects and retrofit of existing facilities on the Campus. The University has embraced the need to actively support the technology environment of today as well as decades into the future. Key to this mandate is the necessity to integrate the budgetary, engineering, and architectural implications of a standards-based Information Technology Infrastructure system of pathways and spaces within and between the buildings of the Campus.
Inter building Communication Infrastructure is designed for a useful life of 20 to 50 years. Intrabuilding pathways and spaces have the approximately the same useful life, and are intended for reuse when cable media is replaced. Cable media and equipment for Inter-and Intrabuilding distribution should be planned for a range of 5 to 15 years, which varies based on developments and changes in technology.

The TIA, EIA and the BICSI design manuals are the basis for the UNM Design Guidelines and Specifications. For specific requirements not included in these documents, refer to the reference documents in section 1.3 of this document.

All questions concerning the intent, updates, and information not included in the UNM Design Guidelines and/or Specifications and the information contained within this document shall be direct to the UNM Information Technology Services / Communication Network Services Department (CNS).
Note: For further details of design and specification requirements refer to the UNM Information Technology Design Guidelines at
http://its.unm.edu/communications/designguidelines/ .

## 2. Purpose and Scope

To provide programmers, budgeters, planners, designers and architects the requirements, standards and guidlines, for inclusion in the construction programming of information technology infrastructure facilities. These guidelines apply to the physical aspects of new construction projects, as well as retrofit and upgrades of existing communication infrastructure facilities on the University of New Mexico (UNM) Campus.

**Note: The provisions for use of this document are specified in UNM Policy 5310; Information Technology for Facilities. Architectural and/or engineering firms selected for the planning and design of University buildings must provide qualified IT design expertise, including a Registered Communications Distribution Designer (RCDD), to University projects. These resources must be**

**actively involved in the project design teams. General contractor bids for IT infrastructure shall include an IT subcontractor approved by UNM RFP 779 a list is available form UNM's Information Technology Services (ITS)/ Communications Network Services Department (CNS).**

**Note: All deviations, changes or modifications to the requirements of these specifications, equipment, materials, methods, procedures and requirements of these documents are subject to the Approval of UNM Information Technology Services / Communications Network Services Department.**

This document provides descriptions and general specifications for the components that encompass the pathways, spaces, and cable media for both interbuilding and intrabuilding information technology infrastructure systems. UNM has a published set of specifications for the Campus Data Communication Network that includes information for infrastructure, which these guidelines are intended to complement.

The application of the Guidelines varies from building to building, based on the building's purpose and layout. There are the specified minimum requirements for the infrastructure features described within this document; however, these may be subject to specific exception and modification upon approval by CNS/ITS according to the complexity and purpose of an individual building. In the case where the requirements set forth within this document expand upon or exceed those provided by UNM in their existing specifications, the more stringent requirement shall prevail.

When applying these Guidelines to retrofit projects in existing building, the designer should consider that some of the requirements, particularly for space, might not be practical or even possible to achieve. These exceptions and modifications also shall be submitted to ITS/CNS for reviewed and approved by CNS.

**Note: The architect, design team and contractor are directly responsible to provide, plan, design, engineer, construct and install all ITS facilities and fixtures within these guidelines requirements providing installed systems are Sustainable, Assessable and Coordinated with other building systems to allow for Flexibility and Optimal use for future operational and maintenance activities.**

This document includes guidelines for the planning and construction of Information Technology Infrastructure Facilities. Note that they are arranged in order starting with Intrabuilding infrastructure and media components for placement within buildings, and moving outward to the inter-building physical communication infrastructure. These are features created between buildings necessary to coherently connect them together.

**Intrabuilding Spaces**
- Service Entrances
- Equipment Rooms
- Technology Rooms
- Server Rooms

**Intrabuilding Pathways**
- Conduits
- Cable Tray
- Pull Boxes

**Intrabuilding Cable Media**
**Equipment Racks and Cabinets**
**Optical Fiber Backbone Cable**
**Multi pair Copper Backbone Cable**
**Coaxial Cable**
**Horizontal Copper UTP Cable or FTP (as approved by CNS)**
**Inter Building Spaces (Transition Structures)**
**Communications Vaults/Maintenance Holes**
**Hand Holes**
**Inter Building Pathways**
**Ductbanks**
**Utility Tunnels**
**Inter Building Cable Media**
**Optical Fiber Backbone Cable**
**Multi pair Copper Backbone Cable**
**Coaxial Cable**
**Wireless**
**Special Systems**
**Emergency Phones**
**Alarms**
**Multi Media & Classroom Technologies**
**Project Requirements, Documents and Warranty**
**Project Design and Communication Requirements**
**Scheduling Requirements**
**Testing, Labeling, Documentation and Acceptance**
**Warranty Requirements**

## 3. Life of These Guidelines

This set of Guidelines is a living document and intended for review and update by UNM periodically as warranted by changes in building construction techniques and communications technology. ITS/CNS retains the right to modify these documents

on an interim basis between updates or for project specific requirements to meet the needs of UNM or ITS.

## 4. Submittal Requirements

The design professional should provide the following submittals for all UNM major capitol projects. All requests for changes to the submittal package shall be approved the ITS/CNS.

**Note: All Information Technology construction documents shall be in CSI Division 27 format.**

**Schematic Design Phase Submittals:** The design professional should provide the following at the completion of the schematic design phase:

Existing site plan showing IT, ISP, Telephone and CATV utility locations and elevations
IT demolition requirements

Line Drawing of building and local distribution including IT rooms, (location and size, cable tray routing.

Floor plans with IT outlet locations

Plans of special floors or areas such as classrooms

Diagrammatic sections 1/16-inch scale

IT symbol list (Use symbol list and acronyms from the BICSI Telecommunications Distribution Methods Manual).

IT equipment and special equipment (example classroom technology components) that influences design

Telecommunications Report:
Service Line or Entrance Facility point of Entrance
Description of systems and capabilities

Technologies Report:
Detailing IT equipment for classroom multimedia and other special applications

IT Code Analysis:
Provide written statement describing methods proposed to comply with governing codes and regulations, occupancy, life safety, fire protection,

and fire resistance (examples: fire rating of cabling as related to NFPA 90 A, fire rating requirements for IT spaces, ADA requirements, etc.

IT Program Conformance Analysis:

Provide a written general statement describing how the proposed IT design meets the technical and functional requirements of the IT program and general program. Note and describe any departures from the program or provide recommended changes and reasons for departure. Include:

- Voice Systems
- Data Systems
- Classroom Technology
- Multimedia Systems
- Distant Learning Technology
- Special Systems and Technology
- IT Room/Name/Number Systems

Assign IT rooms and spaces a name (Example: ITS Equipment Room (ER) and space number that will appear thereafter through construction, completion of the architects work and occupancy. Numbering and naming should be approved by the Office of Planning and Space Management, and the nomenclature should be consistent with the TIA Reference Standards listed in the following section.

IT Project Cost Estimate

IT Construction Cost

IT Consultants Cost

IT Fixture and Equipment Cost

IT Owners Other Direct/Indirect Cost

**Note: The rate of technology change from programming through construction can be significant. The programmer, designer, project manager and construction manager need to ensure that a project contingency for technology is in place to accommodate these changes. The recommended contingency is 25% for Information Technology rate of change. This contingency is to be separate and apart of the assigned project contingency.**

Schedule: Provide a project schedule that reflects the completion of IT scheduled activities, design activities and construction phase milestones and related activities.

List of Exceptions: Provide a statement outing exceptions to the UNM ITS Design Guidelines and Design Guide Specifications.

Classrooms:

Floors Plans and interior elevations: Locate furniture and technology related components.
Include site lines, viewing and noise obstructions. Evaluate technology viewing clearances

Define lighting zones, impacts and switches.

**Design Phase Submittals:** The design professional is to provide the following at the completion of the design phase:

Details of IT distribution and components for building and local distribution

Provide a specification that addresses all Division 27 related items and activities. Include in specifications cabling system performance requirements, approved manufacturers and systems, testing requirements and warranty requirements.
Specifications shall only call out materials and systems or “approved equals” specified in the UNM Guide Specifications. The term or similar terms such as “or equal” shall not be specified or recognized as an approved equal. All “approved equals” shall have the approval of ITS/CNS.

Provide substantially complete specification for the IT systems. Address all applicable requirements of the ITS guide specifications and CSI Division 27 activities and items.

Riser Diagrams

Voice, Data and Wireless Access Point Locations with Outlet ID

Detail diagram of IT Equipment and Telecommunication’s Rooms fit out and footprint including cable tray, ground bar, backboard, equipment racks locations, etc. Ghost electrical, lighting, fire protection, HVAC and other support systems. Verify all clearances are met.

Detail diagram of equipment rack layout that includes components (i.e. UPS, electrical outlets, data switches, patchpanels, fiber optic hardware, etc.

Site drawing that identifies all ITS and other service provider (i.e. local exchange carrier, ISP, CATV etc.) infrastructure. Include the locations of

Code Blue Emergency Phones and supporting infrastructure. Include connection to nearest available connection points.

Notes applicable to the installation numbered to plan. Include conduit requirements for bend radius and transitions and similar specifics for construction or installation requirements.

Provide Raceway Distribution Plan

Define wireless coverage and design to requirements

Typical detail diagram of penetrations including firestop assemblies

Typical detail diagram related to cable tray design including, grounding, bonding, splicing, water falls and other transitions.

Typical detail diagram of cable support systems

Typical detail diagram of pull box and conduit assemblies

Typical detail diagram of raised floor sections and fit out.

Typical detail diagram of surface raceways and fit out including conduit entrance.

Typical detail diagram of floor boxes and poke tru devices including conduit entrance and power assemblies. Include all apparatus needed for assembly.

Typical detail diagram of Code Blue Emergency Phones including unit, pad, IT and Electrical components. Include the location of Emergency Phones on the Telecommunications Site Plan.

Typical detail diagram of elevator phone, include make and model.

Typical detail diagram of outlet components

Detail of outlet box and conduit assembly to wall, floor, ceiling or access point.

Wireless Access Point Outlets and Hardware

Interface outlets and interface of Alarms and Building Systems

Detail of all ADA IT equipment requirements

Typical detail diagram of all other accessory and support apparatus

Typical detail diagram of all classroom equipment installations

Typical detail diagram of special IT equipment installations

Typical detail diagram of all multimedia equipment installations

Classrooms:

Provide more detail of room layouts, technology equipment, obstructions, and viewing lines from student seating and instructor positions.

Provide more details related to lighting, zoning and switching.

Define specific locations of changes in ceiling planes, light fixtures, technology projector lighting paths, HVAC diffusers with their air throw impact on projector screens, air return locations and noise. Define noise criteria (NC)

Provide a written Acoustical Report for classrooms.

Provide a written report of all Value Engineering decisions and items

Provide and updated Project Cost Estimate for IT deliverables.

Update the project schedule as related to IT activities.

**Construction Phase Submittals:** The design professional is to provide the following at the completion of the construction design phase:

Provide a complete final specification for the IT systems. Address all applicable requirements of the ITS guide specifications and CSI Division 27 activities and items

Provide notes and cross references for common work results in specifications. Place notes in related sections.

Provide a complete final of plans for the IT systems. Address all applicable requirements of the ITS guide specifications and CSI Division 27 activities and items.

Provide notes and cross reference notes and for all common work on related plans.

Provide notes for all transitions and instructions related to ceilings, confined spaces, walls, floors and other spaces.

Provide notes for specific instructions to the contractor for IT related work activities.

Ghost ceiling plans to IT drawings. Note all IT rooms and spaces are to be clear to deck above.

Provide outlet schedule that includes each Outlet ID shown on the IT plans, final room numbers Room, outlet requirements (Ports), Performance Requirements (i.e. Category 5E or 6 10 G), Activation requirements for voice and data, Set type (i.e. single line, digital multi line service set, FAX, wall phone, Code Blue Emergency Phone, elevator phone, alarm etc. Verify outlet schedule to program requirements. Provide in electronic format to ITS and on plans as this will be used to assemble the cut sheet.

Provide final details for classrooms.

Floor plans, elevations and layout specifics

Technology equipment and relationship to view lines and obstructions

Define details and changes to IT equipment

Finalize lighting, zoning, switching, noise (NC), clearances HVAC requirements

Include final security requirements for classrooms and equipment.

Provide a final written report of all IT Value Engineering decisions items and activities.

Provide and updated a final Project Cost Estimate for IT deliverables.

Provide a final project schedule as related to IT activities.

**Bid, Award and Construction Documents:** The design professional is to provide the following during the construction phase.

ITS/CNS shall be notified prior to the acceptance of all awards the selected IT contractor and systems selection and included in the final approval process for these systems.

Only ITS/CNS approved contractors on RFP779 and systems shall be considered for award.

Notification of all substitutions for parts, products or systems is at the discretion of ITS/CNS.

All work designed and installed that does not meet UNM ITS/CNS guidelines or specifications may be rejected and shall be corrected, modified or installed at the project design team and contractors expense.

ITS/CNS reserves the right to approve all assumptions and exceptions to IT project deliverables.

CNS/ITS shall receive copies of all RFI's or other informational request related to IT project deliverables upon receipt by the project's design team.

**Construction Substantial Completion Phase Submittals:** The design professional is to provide the following at the completion of the construction phase:

As built floor plans with final outlet locations that include each outlet ID two weeks prior to first move date

Provide as built outlet schedule that includes each outlet ID shown on the IT plans, final room numbers Room, outlet requirements (Ports), Performance Requirements (i.e. Category 5E or 6 10 G), Activation requirements for voice and data, Set type (i.e. single line, digital multi line service set, FAX, wall phone, Code Blue Emergency Phone, elevator phone, alarm etc. Provide two weeks prior to first move date.

Test results for all ITS cabling including optical fiber, building distribution and horizontal cabling two weeks prior to first move date. Provide in electronic format direct from tester. Hand written test results are not acceptable.

Copy of contractor punch list for open IT items

Copy of cabling system warranty application two weeks prior to first move date

Training and information on all IT and equipment support systems, including fire protection, HVAC, alarm systems, etc.

**Construction Completion Phase Submittals:** The design professional is to provide the following final documents at the completion of the project.

Final as built plans including modifications made during substantial completion.

Final as built outlet schedule including labeling ID

Final test results after punch list completion and ITS verification.

Cabling system warranty certificate assigned to UNM Information Technology Services.

Resolution report for all punch list items
Final Value Engineering Report for IT items.

Manuals for all IT equipment and support systems

## 5. Codes & Standards

The specifications included within these Guidelines, incorporate generally accepted communications infrastructure practices described in industry recognized standards documents (and addenda) published by recognized standards bodies and organizations. These include applicable standards published by ANSI, IEEE, the Telecommunications Industry Association/Electronics Industries Alliance (TIA/EIA), ISO/IEC and Building Industry Consultant Services International (BICSI).

**Note: It is the responsibility of the architect, design team and contractor to provide, plan, design, engineer, construct and install IT systems that meet the requirements of the UNM IT Design Guidelines/Guide Specifications that is industry standard's compliant and meets the warranty and installation requirements of the system's manufacturer.**

**Note: The architect, design team and contractor are directly responsible to provide, plan, design, engineer, construct and install all ITS facilities and fixtures in compliance to all building and trade codes and laws applicable to the State of New Mexico, City and the code Authority Having Jurisdiction (AJH). This includes code modifications to existing conditions with the project boundaries and adjacent areas where associated project work is required such as pathways and IT equipment spaces.**

Provide full compliance with the American Disabilities Act of 1990 for all IT installations.

The most recent editions of the codes, laws, standards and specifications listed below shall be referenced for project design and construction requirements unless specifically addressed in the UNM Design Guideline and/or Specifications.

**ANSI/TIA/ EIA 568B, Commercial Building Telecommunications Cabling Standard**
This prescribes the requirements for Intra building copper and optical fiber cable performance, installation and testing.

**ANSI/TIA/EIA 569A, Telecommunication Standard for Pathways and Spaces**
This standard includes specifications for the design and construction of pathways and spaces within buildings required to support information technology equipment and cable media.

**ANSI/TIA/EIA 607, Commercial Building Grounding and Bonding Standard**
This document includes the components of an effective grounding system for communication systems within public and commercial buildings.

**ANSI/TIA/EIA 758 Customer Owned Outside Plant Telecommunications Cabling Standard**
This standard provides specifications for Inter Building communication facilities that include cable media, pathways and spaces.

**ANSI/TIA/EIA 862, Building Automation Systems Cabling Standard for Commercial Buildings**
This standard describes the generic cable system for building automation systems (BAS) that are intended to support a multi-product, multi-vendor automation environment within public and commercial buildings.

**ISO/IEC 11801**
International Standard ISO/IEC 11801 specifies general-purpose telecommunication cabling systems (structured cabling) that are suitable for a wide range of applications (analog and ISDN telephony, various data communication standards, building control systems, factory automation).

**Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual**
This is a manual of proven design guidelines and methods accepted by the telecommunications industry.

**Building Industry Consulting Services International (BICSI) Specialty Manuals**

Customer Owned Outside Plant
Wireless

**ANSI/NFPA 70, National Electrical Code, (NEC) Current Edition**

In addition to standards related to electrical safety, the NEC has several sections which specifically address low voltage cable installation.

**NFPA 90 A: Installation of Air Conditioning and Ventilating Systems**
This standard prescribes requirements for cabling fire ratings in ceiling spaces and the distribution of cabling within.

**American Disabilities Act of 1990**
This law mandates construction and installation requirements for handicap accessibility

**Additional Standards:**

All work not specifically related to the fore mentioned standards shall be performed in accordance with the applicable ANSI or International Standards associated to it.

**Manufactures Specifications and Instructions:**
In addition all work shall be performed to the applicable manufacturer's specifications and instructions pertaining to that work.

**6. Definitions and General Requirements**

These definitions are arranged to present the logical order of their relationships to each other in an overall infrastructure topology.

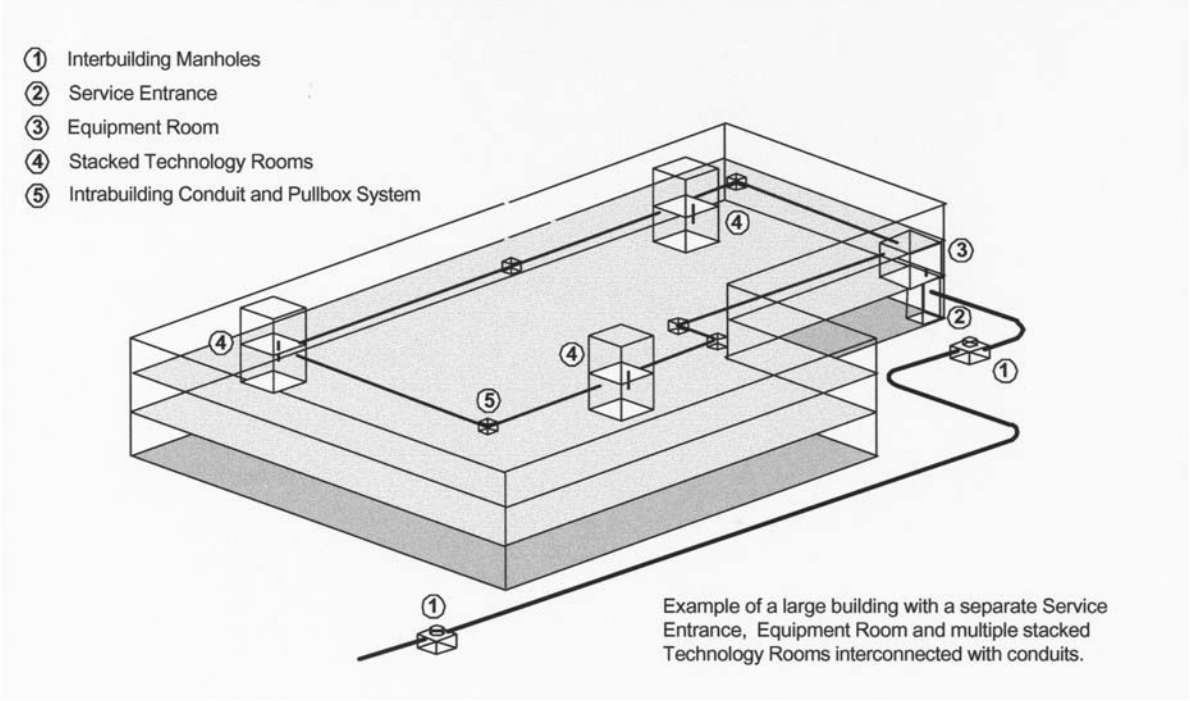
**Pathways – Structures** - or hardware that provides a permanent and reusable route for housing and the protection of cable media installed between two points. These facilities also provide a permanent enclosure or mechanism that facilitates the addition or replacement of cable over time. Intrabuilding Pathways include cable tray and conduit, which may be used for horizontal or vertical routing of cable. The Intrabuilding communication cable system infrastructure includes the pathway and support hardware that concentrates supports and protects horizontal cable media between its origination point in the Equipment or Technology Room and the workstation outlet location. Horizontal support hardware is further defined as continuous, (e.g. Conduit, Cable Tray) and non-continuous (e.g. J-Hooks).

**Inter Building Pathways** - include direct buried and concrete encased ducts as well as the existing utility tunnel system that is now in use for the routing of the majority of the University's legacy communication cable system. Aerial cable routes are also examples of Inter Building Pathways, however, underground pathways will be constructed wherever possible, and Aerial Pathways shall only be used when buried or concrete encased facilities are not an option.

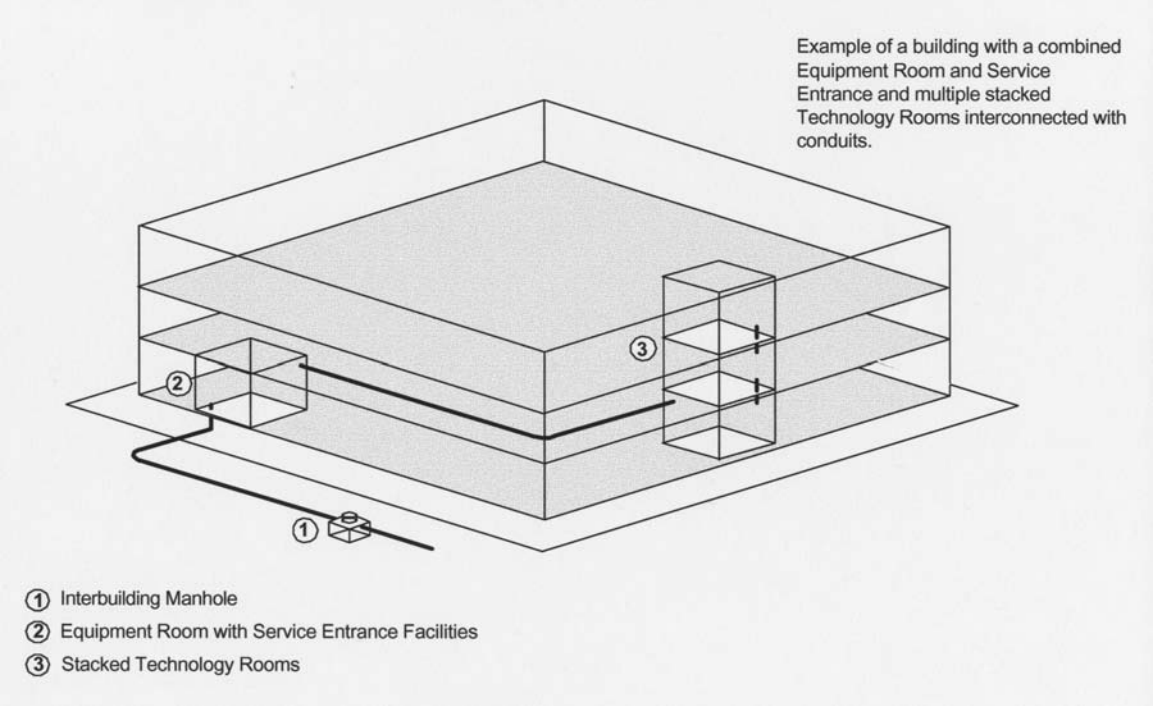
**Spaces**—Permanent structures that provide a protected area for the termination of cable and placement of equipment, allow for the dispersion and distribution of cable

and worker access to facilitate the placement of cable. Intrabuilding Spaces include Service Entrances, Equipment Rooms, Technology Rooms, Server Rooms and Pull Boxes. Inter Building Spaces include Transition Structures such as Underground Communication Vaults (Maintenance Holes), Hand Holes and Termination Spaces such as Pedestals. See Diagram 1, Typical Large Building with Separate Service Entrance, Equipment Room and Multiple Technology Rooms; and Diagram 2, Typical Building with Equipment Room/Service Entrance and Multiple Technology Rooms; for an illustration of the relationship of Intrabuilding Space.

**Typical Building Infrastructure With a Service Entrance**



## Typical Building With a Combined Service and Equipment Room




**Service Entrance Rooms** - These are rooms typically located in building basements or on the ground floor of a building where there is no basement, and are the terminus of Inter Building conduits. Service Entrances are often the location where unrated Inter Building backbone cable is spliced to rated cable and/or electrical protector units for distribution within the building. There is no need for significant environmental support in these rooms other than what is provided in a standard office, since they do not contain sensitive electronic communications equipment. Convenience power, normal ventilation, adequate lighting, and a secured entry door are usually sufficient for these facilities. See Diagram 3, Typical Service Entrance Detail for an example of an a Service Entrance Room layout.

**Equipment Rooms (ERs)** – These facilities are also referred to as MDF (Main Distribution Frame) Rooms or BDF (Building Distribution Frame) Rooms, and they are special-purpose rooms that provide space and maintain a suitable operating environment for the termination of backbone and campus cabling and house centralized communications and/ or computer equipment such as Core Switches,

Servers and PBX. The Equipment Room is considered the demarcation point within the building itself, the location where the Inter Building and Intrabuilding communication distribution systems, interconnect companies, ISP's , CATV and other outside service providers. Equipment Rooms differ from Technology Rooms in that Equipment Rooms are generally considered to serve a building or campus area, whereas Technology Rooms serve a floor area of a building.
Equipment Rooms may also include other building information systems such as classroom technology, community antenna television [CATV], multimedia, fire alarm, security, building management systems (BMS) and other building signaling systems. In some cases, an Equipment Room may also contain the service entrance facility for campus backbone, access providers, or both and serve as a Technology Room (TR). The Equipment Room is the recognized termination point for all backbone cabling in a building. The Equipment Room may require adjacent space and electrical provisions allocated for batteries, UPS, rectifiers, fire suppression systems, HVAC and other support systems. See Diagram 4, Typical Equipment Room Detail for an example of an Equipment Room layout. Ensure room size is adequate to accommodate the existing footprint with growth for the additional systems.

**Technology Rooms (TRs**) --, Also known as Wire Centers, IDF Closets, Telecommunications Closets or Tele/Data Rooms, differ from Equipment Rooms (ERs) and entrance facilities in that they are generally considered to be floor-serving (as opposed to building or campus-serving) spaces that provide a connection point between backbone and horizontal distribution pathways. Technology Rooms provide an environmentally suitable and secure area for installing cables, patchpanels, cross-connects rack- and wall- mounted hardware and technology equipment. The Technology Room is the recognized connection point between the backbone and horizontal pathways. Technology Rooms may require space and electrical provisions allocation for batteries, UPS, rectifiers, fire suppression systems, HVAC and other support systems. See Diagram 5, Typical Technology Room Detail for an example of a Technology Room layout. . Ensure room size is adequate to accommodate the existing footprint with growth for the additional systems.

**Server Rooms** – The requirements for Server Rooms is similar to Equipment Rooms or Technology Rooms. The Server Room requires racks, ladder racks, dedicated and convenience power and air conditioning. Air conditioning requirements could be higher and the calculation is provided in the Equipment Room section of this document. An infrastructure connection is required for cabling to either the Equipment Room or Technology Rooms to provide connectivity to the University data network. All requests and requirements for new server rooms shall be submitted to CNS and the Office of the CIO for approval during programming and prior to design.

**Intrabuilding Backbone Cable** – These cables are used to connect the Equipment Room to the respective Technology Rooms, primarily to carry signals to and from

the edge and core communication electronics equipment. Multi pair Copper Backbone Cable may also be used to concentrate alarm and building control system signals distributed throughout a building. Typically, Intrabuilding Backbone Cable consists of Multi pair Copper, High Strand Count Fiber Optic and Coaxial Trunk cables.

**Inter Building/Campus/Off Campus Infrastructure** – Includes the conduits, manholes, easements, right of ways, antenna, and other systems that support inter building IT transport systems. Also included are provisions necessary for public and private service providers to provide ITS services to UNM off site facilities, buildings and campuses. ITS will be the ultimate provider of these services, however projects may have both fiscal and material responsibilities for their provision. The programmer or designer needs to address and include with ITS/CNS these requirements when planning for both on and off campus locations in the planning and design of all UNM facilities.

**Note: Easements and/or written agreements are required for non UNM entities such as the local telephone company, CATV providers and other carriers for the placement of their facilities on UNM/UNMH properties. It is the responsibility of the project design team to make application to and receive approval from the UNM Department of Real Estate for these requirements prior to construction and placement.**

**Inter Building Backbone Cable** -- Inter Building Backbone Cable is used to connect buildings together, in order to concentrate and distribute aggregated signals to and from Zone Hub-Level Core Electronic Systems. Inter Building Backbone is typically Multi pair Copper (hundreds to over one thousand pairs), High Count Optical Fiber Cable (up to hundreds of strands), and Coaxial Trunk Cable. Inter Building Backbone Cable is constructed to withstand the elements of cold, heat and moisture as well as the harsh external installation environment. The cable is manufactured with heavier jackets and sometimes even “armor” where rodent damage to cable is common. With few exceptions, it is not rated for installation within buildings, and must be spliced to riser or plenum-rated cable for continuation within buildings. These splices normally are housed in the Service Entrance, or in smaller buildings, co-located within the Equipment Room. See Optical Fiber Section for performance requirements for optical fiber.

**Optical Fiber Cabling** – Inter and Intra Building Backbone
Both Single Mode and Multi Mode optical fiber shall be specified for intra building systems. Single Mode fiber shall exceed ITU G.652.c/d., shall be low water peak and suitable for CWDM applications. Multimode Fiber shall be laser optimized and specified as 50/125 Um that exceeds TIA/EIA-568-B3.1 (ISO11801 OM3) for 500-meter lengths at 10 Gigabit data rates. Separate cables shall be installed for multimode and single mode applications and each cable terminated in a dedicated FDU. All terminations are to be LC connectorized with pigtails and fusion spliced in

the FDU. The designer and contractor shall verify both specified and submitted optical fiber cable and components for exact matching as specified by the manufacturer and the system being installed. This matching includes both performance and physical optical fiber matching. Only Corning glass shall be specified for new optical fiber installations at UNM.

**Horizontal Cable** – This is predominantly 4-pair, high performance Screened /Foiled and/or Unshielded Twisted Pair (UTP) cable, as specified UNM ITS CNS, that is run from the Technology Room to the workstation. In limited applications, Optical Fiber and Coaxial cable is also installed in the horizontal environment. Generally, one cable is required to support each user device, (e.g. PC, printer, telephone) and dependent upon the projected equipment density, several UTP cables are usually installed in each workstation faceplate.

Industry standard practices dedicate Horizontal Cable to a particular floor, although in CNS approved cases, small numbers of Horizontal Cable may serve to feed floor box devices or pokethru's from more than one floor from a single Technology Room. Total cable length limitations of 90 meters1 or 295 feet dictate the reach of Horizontal Cable from the Technology Room, and often, floor plate areas require the provision of more than one Technology Room per floor to conform to cable distance limitations.

Twisted pair cable has different performance ratings or Categories, with Category 7 currently the highest level of performance. Category 5E Gigabit and Category 6 -10 Gigabit – foiled/screened type cabling systems (F/UTP) are the current typical cabling installations installed at UNM. The level of cabling performance should to be determined by evaluating the end-user's needs and ITS CNS requirements.

Category 6, 23 AWG should be installed for all Power Over-Ethernet (POE) applications to more effectively dissipate heat generated from the power applications.

Outlet and Cable Labeling is essential to the successful installation, testing and quality control of cabling systems. The designer shall provide labeling identification for outlets on plans and provide a labeling schedule for each outlet. The outlet plan and schedule is to be kept updated at each phase. The contractor is to maintain the outlet plan and schedule in the projects as-built drawings and as-built schedule during construction. The outlet as built plans and outlet schedule shall be made available upon request to ITS/CNS during construction for inspection, quality control or other purposes. A copy of the changes to outlets schedules and plans shall be provide to CNS two weeks prior to occupancy. A final copy of the plans and schedule are to be submitted directly to CNS as part of the final document submittal.

The NEC specifies installation ratings in plenum and non-plenum environments. However, plenum-rated cable should be used exclusively in all new and retrofit installations. Exceptions to the use of plenum rated cabling must be approved by CNS and the AHJ (Authority Having Jurisdiction) for code requirements. This decision is dependent upon requirements met in NFPA 90A.

Optical fiber and multimedia cabling may be required for special applications in the horizontal cabling. The needs for these special applications need to be identified during programming. A centralized optical fiber distribution topology may be acceptable for a limited distribution of horizontal optical cabling to the desktop and is subject to the approval of ITS/CNS.

**CATV/CCTV Media Cable** – In many locations on campus, coaxial cable is used for television signal distribution. In general, where this is required for legacy CATV (Community Antenna Television) distribution, a system of RG-6 and RG-11 cable should be installed. RG-6 will typically be sufficient for station or "drop" cable, whereas RG-11 is better suited for backbone cable use. Coaxial cable distribution systems require individual engineering for each building location which includes the placement of active and passive components (amplifiers, splitters and taps) at specific points in the system to ensure proper signal levels. As with UTP cable, plenum-rated coaxial cable should be installed wherever practical. The designer shall verify CATV requirements and include CATV and CCTV systems in their needs assessment.

**Wireless Data** - Wireless data access is being deployed through out the University as part of the ITS campus wireless project. Wireless access points (WAPS or AP's) shall be planned for and installed per the requirements of the end-users and the requirements set forth by ITS/CNS. Wireless shall be deployed in all public areas such as classrooms, conference rooms, study areas, stadiums, open areas adjacent to buildings, etc..
Typically a wireless access point survey will be conducted by CNS Data Networking for final placement so cabling for the access points need to be planned for an extension of up to 25 feet. Typical power deployment for wireless at UNM uses Power Over-Ethernet Technology (POE) eliminating the need for a power outlet at the access point. The requirements for wireless service can vary depending up the planned use of the system and the exact system requirements. These needs should be determined during programming and early design with CNS assistance because of budgetary and service considerations. For specific wireless deployment guidelines refer to the UNM Wireless Guideline Specification.27 15 53 and contact CNS, Voice and Data Networking Department for specific requirements and assessment.

**Multi Media, Visualization Labs and High Technology Classrooms** - New Classrooms, meeting rooms, auditoriums, and other areas that have requirements for high-speed data, video, teleconferencing and other technology applications must be planned for and installed according to the needs of the end-users and the

University's Information Technology Department. All related requirements should be planned, programmed, designed and approved by the Office of the CIO/ITS/CNS. Systems shall be designed and installed to the manufacturer's specifications and applicable ANSI/ISO standards. Provide an equipment and system warranty as well an equipment schedule and owners manuals to CNS two weeks prior to occupancy. Provide to CNS, coordinate and verify cabling and/or wireless equipment transport requirements. Ensure equipment and project provided transport compatibility.

**Special Conditions** – The Design Team shall identify special requirements for work done in operational areas adjacent to or within projects. Special instructions shall be give pertaining to dust and water mitigation, security, occupant safety, utility location, traffic control, and similar needs or conditions. Special considerations shall be given to areas that provide patient care, research, artifacts, and similar areas.

## 7. Design Criteria – Spaces

**Note: The information provided in this document contains common work requirements with other trades and disciplines. The design team is responsible that common work results are included in the design and are distributed to all disciplines to ensure continuity in the design and construction of ITS project requirements.**

## 8. Design Criteria for Service Entrances

**Size and Location of Service Entrance -** A separate Service Entrance may be required in large buildings where a separate Equipment Room is to be built. In buildings of 10,000 sq. ft., or larger, a room size of 80 sq. ft. is a minimum size with a minimum dimension of 8 feet.2 The Service Entrance shall be dedicated solely to Information Technology and related facilities. Equipment that does not support the Service Entrance (e. g., pipes, duct work, distribution of building power) shall not be located in or pass through the Service Entrance. Do not locate Service Entrances in any place that may be subject to water infiltration, steam infiltration, humidity from nearby water or steam, heat (e. g., direct sunlight) or any other corrosive atmospheric or adverse environmental conditions. Avoid locations that are below water level unless preventive measures against water infiltration are employed. Locate the Service Entrance far enough away from sources of EMI to reduce interference with the telecommunications cabling, including EMI from electrical power supply transformers, motors, generators, Magnetic Resonance Imaging (MRI) and X- ray equipment, radio transmitters, radar transmitters, and induction heating devices. Provide conduits for both a primary and redundant entry points into the buildings.

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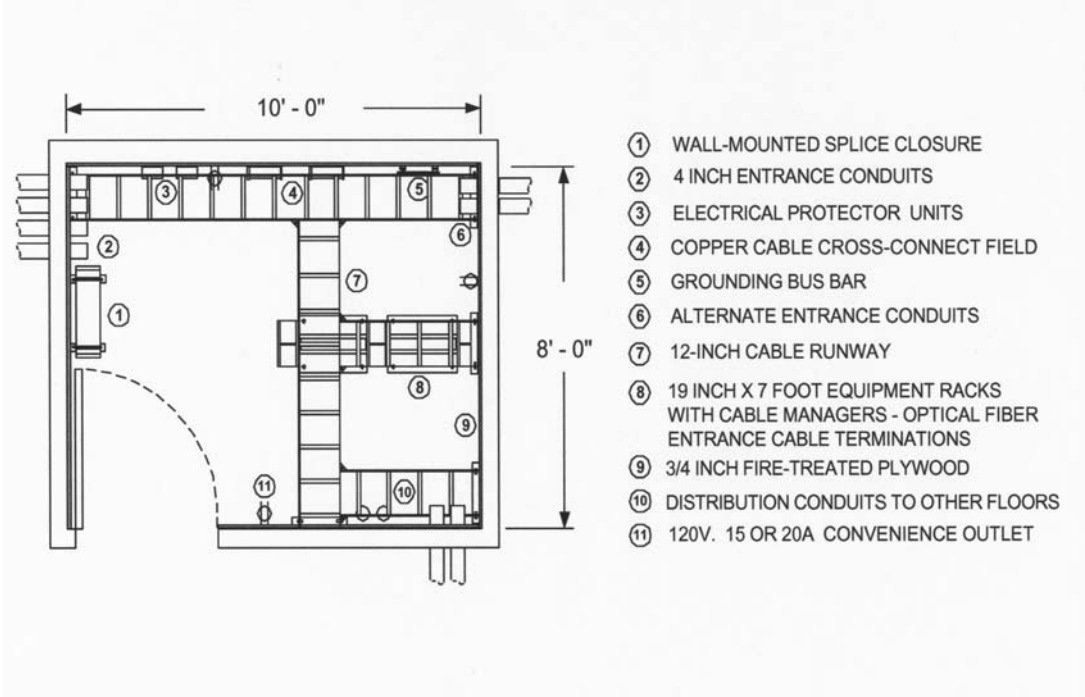
## Typical Service Entrance




**Ceiling Clearance**-The minimum ceiling clearance shall be 9.5 ft above the finished floor with ceiling protrusions (e. g., sprinkler heads) placed to assure a minimum clear height of 9 ft. clear of obstructions, to provide space overhead for Ladder Racks or cable trays and conduits. To permit maximum flexibility and accessibility of cabling pathways, ceilings are not allowed in Service Entrances.

**Doors and Access Control Service Entrances**
Doors should be equipped with electronic access controlled locks and be at least 3 ft. wide and 7 ft. tall.3 Doors should be equipped with sweeps, however, doorsills are not recommended because they impede the movement of equipment. NOTE: doors should be provided that open outward unless prohibited by code. This provides additional usable space and reduces constraints on the service entrance room layout and space requirements.

**Flood Prevention** - Locate the Service Entrance Rooms above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens). Ensure walls are sealed to prevent water seepage. Provide a floor drain to prevent flooding from the accidental seepage of water from entrance cables and ducts. It is recommended that water detection alarm system be installed in the service entrance room.

**Cable Trays and Raceways** - Provide ladder type cable trays, splice supports, and other support devices to support entrance cables. Also include 4 inch rigid conduits or heavy duty ladder type trays to extend cabling to the building equipment room. Note: cables exiting the service entrance room shall be transitioned from and outdoor to the NEC specified fire rated cable type.

**Wall Requirements** - Service Entrance walls should extend from the finished floor to the structural ceiling (e. g., the slab), painted white and be fire-rated for a minimum of one hour.4 Service Entrance walls should not have windows installed, nor is it desirable to locate Service Entrances on perimeter/curtain walls where windows comprise the entire surface of the wall.

**Backboard** - Provide AC-grade plywood, 8 ft. high with a minimum thickness of 0.75 in. around the perimeter of the room. Plywood shall be fire-rated and treated on all sides with at least two coats of white latex, or preferably, white, fire resistant paint.5 The bottom of the plywood shall be mounted 18 in. AFF (Above Finished Floor).

**Lighting** - Provide adequate and uniform lighting that provides a minimum equivalent of 50 foot-candles when measured 3 ft. above the finished floor level. Locate light fixtures a minimum of 9 ft. above the finished floor. Locate light switches near the entrance to the Technology Room.

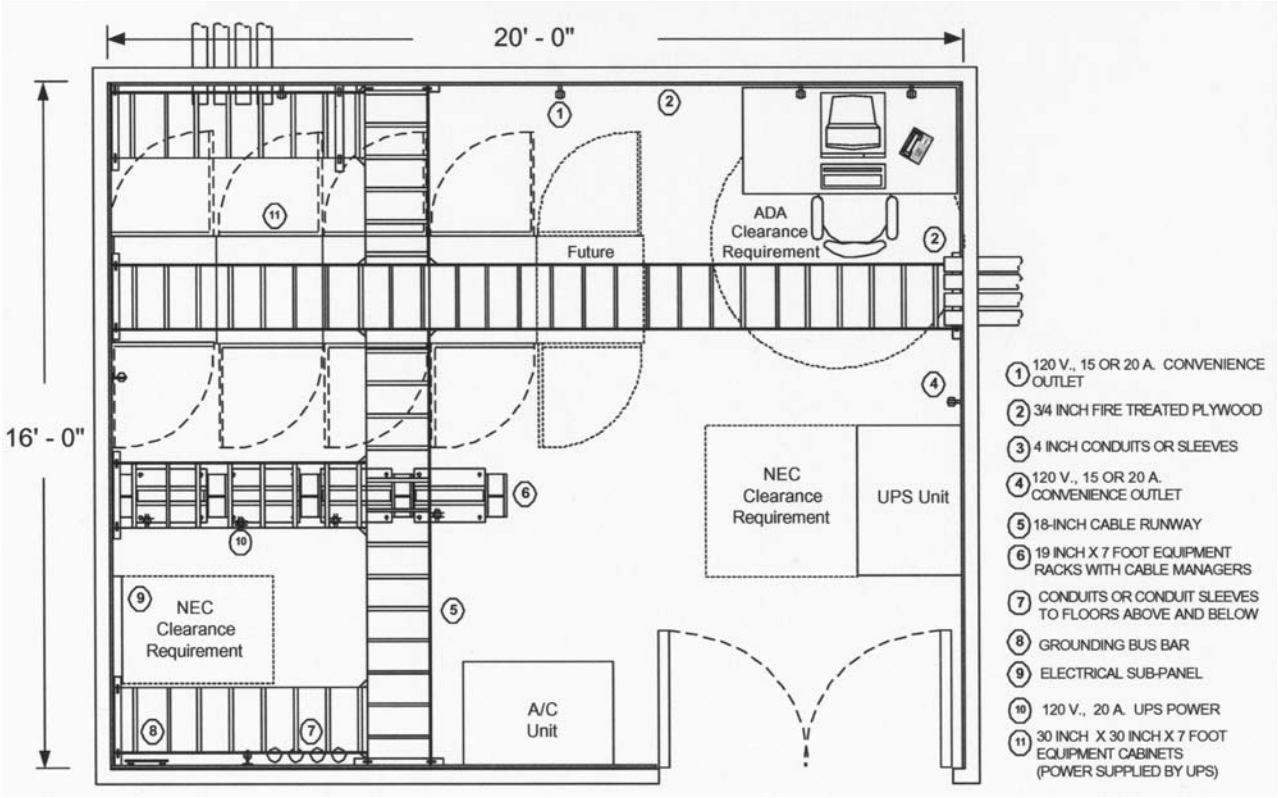
**Environmental Control** - The Service Entrance should be provided with ventilation, heat and cooling which is similar to a standard office to prevent extremes in temperature and humidity. Unless active electronic components are present, separate, 7 x 24 hour environmental control is not required.

**Power and Grounding** - Provide 120 V., 15A or 20A, 60 Hz, non-switched, convenience power receptacles (NEMA 5-15R, 5-20R) on perimeter walls.6 Outlets should be recessed in walls, surface-mounted outlets and conduits are not acceptable. A ground bus, connected directly to the building ground shall also be provided, using a conductor sized as required to provide a minimum of 2 Ohms of resistance. Provide labeling which states: “DO NOT DISCONNECT”.

**Fire Control and Detection** - The Service Entrance should be equipped with a standard pressurized fire sprinkler system as required for general office and common spaces. Smoke detectors connected to a central fire alarm panel within the building shall also be provided.

## 9. Design Criteria for Equipment Rooms

## Typical Equipment Room




**Size and Location of Equipment Room** - The Equipment Room may vary from 150 sq. ft. to 1000 sq ft or larger in size, with a minimum dimension of 15 ft. in one direction7. The size of the Equipment Room must be determined by the footprints of equipment to be installed to assure proper sizing and include space for future equipment installation. The final size of the Equipment Room shall be approved by ITS/CNS.

If the Equipment Room supports the outside cabling connections, it shall be located so that it can support two physically separate points of entry. The space shall be planned to accommodate the outside plant cabling and other systems located in the equipment room when no Service Entrance room is provided.

The Equipment Room shall be accessible for the delivery of large equipment throughout its useful life.

Collocation of other approved low voltage systems in the technology room may require additional space allocation to the room. The Equipment Room may also serve as a distribution point for horizontal cabling. If so the equipment shall be located to accommodate horizontal cabling distance requirements of 295 feet to the

[7]Vantage Technology Consulting Group, Inc., *TR and ER Standards, 2002.* Additional guidance for the sizing of Equipment Rooms may be found in Building Industry Consulting Services International (BICSI) *Telecommunications Distribution Methods Manual, 9th Edition* Chapter 7, p.7-12

voice/data outlet. The room should also be aligned for a vertical riser to the Telecommunications Rooms on each floor.

**Unacceptable Locations** - The Equipment Room shall be dedicated solely to telecommunications, campus backbone cabling, centralized computer equipment and other related infrastructure. Do not locate Equipment Rooms in any place that may be subject to water infiltration, steam infiltration, humidity from nearby water or steam, heat (e. g., direct sunlight) or any other corrosive atmospheric or adverse environmental conditions. Avoid locations that are below water level unless preventive measures against water infiltration are employed. Locate the Equipment Room far enough away from sources of EMI to reduce interference with the telecommunications cabling, including EMI from electrical power supply transformers, motors, generators, Magnetic Resonance Imaging (MRI) and X- ray equipment, radio transmitters, radar transmitters, and induction heating devices. As Equipment Rooms are frequently occupied by working technicians and sensitive electronic equipment, the room location should not be adjacent to sources of constant, excessive, low or high frequency noise, such as air-handling equipment, pumps, generators, and the like.

**Note: Systems that do not support the Equipment Room (e. g., pipes, duct work, distribution of building power) shall not be located in or pass through the Equipment Room. This includes plumbing, electrical, HVAC, gas and other utilities.**

**Architectural Requirements**

**Clearances** - The following clearances shall be maintained for equipment racks and cabinets in the Equipment Room. A minimum of 3 ft. of clear working space from equipment and cross-connect fields. Including an additional minimum of 6 in. depth off wall for wall- mounted equipment. Aisle clearances shall be a minimum of 36 in. wide.

**Cable Pathways within the Equipment Room**

**Overhead cable trays** - Cable tray systems shall be provided for routing equipment and backbone cables between cross- connects, equipment, and backbone pathways. Tray shall be coordinated with lighting, air-handling systems, and fire extinguishing systems so that fully loaded trays will not obstruct or impede their operation. Ladder racks trays are to be specified in equipment rooms and for all cable entrance points into rooms. Cable Tray layout shall be approved by CNS prior to construction and a detail drawing of the equipment room is to be provided. Ensure tray systems are specified and supported to meet both weight and the number of installed cables including an additional 40%of space for future growth. The sagging of cable trays is acceptable.

**Access floor systems** - Access floors may be provided to route cables in large Equipment Rooms. Access floor systems (often called “raised floors”) are often recommended by equipment manufacturers and are frequently used for telecommunications cabling when the Equipment Room serves multiple applications (e. g., both computer and PBX equipment). Raised floor applications require cable tray and/ or raceways for cabling distribution. Design and install to manufacturer specifications and project requirements.

**Ceiling Clearances** - The minimum ceiling clearance shall be 9.5 ft. above the finished floor with ceiling protrusions (e. g., sprinkler heads) placed to assure a minimum of 9 ft. clear of obstructions, to provide space over the equipment frames for cables and suspended cable trays. To permit maximum flexibility and accessibility of cabling pathways, drop ceilings are not allowed in Equipment Rooms. The ceiling space should be open and walls extended from floor to deck .

**Doors and Entryways** - Design entryways to accommodate the transport of heavy equipment in and out of the space. If freight elevators are not available design to accommodate rigging for equipment movement. Ensure the primary access is not impeded by stairs or other impediments to the movement of heavy equipment.

Equipment Rooms shall have doors that are at least 3.5 ft. wide and 7 ft. tall equipped with a door sweep. Since large equipment is often located in the Equipment Room, a double door 6 ft. wide by 7.5 ft. tall is recommended. Doorsills are not recommended because they impede the movement of equipment. Outside door access is preferred with an entrance to the inner building or provides direct access from a public area or hallway.

Ensure that doors are installed and lockable prior to cable termination and equipment installation.

**NOTE: Doors that open outward (unless prohibited by code) provide additional usable space and reduce constraints on Equipment Room layout. Additional space shall be provided to provide for the loss of usable space when doors open inward of the equipment room.**

**Security and Access Control** - Equipment Rooms will typically house high-value and mission critical electronic equipment. Electronically controlled access systems (proximity readers, card swipe, etc.,) shall be provided to ensure restricted access. Planners should consider the addition of security surveillance systems to record ingress and egress occurrences for Equipment Rooms that are not frequently occupied by technicians. Provide final key requirements to the UNM Police.

**Dust and Static Electricity** - Bare concrete floors are a considerable source of dust, and conventional vinyl floor tile promotes the generation of static electricity. Anti-static floor tiles should be provided in each Equipment Room. Imbed 2 in.

copper tape between the anti-static tile and the conductive adhesive 1.5 feet from the wall. Leave 12 in. of copper tape exposed above the anti-static tile for grounding to copper signal ground busbar in each Equipment Room.

**Note: Ensure that the Equipment Room is free and sealed from dust prior to cable termination and equipment installation. Provide doors, locks and seal penetrations prior to the termination of cabling, installation of IT hardware and equipment.**

**Flood Prevention** - Locate Equipment Rooms above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens). Do not install fan coil units or water piping in equipment rooms overhead. Place water detection alarm devices in the room.

**Wall Requirements** - Equipment Room walls should extend from the finished floor to the structural ceiling (e. g., the slab), be covered with two coats of white latex or fire-retardant white paint and be fire rated for a minimum of one hour. Equipment Room walls should not have windows installed, nor is it desirable to locate Equipment Rooms on perimeter/curtain walls where windows comprise the entire surface of the wall.

**Backboard** - Provide AC-grade plywood, 8 ft. high with a minimum thickness of 0.75 in. around the perimeter of the room. Plywood shall be fire-retardant and treated on all sides with at least two coats of fire- resistant paint. The bottom of the plywood shall be mounted 18 in AFF (above finished floor). Ensure the fire retardant stamp is visible in one location.

**Structural Requirements** - The floor rating under distributed loading must be 4.8 kPa – 12kPa(100-250 lbs/sq.ft.) and the rating for concentrated loading must be greater than 8.8 kN (2000 lb/sq.ft) in areas that will support telecommunications equipment such as batteries and UPS equipment. If access flooring is used in the Equipment Room, it must be rated accordingly.8 Provide minimum of 18” of clearance underneath raised floor applications, verify exact raised floor height requirements with CNS/ITS prior to specification. Verify floor loading requirements the requirements of the planned equipment installation.

**Mechanical System (HVAC) Requirements**

**Environmental Control** - Provide Equipment Room with either dedicated HVAC equipment, or access to the main HVAC delivery system. Thermostatic controls should be located within the room itself to prevent setting changes by unauthorized personnel. ITS equipment requires the HVAC system to function 24 hours per day, 365 days per year. If a building’s HVAC system cannot ensure continuous operation (including weekends and holidays), provide a stand- alone HVAC unit with

independent controls for the Equipment Room. If an emergency power source is available in the building, connect the HVAC system that serves the Equipment Room to it.

Plan the design of HVAC systems for easy future upgrades and replacement. The heat dissipation requirements for IT equipment are increasing with the need for more power to produce higher bandwidth transmission.

The HVAC system that serves the Equipment Room should be tuned to maintain a positive air pressure differential with respect to surrounding areas with a minimum of one air change per hour in the Equipment Room. Provide equipment to control humidity and air quality if needed.

Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). The system shall include a manual thermostat within the room for override control as required. Maintain positive pressure with a minimum of one air change per hour in the Technology Room.

**Provide:**

**Temperature:** mean of 63 degrees with an operating range of 41 to 86 degrees

**Relative Humidity:** 15 to 65%

**Estimated Heat Loads**: 2500 to 7,500 BTU per equipment cabinet or rack. Verify exact requirements.

Estimated Heat Loads for Server Rooms should be calculated using the following: Estimate 5-7 Kilowatts per rack. The conversion is 3,412 BTU's Per 1KW.

The mounting of HVAC units or water piping above equipment or equipment racks shall not be permitted. Do not locate HVAC units requiring chilled water or drainage in the equipment room. Install drains for condensation lines. Install heaters when necessary to achieve proper humidity levels.
The need for a humidifier shall be evaluated when interfacing an HVAC unit into spaces with swamp coolers or other high humidity areas.

**Electrical System Requirements**

**Lighting** - Provide adequate and uniform lighting that provides a minimum equivalent of 50 foot-candles when measured at the finished floor level, properly distributed throughout the room. Locate light fixtures a minimum of 9 ft. above the finished floor. Locate light switches near the entrance to the Equipment Room.

Emergency lighting systems that operate on trickle-charge storage batteries are required as a safety precaution in the event of an inadvertent power outage or emergency power shutdown.

Coordinate the lighting layout with the equipment layout, especially overhead cable trays, to ensure the light is not obstructed. Power for the lighting shall not come from the same circuits as power for the telecommunications equipment.

**Power** - Verify exact equipment power requirements with ITS/CNS. Coordinate exact power requirements equipment and footprint with ITS prior to design.

**Note: All power outages shall be coordinated and approved by ITS/CNS once operational and notice given seven days in advance of the outage to CNS/ITS and/or UNMH IS-Network Infrastructure.**

Provide individual branch circuit serving a single load from the feeder panel directly to a branch circuit receptacle (for cord- and- plug connected equipment), or equipment power terminal (for hardwired equipment).

Provide branch circuits for equipment power that are protected and wired for 110V, 30A (NEMA L5-30R) and 208V, 20A (NEMA L6-20R) as shown on the drawings.

Provide above each equipment rack dedicated to electronic equipment a tray mounted dedicated 110 V 20A 4-plex, 110V 20A twist lock and 208V 20A outlets secured to cable tray and mounted above the equipment racks in addition to wall outlets.

At minimum, provide wall mounted dedicated, non-switched 20A, 120 Volt (V) alternating current (AC) with locking electrical outlets (NEMA L5-20R) and straight blade NEMA 5-20R receptacles for equipment power, each on separate branch circuits. Dependent on equipment requirements, wall mounted 208VAC power may also be required.

If emergency power is provided for the building, provide for emergency service to the equipment room for dedicated power. Connect lighting and HVAC to the generator. Generator emergency power is necessary to provide uninterrupted voice service for VOIP service and certain data networking requirements for an extended service beyond UPS capacity. Verify the requirement for a power generator with ITS/CNS during programming and prior to design.

Any outlets in the Equipment Room that are protected by UPS or generator power shall be terminated on red receptacles for ease of identification.

Identify dedicated power outlets by circuit number labeling

All outlets must be on non-switched circuits.

Design, and provide for power and space and rack(s) for a rectifier and or batteries when needed. Verify requirements with CNS/ITS.

UNM ITS will provide local UPS's to power essential IT equipment.

Maintain the clearances specified in the NEC between power and ITS equipment.

If the Equipment Room houses RF generating equipment, power should originate from an isolation transformer.

Do not install transformers or other high EMI emitting equipment in any technology or equipment room.

Do not install transformers in any technology or equipment room. If the Equipment Room houses RF generating equipment power should originate from an isolation transformer.

Provide surge protection for equipment power circuitry.

**Emergency Power-Off Switches (EPO)** - The Equipment Room shall have an Emergency Power Off Switch (EPO) located in the corridor adjacent to the entrance of the Equipment Room. EPO switches control power to all equipment within the particular room and allow a complete power shutdown in the event of a fire or other extreme emergency. The EPO switch also needs to control power to the rectifier, batteries (if present) and the HVAC system. The EPO switch shall also have signage and a hinged, clear plastic cover installed over it to prevent accidental power shut down. Signage shall note Emergency Power Shut Off.

**Convenience Power** - Provide separate duplex 120 V AC convenience outlets (NEMA 5-15R) for tools, test sets, etc., located at least 15 in. above the finished floor, placed at approximately 6 ft. intervals around perimeter walls and identified and marked as such. Label outlets to identify them as for convenience.

**Dedicated Power Feeders** - Provide Equipment Rooms with a power supply circuit that serves only the Equipment Room and terminates in its own electrical panel. The feeders that supply the power for telecommunications equipment in Equipment and Technology Rooms should be dedicated only to supplying that equipment. More than one dedicated feeder may be required for large installations with a wide variety of telecommunications equipment. Power required for other equipment in the room (e. g., fluorescent lighting, motors, and air conditioning equipment) shall be supplied by a separate feeder, conduit, and distribution panel.

**Backup Power** - Because of the “mission-critical” nature of the Equipment Room, it is strongly recommended that backup power be provided, allowing a controlled shutdown of the equipment in the event of a power failure. If emergency power is provided for the building, provide for emergency service to the equipment room for dedicated power. Lighting and HVAC should be connected to the generator. A single module UPS with parallel (maintenance) bypass, 100% isolation from raw utility power and 30 minute (expandable to 60 minute) battery capacity at full load shall be provided. Any outlets in the Equipment Room that are protected by UPS or generator power shall be terminated on red receptacles for ease of identification.

**Bonding and Grounding** - Provide a copper signal ground busbar in each Equipment Room. The ground conductor shall be copper cable sized as required to provide less than 2 Ohms of resistance. The conductor shall be cad-welded directly to the Ufer Ground, Main Building Entrance Ground, or building steel. Provide labeling which states: “DO NOT DISCONNECT”. Ground bars shall minimally comply with the TIA 607 standard. Bonding of the cable tray and conduits must be continuous from the TGB in each Telecommunications room to TMGB located in the equipment room. Continue bonds to each equipment rack. Bond each equipment rack individually to TMGB or TMG.

**Fire Suppression System Requirements**

**General** - Coordinate the layout of fire protection systems with the equipment layout to avoid obstructing sprinklers, access to the alarm, or other protective measures.
Preaction Sprinkler Systems
Provide a fire alarm system with heat and smoke detectors and multi-zone, pre-action, dry pipe fire suppression system. A manual fire suppression “hold-off” shall be installed adjacent to the main entrance to the data center. Locate a phone and data connection in the Equipment Room in order to contact emergency response personnel. Provide sprinkler heads in wire cages to prevent accidental operation.

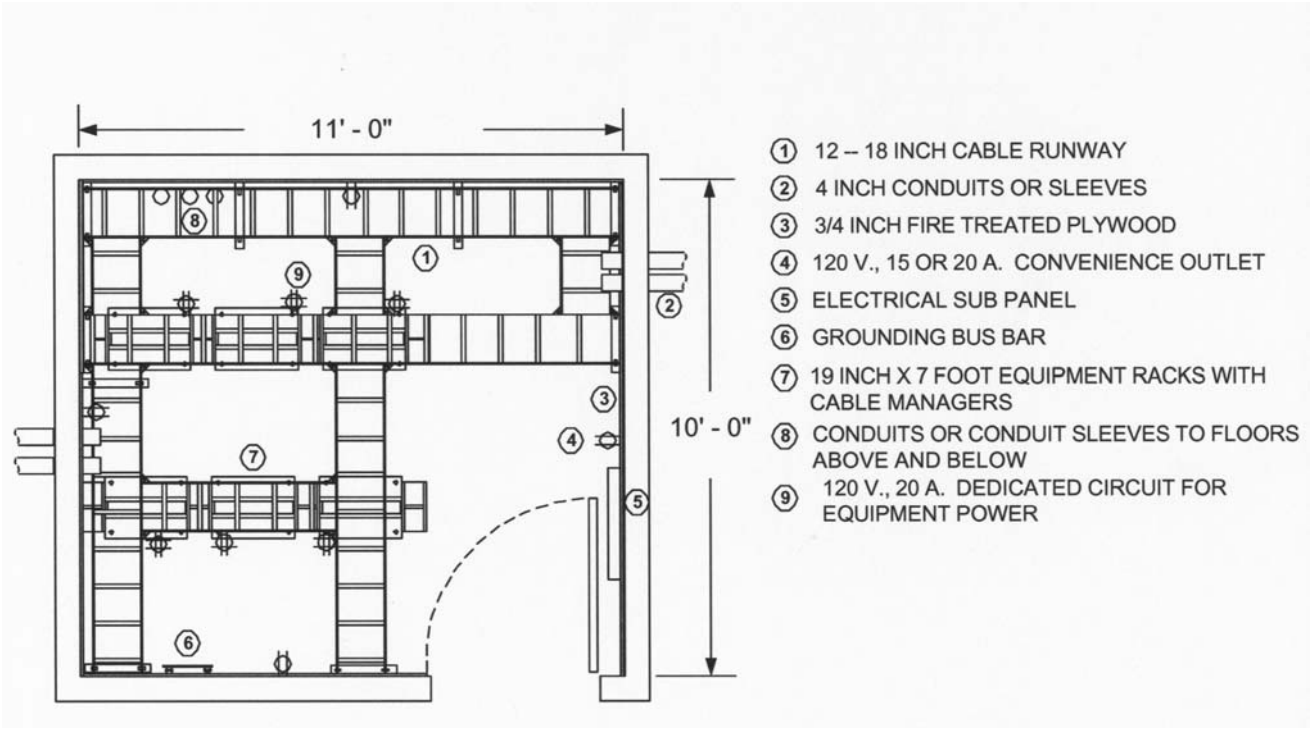
**Gas Fire Suppression Systems** - Dependent upon the density and criticality of electronic equipment housed in the Equipment Room, planners should consider the installation of a gas fire suppression system. An example of where this may be appropriate is Core Network Hub Rooms. Gas fire suppression systems such as FM 200 system employing agents such as heptafluoropropane, requires construction of an air-tight envelope, provision of space for tanks and manifold equipment as well as special discharge annunciator systems. For this reason, planners must weigh the acquisition costs of these systems versus the risk of extended service outages that could be caused by a catastrophic fire in the most critical Equipment Rooms.

**Portable Fire Extinguishers** - Mount portable fire extinguishers (with appropriate ratings) in the Equipment Room as close to the entrance as possible.

## 10. Design Criteria for Technology Rooms

The following provides general requirements for all Technology Rooms.

### Typical Technology Room




### Size and Location of Technology Rooms

**Floor Space Served** - There must be at least one Technology Room per floor or up to 10,000 sq ft. Multiple rooms are required if the cable length between the Technology Room and the telecommunications outlet, including slack, exceeds 295 ft.

**Size Requirements** - Technology Rooms shall be minimally 100 to 120 Sq. Ft. in size, depending on the systems they will contain. The rooms shall be roughly square, with a minimum clear dimension of 10 ft. in one direction. The size of the Technology Room must be determined by the footprints of equipment to be installed to assure proper sizing. Collocation of other approved low voltage systems in the technology room will require additional space allocation to the room. Ensure space for special data systems such as LANS, CATV, patient monitoring and other health care systems.

**Clearances** - The following clearances shall be maintained for equipment and cross-connect fields in the Technology Room:

A minimum of 36 in. of clear working spaces for aisles, in front of and behind equipment and patch panels, doorways, electrical panels and other equipment

A minimum of 6 in clearance depth off wall for wall-mounted equipment

Verify equipment footprints: design equipment and fixtures to ensure working clearances with future growth of minimally one rack.

## Architectural Requirements

**Ceiling Clearance** - The minimum ceiling clearance shall be 9.5 ft. above the finished floor. To permit maximum flexibility and accessibility of cabling pathways, suspended ceilings are not allowed in Technology Rooms. Ceiling shall be open from floor to deck.

**Doors** - Technology Rooms shall have doors with electronically controlled access that are at least 36 inches wide and 7 ft. tall. Doors shall be equipped with sweeps, however, doorsills are not recommended because they impede the movement of equipment. Provide doors that open outward unless prohibited by Code, Ensure the primary access is not impeded by stairs or other impediments to the movement of heavy equipment. Provide direct access from a public area or hallway. Ensure 36 inch clearances from all equipment. Ensure that doors (temporary or permanent) to Technology Rooms are installed prior to cable hardware installation and termination.

**Dust and Static Electricity** - Bare concrete floors are a considerable source of dust, and conventional vinyl floor tile promotes the generation of static electricity. Anti-static floor tiles should be provided in each Equipment Room. Imbed 2 in. copper tape between the anti-static tile and the conductive adhesive 1.5 feet from the wall. Leave 12 in. of copper tape exposed above the anti-static tile for grounding to copper signal ground busbar in each Technology Room.

Prior to the installation of technology hardware, cable termination, ensure that room is clean and free of dust and dirt.

**Flood Prevention** - If possible, locate Technology Rooms above any threat of flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e. g., restrooms and kitchens).

**Floor Loading** - In general, provide a minimum floor loading of 2.4 kPa – 4.8 kPA(50 –100 lb/sq.ft.). Ultimately, the Architect shall determine structural requirements

**Other Uses** - Technology Rooms must be dedicated Information Technology functions including multi media, CATV, CCTV, classroom technologies and related support facilities, such as alarms and other low voltage communications systems. Equipment not related to the support of the Technology Rooms such as piping, duct work, and distribution of building power shall not be located in, or pass through, the Technology Room. Technology Rooms must not be used as passageways for unauthorized persons to other facilities within the building. Technology Rooms shall not have roof access for maintenance (such as hatches) that could pose security or environmental (i.e., rain leakage) threats.

**Wall Requirements** - Technology Room walls shall extend from the finished floor to the structural ceiling (e.g., the slab), be covered with two coats of white latex or fire-retardant white paint and be one hour fire-rated or as required by the applicable codes and regulations. Technology Room walls should not have windows installed, nor is it desirable to locate Technology Rooms on perimeter/curtain walls where windows comprise the entire surface of the wall.

**Backboard** - Provide AC- grade or better plywood, 8 ft. high with a minimum thickness of 0.75 in. around the perimeter of the room. Plywood shall be either fire-rated or treated on all sides with at least two coats of fire- resistant paint. The bottom of the plywood shall be mounted 18 in. AFF (Above Finished Floor)

**Mechanical System (HVAC) Requirements**

Provide HVAC that will maintain continuous and dedicated environmental control (24 hours per day, 365 days per year). If the building's HVAC system cannot ensure continuous operation (including weekends and holidays), provide a stand- alone HVAC unit with independent controls for the Technology Room. Thermostatic controls should be located within the room itself to prevent setting changes by unauthorized personnel. Maintain positive pressure with a minimum of one air change per hour in the Technology Room. Design to accommodate future HVAC upgrades and replacements.

**Provide:**

**Temperature:** Mean of 63 degrees with an operating range of 41 to 86 degrees

**Relative Humidity:** 15 to 65%

**Estimated Heat Loads:** 2500 to 7,500 BTU per equipment cabinet or rack.

The mounting of HVAC units or water piping above equipment racks shall not be permitted. Install drains for condensation lines. Install heaters when necessary to achieve proper humidity levels.

**Electrical System Requirements**

**Lighting** - Provide a minimum equivalent of 500 Lux (50 foot-candles) measured at floor level, evenly distributed. Locate light fixtures a minimum of 2.6 m (8.5 ft) above the finished floor. Emergency lighting systems which operate on trickle-charge storage batteries are required as a safety precaution in the event of an inadvertent power outage.

Coordinate lighting with equipment racks, trays, HVAC equipment and other obstructions to ensure the required light levels. Power for lighting shall not be on circuits providing power for IT equipment or convenience outlets.

**Power** - Technology Rooms shall be equipped to provide adequate electrical power. Verify all equipment power requirements with ITS.

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At minimum, provide three wall mounted dedicated, non-switched 20A, 120 Volt (V) alternating current (AC) with locking electrical outlets (NEMA L5-20R) and straight blade NEMA 5-20R receptacles for equipment power on racks, each on separate branch circuits.

Provide tray mounted dedicated 110 V 20A 4 plex, 110V 20A twist lock and 208V 20A outlets secured to cable tray and mounted above the equipment racks in addition to wall outlets. Dependent on equipment requirements, wall mounted 208VAC power may also be required.

Do not install transformers in any technology room. If the Technology Room houses RF generating equipment power should originate from an isolation transformer.

The room should include a dedicated power panel that supports both voltages to allow for future addition of circuits and allow for isolated equipment shutdowns.9 Provide circuit number labeling on dedicated outlets. Dedicated power should feed from the dedicated panel in the Equipment Room.

If emergency power is provided for the building, provide for emergency service to the Technology room for dedicated power. Connect lighting and HVAC to the generator. UNM ITS will provide UPS's to power essential IT equipment.

Any outlets in the Technology Room that are protected by UPS or generator power shall be terminated on red receptacles for ease of identification.

Provide separate duplex 120 V AC convenience outlets (NEMA 5-15R or 5-20R) for tools, test sets, etc., located at least 18 in. above the finished floor, placed at approximately 6 ft. intervals around perimeter walls and identified and marked as such.

All outlets must be on non-switched circuits.

Provide surge protection for equipment circuitry.

**Bonding and Grounding** - Provide a copper signal ground busbar in each Technology Room. The ground lead shall be a copper cable sized appropriately to provide a minimum of 2 Ohms of resistance, cad-welded to the Ufer Ground or building steel. Provide labeling which states: “DO NOT DISCONNECT”.

**Provide:**

Ground bars shall minimally comply with the TIA 607 standard.

Bonding of the cable tray and conduits must be continuous from the TGB in each Technology Room to TMGB located in the equipment room. Continue bonds to each equipment rack.

Bond each equipment rack individually to TMGB or TMG.

**Fire Suppression System Requirements** - Provide wet-pipe system with sprinkler heads in wire cages to prevent accidental operation. Smoke detectors are required.

## 11. Communication Cable Trays

**Purpose -** Cable Tray is intended for above ceiling installation for the creation of main pathways for the management of high volumes of cable through corridors, and for access and egress to Equipment Rooms and Technology Rooms.

### General Installation Considerations

**Coordination with Other Trades** - Cable Tray installation must be coordinated continuously with the other trades, (Structural, Electrical, Mechanical, Ceiling installers, etc.,) during construction to ensure that it will be accessible once construction is completed. In general the tray should be placed about 8 inches above the suspended ceiling to ensure access once the ceiling is in place. One foot clearance shall be maintained on two sides of the cable tray.

**Routing** - Where possible, Cable Tray should be routed over common use areas such as corridors and not be routed over restrooms, electrical rooms. Avoiding routes over classrooms, exam rooms, offices and other private areas is important where repeated access to the tray would disrupt normal teaching or work activities. Use manufacturer specified turns and waterfalls for elevation transitions. Cable tray shall be installed continuous. Use 4 inch conduits through solid ceiling or in accessible areas. Bonding of the cable tray and conduits must be continuous. The capacity of the conduits shall equal the capacity of the cable tray. Maintain clearances from fluorescent lights, ballast and other EMI sources as specified by the manufacturer of the cabling system and the industry standards specified in this document.

**Heavy Duty or Medium Cable** - Tray shall be installed in areas where a high density of communication cable is to be installed. IT designers should be consulted during early stages of design to determine the projected density of cable to be supported. Aluminum is preferable to steel due to weight and corrosion considerations. Ladder rack type cable tray is preferable as it allows access and egress of cable from above or below the tray. Ladder type cable tray shall be installed in equipment rooms, technology rooms, in the corridors adjacent to those rooms, and in areas supporting more than 200 cables. Solid bottom configurations may be required in transition areas, (e.g. across hard ceilings), in areas where the tray is accessible to the public or areas where the density of air handling equipment or structural members above the ceiling prohibits access to the tray. Flanges should be configured inward to assist in containment of cable within the tray.

**Light Duty Cable Tray** - Welded wire or “Basket”-type Cable Tray is acceptable for installation in areas where the density of cable, typically 200 cables or less and does not warrant the installation of a Heavy or Medium Duty Cable Tray. Basket type tray is particularly well suited for installation below raised access floors. Install wire or welded type cable tray areas where a two foot clearance is accessible from one side and one foot from the top side. The arch of clearance shall be continuous.

**Dimensions** - In general, Cable Tray should be a minimum of 18 in. wide, with a depth of 4 in. Narrower cable tray may be acceptable for locations with low volumes of cable; however, narrower Cable Tray shall not be substituted for the 18 in. standard without prior approval. Ensure rail height will accommodate future growth.

**Support Requirements** - Where possible and practical, wall mounted angle brackets shall be used to support the cable tray. For locations away from a supporting wall, a trapeze-style support is to be used along the span of the Cable Tray. The trapeze is constructed of channel stock (i.e., Unistrut) and 5/8 in. threaded rod. The trapeze support elevation should allow a minimum of 8 in. between the top edge of the cable tray and the slab above. Appropriate threaded rod anchors are to be selected and approved by the Project Structural Engineer.

Trapeze supports to manufacturers specifications and at cable tray intersections and terminations. Sagging of cable tray due to heavy cable loads is not acceptable. Place labels on each side rail 20 feet apart: “Not for Support ‘Do Not Stand or Walk”.

Seismic bracing for the Cable Tray as required by Code, shall be installed along Cable Tray routes. Coordination of lateral and oblique bracing locations must be effected with the other disciplines whose equipment and systems share the area above the suspended ceiling.

**Cable Tray Bonding and Grounding Requirements** - Cable Tray shall be bonded to the Telecommunications Grounding Bus Bar in the Technology Room(s) on the same floor. All non-contiguous segments of the Cable Tray shall be bonded together using appropriately-sized copper wire ensuring less than 2 Ohms of resistance, with crimp-on lugs. The lugs shall be bolted to each segment of the Cable Tray to ensure electrical continuity throughout the length of the Cable Tray system. . Cable tray bonding shall minimally comply with the TIA 607 standard and meet the manufacturer’s installation specification using manufacturer approved methods. Bonding of the cable tray and conduits must be continuous from the TGB in each Telecommunications room to TMGB located in the equipment room. Continue bonds to each equipment rack.

**Cable Tray Fire and Smoke Stopping Requirements** - Cable Trays that penetrate fire-rated walls shall be equipped with wall penetration sleeves at each location, and have appropriate firestopping materials installed after the placement of cable has been completed. Fire and smoke stopping applications for cable trays must be re enterable. The use of foam type products is not approved. Firestopping bricks and pillows are recommended for most applications. All systems are to be UL approved for the application intended. Provide and complete the manufacturer’s firestopping label at all penetrations.

**Communication Cable Ladder Rack** - Ladder sacks, shall be installed within Technology and Equipment Rooms to route cable to or from sleeves, risers, ducts, cable trays to termination fields within equipment racks or mounted on walls. It does not have the trough characteristics of cable tray, and therefore, it provides continuous support with an ease of access. This is a highly desirable in Technology Rooms where moves, adds and changes to cable routing are relatively frequent.

Install ladder racks around the perimeter of equipment rooms and technology rooms. Provide cross runs of Ladder Racks perpendicular to perimeter runways while overhead and parallel to equipment racks.

**Materials and Applications** - Ladder Rack is available in various widths, and therefore may be used for a range of cable types and volumes. Ladder Racks may be mounted vertically on walls and be used to support riser cable from floor to ceiling

as it passes between floors. Ladder Rack systems are typically contained within the confines of a single room or closet, and it is not normally installed through walls, floors or ceilings in the same manner as conduit and cable tray. The well-designed Ladder Racks system uses a combination of the walls, the top of equipment racks and threaded rods for bracing and support.

Attachment of Ladder Racks to these components provides the integrity of a mutually supporting system. Provide manufacturer specified transitions, turns, waterfalls and other parts to maintain bend radius requirements for the structured cabling system. Despite this level of structural integrity, Local Building Codes may require additional seismic bracing for code compliance.

**Communication Ladder Racks Bonding and Grounding** - In Technology and Equipment Rooms, the ladder rack system shall be bonded to the Telecommunications Ground Bus with an appropriately sized copper wire to ensure not more than 2 Ohms of resistance. In areas where Ladder Racks is installed outside of Technology and Equipment Rooms, including riser closets and other locations, bonding and grounding of Communication Ladder Rack is also required. Bond ladder racks to the cable tray distribution system.

## 12. Communications Conduit Systems

**Purpose** - Conduit is intended as a permanent and continuous Intrabuilding pathway for communication cable. Conduits are used in locations where access to cable tray is unavailable, where portions of the pathway span are inaccessible (i.e. embedded in walls), and used as a pathway for small quantities of cable where cable tray is impractical. Conduit is relatively easy to bend, and it is used extensively to provide structured pathways where significant changes in cable direction are necessary. Conduit is used to protect cable from damage, and to minimize EMI interference. In addition, certain conduit materials may be used to house non-rated cables between end points to ensure NEC Code compliance.

**Conduit General** - All conduits shall be supported to meet code requirements. Ream all conduits ends. Install bushings at all ends and terminate in boxes. Conduits shall not extend beyond terminators and shall not extend into boxes. Does not use pull boxes or LB's for conduit turns. Maintain conduit diameter when hand bending.

Conduit Quantity and Diameter - The quantity and diameter of Conduits vary with their application. In general and typically, large diameter Conduits, such as 4-inch Conduit, is typically used for major trunk routes, and they are installed in multiples to provide spare capacity. Install 4 inch conduits in all intra and inter building pathways including building entrances.

**Conduit Bend Limitations** - In general, conduits shall not have more than 180 degrees of bends or turns in a segment without the installation of a pullbox. Placement of pull boxes must be considered as another contender for above-ceiling space when planning conduit routes. Typically supply large pull boxes with hinged covers that are accessible from the bottom of the box. Provide sufficient access to the cover to perform cable-pulling operations. (See the discussion of Intrabuilding Communication Cable System Pull Boxes, in Section7.5).

**Conduit Fill Ratios** - Communication Conduits have fill limitations based on the number and size of cables installed within them. Planning the number and diameter of conduits required for specific routes should be based on the anticipated cable load, and guidance for fill ratio calculations provided in ANSI/ TIA/EIA/569 and the NEC.

Provide for a 40% growth of the cable system for future installations.

**Conduits to Individual Communication Outlets, Floor Boxes and SMR** - Conduits serving individual workstation outlets are smaller in diameter and typically are specified to be 1.00 inches in diameter for up to six cables for Category 5E, four cables for Category 6 10G FUTP, or 3 cables for Category 6 A 10G. Conduit to floor boxes should be 1.50 inches in diameter. In new construction conduits should be run continuous from the outlet box to the cable tray installing pull boxes where necessary to meet bend radius requirements. They are to be connected to double-gang, deep device boxes (2 1/8 “box with a 1” box extension and mud ring), equipped with a single-gang drywall ring at the outlet location.

Conduits to Surface Mounted Raceways (SMR) shall be sized to equal the capacity of the SMR channel or cabling capacity. The raceway size of the SMR must be designed to meet the size and number of cables to be installed and include space for the installation of communication outlets. Individual workstation conduits are to be dedicated to only one outlet box, floor box or SMR each, and shall not be “daisy-chained” together.

**Note: the designer is to verify outlet box specifications and ensure adequate space is provided to meet all warranty requirements, bend radius and termination requirements.**

**Conduits to Building Roof** - A minimum of one 2-inch rigid galvanized steel conduit should be installed which penetrates the roof membrane and routed to the Technology Room on the uppermost floor of the building. This conduit will provide a pathway to the roof for the connection of antennas to the building backbone. The penetration of the roof must be weather-sealed as specified by UNM Facilities. The exposed end of the conduit shall be equipped with a weather head to prevent the entrance of moisture, insects, birds, etc. Should the penetration point not be collocated with the antenna placement location, and it is not practical to route

conduit within the building, horizontal conduit shall be placed along the roof from the penetration in the roof of the Technology Room to where the antenna is to be set. Horizontal conduit shall be affixed to free-standing redwood blocks (2"X 4"X 12") with galvanized conduit straps. The redwood blocks are to be placed along the route from penetration to the antenna site no more than 8 feet apart. Should the antenna require power for steering motors, separate power conduits must also be provided.

**Conduit Materials**

**Rigid Galvanized Steel** - (RGS, or Rigid Metallic Conduit [RMC] per NEC) is used in areas exposed to the outside elements both above and below ground or in hazardous conditions, etc.. It is an optional material specified by the NEC for the containment of non-rated cables that pose a smoke inhalation hazard in the case of fire.10 RGS Conduit is heavier than either Intermediate Metallic Conduit (IMC) or Thin wall Electrical Metallic Tubing (EMT) and thus requires more robust support structures to hold it in place. RGS also requires the use of threaded couplers and fittings that add to installation costs due to the increased labor necessary to assemble several sections together. The thickness of the walls of RGS Conduit make the use of Conduit bending machines an absolute necessity for field installation.

**Intermediate Metallic Conduit** - (IMC) IMC Conduit is used in areas exposed to the outside elements, and although it is Galvanized like RGS Conduit, its walls are of thinner gauge steel, and IMC is not often used in direct-buried applications. IMC Conduit is acceptable for non-rated cable installation. IMC Conduit may be used, however, to carry riser-rated cable and inner duct in vertical and horizontal cable applications. The thickness of the walls of IMC Conduit makes the use of Conduit bending machines strongly recommended.

**Thin Wall Electrical Metallic Tubing** (EMT) - EMT is used primarily for both high- and low- voltage electrical installations within the confines of an environmentally-controlled building. EMT is relatively light, and in smaller diameters, easy to form using only hand tools. EMT Conduit connectors and fittings are available in two configurations, either the more commonly seen "Set-Screw" Type, or the virtually air-tight "Compression" Type fittings. In general, set-screw connectors and fittings comply with NEC Code for low-voltage applications and are suitable for most installations. EMT Conduit is not acceptable for non-rated cable installations or building entrances. EMT Conduit may be used, however, to carry riser-rated cable and inner duct in vertical and horizontal cable applications. Short sections of EMT Conduit are commonly used as sleeves for wall penetrations, and floor cores for riser applications.

**Flexible Conduit** (Flex) - The use of Flexible Conduit is not the preferred alternative for communication cable installation and shall not be used when EMT Conduit is practical for use. Installation of Flex Conduit is an acceptable option in congested ceilings, walls, for connections into modular furniture, or similar applications when approved. When using Flex Conduit, increase the diameter of the Flex by one trade size over what the requirement would be using smooth-wall conduit.

**Plastic Conduit/Polyvinyl Chloride (PVC)/Liquitight Conduit -** Plastic and PVC Conduit is to be used for underground duct construction between buildings and vaults. Liquitight Conduit is commonly used as a flexible pathway for higher voltage electrical conductors in wet environments. The use of Plastic, PVC or Liquitight Conduit within buildings is not recommended due to NEC Code compliance issues for fire rating.

**Innerduct** - Innerduct is sometimes referred to as sub-duct and is used primarily as a means to subdivide large diameter metallic or plastic Conduits into distinct pathways for fiber optic cable, however, copper cable is sometimes placed within Innerduct to prevent tangling with other cables already present. Innerduct is available in plenum, riser-rated, and non-rated materials, for interior and exterior applications, in a range of diameters, as well as a variety of colors for ease of identification. The most common configuration is corrugated Innerduct which is very flexible and provides a low friction pulling environment. Innerduct is produced in solid and ribbed styles as well. Beside installation within conduit, Innerduct can be placed by itself within cable trays, suspended from ceilings using cable hangers, and run vertically through sleeves as pathways for riser cables.

**Conduit Support Requirements** - Conduits require substantial support mechanisms such as channel stock/threaded rod trapeze supports. Individual Conduits may be supported using threaded rods with clamps. Conduits can also be attached to the underside of cable trays and affixed to walls where practical. Supports are particularly critical at points on the pathway route where significant changes in direction (i.e. 90-degree bends) occur. This support is necessary due to the lateral forces incurred by the conduit when cable is pulled through the bend itself. In some areas, seismic bracing of conduit is required by local building codes. Accommodations for lateral and oblique bracing struts must be coordinated with the other disciplines that vie for critical ceiling space.

**Bonding and Grounding of Conduits** - Bonding of Conduits to the Telecommunications Grounding System is required. At the termination of Conduit runs within Technology Rooms, attachment of a ground wire between the Telecommunications Ground Bus to grounding rings installed on Conduit box connectors should be accomplished to ensure electrical continuity of the conduit system. Bonding and grounding must be performed where metallic conduit is installed or embedded in concrete.

**Firestopping of Conduits** - Partially filled and empty conduits that pass through fire-rated walls or through floors shall be fire stopped in accordance with NEC11 and Local Fire Codes. Metallic re-enterable listed devices are preferred. Flexible non-hardening, firestopping putty or pillows are also commonly used as these materials can be readily removed (and replaced) for additional cable installation when necessary.

**Labeling of Conduit** - All newly placed conduits designed to carry distribution cables, both fiber optic and copper, shall be labeled as "Communications" at least every 25 feet. The labeling shall be of a permanent nature such as manufactured labels stenciling or other ITS/CNS agreed upon methods.

**Miscellaneous Conduit Requirements** - In order to protect cable from damage during installation or static conditions following installation, Conduits should be cut square, with the cut ends reamed and deburred. Plastic bushings are to be installed over the each end of every Conduit. To facilitate cable installation, nylon or polyethylene pull strings shall be placed in each Conduit from end to end. Conduit plugs are not necessary for empty or spare Conduits in indoor environments, however, any empty conduit or duct which traverses the outdoors should have a conduit plug installed to prevent the introduction of noxious gases or water into the building.

**Pull boxes**

**Intra Building Communication Cable System Pull Boxes** - Pull Boxes are used in conjunction with conduit installations to provide access to cables at appropriate locations for distribution to tributary locations and to facilitate cable installation along the route after the length and the number of bends in a conduit run make cable pulling difficult.

**Materials** - For indoor use, NEMA Type 1 pull boxes are adequate for most applications. For areas exposed to heavy moisture, chemicals or weather elements, NEMA Type 3 or 4 Pull Boxes are usually required. The configuration of pull boxes varies, as some are equipped with hinged covers, others with removable covers which are screwed or bolted on. The configuration selected should account for the accessibility of the pull box once all construction is completed, and other fixtures or finishes may interfere with removal of the cover for access.

**Placement** - In general, a pull box is required every 100 feet of conduit run, and/or after 180 degrees of directional change has been affected. For example, a pull box should be placed along the route after two 90 degree bends, 25 feet apart are encountered. Consideration should be made for the direction of cable pulls, or, if this is ambiguous, pull boxes should be placed on both end of such bends. The use of

pull boxes for directional change itself shall be avoided, since the pulling and frictional forces absorbed by the inside radius of conduit sweeps cannot be mitigated. Pull boxes should be placed after bends in conduit such that the resulting pulls are straight through the pull box and the directional change is accommodated by the sweep of the conduit.

The size of pull boxes make placement above suspended ceilings a challenge, since in most commercial buildings, the area above the T-bar grid is typically congested with mechanical and electrical equipment. This equipment occupies the area above ceilings in addition to structural components that comprise the basic building itself.

Ensure conduit terminations and terminations are mounted flush to the surface of the pull box to ensure optimal usage. Ensure all box covers are secured tightly.

**Pull Box Support Requirements** - Pull Boxes are structures permanently affixed to the building structure. They can be attached directly to the ceiling slab, or suspended by 4-point threaded rod supports anchored to the ceiling.

**Pull Box Bonding and Grounding Requirements** - As pull boxes become an integral part of the conduit system, the conduit connectors that attach the conduits to the box create electrical continuity with the conduits themselves. Individual bonding of pull boxes is not normally required.

**Firestopping of Pull Boxes** - As pull boxes are designed to be resealed with the appropriate cover after they have been accessed, firestopping of conduits within Pull Boxes is not required.

**Labeling of Pull Boxes** - All newly placed pull boxes designed to carry distribution cables, both fiber optic and copper, shall be labeled as "Communications". The labeling shall be of a permanent nature such as manufactured labels stenciling or other ITS/CNS agreed upon methods.

**Horizontal Cable Support Hardware (Non-Continuous)** - Non-Continuous Horizontal Cable Support Hardware is used in locations where the communication cable is not supported by continuous systems such as cable trays or conduit. Since support is not continuous, cable weight is concentrated at the intervals of the support hardware. Therefore, Non-Continuous Cable Supports shall be placed not more than 4 feet apart in linear runs.

**J-Saddle Hooks** - These components are metal stampings configured in a “J” form, which provide a broad cradle or saddle support for bundles of cable. The larger surface area of the saddle prevents kinking, or crimping of high-performance UTP cable. J-Saddle Hooks are available in a variety of sizes and they can accommodate a range of cable bundle sizes and weights. These hangers may be supported by threaded rod, beam clamps, etc., and can be “ganged” together to

provide a number of support way points along a cable route. As this type of hanger preserves critical UTP cable geometry, they are the preferred method for non-continuous cable support. These are approved for use in small projects and renovations when approved. All j-Saddle hooks shall be rated by the manufacturer for the Category of cables (i.e. Category 5E) being installed.

**Bridle Rings** - The use of bridle rings is not approved for supporting communications cabling.

## 13. Intra & Inter Building Cabling Systems

### Inter Building Cabling Approved Manufacturers

**OSP Copper Cable** - Superior Essex, General, Systemax

**OSP Optical Fiber Cable** – Corning, Mohawk, Bertek, Systemax

**OSP Optical Fiber Splicing** – Corning and Components As Specified and/or Approved by ITS/CNS

**OSP Copper Splicing** – Components as Specified and/or Approved by ITS/CNS

### Intra Building Cabling Approved Manufacturers

**Riser Copper Cable** – Systemax, Mohawk, Bertek, Approved Systems

**Riser Optical Fiber Cable** (Corning glass only) – Corning, Mohawk, Bertek, Systemax, and Approved Cabling Systems

**Horizontal Cabling Systems** –

**Category 5-E** UTP– Ortronics, AMP, Siemons, Systemax, Belden

**Category 6 UTP** - Ortronics, AMP, Siemons, Systemax, Belden

**Category 6-10-G F/UTP** - Ortronics, AMP, Siemons, Systemax

**Requirements** - The cabling system shall meet or exceed the following performance requirements:

**Intrabuilding Backbone** (Riser) - The Intrabuilding Backbone shall support standards-based network protocols up to and including 10 Gigabit Ethernet.

**Intrabuilding Backbone** (Link): The Link connections (between Technology Rooms on a floor) shall support standards-based network protocols up to and including 10 Gigabit Ethernet.

**Horizontal Cable**: The horizontal cabling shall support standards-based network protocols of up to1 Gigabit Ethernet or 10 Gigabit Ethernet as determined through programming or by end user requirements. It shall be installed or supplemented in specific locations as defined by end user requirements with either copper or optical fiber cabling that shall support up to10 Gigabit Ethernet connections.

Category 6 UTP 23 AWG shall be installed for all wireless applications.

All cables shall be certified to comply with advertised performance and warranted against defects by the manufacturer for industry-standard time periods.

Specifically, the cabling system shall support the following network and communication protocols:

**Note: The designer is to ensure that the manufacturer of the selected cabling system shall have included horizontal cabling link loss budget test requirements for the installed system. Any cabling system that does not have established link loss budgets shall not be approved for use. Provide Link Loss budget requirements for the UTP or F/UTP to ITS/CNS prior to the final product selection.**

Continued Below

| Cable Types | Quantity |
|---|---|
| Single mode optical fiber- Low water peak 10 gigabit Single-Mode suitable for CWDM use complies with ITU G.652.c/d. Tight buffered, plenum rated or as specified | 12 optical fibers minimum) Single sheath |
| Multimode optical fiber that exceeds TIA/EIA-B.3-1(ISO 11801 OM3) for 500 meter lengths at 10 Gigabit data rates Tight buffered, plenum grade or as specified | 12 optical fibers minimum) Single sheath |
| Voice-grade Category 5E 24 AWG twisted pair copper cable plenum grade (CMP) or ARMM-type riser rated Category 5E (CMR) may be used in certain applications | 2 pairs per outlet, or 2 pairs per 100 square feet, which ever value is greater + 25% growth |
| RG-11 Quad-Shield Coaxial Cable, plenum grade (CMP) | As Required |
| Category 5E or 6 UTP or F/UTP copper cabling plenum grade (CMP) | 12 cables when specified, if distance is less than 100 Meters |

| Technology / Protocol | Comment |
|---|---|
| 10 Gigabit Ethernet | Category 6 A 10G F/UTP |
| Gigabit Ethernet (including trunked connections) 1000/100/10 Mbps Ethernet | Category 5E UTP |
| Power Over Ethernet (PEO) and Wireless Applications | Category 6 UTP – 23 AWG |
| ATM (up to OC-48) | As specified |
| Legacy Protocols, including Token Ring and FDDI. | As specified |
| OC-3, OC-12 and OC-48 connections | As specified |
| T1 and T3 connections | As specified |
| Telemetry and Patient Monitoring (IP and RS-232) | RS-232 over copper or Category 5E UTP cabling only as specified. |
| Analog and Digital Telephone Service | Category 5E UTP |
| Broadband and Baseband Video Signals | Optical fiber and optional coaxial cabling or) as specified |

| Cable Type – Intra Building Backbone | Quantity |
|---|---|
| Single mode optical fiber- Low water peak 10 gigabit Single-Mode suitable for CWDM use complies with ITU G.652.c/d. Tight buffered, plenum rated (OFNP) | 12 elements, 6 pairs minimum, single sheath Exact counts to be determined by ITS/CNS |
| Multimode optical fiber that exceeds TIA/EIA-B.3-1(ISO 11801 OM3) for 500 meter lengths at 10 Gigabit data rates | 12 elements, 6 pairs minimum, single sheath Exact counts to be determined by ITS/CNS |
| Cat 5E or 6 F/UTP UTP copper cabling plenum grade (CMP) | 12 cables, if distance is less than 100 Meters Exact counts to be determined by ITS/CNS |
| RG-11 Quad-Shield Coaxial Cable, plenum grade (CMP) | As Required |

## 14. Equipment Racks and Cabinets

**General** - Intrabuilding Cable patch panels used for both Intrabuilding Cable and Horizontal Cable termination, wire managers, and electronic equipment, will be mounted in standard 19-inch x 7-foot aluminum equipment racks. Manufacturers shall be approved by UNM.

**Cable Management** - Essential to the proper installation of cable and equipment is vertical and horizontal cable management hardware which must be considered in the space planning layout of every Equipment and Technology Room. Typical vertical cable managers add approximately 6 inches of width to each of the outboard sides of a single equipment rack. Ensure vertical and horizontal management system will accommodate patch cords for a fully loaded patchpanel and allow for an additional 20 percent growth. The designer and architect shall take the additional space requirements for vertical and horizontal managers in consideration to determine the equipment footprint, the specified clearances and room space requirements. In situations where rows of multiple racks are “ganged” together, one vertical cable manager is placed between two adjoining racks. (i.e., an array of two racks would require a minimum of three vertical cable managers).

**Equipment Racks** - The equipment racks are to be mounted in Equipment Rooms and Technology Rooms in the quantity necessary to support all necessary cable, hardware and equipment. Four post racks are typically specified. The layout or footprint of equipment racks and equipment must be detailed on project plans and approved by ITS/CNS. A minimum allowance of 25% percent vacant rack unit space or 1 vacant rack minimum (which either is larger) is required for future growth in the Equipment Room and Technology Rooms of each facility. One rack unit (RU) is 1-

3/4 inches in height, and a standard 7 –foot equipment rack has a mounting capacity of approximately 44 RU's. Termination and cable management equipment are manufactured in standard multiples of RU's in height.
Equipment racks are typically supported and braced by overhead Ladder Racks (Ladder Rack) which serves the dual purpose of providing support and a means for routing cable to the termination hardware installed within the racks themselves. Provide both vertical and horizontal transitions. Use only manufacturer approved accessories and attachments.

**Equipment Cabinets** - Equipment cabinets are used typically in Equipment and Server Rooms where large and heavy electronic equipment is mounted. However, depending upon program or technology requirements, space and clearance requirements for cabinets should be taken in consideration when planning Technology rooms. Equipment Cabinets have the same mounting configuration as equipment racks, the mounting rails are typically 19-inches wide, 7-feet tall, and have a 44-RU capacity. Since they have a depth dimension as well, Equipment Cabinets allow four-point support and suspension of hardware. For example, large zone hubs can be 10-12 RU's in height, and be 20 inches in depth. They may weigh over 100 lbs. Manufacturers of such hardware usually specify mounting rails that require attachment to the front and rear of a cabinet for adequate support. Cabinets can be customized with, cooling, fans, locking doors, and other appliances that make them a versatile element of the communications infrastructure. Additional space shall be planned for to allow the installed cabinets to meet the space and clearance requirements previously specified in this document. Requirements for these products are project specific and should be determined during programming or as early in the design phase as possible.

Provide vertical and horizontal cable and patch cord management to accommodate a fully loaded unit as specified for equipment racks in determining patch cord management requirements.

## 15. Intra Building Cable Termination Hardware

**Intra Building Copper Backbone Cable Termination Hardware** - Multi pair Copper Backbone cable is to be terminated on 110-style termination blocks, with 5-pair connectors. 110 blocks will either be attached to the plywood backboard or mounted on brackets within the equipment racks as determined by UNM. The layout or footprint of termination hardware and equipment must be detailed on project plans and approved by Information Technology/Telecommunications.

**Data Patchpanels** – Install system compliant patchpanels that are four pair pinned TIA/EIA B per manufacturer's specifications and instruction.

**Telco Patchpanels** - Install Telco pinned, connectorized, 48 port patchpanels with pins 3,4,5&6 activated and install 25 pair connectorized cables. Terminate the 25

pair cables to the 110 connector blocks activate 2 pair per patch panel port or jack. Test each port pair and pin for continuity, grounds, shorts, opens, crosses and splits.

**Intra Building Optical Fiber Backbone Cable Termination Hardware** - Optical fiber cable shall be terminated within a Fiber Distribution Unit (FDU) with appropriate connectors according to UNM specifications. The FDU is to be mounted within the Equipment Racks according to UNM guidelines. Dedicate each optical fiber cable to a FDU that incorporates splice trays. Fusion spliced pigtails using LC connectors. The layout or footprint of FDU's and optical fiber equipment must be detailed on project plans and approved by Information Technology/Telecommunications.

**Centralized Optical Fiber Distribution and Optical Fiber to the Desktop** - When a limited number of optical fiber connections are required to the desktop with locations scattered on various floors, the installation of a centralized optical fiber distribution system is permitted with approval from ITS/CNS. The use of this system will optimize the use and cost of optical fiber ports and equipment. The design and installation of the system shall meet all the requirements of TIA/EIA 568-B and the NEC.
The designer is to ensure that deep outlet boxes are specified during the design to accommodate optical fiber bend radius and termination requirements.

The designer will specify 50/125 um optical fiber per the requirements of TIA/EIA 568-B.3 including addendum 1.The purpose of this addendum is to provide additional transmission performance specifications for 50/125 µm optical fiber cable capable of supporting 10 Gb/s serial transmission up to 300m (984 ft.) using 850 nm nominal wavelength lasers. Specify 850 nm Laser-Optimized 50/125 µm multimode optical fiber cables. The cables shall be 900 µm tight buffered fibers. Cable color shall be orange.

Mechanical optical fiber terminations are preferred at the work area outlet. Verify with ITS/CNS the exact connector requirements for the planned installation.

## 16. Intra Building Optical Fiber Testing, Labeling and Acceptance Requirements

**Optical Fiber Testing, Labeling and Acceptance Requirements** - Intra building optical fibers shall be tested using a tester and power meter that is specified to test links at short distances. Test and label the optical fiber to the manufacturer's system requirements, TIA/EIA 568-B standard's requirements and UNM specifications. Verify labeling is consistent with numerical alignment of fibers Power meter test results (attenuation) and OTDR traces shall be submitted to CNS two weeks prior to occupancy. Bi-directional testing is required for all links.

**Optical fiber coupler/panel insert colors**:

Single Mode – Blue

Laser Optimized Multi model 50 Um– Aqua
Multi Mode - Tan

All FDU's and optical fiber connectors are to be labeled using an electronically printed label. An adhesive shall be secured to the FDU door. All FDU's are to be labeled sequentially on equipment racks.

All contractors for optical fiber cabling systems shall be selected from the list of contractors approved on UNM RFP 779 and are project approved by UNM ITS/CNS. Project approval by UNM ITS/CNS is subject to the contractors workload at UNM, past performance and technical capabilities. The selected contractor shall employ a RCDD who is the contractor's site project manager, primary point of contact and the contractor representative at project meetings.

Acceptable Testers: Fluke DTX 1800 for Intra building testing procedures.. Others testers are acceptable with prior approval by CNS.

## 17. Horizontal Cabling Media

**Horizontal Cable Media** - There remains a large installed base of Category 5 and 5e cable on the UNM campus. However, as new buildings are constructed, and renovations of older buildings occur, UNM intends to transition to the deployment of Category 6 - 10G F/UTP UTP cable for high speed applications. Category 6 - 10G FUTP cable is a standardized cabling media for the support of converged technologies at 10 Gigabit data speeds. The end user and UNM's ITS/CNS data requirements must be verified during programming of early design to determine the exact category of performance for cabling requirements. Category 6 UTP is specified for all POE and Wireless applications.

Horizontal (station) Category 5E UTP or Category 6 10G F/UTP UTP cabling systems shall be, supplied by manufacturers approved by UNM, will run from the Technology Rooms to outlets located throughout the facility. Maximum cable length is 90 Meters (295 feet). Each outlet will be provided with multiple, standards-based cables, faceplates, and connectors. Workstation termination hardware shall be manufactured by providers approved by UNM. The typical number of cables for each outlet is three cables which can be of mixed category cabling media. An outlet schedule shall be prepared during programming to determine the exact requirements for each outlet. This schedule will determine the exact horizontal cabling requirements for both design and budget. It also allows each outlet to support multiple information systems without requiring re-cabling. The following cables will be provided installed as "home runs" from the Technology Room to each outlet it serves.

| Cabling Type Horizontal | Quantity |
|---|---|

| | |
|---|---|
| **Cat 5E, or 6 10G F/UTP UTP copper cables and termination hardware. Cable color blue.** | **Determined by programmed outlet schedule or typical of three.** |
| **Option: 50/125 um 900 um tight buffered multimode optical fiber that meets or exceeds TIA/EIA-B.3-1(ISO 11801 OM3) laser optimized for 500 meter lengths at 10 Gigabit data rates with LC connectorization at the patch panel. Outlet connectorization TBD by ITS/CNS**<br>**Cable Color: Orange** | **Determined by programmed outlet schedule.** |
| **Option: RG-6 Quad-Shield coaxial cable for legacy media distribution with F – connectorization.**<br>**Cable Color: White** | **Determined by programmed outlet schedule** |

**Horizontal Cable Media Termination Hardware -** Horizontal UTP Cable for either voice or data applications will be terminated on 48-port, RJ-45 style patch panels. Terminating connectors shall be modular and patchpanels shall be interchangeable support multiple categories of performance of applications. Optical fibers and coaxial links to the horizontal shall be terminated in separate dedicated patchpanels. Optical fiber horizontal links are to be LC connectorized using mechanical or hand polished connectorization at the patchpanel and mechanical connectorization with connector type as specified by ITS/CNS at the outlet. Verify exact connector types with UNM Information Technology/Telecommunications.

The category and number of cables per outlet shall be specified in programming and approved by CNS prior to design. Typical installations for UNMH installations require outlets require four - Category 6 FTP 10 Giga Bit cables for new projects. Verify with owner the exact number and category of cabling and ports per outlet with the owner before designing.

**Future Growth** - Planners shall provide enough spare ports to support 25 percent growth of the standard outlet configurations in the facility being served. (e.g., for a facility with 100, 4-cable outlet terminations in a particular Technology Room, the planner must provide space for the greater than of 25 additional outlets or 100-additional ports for growth.

**Optical Fiber to the Desktop** - Certain program requirements for high bandwidth may require optical fiber to the desktop. Typically a four fiber 50/125 UM 900 um tight buffered cable terminated at the FDU (patchpanel) connectorized with LC connectors shall be installed. The optical fiber shall meets or exceeds the requirements of TIA/EIA-B.3-1(ISO 11801 OM3) laser optimized for 500 meter lengths at 10 Gigabit data rates with LC connectorization at the patch panel. Outlet connectorization will be specified by ITS/CNS.

**Intra Building Coaxial Cable Termination Hardware** - Where coaxial cable is used for signal distribution, the design of the broadband system will dictate the location of cable termination hardware. Typically, broadband signals require the placement of splitters, amplifiers and directional taps, which are more practical to mount on plywood backboards. In some cases, however, rack-mounted patch panels equipped with BNC or F-type connectors may be sufficient for system requirements.

## 18. Horizontal Cable Media Testing, Labeling and Acceptance

**Horizontal Cabling Testing** - Test results for cabling shall be submitted to CNS two weeks prior to occupancy. Testing shall be performed is accordance to the TIA/EIA 568-B or other applicable standards body testing requirements and the manufacturers specifications for the installed system.

The testing of systems shall meet the requirements of the current draft or standard. The performance of the tested cabling system shall meet the more stringent requirements of either the draft standard or manufacturer's specification.

**Minimum Testing Requirements** - The passing of both link and channel parameters are required as the primary measurements of acceptance. The manufacturer shall provide test requirements for both link and channel performance for twisted pair cabling systems to pre qualify for the proposed system. Marginal or star pass measurements either pass or fail will not be accepted by CNS/ITS.

Optical fiber links shall be tested using a power meter measuring for link loss at a budget established from the link component's (connector + optical fiber + connector) as specified by the manufacturer and TIA/EIA 568-B. One directional testing is required for horizontal links that pass initial testing.

Test results shall be submitted in electronic format directly from the tester. The results shall be submitted in Excel format. Hand written test results will not be accepted.

Acceptable Testers: Fluke DTX 1800 for Intra building testing. Other testers are accepted as approved by ITS/CNS.

**Note: No cabling system shall be specified nor will be accepted by ITS/CNS that does not meeting the aforementioned cabling testing requirements**.

**Optical Fiber Polarity** - All optical fibers in the optical fiber shall be terminated in numerical order without a compensation for polarity. ITS/CNS will make the required polarity adjustments at the patchcord.

**Labeling and Documentation** - all labeling and as-built outlet schedules shall be completed prior to testing. All patchpanels and outlets are to be labeled using an electronically printed label. An adhesive label or otherwise secured attachment method shall be secured to the patchpanels. Patchpanels, ports and cables are to be labeled sequentially on equipment racks. Ports and cables are to be labeled sequentially on patchpanels by outlet number except for changes made after base termination. Telecommunications plans shall show the placement of outlets and outlet identification designations on plans no later than design documents.

**Approved Contractors** - All contractors for copper horizontal cable systems shall be selected from the list of contractors approved on UNM RFP 779. Acceptable manufacturer systems for UTP and FUTP cabling systems are: Ortronics, Siemon, Systemax, AMP, and Belden and their system partners.

## 19. Inter Building Pathways

**Ductbanks** - Inter Building Communication Duct Banks are communication infrastructure pathways that carry communication cables between buildings in a campus environment. The duct itself is typically constructed of contiguous segments of schedule 40 or 80 PVC conduit. In the absence of a multi-building campus, ductbanks complete the underground connection between the building and specified ITS/CNS vaults or building where a combination of copper, fiber optic and in some cases, coaxial cable is distributed from the carrier to the user building. Ductbanks can be constructed in several configurations, each with a differing level of permanence and durability. Duct banks are to be concrete encased unless otherwise specified or approved by ITS/CNS.

**Transition Structures** - Are spaces classified as vaults, manholes, handholds, and pedestals where cable is distributed and routed to other locations such as buildings. These structures allow technicians access to cable and splices to perform maintenance or to modify distribution configurations. The size of the transition structure selected for installation is determined by the number of ducts and potential cable count the structure must contain with spares for maintenance and repairs.. Transition structures should be placed at accessible locations for critical inter building backbone cables and splices, and therefore shall be secured by tamper resistant locking mechanisms. This measure will minimize the potential for serious disruption to campus communications in the event of malicious damage or destruction of these cables.

The following provides general requirements for all inter building communication duct banks and transition spaces as components of the overall communication cable system infrastructure. Ductbanks used for low voltage communication facilities are not permitted by Code to be collocated with electrical transmission cables.

**Inter Building Communication Duct Banks** - Inter Building Communication Duct Banks are designed to provide a permanent and durable pathway system which is available for the delivery of entrance cable from carrier service providers, or as part of a campus Inter Building backbone system connecting several buildings together.

**Building Entrance Conduit Requirements** – Entrance conduits requirements for buildings will vary depending upon the size, use and ITS service requirements. Large buildings, zone hubs, PBXs', entrances for LEC's and CLEC's may require from 6 to 10 or more conduits. The minimum conduit entrance facility is 4-4" conduits, encased in a concrete mixture, sloped out and down to the entrance manhole. The minimum size conduit diameter is 4" for all conduits relating building entrances. Seal building entrances with water tight conduit plugs. Requirements are project specific and the designer shall contact ITS/CNS for specific requirements.

**Duct Bank Conduit Requirements** – The ductbank size for backbone systems shall be 4 – 4" conduits encase in a concrete mixture. Install a minimum of a #6 AWG ground wire terminated to a ground rod in each pass through structure and a measured pull line of 400 lbs continuous through the system. Terminate the ground wire at the building grounds at all termination points. Install water tight plugs, rod and mandrel to clean system after its construction. The minimum size conduit diameter is 4" for all applications in inter building applications.

**Routing of Ductbanks** - Inter Building Communication Duct Banks carry vital backbone cable media which serve a host of facilities on Campus. Severing of the inter building backbone can potentially cause a loss of communications to the buildings downstream of the damage.. For this reason it is critical that ductbanks be routed around buildings, and that in no case does the pathway for the inter building backbone pass through a building on its route through campus.

**Note: The architect is to submit to the UNM Office of Capital Project and PPD all proposed routes to ensure the placement of cables, duct banks and manholes do not conflict with future projects. Campus right of ways and easements for non UNM carriers and service providers shall be applied for and approved by the FREM Department of Real Estate during design and prior to construction.**

**Duct Bank Configuration and Quantity of Ducts** - Once it is in place, modification to communication ductbank is often impractical. It is critical, therefore, to plan for adequate expansion and growth of the communication system at the time the ductbank is constructed, rather than after the fact. This is especially true of concrete-encased duct banks. No less than four ducts should ever be installed at the time of construction, including for building entrances of over 10,000 sq ft. The exact number of ducts required shall be approved by ITS/CNS. This rule applies, even if only a small number of cable pairs or strands of fiber that partially fill just a single duct are

projected to be required over time. Ductbanks are configured in arrays, typically with several rows stacked together. 1 x 4, 3 x 3, 3 x 4 are examples of duct arrays, which also correspond to the arrangement of duct openings in pre-cast concrete vaults and manholes where transitions occur.

**Duct Bank Construction Materials and Methods** - As the majority of inter building communication ductbanks are installed in utility populated areas; the ducts must share underground pathways with existing underground infrastructure components such as water lines, gas lines, and sanitary systems and so on. As these utilities frequently need to be dug up for maintenance and repairs, it is critical that the communications infrastructure be provided the highest level of durability to prevent inadvertent damage by backhoes and other heavy equipment. Only 3000 p.s.i. compaction concrete-encased ductbanks are considered acceptable for installation in these environments.12 The duct material itself should be Trade Size 4 (4-inch diameter), PVC Schedule 40 EB or equal for concrete encasement, and suitable for contact with concrete. Schedule 80 EB or Rigid Steel conduits shall be installed in areas where non – encased duct banks have been approved. Install a measured pull line rated a minimum of 800 lbs tensile strength into each duct secured on each end. Install re enterable duct plugs in vacant ducts.

**Duct Placement** - Duct routing should be planned with consideration for distance between Transition Structures and difficulty of cable pulls, particularly when high-count multi pair copper cables are necessary. The minimum radius for curves is 15 feet. Trenches should be dug with the following depth and width considerations for concrete pours:

**Concrete-Encased Ductbank Dimension Guidelines**

| | |
|---|---|
| **Ground Cover** | **Minimum of 36 inches** |
| **Top Level of Concrete** | **Minimum 2 Inches above top duct** |
| **Concrete on Outer Sides of Ductbank** | **Minimum 4 inches** |
| **Concrete Between Ducts** | **1 inch (above, below and to each side)** |
| **Bottom Level of Concrete** | **Minimum 1.5 inches** |

**Ductbank Marking and Locating** - A metallic warning tape, detectable with magnetic location equipment, shall be buried directly over the path of the Ductbank approximately 18 inches above the ducts.

**Ductbank Termination At Building and Vaults** - Communication Ducts should be terminated with bell-end connectors, flush with the inner surface of the wall.

**Duct Bank Grounding and Bonding** - A solid copper insulated # 6 copper wire shall be installed and terminated in an empty duct for duct bank locating purposes. Provide continuous grounding wire connectivity the entire length of the ductbank.

**Inter Building Spaces: Vaults, Hand Holes, etc. (Transition Structures)**

**Purpose** - Inter building spaces are essentially Transition Structures that allow access to cable installed within underground ductbanks ( i.e. vaults, manholes, hand hole, etc). These structures are required by Codes to be exclusively for low voltage communication cable and equipment. They may not be collocated with electrical transmission lines or facilities. Transition structures provide a protected location for the storage of splice cases and slack loops of cable. The transition structures also facilitate the distribution of cable to multiple locations by providing a junction point for ducts radiating in several directions.

Pedestals are above-ground enclosures which are used for the termination or splicing of campus backbone cables. As pedestals are vulnerable to vandalism and other damage such as from vehicle impact, their use on the UNM Campus is not permitted without approval from UNM Information Technology/Telecommunications.

**Selection of Transition Structure Type** - The type of structure chosen for installation is dependent on the number of ducts in the span. These can range from vaults measuring 20 feet long, and 12 feet deep, to small, shallow, hand holes only a several feet square. In most cases, preformed concrete structures are available in several sizes and capacities from large vaults down to hand holes. Rarely is it necessary to form and pour a custom structure on-site. Structures also have weight-bearing cover/lid capacities that range from light pedestrian traffic to deliberate heavy vehicular traffic. The appropriate rating should be selected based on the anticipated exposure of the structure to these differing traffic types. Minimum accepted rating for transition structures is typically 20-H and the use of Quazite Pre-cast Polymer Concrete boxes is not permitted with out ITS/CNS approval. The impact resistance rating of the structure shall also be evaluated prior to specification. Verify exact size, impact rating and load requirements with CNS. Contact UNM / IT/ CNS for approval before specifying this type of structure.

**Placement of Transition Structures** - Structures should be placed after 180 degrees of directional change has been affected in the ductbank route. In straight or relatively straight runs, there should be no more than 400 feet between structures. Structures should not be used as the apex of 90 degree changes in duct direction. Sweeps and structures should be planned such that the sweep occurs outside of the structure, allowing straight cable pulls through the structure itself.

**Transition Structure Accessories and Equipment** -Transition structures require the following equipment: or hardware to be installed:

A sump, or gravel drainage in the case of small hand holes

Corrosion-resistant pulling eyes

Cable racking and attachments

Grounding cables installed per applicable codes or practices

Ladder

Watertight duct plugs

## 20. Inter Building Backbone Cable Media

General - This section describes the cable materials and configuration of inter building backbone cable media. This type of cable is specifically designed for use in areas exposed to the elements and that will be subjected to harsh installation conditions. Every type of cable listed shall be warranted by the manufacturer against defects in material or performance. The contractor shall verify upon receipt the cable; regardless of type (copper or optical fiber shall be free from defects or damage and meets the specified and code requirements for the installation. The liability for replacement of installed defective, damaged, non specified or non code compliant cable is at the expense of the contractor.

**Note: The contractor shall verify and ensure that the cables specified and installed meet the intended use and are code compliant prior to procurement.**

**Optical Fiber Backbone Cable Requirements** - UNM has determined that dependent upon the purpose and/or the tenant assets within a specific building, cables of standard sizes shall be installed between their end points. It will be the responsibility of UNM to specify the strand count and routing of cables in each instance. For general applications the standard strand counts are shown below.

| Strand Count & Type | Application |
|---|---|
| **Strand count as specified and approved by ITS/CNS. Single mode optical fiber- Low water peak 10 gigabit Single-Mode suitable for CWDM use complies with ITU G.652.c/d., loose tube, dry block, rod and yarn construction with central member, with the jacket rated for the specified use. Provide with a locatable sheath, or install a # 6 copper locating wire that is terminated on each end using an attachment for that purpose. Corning glass for all new installations. Match existing type of glass of additions and modifications to existing strands.** | **Inter Building Networking for voice, data and video applications.** |
| **Strand count as specified and approved by ITS/CNS. Multimode optical fiber that exceeds TIA/EIA-B.3-1(ISO 11801 OM3) for 500 meter lengths that is laser optimized and performs at 10 Gigabit data rates, loose tube, dry block, rod and yarn construction with central member, with the jacket rated for the specified use. Match existing type of glass of additions and modifications to existing strands.** | **Inter Building Networking for voice, data and video applications when specified** |

**Optical Fiber Backbone Splicing** – All optical fiber splices in the backbone shall be fusioned spliced. The splice case and splicing apparatus shall be approved by ITS/CNS.

**Optical Fiber Backbone Termination** – Termination of optical fiber back bone cabling shall be fusion spliced with LC pigtailed connectors in a splice tray incorporated into the Fiber Distribution panel. Optical fibers are to be terminated in numerical sequence without compensation for polarity.

Optical fiber coupler/panel inserts colors:

Single Mode – Blue

Laser Optimized Multi model 50 Um– Aqua

Multi Mode - Tan

**Testing Backbone Optical Fiber Cable, Labeling and Acceptance** - Inter building optical fiber cable- shall be tested using both at tester capable of providing both power loss and an OTDR trace. When building and testing installed circuits the installer shall provide a circuit loss budget (attenuation) and OTDR trace for the channel (end to end). Bi-directional testing is required for all links and circuit

channels. Acceptable testing perimeters shall meet the link loss budget for combined components.

All FDU's and optical fiber connectors are to be labeled using an electronically printed label and shall be visibly secured to the FDU door. All FDU's are to be labeled sequentially on equipment racks.

All contractors for optical fiber cables systems shall be selected from the list of contractors approved on UNM RFP 779.

Approved manufacturers - approved manufacturer systems for optical fiber systems are: Corning, Bertek, Comscope, Systemax, Siemon and Ortronics. Only Corning glass shall be specified unless matching existing glass from another manufacturer in an existing cable. Strand count shall be specified by ITS/CNS.

Acceptable Testers: Fluke DTX 1800 for Intra building testing. Others testers as approved by CNS.

## 21. Multi pair Copper Inter Building Backbone Cable

**Multi pair Copper Inter Building Backbone Cable** is diminishing in its utility in campus backbone scenarios, since optical fiber has overshadowed copper cable's bandwidth carrying capacity and physical size. Nonetheless, multi pair copper backbone cable will remain an important element in the Campus backbone for years to come.

Typical multi pair Outside Plant (OSP) Copper Backbone Cable is constructed with a heavy polyethylene jacket over a metallic shield. The cable pairs inside the jacket are coated with a water displacement gel in the event the water integrity of the jacket is lost.

Multi pair copper backbone cable is unrated and according to NEC, must be terminated, spliced within 50 feet of building entry, or if these distances are exceeded, the cable must be installed in rigid conduit for its entire length. All OSP cables are to be transitioned by splicing non filled rated pre terminated protector rated cable assemblies. Multi pair copper cable is conductive and capable of delivering damaging and potentially lethal electrical surges to equipment and personnel caused by lighting strikes or by exposure to high voltage electrical current. For this reason, multi pair copper cable spliced to, manufacturer electrical protector units with cable tails at the service entrance. This equipment protects personnel and equipment within the building from electrical shocks caused by factors outside the building. The type and manufacture of electrical protector units will be determined by UNM Standards; however, splices or protector unit panels should be mounted on

backboards within the Service Entrance/Equipment Room.The square footage necessary for this equipment varies with the pair count of the multi pair copper cable entering the building and should be calculated within the planned size for the space as part of the footprint.

**Copper Splicing** - Splices for all inter building backbone cable types are to be spliced within building service entrances or manholes. The contractor is to provide a well ventilated, clean working environment for all placement splicing and termination operations. All work areas shall be left cleaned, all cables are properly supported, landscape restored, safe and water sealed during and at completion of work.

Approve splice modules are 3M 4000 or 710 series. All splices are to be colored coded, dressed, wrapped per applicable use, and bonded. All OSP spices shall be filled with a re enterable waterproofing encapsulate and sealed in an splice case approved by ITS/CNS. Splice diagrams shall be submitted to ITS/CNS upon completion.

**Inter Building Multi Pair Cable Testing**

Provide to ITS/CNS wire map test and results for opens, shorts crosses, grounds and splits. Provide measurements for all failures and repair deficiencies. Provide results of all pairs whether pass or fail for each pair directly from the test equipment nor in Excel format if not. Include the project name, technician names and date tested. Provide test results two weeks prior to substantial completion of the project

**Note: All defective pairs shall be corrected and retested prior to the submittal of test results.**

**Note: ITS/CNS recommends that all testing be completed prior to the closing of splice cases, to allow for immediate repair of defective pairs. The contractor is responsible to protect all work until acceptance.**

**Inter Building Coaxial Backbone Cable**
Where necessary, coaxial backbone cable shall be installed for the distribution of baseband and broadband signals. Coaxial cable is subject to high levels of attenuation (signal loss over distance) and large diameter coaxial cable is often used to mitigate this loss. Coaxial cables of ½ inch diameters and larger, are expressed as decimal equivalents for the diameter in inches, (e.g. .500, .625, .750 and 1.000) this type of Coaxial cable is very rigid, and must be installed using specialized equipment. The engineering of coaxial distribution systems will dictate the cable diameter, location of splices, amplifiers and other distribution equipment throughout the system. Additional conduit shall be provided for required installations.

## 22. Warranties, Quality Control and Commissioning for Horizontal, Intra and Inter Building Cabling Media

**ITS/CNS acts as the UNM project team member charged with the final acceptance for the performance and quality control for the Information Technology items infrastructure and systems addressed and included within this document. ITS/CNS will perform quality control observations, inspections, testing, verification and owns the right to engage and assign third party testing, inspection and commissioning agents to inspect, observe, verify, test and document deliverables as a condition of acceptance on behalf of UNM through all phases of a project's design and construction.**

The Contractor shall provide a one year warranty on all parts, product and labor for all project deliverables. The Contractor shall apply for and receive a manufacturer's warranty of not less than 20 years for labor and material prior to start of work for the cabling system.
ITS/CNS shall be copied on the contractor's notification to manufacturers for warranties.

The Contractor shall request for the cabling system manufacturer a warranty inspection at infrastructure rough in and at the completion of termination. ITS/CNS representation shall be included in the warranty inspections.

The manufacturer's warranty certificates shall be assign to UNM ITS/CNS.

**Note: For further details and specific requirements of design and specification requirements refer to the UNM ITS/CNS Guide Specifications and contact ITS/CNS for all questions or areas not addressed in this Document.**

## 23. Special Work Requirements for UNMH

Care must be taken to ensure patient privacy to ensure patient privacy right are protected as per the requirements of HIPPA and other state and federal laws.

The contractor shall ensure that all cabling firestopping is completed and documented. The contractor is responsible to report all missing firestop applications prior to the start of work to ITS/CNS. In failing to do so the contractor is subject at the discretion of ITS/CNS to restore missing firestop at their expense.

Ceiling tiles must be replaced at the end of each day in all clinical areas.

Patient monitoring cables are to be installed on a separate patchpanel near the top of the equipment rack with red outlet jacks at the work area outlet.

The contractor is required to maintain safe conditions that protect patients and staff when working in operational areas. Provide proper barricades, signage, ensure the area is clear of trip hazards and ensure staff and patient safety at all times.

Protect operational areas against dust, water and other pollutants in patient and clinical areas.

## 24. Information Technology Infrastructure Reinforcement Guidelines

The threat of terrorism to our critical infrastructure assets dictate that facility and technology management take precautions toward the hardening and preservation of key facilities and equipment. Awareness of the unconventional means that terrorist elements use to effect their ends, Information technology infrastructure is particularly vulnerable to these threats due to the ubiquitous nature of communications facilities. The following Table provides suggested steps that planners and designers implement in order to mitigate the threat of vandalism, or sabotage.

### Reinforcement Requirements: Vantage Consulting

The threat of terrorism to our critical infrastructure assets dictate that facility and technology management take precautions toward the hardening and preservation of key facilities and equipment. Awareness of the unconventional means that terrorist elements use to effect their ends, Information technology infrastructure is particularly vulnerable to these threats due to the ubiquitous nature of communications facilities. The following Table provides suggested steps that planners and designers implement in order to mitigate the threat of vandalism, or sabotage.

### Facility Class Definitions

| **Facility Class Definitions** | |
|---|---|
| **Class** | **Explanation** |
| **General Campus Areas** | **This applies to the Campus as a whole, or because of the location of a facility, it may not belong to a specific building, but be placed in a common area.** |
| **Class 1 Facility** | **This would be classified as a critical building or facility, where the damage or loss of the communication infrastructure would cause a major safety or health and welfare crisis on the Campus. Examples include: The UNM Building, The Hospital, The** |

| | |
|---|---|
| | **Telecommunications Building, and Public Safety.** |
| **Class 2 Facility** | **This type of Facility is key to the operation of the University, yet not as critical as a Class 1 Facility. Examples could include, Scholes Hall, Residence Halls, and major classroom buildings.** |
| **Class 3 Facility** | **A Class 3 Facility is one which has importance to the University, however, it is not a building heavily reliant on communications. Examples could include Lecture Halls and warehouse facilities.** |

### Vantage Infrastructure Reinforcement Elements

The following table provides a list of Infrastructure Elements that may be implemented as buildings are retrofitted, or in new construction projects. Their overall benefit will be to enhance the physical security of critical information technology assets.

| **Infrastructure Reinforcement Elements** | | | | | |
|---|---|---|---|---|---|
| **Infrastructure Reinforcement Elements** | **General Campus Areas** | **Class 1 Facility** | **Class 2 Facility** | **Class 3 Facility** | **Explanation/Purpose** |
| Install locks and liquid-tight seals on manholes/handholes | **X** | | | | Prevent unauthorized access and the introduction of flammable liquids into manholes. |
| Enclose generators, fuel tanks, and oil, coolant reservoirs for emergency power generation systems | **X** | | | | Prevent sabotage of equipment. |

| Infrastructure Reinforcement Elements | | | | | |
|---|---|---|---|---|---|
| **Infrastructure Reinforcement Elements** | **General Campus Areas** | **Class 1 Facility** | **Class 2 Facility** | **Class 3 Facility** | **Explanation/Purpose** |
| Construct Secondary and Tertiary access pathways | | **X** | | | Provide alternate pathways of ingress/egress into buildings in the event of destruction of primary route or cable. |
| Construct Secondary access pathways | | | **X** | | Provide an alternate pathway of ingress/egress into buildings in the event of destruction of primary route or cable. |
| Install security access controls to Service Entrances, Equipment Rooms and Technology Rooms | | **X** | **X** | **X** | Implement card readers, surveillance cameras and the "Two-Man Rule"for access of 3rd party vendors and maintenance technicians. |
| Secure air handling equipment serving communications facilities to prevent tampering | | **X** | **X** | | Prevent the shutdown, or intentional contamination of air supplies (chemical or bacteriological) and HVAC systems serving critical communication facilities |
| Remove labels and signs from Service Entrances, Equipment Room, and Technology Room doors. | | **X** | **X** | **X** | Make rooms look non-descript, make identification by non-communications/technology personnel difficult. |
| Transition all aerial cable to underground facilities | **X** | **X** | **X** | **X** | Aerial cable is vulnerable to damage from fire, extreme weather, vehicle impact and outright destruction from chainsaws or axes. |

| Infrastructure Reinforcement Elements | | | | | |
|---|---|---|---|---|---|
| **Infrastructure Reinforcement Elements** | **General Campus Areas** | **Class 1 Facility** | **Class 2 Facility** | **Class 3 Facility** | **Explanation/Purpose** |
| Plug and seal duct opening in duct banks including vacant ducts and ducts with existing Cable installed. | **X** | **X** | **X** | **X** | Prevent the introduction of flammable liquids or water into ducts. |

| Infrastructure Reinforcement Elements | | | | | |
|---|---|---|---|---|---|
| **Infrastructure Reinforcement Elements** | **General Campus Areas** | **Class 1 Facility** | **Class 2 Facility** | **Class 3 Facility** | **Explanation/Purpose** |
| Install locks and liquid-tight seals on manholes/handholes | **X** | | | | Prevent unauthorized access and the introduction of flammable liquids into manholes. |
| Enclose generators, fuel tanks, and oil, coolant reservoirs for emergency power generation systems | **X** | | | | Prevent sabotage of equipment. |
| Construct Secondary and Tertiary access pathways | | **X** | | | Provide alternate pathways of ingress/egress into buildings in the event of destruction of primary route or cable. |

| Infrastructure Reinforcement Elements | | | | | |
|---|---|---|---|---|---|
| **Infrastructure Reinforcement Elements** | **General Campus Areas** | **Class 1 Facility** | **Class 2 Facility** | **Class 3 Facility** | **Explanation/Purpose** |
| Construct Secondary access pathways | | | **X** | | Provide an alternate pathway of ingress/egress into buildings in the event of destruction of primary route or cable. |
| Install security access controls to Service Entrances, Equipment Rooms and Technology Rooms | | **X** | **X** | **X** | Implement card readers, surveillance cameras and the "Two-Man Rule"for access of 3rd party vendors and maintenance technicians. |
| Secure air handling equipment serving communications facilities to prevent tampering | | **X** | **X** | | Prevent the shutdown, or intentional contamination of air supplies (chemical or bacteriological) and HVAC systems serving critical communication facilities |
| Remove labels and signs from Service Entrances, Equipment Room, and Technology Room doors. | | **X** | **X** | **X** | Make rooms look non-descript, make identification by non-communications/technology personnel difficult. |
| Transition all aerial cable to underground facilities | **X** | **X** | **X** | **X** | Aerial cable is vulnerable to damage from fire, extreme weather, vehicle impact and outright destruction from chainsaws or axes. |
| Plug and seal duct opening in duct banks including vacant ducts and ducts with existing Cable installed. | **X** | **X** | **X** | **X** | Prevent the introduction of flammable liquids or water into ducts. |

## 25. Acknowledgements:

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| | |
|---|---|
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