The University of Georgia
Telecommunications Design Guide and Standards

Security, Network Operations and Infrastructure and Telephone Services Department
Enterprise Information Technology Services
The University of Georgia

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1 Purpose

A structured telecommunications cabling network is an integral part of the University of Georgia's mission. These standards provide consistent guidelines to insure that the telecommunications cabling in new or upgraded buildings will meet the electronic information needs of the University (both short and long term) in the most cost-effective manner. Specifically, the goal of these standards is:

To provide a telecommunications wiring standard for new buildings and renovations with a view toward future expansion and adequate service.
To facilitate ease of expansion and upgrading of present services.
To provide for realistic cost considerations.
To provide a consistent wiring plan that can be implemented in such a way as to maximize telecommunications services while minimizing cost and initial design effort.
To provide a consistent and uniform physical network infrastructure that can be efficiently maintained by the University of Georgia.

2 Scope

2.1 This policy applies to all University staff, faculty, administrators, officers, and students (collectively, "users"), including those on the regional campuses. Telecommunications components include, but are not limited to data, voice (telephone), and cable TV.

2.2 IEEE 802.11 wireless network standards are covered in a separate document.

3 Policy

3.1 All new installations and upgrades of building telecommunications wiring for the transport of voice, data, video, imaging information, etc. must meet or exceed the wiring standards as specified in this document.

4 Responsibility

4.1 The University Of Georgia (UGA) Enterprise Information Technology Services Network Infrastructure Group (UGA EITS-NI) is solely responsible for establishing and enforcing network cabling standards.

4.2 UGA EITS-NI has oversight over any physical network infrastructure in any building or facility that connects directly to the UGA campus network.

5 Contact Information

This Standard is the responsibility of EITS-NI. For contact information for EITS-NI, please see: http://www.eits.uga.edu/noi/ni/contacts.html

6 Introduction

6.1 This document shall be used by anyone needing information pertaining to the telecommunications requirements at the University of Georgia. In particular, this information shall be used by design professionals, architects, electrical engineers and UGA departments involved in construction or renovation projects. Those individuals shall verify, with assistance from UGA EITS-NI, that all applicable portions of these standards are incorporated into the project's design, drawings, specifications, and final construction.

6.2 These standards apply to any construction or renovation occurring at the University of Georgia. Departments wishing to directly contract (or perform the work themselves) cabling work shall adhere to these standards and notify UGA EITS-NI of any and all work to be performed. This includes, but is not limited to, the installation of additional voice, data, and/or CATV cabling; the installation of data cabling for wireless installations; and upgrades and/or refresh of building data, voice, and/or CATV cabling.

6.3 IMPORTANT NOTE: If there is any part of this document that is unclear or that Project Owners or Contractors feels is incomplete, it is the responsibility of the Project Owner or Contractor to contact UGA EITS-NI. This is a "living" document and therefore subject to change at any time. It is the responsibility of the Project Owner to ensure that all network infrastructure work conforms to the current standards at the time of the project.

7 Definition of Roles

7.1 UGA Project Owner: This may be a project manager or representative of the Office of University Architects for Campus Planning, the UGA Real Estate Foundation, the UGA Physical Plant Division, or design firms designated by the project owner. This term also applies to UGA departmental or unit staff responsible for requesting and procuring additions or changes to the network cabling in their respective buildings, either through the UGA EITS-NI, or outside, private cabling contractors.

7.2 Contractor, Installer: This is the personnel physically installing the network cabling and components. This includes EITS-NI, outside contractors, or UGA departmental or unit staff installing cabling.

8 General

8.1 UGA EITS-NI is the responsible unit for low-voltage installations at the University of Georgia. This responsibility includes but is not limited to any and all UGA property and structures including hand holes, maintenance holes, pull boxes, pedestals and enclosures as well as inside and outside plant installations.

8.2 Project Owners for projects relating directly or indirectly to areas listed above shall verify that all applicable portions of these standards are incorporated into the project's design, drawings, specifications, and final construction. Requests for variances from these standards shall be submitted in writing to the EITS-NI Project Manager for review and written approval or rejection.

8.3 The specifications contained herein are the minimal acceptable standards for voice, data, video and other general telecommunications distribution standards at the University of Georgia. These specifications may be modified by UGA EITS-NI as necessary to accommodate special design or functional requirements of any particular space.

8.4 It is recommended that coordination between telecommunications designers and UGA EITS-NI begin early. UGA EITS-NI welcomes any questions or concerns that may arise, and would be happy to comment on preliminary plans for locations of equipment, etc.

8.5 Telecommunications standards are dynamic in nature and continually change -- as technology evolves telecommunications and networking industry standards are modified. Project Owners shall coordinate with UGA EITS-NI to ensure that the latest standards are being used. Telecommunication Contractors shall coordinate with UGA EITS-NI to ensure that the proper specifications are being used prior to ordering products or beginning work.

8.6 Telecommunication Contractors awarded work on the University Of Georgia Campus shall be a firm normally employed in the low voltage cabling industry with a reference list of five (5) projects and contact names to confirm successful Category-rated UTP and Fiber-Optic cable projects. The Telecommunications Contractor must be licensed and bonded in the state.

8.7 The contractor shall purchase, install, test, and document all communications cabling, connectivity and support hardware as specified herein. Active telecommunications network equipment (electronics) will typically be supplied and installed by UGA EITS but may be specified for installation by a contractor in accordance with specifications from UGA EITS-NI. Project Owners shall verify requirements for each specific project with UGA EITS-NI during the design phase.

8.8 EITS-NI reserves the right to exercise its discretion to require the Telecommunication Contractor to remove from the project any such employee that EITS-NI finds to be incompetent, careless, or insubordinate.

8.9 These standards are not to be used as a final specification or bid document. They are intended to be a starting point in a process of collaboration between the architect/designer, UGA EITS-NI, and the occupant throughout the project design process.

9 Adherence to Industry Standards

9.1 UGA's communications systems follow the codes and standards set forth by standard-making bodies, including but not limited to current editions of the NEC, NESC, NFPA, ANSI/TIA/EIA Telecommunications Infrastructure Standards, FCC, IEEE, and BICSI's Telecommunications Distribution Methods Manual and Customer Owned Outside Plant Manual.

9.2 When a discrepancy arises between the above mentioned standards and the standards contained in this document, it shall be brought to the attention of UGA EITS-NI immediately for resolution. Typically the more stringent of the two guidelines will be implemented.

9.3 UGA EITS-NI recognizes and adopts industry standards and practices as interpreted by BICSI. As such, this document is intended to identify and define requirements specific to the University of Georgia.

10 Review Guidelines

10.1 UGA EITS-NI shall be involved in initial planning and preliminary design.

10.2 As the project moves toward the construction documentation and code review phases, it is required that the project construction documents be submitted to UGA EITS-NI for an internal review process for compliance with University standards. Plans are to be submitted for review at:

Completion of Schematic Design;
Completion of Design Development;
At 50% completion of construction documents;
At 85% completion of construction documents;
At 100% completion of construction documents.

UGA EITS-NI will document any comments on these documents and provide these comments to the Project Owner. The Project Owner shall provide timely

and coordinated responses to all review comments. The purpose of this review process is to confirm compliance with the current version of these standards.

11 Preliminary Design and Design Development

11.1 During preliminary design, the Project Owner is to consult with UGA EITS-NI to ascertain the requirements for telecommunications use and installation. The Project Owner is to cooperate with any adjunct professionals providing assistance to the University, and is to coordinate his work with other disciplines so that a cohesive set of documents is produced for the telecommunications work.

11.2 During preliminary design and design development the Project Owner is to consult with UGA EITS-NI to define system distribution strategies and to discuss any obstacles that might be preexisting in a building, or problems inherent in a particular design or structural system.

11.3 UGA EITS-NI will provide information on design requirements for point of entry (POE), main distribution frame (MDF), and intermediate distribution frames (IDFs). This information will be based on the number of outlets anticipated for the project, the length of wiring runs in the project, the distance of terminations from POE, MDF, and IDFs, and any other pertinent information.

12 Guidelines and Requirements for Documentation and Submittals

12.1 Prior to starting any work, The Telecommunications Contractor shall furnish the required information in a single consolidated submittal.

12.2 The Telecommunications Contractor shall provide the name of the person within their organization who will act as the official point of contact with the Project Owner, EITS-NI, and any other UGA Departments or outside consultants.

12.3 The Telecommunications Contractor will obtain and supply copies of all required permits to the Project Owner, EITS-NI, and other UGA Departments or outside consultants as required.

12.4 The Telecommunications Contractor shall furnish samples and manufacturer's product literature for any portion of the installation that they are required to supply materials for to the Project Owner, EITS-NI, and any other UGA Departments or outside consultants.

12.5 The Telecommunications Contractor shall provide a list of any and all deviations in materials, construction and workmanship from those specified in this

document or in the project drawings or specifications. The Project Owner, EITS-NI, and/or any other UGA Department or outside consultant will review the list and declare each item as either an approved exception, or as one the Telecommunications Contractor must correct.

12.6 Periodic inspections to the telecommunications installation will be conducted by the Project Owner, EITS-NI, and/or other UGA Departments, or outside consultants to ensure that supplied materials and workmanship conform to the project requirements.

12.7 The University has records and drawings on paper of their telecommunications plant. As modifications or changes are made to the system, it is necessary to update the University drawings and records. Therefore, drawings and records must be provided on each project. Telecommunication Contractors will be given paper prints and they are required to prepare and provide scaled drawings illustrating the new distribution system(s). The Telecommunications Contractor will prepare and submit two copies of drawings (to scale) on white paper with black print. Approximate size should be, 24" x 36". An electronic copy of all drawings produced in AutoCAD will also be required. The Telecommunications Contractor must deliver all drawings and test records to the Project Owner, and/or UGA EITS-NI.

12.8 It is the Telecommunication Contractor's responsibility to insure that all building, outside plant, station, and all other records and drawings that would relate to the project are updated and provided to UGA EITS-NI This will include additions that are performed by other parties such as the general contractor or his subcontractors. Questions from the telecommunications contractor regarding this issue should be addressed to UGA EITS-NI.

12.9 The Telecommunications Contractor will furnish operating instructions, service and maintenance instructions, one-line diagrams, data sheets for the exact equipment installed, manufacturers parts lists and parts numbers or other identification established by the original manufacturer, schematic diagrams of the frames, and other diagrams included as part of the manufacturers data sheets. "As built and installed" drawings shall be included in the service manuals and shall show all cable and terminal markings corresponding with the equipment. Upon completion of all work, test results will be provided via actual records. One preliminary copy of the information shall be delivered to UGA EITS-NI for approval prior to the completion of the manuals. If additions or revisions are required, the contractor shall make them and resubmit a preliminary manual. After approval deliver two completed copies to UGA EITS-NI, and/or the Project Owner.

12.10 All drawings shall indicate the following information for copper feeder cable: cable type, size, gauge, year installed, cable no., pair counts, distance(s), and any and all splice location(s).

12.11 All drawings shall indicate the following information for fiber feeder cable: type cable, size, cable number, fiber count, distance(s), splice locations and cable length.

12.12 All drawings shall indicate the following terminal information: terminal identity, quantity and type of protectors, quantity and type termination blocks, cable and pairs entering and/or leaving.

12.13 All drawings shall indicate the following information for riser cable: cable type, size, gauge, year installed, length, splice points, cable number and pair count(s).

12.14 The Telecommunications Contractor shall test every pair in every cable, on an end-to-end basis after splicing and termination for conformity to the design standards and specifications. The test procedures and results will be documented with certification that the system meets all applicable standards and specifications. The contract shall state the beginning date and duration of system acceptance checkout. Performance detail sheets will be submitted for final review and system acceptance by the University. Test record forms are to be completed and turned over to UGA EITS-NI.

12.15 All cable test parameters as listed in 19 of this document shall be tested and the test reports provided to UGA EITS-NI.

13 Placing a Service Request

As soon as possible after any project involving telecommunications has been approved and funded the appropriate point of contact for the project shall complete and submit the online request form located at the following URL: http://eits.uga.edu/mail-forms/cable.php

Completion and submittal of this form will initiate a Remedy ticket within UGA EITS-NI. This will allow UGA EITS-NI to assign an internal project manager to the project. This form should be submitted as early in the project as possible, or when any assistance from UGA EITS-NI is needed before the project has been approved and funded.

14 Labeling

14.1 Label all telecommunications infrastructure and equipment components in accordance with ANSI/TIA/EIA-606-A.

14.2 All labeling shall be unique.

14.3 All labeling shall be legible and made with a mechanical labeling system, not handwritten.

14.4 All labeling shall be permanent enough to last the life of the component.

14.5 Labels at one end of cables, conduits, etc. shall exactly correspond with the label at the other end of the cable, conduit, etc.

14.6 All labeling schemes shall be presented to UGA EITS-NI before any components are labeled for UGA EITS-NI approval.

14.7 The installer shall obtain and adhere to the UGA labeling scheme for telephone outlets from UGA EITS-NI.

15 Outside Infrastructure Requirements

This section constitutes the general outside infrastructure for telephone, data, and cable TV (TDC) services for new buildings and renovation of existing buildings where expanded services to the building will be required. This section also applies to the installation of additional network services in existing buildings not undergoing renovation.

15.1 Outside Infrastructure Requirements - Planning and Design

15.1.1 The Project Owner shall plan and coordinate installation of the necessary connections to the appropriate maintenance hole/vault serving the campus infrastructure, with guidance and input from UGA EITS-NI.

15.1.2 The planning process shall include all TDC services.

15.1.3 It shall be the responsibility of the Project Owner to ensure that all three cabling needs have been reviewed and approved by UGA EITS-NI following the guidelines in 10 and 11 of this document.

15.1.4 It shall be the responsibility of the Project Owner to submit documentation and test results as described in 12 of this document.

15.2 Outside Infrastructure Requirements - Coordination of Work

15.2.1 Conduit

15.2.1.1 The Project Owner will determine, with approval from UGA EITS-NI, the type and position of the connection of the conduit into the maintenance hole/vault.

15.2.1.2 The Project Owner shall be responsible for coordination and installation of any needed infrastructure that might be necessary “behind” the first serving maintenance hole/vault back to the service entrance/MDF serving this building.

15.2.2 Cabling

15.2.2.1 Cabling for TDC services will be coordinated by the Project Owner in consultation with UGA EITS-NI.

15.2.2.2 The Project Owner will ensure that all cabling is placed, spliced and terminated to meet ANSI/EIA/TIA 606, BICSI, and UGA EITS-NI standards.

15.2.2.3 UGA EITS-NI will consult with the Project Owner on cabling requirements.

15.2.2.4 Testing will include all industry standard-cabling tests, with results documented and given to UGA EITS-NI in both electronic and hard copy. (Refer to 19 for specific tests required.)

15.3 Outside Infrastructure Requirements - Cost Estimates and Funding Responsibility

15.3.1 For new buildings and renovation projects, the conduit, common equipment, and cabling costs for TDC will be included as part of the overall project cost. UGA EITS-NI will assist in the cost estimates as requested by the Project Owner.

15.4 Service Entrance Requirements – Types

The service entrance is the route by which telecommunication services and cables enter a building. Following is the guidelines to install service entrances to buildings and information for the termination of those cables. There are three types of service entrances:

15.4.1 Underground Entrance – Buried Conduit. Conduit sizing and quantities between Buildings, and/or Maintenance Holes and Vaults shall be determined by the quantities and requirements for the cabling needed to serve the building.

15.4.1.1 The recommended conduit size for use in an underground entrance is 4 inches in diameter. A minimum of one 4 inch conduit (with pull wire) for telephone, one 4 inch PVC conduit (with pull wire) for data/CATV, and two spare (empty) 4 inch PVC conduits (with pull wire) will be installed for most new buildings. Minimally, there needs to be one 4 inch conduit installed for

each desired service (voice, data/CATV, and/or leased common carrier) along with one spare 4 inch conduit. Therefore, the minimum conduit run to any building would be 2, 4 inch conduits.

15.4.2 Conduit must be buried at a minimum depth of 24 inches to the top of the concrete and encased in concrete rated at 3,000 psi. Conduit that will be placed under load should be encased in concrete rated to 3,500 psi. To minimize accidental digging or damage, a detectable, warning tape shall be placed in the trench a minimum of 12 inches below the surface and directly over the conduit. Install a # 6 ground wire at the bottom of the conduit path, terminate and ground in all pull boxes and terminate before entrance of any building with an 8 ft. long ground-rod. This is used to bleed off static charges and to provide a signal path to locate non-metallic systems.

15.4.2.1 Telecommunications conduit is not to be placed in the same trench or duct banks with other utilities. Design of underground conduit should be fully coordinated with EITS-NI.

15.4.2.2 Entrance conduit must not have more than two 90 degree bends without a pull box, handhole or maintenance hole. Bends must be sweeping with a radius not less than 10 times the inside diameter of the 4 inch conduit.

15.4.2.3 All buried conduit will be corrosive resistant, plastic polyvinyl chloride (PVC). Conduits shall be installed concrete encased; PVC conduit with concrete encasement is unacceptable.

15.4.2.4 All 4 inch conduits conveying fiber optic cable shall be compartmentalized into multiple channels via multi-cell duct liner.

15.4.2.5 Conduits shall have a nylon pull cord installed with a minimum test rating of 200lbs pulling strength in each conduit or compartment within the conduit.

15.4.2.6 Conduits entering a building from below grade shall extend 4 inches above the finished floor.

15.4.2.7 Conduits entering the building through the ceiling shall extend to 8 ½ ft. above the finished floor.

15.4.2.8 Conduits entering the building through walls shall have sweeps installed in a manor that allows the conduit to extend to 8 ½ ft. above the finished floor.

15.4.2.9 All conduits entering buildings will be sealed to prevent water, noxious gases and rodents from entering the building.

15.4.2.10 All conduits shall be securely fastened to the structure to withstand typical cabling installation.

15.4.2.11 Telecommunications conduits are for the exclusive use of telecommunications cables. They shall not be shared with any other utility.

15.4.2.12 Multiply service entrance conduits (two diverse routes) should be considered for buildings which provide crucial services, including research, health care and emergency services.

15.4.3 Buried Entrance – This method is generally not acceptable. It may be used for temporary service.

15.4.4 Aerial Entrance – This method is also generally not acceptable. It may also be used for temporary service or in cases where underground entrance would be too invasive or costly. Aerial cable entrance designs should be coordinated with EITS-NI.

15.5 Outside Infrastructure Requirements - Telecommunications Vaults

The University of Georgia has an extensive network of telecommunications conduit and maintenance holes throughout the campus. Building designs should assure that all projects connect to this system as needed. All new maintenance holes or telecommunication vaults shall be coordinated with EITS-NI.

15.5.1 Telecommunication vaults shall be placed in outside plant conduit runs at an interval no greater than every 400’ if a direct path between structures is attainable (i.e. no 90 degree bends) The maximum distance between maintenance holes shall be reduced by 50 feet for every 90 degree bend installed in the pathway up to a maximum of two bends.

15.5.2 Conduit routing between two telecommunications vaults, or between a vault and a building, shall contain no more than two 90-degree bends or a total of 180 degrees of bend. If additional conduit bends are required, additional vaults shall be placed as needed.

15.5.3 Telecommunications vaults are typically constructed of pre-fabricated cast concrete, and contain a floor section, wall section, and top section. Vaults shall be 6’ wide by 12’ long by 7’ headroom standard inside dimension. Smaller vaults may be used as a pulling point between the main conduit vaults and a building but only as a pass through with no splicing in them and shall be approved in advance by UGA EITS-NI.

15.5.4 The following vault manufacturers and part numbers are acceptable for use on the UGA campus:

15.5.4.1 Manhole – Old Castle Precast (1-800-242-7314) or equivalent.

15.5.4.2 Handhole – Quazite or NewBasis.

15.6 Outside Infrastructure Requirements – Cabling

15.6.1 Outside cabling will be enclosed in PVC conduit as noted above unless otherwise agreed upon by UGA EITS-NI. General guidelines for outside cabling from the building Entrance Room or MDF to the nearest vault are noted below.

15.6.2 Telephone backbone cable shall be type PE-89, 24-AWG, 100-ohm, Category 3, filled cable. The number of planned telephone outlets shall determine the number of telephone pairs needed for the building. As a general rule, the building shall be provided telephone pairs using the following equation: the number of outlets times 4 + 20 % growth.

15.6.3 Fiber Optic backbone cabling shall be comprised of a combination of singlemode and multimode cable with each buffer tube containing 12 fibers. The actual fiber counts will be determined by building use, occupancy, and future bandwidth needs. EITS-NI should be consulted to determine the needs. The cable core interstices shall be filled with a water-blocking compound that is a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel, easily removed with non-toxic solvents.

15.6.3.1 All fibers shall be terminated with SC style connectors. Fusion spliced pigtails, epoxy minimal polish connectors and UNICAM style connectors are all acceptable methods of fiber termination for backbone cables.

15.6.3.2 Multimode fiber shall be 50 micron and specified to accommodate 10 gigabit applications out to 300 meters.

15.6.3.3 Singlemode backbone fiber shall meet Low Water Peak specifications per ITU-T G.652.C. Singlemode fiber should be terminated with a minimum of 1 pair of Angle Polish Connectors at each end of the cable to support video/CATV service.

15.6.4 The following cable manufacturers and part numbers are acceptable for use on the UGA campus:

15.6.4.1 Fiber… TBD

15.6.4.2 Telephone…TBD

15.6.4.3 Coax…TBD

15.6.5 The following splice cases are acceptable for use on the UGA campus:

15.6.5.1 Fiber…TBD

15.6.5.2 Telephone…TBD

16 Inside Horizontal Cabling

The University Of Georgia's High-speed data network is designed to accommodate Ethernet applications up to 1 Gigabit with a manufactures guaranteed electrical performance up to 550 MHz for, 4 pair, 24 AWG, 100 ohm, UTP Category 6 cable . The applications for use would include; high-speed internet access, Voice Over IP (VoIP), and other current and emerging applications.

Use Siemon cable or approved Siemon cable partners. Following is a list of approved CAT6 cables.

- **Siemon System 6 9C6P4-E3-06-RXA**
- **Siemon Premium 6 9C6P4-E4-06-RBA**
- **Berktek LanMark 1000 10032093 (reel)**
- **Berktek LanMark 1000 10032094 (box)**
- **Berktek LanMark 1000 10065423 (reel in a box)**
- **Berktek LanMark 2000 10032251**
- **General Cable GenSpeed 6500 7131431**
- **General Cable GenSpeed 6600 7131721**
- **Mohawk AdvanceNet 6E M57193**
- **Mohawk GigaLan 6E+ M57414**
- **Superior Essex DataGain 450 66-272-2B (reel)**
- **Superior Essex DataGain 450 66-246-2B (brake box)**
- **Superior Essex DataGain 450 66-240-2B (POP box)**
- **Superior Essex Nextgain 54-272-2B (reel)**

- **Superior Essex Nextgain 54-246-2B (reel in a box)**

16.1 Inside Cabling - General

16.1.1 Unless other arrangements have been made with UGA EITS-NI, the contractor is required to provide all labor and materials for installation of the inside infrastructure.

16.1.2 The contractor shall install the inside infrastructure in accordance with the Standard Cabling System (SCS) described in Section 16.3 through Section 16.13 below.

16.1.3 Exceptions may be incorporated in addition to the SCS if cabling for specific functional requirements is needed.

16.2 Inside Cabling - Contractor Qualifications

16.2.1 In order to assure the quality and reliability of the contractor hired to perform cabling work, the University of Georgia requires that cabling contractors meet the following criteria:

16.2.1.1 Be in business a minimum of five (5) years.

16.2.1.2 Contractor shall demonstrate satisfaction of sound financial condition and can be adequately bonded and insured if the project deems necessary.

16.2.1.3 Shall possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.

16.2.1.4 Shall have personnel knowledgeable in local, state and national codes and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.

16.2.1.5 Shall possess current liability insurance certificates.

16.2.1.6 Contractor shall be registered with BICSI and have at least one RCDD on staff.

16.2.1.7 Shall have personnel fluent in the use of Computer Aided Design and possess and operate CAD software using .DWG or .DXF format.

16.2.2 Required Contractor Training

16.2.2.1 The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems.

16.2.2.2 The Contractor shall provide references of the type of installation provided in this specification.

16.2.2.3 The Contractor shall have personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques. Personnel must have experience using an optical light source and power meter plus OTDR.

16.2.2.4 The Contractor shall have personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.

16.2.2.5 All Contractors doing telecommunications work at UGA shall hold and show proof of current certifications on the following manufactures equipment regardless of the connectivity being installed:

- Siemon
- Panduit
- Uniprise

16.3 Inside Cabling - Acceptable Connectivity Products for Horizontal Cabling

16.3.1 All installations shall be comprised of the Siemon System 6 UTP Cabling System.

16.3.2 All Telephone, Data, and CATV installations shall include, but may not be limited to the following Siemon System 6 UTP Cabling System products:

- Category 6 Cross-Connect Wire
- HD6 Patch Panels
- MAX 6 Modules
- MAX Modular Faceplates
- MAX Patch Panels
- MC 6 Modular Cords
- S210 Connecting Block
- S210 Field Termination Kits

16.4 Inside Cabling – Telecommunication Rooms

Wiring and cross connect locations within a building are referred to as Telecommunications Rooms (TR's). These rooms have traditionally been referred to as Main Distribution Frame (MDF) which serves the building, and Intermediate Distribution Frame (IDF) which is floor serving. There should be a minimum of one IDF per floor. It is recommended that multiple IDFs be provided on the same floor if

usable floor space exceeds 10,000 sq ft. or the cable pathway length between the horizontal cross-connect in the IDF and any telecommunication outlets being served exceeds 250 feet. The Maximum allowable cable length of horizontal cable installed to outlets must not exceed 295 feet. Pathway lengths should be kept to a maximum of 250 feet to accommodate the cable length.

16.4.1 All buildings will provide one dedicated MDF. This room may be used to terminate both backbone and horizontal cabling. In addition to cable terminations and cross connects, these rooms may serve to house equipment for data, video and other equipment. These rooms are not to be shared facilities for other services such as, electrical, plumbing, or storage. Utilities such as HVAC duct work, sprinkler pipes, electrical conduits, drain pipers, or other water pipes or systems not providing direct service to the space shall pass through the interior of the room. The MDF or IDF shall be accessible from a hallway or other common space in the building. The room should have only one door to eliminate the possibility of the space being used as a passage. NEC Section 110-16 provides requirements for working space and clearances around exposed electrical equipment. Per this requirement allow 1 meter (3.3 ft.) of clear working space from equipment and equipment racks and any wall where wall mounted cross-connect fields are mounted when determining the size of the room.

16.4.2 The number of IDFs shall be approved by UGA EITS-NI to ensure horizontal category cable runs do not exceed a distance of 90m (295ft) (plus an additional 10m (33ft) for equipment jumpers).

16.4.3 As a general rule, a minimum of 150 square feet of telecommunications space and up to .75 square feet per 100 square feet of building space is required.

16.4.4 The MDF should be at least 12’x20’ in size and each IDF should be at least 10’x12’. Typically, small structures and spaces require less space for providing telecommunications services. In those cases, a single MDF or IDF with less total square footage is adequate to serve the space. Project Owners shall consult EITS-NI to determine the actual size required for those MDFs/IDFs.

16.4.5 In new buildings, MDFs and IDFs shall be designed to be vertically aligned directly above each other. All walls will be furnished with full size panels of 4'x8'x¾” thick plywood backboards painted on all sides with fireproof paint and mounted to all walls of the room.

16.4.6 All access doors in the MDF and IDF shall open outward unless prohibited by local codes. Inward swinging doors eliminate three (3) feet of useable wall space, therefore; room size shall be increased to compensate for the lost area.

16.4.7 Floor loading in MDFs and IDFs shall be a minimum of 50 lbf/ft2 as specified by ANSI/TIA/EIA-569-A standards. However, floor loads should be determined by the actual equipment to be housed within the space. To minimize dust and static electricity, floors shall be VDT tile or painted. CARPET IS PROHIBITED.

16.4.8 MDFs/IDFs shall provide adequate air conditioning, security (i.e., a lockable door), lighting, and be equipped with appropriate dedicated power (minimum of four 20 amp dedicated quad outlets, unless stated otherwise by UGA EITS-NI). If emergency (generator) power is provided for the building, it is strongly recommended that the network equipment in the MDFs and IDFs be placed on these circuits.

16.4.9 A 250 MCM ground wire, run from the main building electrical panel, must be provided with ground bar.

16.4.10 These rooms must not house, or be near equipment (minimum of 10 foot radius) that emits high RF/EMI radiation, or be exposed to any other adverse environmental conditions.

16.4.11 For Security reasons MDFs and IDFs shall solely be used for network infrastructure and network electronics. Use of MDFs and IDFs for storage, office space, etc. is prohibited.

16.4.12 It is highly recommended that these rooms be equipped with a pre-active (dry pipe) sprinkler system in lieu of the traditional fire control sprinkler approach. Water sprinkler systems shall not be installed in MDF/IDF rooms.

16.4.13 Each MDF and IDF must be provided with a means of wiring egress. It is recommended that this be accomplished by providing four 4" "home run" conduits with pull string in each conduit with pull boxes if needed, running from MDF to IDF #1 to IDF #2, etc., or by providing four 4" conduit sleeves in each MDF/IDF room. However if this latter sleeve approach is used, the sleeves must extend to the cable tray in the hall.

16.4.14 There must be a cable tray placed in all hallways for present and future needs to route cabling from MDF to IDFs and to the outlets.

16.4.15 Under no circumstances shall any conduit contain more than two (2) 90 degree bends nor exceed 180 degrees of total bend without the installation of pull box(s) to accomplish the above.

16.5 Inside Cabling – MDF/IDF Equipment

16.5.1 Acceptable patch panel manufacturer(s) and part numbers.

- Siemon HD® 6 Patch Panels
  p/n HD6-24
  p/n HD6-48
- Siemon Angled Max Patch Panels
- P/n MX-PNLA-24
- P/n MX-PNLA-48
- Siemon S210® Field Termination Kits
  p/n S210AB2-64FT
  p/n S210AB2-192FT

16.5.2 Acceptable rack manufacturer(s) and part numbers.

- Siemon RS3 Series Racks
  p/n RS3-07-S
- Hoffman
- p/n EDR19FM45U

16.5.3 Wall mount cabinets and free standing cabinets are acceptable for use. The Project Owner shall consult EITS-NI for the acceptable circumstances under which this equipment can be used.

16.5.4 Acceptable cable management manufacturer(s) and part numbers.

- Siemon RS3 Series Horizontal Cable Managers
  p/n RS3-RWM-2
- Siemon Vertical Patching Channels
- p/n VPC-6, VPC-12
- Hoffman CableTek Horizontal Cable Mangers
- p/n DCHS2
- Hoffman CableTek Vertical Cable Mangers
- p/n DV6D7, DV10D7, DV12D7

16.6 Inside Cabling - Work Station Requirements

All station wiring for telephone and data shall be Siemon, or an approved Siemon Cable Partner, blue jacketed, plenum rated, Category 6 UTP (Cat6) cable. See approved cable list at the beginning of Section 16.

16.6.1 Wiring shall be placed in 1” I.D. minimum conduit for up to 11 cables. There can be up to 44 cables in a 2” conduit, 98 cables in a 3”conduit, and 122 cables in a 4” conduit.

16.6.2 Station wiring runs for CATV shall be plenum rated RG-6, and shall be placed in a 1” I.D. minimum conduit for up 6 cables. Use Commscope 2227V or General Cable C3525 ONLY.

16.6.3 Under no circumstances shall any conduit contain more than two 90 degree bends nor exceed 180 degrees of total bend without the installation of pull box(s) to accomplish the above..

16.6.4 The station receptacle box (outlet) shall be a minimum of 1.75” deep, single gang box.

16.6.5 The conduit for the station receptacle box (outlet) shall run from a receptacle box (as marked on the building plans) to a cable tray in the hall way or at least stubbed above the ceiling. Sleeves will need to be placed to the hallway cable tray if conduits do not run unbroken to cable tray from the outlet. From the hallway cable tray, cable will be routed to appropriate MDF/IDF.

16.6.6 The receptacle (outlet) must be within 250 cable feet of the MDF/IDF.

16.6.7 If divided raceway is used to serve both electrical and telecommunications, the raceway must be metal with dividers between.

16.6.8 Under no circumstances should cable be installed below ceiling in an exposed fashion, i.e., all surface mounted cable shall be enclosed in conduit except when specified for architectural purposes.

16.6.9 Cables shall not be tie wrapped or routed along electrical or gas conduit.

16.6.10 Horizontal cable run in hallways above a suspended ceiling shall be in a cable tray or supported by J-hooks with a spacing of about 4-ft or 5-ft on center to minimize cable sag..

16.6.11 Once in work areas, if conduit is not "home-run" to outlet, it may be secured to the wall directly above the suspended ceiling or to the concrete ceiling structure every three feet by cable hangers.

16.6.12 Cable ties must be trimmed off cleanly at a locking hole.

16.6.13 Cables shall be secured at every corner.

16.6.14 Cables shall be run in a uniform fashion and shall not be woven among other utilities.

16.6.15 At the outlet end, enough additional cable (slack) must be left to reach the farthest corner of the wall, plus five feet.

16.6.16 At the MDF/IDF end, at least 15 feet of additional cable (slack) must be provided past the center point of the appropriate telephone or data racks.

16.6.17 For renovation projects when it is necessary to have exposed interior wiring runs, the wire shall be enclosed using wire molding or conduit. Under no circumstances should cable be installed below ceiling in an exposed fashion, i.e., all surface mounted cable should be enclosed in conduit except when specified for architectural purposes.

16.6.18 Each wiring run must be individually labeled (tagged) using a UGA EITS-NI approved scheme. The scheme must adhere to the ANSI/TIA/EIA-606-A standard.

16.6.19 The identification assigned to the station jack shall be the same as the corresponding label on the patch panel.

16.7 Inside Cabling - Distribution Specifications for Inside Data/Voice Cabling

16.7.1 A minimum of three blue jacketed plenum rated, Category 6 (Cat 6) UTP cables shall be run from the receptacle box (outlet) to the appropriate MDF/IDF. 2 data and 1 voice in a typical office space per receptacle box.

16.7.2 No wiring runs will exceed the specification of the cable used (receptacle box to serving MDF/IDF wiring frame). If extenuating circumstances dictate this, the customer and UGA EITS-NI must be notified.

16.8 Inside Cabling – Fiber

16.8.1 The MDF shall be connected to each IDF with 12 singlemode and 12 multimode strands of OFNP type (optical fiber, non-metallic, plenum rated) "home-run" fiber optic cable.

- **USE ONLY Siemon or Corning Fiber Systems.**

16.8.2 The singlemode and multimode cables may be in separate sheaths.

16.8.3 Armored OFNP cable may be used instead of conduit or innerduct.

16.8.4 Only 50/125 Laser Optimized multimode fiber shall be used.

16.8.5 This fiber optic cable shall have at least 30 feet of additional cable (slack) on each end upon entering each IDF/MDF room.

16.8.6 This fiber shall not have a bending radius of more than ten (10) times the outside diameter of the cable, or exceed the bending radius specs of the cable manufacturer.

16.8.7 Fiber cables shall be terminated in Rack Mount Interconnect (RIC) Fiber Connect patch panels or Wall Mount Interconnect Center.

16.8.8 Acceptable fiber optic patch panels and enclosures.

- Siemon
  - Siemon Rack Mount Interconnect Center
    p/n RIC3-24-01
    p/n RIC3-36-01
    p/n RIC3-48-01
    p/n RIC3-72-01
  - Siemon Fiber Connect Panels
    p/n FCP3-DWR
  - Siemon Wall Mount Interconnect Center
    p/n SWIC3-A-01
    p/n SWIC3G-AA-01

- Corning
  - TBD

16.8.9 Acceptable fiber adapter plates.

- Siemon
  - Siemon Quick-Pack Adapter Plates
    p/n RIC-F-SC6-01 (SC/UPC)

- Corning
  - TBD

16.8.10 Connectors shall be duplex SC/UPC for data and minimum 1 pair, green in color, Singlemode SC/APC for CATV use.

16.8.11 Approved manufacturer(s) and part numbers for multimode and singlemode fiber.

16.8.11.1 Multimode

- Siemon
  - Siemon 12-strand 50/125 Multimode Indoor Tight Buffered Distribution Fiber, OFNP
    p/n 9BB5P012G-T312

- Corning
  - TBD

16.8.11.2 Singlemode

- Siemon
  - Siemon 12-strand Singlemode Indoor Tight Buffered Distribution Fiber, OFNP
    p/n 9BB8P012G-E205A

- Corning

- TBD

16.8.12 Approved methods of fiber termination.

- All fibers shall be terminated with SC style connectors. Fusion spliced pigtails, epoxy minimal polish connectors, and UNICAM style connectors are all acceptable methods of fiber termination.

16.8.13 Approved manufacturer(s) and part numbers for multimode and singlemode pigtails.

16.8.13.1 Multimode

- Siemon
  - Siemon 50/125 Multimode Simplex Pigtail, SC, 1m
    p/n P1B-SC5MM-01

- Corning
  - TBD

16.8.13.2 Singlemode

- Siemon
  - Siemon Singlemode Simplex Pigtail, SC/UPC, 1m
    p/n FP1B-SCUL-01

  - Siemon Singlemode Simplex Pigtail, SC/APC, 1m
    p/n FP1B-SCA-01

- Corning
  - TBD

16.8.14 Approved manufacturer(s) and part numbers for fusion splice trays.

- Siemon
  - Siemon Fusion Splice Tray
    p/n TRAY-3

- Corning
  - TBD

16.8.15 Approved manufacturer(s) and part numbers for multimode and singlemode fiber jumpers.

16.8.15.1 Multimode

- Siemon
  - Siemon 62.5/125 Multimode Fiber Jumper, SC, Duplex
    p/n FJ2-SCSC6MM-01 (1m)
    p/n FJ2-SCSC6MM-02 (2m)

p/n FJ2-SCSC6MM-03 (3m)
p/n FJ2-SCSC6MM-05 (5m)

- Corning
  - TBD

16.8.15.2 Singlemode

- Siemon
  - Siemon Singlemode Fiber Jumper, SC Duplex
    p/n FJ2-SCUSCUL-01 (1m)
    p/n FJ2-SCUSCUL-02 (2m)
    p/n FJ2-SCUSCUL-03 (3m)
    p/n FJ2-SCUSCUL-05 (5m)

- Corning
  - TBD

16.9 Inside Cabling – Telephone

16.9.1 Twenty-four (24) gauge, plenum, CAT 3 or higher UTP copper cable (wire) shall be used for telephone riser and shall "home-run" from each IDF back to the MDF.

16.9.2 This copper cable (wire) shall be large enough to provide a minimum of 1 ½ pair of wires per receptacle box served by that individual MDF/IDF.

16.9.3 Approved Manufacturer(s) and part number(s) for telephone termination blocks.

- Siemon S110 Field Termination Kits
  p/n S110AB2-100FT
  p/n S110AB2-300FT

16.10 Inside Cabling – CATV

16.10.1 CATV coaxial cable shall be plenum rated, quad-shielded, RG-6, from each outlet back to the appropriate MDF/IDF with no more than 250 feet of cable. Use Commscope 2227V or General Cable C3525 ONLY.

16.10.2 Cable shall be terminated on wall mounted patch panels/taps.

16.10.3 Any individual cable length over 250 feet will need to be approved by UGA EITS-NI.

16.10.3.1 CATV Connectors

Compression style CATV connectors with rubber o rings shall be used.

- Siemon RG6C Compression Connectors
  p/n RG6C
- PCT –DRS-6

16.10.3.2 CATV Patch Panels/Connectors

- Siemon MAX Patch Panel and F-Type MAX Modules
  p/n MX-PNL-24
  p/n MX-PNL-48
  p/n MX-F-FA-01

16.11 Inside Cabling – IEEE 802.11 Wireless Networks

16.11.1 Wireless networks shall be installed only as extensions or additions to hard-wired networks and not as a replacement for cabled telephone, data, or CATV networks.

16.11.2 UGA EITS-NI must be contacted for more specific information on wireless deployments. These networks shall adhere to the wireless standards located at http://www.eits.uga.edu/noi/ni

16.12 Inside Cabling - Execution for Telephone and Data

16.12.1 The installer shall obtain the UGA labeling scheme for telephone jacks from UGA EITS-NI.

16.12.2 Station Jack Installation – General

16.12.2.1 Station jack installation shall conform to ANSI/TIA/EIA-568-B (Commercial Building Telecommunications Cabling Standards).

16.12.2.2 All voice and data jacks shall be Siemon WHITE MAX 6 Modules, part number MX6-02 for angled jack or, part number MX6-F02 for flat jack with red icon to indicate data, and white icon to indicate voice connection. The cable must be installed so that mechanical strain does not reach the jack. Please note; flat jack to be used for surface mounted boxes ONLY.

16.12.2.3 Before wiring the actual jacks, UGA EITS-NI must be contacted for purposes of approving the proposed wiring method. Failure to do so will result in non-compliance with UGA EITS-NI standards.

16.12.3 Station Jack Installation - Surface Mount

16.12.3.1 Surface mount station jacks shall be installed in accordance with NEC specifications.

16.12.3.2 Surface mount station jacks shall be mounted on wall at 1.5 feet from the floor (unless specified otherwise).

16.12.3.3 The modular jack opening shall face out, down, or to either side, but not up. Where the opening faces out, the notch for the locking tab shall be on the bottom.

16.12.3.4 Surface mount station jacks shall be secured to the wall with two or more screws.

16.12.3.5 All surface mounted outlets shall be 4 port, WHITE, Siemon MX-SM Surface Mount Box, part number MX-SM4-02 or MX-SM6-02 for 6 port box. All surface mount boxes will use Siemon Flat modules.

16.12.4 Station Jack Installation - Flush Mount

16.12.4.1 Flush mount station jacks shall be installed in metal or plastic outlet boxes in the wall at 1.5 feet above floor.

16.12.4.2 The boxes must be secured in the wall so that no movement occurs during installation use or during normal use.

16.12.4.3 The jack and wall plate must each be secured to the box by metal screws.

16.12.4.4 The jack shall be oriented so the locking tab is facing downward.

16.12.4.5 All flush mount, in wall outlets shall use WHITE Siemon MAX Modular single gang or double gang style faceplates in whatever port configuration is necessary.

16.12.4.6 All in-wall faceplates will use angled modules.

16.12.4.7 The following are suitable faceplate part numbers:

- MX-FP-S-01-02 single gang 1-port
- MX-FP-S-02-02 single gang 2-port
- MX-FP-S-03-02 single gang 3-port
- MX-FP-S-04-02 single gang 4-port
- MX-FP-S-06-02 single gang 6-port
- MX-FP-D-06-02 double gang 6-port
- MX-FP-D-08-02 double gang 8-port

- MX-FP-D-12-02 double gang 12-port

16.12.5 Station Jacks

16.12.6 Each station jack shall be a Category 6, WHITE, Siemon MAX 6 Module, providing eight terminals for the station cable and utilize red slide-in icons to indicate data and white slide-in icons to indicate a telephone connection.

16.12.7 The following are suitable part numbers for all Telephone, Data, and CATV jacks and modules:

16.12.7.1 For in-wall, flush mount faceplates, use Siemon WHITE, MAX 6 angled modules, part number MX6-02.

16.12.7.2 For surface mount boxes use Siemon WHITE, MAX 6 flat modules, part number MX6-F02.

16.12.7.3 CATV connections in flush mount, in-wall faceplates shall use, Siemon WHITE, F-type coax MAX, flat module, part number MX-FA-02 mounted in a Siemon CT2-FP-02 faceplate in conjunction with bezel p/n CTE-MXA-01-01.

16.12.7.4 CATV connections in surface mount boxes shall use part number MX-F-FA-02.

16.12.8 Only one color scheme shall be used throughout the project.

16.12.9 Station jacks shall conform to ANSI/TIA/EIA-568-B (Commercial Building Telecommunications Cabling Standards) specifications.

16.13 CATV: Cabling Standards for Video Services

16.13.1 The cabling specifications for video services will be determined based on the specific functional requirements of the building.

16.13.2 UGA EITS-NI shall provide consultation and preliminary planning guidance to assist the designers in determining the cabling requirements on a case-by-case basis for each building.

16.13.3 The following general specifications will be required for buildings which are connected to The University of Georgia Cablevision network.

16.13.3.1 The network must be two-way capable with 862 MHz actives and 1 Gig passives. The downstream frequency will be from 54 MHz-862 MHz for digital/analog video and data transmissions. The upstream frequency will be from 5 MHz - 42 MHz for digital/analog video and data transmissions.

16.13.3.2 The network must deliver a signal at the following levels:

16.13.3.2.1 The signal level at each outlet/ drop should have minimum of 6 dBmV and a maximum of 15 dBmV on all channels.

16.13.3.2.2 The signal to noise ratio must be 43 dB or better.

16.13.3.2.3 The signal to composite triple beat must be 51dB or better.

16.13.3.2.4 Network hum must be less than1%.

16.13.3.2.5 System response must be +/- 1 ½ dBmV within any channel.

16.13.3.2.6 Signal to beat interference must be 57 dB or better.

16.13.3.2.7 For digital signals, a 32 MER reading or better is required.

16.13.3.2.8 Radiation must be within FCC Specifications, i.e., less than 20 uv/m within ten feet with a tuned dipole antenna.

16.13.3.3 All rooms will be “home run” to MDF/IDF equipment room(s). It is permissible for one loop-through within one room.

16.13.3.4 All outlets will be the standard CATV termination known as an F-81 barrel splice type connector (no solder or screw systems will be allowed).

16.13.3.5 Outlet(s) will be mounted strategically in the room depending on room arrangement.

16.13.3.6 All classroom drops will be coordinated with UGA EITS-NI for placement.

16.13.3.7 Cable, conduit and installation shall be in accordance with applicable national, state and local building codes.

16.13.3.8 All working drawings of video distribution networks, which are intended to be attached to the University of Georgia Cablevision video network shall be approved by UGA EITS-NI.

16.13.4 CATV: Coaxial Cable Preparation and Connection

16.13.4.1 Hardline .500, .750, and .100 jacketed and unjacketed cables must be used.

16.13.4.2 For flooded cable, clean flooding compound off the aluminum sheath to keep the ground loop complete.

16.13.4.3 Follow manufacturer's instructions for completing connections.

16.13.4.4 Clean, sharp, serviced, coring tools must be used.

16.13.4.5 Metallic knives MAY NOT be used when cleaning dielectric from center conductor. This will cause a problem with the 'skin effect' for higher frequencies to ride on the cable center conductor. Use plastic removal tools.

16.13.4.6 The standard connectors to be used are as follows;

- Siemon RG6C Compression Connectors p/n RG6C
- PCT-DRS-6

16.13.5 RG-11 and RG-6 CATV wire.

16.13.5.1 Use proper preparation tools for specific connectors for correct installation. Change blades when necessary.

16.13.5.2 Active and Passive RF Components…TBD

16.13.5.3 Physical coaxial cable, brand and make, specify here…TBD

16.13.6 CATV: Activation and Testing

16.13.6.1 Wiring – See 19.

16.13.6.2 Passives verification - use sweeping methods for verification.

16.13.6.3 All cables must be labeled with room number (where outlet is) both on the outlet and in the MDF/IDF wiring closet.

17 Fire Safety Guidelines

17.1 Per the UGA Fire Safety Office, assume that a wall that goes all the way to the decking of the floor above it, or to the roof, is a firewall. In this document all such walls are assumed to be firewalls unless the installer has specific and documented evidence to the contrary.

17.2 All installations shall meet State of Georgia, National, and Local fire codes.

17.3 All products to be used must be UL-approved and must be installed according to the manufacturer's specifications.

17.4 If a firewall is penetrated, a UL-approved sleeve and fire caulk must be installed according to the manufacturer's standards.

17.5 When penetrating a firewall, write legibly and in permanent ink, the date and your affiliation (vendor name, department, etc.) next to the penetration on both sides of the firewall being penetrated.

17.6 All materials used in a plenum (wires, conduit, wire ties, etc.) must be plenum-rated.

17.7 Under no circumstances shall the walls, ceiling, floor, etc. of a stairwell be penetrated.

18 Abbreviations

ANSI	American National Standards Institute
APC	Angled Physical Contact (fiber connector)
BICSI	Building Industry Consulting Services International
CATV	Cable Television
EIA	Electronic Industries Alliance
EITS	Enterprise Information Technology Services (UGA)
EITS-NI	Network Infrastructure Group, a unit of UGA EITS
EMI	Electronic Magnetic Interference
FCC	Federal Communications Commission
I.D.	Inside Diameter
ICEA	Insulated Cable Engineers Association
IDF	Intermediate Distribution Frame
IEEE	Institute of Electrical and Electronics Engineers
LIU	Light Interface Unit
MDF	Main Distribution Frame
MHz	Megahertz
MM	Multi Mode Optical Fiber
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electric Safety Codes
NFPA	National Fire Protection Association
OFNP	Optical Fiber Non-Metallic Plenum
OTDR	Optical Time Domain Reflectometer
POE	Point of Entry
RF	Radio Frequency
RUS	Rural Utilities Service (formerly REA)
SC	Subscriber Connector (fiber connector)
SCS	Standard Cabling System
SM	Single Mode Optical Fiber
TDC	Telephone, Data, and CATV
TDR	Time Domain Reflectometer
TIA	Telecommunications Industry Association
UPC	Ultra Physical Contact (fiber connector)
UTP	Unshielded Twisted Pair

19 Testing Parameters

19.1 Optical Fiber Testing: Singlemode and Multimode Fiber

19.1.1 Fiber horizontal cables shall be 100% tested for insertion loss and length.

19.1.2 Insertion loss shall be tested at 850 nm and 1300 nm for 50/125um and 62.5/125um multimode cabling in at least one direction using the Method B (1-jumper) test procedure as specified in ANSI/TIA/EIA-526-14A.

19.1.3 Insertion loss shall be tested at 1310 and 1550 for singlemode cabling in at least one direction using the Method A.1 (1-jumper) test procedure as specified in ANSI/TIA/EIA-526-7.

19.1.4 Length shall be tested using an OTDR, optical length test measurement device or sequential cable measurement markings.

19.1.5 The multimode backbone link performance guarantees are as follows:

Backbone Link Performance	
Parameter	**62.5/125μm (850nm/1300nm)**
Max. Insertion Loss (dB)	8.5/3.5
Bandwidth (MHz•km) [1]	200/500
Guaranteed Transmission Distance (m) [2]	275/550
Min. Return Loss (dB) [3]	20

1 Bandwidth is an important performance parameter, but because it is intrinsic to the fiber and cannot be adversely affected by installation practices, it does not require testing in the field.
2 The protocol pertinent to the transmission distances as noted is Gigabit Ethernet per IEEE 802.3:2000.
3 If the insertion loss is within the limits as noted in the above chart, it is indicative that the Return Loss performance of the link will be within the limits as indicated.

Acceptable attenuation test results shall be determined using the following calculation:
Link Attenuation = Cable Attenuation + Connector Attenuation + Splice Attenuation
where:
Cable Attenuation (dB) = Attenuation Coefficient (dB/km) x length (km)
Attenuation Coefficient = 3.5 dB/km @ 850 nm
Attenuation Coefficient = 1.0 dB/km @ 1300 nm
Connector Attenuation (dB) = Number of Connector Pairs (n) x Connector Loss = n x 0.75 dB
Splice Attenuation (dB) = Number of Splices (s) x Splice Loss (dB) = s x 0.3 dB

19.1.6 The singlemode backbone link performance guarantees are as follows:

Backbone Link Performance	
Parameter	**Singlemode (1310nm/1550nm)**
Max. Insertion Loss (dB)	2.9/2.9
Zero Dispersion Wavelength (nm) [1]	1300 - 1322
Zero Dispersion Slope ($nm^2 \bullet km$) [1]	<0.092
Gigabit Transmission Distance (m) [2]	3,000/3,000
10 Gigabit Transmission Distance (m) [3]	3,000/3,000
Min. Return Loss (dB) [4]	40

1 Dispersion is an important performance parameter, but because it is intrinsic to the fiber and cannot be adversely affected by installation practices, it does not require testing in the field.
2 The protocol pertinent to the transmission distances as noted is Gigabit Ethernet per IEEE 802.3:2000.
3 The protocol pertinent to the transmission distances as noted is 10 Gigabit Ethernet per IEEE 802.3ae.
4 If the insertion loss is within the limits as noted in the above chart, it is indicative that the Return Loss performance of the link will be within the limits as indicated.

Acceptable attenuation test results shall be determined using the following calculation:
Link Attenuation = Cable Attenuation + Connector Attenuation + Splice Attenuation
where:
Cable Attenuation (dB) = Attenuation Coefficient (dB/km) x length (km)
Attenuation Coefficient (Inside Plant) = 0.5 dB/km @ 1310 and 1550 nm
Attenuation Coefficient (Outside Plant) = 0.4 dB/km @ 1310; 0.3 dB/km @ 1550 nm
Connector Attenuation (dB) = Number of Connector Pairs (n) x Connector Loss = n x 0.5 dB
Splice Attenuation (dB) = Number of Splices (s) x Splice Loss (dB) = s x 0.3 dB

19.1.7 OTDR (Optical Time Domain Reflectometer) Testing

19.1.7.1 In addition to insertion loss testing, OTDR testing shall be performed for each strand and OTDR traces provided. The wavelength(s) used in creating the OTDR trace should be the same as that used with the insertion loss testing. The OTDR trace characterizes elements along a fiber link, including fiber segment length, attenuation uniformity and attenuation rate, connector location and insertion loss, splice location and splice loss, and other power loss events such as a sharp bend that may have been incurred during cable installation.

19.2 Twisted Pair/ Copper Testing

19.2.1 The current field acceptance test parameters for twisted-pair cabling are:

19.2.1.1 All category 6 field-testing shall be performed with an approved level III balanced twisted-pair field test device.

19.2.1.2 All installed category 6 channels shall perform equal to or better than the minimum requirements as specified by the table below:

Parameter	Performance @ 100MHz	Performance @ 200MHz	Performance @ 250MHz
Insertion Loss	20.3 dB	29.7 dB	33.7 dB
NEXT Loss	42.1 dB	37.5 dB	36.1 dB
PS NEXT Loss	40.6 dB	36.1 dB	34.6 dB
ACR	21.8 dB	7.8 dB	2.4 dB
PS ACR	20.3 dB	6.4 dB	0.9 dB
ACR-F	23.9 dB	17.9 dB	15.9 dB
PS ACR-F	20.9 dB	14.9 dB	12.9 dB
Return Loss	14.0 dB	11.0 dB	10.0 dB
Propagation Delay	528 ns	527 ns	526 ns
Delay Skew	40 ns	40 ns	40 ns

19.2.2 Category 3, balanced twisted-pair horizontal and backbone cables, whose length does not exceed 90 m (295 ft) for the basic link, and 100 m (328 ft) for the channel shall be 100 percent tested according to ANSI/TIA/EIA-568-B.1. Test parameters include wire map plus ScTP shield continuity (when present), insertion loss, length and NEXT loss (pair-to-pair). NEXT testing shall be done in both directions.

19.2.3 All balanced twisted-pair backbone cables exceeding 90 m (295 ft) or 100 m (328 ft) shall be 100% tested for continuity if applications assurance is not required.

19.2.4 Category 6 balanced twisted-pair horizontal and backbone cables, whose length does not exceed 90 m (295 ft) for the basic link, and 100 m (328 ft) for the channel shall be 100 percent tested according to ANSI/TIA/EIA-568-B.1. Test parameters include wire map plus ScTP shield continuity (when present), length, NEXT loss (pair-to-pair), NEXT loss (power sum), ELFEXT loss (pair-to-pair), ELFEXT loss (power sum), return loss, insertion loss, propagation delay, and delay skew.

19.2.5 Test Equipment Criteria

19.2.5.1 All balanced twisted-pair field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing.

19.2.5.2 Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters

19.2.5.3 Test settings selected from options provided in the field testers shall be compatible with the installed cable under test.

19.3 CATV Coaxial Cable Testing

19.3.1 CATV coaxial cabling at 75 Ohms will be tested for bi-directional use

19.3.2 DC loop resistance

19.3.3 Impedance

19.3.4 Length

19.3.5 TDR

19.3.6 Frequency Attenuation variation

19.3.7 Structural loss- physical damage to cable

19.3.8 These are tested with Digital Multi-meters, TDR's, Sweep Generation Testing and other testing equipment.

19.4 Telephone Cable Testing

19.4.1 All telephony cables shall be 100% tested for continuity.

20 Optical Cabling

Multimode - The fiber cable shall be a graded index fiber with a nominal 50/ 125µm core/ cladding. The fiber shall conform to the following standards or international equivalents:

- ANSI/TIA/EIA-568-B (overall requirements)
- ANSI/TIA/EIA-492AAAC (Laser bandwidth DMD specification)
- ANSI/ICEA-83-596 (indoor optical cables)
- ANSI/ICEA-87-640 (indoor optical cables)

Single-mode - The fiber shall be at least Class IVa Dispersion unshifted single-mode optical fiber. It shall conform to the following standards or international equivalents:

- ANSI/TIA/EIA-568-B (overall requirements)
- ANSI/TIA/EIA-492CAAA (fiber specifications)
- ANSI/ICEA S-83-596 (indoor optical cable)
- ANSI/ICEA S-87-640 (outdoor optical cable)