

ATTACHMENT A – STATEMENT OF WORK

FOR

**TELECOMMUNICATION INFRASTRUCTURE
PROJECT SERVICES 2**

(TIPS 2)

RFP NO: DMS-18/19-045

REQUEST FOR PROPOSAL

THE STATE OF FLORIDA

DEPARTMENT OF MANAGEMENT SERVICES

SECTION 1. Introduction

1.1 Applicability

All provisions of the Statement of Work (SOW) apply to both Division One and Division Two services and, unless otherwise stated, apply to both Projects and Moves, Adds and Changes (MACs). Statement of Work section 3 is only applicable to Contractors providing E-Rate eligible services and equipment.

	Division One	Division Two
Service	Cabling Distribution System	E-Rate Category Two
Service is E-Rate eligible	Yes. Includes E-Rate Category Two eligible services and equipment.	Yes. Includes only E-Rate Category Two eligible services and equipment.
Customers	All Customers (E-Rate eligible and Non E-Rate eligible)	All Customers (E-Rate eligible and Non E-Rate eligible)
Contractors	All Contractors	Contractors registered and compliant with the USAC E-Rate program (E-Rate Contractors)

1.2 Description of Purchase

The TIPS-2 will provide Customers with infrastructure cabling, equipment components, and design of telecommunications infrastructure systems, along with total Project and MAC management services. Services offered through TIPS-2 Contracts will comply with any and all requirements set forth in Florida Statutes, the current National Electrical Codes, current Telecommunications Industry Association (TIA) standards, and Building Industry Consulting Service International (BICSI) standards. The Contract(s) shall provide:

- Design and installation of structured cabling infrastructure systems;
- Installation of low voltage cabling for telephones, computers, audio, and visual technologies, including all equipment and services necessary for installation of cabling;
- Installation of low voltage cabling equipment, including all equipment necessary for the installation. Low voltage cabling equipment includes, but is not limited to: racks, cabinets, conduits, and wire management;
- Repairs to cabling systems and telecommunication infrastructure equipment; and
- Moving information technology systems.

The Contractor will be responsible for all aspects of the services provided. The Contractor shall complete all projects no later than the expiration date of the Contract or, where applicable, the expiration dates of any purchase orders issued off the Contract.

1.3 Contract Divisions of Work

There are two (2) Divisions of work:

Division One – Cabling Distribution System. Contracts that include this Division will provide labor, materials, tools, services, and equipment for cabling distribution systems for analog, digital, and VoIP telephony, audio, video, and networking data. Cabling distribution systems include E-Rate Category Two eligible cabling services. The Division

One Contractors will provide cabling distribution systems for new building construction, building renovations, inter-building, intra-building, outside plant, and MACs to existing systems. All Customers, E-Rate and non-E-Rate eligible may purchase from this Division. Both E-Rate Contractors and non-E-Rate Contractors are authorized to supply Division One services and equipment. Contracts for these services will have all-inclusive prices including all installation and material costs.

Division Two – E-Rate Category Two Equipment. Contracts that include this Division will be limited to providing labor, tools, materials, and equipment, and services described in SOW subsection 3.5. These equipment and services are designated by the Federal Communications Commission as eligible under the E-Rate program Category Two, Internal Connections, and include the provision of cabling necessary to fulfill Customer orders for E-Rate Category Two eligible equipment contemplated herein. Only E-Rate Contractors will be eligible for Division Two Contracts under this procurement. However, all Customers, E-Rate and non-E-Rate eligible, may purchase from this Division. Contracts for these services will have separate labor and equipment costs. See Attachment C, Pricing Workbook.

1.4 State of Florida Regions

For purposes of this Contract, the State will be divided into the following regions:

Region 1	Escambia, Okaloosa, Santa Rosa
Region 2	Bay, Franklin, Gulf, Holmes, Walton, Washington
Region 3	Calhoun, Gadsden, Jackson, Jefferson, Leon, Liberty, Madison, Taylor, Wakulla
Region 4	Alachua, Bradford, Citrus, Columbia, Dixie, Gilchrist, Hamilton, Lafayette, Levy, Marion, Putnam, Suwanee, Union
Region 5	Baker, Clay, Duval, Flagler, Nassau, St. Johns
Region 6	DeSoto, Hardee, Hernando, Highlands, Hillsborough, Manatee, Pasco, Pinellas, Polk, Sarasota
Region 7	Brevard, Lake, Orange, Osceola, Seminole, Sumter, Volusia
Region 8	Charlotte, Collier, Glades, Hendry, Lee
Region 9	Indian River, Martin, Okeechobee, Palm Beach, St. Lucie
Region 10	Broward, Miami-Dade, Monroe

SECTION 2. General Requirements

2.1 Cooperation with Other Contractors

The Contractor must not commit or permit any act which will interfere with the performance of work by any other Contractor or DMS employees.

2.2 Cooperation with General Contractors and Project Contacts

The Contractor shall coordinate installation and construction sequences with the General Contractor when a General Contractor is in charge of site construction and with the Project Contact when the Project Contact is in charge of construction improvements.

2.3 Work Coordination

The Contractor shall strive to perform work in a manner that will not disrupt the Customer’s day-to-day operations at the site. When disruptions to the Customer’s day-to-day operations are necessary to perform the services requested, the Contractor shall coordinate with the Project Contact in advance and obtain written approval from the Project Contact. The Contractor shall provide an electronic copy of the Project Contact’s

approval to disrupt the Customer's day-to-day operations to the DMS Product Manager for the Project file.

Upon request, the Project Contact will provide the Contractor with the available information for the facility, such as construction or as-built drawings, equipment installation, and aboveground/underground utilities details. On projects where this information is not available, the Contractor will provide surveys that are included as part of the services of this Contract, at no additional cost. Where hazardous materials are detected during the surveys or during construction, the Contractor shall stop work and notify the DMS Product Manager and the Project Contact of the hazardous conditions immediately for determination and disposition of the issue.

The Contractor shall be responsible for coordinating activities with other vendors as needed for the successful implementation of the system. Contractor will continue such coordination throughout the Project or MAC, including pre-planning, planning, integration, general construction, finishing construction, as well as all other construction timeline items. Neither the Department nor the Customer will be liable for any additional costs that result from the Contractor's failure to meet specified deadlines in a request for quote (or mini-bid for E-Rate customers) or the Contractor's failure to properly coordinate with other trades.

2.4 Contractor is Responsible for Contractor Materials

A storage facility will not be provided to the Contractor for the storage of installation materials. The Contractor shall be responsible for all materials brought onto any job site. Theft, misplacement, or loss of any materials shall be the responsibility of the Contractor. Claims associated with such losses shall be processed against the Contractor's identified insurance policies or other means.

2.5 Subcontracting

The Contractor shall be fully responsible for all work performed under the Contract. Should the Contractor need to Subcontract out any services, the Contractor shall submit a written request to the Department's Contract Manager identified in the Contract. The written request shall include, but is not limited to, the following:

- a) The name, address and other information identifying the Subcontractor.
- b) Component / type of services to be performed by the Subcontractor.
- c) Time of performance of the identified service.
- d) How the Contractor plans to monitor the Subcontractor's performance of the identified services.
- e) Certification that the Subcontractor has all licenses and / or has satisfied all legal requirements to provide the services to the Department. Also, Contractor shall certify that the Subcontractor is approved by the Florida Department of State to transact business in the State of Florida.
- f) A copy of the written subcontract agreement.
- g) Acknowledgement from the Subcontractor of the Contractor's contractual obligation to the Department and that Subcontractor agrees to comply with all terms and conditions of the Proposal and resulting Contract.

- h) The Contractor acknowledges that it shall be not released of its contractual obligation to the Department as a result of any Subcontract.

2.6 Staffing Requirements and Responsibilities

The Contractor shall provide sufficient, qualified personnel to oversee and carry out the services of the Contract. The term “Contractor staff” includes all staff employed by the Contractor and by its Subcontractors relevant to the Contract. The staffing requirements and responsibilities include the following:

- a) The Contractor staff responsibilities include conducting all components of the Contract in a timely, efficient, productive, consistent, courteous and professional manner as representatives of the State.
- b) The Contractor staff shall devote the time and resources necessary to successfully manage the State of Florida account, including being available for telephonic, email, and on-site consultations.
- c) The Contractor shall provide each Contractor staff member orientation and training on all components of the Contract prior to working on any component of the Contract. Documentation of this training shall be provided to DMS upon request.
- d) DMS will have the right to request the replacement of any Contractor staff and Contractor will remove such staff within thirty (30) calendar days’ or earlier upon DMS’s notice to Contractor.
- e) The Contractor must provide a sufficient number of Contractor Staff to handle the workload projected for the start of the Contract and shall be scalable and flexible so it can be adapted as needed.
- f) The Contractor shall have a minimum of one (1) employee with the BICSI Registered Communications Distribution Designer (RCDD) certification on staff for the term of the Contract. This requirement will be met if the Subcontractor has an employee with the RCDD certification. The RCDD employee shall be made available as needed for Projects requiring an RCDD. If the employee with the RCDD certification identified in the Contractor’s Proposal is no longer affiliated with the Contractor, a copy of the RCDD Certification for another employee shall be provided to DMS within fourteen (14) calendar days of the change.

2.7 Invoice

The Contractor shall submit invoices to DMS in accordance with the timeline stated in SOW section 6, Service Level Agreements. The Contractor is required to submit the invoice electronically to the Contract Manager, in preferably either a Microsoft Excel document to the Contractor Manager, or in CSV format (preferred format) in the Communications Service Authorization Billing System (CSAB). The invoice must be accompanied by sufficient detail to appropriately document the services delivered, in accordance with all Florida Statutes.

2.8 E-Rate Invoicing

When invoicing for services to an E-Rate customer, the Contractor shall separately itemize the price, for any materials or services that are ineligible for E-Rate funding. The invoice should include both E-Rate eligible and ineligible items on the same invoice, not invoice separately. The Contractor must include the following information on all invoices:

- a) Location of site where service was provided;
- b) Eligible Price;
- c) Ineligible Price;
- d) Quantity of Eligible and Ineligible Items;
- e) Associated Funding Request Number and Funding Request Line Item number (provided by the Customer); and
- f) CSAB Item number that matches delivered and/or installed equipment.

Contractors will offer Service Provider Invoice (SPI) billing to E-Rate customers. SPI invoicing (Federal Communications Commission (FCC) Form 474) is an FCC form that service providers submit to request reimbursement for discounted eligible services already provided to the schools or libraries on their customer bills (also known as a SPI credit).

2.9 Travel

Travel costs are not allowed under this Contract.

2.10 Permits, Fees, and Inspections

The Contractor shall obtain and pay for all permits, fees, impact fees, fines, and inspections. The Contractor shall submit in CSAB a copy of permits and inspection certificates, as a PDF, issued by authorities having jurisdiction, to the DMS Product Manager.

2.11 Ad-hoc

Cabling distribution systems contain a variety of related components. The Contract provides pricing for numerous standard products; however, there may be rare circumstances where orders may contain products not listed in the CSAB Catalog, but which are necessary to deliver overall functionality. In these instances, the necessary products will be provided at no more than the Contractor's cost.

2.12 Updates to Equipment

DMS anticipates the equipment may change over the term of the Contract and should be flexible to remain current throughout the life of the Contract. Changes in equipment offered by Contractor in the same or equivalent form and within the scope of the Contract are permissible updates. Updates may be prompted by the Contractor, DMS, or Customers. At DMS's sole discretion, updates may require a Contract amendment, and any updates will not be incorporated into the CSAB system without DMS's approval. For equipment updates, Contractor must price the item at the same profit margin or percentage discount off the Manufacturer's Suggested Retail Price (MSRP) offered in Attachment C – Pricing Workbook. The Contractor shall not increase the pricing of any existing equipment or services.

If applicable, all Contractors will be given the same opportunity to offer the updated, or new related service.

2.13 Acceptable Substitution

The Contractor may provide a substitution for a product if it is approved in writing by the Department, is of similar quality, and the cost will not exceed the cost in the Attachment C – Pricing Workbook.

2.14 Catalog Items

Products within the scope of the Contract may be added in accordance with SOW section 2.12 or removed from CSAB at DMS's sole discretion.

2.15 Acceptable Publications

The Department may request, and the Contractor shall provide within three (3) business days of any request, acceptable and supporting information or documentation relative to equipment sold. Acceptable and supporting information or documentation includes, but is not limited to:

1. MSRP list. The MSRP and MSRP list may not be custom or solely developed, created, maintained, altered, revised, changed, or utilized for purposes of the Contract
2. The Manufacturer's official retail websites.
3. Technical documentation with specifications of equipment.

2.16 Customer Service

The Contractor will provide a high level of customer service. This will include providing professional, timely, and accurate communication to Customers and DMS at all times. Contractor is to return Customer's phone calls and emails within two (2) business days. Contractor is to seek Customer feedback. Throughout the Project or MAC, the Contractor will document all Customer complaints and submit such complaints to the Department's Contract Manager in writing within five (5) business days.

SECTION 3. E-RATE Requirements

Section 3 is only applicable to E-Rate Contractors who provide E-Rate eligible equipment and services. In this section, "Contractor" refers to E-Rate Contractors registered and compliant with the USAC E-Rate program.

3.1 E-Rate Introduction

If the Contractor is providing E-Rate eligible equipment and services under the Contract to E-Rate Customers, the Contractor shall meet the requirements within this SOW section 3.

The E-Rate Program helps ensure that schools and libraries can obtain high-speed Internet access and telecommunications at affordable rates.

The Contract(s) that result from this procurement have been competitively bid by a state government entity for use by eligible entities in accordance with USAC State Master Contracts.

The Contractor will neither be deemed a consultant of DMS nor of any E-Rate Customer

3.2 E-Rate Registration and Compliance

To ensure compliance with all applicable USF regulations, program mandates, and auditing requirements, Contractors must comply with the following:

- a) The Contractor shall maintain eligibility and remain in good standing as a USF service provider for the duration of the Contract and shall comply with all applicable FCC orders and regulations and USAC E-Rate requirements.
- b) The Contractor must have an identified employee who is responsible for submitting E-Rate forms and who is qualified to answer questions and to receive correspondence regarding the E-Rate program. The contact details for this named person shall be submitted to the DMS Contract Manager within thirty (30) days of Contract execution.

- c) The Contractor shall assist DMS and its E-Rate Customers in completing any forms related to the USF program.
- d) The Contractor must take all actions necessary to provide E-Rate eligible equipment and services in compliance with the terms and conditions of the Contract and E-Rate rules and regulations. E-Rate rules will be the minimum performance standard requirements met under this Contract. Where this Contract has performance requirements greater than those of E-Rate rules, the Contractor must meet those higher Contract standards.
- e) The Contractors shall have, at a minimum, a working knowledge of the USF and Federal Communications Commission's Registration Number (FCCRN) and will keep current with all requirements pertaining to the USF program.
- f) The Contractor shall timely provide to the DMS Contract Manager all information and documentation needed to timely prepare its E-Rate applications, document transactions eligible for E-Rate support, or timely respond to any USAC inquiries and audits.
- g) The Contractor shall label all equipment with an identifying tag to demonstrate the equipment was purchased with E-Rate funding.
- h) The Contractor shall complete a DMS inventory log identifying the location of installed equipment at eligible E-Rate locations and provide the completed inventory log via email to the DMS Contract Manager once the Project or MAC is complete.
- i) The Contractor must submit a Service Provider Annual Certification (SPAC) (Form 473) to USAC each funding year to certify that it will comply with program rules. A copy of this certification will be sent to the to the DMS Contract Manager and DMS E-Rate Coordinator annually.
- j) The Contractor shall obtain a Service Provider Identification Number (SPIN) from USAC within sixty (60) days of Contract award. Documentation validating that the Contractor has obtained SPIN number shall be sent to the DMS Contract Manager and DMS E-Rate Coordinator.
- k) The Contractor shall maintain compliance with the Lowest Corresponding Price (LCP) as defined in 47 C.F.R. § 54.500.
- l) The Contractor agrees to comply with all FCC/USAC E-Rate document retention regulations and requirements.
- m) The Contractor agrees to comply with all E-Rate gift rules, in accordance with 47 C.F.R. § 54.503 and FCC/USAC regulations and requirements.

3.3 E-Rate Filings

Both the Contractor and DMS agree that:

- a) Per FCC guidelines, DMS is the applicant and files all FCC related forms on behalf of E-Rate Customers.

- b) DMS acknowledges that it has posted an E-Rate Description of Services Requested and Certification Form (Form 470) in connection with this procurement, which is a prerequisite to E-Rate eligible entities utilizing Contract(s) awarded as a result of the procurement as the basis for E-Rate funding applications.
- c) Awarded contracts will be between DMS and the Contractor. If necessary, an E-Rate Customer will conduct a mini bid to select the most cost-effective Contract.
- d) E-Rate has specific rules and regulations regarding eligibility of services, the manner and timeframes under which USAC Schools and Libraries Division approve funding requests and distributions, the format and submission of customer bills and USAC invoices, and audits in connection with funding under the E-Rate program, which the Contractor is required to adhere to.

3.4 Contractor's Liability for Maintaining Eligibility as a USF Service Provider

The Contractor must maintain eligibility as a USF service provider and must not be placed on "Red Light Status" by the FCC or placed on the Suspension and Debarment List of the USAC. In the event that the FCC or USAC determines that the Contractor or one of its subcontractors has not acted in compliance with the E-Rate Program, the Contractor will be liable for the equivalent to the actual loss of DMS (and any of its E-Rate Customers) where the Contractor's or Subcontractor's USF ineligibility is due to circumstances within Contractor's control. Whether a Contractor's ineligibility is due to circumstances beyond Contractor's control is a determination solely within the discretion of DMS.

If Contractor becomes ineligible as an E-Rate Service Provider due to:

- a. Circumstances within the Contractor's control; or
- b. Becomes unwilling or unable to provide E-Rate eligible equipment in compliance with E-Rate rules and regulations or the Contract; or
- c. Violates E-Rate rules and regulations in a way that causes USAC to deny E-Rate Customer funding in whole or in part,

DMS and E-Rate Customers have the following remediation:

- a. May seek to change to another Contractor;
- b. May seek substitute equipment; or
- c. May seek damages.

The Contractor agrees to pay liquidated damages in the event it becomes ineligible as a USF provider. In such an event, liquidated damages shall be calculated as the additional cost to DMS and any of its E-Rate Customers above the E-Rate discount. Payment of such liquidated damages shall be the sole responsibility of the awarded Contractor and will be assessed at the time the Customer is billed by the ineligible Contractor. DMS and any of its E-Rate Customers shall only be responsible for the E-Rate discounted price of the services.

In the event DMS or E-Rate Customer are unable to obtain USAC approval to change to a new Contractor, and such USAC denial is a result of the Contractor's actions not being an eligible reason for USAC to approve a change of service providers under E-Rate rules, the Contractor will be liable to DMS for the amount of E-Rate funding forfeited as a result.

If the Contractor's violation of the E-Rate rules and regulations is the reason for the E-Rate Customer's loss of E-Rate funding, in whole or in part, the value of the lost funding associated with the Contractor's violation will be considered a liquidated damage under this subparagraph.

3.5 E-Rate Category Two Equipment and Services

The Eligible Services List (ESL) for each funding year provides guidance on the eligibility of products and services under the E-Rate program. The ESL is updated by the FCC on an annual basis. The E-Rate Category Two equipment and services eligible for E-Rate support includes the internal connections needed for broadband connectivity within, between, or among schools and libraries. Support is limited to the internal connections necessary to bring broadband into, and provide it throughout, schools and libraries. These are broadband connections used for educational purposes within, between, or among instructional buildings that comprise a school campus or library branch.

The eligible components and services in E-Rate Category Two subject to this procurement are listed below:

- a) Infrastructure – to provide options for industry standard compliant equipment to develop a telecommunications infrastructure. This includes all components necessary to internal connections needed to bring broadband into, and provide it throughout, buildings, which may connect to a wireless infrastructure or other equipment such as:
 - a. Switches - a mechanical or electronic device that completes or breaks an electrical path or that selects the paths for communication
 - b. Routers –switching devices that can act as an interface between two networks and connect different segments, such as departments or floors in a building
 - c. Cabling –the wires or groups of wires capable of carrying voice, video, or data transmissions
- b) Wireless Access – to provide options for industry standard compliant wireless equipment. This includes all components necessary to provide wireless networking capabilities which then connect to a wired infrastructure. Components include:
 - a. Wireless access points used in a local area network (LAN) or wireless local area network (WLAN) - Wireless access points provides internet access to devices capable of receiving wireless broadband
 - b. Wireless controller systems - Wireless controller systems are used in conjunction with access points to create a wireless local area network
- c) Related Components – to provide options for industry standard compliant components related to infrastructure and wireless access. This includes all components necessary for the functionality of broadband distribution:
 - a. Antennas - devices for transmitting and/or receiving radio frequency signals
 - b. Connectors - devices that connect wires or fibers
 - c. Related components used for internal broadband connections – miscellaneous components to transport broadband internally
 - d. Racks - metal supporting framework for mounting cables, equipment, and/or wires.
 - e. Uninterruptible Power Supply (UPS)/Battery Backup - devices that provide backup electric energy to a piece of equipment in the event of a power failure
 - f. Software – software supporting the components in this section used to distribute high-speed broadband throughout school buildings and libraries
- d) Installation, configuration, and activation of all equipment contemplated within this Statement of Work.

3.6 Mini-Bid Process

E-Rate Customers must determine the cost effectiveness of qualified bidders by conducting the mini-bid process. This multiple step process is consistent with USAC's direction regarding cost effectiveness (see <http://www.usac.org/sl/applicants/step02/default.aspx>) and in accordance with 47 CFR 54.511.

Customers will use this process to request in CSAB specific work within their facilities based on their own unique technological needs. The format of each Customer's quote request will be left to the discretion of DMS. In all cases, the Contractor's quote must include a well-defined, detailed breakdown of the total cost of the proposed service, with E-Rate eligible and ineligible items separately listed, and prices that do not exceed those set forth in the Contractor's Pricing Workbook.

If a Contract is awarded to a Vendor to provide both Division One and Division Two services in a region and a Customer requests equipment in a region where Contractor has a listed price in Division One and a percentage off MSRP in Division Two, the Contractor's response will include, at a minimum, the price or MSRP discount which provides the Customer with the most cost-effective solution.

When a quote is obtained for Division Two equipment, and the manufacturer proposed was not specifically referenced within the Contractor's price sheet, the percentage off MRSP listed as, "any other manufacturer offered by the Respondent as an equivalent" within the Contractor's price sheet will be utilized.

If the Contractor accepts the quote request, the Contractor shall timely submit a quote to the Customer in CSAB. If the Contractor does not accept the quote request, it will opt-out in CSAB. The quote must be accepted by DMS in writing before any implementation. The quote must contain all information including manufacturer's data needed for the Customer to review and approve the service. The quotes will contain sufficient detail necessary for audit processes.

E-Rate Customers will seek quotes from qualified E-Rate Contractors for specific E-Rate eligible goods and services. A quote request contemplated in this mini-bid process may not expand the scope of a Contract, and the Contractor is limited to providing quotes only for services contemplated in the Contract between the Department and the Contractor.

TIPS 2 E-Rate eligible Customers may request, as part of their quote, specific manufacturers. E-rate rules require that when specific manufacturers are identified in the mini-bid, Contractors must be able to submit quotes for equivalent products and services. Contractors proposing equivalent equipment must provide DMS with documentation demonstrating the Contractor proposed equipment has equivalent attributes to the requested manufacturer's product such as performance, weight, size, durability, visual effect, and specific features and requirements indicated. Quotes for equivalent equipment will not be considered unless all of the outlined information has been provided and determined satisfactory by the Customer.

The E-Rate Customer will be responsible for determining the factors to use in evaluation of quotes received in response to the E-Rate Customer's mini-bid, and the E-Rate Customer can have as many evaluation criteria as necessary to assist in the selection of the most cost-effective solution, as long as price for E-rate eligible services is the most heavily weighted factor in the evaluation. This process will be governed by USAC's guidelines and criteria as described in the "mini-bids" section found at

<http://www.usac.org/sl/applicants/step02/state-master-contracts.aspx>. USAC guidance for conducting a bid evaluation can be found at <http://www.usac.org/sl/applicants/step02/evaluation.aspx>.

The bid evaluation must also follow applicable local procurement regulations.

The Customer will accept the quote in CSAB.

The E-Rate Customer, DMS Contract Manager, and the DMS E-Rate staff will maintain all documentation related to this mini-bid.

SECTION 4. NON-ERATE Quote Requests

TIPS 2 Non E-Rate Customers will use this process to request in CSAB specific work within their facilities based on their own unique technological needs. The format of each quote request will be left to the discretion of DMS. In all cases, Contractor's quote must be well-defined with a detailed breakdown of the total cost of the proposed service and prices that do not exceed those set forth in the Contractor's Pricing Workbook.

If a Contract is awarded to a Vendor to provide both Division One and Division Two services in a region and a Customer requests equipment in a region where Contractor has a listed price in Division One and a percentage off MSRP in Division Two, the Contractor's response will include, at a minimum, the price or MSRP discount which provides the Customer with the most cost-effective solution.

When a quote is obtained for Division Two equipment, and the manufacturer proposed was not specifically referenced within the Contractor's price sheet, the percentage off MRSP listed as, "any other manufacturer offered by the Respondent as an equivalent" within the Contractor's price sheet will be utilized.

A quote request may not expand the scope of a Contract, and the Contractor is limited to providing quotes only for services contemplated in the Contract between the Department and the Contractor.

TIPS Non-E-Rate Customers may request, as part of their quote, specific manufacturers. Contractors proposing equivalent equipment must provide DMS with documentation demonstrating the Contractor proposed equipment has equivalent attributes to the requested manufacturer's product such as performance, weight, size, durability, visual effect, and specific features and requirements indicated. Quotes for equivalent equipment will not be considered unless all of the outlined information has been provided and determined satisfactory by the Customer.

If the Contractor accepts the quote request, the Contractor shall timely submit a quote to the Customer in CSAB. If the Contractor does not accept the quote request, it will opt-out in CSAB, or by electronic message to the Product Manager, or by not responding. The quote must be accepted by DMS in writing before any implementation. The quote must contain all information and manufacturer's data needed for the Customer to review and approve the service. The Customer will be responsible for determining the factors to use in evaluation of quotes received in response to the Contractor's quote. The quotes will contain sufficient detail necessary for audit processes. The Customer will accept the quote in CSAB.

SECTION 5. Management Requirements

The Contractor shall be required to perform management activities associated with delivery of services contemplated in this SOW including, but not limited to, managing deliveries, scheduling, quality assurance, and Subcontractors. Unless otherwise specified, the documents required in this section are to be delivered to the DMS Product Manager and the Customer in CSAB.

5.1 Project Commencement Submittals

Prior to commencement of any Project, the Contractor shall submit in CSAB a document or multiple documents (as needed due to file size) in Portable Document Format (PDF) described within this section. Each section set forth below must be addressed in the Project Commencement Submittals to be considered complete. If a section, such as section D, is not applicable for the Contractor to complete for the specific Project, a statement of such shall be included in the Project Commencement Submittal. Work shall not proceed without the DMS Product Manager's written approval.

The document name[s] shall consist of the unique Identifier with "PCS" after the Identifier. The Identifier shall consist of: The Customer CSAB order date in year-month-day format, agency acronym, abbreviation of the city where the work is to be performed, and street number of the location. For instance, 20120301DMSTL4030 is the Identifier for a Project that was originally ordered in CSAB on March 1, 2012 for DMS for a site in Tallahassee with the address numbers 4030. The Identifier format may be accomplished, implemented, and amended by DMS without a formal amendment to the Contract.

Section A – Documents for Commencement of Project. Submittal identification shall include the following: the Project name; the unique Identifier;; the Contractor's name; Contractor Project Manager's name, address, and contact information; Subcontractor's full name, address, and contact information; Customer's full name, physical address of the Project including building name (if applicable), date of Project commencement, and the Project Contact's name, phone number, and email address. Please see the sample form in Attachment F – Project Commencement Submittal Section A for an example of the submittal of Section A and the format required. The information required for Project Commencement Submittal, Section A may be modified during the term of the Contract at the Department's sole discretion.

Section B - Manufacturer's Data Information. The Contractor shall submit manufacturer's data on all products needed to complete the Project, which includes the bill of materials, manufacturer's technical data sheets, and manufacturer's catalog information showing dimensions, colors, and configurations. The technical manufacturer's technical data sheet(s) shall include the physical specifications of the products as well as the cable electrical and transmission characteristics, such as mutual capacitance, impedance, direct current (DC) resistance, insertion loss, structural return loss (SRL), attenuation to cross talk ration (ACR), power sum near end crosstalk (PSNEXT), worst pair-to-pair NEXT.

Section C - Project Equipment. The Contractor shall verify the color selection and quantity of the equipment with the Customer prior to ordering the following equipment:

- a) Patch cords
- b) Horizontal cable
- c) Racks and/or cabinets
- d) Faceplates
- e) Jacks

Please see the sample form in Attachment G - Project Commencement Submittal Section C for an example of the submittal of Section C and the format required. The information required for

Project Commencement Submittal Section C may be modified by DMS during the term of the Contract. If the color requirements for all components are stated in the specification for the Project, the color selection does not have to be verified, and the Contractor should respond to this section as “not applicable colors are determined in the specification.”

Section D – Permit Information. The Contractor shall provide all applicable permits required for the Project or MAC, issued by the proper authorities having jurisdiction.

Section E - Engineering Approvals. The Contractor shall provide the approval of a licensed structural engineer in accordance with SOW section 8.5, Cutting and Patching, as applicable.

Section F - Insurance and Bonding Documents. The Contractor shall provide insurance and performance bonding documents as required by the Contract.

Section G – Drawings. The Contractor shall provide AutoCAD installation/layout drawings for the entire system, showing equipment model numbers, complete part quantities and numbers, configurations and the inter-relationship and position of all components. Drawings shall be a minimum of 11" X 17" in size. The drawing submittal requirement may be waived if drawings have been provided by DMS, the Project Contact, or Customer as part of the design.

5.2 Project Final Submittals

Prior to final invoicing of any Project, the Contractor shall submit in CSAB a document or multiple documents (as needed due to file size) as a PDF as described within this section. These documents will be submitted in accordance with the timeline stated in SOW section 6, Service Level Agreements.

The document name[s] shall consist of the unique Identifier with “PFS” after the Identifier. The Identifier shall consist of: The Customer CSAB order date in year-month-day format, agency acronym, city abbreviation of the work, and street number of the location. For instance, 20120301DMSTL4030 is the Identifier for a Project that was originally ordered in CSAB on March 1, 2012, for DMS, for a site in Tallahassee with the address numbers 4030. The Identifier format may be accomplished, implemented, and amended by DMS without a formal amendment to the Contract.

Each section must be addressed in the Project Final Submittals to be considered complete. If a section is not applicable for the Contractor to complete for the Project, a statement of such shall be included in the Project Final Submittal. Final Submittals must be approved by DMS prior to final invoicing. DMS approval will signify completion of on-site work.

Section A – Documents for Finishing Project: Submittal identification shall include the following: the Project name; the unique Identifier; Project commencement date; the Contractor Project Manager’s name, address, and contact information; Subcontractor’s full name, address, and contact information; Customer’s full name, physical address of the Project including building name (if applicable), date of Project commencement, and the Project Contact’s name, phone number, and email address. Please see the sample form in Attachment H – Project Final Submittal Section A for an example of the submittal of Section A and the format required. The information required for Attachment H – Project Final Submittal Section A may be modified during the term of the Contract at the Department’s sole discretion.

Section B - Testing Documentation: The Contractor will perform test measurements and system calibrations for the entire system and provide the results. This documentation shall include test measurements and system calibrations specified in SOW section 8.38, Testing

Requirements. The Contractor shall provide a certification report, listing the item, a description of the test results with both the calculated and measured loss for each fiber, and the model number and serial number for the item. Please see the sample form in Attachment I – Project Final Submittal Section B for an example of the submittal of Section B and the format required. The information required for Attachment I – Project Final Submittal Section B may be modified during the term of the Contract at the Department’s sole discretion.

Section C - General Requirements: The Contractor shall submit all of the following documentation, prior to final invoicing of any Project:

- a) All DMS inspection reports with each item signed off by the Contractor indicating completion of those items. DMS inspection reports will list items to be completed or repaired by the Contractor prior to DMS payment to the Contractor.
- b) A letter stating that the system is installed properly and that all system components meet or exceed specifications of this Contract. The Contractor’s one (1) year guarantee of installation shall be included in this letter.
- c) Manufacturer’s Warranty as specified in SOW section 7.1, if applicable.
- d) Inspection certificates issued by authorities having jurisdiction.
- e) Contractor’s Affidavit of Contract Completion (form will be provided by DMS).
- f) A properly executed Consent of Surety Company to Final payment, AIA Document G707, if applicable.
- g) Contractor’s Affidavit of Release or Waivers of Lien on AIA Document, Form G706.

Section D - Drawings: The Contractor shall provide detailed documentation of the distribution system, including as-built drawings prepared to scale in AutoCAD if specified in the Project’s specification or requested by the Project Contact. The drawings shall be submitted in CSAB as a PDF, as well as an electronic AutoCAD file.

The Contractor shall include in the as-built drawings: cable routes and outlet locations with all cables and terminations identified by their sequential number as defined by the numbering convention; riser and backbone riser diagrams; a bill of materials of all installed equipment and wiring; and racks and equipment layouts showing placement of equipment and model numbers of all installed equipment. Drawings shall be a minimum of 11" X 17" in size. If drawings have been provided to the Contractor as part of the design, these documents will be modified accordingly by the Contractor to denote as-built information if required in the Project’s specification or requested by the Project Contact. Contractor shall provide AutoCAD installation/layout drawings for the entire system, showing equipment model numbers, complete part quantities and numbers, configurations and the inter-relationship and position of all components. The drawing submittal requirement may be waived if drawings have been provided by DMS, the Project Contact, or Customer as part of the design.

5.3 MAC Commencement Submittals

A Project Commencement Submittal, as outlined in SOW section 5.1, does not need to be submitted for MACs on existing telecommunication systems when the Contractor installs components from the same Manufacturer or equivalent of existing components. Otherwise the Project Commencement Submittal is required. The Contractor shall verify in writing the materials and equipment to be installed and the quantity of materials needed prior to work commencement, and verification shall be submitted by the Contractor to the DMS Product Manager in CSAB as a PDF.

5.4 MAC Final Submittals

A Project Final Submittal, as outlined in SOW section 5.2, does not need to be provided for MACs on existing telecommunication systems when the Contractor installs

components from the same Manufacturer or equivalent of existing components. Otherwise, the Project Final Submittal is required. Prior to final invoicing of any MAC, the Contractor shall do the following:

- 5.4.1 The Contractor shall perform test measurements and system calibrations for the components installed and provide these test measurements and system calibrations to the DMS Product Manager in CSAB as a PDF. This documentation shall include test measurements and system calibrations specified in SOW section 8.38, Testing Requirements. The Contractor shall provide a certification report, listing the test results with both the calculated and measured loss for each fiber.
- 5.4.2 The Contractor shall update the existing drawings to include the new components from the Customer MAC order and submit the drawings in CSAB if requested by the Project Contact in the CSAB order. The Contractor shall include in the as-built drawings: cable routes and outlet locations with all cables and terminations identified by their sequential number as defined by the numbering convention; riser and backbone riser diagrams; a bill of materials of all installed equipment and wiring; and racks and equipment layouts showing placement of equipment and model numbers of all installed equipment. Drawings shall be a minimum of 11" X 17" in size. The drawings shall be submitted in CSAB as a PDF and as an electronic AutoCAD file.
- 5.4.3 The Contractor shall provide detailed documentation of the distribution system, including as-built drawings prepared to scale in AutoCAD if specified in the Project's specification or requested by the Project Contact. The drawings shall be submitted in CSAB as a PDF and as an electronic AutoCAD file.
- 5.4.4 The Contractor shall submit the Manufacturer's Warranty documentation as specified in SOW section 7.1 as a PDF in CSAB.

5.5 Project and MAC Inspection and Acceptance

5.5.1 Contractor-installed products

For Contractor-installed products, the date of acceptance is the date the Customer or Project Contact accepts the product as installed and in good working order. Acceptance shall be signed off by the Customer or Project Contact in CSAB for every Project and MAC. The DMS Product Manager will subsequently sign off in CSAB for every Project and MAC. Inspection and acceptance shall be at destination at Project or MAC completion, unless otherwise provided.

5.5.2 Customer-installed products

For Customer-installed products where the Contractor just delivers the product(s) to the Customer, acceptance is complete when the Customer or Project Contact signs off on receipt of the product. Mere acknowledgement by Project Contact or Customer personnel of the delivery or receipt of products (e.g., a signed bill of lading) shall not be deemed or construed as acceptance of the products received. Until sign-off acceptance, risk of loss or damage shall remain with the Contractor. The Contractor shall be responsible for filing, processing and collecting all damage claims.

- a.) To assist the Contractor with damage claims for Customer-installed products, the Customer or Project Contact will: record any evidence of visible damage on all copies of the delivering carrier's Bill of Lading; report in writing damage to the carrier and the Contractor; and provide the Contractor with a copy of the carrier's Bill of Lading and damage inspection report. A damage inspection report is created by the Contractor and submitted to the Department.

- b.) Any delivery of Customer-installed product that is substandard or does not comply with the Contract terms may be rejected or accepted on an adjusted price basis, as determined by the Customer. The Customer will have five (5) calendar days to accept or reject a product. When the Customer rejects a product, Contractor shall remove the uninstalled product from the premises within ten (10) calendar days after notification of rejection. Upon notification of rejection, the risk of loss of rejected or non-conforming product shall remain with the Contractor. If the Customer agrees to accept the non-conforming product on an adjusted price basis, the Contractor will invoice the Customer accordingly.
- c.) Rejected uninstalled Customer-installed product not removed by the Contractor within ten (10) calendar days shall be deemed abandoned by the Contractor and DMS shall have the right to dispose of it as its own property. Contractor shall reimburse DMS for costs and expenses incurred in storing or effecting removal or disposition of rejected product.

5.6 Changes

During the Project or MAC, Customers may submit changes to their orders through CSAB. Contractors will work with Customers and the Department to incorporate those changes into the Project or MAC, wherever feasible. Depending on the change, the Department may require revised quotes and / or revised Project or MAC submittals.

5.7 Work Schedule

The Contractor shall submit to DMS adequate information, in a format acceptable to DMS, which demonstrates the schedule of the work to be done and the Contractor’s plan to manage to that schedule. The Department reserves the right to request additional documentation as needed.

SECTION 6. Service Level Agreements

6.1 All products and services provided under the Contract must meet or exceed all conditions and specifications. Contractors are required to submit to the Department and Customer documentation as required in this Statement of Work. This documentation, and any other documentation requested from the Contract and DMS customers, may be used to determine compliance with the Contract and the Contract’s Service Level Agreements.

Standards and Deliverables	Service Level	Financial Consequence
General Requirements		
The Contractor shall submit invoices within forty-five (45) calendar days of completion of services and in accordance with SOW section 2.7. The completion of services shall mean the completion of on-site work, work completion sign-off by the Customer or Project Contact and the DMS Product Manager, and the delivery of the Project Final Submittals documentation specified in SOW sections 5.2 and 5.4.	Contractor will submit a complete, and accurate invoice	\$100.00 for every business day this deliverable is past due, capped at 50% of the invoice.
Projects		

All Project Commencement Submittals documentation set forth in SOW section 5.1 shall be submitted by the Contractor in CSAB at least four (4) business days prior to the commencement date of the Project.	Contractor will timely provide complete and accurate Project Commencement Submittals	\$250.00 for each business day this deliverable is past due, capped at fifty percent (50%) of the invoice.
All Project Final Submittals documentation set forth in SOW section 5.2 shall be submitted in CSAB by the Contractor within twenty-one (21) business days after Customer or Project Contact inspection and acceptance.	Contractor will timely provide complete and accurate Project Final Submittals	\$250.00 for each business day this deliverable is past due, capped at fifty percent (50%) of the invoice.
MACs		
All MAC Final Submittals documents set forth in SOW section 5.4 shall be submitted in CSAB by the Contractor within twenty-one (21) business days after completion of on-site work for the MAC.	Contractor will timely provide complete and accurate MAC Final Submittals	\$250.00 for each business day this deliverable is past due, capped at fifty percent (50%) of the invoice.

Opting Out, Suspension of Services

- a) If, within one (1) calendar month, a Contractor opts out on a total of six (6) or more orders for services for Projects, MACS, or a combination thereof, denying services to Customers, the Contractor shall be suspended from services for seven (7) consecutive days.
- b) If, within one (1) calendar month, a Contractor opts out on 24 (twenty-four) or more orders for services for Projects, MACs, or a combination thereof, denying services to Customers, the Contractor shall be suspended from services for 30 (thirty) consecutive days.
- c) The DMS Contract Manager will inform the Contractor in writing of the start and ending date of the suspension fourteen (14) calendar days prior to the suspension. Suspension shall mean the Contractor will be unable to receive new Project or MAC orders during the suspension timeframe. The suspension shall not keep the Contractor from completing work ordered prior to the suspension.

SECTION 7. Warranties

7.1 Manufacturer Warranty

At no additional cost a minimum fifteen (15) year Manufacturer’s extended product warranty and system assurance warranty shall be provided for Projects or MACs which meet Manufacturer’s warranty requirements. If a Customer requests a Manufacturer’s extended product warranty and system assurance warranty greater than fifteen (15) years for a specific project. the Contractor shall meet this requirement if the Manufacturer provides such warranty.

For E-Rate eligible components, a manufacturer’s multi-year warranty for a period up to three (3) years that is provided as an integral part of an eligible component, without a separately identifiable cost, may be included in the proposed cost of the component. All other manufacturer warranties are ineligible for E-Rate support and may not be included in the proposed cost for a component.

7.1.1 Extended Product Warranty

The extended product warranty shall insure against product defects. All cabling components shall meet or exceed the specifications of TIA 568-C. The system shall meet or exceed the attenuation and Near End Cross Talk (NEXT) requirements of TIA 67. The installation shall meet or exceed the loss and bandwidth requirements of TIA 67 for fiber links/channels, for a minimum of a 15-year period from the date of final acceptance by Customer. The extended product warranty shall apply to all passive system components.

7.1.2 System Assurance Warranty

The system assurance warranty shall cover the failure of the cabling system to support the applications for which it was designed to support for a minimum of a fifteen (15) year period from the date of final acceptance by the Customer.

7.1.3 Extended Product Warranty

The extended product warranty and the system assurance warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s). Upon successful completion of the installation, subsequent inspection, and testing, the Customer shall be provided a numbered certificate, from the manufacturing company, registering the installation.

7.2 Contractor Warranty

Contractor warrants that all products furnished under the Contract shall be free of defective material and workmanship, and shall otherwise perform in accordance with required performance criteria, for a period of no less than one (1) year from date of final acceptance by the Customer. Warranty repairs shall be completed by the Contractor at no cost to the Customer.

SECTION 8. Technical Specifications

The Contractor shall provide equipment and services in accordance with the Contract and Project or MAC specifications and the applicable technical specifications set forth herein.

8.1 Codes and Standards

The Contractor shall provide and install the cabling distribution system in accordance with the codes, standards, regulations, and best practices from the following organizations set forth herein, and any codes and standards individually referenced herein, which shall include the latest edition, amendment and all applicable addenda. DMS will verify that codes and standards have been followed by inspection of Contractor's work and by reviewing Contractor inspection documentation and testing documentation provided by the Contractor pursuant to the requirements set forth in this Contract. Where there is a conflict between the Contract documents and the applicable codes, standards, regulations, and best practices, the most stringent requirements shall govern.

The following codes and standards are incorporated by reference and are applicable to work performed and the equipment offered under this Contract, where applicable. The work performed and equipment offered under this Contract shall be provided in accordance with all of the applicable regulations, standards, codes, and best practices from the following organizations, where applicable, and are all incorporated by reference:

- 8.1.1 Underwriters' Laboratories (UL). All materials shall be UL listed and labeled. All applicable systems shall have a UL systems label. If there are no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels.

- 8.1.2 Telecommunications Industry Association (TIA) standards, revision D or the most recent revisions.
- 8.1.3 National Electrical Code (NEC), latest editions.
- 8.1.4 Building Industry Consulting Service International (BICSI) International Standards Program (ANSI/BICSI), latest editions.
- 8.1.5 The most recent editions of the following Building Component Safety Information (BCSI) Manuals:
 - a) Telecommunications Distribution Methods Manual
 - b) Outside Plant Design Reference Manual
 - c) Information Technology Systems Installation Methods Manual
 - d) AV Design Reference Manual

The work performed and equipment offered under this Contract shall be provided in accordance with all of the applicable regulations, standards, codes, and best practices from the following organizations, which are all incorporated by reference:

- 8.1.6 Institute of Electrical and Electronics Engineers (IEEE) Applications standards, latest editions
- 8.1.7 Occupational Safety and Health Administration Regulations (OSHA).
- 8.1.8 National Fire Protection Association (NFPA).
- 8.1.9 American National Standards Institute (ANSI).
- 8.1.10 Telecommunications Industry Association (TIA).
- 8.1.11 National Electrical Contractors Association (NECA).
- 8.1.12 Society of Cable Television Engineers (SCTE).
- 8.1.13 National Electrical Manufacturers Association (NEMA).
- 8.1.14 National Electrical Safety Code (NESC).
- 8.1.15 The State Uniform Building Code for Public Educational Facilities Construction (UBC), State Requirements for Educational Facilities.
- 8.1.16 International Standards Organization and International Electrotechnical Commission (ISO/IEC)

8.2 Manufacturer and Equipment Requirements

- 8.2.1 The Contractor shall ensure telecommunication equipment provided meets the specifications herein and any additional requirements provided by the specifications for each Project and/or MAC.
- 8.2.2 On MACs to existing telecommunication systems, the Contractor shall utilize the same manufacturer or the equivalent of components currently installed in the facility unless otherwise directed by the Project Contact. The Contractor shall notify the DMS Product Manager in writing if directed by the Project Contact to utilize manufacturer components that are a different manufacturer than the existing telecommunication system components and where the new components or materials would void an existing telecommunication system warranty.
- 8.2.3 On renovation and new construction Projects, the Contractor shall comply with the Project Contact or DMS Product Manager requirements as indicated by each Project specification. These requirements will be provided to the Contractor by the DMS Product Manager or Project Contact for the specific Project. When feasible, the Contractor shall match all system components to the same manufacturer or the equivalent Project wide and obtain

a Project warranty. Contractor will notify Project Contact or DMS Product Manager if not feasible and Contractor must be further authorized in writing to proceed.

- 8.2.4 On Projects where the manufacturer is not listed, the Contractor shall select the manufacturer which meets all the requirements of the Project specifications, Customer's request, and any supplementary requirements.
- 8.2.5 When feasible, the Contractor shall install equipment from the same manufacturer or the equivalent of the components currently in place and specifically indicated as acceptable components by the cable manufacturer.
- 8.2.6 For all drilling work specified in this Statement of Work, the drilling equipment manufacture shall have at least five (5) years of successful manufacturing of products with characteristics and capacities required by the particular section of this Statement of Work.

8.3 Damage to Other Work and Personnel

- 8.3.1 During construction, the Contractor shall adequately protect the Customer's workspace, equipment, fixtures, and materials and, upon work completion, ensure all workspaces, equipment, fixtures, and materials are clean and in good condition.
- 8.3.2 The Contractor shall carry insurance for protection of Customer's employees, third parties, materials, and equipment on the building site, as prescribed by law for the duration of the Contract and as required in the specific Project or MAC.
- 8.3.3 The Contractor is responsible for repairing all damages caused by their personnel, including their Subcontractors.

8.4 Fire and Smoke Rated Walls, Floors, Roofs, and Ceilings

Where fire and smoke rated walls, floors, roofs, and ceiling assemblies are penetrated or cut by the Contractor as a result of this Contract, the Contractor shall provide and install all materials, including fire and smoke rated assemblies, as required to re-establish the rating of the wall, floor, roof or ceiling assembly to the satisfaction of the authority having jurisdiction.

8.5 Cutting and Patching

- 8.5.1 The Contractor shall cut and patch all walls, partitions, floors, pits, and chases as required by the scope of work for the Project or MAC, design and specifications of the Project or MAC.
- 8.5.2 Prior to cutting any structural member, the Contractor shall obtain the approval of a structural engineer licensed in the State of Florida in accordance with Chapter 471, Florida Statutes, and submit a copy of the approval as a PDF in CSAB to the DMS Product Manager. Such approval shall contain the engineer's instruction for methods to be implemented for cutting and patching.

8.6 Removal of Rubbish

During construction, the Contractor shall keep the job site clean and remove all rubbish at the close of each workday. Upon completion of work, the Contractor shall leave the premises and workspace in a clean and acceptable condition. The Contractor shall remove all tools, scaffolding, unused materials, and rubbish from the building and site upon completion of work.

8.7 Removal of Accessible Abandoned Cable

The Contractor shall remove accessible, abandoned cable pursuant to the National Electric Code. Removal of abandoned cable by the Contractor shall be coordinated with the DMS Product Manager and the Project Contact to determine the scope of demolition and the cost to the Customer. The Contractor shall submit its demolition proposal as a draft order in CSAB to the DMS Product Manager.

8.8 Cutting, Trenching, Excavation, and Obstructions

The Contractor shall verify with the Project Contact, utility companies, municipalities, and other interested parties that all available information has been provided before any cutting, trenching, or excavation operations begins and shall verify the locations given to ensure accuracy. Should Contractor encounter obstructions during performance of the Project or MAC, whether shown or not, the Contractor shall obtain written approval from the Customer to implement any modification of the Project or MAC, including altering the route of new work, rerouting existing lines, removing the obstruction where permitted, or otherwise performing the work as necessary to satisfy the purpose of the new construction and leave existing services and structures in a satisfactory and serviceable condition.

8.9 Installation Guidelines

The Contractor shall adhere to the following specifications, and in accordance with SOW section 8.1, Codes and Standards, for the installation of any material or component, or for any other services provided for Projects or MACs utilizing this Contract:

8.9.1 General Installation

- a) The Contractor shall install systems and materials in accordance with manufacturer instructions, specifications, drawings, and details.
- b) The Contractor shall inspect all installation and safety equipment for defects and replace any unsafe equipment.
- c) Electricians and technicians of the Contractor shall perform the system installation under direct supervision of a person with a State of Florida electrical license.
- d) All components shall be installed in an organized, clean, and neat manner, consistent with the best electrical, voice, and data installation practices.
- e) The Contractor shall run exposed conduits parallel or at right angles to the building or other construction lines in a neat and orderly manner.
- f) The Contractor shall provide all conduit, raceway, sleeves, and cable trays even when not specifically identified in the Project or MAC drawing or specifications.
- g) The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of its work or the work of its Subcontractor. The Contractor shall repair all damaged surfaces to match adjacent finishes.
- h) The Contractor shall schedule above ceiling cable and conduit installation work prior to ceiling tile installation. On retrofit work orders, if the Contractor is required to remove ceiling tiles, the Contractor should avoid damaging tiles or disturbing

grid. The Contractor shall replace all damaged surfaces and coordinate tile replacement with the Project Contact or General Contractor.

- i) The Contractor shall provide wire management devices on backboards and racks to facilitate organized routing of exposed cables and patch cords.
- j) The Contractor shall secure written approval from the Project Contact on the final locations of telecommunication outlets, especially those located in floor slabs.
- k) All equipment installed by the Contractor shall be plumb and level.
- l) The Contractor shall ensure that all outlets have unique sequential numbers and shall modify outlet numbers if the same number is shown for more than one outlet on the drawings.
- m) The finished installation shall be required to meet the approval of the Project Contact for overall quality, cleanliness, and organization.

8.10 Layout

The Contractor shall field-verify the exact location of all equipment, devices, and openings. The layout of equipment shall include ample space around equipment for inspection and maintenance. The Contractor shall provide outlets, racks, and patch panels at locations as shown on the drawings.

8.11 Color Coding

Color identification and coding of termination fields installed by the Contractor shall comply with TIA 606A. Acceptable methods of color-coding termination fields include the use of colored connections, cable assemblies, covers, or labels.

8.12 Demolition

The Contractor shall remove all existing equipment from areas as indicated in the Project or MAC scope of work and remove accessible abandoned telecommunication cable. Any existing unused conduit which is concealed, or which does not interfere with the work, may remain in place. Telecommunication cable and equipment to be demolished, except items noted to be relocated or delivered to the Customer, become the property of the Contractor for disposal.

8.13 Fire Stopping

- a) All penetrations through fire-rated walls, floors, and ceilings assemblies shall be sealed by the Contractor with a UL Listed fire stop system approved by the authority having jurisdiction. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire-rated structure).
- b) Creation of penetrations and openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of the Contractor. Conduit sleeves shall be provided by the Contractor as a means of routing cables between various distribution frame rooms. Openings in sleeves and conduits used for the system cables and those that remain empty (spare) shall be sealed by the Contractor with a UL listed fireproof, removable sealing material approved by the authority having jurisdiction.

8.14 Cable

- a) The telecommunication system wiring shall be installed above ceilings by the Contractor, unless otherwise approved by the Customer. All communications cabling used throughout the projects shall comply with the requirements as outlined in the National Electric Code (NEC) Article 800.
- b) The Contractor shall minimize cable pulling tensions using suitable equipment and practices. Installation procedures implemented by the Contractor shall include smooth uniform pulling and continuous management of the cable feed. The Contractor shall not install exposed cable in public access spaces. Cable installation shall comply with the minimum bending radius and maximum pulling tension allowed by the manufacturer and the specification requirements set forth in SOW section 8.1, Codes and Standards.
- c) The bending radius and pulling tension requirements of all cables shall be adhered to by the Contractor during handling and installation to prevent damage to the cable.
- d) The Contractor shall coil cables in the wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius. In hollow wall installations where box-eliminators are used, the Contractor is permitted to store excess cable in the wall. No more than 12 inches of copper cable and 36 inches of fiber cable slack shall be stored in an in-wall box, modular furniture raceway, or an insulated wall. The Contractor shall loosely coil excess slack and store it in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- e) Cables shall be dressed and terminated in accordance with the recommendations of TIA 568-C, the manufacturer's recommendations, and best industry practices.
- f) Cable installed in cable trays, conduits, and raceways shall comply with the cable fill limits set by BICSI and TIA 569-A, not to exceed forty percent (40%), and shall not exceed the manufacturer's recommendations or impact the cable shape. The Contractor shall avoid over filling cable trays, conduits, and raceways.
- g) The Contractor shall inspect conduits for plastic insulating bushings and shall install plastic insulating bushings on the conduit when the bushings are missing prior to pulling cable through the conduit. Cables installed by the Contractor in conduits without plastic insulating bushings shall be removed. Such cables shall be replaced and not reused.
- h) The Contractor shall install each run of cable between the termination block/interconnect unit and the information outlet/building control device shall be continuous without any joints or splices. Bridge taps or repairs to cable are not allowed. Damaged or broken cables shall be replaced by the Contractor.
- i) When transition or consolidation points are allowed, the Contractor shall locate and house them in accessible locations in an enclosure suitable for its purpose.
- j) The Contractor shall ensure that cable installations comply with the manufacturer's requirements, with SOW section 8.1, Codes and Standards, best industry practices, and Contractor shall ensure the following requirements are met:
 - 1. Folds shall not exceed 90 degrees;

2. Avoid excessive cable bending;
3. Tie wraps must be tightened without tools but must also be tight enough to hold cables together;
4. Avoid, overly tight tie wraps close to cable bends and pulling of a looped cable that could cause a cable to twist tightly;
5. Replace all cables with torn jackets, cut jackets, skinned jackets or wear-through due to abrasion or sharp edges;
6. Avoid excessive scoring of the jacket that cuts into the copper conductors;
7. The bend radius of the horizontal cable shall not be less than four (4) times the outside diameter of the cable; and
8. Cable and pathways shall be installed to provide for a minimum bending radius greater than six (6) times the cable diameter for copper cable and ten (10) times the cable diameter for optical fiber. A greater bending radius shall be used if required by the manufacturer cable specifications.

8.15 Horizontal Cable Installation

- a) The Contractor shall organize and keep all cables clean and organized at the racks, in the wire management devices, and interconnect cabinets. Hook and Loop or "Velcro" Cable wraps shall be used by the Contractor to secure and release cables quickly and safely in the racks for station cables and patch cords and in the Customer's telecommunication room where cables are reconfigured.
- b) The Contractor shall install cable in accordance with manufacturer's recommendations, SOW section 8, Codes and Standards, and best industry practices.
- c) The Contractor shall install 200-pound nylon pull cord with a thickness of 1/8-inch minimum in every conduit.
- d) The Contractor shall not fill cable raceways greater than maximum fill limits set by BICSI, the TIA-569-A maximum fill for the particular raceway type, or forty percent (40%), whichever is more stringent.
- e) Any cable damaged or cable exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to the Customer's final acceptance at no cost to the Customer.
- f) The Contractor shall identify cables with a self-adhesive label in accordance with TIA-606A. The Contractor shall apply the cable label to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- g) Contractor shall ensure copper cable is installed in such a way that there are no bends smaller than four (4) times the cable outside diameter at any point in the run and at the termination field.

- h) Contractor shall ensure that pulling tension on four-pair UTP cables does not exceed 25 pounds per foot during installation.
- i) The Contractor shall ensure that cables installed on the outer surface of ceilings or sidewalls be supported by the structural components of the building structure in such a manner that the cable is not damaged by normal building use. Cables shall be attached by the Contractor to structural components with approved hangers to avoid cable damage.
- j) The Contractor shall install all cables parallel to or at right angles to the building or other construction lines in an organized and orderly manner.

8.16 Backbone Cable Installation

- a) The Contractor shall organize and keep all cables clean and organized.
- b) The Contractor shall secure vertical cable at the top of the run and at every other floor to bear the weight of the cable. The cable attachment point by the Contractor shall comply with the minimum bend radius of the cable. The Contractor shall utilize split mesh grip or other approved devices to bear the weight of the cable. The Contractor shall provide supporting hardware at each vertical closet location to prevent slippage of vertical cable. The Contractor may only use cable ties to prevent lateral movement.
- c) Contractor shall install backbone cables separately from horizontal distribution cables.
- d) The Contractor shall install cable in accordance with manufacturer's recommendations, SOW section 8, Codes and Standards, and best industry practices.
- e) Contractor will install a 200-pound nylon pull cord with a thickness of 1/8-inch minimum in every conduit.
- f) Where backbone cables and distribution cables are installed in a cable tray or wire way, the Contractor shall install backbone cables first, and bundled separately from the horizontal distribution cables.
- g) The Contractor shall securely fasten all backbone cables to the sidewall of the Customer's telecommunication room on each floor.
- h) Where backbone cables are installed in an air return plenum, the Contractor shall install riser-rated cable in metallic conduit.
- i) The Contractor shall ensure that backbone cables spanning more than three floors are securely attached at the top of the cable run with a wire mesh grip and on alternating floors.
- j) The Contractor shall install vertical runs of cable supported by messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
- k) Contractor shall ensure that all large bundles of cables and heavy cables are attached using metal clamps or metal banding to support the cables.
- l) The Contractor shall install the building backbone cable in a star topology with separate segments of fiber optic cable originating in the Equipment Room and terminating in each Telecommunications Space without splices.

8.17 Optical Fiber Cable

- a) The Contractor shall organize and keep all cables clean and organized.
- b) The Contractor shall install cable in accordance with manufacturer's recommendations, SOW section 8, Codes and Standards, and best industry practices
- c) The Contractor shall install the building backbone cable in a star topology with separate segments of fiber optic cable originating in the Equipment Room and terminating in each Telecommunications Space without splices.
- d) All fiber backbone cables shall be installed by the Contractor in innerduct for physical protection. The Contractor shall provide 1-inch, 1 ½-inch and/or 2-inch nonmetallic corrugated flexible innerduct for use in plenum, outside duct banks, and riser applications. In plenum rated areas, the Contractor shall place plenum rated cable in plenum rated inner duct.
- e) Where specifically requested, the Contractor shall provide flexible engineered fabric conduit. Engineered fabric shall include 3 cells, not rip or tear, and shall be chemically resistant to ground chemicals and petroleum products. The Contractor shall install a pull cord in each cell. In plenum rated areas the Contractor shall provide plenum rated fabric.

8.18 Terminations

The Contractor shall strip a maximum of 1 inch of the jacket at both ends of the Category 3, 5e, 6, and 6a cables, maintaining the twisting of the individual pair as close as possible to the termination point, maintaining the wire twist within a ½-inch of the end of the wire. The Contractor shall cleanly route cable directly to the connection blocks without open loops. The Contractor shall provide pair termination cable with tight and non-distorted twists that are maintained up to the connecting blocks. From each jack location, there will be one sheath of wiring cable to the associated distribution frame.

8.18.1 Copper Termination Hardware

- a) The Contractor shall dress and terminate cables in accordance with TIA 568-C standard, manufacturer's recommendations, SOW section 8.1, Codes and Standards, and best industry practice. The Contractor shall install cables in organized bundles and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- b) The Contractor shall ensure that all data jacks are located in the bottom position(s) of each vertical faceplate and data jacks in horizontally oriented faceplates shall occupy the right-most position(s).
- c) Contractor shall ensure that voice jacks are located in the top position(s) on the vertical faceplates and in the left most position(s) in horizontally oriented faceplates.

8.19 Identification

- a) The Contractor shall utilize clear permanent typewritten labels matching the scheme indicated on the drawings for identification. All labeling shall be a minimum 12-point in

size. The Contractor shall submit all labeling systems and schemes to the Project Contact for approval prior to identification. Labeling shall last as long as the system is in use.

- b) The Contractor shall identify each outlet jack and fiber connector with a unique label, in accordance with the drawings or as required by the Project Contact.
- c) The Contractor shall identify each end of every cable and shall include the jack/connector, in accordance with the drawings or as required by the Project Contact.
- d) The Contractor shall clearly label each cable on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle where the label is obscured from view are not acceptable.
- e) The Contractor shall identify the rack or cabinet with the telecommunications room number in accordance with the Project or MAC requirements or as required by the Project Contact.
- f) The Contractor shall identify fiber optic cable and innerduct on each floor and by each distribution frame with a plastic tag identifying the origination point and termination point.
- g) The Contractor shall label each end of the riser and tie cables and include on the label the termination communication closet number and the cable pair or cable numbers. The cable numbers shall continue until the total cable quantities for all riser and tie cables are reached.

8.20 Cable Supports

The Contractor shall ensure that the following cable support requirements are met:

- a) J-hook hanging supports shall be located on 5-foot centers maximum and shall be located as required to adequately support and distribute the cable's weight. The Contractor shall utilize supports specifically designed for the required cable weight and volume and a minimum of two hangers shall be provided at all 90-degree bends. The Contractor shall provide a hanger to support the extra cable loop at the outlet location.
- b) Bridle rings and trapeze hangars are not approved cable supports. Tie wraps shall not be used as cable supports.
- c) The Contractor shall utilize cable trays where the cable quantity exceeds the design amount for a J-hook. The Contractor shall utilize a cable tray when any area contains 40 or more cables, unless the use of multiple J-hooks is specifically approved by the DMS Product Manager. The Contractor shall not exceed the cable installation area of the J-hook. The Contractor shall support the cable where the cable leaves the cable tray. Use of ceiling tiles, ceiling grid hanger wires, or lighting fixture wires for support of cables is prohibited.
- d) In suspended ceiling and raised floor areas where cable trays or conduits are not utilized, or in the cable tray in the telecommunications room, the Contractor shall bundle station wiring. The bundles shall consist of forty (40) or fewer cables with the cables secured snugly at appropriate distances with cable ties. Bundling cables shall not deform the cable geometry.

- e) The Contractor shall route station cables and tie cables installed within ceiling spaces through these spaces at right angles to electrical power circuits and supported only from the building structure.
- f) Cable shall be installed above fire-sprinkler systems and shall not be attached to the fire-sprinkler system or any ancillary equipment or hardware. The cable system and support hardware shall be installed by the Contractor without obscuring any valves, fire alarm conduits, boxes, or other control devices.
- g) Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.
- h) The Contractor shall adhere to the manufacturers' requirements for bending radius and pulling tension of all data and voice cables. Cable tensions in suspended cable runs shall be minimized by the Contractor by using suitable equipment and practices.
- i) The Contractor shall consider electromagnetic interference (EMI) and shall avoid sources of EMI as outlined in section 10.3 of TIA 569A: Pathways.
- j) The Contractor shall comply with NFPA 70 Article 800.52 for separation of cable from power conductors.
- k) Open wiring shall be separated and routed away from any cable that passes through or is adjacent to the outside of the building, which might be hit by lightning strikes, or subject to power surges.

8.21 Cabinet Wiring

In cabinets, the Contractor shall bundle station wiring, in bundles of forty (40) or less, with Velcro type cable ties, snug, but not deforming the cable geometry, at appropriate distances to support and secure cable in the cabinets.

The patch panels will be co-located on 19-inch racks with the network hubs and the fiber optical interconnection cabinets as designated on the drawings or as required by the Project Contact. The configuration of the patch panels shall be in an arrangement that minimizes patch cord lengths

8.22 Racks

The Contractor shall ensure the following requirements are met:

- a) The Contractor shall secure racks in place with appropriate fasteners and attached to the concrete floor using a minimum of 3/8-inch hardware or as required by manufacturer.
- b) Each rack shall be mounted on an isolation pad and utilize nonconductive washers to secure the rack to the floor.
- c) The Contractor shall provide isolation pads, except where the rack is mounted on vinyl ceramic tile.
- d) Floor mounted open racks shall be secured from the top rail to the backboard in the room with a length of cable runway to prevent movement.

- e) The Contractor shall place racks with a minimum of 36 inches of clearance from the walls on all sides of the rack. When racks are mounted in a row, the Contractor shall maintain, at a minimum of 36 inches from the wall behind, in front of the row of racks, and from the wall at each end of the row.
- f) All racks shall be grounded to the telecommunications ground bus bar.
- g) Rack mount screws not used for installing patch panels and other hardware shall be bagged by the Contractor and left with the Customer upon completion of the installation.
- h) The Contractor shall mount all mounted termination block fields on the telecommunication backboard. The telecommunication backboard shall be mounted vertically 12 inches above the finished floor, if possible.
- i) Wall mounted termination block fields shall be installed by the Contractor with the lowest edge of the mounting frame 18 inches from the finished floor.

8.23 Space Cable

- a) The Contractor shall terminate copper or fiber cables in the Customer's telecommunication and equipment rooms with enough spare cable length to be routed to the equipment rack with a 10-foot figure-eight service loop neatly managed and secured above the equipment rack in the cable tray.
- b) The Contractor shall terminate copper cables at outlets with two feet of spare cable length supported above the ceiling at the closest J-hook location.
- c) The Contractor shall ensure that category 5e, 6, or 6a cable maximum length of 295 feet shall include the spare cable lengths listed above. If link length exceeds the maximum length, the Contractor shall coordinate routing and spare cable length with the DMS Product Manager, prior to commencing cable installation.

8.24 Boxes

Telecommunication outlets installed in dry-wall, plaster or concrete block walls must be installed by the Contractor in a 4-inch square by 2 ½-inch deep outlet box. Knockouts shall comply with the size of conduit specified. The Contractor shall comply with the applicable requirements of the NEC for the material and installation of electrical outlet boxes in addition to the following requirements:

- a) Outlet boxes shall not be placed back to back.
- b) Cover plates for wall-mounted outlets shall be single or double gang to match devices specified.
- c) Telecommunication outlets shall be installed at the same level as the adjacent duplex receptacles unless otherwise noted.
- d) All outlet plates shall be securely mounted, plumb, and level.
- e) A blank device plate for each spare or unused box shall be provided.

8.25 Outlets Mounting

- a) If the interior walls are not obstructed, the Contractor shall conceal the horizontal wiring internally within the walls. If an obstruction exists, the Contractor shall secure approval from the Project Contact prior to the use of alternate methods of installation.
- b) Telecommunication outlets that require surface mounting shall be mounted by Contractor in non-metallic back-boxes with surface raceways and raceways and shall be secured every 16 inches with screws and wall anchors.
- c) Telecommunication outlets being installed by Contractor in existing dry wall may utilize a single gang or double gang low voltage mounts specifically designed to accommodate the thickness of the drywall and the outlets specified.

8.26 Telecommunication Outlets

- a) The Contractor shall provide fiber optical outlets with connectors as designated on the drawings or as required by the Project Contact in single or double gang faceplates to match devices specified. The Contractor shall provide recessed angled jacks to protect mating cables. The modular design of the outlet shall allow for the adoption of interchangeable units for standard or customized voice, video, and data applications. The outlets shall include a decorative cover and all associated mounting hardware, modules, couplings, adapters, and connectors. Covers shall come with recessed label space for circuit identifications.
- b) The Contractor shall identify outlets with clear permanent typewritten labels matching the numbering plan indicated on the drawings. Each module shall be labeled by the Contractor as to its current function using color-coded icons. All labeling must be permanent. All labeling shall be a minimum 12-point in size. All labeling systems and schemes shall be submitted to the Project Contact for approval prior to labeling. Labeling shall last as long as the system is in use.
- c) The Contractor shall provide a surface mounted enclosure that attaches directly over the standard electrical box provided.
- d) The Contractor shall provide a means of securing fiber cables while maintaining a minimum bend radius of 30 millimeters.

8.27 Structural Supports

The Contractor shall utilize hardware specifically designed to support the weight of: conduits, raceways, cable trays, cables, and J-hooks when suspending these materials from or attaching these materials to structural ceilings or walls. Supports shall be structurally independent of the suspended ceiling. All conduits, cable trays, and raceways shall be reamed and free of burrs, sharp edges, or projections that can damage cable insulation. The Contractor shall maintain a 3-inch separation between cable supports and suspended ceilings. Horizontal cables shall not rest directly on ceiling panels of suspended ceilings.

8.28 Conduits and Fittings

8.28.1 Contractor is required to meet or exceed the following specifications for all conduits and fittings:

8.28.1.1 Electrical Metallic Tubing (EMT)

The electrical metallic tubing shall use compression type, malleable iron either cadmium plated or hot dipped galvanized fittings. The EMT conduit shall be UL 797 Listed.

8.28.1.2 Electrical Non-Metallic Tubing (ENT)

The electrical non-metallic tubing shall be corrugated and hand bendable PVC. The ENT conduit shall be UL 1653 Listed.

8.28.1.3 Rigid Nonmetallic Conduit (RNMC)

The rigid nonmetallic conduit shall be 90 degrees Celsius rated Schedule 40 PVC suitable for direct burial and contain solvent weld socket type fittings. The rigid nonmetallic shall be UL 651 Listed.

8.28.1.4 Galvanized Rigid Conduit (GRC)

The hot dipped galvanized rigid conduit shall be constructed from steel with zinc coated threads and an outer coating of zinc chromate. Threaded, malleable iron, either cadmium plated or hot dipped galvanized fittings. The GRC shall be UL 6 Listed

8.28.1.5 Intermediate Metal Conduit (IMC)

The galvanized intermediate conduit shall be constructed from steel with zinc coated threads and an outer coating of zinc chromate and contain threaded, steel either cadmium plated or hot dipped galvanized fittings. The IMC shall be UL 1242 Listed.

8.28.2 Contractor shall ensure that all conduits comply with the following requirements:

- Conduits shall be ¾-inch minimum.
 - Contain no conduit bodies, or 90-degree conduits (i.e. el backs, LBs).
 - Contain no more than two 90-degree bends or a total of 180 degrees of bend between pull boxes.
 - Contain no metal flexible conduit.
 - Contain no more than 100 feet between pull boxes.
 - Conduit bend radius internal diameter (I.D.)
 - Conduit 2-inch I.D. or less: radius = 6 times I.D.
 - Conduit greater than 2-inch I.D.: radius = 10 times I.D.
 - Conduit for optical fiber: radius = 10 times I.D.
- a) All conduits shall be clean, dry, unobstructed, capped for protection, and labeled for identification. The Contractor shall provide a nylon or plastic line with a minimum test rating of 200 pounds on all conduits. The Contractor shall clean and swab dry conduits installed below slab or below the exterior grade of the structure prior to the installation of cabling.
- b) The Contractor shall terminate all conduits entering Customer's telecommunication room as close to the wall nearest the backboard or rack to minimize the cable route inside the closet. Conduits from the floor shall be

terminated 4 inches above finished floor. Conduits above racks shall terminate 4 inches above the rack.

- c) Conduits installed in ceilings and walls shall be electrical metallic tube and shall meet the NEC requirements. The Contractor shall conceal conduit in finished areas.
- d) Conduits installed above exterior grade shall be galvanized rigid steel conduit. If service is in floor slab, the Contractor shall use galvanized rigid steel conduit. Outside plant cable not rated for interior use installed 50-foot or greater in the building shall be installed by the Contractor in a galvanized rigid steel conduit within the building.
- e) The Contractor shall install conduits below exterior grade, and shall be Schedule 40 PVC unless noted otherwise. The Contractor shall provide rigid steel conduit elbows coated with black asphaltic paint.
- f) The Contractor shall terminate metal conduit using plastic bushings.
- g) The Contractor shall place conduit runs in the shortest straight route possible. Any section of conduit longer than 100 feet or containing more than the equivalent of two 90-degree bends for telecommunications cabling and of four 90-degree bends for electrical wiring will require pull boxes.
- h) The Contractor shall ensure that each conduit bend be a long sweep radius wherever possible. In no instance shall the inside radius or bend be less than 6 times the internal diameter of the conduit. All bends shall be free from flattening or indentations.
- i) Contractor shall bury conduit at a minimum depth of 24 inches and meet all applicable codes.
- j) Contractor shall thread all riser sleeves, extended 4 inches above finished floor and equipped with caps.
- k) Conduit shall be provided by the Contractor from the communication cabinet(s) and outlet boxes to above the ceiling with a 90 degree bend, and shall be sized for the number of cables installed within maximum fill limits set by BICSI and TIA 569-A or 40 percent, whichever is more stringent and shall include 25 percent spare capacity.
- l) The Contractor shall ensure that all electrical power conduits are continuous between outlets, junction and pull boxes, and panels. Metallic conduit shall enter and be secured to enclosures so that each system is electrically continuous throughout. Where knockouts are used, provide double locknuts, one on each side.
- m) The Contractor shall run concealed conduit as directly and with the largest radius bends as possible. The Contractor shall run exposed conduit parallel or perpendicular to the building or other construction lines in an organized and orderly manner.

- n) The Contractor shall securely fasten and support exposed conduit to metal framing using hot dipped galvanized steel pipe straps or other approved means.
- o) The fill ratio of innerduct should not exceed 50 percent. The Contractor shall avoid excessive tension and deformation when placing innerduct. Any innerduct damaged during placement shall be replaced by the Contractor at no cost to the Customer. Where innerduct will be continuous, the Contractor shall allow sufficient slack so it can be secured on racks and maintain bend radius. Where the innerduct is not continuous, the Contractor shall allow for slack due to innerduct relax. The Contractor shall provide fiber optic warning signs on innerduct which identify the cable as containing fiber optic cable.

8.29 Electrical Power Work

- a) The Contractor shall install all materials in accordance with manufacturer's instructions.
- b) The Contractor shall not install the conductors until the conduit raceway system is complete. The Contractor shall not exceed manufacturer's maximum pulling tension or bending radius recommended for the conductors.
- c) The Contractor shall mount receptacles vertically in a suitable steel outlet box at the height required by the Project or MAC requirements.
- d) After all electrical power circuits have been completed and put into operation, the Contractor shall test each electrical power circuit under design conditions simulating the intended use to assure proper operation. All work shall be tested and adjusted by Contractor to ensure proper operation.

8.30 Outside Plant Installation Preparation

- a) Prior to placing any cable or duct for outside plant projects, the Contractor shall provide in writing for DMS approval accurate route surveys and maps to the DMS Product Manager with the installation method to be used and all potential problems and obstructions noted on it.
- b) The Contractor shall resolve all right-of-way issues and obtain permits necessary for the services provided pursuant to the Customer's Project or MAC from the authorities having jurisdiction before beginning installation. The Contractor shall obtain permitting in order to provide services under this Contract and as necessary to meet state, federal, and local requirements.
- c) The Contractor shall obtain written permission from all property owners prior to working on private property.
- d) The Contractor shall allocate sufficient safety personnel and equipment for safe installation of the outside plant cabling and coordinate the placement of pedestrian and vehicular traffic barricades, traffic cones, and warnings signs with appropriate agencies.
- e) The Contractor shall investigate and accommodate any potential future road and utility improvements that may impact the cable placement route.
- f) The Contractor shall design the location of all splice points along the route and provide enough cable slack on each cable to reach a splice vehicle plus 16 feet. Subsequent

splice points will need to be approved by the Project Contact and DMS Product Manager prior to cutting the cable.

- g) The Contractor shall comply with the manufacturer's minimum bend radius and the maximum pulling tension and avoid cutting or crushing the cable during the installation process.

8.31 Outside Plant Aerial Installations

- a) The Contractor shall maintain required clearance from electric power lines and other cables based on the NESC and applicable local codes and requirements and ensure that there is sufficient separation to avoid flashover from a power line when installing a metallic messenger cable.
- b) The Contractor shall verify existing pole and guy support capabilities and any owner restrictions.
- c) Telecommunications aerial construction shall meet applicable codes and the NESC and ANSI O5.1, whichever is more stringent.
- d) The Contractor shall secure all equipment to prevent it from falling when working on ladders, lifts, or bucket trucks.

8.32 Outside Plant Underground Installations

- a) Open trenches and holes shall be refilled by the Contractor as soon as possible and shall be protected by barricades. The Contractor shall avoid unnecessarily damaging of tree roots, shrubs, or other vegetation.
- b) Prior to installation, the Contractor shall locate all existing underground facilities including, but not limited to, power, water, sewer, gas, CATV, fiber, and telephone and install all materials to comply with all local requirements regarding separation distances from other utilities, with a minimum of 12 inches of separation.
- c) Fiber Optic backbone cables shall be installed by the Contractor with a conductive marker tape secured at each end of the conduit for future location of fiber run. At a minimum, the tape shall be marked "Warning-Optical Cable."
- d) Minimum underground depth placement is 24 inches under finished grade. Additional depth may be required based on the specific location, local codes, or Customer requirements.
- e) Rigid metallic or rigid PVC duct is required under any vehicular, cycle, or pedestrian transportation pathway.
- f) The Contractor shall provide any rodding or slugging on all existing underground duct banks as required to install all necessary cabling.
- g) The Contractor shall backfill trenches with soil, sand, or sandy loam free of large rocks or debris greater than 9 inches in diameter. The material used to backfill shall be uniformly compacted in 6-inch to 9-inch horizontal layers. The Contractor shall not use water to compact fill. Indigenous soil shall be used by the Contractor to complete backfill of trenches. The Contractor shall remove any debris, trash, and excess soil after

completion of backfilling and restore the ground surface with seed or sod as required to match the original conditions of the ground surface.

- h) The Contractor shall remove concrete or paved surfaces, where necessary, for the purposes of cabling and equipment installation. Any removed surfacing material shall be disposed of by Contractor at approved disposal sites. The Contractor shall match the existing surface when replacing the damaged concrete or paved surface. Where trenching is done through and under said paved surfaces, the trench shall be backfilled with clean, dry sand.
- i) Nonmetallic conduits shall be encased in concrete that is at a minimum 2500 pounds per square inch compressive strength where vehicular traffic is above the pathway, or where a bend or sweep is placed. For direct burial or encasement in concrete, the conduits shall meet NEMA standard TC-2.
- j) To prevent the accumulation of water, the Contractor shall install underground conduit a drain slope of no less than 0.125 inch per foot when extending conduits away from building structures and from the middle of the span where conduit extends between maintenance holes.

8.33 Hand Holes

Contractor will ensure that the following requirements regarding hand holes are met:

- a) Hand hole boxes shall be lightweight, sunlight resistant, and resistant to weathering and chemicals. Hand hole boxes shall include stainless steel inserts and bolts. The top surface of the hand hole cover shall be labeled with "TELECOM" and shall include a communications logo.
- b) Enclosures and covers shall be concrete gray colored and not rated for less than 8000-pound design load. Hand holes shall be designed for sidewalk applications with a safety factor for light vehicular traffic. Where the area of installation is subject to vehicular traffic, traffic bearing covers shall be installed. Hand Holes shall be made of closed mold pre-cast polymer concrete.
- c) The Contractor shall provide six to eight inches of gravel or crushed rock for drainage below the box. The hand hole shall be installed by the Contractor flush with finished grade.
- d) Hand holes shall be placed by the Contractor where conduits or duct section lengths exceed 600 feet.
- e) Hand holes shall have provisions for drainage and shall not be shared with electrical installations other than those needed for telecommunications equipment.
- f) The hand holes shall not exceed 4 feet long by 2.5 feet wide and 3 feet deep and shall include racking devices and clearance space.
- g) The Contractor shall place cable slack horizontally in the hand hole and ensure bend radius and cable is routed through hand hole. The Contractor shall store the cable slack so that the cable is not damaged. The Contractor shall provide larger quantities of cable slack where there are large numbers of intermediate hand holes.
- h) All conduits sealed in the hand holes shall be sealed with bell housing covers to protect

the cable from rocks and debris.

8.34 Directional Drilling

Contractor will ensure that the following requirements regarding directional drilling are met:

- a) Directional drilling, also referred to as directional boring, horizontal directional drilling, or fluid assisted boring, will be considered on a case-by-case basis by the Customer and DMS Product Manager.
- b) Where directional drilling is required, the Contractor shall furnish all labor, materials, tools, and equipment to install conduit/duct beneath roads, driveways, the ground surface, and existing underground utilities without surface damage or disruption of above ground activities.
- c) the Contractor shall install the materials in accordance with the manufacturer instructions. The Contractor shall provide "as built" maps of the cable installation developed from actual depth and conduit locations as specified by the Project or MAC specification. The Contractor shall furnish all labor, materials, tools, and equipment to install conduits and ducts beneath roads, driveways, the ground surface, and existing underground utilities without surface damage or disruption of above ground activities.
- d) The Contractor's installation crew, including the supervisor, rig operator, locator, mud system operator, backhoe/track hoe operator, and any additional helpers shall be trained in correct operational procedures and experienced in the safe operation of all equipment.
- e) The Contractor shall not exceed manufacturer's maximum bending radius on the conduits.
- f) The Contractor shall not infringe on the right-of-way of existing underground or overhead utilities. The Contractor shall repair all damage to Customer property, surfaces, or existing underground utilities damaged by the directional drilling equipment.
- g) The Contractor shall provide all equipment necessary for a directional drilling installation including, but not limited to, a drill frame, power source, hydraulic drilling fluid, and conduit and guidance system with all the features and options needed for a safe installation.
- h) The Contractor shall provide overhead electronic tracking of the depth and location of the bore head.
- i) The Contractor shall provide directional drilling equipment with the required thrust and pullback for the installation of the conduit system.
- j) The Contractor shall provide the correct drilling fluid with the appropriate mixed additive for the soil conditions. All fluids and additives shall meet DEP and EPA Regulations.
- k) Polyduct: The Contractor shall provide high-density polyethylene conduit that is smooth on the inside and outside. The Contractor shall include a 1/8-inch poly rope

pull-string in each duct and any connection fittings for continuation of conduit system.

- l) Multiduct: The Contractor shall provide high-density polyethylene conduit with multi-cell inner ducts that are smooth on the inside and outside. The Contractor shall include a 1/8-inch poly rope pull-string in each duct and any connection fittings for continuation of conduit system.
- m) Should the Contractor subcontract out these services, the Contractor shall obtain written approval from the DMS Product Manager, noting the Subcontractor's business name, Subcontractor's representative name and contact information, and written certification of the following:
 - The Subcontractor shall have at least three (3) years of successful installation experience on similar installations

8.35 Core Drilling and Boring

- a) The Contractor shall provide all equipment necessary for wet or dry drilling where core drilling or boring is required. The installation crew shall be trained in correct operational procedures and experienced in the safe operation of all equipment and shall operate the equipment in accordance with manufacturer's instructions.
- b) The Contractor shall avoid structural damage to all structural members and pre-stressed concrete, and avoid all conduits, piping, and other equipment embedded in the concrete. Penetrations through steel reinforced walls and all concrete floors and ceilings require x-ray analysis to assure conduit and reinforcing rod locations prior to performing core drilling or boring.
- c) The Contractor shall review all as-built drawings and obtain the approval of a structural engineer licensed in the State of Florida prior to cutting any structural member.
- d) The Contractor shall provide and maintain water and dust barriers to prevent the spread of dust and dirt to adjacent areas. The Contractor shall protect all structures, finishes, and adjacent equipment and systems from damage.
- e) Penetrations through structural concrete walls, floors, and ceilings shall be sealed by the Contractor with an approved UL Listed fire stop system.

8.36 Air Blown Optical Fiber Cable

Contractor will meet the following requirements regarding air blown optical fiber cables:

- a) The Contractor shall furnish all labor, materials, tools, and equipment to provide air blown fiber through compact cable infrastructure tubes. The Contractor shall use air blown fiber equipment from a manufacture with at least five (5) years of successful manufacturing of products with characteristics and capacities required by this section.
- b) The Contractor shall provide racks and key lockable wall-mounted enclosures to terminate optical fibers from the air blown fiber bundles. The enclosures shall support and organize the fibers for termination.
- c) Include all breakout cables, tube couplings, plugs, caps, and organizers. All couplings and caps shall be pressure rated to 200 pounds per square inch.

- d) All optical fibers shall meet the specifications and requirements per fiber type as stated within the quote Customer.
- e) The Contractor shall install the system and all materials in accordance with manufacturer's instructions.
- f) The Contractor shall not install the fiber until the fiber tube cable system is complete.
- g) The Contractor shall not exceed the manufacturer's maximum bending radius on tubes and fiber bundles.
- h) The Contractor shall provide all cable blowing heads and all equipment necessary for blowing the fiber in the tubes, including any air or nitrogen gas required.
- i) Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.
- j) Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cable's strength member shall be securely attached to the cable strain relief bracket in the enclosure.
- k) Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers shall be routed in the splice tray.
- l) Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- m) A maximum of twelve (12) strands of fiber shall be spliced by the Contractor in each tray.
- n) All spare strands of fiber shall be installed by the Contractor into spare splice trays.

8.37 Direct Buried Cable

- a) Where direct buried cable is indicated on the drawings or permitted by the Project Contact, the Contractor shall install materials in accordance with the manufacturer instructions and the Contractor shall provide "as built" maps of the cable installation developed from actual depth and conduit locations.
- b) The Contractor shall furnish all labor, materials, tools, and equipment to install cable with minimal surface damage or disruption of above ground activities.
- c) The Contractor may combine the direct buried cable method with other outside plant installation methods to go beneath roads, driveways, and existing underground utilities.
- d) The Contractor shall assure that the prime mover's horsepower is sufficient for the soil type and cable depth required. The Contractor shall provide tracked or wheeled prime movers dependent on the route placement.
- e) Static or vibratory plow installation will be considered on a case-by-case basis as required.

- f) Should the Contractor subcontract out these services, the Contractor shall use a Subcontractor that has at least three (3) years of installation experience on similar installations. The Contractor shall obtain written approval from the DMS Product Manager, noting the Subcontractor's business name, Subcontractor's representative name and contact information.

8.38 Testing Requirements

Testing shall be performed by the Contractor after all components have been labeled and prior to system cutover. Test results shall meet or exceed manufacturer documentation data. All test equipment shall utilize the latest software recommended by the manufacturer. All test equipment shall be calibrated, tested, and certified within one year of the commencement of the testing or tested within the timeframe recommended by the manufacturer, whichever is more stringent. The Contractor shall perform the applicable calibrations, testing, and certifications listed below:

- 8.38.1 Telecommunications Bonding Backbone testing shall verify the integrity of all bonding connections and compliance to the NEC and Telecommunications Bonding Backbone contained herein. The Contractor shall verify proper grounding at service entrances and at all surge suppression devices.
- 8.38.2 All cables and termination hardware shall be 100 percent tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of TIA-568-C. All pairs of each installed cable shall be verified as performing prior to the Contractor submitting the Project or MAC to the Customer for acceptance. Any defect in the cabling system installation including, but not limited to, the cable, connectors, patch panels, and connector blocks shall be repaired or replaced by the Contractor at no cost to the Customer to ensure 100 percent useable conductors in all cables installed.
- 8.38.3 Contractor shall test all cables in accordance with the specifications of the Contract and the manufacturer's requirements. If any of these tests are in conflict, the Contractor shall bring any discrepancies to the attention of the DMS Product Manager for clarification and resolution.
- 8.38.4 All twisted-pair copper cable links shall be tested by Contractor for continuity, pair reversals, shorts, opens, and performance testing required to verify category performance.
- 8.38.5 The Contractor shall test each cable for correct termination on a pin-by-pin basis and document the results of the testing. The test log shall include outlet identifiers as indicated on the drawings, the test date, the initials of the technician who tested the cable, and the test results. The Contractor shall submit test results with final documentation. The tests for correct termination required by Contractor, at a minimum, are:
 - a) Continuity: The Contractor shall test each conductor for end-to-end continuity. Each pair of installed cable shall be tested using a test unit that shows opens, shorts, polarity, pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested by the Contractor with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to the Customer's final acceptance of the work performed by the Contractor.

- b) Length: Each installed cable link shall be tested by the Contractor for installed length using a time-domain reflectometer type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet, or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA 568-C Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

8.38.6 For Category 5e, 6, or 6a copper cables, each jack in each outlet shall be tested by the Contractor to verify both the integrity of all conductors and the correctness of the termination sequence. Testing shall be performed between modular jacks at the outlets and the modular jacks at the telecommunications closet (TC) station field. For Category 5e, 6, and 6a copper cables, the Contractor shall follow the requirements established in TIA 568-C:

- a) The basic tests required to be performed by the Contractor for Category 5e, 6, and 6a copper cables are:
 - 1. Wire Map
 - 2. Length
 - 3. Attenuation
 - 4. Near End Crosstalk (NEXT)
 - 5. Return Loss
 - 6. Equal Level Far End Crosstalk (ELFEXT) Loss
 - 7. Propagation Delay
 - 8. Delay skew
 - 9. Power Sum Near End Crosstalk loss (PSNEXT)
 - 10. Power Sum Attenuation to Crosstalk Ratio, Far-End (PSACRF)
- b) Provide connector testing of each Category 5e, 6, or 6a data link for TIA 568-C compliance, using an appropriate testing instrument. Every wire and connector pin for each cable from an outlet to the distribution frame shall be tested for continuity, shorts, crossed pairs, reversed pairs, split pairs and any other miss-wires.
- c) Provide 100-megahertz sweep tests, continuity, polarity checks, NEXT, insertion loss, and the installed length for all Data/Voice station cables, backbone cables, and pairs.
- d) Each cable link shall be labeled and verified to be in working order. The Contractor shall provide a verification sheet for each individual link and include the test data listed above each link, a table of test results, and shall be signed by the Contractor and provided as a PDF in CSAB.
- e) All circuits shall be tested to ensure transmission capability of 100 megahertz. The test shall be conducted both ways from the outlets to the patch panel connections. The Contractor shall provide in CSAB a transmission verification test sheet recording the cable tested (the cable number), the test results, the date of the test, and the initials of the testing personnel. The Contractor shall submit data on the test equipment being used to the DMS Product Manager prior to commencing tests.
- f) Testing shall confirm the Category 5e permanent links shall meet the following transmission characteristics:

Frequency (MHz)	Maximum Insertion loss (dB) @ 20°C	Minimum NEXT loss (dB)	Minimum ACRF (dB)	Minimum PSACRF (dB)	Minimum PSNEXT (dB)
1.0	2.1	60.0	58.6	55.6	57.0
4.0	3.9	54.8	46.6	43.6	51.8
8.0	5.5	50.0	40.6	37.5	47.0
10.0	6.2	48.5	38.6	35.6	45.5
16.0	7.9	45.2	34.5	31.5	42.2
20.0	8.9	43.7	32.6	29.6	40.7
25.0	10.0	42.1	30.7	27.7	39.1
31.25	11.2	40.5	28.7	25.7	37.5
62.5	16.2	35.7	22.7	19.7	32.7
100.0	21.0	32.3	18.6	15.6	29.3

- g) Testing shall confirm the Category 6 permanent links shall meet the following transmission characteristics:

Frequency (MHz)	Maximum Insertion loss (dB) @ 20°C	Minimum NEXT loss (dB)	Minimum ACRF (dB)	Minimum PSACRF (dB)	Minimum PSNEXT (dB)
1.0	1.9	65	64.2	61.2	62.0
4.0	3.5	64.1	52.1	49.1	61.8
8.0	5.0	59.4	46.1	43.1	57.0
10.0	5.5	57.8	44.2	41.2	55.5
16.0	7.0	54.6	40.1	37.1	52.2
20.0	7.9	53.1	38.2	35.2	50.7
25.0	8.9	51.5	36.2	33.2	49.1
31.25	10.0	50.0	34.3	31.3	47.5
62.5	14.4	45.1	28.3	25.3	42.7
100.0	18.6	41.8	24.2	21.2	39.3
200.0	27.4	36.9	18.2	15.2	34.3
250.0	31.1	35.3	16.2	13.2	32.7

- h) The Category 6a permanent links shall meet the following transmission characteristics:

Frequency (MHz)	Maximum Insertion loss (dB) @ 20°C	Minimum NEXT loss (dB)	Minimum ACRF (dB)	Minimum PSACRF (dB)	Minimum PSNEXT (dB)
1.0	1.9	65	64.2	61.2	62
4.0	3.5	64.1	52.1	49.1	61.8
8.0	5.0	59.4	46.1	43.1	57.0
10.0	5.5	57.8	44.2	41.2	55.5
16.0	7.0	54.6	40.1	37.1	52.2
20.0	7.8	53.1	38.2	35.2	50.7
25.0	8.8	51.5	36.2	33.2	49.1
31.25	9.8	50.0	34.3	31.3	47.5
62.5	14.0	45.1	28.3	25.3	42.7
100.0	18.0	41.8	24.2	21.2	39.3
200.0	26.1	36.9	18.2	15.2	34.3
250.0	29.50	35.3	16.2	13.2	32.7
300	32.7	34.0	14.6	11.6	31.4
400	38.4	29.9	12.1	9.1	27.1
500	43.8	26.7	10.2	7.2	23.8

- i) The testers shall meet TIA – 1152 accuracy level.

8.38.7 Fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the proposal or Project/MAC specifications. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system, subject to the following:

- a) Testing shall be in accordance with TIA-526-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant for multimode fiber; and TIA-526-7 Optical Power Loss Measurements of Installed Single-mode Fiber Plant for single-mode fiber.
- b) Each fiber shall undergo a power meter test at 850 nanometers and 1300 nanometers for multimode at 1310 nanometers and 1500 nanometers for single-mode and a high-resolution Optical Time Domain Reflectometer (OTDR) test. Horizontal and backbone fiber links less than 300 feet in length shall not require an OTDR test. Each fiber strand tested is to be recorded in a log with the Project/MAC information, fiber number, date test was performed, attenuation in decibels, and the initials of the technician who tested the fiber.
- c) The OTDR tester shall meet TIA – 1152 accuracy level and provide precise, automated fiber analysis software with automatic loss mode and cursor functions.
- d) The Contractor shall notify the Project Contact and DMS Product Manager no less than five (5) days prior to commencing fiber optic cable testing. The DMS Product Manager may elect to be present for and witness fiber optic cable testing. The Contractor shall record all test procedures and setup parameters, including test jumper length and loss, and include this information with test documentation.
- e) If the power meter or OTDR test results, in the judgment of the Project Contact or DMS

Product Manager, indicate excessive power loss, the Contractor shall re-polish the fiber, clean the fiber, clean the connector, replace the connector, or replace the affected cable(s) as required to achieve specified performance levels. The cable shall be retested to verify system compliance after the corrective measures are complete.

- f) The fiber attenuation characteristic shall not exceed the maximum loss allowable for all components in the link. Maximum loss allowable = (allowable cable loss per kilometer (as stated in TIA -526-14A and TIA-526-7) multiplied by the kilometers of fiber link) plus (0.4 decibels multiplied by the number of connectors) plus (0.3 decibels multiplied by the number of splices).
- g) Cable Acceptance: The Contractor shall evaluate the continuity and quality of the cable both on the reel and installed. The Contractor shall use an OTDR to:
 - a. Measure normalized fiber loss in decibels per kilometer at 850 nanometers for multimode and 1310 nanometers for single mode.
 - b. Detect point faults or discontinuities caused by poor handling during shipping or installation.
 - c. Measure overall length.
- h) Splice and Connector Loss: The Contractor shall measure and document the losses of individual splices and connectors.
- i) Documentation: Printed copies of OTDR traces provide proof of actual system integrity and performance. A trace of the entire length of fiber shall be documented for Customer cable acceptance, maintenance, and system upgrades.
- j) Cable Route Diagram: The cable route shall provide locations and routes of "as-built" cable plant and include:
 - a. End points
 - b. Fiber routing
 - c. Splice points
 - d. Patch panels
 - e. Termination connector type
 - f. Cable lengths, including slack
- k) Troubleshooting and Fault Location: All fiber backbone cable runs shall be documented as installed with an OTDR for initial cable acceptance. Signature traces of the system shall include a record of:
 - a. Wavelength
 - b. Fiber type
 - c. Fiber and cable number
 - d. Measurement direction
 - e. Test equipment model and serial numbers
 - f. Date of testing
 - g. Reference setup, including refraction index
 - h. Operator (crew members)

8.38.8 The Contractor shall provide cable records for cable data, which include the following:

- a) Part number

- b) Reel or serial number, if available
- c) Fiber type
- d) Attenuation specifications
- e) Bandwidth specifications

8.38.9 The Contractor shall test each coaxial cable for ground, shorts, leakage, radio frequency pickup, continuity, and attenuation and shall check each cable for correct termination. The Contractor shall verify proper grounding at service entrance and at all surge suppression devices. The Contractor shall test each wall tap to verify correct signal strength. The Contractor shall document results of testing and submit to the DMS Product Manager for review and approval. The test log shall include the outlet identifier, the test date, the initials of the technician who tested the cable, and the test results.

8.38.10 The Contractor shall perform a Cumulative Leakage Index (CLI) test on the completed system utilizing industry standard test equipment. Leakage shall be no more than allowed by FCC rules and regulations. The Contractor shall document results of testing and submit to the DMS Product Manager for review and approval. The test results shall include documentation on the instrumentation used, the test date, the name of the technician who performed the test, and the test results, compared to the applicable FCC rules and regulations.

8.38.11 The Contractor shall conduct proof of performance of the system in the presence of the DMS Product Manager or the Project Contact. The Contractor shall supply all applicable test equipment. Any equipment or material not meeting specifications shall be remedied or replaced by the Contractor with other equipment to the satisfaction of the Project Contact. These tests shall be conducted after the Contractor has adjusted the system to its satisfaction. The Project Contact reserves the right to conduct any test in addition to those prescribed in this specification.

8.39 Prohibited Materials—Asbestos

Per section 255.40, Florida Statutes, the use of asbestos or asbestos-based fiber materials is prohibited in any buildings where the construction has commenced after September 30, 1983, which is financed with public funds or is constructed for the express purpose of being leased to any governmental entity. No asbestos or asbestos-based fiber materials are allowed under this Contract.

8.40 The Contractor will meet the following requirements regarding Cabling:

8.40.1 Copper Cabling

The copper cable distribution system shall be aerial, direct-buried, underground, or any combination thereof, as required by the specific project. Copper cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. All damaged cable will be replaced at no cost to the Customer. For all copper cabling, the Contractor shall use cable from a cable manufacturer that is ISO-9001 certified.

8.40.2 Aerial Copper Cable

Aerial air core copper cable shall be self-supporting with an integral support messenger or lashed cable consisting of plastic-insulated solid conductors covered by a plastic core wrap and surrounded by an inner polyethylene jacket, a corrugated aluminum shield, a corrugated steel wrap, and a bonded ultraviolet resistant polyethylene jacket. The cable shall meet the requirements of TIA 568-

C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

8.40.3 Plenum Copper Cable

Plenum rated copper cable shall be certified to conform to NFPA 262, communications metallic plenum (CMP) and shall be marked as such. The plenum cable shall be composed of 22 to 24-gauge bare solid copper conductors insulated with foam fluorinated ethylene propylene (FEP). The insulated conductors are twisted into pairs and jacketed with low smoke, flame-retardant polyvinyl chloride (PVC). The cable shall meet the requirements of TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

8.40.4 Riser Copper Cable

Riser rated copper cable shall be certified to conform to UL-1666, communications riser cable (CMR), and IEC 332-1 and shall be marked as such. The non-plenum cable shall be composed of 22 to 24 gage bare solid copper conductors insulated with polyethylene or polyolefin (PE) covered by a PVC jacket and placed in a conduit as required. The PVC sheath shall have improved frictional properties, allowing it to be pulled through a conduit without the use of lubricants. The cable shall meet the requirements of TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

8.40.5 Outside Plant Copper Cable

Outside plant copper cables shall be composed of 22 to 24 gage solid bare copper conductors individually insulated with polyethylene. The outside plant fiber cable shall have water blocking technology to prevent the migration of water throughout the cable and jacketed with UV resistant polyethylene. The cable shall meet the requirements of TIA 568-C2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

8.40.6 Category 3 Copper Cable

The minimum rating of the Category 3 data wiring distribution system and all support apparatus shall be a minimum of 16-megahertz frequency. All Category 3 Unshielded Twisted Pair (U/UTP) copper cables shall be round and consist of 22 to 24 gage solid bare copper conductors individually insulated with thermoplastic and sheathed with a PVC outer jacket. All Category 3 copper cable shall be capable of being used for plenum, non-plenum, riser, and outside plant and meet or exceed the following requirements:

8.40.6.1 All Category 3 cables shall conform to the requirements of TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard.

8.40.6.2 Applications include 10Base-T and Voice.

8.40.6.3 All Category 3 cables shall meet or exceed the following representative electrical and transmission characteristics:

Frequency megahertz	Maximum Insertion loss decibels per 100 meters	Pair to Pair NEXT decibels
1.0	2.6	41.3
4.0	5.6	32.3
8.0	8.5	27.8
10.0	9.7	26.3
16.0	13.1	23.2

Mutual Capacitance 6.6 nanofarads per 100 meters at 1 kilohertz
Impedance Z 100 (plus or minus 15 %) Ohms from 1 to 16 megahertz
DC Resistance Maximum 9.38 Ohms per 100 meters

8.40.7 Category 3 Voice Cross-Connect Copper Cable

Category 3 voice cross-connect wire shall consist of 24 AWG solid annealed copper conductors, individually insulated with 0.20-millimeter PVC, for the punch down block. The wire shall meet or exceed the following electrical specifications:

- a) DC Resistance: 1.71 Ohm per 100 meters
- b) Mutual Capacitance: 4.9 nanofarads per 100 meters maximum

8.40.8 Category 5e Copper Cable

The minimum rating of the Category 5e data wiring, distribution system and all support apparatus shall be a minimum of 100-megahertz frequency. All Category 5e U/UTP copper cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated and sheathed with an outer jacket. All Category 5e copper cable shall be capable of being used for plenum, non-plenum, riser, and outside plant and meet or exceed the following requirements:

- 8.40.8.1 All Category 5e cable shall conform to the requirements of TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
- 8.40.8.2 Applications include IEEE 802.3 10 Base-T at 10 megabits per second, IEEE 802.3 100 Base-TX at 100 megabits per second, IEEE 802.3 1000 Base-T 1 gigabits per second, and 155 megabits per second ATM.
- 8.40.8.3 Each sheath shall contain four (4) unshielded copper pairs. Each pair shall have a different twist ratio per foot.
- 8.40.8.4 All Category 5e cables shall meet the following representative electrical and transmission characteristics:

Frequency megahertz	Maximum Insertion loss decibels	Minimum NEXT loss decibels	Minimum PSNEXT loss decibels	Minimum ACRF decibels	Minimum PSACRF decibels
1.0	2.0	65.3	62.3	63.8	60.8

4.0	4.1	56.3	53.3	51.8	48.8
8.0	5.8	51.8	48.8	45.7	42.7
10.0	6.5	50.3	47.3	43.8	40.8
16.0	8.2	47.3	44.2	39.7	36.7
20.0	9.3	45.8	42.8	37.8	34.8
25.0	10.4	44.3	41.3	35.8	32.8
31.25	11.7	42.9	39.9	33.9	30.9
62.5	17.0	38.4	35.4	27.9	24.9
100	22.0	35.3	32.3	23.8	20.8

Mutual Capacitance 5.6 nanofarads per 100 meters at 1 kilohertz
DC Resistance Maximum 9.38 Ohms per 100 meters

8.40.9 Category 5e- 25 Pair High Speed Data Tie Copper Cable

The minimum rating of the Category 5e data wiring, distribution system and all support apparatus shall be a minimum of 100-megahertz frequency. All Category 5e U/UTP copper cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated and sheathed with an outer jacket. All Category 5e copper cable shall be capable of being used for plenum, non-plenum, riser, and outside plant and meet or exceed the following requirements:

8.40.9.1 All Category 5e cable shall conform to the requirements of TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

8.40.9.2 Applications include IEEE 802.3 10Base-T at 10 megabits per second, IEEE 802.3 100 Base-TX at 100 megabits per second, IEEE 802.3 1000 Base-T 1 gigabits per second, and 155 megabits per second ATM.

8.40.9.3 Each cable shall contain 25 unshielded copper pairs. Installed in tight sub-units to meet power sum NEXT, and swept insertion loss requirements. The insulated conductors shall be twisted into pairs and stranded into mini-units. Each pair shall have a different twist ratio per foot.

8.40.9.4 All Category 5e cables shall meet the following representative electrical and transmission characteristics:

Frequency	Maximum Insertion loss	Minimum NEXT loss	Minimum PSNEXT loss	Minimum ACRF	Minimum PSACRF
megahertz	decibels	decibels	Decibels	decibels	decibels
1.0	2.0	65.3	62.3	63.8	60.8
4.0	4.1	56.3	53.3	51.8	48.8
8.0	5.8	51.8	48.8	45.7	42.7
10.0	6.5	50.3	47.3	43.8	40.8
16.0	8.2	47.3	44.2	39.7	36.7
20.0	9.3	45.8	42.8	37.8	34.8
25.0	10.4	44.3	41.3	35.8	32.8
31.25	11.7	42.9	39.9	33.9	30.9
62.5	17.0	38.4	35.4	27.9	24.9

100	22.0	35.3	32.3	23.8	20.8
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Mutual Capacitance 5.6 nanofarads per 100 meters at 1 kilohertz
DC Resistance Maximum 9.38 Ohms per 100 meters

8.40.10 Category 6 Copper Cable

8.40.10.1 All Category 6 Foiled Twisted Pair (U/FTP) copper cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated, the pairs individually shielded with foil and sheathed with an outer jacket.

8.40.10.2 All Category 6 Foiled Unshielded Twisted Pair (F/UTP) copper cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated, with an overall foil sheath, and sheathed with an outer jacket.

8.40.10.3 All Category 6 Screened Foiled Twisted Pair (S/FTP) copper cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated, the pairs individually shielded with foil, with an overall braided screen sheath, and sheathed with an outer jacket.

8.40.10.4 All Category 6 copper cable shall be capable of being used for plenum, non-plenum, riser, and outside plant.

8.40.10.5 All Category 6 copper cable shall meet or exceed the following requirements:

- a) All Category 6 copper cable shall conform to the requirements of TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
- b) Applications include IEEE 802.3 10 Base-T at 10 megabits per second, IEEE 802.3 100 Base-TX at 100 megabits per second, IEEE 802.3 1000 Base-T 1 gigabits per second, TIA/EIA-854 1000 Base-TX at 1 gigabits per second, and 155 megabits per second ATM.
- c) Each sheath shall contain four unshielded copper pairs. Each pair shall have a different twist ratio per foot.

8.40.10.6 All Category 6 copper cables shall meet the following representative electrical and transmission characteristics:

Frequency	Maximum Insertion loss	Minimum Pair to Pair NEXT loss	Minimum PSNEXT loss	Minimum ACRF	Minimum PSACRF
megahertz	decibels per 100 meters	decibels	decibels	decibels	decibels
1.0	2.0	74.3	72.3	67.8	64.8
4.0	3.8	65.3	63.3	55.8	52.8

8.0	5.3	60.8	58.8	49.7	46.7
10.0	6.0	59.3	57.3	47.8	44.8
16.0	7.6	56.2	54.2	43.7	40.7
20.0	8.5	54.8	52.8	41.8	38.8
25.0	9.5	53.3	51.3	39.8	36.8
31.25	10.7	51.9	49.9	37.9	34.9
62.5	15.4	47.4	45.4	31.9	28.9
100	19.8	44.3	42.3	27.8	24.8
200	29.0	39.8	37.8	21.8	18.8
250	32.8	38.3	36.3	19.8	16.8

Mutual Capacitance 5.6 nanofarads per 100 meters at 1 kilohertz
DC Resistance Maximum 9.38 Ohms per 100 meters

8.40.11 Category 6a Copper Cable

8.40.11.1 The minimum rating of the Category 6a data wiring, distribution system and all support apparatus shall be a minimum of 500-megahertz frequency. All Category 6a U/UTP copper cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated and sheathed with an outer jacket.

8.40.11.2 All Category 6a U/FTP cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated, the pairs individually shielded with foil and sheathed with an outer jacket.

8.40.11.3 All Category 6a F/UTP cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated, with an overall foil sheath, and sheathed with an outer jacket.

8.40.11.4 All Category 6a S/FTP cables shall be round and consist of 24 AWG solid bare copper conductors individually insulated, the pairs individually shielded with foil, with an overall braided screen sheath, and sheathed with an outer jacket.

8.40.11.5 All Category 6a copper cable shall be capable of being used for plenum, non-plenum, riser, and outside plant.

8.40.11.6 All Category 6a copper cables shall meet or exceed the following requirements:

8.40.11.6.1 All Category 6a copper cable shall conform to the requirements of TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

8.40.11.6.2 Applications include IEEE 802.3 10Base-T at 10 megabits per second, IEEE 802.3 100 Base-TX at 100 megabits per second, IEEE 802.3 1000 Base-T 1 gigabits per second, TIA/EIA-854 1000 Base-TX at 1 gigabits per second, IEEE 802.3 10 GBase-T at 10 gigabits per second, and 155 megabits per second ATM.

8.40.11.6.3 Each sheath shall contain four unshielded copper pairs. Each pair shall have a different twist ratio per foot.

8.40.11.7 All Category 6a copper cables shall meet the following representative electrical and transmission characteristics:

Frequency megahertz	Maximum Insertion loss decibels per 100 meters	Minimum Pair to Pair NEXT loss decibels	Minimum PSNEXT loss decibels	Minimum ACRF decibels	Minimum PSACRF decibels
1.0	2.1	74.3	72.3	67.8	64.8
4.0	3.8	65.3	63.3	55.8	52.8
8.0	5.3	60.8	58.8	49.7	46.7
10.0	5.9	59.3	57.3	47.8	44.8
16.0	7.5	56.2	54.2	43.7	40.7
20.0	8.4	54.8	52.8	41.8	38.8
25.0	9.4	53.3	51.3	39.8	36.8
31.25	10.5	51.9	49.9	37.9	34.9
62.5	15.0	47.4	45.4	31.9	28.9
100	19.1	44.3	42.3	27.8	24.8
200	27.6	39.8	37.8	21.8	18.8
250	31.1	38.3	36.3	19.8	16.8
300	34.3	37.1	35.1	18.3	15.3
400	40.1	35.3	33.3	15.8	12.8
500	45.3	33.8	31.8	13.8	10.8

Mutual Capacitance 5.6 nanofarads per 100 meters at 1 kilohertz
DC Resistance Maximum 9.38 Ohms per 100 meters

8.41 The Contractor will meet the following requirements regarding Patch Cords, Patch Panels, and Modular Jacks:

8.41.1 Category 5e, 6, and 6a Modular Patch Cords

The Category 5e, 6 and 6a patch cords shall be 100 percent factory assembled and tested for each modular patch panel jack. Cable shall be sized for the longest cross connects and installed in accordance with a schedule developed by the installation Contractor. The length of the patch cable shall not exceed 25 feet. The Contractor shall provide color coded boot assemblies to match the Project Contact's requirements.

8.41.1.1 All Category 5e, 6, or 6a patch cords shall be round, and consist of 24 AWG copper, stranded conductors insulated with high density polyethylene, tightly twisted into individual pairs and jacketed with flame retardant PVC and shall meet or exceed the specifications listed below:

- a) Plug insertion life - minimum 750 plug insertions
- b) Plug Retention Force - 110 newton minimum between modular plug and jack

8.41.1.2 All Category 5e, 6, and 6a patch cord cables shall conform to the requirements of TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards and shall meet the electrical and transmission characteristics therein.

8.41.1.3 All Category 5e, 6, and 6a patch cord cables shall meet the requirements of Category 5e, 6, and 6a copper cables in SOW section 8.47, 8.49, and 8.50 respectively.

8.41.1.4 All Category 5e, 6, or 6a patch cords shall have built-in exclusion features to prevent accidental polarity reversals and split pairs.

8.41.1.5 For all Category 5e, 6, or 6a patch cords, the Contractor shall use patch cords from a manufacturer that is ISO-9001 certified.

8.41.1.6 The cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. The Contractor will replace all damaged cable at no extra cost to the Customer.

8.41.2 Category 5e, 6, and 6a Patch Panels with 110 Termination

All Category 5e, 6, and 6a patch panels with 110 termination shall have eight wires, 8-position modular jacks (RJ-45) with 110 terminations on the rear for connection of station cables. The Category 5e, 6, and 6a copper cables to the outlets will be directly connected to 110 insulation displacement hardware associated with each jack on the patch panel. These patch panels will be designed to operate at a minimum of 100, 250, and 500 MHz for Category 5e, 6, and 6a patch panels respectively. Modular jack quantities sufficient for all positions of every outlet are required.

8.41.2.1 The patch panel shall be a Category 5e, 6, and 6a modular jack panel with the following characteristics:

- a) The patch panel will utilize a 110-insulation displacement connector field on the back of the panel to terminate the horizontal cables. The 110 field is to remain continuous to the 8-pin modular jack field in the front of the panel.
- b) The cross-connect patch panel shall meet TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

8.41.2.2 The Category 5e patch panels shall be approved to work in all applications up to 100 megahertz.

8.41.2.3 The Category 5e patch panels shall meet or exceed the following representative electrical and transmission characteristics:

Frequency	Maximum Insertion loss	Minimum NEXT loss	Minimum FEXT loss
megahertz	Decibels	decibels	decibels
1.0	0.10	65.0	65.0
4.0	0.10	65.0	63.1
8.0	0.11	64.9	57.0
10.0	0.13	63.0	55.1
16.0	0.16	58.9	51.0
20.0	0.18	57.0	49.1
25.0	0.20	55.0	47.1
31.25	0.22	53.1	45.2
62.5	0.32	47.1	39.2
100.	0.40	43.0	35.1

8.41.2.4 The Category 6 patch panels shall be approved to work in all applications up to 250 megahertz.

8.41.2.5 The Category 6 patch panels shall meet or exceed the following representative electrical and transmission characteristics:

Frequency	Maximum Insertion loss	Minimum NEXT loss	Minimum FEXT loss
megahertz	Decibels	decibels	decibels
1.0	0.10	75.0	75.0
4.0	0.10	75.0	71.1
8.0	0.10	75.0	65.0
10.0	0.10	74.0	63.1
16.0	0.10	69.9	59.0
20.0	0.10	68.0	57.1
25.0	0.10	66.0	55.1
31.25	0.11	64.1	53.2
62.5	0.16	58.1	47.2
100	0.20	54.0	43.1
200	0.28	48.0	37.1
250	0.32	46.0	35.1

8.41.2.6 The Category 6a patch panels shall be approved to work in all applications up to 500 megahertz.

8.41.2.7 The Category 6a patch panels shall meet or exceed the following representative electrical and transmission characteristics:

Frequency	Maximum Insertion loss	Minimum NEXT loss	Minimum FEXT loss
megahertz	Decibels	decibels	decibels
1.0	0.10	75.0	75.0
4.0	0.10	75.0	71.1
8.0	0.10	75.0	65.0
10.0	0.10	74.0	63.1
16.0	0.10	69.9	59.0

20.0	0.10	68.0	57.1
25.0	0.10	66.0	55.1
31.25	0.11	64.1	53.2
62.5	0.16	58.1	47.2
100	0.20	54.0	43.1
200	0.28	48.0	37.1
250	0.32	46.0	35.1
300	0.35	42.9	33.6
400	0.40	37.9	31.1
500	0.45	34.0	29.1

8.41.3 Category 5e, 6, and 6a Blank Face Patch Panels

The blank patch panels shall have blank faces with cutouts that accept Category 5e, 6, and 6a snap-in modular jacks. These blank face patch panels, when populated, will be designed to operate at a minimum of 100, 250, and 500 megahertz for Category 5e, 6, and 6a respectively. Modular jack quantities sufficient for all positions of every outlet are required.

8.41.3.1 The blank face patch panels shall be Category 5e, 6, and 6a and shall meet TIA 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

8.41.3.2 The Category 5e blank face patch panels shall be approved to work in all applications up to 100 megahertz and shall meet or exceed the electrical and transmission characteristics contained herein.

8.41.3.3 The Category 6 blank face patch panels shall be approved to work in all applications up to 250 megahertz and shall meet or exceed the electrical and transmission characteristics contained herein.

8.41.3.4 The Category 6a blank face patch panels shall be approved to work in all applications up to 500 megahertz jacks shall meet or exceed the electrical and transmission characteristics contained herein.

8.41.4 Category 3 Modular Jacks

All Category 3 modular jacks shall meet or exceed the following electrical and mechanical specifications:

- a. Insulation resistance: 500 megaohms
- b. Dielectric: withstand 1,000 volts alternating current root mean square (VAC RMS), 60 hertz minimum, contact-to-contact and 1,500 VAC RMS, 60 hertz minimum from any contact to exposed conductive surface
- c. Contact resistance: 20 megaohms maximum
- d. Current rating: 1.5 amps at 68 degrees Fahrenheit per IEC 512-3, Test 5b
- e. Plug Insertion Life: 750 insertions
- f. Contact Force: 3.5 ounces (99.2 grams) minimum using FCC-Approved modular plug
- g. Plug Retention Force: 30 pound-force (133 newtons) minimum between modular plug and jack
- h. Temperature Range: negative 40 degrees Fahrenheit to 150 degrees Fahrenheit
- i. TIA 568-C Category 3 minimum transmission requirements

- j. UL Listed
- k. Provided by a manufacturer that is ISO 9001 Certified
- l. Comply with FCC Part 68

8.41.5 Category 5e Modular Jacks

The Category 5e modular jacks shall meet or exceed the following standards:

8.41.5.1 TIA 568-C Commercial Building Wiring Standard

8.41.5.2 The Category 5e modular jacks shall meet the following electrical performance and certification requirements:

- a) Insulation resistance: 500 megaohms
- b) Dielectric: withstand 1500 VAC RMS, minimum, contact to contact
1000 VAC RMS, 60 hertz minimum to exposed conductive surface
- c) Contact Resistance: 20 megaohms maximum
- d) Current Rating: 1.5 amps at 20 degrees Celsius

8.41.5.3 The Category 5e modular jacks shall meet the following physical requirements:

Connectors shall accept 22 to 24-gauge AWG solid conductor wire as applicable. Jack wires shall be square copper alloy wires with 50 micro-inch lubricated gold plating over 100 micro-inch nickel plate, high impact, flame retardant UL-rated 94V-0 thermoplastic.

8.41.5.4 The Category 5e modular jacks shall meet the following mechanical requirements:

- Plug insertion life: minimum 750 plug insertions
- Contact Force: 100 grams minimum using FCC-approved modular plugs
- Plug Retention Force: 30 pound-force (133 newtons) minimum between modular plug and jack
- Temperature Range: negative 40 degrees Fahrenheit to 150 degrees Fahrenheit

8.41.5.5 The Category 5e modular jacks shall be approved to work in all applications up to 100 megahertz.

Frequency megahertz	Maximum Insertion loss Decibels	Minimum NEXT loss decibels	Minimum FEXT loss decibels
1.0	0.10	65.0	65.0
4.0	0.10	65.0	63.1
8.0	0.11	64.9	57.0
10.0	0.13	63.0	55.1
16.0	0.16	58.9	51.0
20.0	0.18	57.0	49.1
25.0	0.20	55.0	47.1
31.25	0.22	53.1	45.2

62.5	0.32	47.1	39.2
100	0.40	43.0	35.1

8.41.6 Category 6 Modular Jacks

The Category 6 modular jacks shall meet or exceed the following standards:

8.41.6.1 TIA 568-C Commercial Building Wiring Standard

8.41.6.2 The Category 6 modular jacks shall meet the following physical requirements:

Connectors accepting 22 to 24-gauge AWG solid conductor wire as applicable. Jack wires shall be square copper alloy wires with 50 micro-inch lubricated gold plating over 100 micro-inch nickel plate, high impact, and flame retardant UL-rated 94V-0 thermoplastic.

8.41.6.3 The Category 6 modular jacks shall meet the following mechanical requirements:

- Plug insertion life: minimum 750 plug insertions
- Contact Force: 100 grams minimum using FCC-approved modular plugs
- Plug Retention Force: 133 newtons minimum between modular plug and jack
- Temperature Range: negative 40 degrees Fahrenheit to 150 degrees Fahrenheit

The Category 6 modular jack shall be approved to work in all applications up to 250 MHz.

Frequency megahertz	Maximum Insertion loss Decibels	Minimum NEXT loss decibels	Minimum FEXT loss decibels
1.0	0.10	75.0	75.0
4.0	0.10	75.0	71.1
8.0	0.10	75.0	65.0
10.0	0.10	74.0	63.1
16.0	0.10	69.9	59.0
20.0	0.10	68.0	57.1
25.0	0.10	66.0	55.1
31.25	0.11	64.1	53.2
62.5	0.16	58.1	47.2
100	0.20	54.0	43.1
200	0.28	48.0	37.1
250	0.32	46.0	35.1

8.41.7 Category 6 Modular Jacks

The Category 6a modular jacks shall meet or exceed the following standards:

8.41.7.1 TIA 568-C Commercial Building Wiring Standard

8.41.7.2 The Category 6 modular jacks shall meet the following physical requirements:

Connectors accepting 22 to 24-gauge AWG solid conductor wire as applicable. Jack wires shall be square copper alloy wires with 50 micro-inch lubricated gold plating over 100 micro-inch nickel plate, high impact, and flame retardant UL-rated 94V-0 thermoplastic.

8.41.7.3 The Category 6 modular jacks shall meet the following mechanical requirements:

Plug insertion life: minimum 750 plug insertions
Contact Force: 100 grams minimum using FCC-approved modular plugs
Plug Retention Force: 133 newtons minimum between modular plug and jack
Temperature Range: negative 40 degrees Fahrenheit to 150 degrees Fahrenheit

8.41.7.4 The Category 6 modular jack shall be approved to work in all applications up to 500 megahertz.

Frequency	Maximum Insertion loss	Minimum NEXT loss	Minimum FEXT loss
megahertz	Decibels	decibels	decibels
1.0	0.10	75.0	75.0
4.0	0.10	75.0	71.1
8.0	0.10	75.0	65.0
10.0	0.10	74.0	63.1
16.0	0.10	69.9	59.0
20.0	0.10	68.0	57.1
25.0	0.10	66.0	55.1
31.25	0.11	64.1	53.2
62.5	0.16	58.1	47.2
100	0.20	54.0	43.1
200	0.28	48.0	37.1
250	0.32	46.0	35.1
300	0.35	42.9	33.6
400	0.40	37.9	31.1
500	0.45	34.0	29.1

8.42 The Contractor will meet all requirements below with regard to Fiber Cables, Connections and Terminations:

8.42.1 Optical Fiber Cable

The optical fiber cable distribution system shall be aerial, buried, underground, or any combination thereof, as required by the specific project. All optical fiber cable

shall meet the following requirements:

- 8.42.1.1 All optical fiber cable shall conform to the requirements of TIA 568-C.3 Optical Fiber Cabling Components.
- 8.42.1.2 The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, including but not limited to: plenum, non-plenum, riser, armored or outside plant.
- 8.42.1.3 Cable Manufacturer shall be ISO-9001 certified.
- 8.42.1.4 The cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. All damaged cable will be replaced.
- 8.42.1.5 All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of the specification. All fibers in the cable must be usable.
- 8.42.1.6 All fibers in the cable shall meet the industry standard for maximum attenuation and minimum bandwidth. Cables that state attenuation and bandwidth as average or nominal values are unacceptable. All optical fibers shall be 100 percent attenuation tested. The attenuation of each fiber shall be provided with each cable reel. The attenuation shall be measured at 850 nanometers and 1300 nanometers for multimode fibers and 1310 nanometers and 1550 nanometers for single-mode fibers.

8.42.2 Plenum Fiber Cable

Plenum rated fiber cable shall be certified to conform to NFPA 262 and be optical fiber nonconductive plenum (OFNP) rated.

8.42.3 Riser Fiber Cable

Riser rated fiber cable shall be certified to conform to UL-1666 and be optical fiber nonconductive riser (OFNR) rated.

8.42.4 Outside Plant Fiber Cable

Outside plant fiber cable shall have a medium-density polyethylene jacket to provide durability and superior protection against ultraviolet radiation, fungus, and abrasions. The outside plant fiber cable shall have water blocking technology to prevent the migration of water throughout the cable. Outside Plant fiber cable shall have minimum pull strength of 260 newtons (600 pound-force). Outside Plant fiber cable shall support a bend radius of 10 times the cable outside diameter when not subject to tensile load, and 20 times the cable outside diameter when subject to tensile loading up to the cable's rated limit.

8.42.5 Indoor/Outdoor Fiber Cable

The indoor/outdoor fiber cable shall be suitable for both riser and campus distribution applications. The fiber cable shall comply with the water-blocking requirement of TIA/EIA 455-82. Indoor/outdoor fiber cable shall have minimum pull strength of 260 newtons (600 pound-force). Indoor/outdoor fiber cable shall support a bend radius of 10 times the cable outside diameter when not subject to tensile load, and 20 times the cable outside diameter when subject to tensile

loading up to the cable's rated limit.

8.42.6 Indoor/Outdoor (Tight Buffer) Fiber Cable

The tight buffer fiber cable shall be engineered to provide a superior operating environment for optimum fiber performance. Cable shall be a dry type swell-able cable waterblocking or a gel-filled or flooded technology. Tight buffer fiber cable shall meet the following specifications:

8.42.6.1 Buffer

The coated fiber shall have a low friction slip layer placed between the acrylate coating of the optical fiber and the thermoplastic buffer.

The fiber coating and buffer shall each be removable with commercially available stripping tools in a single pass for connector termination or splicing.

Both buffer tubes and fibers shall be individually color-coded for easy identification. Every cable shall be clearly marked for ease of identification.

8.42.6.2 Strength Yarns

The fibers shall be stranded around a dielectric strength element consisting of water blocking aramid strength yarns. The strength yarns shall be water swell-able to prevent the migration of water throughout the cable. The water blocking element shall be non-nutritive to fungus, electrically non-conductive, and homogenous. The purpose of the strength element is to provide tensile strength. The aramid yarns shall be helically stranded evenly around the buffered fibers.

Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage. Non-toxic and non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the outer jacket.

8.42.6.3 Jacket

Cables shall be sheathed with flame-retardant polyvinyl chloride (PVC). The PVC shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The cable shall contain at least one ripcord under the sheath for easy sheath removal.

The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. Jackets extruded under high pressure are not acceptable.

The jacket or sheath shall be marked with the Manufacturer's name, the year of manufacture, the sequential meter or foot markings, fiber count, fiber type, flame rating and listing marking. The markings shall be repeated at least every one (1) meter. The actual length of the cable

shall be within plus or minus one percent of the length marking. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 millimeters.

8.42.6.4 Armor

Armored tight buffered fiber cables shall include an interlocking aluminum armor applied helically around the outside of the cable jacket. The interlocking armor may be left un-jacketed or may have a PVC outer jacket. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed or flexible metal conduit if not jacketed.

8.42.6.5 Temperature

The installation temperature range for the tight buffered fiber cable shall be 0 degrees Celsius to 60 degrees Celsius for plenum cables and negative 10 degrees Celsius to 60 degrees Celsius for riser cable. The operating temperature range for the cable shall be negative 40 degrees Celsius to 70 degrees Celsius.

8.42.7 **Loose Tube Fiber Cable Construction**

The loose tube fiber cable shall be engineered to provide a superior operating environment for optimum fiber performance. Fibers shall be placed in buffer tubes and suspended in a filling compound that mechanically decouples the fiber from the cable structure. Fiber cable shall be a dry type swell-able cable waterblocking or a gel-filled or flooded technology. Loose tube fiber cable shall meet the following specifications:

8.42.7.1 Buffer Tubes

Optical fiber shall be placed inside a 2.5-millimeter outer diameter loose buffer tube. Each buffer tube shall contain up to 12 fibers. The fibers shall not adhere to the inside of the buffer tube.

The cable shall utilize a highly reliable loose buffer tube design that shall contain multiple fibers within a buffer tube several times larger in diameter than the fibers. The extra space shall effectively isolate the fibers from the effects of tension and temperature felt by the cable, ensuring stable optical performance over a wide range of conditions.

Buffer tubes shall be of a dual-layer construction with the inner layer made of polycarbonate and the outer layer made of polyester. Fillers shall be included in the cable core to lend symmetry to the cable cross-section where needed. Buffer tubes shall be stranded around a central member using the reverse oscillating, or "SZ," stranding process to provide maximum cable flexibility while minimizing fiber strain.

Each buffer tube shall contain a water blocking element for water-blocking protection. The water swell-able element shall be non-nutritive to fungus, electrically non-conductive, and homogenous. The buffer tubes shall be resistant to kinking. A one-meter length of un-aged cable shall withstand a one meter static head or equivalent continuous

pressure of water for one hour without leakage through the open cable end.

Both buffer tubes and fibers shall be individually color coded for easy identification. Every cable shall be clearly marked for ease of identification.

8.42.7.2 Cable Core

The required number of buffer tubes containing 1 to 12 optical fibers in each tube, shall be stranded around a central member to form the cable core. The central member shall consist of a dielectric, glass reinforced plastic (GRP) rod. The purpose of the central member is to provide tensile strength and prevent buckling of the cable.

The tensile strength shall be provided by the central member, and additional dielectric yarns as required. The dielectric yarns shall be helically stranded evenly around the cable core. Filler rods may be included as necessary to maintain the circularity of the cable core.

Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage.

8.42.7.3 Jacket

Cables shall be sheathed with flame-retardant PVC. The PVC shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.

The cable shall contain at least one ripcord under the sheath for easy sheath removal.

The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. Jackets extruded under high pressure are not acceptable.

The jacket shall be marked with the Manufacturer's name, the year of manufacture, the sequential meter or foot markings, fiber count, fiber type, flame rating and listing marking. The markings shall be repeated at least every one (1) meter. The actual length of the cable shall be within plus or minus one percent of the length marking. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 millimeters.

8.42.7.4 Armor

Armored loose tube fiber cables shall include an interlocking aluminum armor applied helically around the outside of the cable jacket. The interlocking armor may be left un-jacketed or may have a PVC outer jacket. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed or flexible metal conduit if not jacketed.

8.42.7.5 Pulling Tension

The maximum pulling tension shall be 2700 newtons (600 pound-force) during installation (short term) and 810 newtons (180 pound-force) long term installed.

8.42.7.6 Temperature

The installation temperature range for the loose tube fiber cable shall be negative 10 degrees Celsius to 60 degrees Celsius. The operating temperature range for the cable shall be negative 40 degrees Celsius to 70 degrees Celsius.

8.42.8 Multimode 62.5/125 micron Tight Buffer Fiber (OM1)

The multimode fiber utilized in the cable specified herein shall meet EIA/TIA-492AAAA-A and IEC 60793-2-10. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, including but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The 62.5/125 micron multimode optical fiber shall meet the following optical characteristics:

850 nanometers:	maximum attenuation	3.4 decibels per kilometer
	minimum OFL bandwidth	200 megahertz-kilometer
	minimum Gigabit distance	300 meters

1300 nanometers:	maximum attenuation	1.0 decibels per kilometer
	minimum OFL bandwidth	500 megahertz-kilometer
	minimum Gigabit distance	550 meters

The multimode fiber utilized in the cable specified herein shall conform to the following specifications:

Buffered Fiber:	62.5/125 micron
Core Diameter:	62.5 plus or minus 2.5 micrometers
Core-to-Cladding Offset:	less than or equal to 1.5 micrometers
Fiber Dimensions:	125 micron cladding plus or minus 2 micrometers
	242 micron coating plus or minus 5 micrometers

8.42.9 Multimode 62.5/125 micron Loose Tube Fiber (OM1)

The multimode fiber utilized in the cable specified herein shall meet EIA/TIA-492AAAA-A and IEC 60793-2-10. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The 62.5/125 micron multimode optical fiber shall meet the following optical characteristics:

850 nanometers:	maximum attenuation	3.4 decibels per kilometer
	minimum OFL bandwidth	200 megahertz-kilometer
	minimum Gigabit distance	300 meters

1300 nanometers:	maximum attenuation	1.0 decibels per kilometer
	minimum OFL bandwidth	500 megahertz-kilometer
	minimum Gigabit distance	550 meters

The multimode fiber utilized in the cable specified herein shall conform to the following specifications:

Buffered Fiber:	62.5/125 micron
Core Diameter:	62.5 plus or minus 2.5 micrometers
Core-to-Cladding Offset:	less than or equal to 1.5 micrometers
Fiber Dimensions:	125 micron cladding plus or minus 2 micrometers 242 micron coating plus or minus 5 micrometers

8.42.10 Multimode 50/125 micron Tight Buffer Fiber (OM2)

The multimode fiber utilized in the cable specified herein shall meet TIA/EIA-492AAAB and IEC 60793-2-10. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The 50/125 micron multimode optical fiber shall meet the following optical characteristics:

850 nanometers:	maximum attenuation	2.8 decibels per kilometer
	minimum OFL bandwidth	700 megahertz-kilometer
	minimum Gigabit distance	750 meters
1300 nanometers:	maximum attenuation	1.0 decibels per kilometer
	minimum OFL bandwidth	500 megahertz-kilometer
	minimum Gigabit distance	600 meters

The multimode fiber utilized in the cable specified herein shall conform to the following specifications:

Buffered Fiber:	50/125 micron
Core Diameter:	50 plus or minus 2 micrometers
Core-to-Cladding Offset:	less than or equal to 1.5 micrometers
Fiber Dimensions:	125 micron cladding plus or minus 2 micrometers 242 micron coating plus or minus 5 micrometers

8.42.11 Multimode 50/125 micron Loose Tube Fiber (OM2)

The multimode fiber utilized in the cable specified herein shall meet EIA/TIA-492AAAB and IEC 60793-2-10. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The 50/125 micron multimode optical fiber shall meet the following optical characteristics:

850 nanometers:	maximum attenuation	3.0 decibels per kilometer
	minimum OFL bandwidth	700 megahertz-kilometer
	minimum Gigabit distance	750 meters
1300 nanometers:	maximum attenuation	1.0 decibels per kilometer
	minimum OFL bandwidth	500 megahertz-kilometer
	minimum Gigabit distance	600 meters

The multimode fiber utilized in the cable specified herein shall conform to the following

specifications:

Buffered Fiber:	50/125 micron
Core Diameter:	50 plus or minus 2 micrometers
Core-to-Cladding Offset:	less than or equal to 1.5 micrometers
Fiber Dimensions:	125 micron cladding plus or minus 2 micrometers 242 micron coating plus or minus 5 micrometers

8.42.12 Multimode 50/125 micron Tight Buffer Fiber (OM3)

The multimode fiber utilized in the cable specified herein shall meet TIA/EIA-492AAAC and IEC 60793-2-10. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The 50/125 micron multimode optical fiber shall meet the following optical characteristics:

850 nanometers:	maximum attenuation	2.8 decibels per kilometer
	minimum OFL bandwidth	1500 megahertz-kilometer
	minimum Gigabit distance	1000 meters
1300 nanometers:	maximum attenuation	1.0 decibels per kilometer
	minimum OFL bandwidth	500 megahertz-kilometer
	minimum Gigabit distance	600 meters

The multimode fiber utilized in the cable specified herein shall conform to the following specifications:

Buffered Fiber:	50/125 micron
Core Diameter:	50 plus or minus 2 micrometers
Core-to-Cladding Offset:	less than or equal to 1.5 micrometers
Fiber Dimensions:	125 micron cladding plus or minus 2 micrometers 242 micron coating plus or minus 5 micrometers

8.42.13 Multimode 50/125 micron Loose Tube Fiber (OM3)

The multimode fiber utilized in the cable specified herein shall meet EIA/TIA-492AAAC and IEC 60793-2-10. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The 50/125 micron multimode optical fiber shall meet the following optical characteristics:

850 nanometers:	maximum attenuation	3.0 decibels per kilometer
	minimum OFL bandwidth	1500 megahertz-kilometer
	minimum Gigabit distance	1000 meters
1300 nanometers:	maximum attenuation	1.0 decibels per kilometer
	minimum OFL bandwidth	500 megahertz-kilometer
	minimum Gigabit distance	600 meters

The multimode fiber utilized in the cable specified herein shall conform to the following specifications:

Buffered Fiber:	50/125 micron
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Core Diameter:	50 plus or minus 2 micrometers
Core-to-Cladding Offset:	less than or equal to 1.5 micrometers
Fiber Dimensions:	125 micron cladding plus or minus 2 micrometers 242 micron coating plus or minus 5 micrometers

8.42.14 Multimode 50/125 micron Tight Buffer Fiber (OM4)

The multimode fiber utilized in the cable specified herein shall meet TIA/EIA-492AAAD and IEC 60793-2-10. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The 50/125 micron multimode optical fiber shall meet the following optical characteristics:

850 nanometers:	maximum attenuation	2.8 decibels per kilometer
	minimum OFL bandwidth	3500 megahertz-kilometer
	minimum Gigabit distance	1100 meters
1300 nanometers:	maximum attenuation	1.0 decibels per kilometer
	minimum OFL bandwidth	500 megahertz-kilometer
	minimum Gigabit distance	600 meters

The multimode fiber utilized in the cable specified herein shall conform to the following specifications:

Buffered Fiber:	50/125 micron
Core Diameter:	50 plus or minus 2 micrometers
Core-to-Cladding Offset:	less than or equal to 1.5 micrometers
Fiber Dimensions:	125 micron cladding plus or minus 2 micrometers 242 micron coating plus or minus 5 micrometers

8.42.15 Multimode 50/125 micron Loose Tube Fiber (OM4)

The multimode fiber utilized in the cable specified herein shall meet TIA/EIA-492AAAD and IEC 60793-2-10. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The 50/125 micron multimode optical fiber shall meet the following optical characteristics:

850 nanometers:	maximum attenuation	3.0 decibels per kilometer
	minimum OFL bandwidth	3500 megahertz-kilometer
	minimum Gigabit distance	1100 meters
1300 nanometers:	maximum attenuation	1.0 decibels per kilometer
	minimum OFL bandwidth	500 megahertz-kilometer
	minimum Gigabit distance	600 meters

The multimode fiber utilized in the cable specified herein shall conform to the following specifications:

Buffered Fiber:	50/125 micron
Core Diameter:	50 plus or minus 2 micrometers
Core-to-Cladding Offset:	less than or equal to 1.5 micrometers
Fiber Dimensions:	125 micron cladding plus or minus 2 micrometers

242 micron coating plus or minus 5 micrometers

8.42.16 Single-mode Tight Buffer Fiber

The single-mode fiber utilized in the cable specified herein shall meet TIA/EIA-492CAAB. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The single-mode optical fiber shall meet the following optical characteristics:

1310 nanometers:	maximum attenuation	0.65 decibels per kilometer
	minimum Gigabit distance	5000 meters

1550 nanometers:	maximum attenuation	0.50 decibels per kilometer
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The single-mode fiber utilized in the cable specified herein shall conform to the following specifications:

Core-to-Cladding Concentricity:	less than or equal to 0.5 micrometers
Cladding Non-circularity:	less than or equal to 0.7 percent
Fiber Dimensions:	125 micron cladding plus or minus 0.7 micrometers
	245 micron coating plus or minus 5 micrometers

Zero Dispersion Wavelength:	1313 plus or minus 11 nanometers
Cable Cutoff Wavelength:	1260 nanometers

8.42.17 Single-mode Loose Filled Fiber

The single-mode fiber utilized in the cable specified herein shall meet TIA/EIA-492CAAB and IEC 60793-2-50. The cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to, plenum, riser, armored, indoor/outdoor or outside plant. The single-mode optical fiber shall meet the following optical characteristics:

1310 nanometers:	maximum attenuation	0.4 decibels per kilometer
	minimum Gigabit distance	5000 meters

1550 nanometers:	maximum attenuation	0.30 decibels per kilometer
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The single-mode fiber utilized in the cable specified herein shall conform to the following specifications:

Core-to-Cladding Concentricity:	less than or equal to 0.5 micrometers
Cladding Non-circularity:	less than or equal to 0.7 percent
Fiber Dimensions:	125 micron cladding plus or minus 0.7 micrometers
	245 micron coating plus or minus 5 micrometers

Zero Dispersion Wavelength:	1313 plus or minus 11 nanometers
Cable Cutoff Wavelength:	1260 nanometers

8.42.18 Fiber Patch Cables

Fiber connectors for the fiber patch cables shall match the fiber connector specifications

specified herein. The patch cable fiber shall match the optical characteristics and specifications of the fiber cable specified herein.

8.42.19 **ST Fiber Connector and Termination**

The only approved method of fiber termination using a straight tip (ST) connector is one approved by the cable manufacturer for the specific cable supplied. The connector shall be installed on the fiber utilizing a manufacturer approved tool kit. This kit contains all tools and instructions to mount the connector quickly and easily, utilizing the manufacturer's installation procedures. The ST fiber connectors and terminations shall meet the following specifications:

8.42.19.1 Multimode

The only approved method of termination is as specified in TIA-568 C.3 Optical Fiber Cabling Components. The connector shall meet the following requirements:

Durability:	500 re-matings
Typical Insertion Loss:	0.2 decibels
Maximum Insertion Loss:	0.5 decibels
Maximum Temperature Cycling:	0.3 decibels

8.42.19.2 Single-mode

The only approved method of termination is as specified in TIA-568 C.3 Optical Fiber Cabling Components. The connector shall meet the following requirements:

Durability:	500 re-matings
Typical Insertion Loss:	0.2 decibels
Maximum Insertion Loss:	0.5 decibels
Maximum Temperature Cycling:	0.3 decibels

8.42.20 **SC Fiber Connector and Termination**

The only approved method of fiber termination using a standard or subscriber connector (SC) is one approved by the cable manufacturer for the specific cable supplied. The connector shall be installed on the fiber utilizing a manufacturer approved tool kit. This kit contains all tools and instructions to mount the connector quickly and easily, utilizing the manufacturer's installation procedures. The SC fiber connectors and terminations shall meet the following specifications:

8.42.20.1 Multimode

The only approved method of termination is as specified in TIA-568 C.3 Optical Fiber Cabling Components. The connector shall meet the following requirements:

Durability:	500 re-matings
Typical Insertion Loss:	0.1 decibels
Maximum Insertion Loss:	0.5 decibels
Maximum Temperature Cycling:	0.3 decibels

8.42.20.2 Single-mode

The only approved method of termination is as specified in TIA-568 C.3 Optical Fiber Cabling Components. The connector shall meet the following requirements:

Durability:	500 re-matings
Typical Insertion Loss:	0.2 decibels
Maximum Insertion Loss:	0.5 decibels
Maximum Temperature Cycling:	0.3 decibels

8.42.21 LC Fiber Connector and Termination

The only approved method of fiber termination using a lucent connector (LC) is one approved by the cable manufacturer for the specific cable supplied. The connector shall be installed on the fiber utilizing a manufacturer approved tool kit. This kit contains all tools and instructions to mount the connector quickly and easily, utilizing the manufacturer's installation procedures. The LC fiber connectors and terminations shall meet the following specifications:

8.42.21.1 Multimode

The only approved method of termination is as specified in TIA-568 C.3 Optical Fiber Cabling Components. The connector shall meet the following requirements:

Durability:	500 re-matings
Typical Insertion Loss:	0.1 decibels
Maximum Insertion Loss:	0.5 decibels
Maximum Temperature Cycling:	0.3 decibels

8.42.21.2 Single-mode

The only approved method of termination is as specified in TIA-568 C.3 Optical Fiber Cabling Components. The connector shall meet the following requirements:

Durability:	500 re-matings
Typical Insertion Loss:	0.2 decibels
Maximum Insertion Loss:	0.5 decibels
Maximum Temperature Cycling:	0.3 decibels

8.42.22 Optical Fiber Cable Interconnect Cabinet

All fiber cables will be terminated at the Customer's telecommunication room sites in fiber interconnect cabinets. These cabinets will be wall or rack mounted, as designated on the drawings or as required by the Project Contact. Rack mounted interconnect cabinets shall be placed at the top of the rack and located to minimize cable distance to electronic equipment. The Contractor shall provide quantities and configurations as shown on the Customer drawings. The fiber interconnect cabinet shall be a manufacturer-certified component and will directly terminate the fiber building cable. The fiber interconnect cabinet shall meet or exceed all the following requirements:

- 8.42.22.1 The fiber unit kit shall contain all parts required for termination of the cable with the specified connectors and couplings.
- 8.42.22.2 The unit shall accommodate the connectors specified.
- 8.42.22.3 Provide plastic split rings fiber bend limiters for routing and expressing cables to manage slack fiber within the unit and rings for routing cable through the unit. It will also contain cable tie brackets for entry and exit of the fiber cable.
- 8.42.22.4 Include provision for labeling of the terminations and installation instructions.
- 8.42.22.5 Labeling for fiber cabling and the fiber interconnect cabinet shall be by distribution frame number, plus the color suffix designating which fiber is terminated.
- 8.42.22.6 Include access for cable entry and provide inserts to enclose the cabinet around the cable entry area.
- 8.42.22.7 The fiber interconnect cabinet shall be UL listed.
- 8.42.22.8 Include grounding lugs in the rear of the unit.
- 8.42.22.9 The fiber interconnect cabinet shall provide cross-connect, interconnect, splicing capabilities, and contain the proper troughs for supporting and routing the fiber cables.
- 8.42.22.10 The fiber interconnect cabinet shall consist of a modular enclosure with retainer rings in the slack storage section to limit the bending radius of fibers.
- 8.42.22.11 The fiber interconnect cabinet shall have a steel enclosure, designed for industrial application, and shall come with a removable outer door and inner door for securing the network section. The interconnect cabinet shall have bottom knockouts for cable entry and shall have a "window" section to insert connector panels for mounting of terminated fibers.
- 8.42.22.12 All loose tube filled cables shall be provided with fan-out kits at each termination point.
- 8.42.22.13 The Contractor shall assure that the connectors for each cabling segment are installed in the correct orientation to ensure proper polarity of an optical fiber system from the main cross-connect to the telecommunications outlet or connector.

8.42.23 Optical Fiber Cable Splices & Closures

All fiber cable splicing shall be performed by the Contractor using the fusion splicing method unless the Project Contact specifically requires the mechanical method. Fiber cable splicing shall meet or exceed the following specifications:

8.42.23.1 Fusion splicing

The fiber splicer shall be fully automatic, calibrated, and operate under the various jobsite environmental conditions (e.g., temperature, humidity, altitude, etc.) for all types of fiber cable being deployed.

1. The mean splice loss for identical dispersion-unshifted single mode fibers shall be equal to 0.05 decibels at 1310 nanometers and 1550 nanometers wavelengths in accordance with CCITT G.652.
2. The microprocessor controlled automatic positioning system shall control the fiber alignment, cleaning, gap-setting correlation of fiber positioning and fusing.
3. The fusion splicer shall measure and document the splice losses of each splice. These measurements shall be saved and submitted to the DMS Product Manager, during final documentation reporting requirements.
4. Heat shrink protection shall be provided for each splice.

8.42.23.2 Mechanical splicing

The fiber splice module shall meet the following specifications:

1. Accept 250 and 900 micron fibers
2. Re-enterable, rearrangeable and reusable
3. Require no polishing
4. Require no adhesives
5. No loose parts
6. Mean splice loss of 0.15 decibels
7. Blind splice loss of less than 0.5 decibels
8. One part index matching gel
9. Stable from negative 40 degrees Celsius to 75 degrees Celsius

8.42.23.3 Splice Closures

The fiber splice canister closure shall seal, bond, anchor, and protect fiber optic cable splices. The splice closure shall be re-enterable with a maximum of six cable entries in a butt-end configuration. The splice cap shall be capable of accepting additional cables without disturbing existing splices. The splice closure shall be designed for application required aerial, underground, and direct buried. It shall use corrosion free construction designed for splicing fibers. The unit shall include slack storage and the splice trays required for the specific installation.

8.43 The Contractor will meet the following requirements regarding Coaxial Cabling:

8.43.1 Plenum Coaxial Cable

Plenum rated coaxial cable shall be certified to conform to NFPA 262 and shall be marked as CMP. The plenum coaxial cable shall be composed of 22 to 24 gauge bare solid copper conductors insulated with FEP. The conductor shall be jacketed with low smoke, flame-retardant PVC.

8.43.2 Flooded Coaxial Cable

All flooded coaxial cable shall be injected with a water-resistant flooding compound and jacketed with UV resistant polyethylene.

8.43.3 RG-6/U Coaxial Cable

All RG-6/U coaxial cables shall be round and consist of 18 AWG solid bare copper conductors individually insulated and sheathed with an outer jacket.

8.43.3.1 The RG-6/U coaxial cable shall conform to the requirements of TIA 568-C.4 Broadband Coaxial Cabling and Components Standard.

8.43.3.2 The RG-6/U coaxial cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, for instance but not limited to: plenum, non-plenum, or flooded.

8.43.3.3 The RG-6/U coaxial cable shall meet the following requirements:

Insulation Dielectric:	Foam fluorinated ethylene propylene (FEP)
Shield Type and Minimum Coverage:	braid shield at 95 percent
Nominal Impedance:	75 Ohms
Maximum Attenuation at 750 megahertz:	5.65 decibels per 100 feet

8.43.3.4 Cable Manufacturer shall be ISO-9001 certified.

8.43.3.5 The cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. All damaged cable will be replaced.

8.43.4 RG-6/UQ Coaxial Cable

All RG-6/UQ coaxial cables shall be round and consist of 18 AWG solid bare copper conductors individually insulated, with four layers of shielding, and sheathed with an outer jacket.

8.43.4.1 The RG-6/UQ coaxial cable shall conform to the requirements of TIA 568-C.4 Broadband Coaxial Cabling and Components Standard.

8.43.4.2 The RG-6/UQ coaxial cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, including, but not limited to: plenum, non-plenum, or flooded.

8.43.4.3 The RG-6/UQ coaxial cable shall meet the following requirements:

Insulation Dielectric:	FEP
Shield Type and Minimum Coverage:	braid shield at 95 percent
Nominal Impedance:	75 Ohms
Maximum Attenuation at 750 megahertz:	5.65 decibels per 100 feet

8.43.4.4 Cable Manufacturer shall be ISO-9001 certified.

8.43.4.5 The cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. All damaged cable will be replaced.

8.43.5 **RG-11/U Coaxial Cable**

All RG-11/U coaxial cables shall be round and consist of 14 AWG solid bare copper conductor individually insulated and sheathed with an outer jacket.

8.43.5.1 The RG-11/U coaxial cable shall conform to the requirements of TIA 568-C.4 Broadband Coaxial Cabling and Components Standard.

8.43.5.2 The RG-11/U coaxial cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, including, but not limited to: plenum, non-plenum, or flooded.

8.43.5.3 The RG-11/U coaxial cable shall meet the following requirements:

Insulation Dielectric:	FEP
Shield Type and Minimum Coverage:	braid shield at 95 percent
Nominal Impedance:	75 Ohms
Maximum Attenuation at 750 megahertz:	3.65 decibels per 100 feet

8.43.5.4 Cable Manufacturer shall be ISO-9001 certified.

8.43.5.5 The cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. All damaged cable will be replaced.

8.43.6 **RG-59/U Coaxial Cable**

All RG-59/U coaxial cables shall be round and consist of 23 AWG solid bare copper conductor individually insulated and sheathed with an outer jacket.

8.43.6.1 The RG-59/U coaxial cable shall conform to the requirements of TIA 568-C.4 Broadband Coaxial Cabling and Components Standard.

8.43.6.2 The RG-59/U coaxial cable construction, including the insulation and outer jacket, shall meet the requirements specified herein and by use, including, but not limited to: plenum, non-plenum, or flooded.

8.43.6.3 The RG-59 coaxial cable shall meet the following requirements:

Insulation Dielectric:	FEP
Shield Type and Minimum Coverage:	braid shield braid shield at 95 percent
Nominal Impedance:	75 Ohms

Maximum Attenuation at 750 megahertz: 9.708 decibels per 100 feet

8.43.6.4 Cable Manufacturer shall be ISO-9001 certified.

8.43.6.5 The cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. All damaged cable will be replaced.

8.44 The Contractor will meet the following requirements for Racks and Cabinets:

The main distribution frame (MDF) shall be located in the Customer's communication equipment room, as designated on the drawings or as required by the Project Contact. The intermediate distribution frame (IDF) shall be located in the Customer's telecommunication room, as required by the specific Project or MAC. The MDF and IDF shall house racks, voice termination fields, and required cable routing hardware. Racks shall be placed by the Contractor in a manner that will allow a minimum of 3 feet of clearance from the front, rear, and one-side mounting surface. If one mounting rail of the rack is placed against a wall by the Contractor, the mounting rail shall be no closer than 6 inches to the wall to allow room for vertical management. Where there is more than one rack, the racks shall be ganged by the Contractor with vertical management hardware to provide inter-bay management. Ganged rack frames will be placed by the Contractor in a manner that will allow a minimum of 3 feet of clearance from the front and rear mounting surfaces and on one side of the ganged assembly. The following are additional terms for racks and/or cabinets, where applicable:

8.44.1 3 Inches Wide Floor Mounted Rack (Free Standing)

The rack will be installed as designated on the drawings or as required by the Project Contact, with each distribution frame equipped with a free standing, self-supporting, seven-foot tall, 3 inches wide channel, 19-inch EIA standard equipment rack to house equipment, patch panels and fiber interconnect cabinets. The Contractor shall provide racks with integral vertical wire management pathways and secure in place with appropriate fasteners. Each rack shall be mounted on an isolation pad by the Contractor and utilize nonconductive washers to secure the rack to the floor.

8.44.2 6 Inches Wide Floor Mounted Rack (Free Standing)

The rack will be installed as designated on the drawings or as required by the Project Contact, with each distribution frame equipped with a free standing, self-supporting, seven-foot tall, 6 inches wide channel, 19-inch EIA standard equipment rack to house equipment, patch panels, and fiber interconnect cabinets. The Contractor shall provide racks with integral vertical wire management pathways and secure in place with appropriate fasteners. Each rack shall be mounted on an isolation pad by the Contractor and utilize nonconductive washers to secure the rack to the floor.

8.44.3 Floor Mounted Cabinet

The cabinet will be installed as designated on the drawings or as required by the Project Contact, with each distribution frame equipped with an 84 inches high by 31.5 inches wide and 48 inches deep electronic cabinet, equipped with 19-inch EIA standard equipment uprights to house equipment, patch panels, and fiber interconnect cabinets. The Contractor shall provide a plexiglas front door with

security lock, vented rear door with security lock, removable side panels, vented top panel, dual packed 275 CFM blower unit, and coasters. All cabinet keys for a Project or MAC shall be keyed alike and provided to the Project Contact upon completion.

8.44.4 Wall Mounted Rack

The rack will be installed as designated on the drawings or as required by the Project Contact, with each distribution frame equipped with a 19-inch EIA standard swing frame equipment rack to house equipment, patch panels, and fiber interconnect cabinets. The Contractor shall secure the wall mounted rack in place with appropriate fasteners.

8.44.5 Wall Mounted Cabinet

The rack will be installed as designated on the drawings, or as required by the Project Contact, with each wall mounted distribution frame equipped with an electronic cabinet. That cabinet shall be equipped with 19-inch EIA standard adjustable equipment uprights to house equipment, patch panels, and fiber interconnect cabinets. The Contractor shall provide a solid front door with security lock and a swing 3-section frame for rear access. The wall mounted cabinet must be able to support left hand or right hand opening. All cabinet keys for a Project or MAC shall be keyed alike and provided to the Project Contact upon completion.

8.44.6 Wire Management Components

1. All equipment racks shall be augmented with horizontal and vertical cable management hardware, both front and rear, to properly dress horizontal cables and patch cords.
2. Wire management shall be closed cover or distribution ring with front cover wire management panels, as required by the Project Contact, sized for the quantity wires anticipated at each location. Each horizontal row of patch panels shall have a wire management panel above and below. Common panels may be used between rows provided they are large enough to contain all wiring.
3. The Contractor shall provide a wire management cable support bar or strain relief brackets designed to provide strain relief at the rear of the 19-inch EIA distribution rack for the horizontal wiring cables terminated at the modular patch panels.

8.44.7 NEMA Enclosures

NEMA enclosures shall be constructed for either indoor or outdoor use to provide a degree of protection for the equipment inside against falling dirt, water, or damage from the external formation of ice on the enclosure.

8.45 Telecommunications Bonding Backbone

The Contractor shall provide a telecommunications bonding backbone utilizing a number 6 AWG or larger bonding conductor that provides direct bonding between the MDF and IDF. The permanent infrastructure for telecommunications grounding and bonding shall

be independent of telecommunications cabling. The co-routed bonding conductor shall be installed by the Contractor as follows:

- 8.45.1 Communication bonding and grounding shall be in accordance with the NEC, NFPA, NESC, BICSI and TIA Standard 607. Horizontal cables shall be grounded in compliance with NFPA 70 and local requirements and practices. Horizontal equipment includes cross-connect frames, patch panels, racks, active telecommunication equipment, test apparatus, and equipment.
- 8.45.2 Copper bonding conductors shall be installed by the Contractor through every major telecommunications backbone pathway and directly terminated on a grounding bus bar in each telecommunication equipment location. The grounding bus bar shall be directly bonded to the building's structural steel and other permanent metallic systems. Each pathway bonding conductor must be terminated on the bus bar. The bus bar shall be visible and physically secured.
- 8.45.3 The Contractor shall route the number 6 AWG copper conductor along each backbone cable route and ensure a minimal separation between the conductor and the cables along the entire distance.
- 8.45.4 The Contractor shall bond each end of the copper conductor at the nearest approved ground in the area which the associated cables terminate or are spliced or cross-connected onto other cables. Such bonding shall be done with a grounding bus bar.
- 8.45.5 The main bus bar shall be directly bonded by the Contractor to the electrical service grounding electrode system. The telecommunications grounding system shall be directly attached to the closest point in the building's electrical service grounding system.
- 8.45.6 The Contractor shall use the grounding bus bars as the local approved ground. Backbone cabling shall be bonded by the Contractor at each sheath opening. All metallic cable trays shall be grounded.
- 8.45.7 The Contractor shall provide telecommunications bonding connections in accessible locations and make all bonding connections with listed bolts, crimp pressure connectors, clamps, or lugs. Multiple grounding bus bars placed in the building shall be directly bonded by the Contractor with a number 6 AWG copper conductor.
- 8.45.8 Bonding conductors shall be routed by the Contractor with a minimum number of bends. The bends placed in the conductor shall be sweeping.
- 8.45.9 A number 6 AWG stranded copper wire cable shall be extended by the Contractor between new ground bars located at each intermediate cross-connect and the building main service ground point. This ground conductor shall be utilized for equipment, termination, equipment rack and computer equipment grounding. All cabinets and racks shall be grounded by the Contractor from the Customer's telecommunication room isolated ground bar to the frame using a standard ground lug and number 6 AWG jacketed green ground cable.

8.45.10 When the Customer's telecommunications room contains an electrical panel, the Contractor shall provide a telecommunications ground utilizing a number 6 AWG or larger bonding conductor that provides direct bonding between telecommunications rooms ground bar and a connection to the telecommunications rooms electrical panel Alternating Current Equipment Ground buss ACEG.

8.45.11 All outside plant installation by the Contractor of metallic cable elements shall be grounded at the building entry points and at each splice location.

8.46 Telecommunications Backboard

Telecommunications backboard shall be 3/4 inch, 4 to 8-foot high, void-free, A/C grade plywood as designated on the drawings or as required by the Project Contact. The Contractor shall paint the backboard with one prime coat and two finish coats of fire-retardant pearl gray latex paint and securely fasten the backboard to a wall.

8.47 Surface Raceways

The Contractor shall mount communication outlets that require surface mounting in non-metallic back-boxes with surface raceways. The Contractor shall omit surface raceways where access into existing walls is available. The Contractor shall mount back-boxes at power receptacle height and secure raceways every 16 inches with screws and wall anchors.

8.47.1 Metallic Mechanical Construction

Contractor is required to meet or exceed the following specifications for all metallic mechanical raceways:

1. Constructed of extruded steel with either durable satin anodized finish or coated with epoxy powder coating.
2. Incorporate a minimum of 2-inch radius control at all bending points (elbows and similar fittings).
3. Incorporate a complete line of modular termination boxes and external means of coupling sections and fittings of raceway together so that no sharp edges, field cuts or threaded ends of fasteners shall be visible or protrude into the raceway. The raceway fittings shall not reduce interior cross sectional area at the couplers.

8.47.2 Non-metallic Mechanical Construction

All non-metallic mechanical raceways shall meet or exceed the following specifications:

1. Constructed of self-extinguishing high impact extruded PVC with internal coloring. The hinge shall allow raceway to be opened repeatedly without fracture and shall latch secure to prevent accidental opening.
2. Incorporate a snap fit cover design with cover removal groove accessible from either the top or side of the raceway.

3. Incorporate a minimum of 2-inch radius control at all bending points (elbows and similar fittings).
4. Incorporate a complete line of modular termination boxes and external means of coupling sections and fittings of raceway together so that no sharp edges, field cuts or threaded ends of fasteners shall be visible or protrude into the raceway. The raceway fittings shall not reduce interior cross-sectional area at the couplers.

8.48 Innerduct

All fiber backbone cables shall be installed by the Contractor in innerduct for physical protection. Innerduct shall be 1-inch, 1 ½-inch, or 2-inch non-metallic corrugated flexible innerduct for use in plenum, outdoor, or riser applications and Contractor will meet or exceed the following specifications for innerducts:

8.48.1 Riser Innerduct

The riser rated multi-tube innerduct shall have a flame resistant PVC outer jacket and meet TIA standards. The operating temperature range shall be 32 degrees Fahrenheit to 122 degrees Fahrenheit. The minimum bending radius shall be 20 cable diameters during installation and 10 cable diameters after installation. The riser rated multi-tube innerduct shall be UL 1666 OFNR rated.

8.48.2 Indoor Plenum Rated Fiber Tubes

The plenum rated multi-tube innerduct shall have a low smoke, flame resistant outer jacket and meet TIA standards. The operating temperature range shall be 32 degrees Fahrenheit to 122 degrees Fahrenheit. The minimum bending radius shall be 20 cable diameters during installation and 10 cable diameters after installation. The plenum rated multi-tube innerduct shall be UL 910 OFNP rated.

8.48.3 Outdoor Innerduct

The multi-tube innerduct shall have a polyethylene outer jacket with a dry tape water blocked cable core and meet TIA standards. The operating temperature range shall be negative 40 degrees Fahrenheit to 158 degrees Fahrenheit. The minimum bending radius shall be 20 cable diameters during installation and 10 cable diameters after installation. The multi-tube innerduct should be UL 1651 OFCP rated.

8.49 Flexible Engineered Fabric

Where specifically requested, the Contractor shall provide a flexible engineered fabric conduit. Engineered fabric shall not rip or tear, shall contain three cells, and shall be chemically resistant to chemicals and petroleum products. The Contractor shall install a pull cord in each cell. In plenum rated areas, the Contractor shall provide plenum rated fabric.

8.50 Cable Trays

The cable trays shall be classified into three categories: ladder cable tray, solid bottom cable tray, and wire mesh cable tray. Above drop ceiling areas, ladder cable trays or wire mesh cable trays shall be installed by the Contractor, dependent on the cable

loading. Ladder cable trays shall be installed by the Contractor in the Customer's telecommunication room. Tray size is dependent on the cable loading. Contractor will meet or exceed the following specifications for all trays:

8.50.1 Ladder Cable Tray

Cable management system shall be installed using support components as recommended by the manufacturer. The Contractor shall install cable trays according to NEC Article 318 or in accordance with manufacturer recommendations, whichever is more stringent. The ladder cable tray shall be hot rolled carbon steel and hot dipped galvanized after fabrication with 6 inch rung spacing utilizing either hot dipped galvanized or cadmium plated fasteners.

8.50.2 Solid Bottom Cable Tray

The solid bottom cable tray shall be constructed from ASTM A36 steel bar. It shall have a baked powder painted surface treatment using polyester coating. The cable management tray width shall be dependent on the cable loading. The Contractor shall utilize cable management fittings and hardware recommended by the manufacturer and shall provide drop-offs, 90 degrees, and tees as required for the equipment served, and support of the cable.

8.50.3 Wire Mesh Cable Tray

The wire mesh cable tray shall be constructed of welded wire mesh with a continuous safety edge wire lip. Provide the mesh system for continuous ventilation of cables and maximum heat dissipation. The mesh size shall be 4 inches by 2 inches.

The wire mesh cable tray shall be surfaced treated after manufacture. The surface treatment shall meet or exceed the following specifications:

1. Electroplated zinc galvanizing shall be electrodeposited zinc coating applied to an average thickness of 0.7 mils to 0.8 mils.
2. Hot dip galvanizing in molten zinc bath providing an average coating thickness of 2.4 mils to 3.2 mils.
3. Powder painted surface treatment using ASA 61 Gray Polyester coating.
4. Cable management tray width and depth is dependent on the cable loading and design.

The cable management fittings shall be field-manufactured from straight sections through use of hardware and instructions recommended by manufacturer. The Contractor shall provide drop-offs, 90 degrees, and tees as required for the equipment served, and support of the cable.

The cable management system shall be installed by the Contractor using splice connectors and support components as recommended by the manufacturer. The Contractor shall install cable trays, where shown, according to NEC Article 392 and in accordance with manufacturer recommendations and suggested span load

8.51 Tele-data Power Poles

- 8.51.1 Tele-data poles shall be provided by the Contractor to extend telecommunication and electrical services from a ceiling to the workstation outlets. The tele-data poles shall include dual channel poles for electrical power circuits in one channel and telecommunication cabling in the other channel.
- 8.51.2 The tele-data power poles shall be provided by the Contractor with circuit feed fittings, ceiling trim plates, T-bar mounting hardware, carpet/floor grippers, and other associated accessories for a complete installation. The tele-data pole shall allow inserts for various manufacturers' telecommunication outlet plates.
- 8.51.3 Tele-data poles shall accommodate the installation ceiling requirement, 10-foot, 12-foot, and 15-foot ceilings. Contractor will coordinate the finish with the Project Contact and will offer Customers a variety of painted, polished and satin anodized finishes.

8.52 Electrical Protection Devices

All copper circuits shall be provided by the Contractor with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed by the Contractor through this protector. The protector shall be connected by the Contractor with a number 6 AWG copper bonding conductor between the protector ground lug and the Customer's telecommunication room ground point. Each protector chassis shall be provided by the Contractor with solid state plug-in or gas-tube protector modules for each pair terminated on the chassis. For small pair-count applications, the Contractor shall supply electrical protection apparatus that consists of a mounting panel for a series of solid-state or gas-tube protector units and a wiring block. The wiring block shall be used for input and output cable terminations. Insertion of the protector units into the mounting block will complete the circuit. The Contractor will meet or exceed the following specification with regard to electrical protection devices:

8.52.1 Solid-State Protector

The solid-state protector unit shall meet the following requirements:	
Operating Temperature Range:	-40°F to +149°F (-40°C to +65°C)
DC Breakdown Voltage (at 2 kV/sec):	220-300V
Surge Breakdown Voltage (at 100V/μsec):	220-300 V
Insulation Resistance (PE-80):	>100 MΩ typical
DC Holdover Current:	260 mA/52V, 200 mA/135V, 140 mA/150V
On-State Voltage (at 100A):	<19/V
Response Time:	<100 nsec
Rated Impulse Discharge:	200 A
Capacitance:	<100 pF
Line Series Resistance:	<4W
Sneak Current Operation (heat coils):	540 mA:<210 sec, 1 A: <15 sec
Number of Operations:	unlimited
UL Listed	
ISO 9001 Certified Manufacturer	

8.52.2 Gas-Tub Protector

The gas-tube protector unit shall meet the following electrical specifications:

DC Breakdown Voltage (at 2 kV/sec):	265-425V
Surge Breakdown Voltage (at 100V/μsec):	200-800 V
Insulation Resistance (PE-80):	>100 MΩ typical
DC Holdover Current:	260 mA/52V, 200 mA/135V, 140 mA/150V
Vented Breakdown Voltage:	<1,000 V
DC Arc Voltage:	20 V typical
Glow-to-Arc Transition Current:	0.5 A typical
Capacitance (PE-80):	<10 pF
AC Discharge (PE-80):	65 A(11 cycles at 60 Hz)
Maximum Impulse Discharge (PE-80):	20 kA (8/20 μsec waveform)
Sneak Current Operation (heat coils):	540 mA: <219 secm 1A: <15 sec
Short Life Duration 60 Hz AC:	1 A, 60 Hz/1 sec burst: >60 operations 10 A, 60 Hz/1 sec burst: >20 operations
Continuous Life:	60 Hz AC, 0.5 A: 140 sec 10 A Surge (10/1,000 μsec waveform) : >1,000 operations
100 A Surge (10/1,000 μsec waveform) :	>100 operations
300 A Surge (10/1,000 μsec waveform) :	>50 operations
UL Listed	
ISO 9001 Certified Manufacturer	

8.53 **Line Voltage Electrical Power Work**

When line voltage electrical power for telecommunication spaces, data centers, cabinets, and equipment is not installed by third parties and is essential to the telephony or data infrastructure system for Customers use of the system, the Contractor shall furnish all labor, materials, tools, and equipment to provide line voltage electrical power for telecommunication spaces, data centers, cabinets, and equipment. Any line voltage electrical power work performed by the Contractor shall meet or exceed SOW section 8.1, Codes and Standards, and the following specifications:

8.53.1 Contractor

All line voltage electrical power work shall be performed by an individual with at least five (5) years of successful installation experience on similar installations and a current and valid State of Florida electrician license with the Department of Business and Professional Regulation.

8.53.2 Subcontracting

Should the Contractor subcontract out these services, the Contractor shall obtain written approval from the DMS Product Manager, provide the information required in SOW section 2.5, Subcontracting, to the DMS Product Manager, and written certification of the following:

1. The electrical equipment manufacturer shall have at least five (5) years of successful manufacturing of products with characteristics and capacities required; and
2. For all line voltage electrical power work, the Subcontractor shall have an individual with at least five (5) years of successful installation experience on similar installations who has a current and valid State of Florida electrician licensed with the Department of Business and Professional Regulation.

8.53.3 Insulated Conductors

Insulated conductors shall be new 600 volt, soft-drawn, annealed, 98 percent conductivity, copper insulated conductors. The copper conductors shall meet the following specifications:

1. Insulation shall be Thermoplastic Heat and Water-Resistant Insulated Wire or Thermoplastic High Heat Resistant Nylon Coated for number 10 & 12 AWG sizes and shall be sized in accordance with the NEC. The Contractor shall provide number 10 conductors for a single phase and 20 ampere circuits that are more than 100 feet from the panel board.
2. The Contractor shall use pressure type lugs or connectors for stranded conductor terminations.
3. The Contractor shall mark conductors according to NEC Article 310 or equal cable markers and provide colored insulated conductors for all circuits as follows:

120/240 volt shall have L1 Black, L2 Red, Neutral White, Ground Green
120/208 volt shall have L1 Black, L2 Red, L3 Blue, Neutral White, Ground Green UL 83 Listed

8.53.4 Electrical Outlet Boxes

Electrical outlet boxes shall be galvanized steel boxes of sufficient size to accommodate wiring devices to be installed at flush outlet. Unless otherwise noted, the Contractor shall provide 2-1/8 inch deep by 4 inch square box and securely fasten outlet boxes in position using the fastener design for the wall type involved. The Contractor shall provide box rings for all boxes in sheetrock and plastered walls and provide an extension ring for the device to be installed. The Contractor shall provide one-piece cast outlet boxes with threaded openings for surface mounting in areas having exposed conduit systems.

8.53.5 Electrical Junction Boxes

Electrical junction boxes shall be galvanized steel junction boxes with an associated cover conforming to NEC and that are UL 514 Listed. The Contractor shall provide NEMA 1 type boxes for interior spaces and NEMA 3R type boxes for exterior spaces.

8.53.6 Receptacles

Receptacles shall be 3-wire, NEMA 5-20R, 20 ampere, 125 VAC duplex receptacles with plastic, steel or stainless steel receptacle plates of the type

required for service and device involved. The receptacles shall be UL 498 Listed.

8.53.7 Circuit Breakers

The Contractor shall provide circuit breakers for the existing or specified manufacturer's panel involved, with the number of poles and ampere ratings required for the equipment installation indicated and UL 67 Listed. The circuit breakers shall meet or exceed the following specifications:

1. Factory assembled molded case quick-break breakers shall be both manual and automatic operation with trip indication.
2. The Contractor shall provide a common trip mechanism that will trip all poles simultaneously on an overload or fault on one pole.
3. The Contractor shall provide single pole 120 VAC breakers, or 208/240 VAC multi-pole breakers with a minimum interrupting rating of 10,000 RMS symmetrical amperes at rated voltage. For each breaker, the Contractor shall provide typewritten circuit identification mounted inside the door for identifying the outlet served.

8.54 **Outlets & Adapters**

Outlets shall consist of single or double gang wall plates equipped with 8-position modular jacks or as specified in the Project and TIA 568-C standard. All outlet cabling shall terminate at the associated intermediate distribution frame. Unless otherwise noted on the floor plans or specified, Contractor will provide all jacks for 24 AWG copper cables with the following specifications:

- 8.54.1 8-position/ 8-conductor modular with insulation displacement, universal application, multivendor supportive, and accepting phone and data plugs.
- 8.54.2 Contain blank module inserts for all unused module locations. Jack module arrangement shall be as required by the specific Project. The Contractor shall provide color-coded inserts at each outlet and at patch panels as specified.
- 8.54.3 All outlets shall be identified in accordance with TIA 606-A.
- 8.54.4 Modular furniture adapters shall snap directly into the standard cutouts in most major modular furniture systems and include any spacers or adapters to ensure a proper fit when used with the panels. The Contractor shall coordinate adapter with modular furniture being supplied prior to ordering.
- 8.54.5 Floor box adapters shall snap directly into the standard cutouts in most major floor boxes and include any spacers or adapters to ensure a proper fit when used with the panels. The Contractor shall coordinate the adapter with floor boxes provided prior to ordering.

8.55 **Utility Telephony Connections**

Contractor will originate wiring utilized for a telephone company central office-based voice, video, and data services at the wall-mounted cross-connect provided by the telephone company per the State of Florida Public Service Commission rules and regulations. The Contractor will locate this service demarcation field in the MDF and

shall originate it at a RJ-21X cross-connect. Contractor will install, terminate, and identify the wiring between the demarcation cross-connect and the premise distribution system in accordance with the specifications herein. The Contractor will identify each telephone company telephone number on the inside cover of the RJ21X.

8.56 Voice Termination, Backbone, and Riser Modular Tower Systems

The Contractor will follow the following specifications with regard to voice termination, backbone, and riser modular tower systems:

- 8.56.1 The Contractor shall provide a modular tower system to provide high-density field terminations, cross-connections, and cable management that are designed for wall mount. The Contractor shall provide assemblies for vertical cable routing including vertical cable managers. Assembly shall include mounting hardware consisting of alternate rows of 110 wiring blocks and horizontal managers and a cable manager at the bottom of the unit. The system shall be securely fastened by the Contractor to the telecommunication backboard, with all required D-rings or other approved cable guides as required, providing an organized and orderly installation.
- 8.56.2 Voice distribution frame locations shall be equipped with 110 patch blocks for termination of voice station and cross-connect cable pairs. The station field blocks shall be supplied by the Contractor as dictated by cable counts with 10 percent spare capacity on total voice cables indicated. Designation strips shall meet the ANSI/TIA/EIA 606 Standards. The Contractor shall terminate all cables in numerical sequence.
- 8.56.3 The termination block shall support the appropriate Category 3, Category 5e, Category 6, or Category 6a applications and facilitate cross-connection and inter-connection using either cross-connect wire or patch cords.
- 8.56.4 The wiring blocks shall be fire retardant molded plastic, with the base consisting of horizontal index strips for terminating 25 pairs of conductors each. To establish pair location, the index strips shall be marked with five colors on the high teeth, separating the tip and ring of each pair. A series of fanning strips shall be located on each side of the block for dressing the cable pairs terminated on the adjacent index strips. Clear label holders with the appropriate colored inserts shall be provided with the wiring blocks. The insert labels shall contain vertical lines spaced on the basis of circuit size (3, 4, or 5 pair) and shall not interfere with running, tracing, or removing jumper wire or patch cords. Separation of the backbone sections is required with two sections of cable managers if the backbone sections are located in the same tower.

8.57 110 Cross-Connect

Contractor will match the 110 cross-connect terminations with the termination on the 110 type communications outlet so that the color codes at both terminations will be the same and the color code will match the cable being installed. The connector shall allow many reconnections with consistent repeatable performance. The cross-connect shall be UL Listed and meet NFPA 70 standards, 47 CFR 15 and 47 CFR 68 standards, and the manufacturer shall be ISO 9001 certified. Contractor will ensure that the 110 blocks meet the following physical requirements:

wire insulation:

Size: 0.050 inches diameter over Dielectric Maximum for top of connecting block
0.07 inches diameter over Dielectric Maximum for bottom of connecting block

Types: all plastic insulants (including PVC, irradiated PVC, Polyethylene, polypropylene, PTFE Polyurethane, Nylon, Teflon)

terminations:

Solid: wire ranges 22 to 26 AWG
greater than 200 terminations

Stranded: 7 strands
wire ranges 22 to 26 AWG
greater than 200 terminations

Wire termination: insulation displacement, slotted beam contact

Wire insertion force: 13 to 28 pound-force

Wire pullout force: 2.2 pound-force

Reconnects: 500 repeated insertions

Wire retention force: horizontal 8 pound-force (36 newtons), vertical 2 pound-force (9 newtons)

Contact material: phosphor bronze

Plating for IDC: solder plate (60 percent tin/40 percent lead)

Temperature: 14 degrees Fahrenheit to 140 degrees Fahrenheit

Humidity: 95 percent (noncondensing)

8.58 Elevator Conduit & Cable

Where the elevator control room is located at the top of the building, the Contractor shall install a one-inch conduit from the telecommunication space located on the upper most floor to each elevator control room. Where the elevator control room is located on the lowest floor of the building the Contractor shall provide a one-inch conduit from the telecommunication space located on the lower most floor to each elevator control room. The conduit shall originate in the vicinity of the 110 termination blocks and terminate in a four-inch square telecommunication outlet box, with a voice jack, located as requested by the Project or MAC specifications or the Project Contact. The Contractor shall install one Category 5e cable from the outlet box to the voice demarcation point.

8.59 Fire Alarm Conduit & Cable

The Contractor shall install a one-inch conduit from the telecommunication space located closest to the fire alarm panel. The conduit shall originate in the vicinity of the 110 termination blocks and terminate in a 4-inch square telecommunication outlet box, with two voice jacks, located as requested by the Project specifications or the Project Contact. The Contractor shall install two Category 5e cables from the outlet box to the voice demarcation point.

8.60 Security Alarm Conduit & Cable

The Contractor shall install a one-inch conduit from the telecommunication space located closest to the security alarm panel. The conduit shall originate in the vicinity of

the 110 termination blocks and terminate in a 4 inch square telecommunication outlet box, with a voice jack, located as requested by the Project specifications or the Project Contact. The Contractor shall install one Category 5e cable from the outlet box to the voice demarcation point.

8.61 T1 Transmission

The Contractor shall provide outlets and circuit wiring for video teleconferencing over T1 transmission lines. The T1 service cable shall be run from the T1 outlet jack to the T1 demarcation outlets as required by the Project or MAC. Each T1 demarcation outlet shall include a RJ48X miniature, non-keyed, 8-position 8-wire jack for each T1 outlet. Each T1 outlet shall include two TIA 568-C 8-position Category 5e modular voice (telephone) jacks connected to a four pair Category 5e cable and one RJ48X miniature. This T1 jack shall be non-keyed, 8-position 8-wire jack with shorting bars on pins 1 & 4 and 2 & 5, 110 type terminations shall be connected to a four pair Category 5e cable.

8.62 Directional Buried Cable Placement

8.62.1 Static or vibratory plow installation will be considered on a case-by-case basis as required.

8.62.2 The Contractor shall furnish all labor, materials, tools, and equipment to install fiber cable with minimal surface damage or disruption of above ground activities.

8.62.3 The Contractor shall assure that the prime mover horsepower is sufficient for the soil type and cable depth required. The Contractor shall provide tracked or wheeled prime movers dependent on the route placement.

8.62.4 Should the Contractor subcontract out these directional buried cable placement services, the Contractor shall obtain written approval from the DMS Product Manager, noting the Subcontractor's business name, Subcontractor's representative name and contact information, and written certification of the following:

1. The Subcontractor shall have at least three (3) years of successful installation experience on similar directional buried cable placement installations. The Subcontractor shall have at least three (3) years of successful installation experience on directional buried cable installations.

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