



Prosper Independent School District
Division of Purchasing

Data and Wireless Network

REQUEST FOR PROPOSAL (RFP) No. 01-2017-ERATE-01

April 5, 2017

Proposals shall be received by 1pm on May 3, 2017.

Proposals shall be delivered to:

Prosper ISD
c/o Business Office
605 East Seventh Street
Prosper, Texas 75078

Written by:

Russ Johnson

Shane Jacobus

Tony Chojnowski, RCDD/OSP, RTPM



PO Box 2169
Hewitt, Texas 76643
www.TNCG.com

Prosper ISD

Data Network, Wireless and Cabling Systems

Request for Proposal

RFP#: 01-2017-ERATE-01

Scope and Specifications of the Proposal

SCOPE: The intent of the RFP is to procure data network and wireless equipment to support a District-wide communication system for Prosper ISD. The District intends to seek E-Rate funding for eligible services contained herein.

Prosper ISD reserves the right to modify the Scope and Specifications as circumstances require, including but not limited to adding, changing, or deleting proposed locations.

By signing this Request for Proposal form, the Respondent guarantees compliance with the provisions stated in this Request for Proposal and agrees to the Terms and Conditions stated in this Request for Proposal.

The Request for Proposal form shall be signed in ink and returned by the stated date and time in order to be considered for an award.

PROPOSAL SUBMITTED BY:

(Company Name)

(Address)

(State/Zip Code)

(Typed Name of Person Submitting the Proposal)

(Phone #) (Fax #)

(Date of Proposal Submission)

IMPORTANT DATES:

RFP Issued: April 5, 2017

Questions Due By: April 8, 2017, 2:00 PM CST

Response to Questions Issued: April 14, 2017, 5:00 PM CST

Due Date for Responses: May 3, 2017, 1:00 PM CST

SUBMITTAL REQUIREMENTS: One original and two complete copies for a total of three (3) complete hard copy sets (each copy contains USB drive with PDF version) of the Proposal shall be submitted on or before 1:00 PM CST, May 3, 2017. Send proposals to the following address:

Failure to include ***all documents***, including proposal bonds, insurance, et cetera, from the original with the copies may result in disqualification.

One original and two (2) complete copies:
Prosper ISD 605 East Seventh Street Prosper, TX 75078 Attn: Business Office

The Proposal is to be signed only by persons authorized to enter into a contract with Prosper ISD.

RESPONDENT’S SIGNATURE

COMPANY NAME

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1 DEFINITIONS AND BACKGROUND INFORMATION

1.01 Definitions

- A. Owner: Prosper Independent School District (also referred to as PISD).
- B. District: Prosper Independent School District (also referred to as PISD).
- C. Consultant: The entity contracted by the District to act as the Owner's representative. This entity is True North Consulting Group.
- D. Respondent/Proposer: The entity submitting a proposal in response to this RFP.
- E. Contractor: The entity contracted by the District to provide and implement the data network systems and services specified within this RFP.
- F. MDF or MER: Main Distribution Frame, also known as main equipment room, MER, or head-end. The primary location in a building for network systems and the point of interconnection for all technology rooms.
- G. IDF or TR: Intermediate distribution frame or technology room – a dedicated room for network and telecommunications infrastructure.

2 SUBMITTAL REQUIREMENTS AND PROPOSAL FORMAT

2.01 Proposal Clarification Questions: After reviewing all proposals received in response to this RFP, the District may develop a list of clarification questions to be addressed by the Respondent. The District or its agent shall send these questions to the Respondent for clarification. The Respondent shall provide a response within three (3) working days following the inquiry.

2.02 Submittal Requirements: Proposals shall be submitted by tab number as instructed below. The Respondent agrees and shall comply with all provisions and specifications as stated in this RFP unless otherwise stated in the Exceptions section of this RFP. Any additional cost or factors to meet a specification or requirement shall be noted in the Exceptions section. Failure to respond to these requirements may result in the proposal being considered non-responsive.

A. Tab 1 – Minimum Criteria

- 1. Cover letter – with overall price, any special conditions, and signature.
- 2. A brief profile of the firm, including the following:
 - a. A brief history of the business
 - b. Organizational structure of business, including principals and officers

3. The overall qualifications of the business to provide the services requested.
- B. Tab 2 – Required Documents
1. Conflict of Interest Questionnaire and Instructions
 2. Felony Convictions Notice
 3. Criminal Background Certification (SB9)
 4. Statement of Debarment
 5. Certificate of Residency
 6. Affidavit of Non-discrimination
 7. Statement of Non-collusions
 8. Proposal Bond (Original with seal to be included in original Proposal.)
 9. Proof of required insurance
 10. Certifications and/or letter from manufacturer(s) that the firm is an authorized installer and maintenance provider.
- C. Tab 3 – Executive Summary/Overview
1. Written summary of the understanding of the scope of work to be performed.
 2. Technical summary of the system proposed, including details about any “improvements” over and above the base request (e.g., resiliency/redundancy, system management, database consolidation, or larger number of ports).
- D. Tab 4 – Cost & Bill of Materials
1. Proposal Form and Cost Detail
 2. Provide separate pricing sheets for each section contained herein, inclusive of labor and maintenance
- E. Tab 5 – Respondent Assumptions
- F. Tab 6 – Installation Methodology and Drawings
- G. Tab 9 – Acceptance Testing
- H. Tab 10 – Contractor Qualifications, Support Capabilities, and References
- I. Tab 12 – Project Team and Maintenance Team Resumes/Certifications
- J. Tab 13 – Exceptions and Clarifications

- K. Tab 14 – Exhibits
- L. Tab 15 – Value-Add

2.03 Exceptions to the RFP: Respondents may find instances where they shall take exception with certain requirements or specifications of the RFP. All exceptions shall be clearly identified in the Exceptions section, and written explanations shall include the scope of the exceptions, the ramifications of the exceptions for the District, and a description of the advantage to be gained or disadvantages to be incurred by the District as a result of these exceptions.

2.04 Alternate Proposals: Respondents who wish to submit an alternate proposal may do so. If more than one proposal is submitted, all shall be complete and comply with the instructions set forth in this RFP.

2.05 Respondent Contact/Questions about the RFP:

- A. This RFP was a joint effort between True North Consulting Group and Prosper ISD. Respondent communications shall be limited to contacts defined herein. Failure to comply with this provision may result in disqualification or evaluation penalty.
- B. It shall be the Respondent’s responsibility to learn all aspects of the RFP requirements. Should any details necessary for a clear and comprehensive understanding be omitted or any error appear in the RFP documents, or should the Respondent note facts or conditions that in any way conflict with the letter or spirit of the RFP documents, it shall be the responsibility of the Respondent to obtain clarifications before submitting a proposal.
- C. Questions may be submitted (by email only) before the due date listed above. After that time, no further questions shall be accepted.
- D. Submit questions to: Shane Jacobus. All questions shall be via email to Shane.Jacobus@TNCG.com. Addenda will posted on the ERate Productivity Center (EPC) portal.

2.06 Addenda: It is incumbent upon each Respondent to carefully examine all specifications, terms, and conditions contained herein. Any inquiries, suggestions, or requests concerning interpretation, clarification, or additional information shall be made in writing, through the recipient named above. The District shall not be responsible for any oral representation(s) given by any employee, representative, or others. The issuance of a written addendum is the only official method by which

interpretation, clarification, or additional information can be given. Addenda shall be signed and included in the RFP response.

- 2.07 Request for Proposal:** It is the sole responsibility of the Respondent to ensure that they have received the entire Request for Proposal. RFP will be posted and made publicly available to all Respondents at on the ERate Productivity Center (EPC) portal.
- 2.08 Proposal Security Bond:** A Proposal Bond in the amount of 5% of the proposal price, payable to Prosper ISD, is required for this RFP. The Proposal Bond can be in the form of a bond, cashier's check, or irrevocable letter of credit (ILOC). The bond shall be issued by an agency authorized to do business in the State of Texas with a rating of "A" or higher as listed in the A.M. Best & Company latest published rating guide. The bond, cashier's check, or ILOC shall not expire until the Contract is awarded and shall guarantee that (1) a Respondent shall not withdraw its proposal after the closing time and date of this RFP, or (2) the awarded Respondent shall promptly execute a Contract and deliver any required specifications required by the District prior to start-up of the Contract. The bond, cashier's check, or ILOC shall be invoked by the District to ensure payment of the Contractor for damages incurred by withdrawal of a proposal, or failure to enter into a Contract after award. Proposal bonds, without interest, shall be returned upon receipt of appropriate insurance documents. No proposal shall be considered without a proper form of security.
- 2.09 SB-9:** All personnel working on any PISD facilities shall obtain through the state and national criminal history background searches DPS criminal history (Fingerprint-based Applicant Clearinghouse of Texas – FACT). In order for Contractors to receive the information through FACT, they shall first establish an account with the DPS for FACT clearinghouse access. The Company owner shall sign a user agreement with the DPS.
- 2.10 Descriptive Material:** The District is not responsible for locating or securing any information that is not identified in the Respondent's proposal and reasonably available to the District. To ensure that sufficient information is available, Respondent shall furnish as a part of the proposal all descriptive material necessary for the District to (1) determine whether the product offered meets the requirements of the RFP and (2) establish exactly what the Respondent proposes to furnish in terms of supplies, materials, and services.
- 2.11 Subcontractors:** The use of subcontractors is permitted. The Contractor and its subcontractors is solely responsible for understanding the full scope of the project and determining its ability to perform under all requirements set herein.
- 2.12 Request for Additional Information:** Prior to the final selection, Respondents may be required to submit additional information regarding the Respondent's

qualifications and experience that the District may deem necessary to further evaluate the proposal's qualifications.

- 2.13 Proposal Award:** The RFP consists of a base proposal configuration that shall be accepted or rejected in its entirety and proposal options that the District may accept or reject individually without regard to the listing order of the option, but only as the District determines is in its best interest.
- 2.14 Right to Accept/Reject:** The District reserves the right to reject any or all proposals and waive any irregularities. The District also reserves the right to choose the proposal that is deemed in the best interest of the District based on any or all criteria, etc. In addition, the District reserves the right to negotiate any or all items and terms of proposal.
- 2.15 After Hours Cost:** Any cutover that the District deems to be disruptive to District business shall take place after hours (at a time to be determined). These costs shall be included in the total price presented in the RFP response.
- 2.16 Denial of Reimbursement:** The District shall not reimburse Respondents for any costs associated with the preparation and submittal of any proposal, or for any travel and/or per diem costs that are incurred.
- 2.17 Gratuity Prohibition:** Respondents shall not offer any gratuities, favors, or anything of monetary value to any official, employee, or agent of Prosper ISD for the purpose of influencing consideration of this proposal.
- 2.18 Proposal Acceptance/Rejection:** The District reserves the right to accept or reject any or all proposals received as a result of this RFP, or to negotiate separately with competing Respondents, and to waive any informalities, defects, or irregularities in any proposal, or to accept the proposal or proposals that, in the judgment of the proper officials, are in the best interest of the District.
- 2.19 Proposal Acceptance Period:** Any proposal in response to this solicitation shall be valid for 90 days after the proposal due date. At the end of this time, the proposal may be withdrawn at the written request of the Respondent if no award has been made. If the proposal is not withdrawn at that time, it remains in effect until an award is made or the solicitation is canceled, regardless of the status of the Proposal Bond. The District reserves the right to request an extension of the proposals.
- 2.20 Rights to Submitted Material:**
- A. All proposals, responses, inquiries, or correspondence relating to or in reference to this RFP, and all reports, charts, and other documentation submitted by Respondents shall become the property of Prosper ISD when received.

- B. The District reserves the right to retain all proposals submitted and to use any ideas in a proposal regardless of whether that proposal is selected. Submission of a proposal indicates acceptance by the Respondent of the conditions contained in this Request for Proposal.

2.21 Open Records Act / Texas Public Information Act

- A. Texas Government Code, Chapter 552, gives you the right to access government records; and an officer for public information and the officer's agent may not ask why you want them. All government information is presumed to be available to the public. Certain exceptions may apply to the disclosure of the information. Governmental bodies shall **promptly** release requested information that is not confidential by law, either constitutional, statutory, or by judicial decision, or information for which an exception to disclosure has not been sought. See https://www.texasattorneygeneral.gov/files/og/publicinfo_hb.pdf for more information.

2.22 Confidential and Proprietary Information:

- A. The Respondent may mark any confidential and proprietary documentation that it claims is not subject to the Open Records Act / Texas Public Information Act.
- B. It is the sole responsibility of the Respondent to clearly note any confidential and proprietary documentation.
- C. Marking a document as confidential and proprietary does not supersede the Texas Government Code, Chapter 552.
- D. Questions regarding the eligibility of the confidential and proprietary information is governed by the Texas Government Code, Chapter 552, and the Office of the Attorney General.

2.23 Selection Criteria: Proposals shall be evaluated based on, but not limited to, the following criteria:

- A. Cost – The price included in the RFP response shall be the price evaluated. There SHALL NOT be an opportunity for a BEST AND FINAL OFFER. Respondent is encouraged to include their best prices in their initial response. Evaluation shall include up-front and maintenance costs as well as long-term price protection.
- B. Technology – Ability to meet the District's technology configuration goals, hardware/network configuration, feature functionality, systems management, and compatibility with existing systems.

- C. Respondent/Manufacturer – Financial stability, strong references, installation methodology, project and maintenance teams experience and certifications, long term product support.
- D. Support – Number of trained technicians, remote and on site response time guarantee, dispatch distance, and adherence to maintenance requirements.

Evaluation Criteria		
Item	Description	Percentage Possible
1	Cost	30%
2	Ability to execute and perform: Length of time in business, financial strength, number of active customers, and provider infrastructure.	15%
3	Technology: Ability to meet the district's technical requirements and compatibility with existing systems.	15%
4	Support: Number of trained technicians, remote and on-site response time guarantee, dispatch distance, and adherence to maintenance agreements.	10%
5	Understanding of requirements: Scope of work, bill of materials	10%
6	References	10%
7	Quality of Proposal	5%
8	Value-Add: Additional services and/or products that the Respondent is adding into their proposal that adds additional value to their proposal.	5%
	Total Points	100%

2.24 Selection Committee: Proposals shall be evaluated by a Selection Committee. The Selection Committee may, at its option, enter into final negotiations with the top Respondent(s).

2.25 Submittal of Qualifications: Respondents should submit experience and qualifications as described in the RFP. Additional information may be submitted as appropriate to further describe vendor and provide product capabilities.

3 TERMS AND CONDITIONS

3.01 Contract: The contract between Prosper ISD and the Contractor shall consist of (1) the Request for Proposal (RFP) and any amendments thereto and (2) the proposal submitted by the Contractor in response to the RFP. In the event of a conflict in language between these two documents, the provisions and requirements set forth and/or referenced in the RFP shall govern. The District also reserves the right to clarify any contractual relationship in writing with the concurrence of the Contractor, and such written clarification shall govern in case of conflict with the applicable requirements stated in the RFP or the Contractor's proposal. In all other matters not affected by the written clarifications, if any, the RFP shall govern.

3.02 Termination/Cancellation of Contract: Prosper ISD may cancel the contract at any time for breach of contractual obligation, convenience, or non-appropriation of funds by providing the Contractor with a written notice of such cancellation. Should the District exercise its right to cancel the contract for such reasons, the cancellation shall become effective on the date as specified in the notice of cancellation sent to the Contractor.

3.03 Compliance with Laws: In connection with the furnishing of supplies or performance of work under the contract, the Contractor agrees to comply with the Fair Labor Standard Act, Equal Opportunity Employment Act, and all other applicable Federal and State laws, regulations, and executive orders to the extent that the same may be applicable, and further agrees to insert the foregoing provision in all subcontracts awarded hereunder.

Contractors shall certify that all equipment, services, and/or goods provided to the District comply with the Department of Justice ADA Title III Regulations.

3.04 Governing Law: This Contract shall be governed by and interpreted or construed in accordance with the laws of the State of Texas, and shall be subject to the exclusive jurisdiction of the courts therein. Venue for any court action brought by either party under this Contract shall remain exclusively in Collin County, Texas.

3.05 Indemnification: The Contractor agrees it shall defend, indemnify, and hold harmless the District, its officers, and its employees against any and all liability, loss, costs, damages, and expenses, including attorney's fees that the District, its officers, or its employees may hereafter sustain, incur, or be required to pay arising out of the negligent or intentional acts or omissions of the Contractor's officers or employees

3.06 Insurance

- A. The Contractor agrees, in order to protect itself and the District under the indemnity provision set forth above, to at all times during the term of this

contract have and keep in force insurance policies that meet or exceed the following limits:

1. A commercial general liability insurance policy in the amount of not less than \$300,000.00 for property damage sustained by any one person, \$300,000.00 for injury and/or damage to any one person, and \$1,000,000.00 for total injuries and/or damages arising from any one accident. The Contractor agrees to name the District as an additional insured on said policy.
 2. An automobile liability insurance policy, including non-owned and hired autos, in the minimum amount of \$300,000.00 for injury and/or damages to any one person, \$300,000.00 for property damage, and \$1,000,000.00 for total injuries and/or damages arising from any one accident. The Contractor agrees to name the District as an additional insured on said policy.
 3. Workers Compensation insurance in the statutory amounts.
- B. Certificates of insurance showing the coverage listed above shall be provided to the District prior to the effective date of this contract, and the District shall be named as an additional insured under the liability policy required above.

3.07 Performance and Payment Bonds: Prior to commencement of work hereunder, Proposer will provide a "Performance Bond" and a "Payment Bond", each in principal amount equal to 100% of the contract amount, conditioned that Proposer will faithfully perform all undertakings in the contract and will fully pay all persons furnishing labor and material in the prosecution of the work provided for in the contract. Any costs associated with project bonding is the sole responsibility of the vendor and shall not be itemized or listed as any part of the proposal.

- A. All Bonds shall be written by a bonding company (insurance company) that is duly authorized to do business in the State of Texas, and which meets all requirements of Texas law in connection with its issuance of Bonds hereunder.
- B. If any surety upon any Bond becomes insolvent or otherwise ceases to do business in the State of Texas, Proposer shall immediately furnish equivalent security to protect the interests of PISD and of persons furnishing labor and materials in the performance of the work under the Contract.
- C. If the amount of the Bond is in an amount in excess of ten percent (10%) of the surety company's capital and surplus, PISD, as a condition to accepting the Bond, will require written certification that the surety company has reinsured the portion of the risk that exceeds 10% of the surety company's capital and surplus with one or more reinsurers who are duly authorized, accredited, or trusted to do business in the State of Texas.

- D. If any surety upon any bond becomes insolvent or otherwise ceases to do business in this State, the Proposer shall promptly furnish equivalent security to protect the interests of PISD and of persons furnishing labor and materials in the prosecution of the work.
- E. The Contractor shall deliver the bonds not later than the 10th day after the date the Contractor executes the contract unless the Contractor furnishes a bid/proposal bond or other financial security acceptable to the District.

3.08 Prevailing Wage Rates: Contractor will abide by the prevailing wage rates for Collin County, Texas.

3.09 Safety: Contractor shall take the necessary precautions and bear the sole responsibility for the safety of the methods employed in performing the work. The Contractor shall at all times comply with the regulations set forth by federal, state, and local laws, rules, and regulations concerning OSHA and all applicable state labor laws, regulations, and standards. The Contractor shall indemnify and hold harmless the District from and against all liabilities, suits, damages, costs, and expenses (including attorney's fees and court costs) that may be imposed on the District because of the Contractor's, Subcontractor's, or supplier's failure to comply with the regulations.

3.10 Ownership of Work Product(s): Any work product, including but not limited to software programs, documentation, memoranda, correspondence, and/or files generated by the Contractor in the course of this work for the District is the sole property of the District. All work products shall be surrendered to the District at the completion of the Contract. The Contractor shall prepare and maintain all records required by the District to substantiate the amount and types of services rendered and for other purposes. The District shall inform the Contractor of the need for and nature of all such records.

3.11 Warranty: In a contract resulting from this RFP, Contractor shall warrant that during the warranty period, all hardware, equipment, and licensed software (including third-party software installed or recommended by Contractor or its subcontractors) of the installed systems shall perform at a minimum in all material aspects within the specifications and functional requirements defined by the Scope of Service/Work of the RFP. The foregoing representations and warranties shall be in force as to each version or release of software, system, components, networks, and equipment.

3.12 Independent Contractor: Nothing contained in this agreement is intended or should be construed as creating the relationship of co-partners or joint ventures within the District. The Contractor shall remain an independent Contractor, and all employees of the Contractor or its subcontractors shall remain the employees of the Contractor or subcontractor and shall not become the employees of the

District. No tenure or any rights or benefits, including worker's compensation, unemployment insurance, medical care, sick leave, vacation leave, severance pay, or other benefits available to District employees shall accrue to the Contractor or employees of the Contractor performing services under this agreement.

3.13 Nondiscrimination: All Contractors agree that during the life of the contract, the Contractor shall not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, marital status, disability, sexual orientation, age, religion, or status with regard to public assistance, and shall intend a similar provision in all subcontracts entered into for the performance thereof. All proposals shall be accompanied by a signed statement of this fact, with failure to sign reason for proposal rejection.

3.14 Default and Cancellation:

- A. If the Contractor fails to perform any of the provisions of this Request for Proposal or so fails to administer the work as to endanger the performance of the contract, this shall constitute default. Unless the Contractor's default is excused, the District may, upon written notice, immediately cancel this agreement in its entirety.
- B. Back orders, failure to meet delivery requirements, or failures to meet specifications in the contract authorizes the ordering entity to cancel the contract, or any portion of it, purchase elsewhere, and charge the full increase in cost and administrative handling to the defaulting Contractor. In the event of default, the District reserves the right to pursue any other remedy available by law. A Contractor may be removed from the Contractors list, suspended, or debarred from receiving a contract for failure to comply with terms and conditions of the contract or for failure to pay the District for the cost incurred on the defaulted contract.

3.15 Severability: Every section, provision, or part of this agreement is declared severable from every other section, provision, or part thereof, to the extent that if any section, provision, or part of this agreement shall be held invalid by a court of competent jurisdiction, it shall not invalidate any other section, provision, or part thereof.

3.16 Third-Party Products: Contractor agrees to assign or pass through to the District or otherwise make available for the benefit of District, any manufacturer's or supplier's warranties applicable to any third-party software, hardware, or equipment or provided by Contractor or its subcontractors under a contract resulting from this RFP.

3.17 Title to Software: By submitting a proposal, the Respondent represents and warrants that it is the sole owner of the software or, if not the owner, that it has

received all legally required authorizations from the owner to license the software, has the full power to grant the rights required by this solicitation, and that neither the software nor its use in accordance with the contract shall violate or infringe upon any patent, copyright, trade secret, or any other property rights of another person or organization.

- 3.18 New Material:** Unless otherwise provided for in this specification, the Respondent represents and warrants that the goods, materials, supplies, or components offered to the District under this RFP solicitation are new; not used or reconditioned. It represents that they are not of such age or so deteriorated as to impair their usefulness or safety and that the goods, materials, supplies, or components offered are current production models of the respective manufacturer.
- 3.19 Order of Precedence within RFP:** Technological solicitations are based on requirements as detailed in the scope of work and/or services. These requirements may be accompanied by drawings or schematics for clarification purposes. The requirements take precedence over the drawings or schematics. The Respondent shall be responsible for providing a turnkey solution based on the requirements. The Respondent shall be responsible for the cost of any system component, including but not limited to hardware, software, or services, not included by the Respondent's response to deliver the requested turnkey solution.
- 3.20 Ownership of Intellectual Property:** All copyright and patent rights to all papers, reports, forms, materials, creations, or inventions created or developed in the performance of this contract shall become the sole property of the District. Upon request, the Respondent shall promptly provide an acknowledgment or assignment in a tangible form satisfactory to the District to evidence the District's sole ownership of specifically identified intellectual property created or developed in the performance of the contract. This excludes ownership of proprietary software belonging to the vendor, except software developed specifically for the District for which the District pays.
- 3.21 Term of Software License:** Unless otherwise stated in the solicitation, the software license(s) identified in the pricing schedule shall be purchased on a perpetual basis and shall continue in perpetuity. The District reserves the right to terminate the license at any time, although the mere expiration or termination of this contract shall not be construed as intent to terminate the license. All acquired license(s) shall be for use at any computing facilities, on any equipment, by any number of users, and for any purposes for which it is procured. The District further reserves the right to transfer all rights under the license to another state agency to which some or all of its functions are transferred.
- 3.22 Third Party Acquisition of Software:** The Contractor shall notify the District in writing should the intellectual property, associated business, or all of its assets be

acquired by a third party. The Contractor further agrees that the contract's terms and conditions, including any and all license rights and related services, shall not be affected by the acquisition. Prior to completion of the acquisition, the Contractor shall obtain for the District's benefit and deliver thereto the assignee's agreement to fully honor the terms of the contract.

3.23 Return of Assets: Except as otherwise provided in the Contract, or upon termination of the Contract, the Contractor shall return all District-owned assets, including but not limited to stored data and information.

3.24 Excessive Downtime: Equipment or software furnished under the contract shall be capable of continuous operation. Should any part of the equipment or software become inoperable for a period of more than four (4) hours, the Contractor agrees to repair and/or replace the failed components.

3.25 Firearms: No provider of services pursuant to this Contract, including but not limited to employees, agents, or subcontractors of the Contractor, shall carry or possess a firearm on District premises or while acting on behalf of Prosper ISD pursuant to the terms of this agreement. Violation of this provision shall be considered a substantial breach of the Agreement and is grounds for immediate suspension or termination of this contract.

3.26 Other Contract Terms:

A. Compliance with Laws/Standards

1. General: The Contractor shall abide by all Federal, State, and local laws, statutes, ordinances, rules, and regulations now in effect or hereinafter adopted pertaining to this Contract or to the facilities, programs, and staff for which the Contractor is responsible.
2. Licenses and Permits: The Contractor shall procure all licenses, permits, or other rights necessary for the fulfillment of its obligation under this Contract. The Contractor indemnifies, saves, and holds harmless the District and any agents, commissioners, officers, employees, or volunteer workers thereof from any and all claims, demands, actions, or causes of action of whatsoever nature or character arising out of, allegedly arising from, or related to the execution or performance of the services of the successful Contractor provided for herein.
3. Force Majeure: Neither party shall be held responsible for delay or failure to perform when such delay or failure is due to any of the following, unless the act or occurrence could have been foreseen and reasonable action could have been taken to prevent the delay or failure: fire, flood, epidemic, strikes, wars, acts of God, unusually severe weather, acts of public authorities, or delays or defaults caused by public carriers, provided the

defaulting party gives notice as soon as possible to the other party of the inability to perform.

4. **Inability to Perform:** Contractor shall make every reasonable effort to maintain staff, facilities, and equipment to deliver the services to be purchased by the District. The Contractor shall immediately notify the District in writing whenever it is unable to provide the agreed upon quality and quantity of services or reasonably believes it is going to be unable to provide this level of service. Upon such notification, the District shall determine whether such inability requires a modification or cancellation of this Contract.
- B. In the event the District terminates the Contract for cause in whole or in part as provided above, the District may procure, upon such terms and in such manner as the District may deem appropriate, services similar to those so terminated, and the Contractor shall be liable to the District for any excess costs for such similar goods or services. The Contractor shall continue the performance of the Contract to the extent not terminated under the provisions for this section.
- C. The rights and remedies of the District provided in this section shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.
- D. **Payment Terms:** Payment terms shall be event-based and negotiated with the successful vendor prior to contract signing. The District shall issue no payment until it has verified each invoice. The District shall retain at least 10% of all authorized payments until acceptance of the work is authorized.
- E. **E-Rate Discount:** Upon funding, the District may elect to require discounted E-Rate invoices from the Contractor for the purchase of E-Rate eligible services contained herein.
- F. **Software Licensing Agreements:** Within the RFP response, Contractor agrees to provide copies of software licensing agreements for all proposed software applications and operating systems.

4 PROPOSAL FORM AND COST DETAIL

4.01 Price Summary

To: Prosper Independent School District, Prosper TX

We, _____, a (joint venture)
(corporation)
(partnership)
(individual)
[Cross out inapplicable]

of _____
Street City County State Zip

Hereby agree to execute the proposed contract and to furnish a satisfactory Payment and Performance Surety Bond in the amount specified within ten (10) days of offering, and to provide all labor and material required for the construction of the project designated above, for the prices hereinafter set forth, in strict accordance with the RFP issued on April 4, 2017.

A. Base Proposal: Campus Core Electronics

Total base proposal for the work of this project is:

_____ DOLLARS (\$_____)

Base Proposal: Campus Access Electronics

Total base proposal for the work of this project is:

_____ DOLLARS (\$_____)

Base Proposal: Wireless LAN Systems

Total base proposal for the work of this project is:

_____ DOLLARS (\$_____)

Base Proposal: Category 6 Horizontal Cabling

Total base proposal for the work of this project is:

_____ DOLLARS (\$_____)

Base Proposal: Fiber Optic Cabling

Total base proposal for the work of this project is:

_____ DOLLARS (\$ _____)

Unit Pricing – Respondent shall provide a complete bill of material (BOM) with all equipment, quantities and unit pricing. This pricing shall be valid for a period of 2 months subsequent to project completion. BOM shall be in a similar format and contain at a minimum the information provided in the table below.

<u>Quantity</u>	<u>Part Number</u>	<u>Manufacturer</u>	<u>Description</u>	<u>Unit Price</u>	<u>Extended Price</u>

4.02 Commencement and Completion of Contract Work

The undersigned agrees, if awarded the contract, to commence the Contract work on a date to be specified in a written Notice to Proceed, and to complete the work timely in accordance with a mutually agreed upon executed schedule.

4.03 Addendum Receipt

We acknowledge receipt of the following Addenda:

Addendum No. _____ Date _____

Addendum No. _____ Date _____

Addendum No. _____ Date _____

Addendum No. _____ Date _____

4.04 Proposer’s Acknowledgement of Specifications and Requirements

By signing this proposal form, such action certifies that the Respondent has personal knowledge of the following:

- A. That said Respondent has examined in its entirety, this RFP and the drawings and specifications, has carefully prepared the proposal form, and has checked the same in detail before submitting said proposal; and that said Respondent, or the agents,

officers, or employees thereof, have not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive proposal in connection with this proposal.

- B. That all of said work will be performed at the Respondent's own proper cost and expense and that the Respondent will furnish all necessary materials, labor, tools, machinery, apparatus, and other means of construction in the manner provided in the applicable specifications and at the time dictated in the contract.

(Firm Name)

(Phone Number)

(Seal, if proposal is by a corporation) By: _____
(Signature of Proposer)

Date: _____

5 CONFLICT OF INTEREST QUESTIONNAIRE

CONFLICT OF INTEREST QUESTIONNAIRE	
For vendor or other person doing business with local governmental entity	
<p>This questionnaire reflects changes made to the law by H.B. 1491, 80th Leg., Regular Session.</p> <p>This questionnaire is being filed in accordance with Chapter 176, Local Government Code by a person who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the person meets requirements under Section 176.006(a).</p> <p>By law this questionnaire shall be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the person becomes aware of facts that require the statement to be filed. See Section 176.006, Local Government Code.</p> <p>A person commits an offense if the person knowingly violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor.</p>	<p>OFFICE USE ONLY</p> <hr/> <p>Date Received</p>
<p>1 Name of person who has a business relationship with local governmental entity.</p>	
<p>2</p> <div style="display: flex; align-items: center; margin-bottom: 10px;"> <input style="width: 30px; height: 30px; margin-right: 10px;" type="checkbox"/> <p>Check this box if you are filing an update to a previously filed questionnaire.</p> </div> <p>(The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)</p>	
<p>3 Name of local government officer with whom filer has employment or business relationship.</p> <p style="text-align: center; margin: 10px 0;">_____</p> <p style="text-align: center;">Name of Officer</p> <p>This section, (item 3 including subparts A, B, C & D) shall be completed for each officer with whom the filer has an employment or other relationship as defined by Section 176.001(1-a), Local Government Code. Attach additional pages to this Form CIQ as necessary.</p> <p>A. Is the local government officer named in this section receiving or likely to receive taxable income, other than investment income, from the filer of the questionnaire?</p> <p style="margin-left: 20px;"><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>B. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer named in this section AND the taxable income is not received from the local governmental entity?</p> <p style="margin-left: 20px;"><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>C. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership of 10 percent or more?</p> <p style="margin-left: 20px;"><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>D. Describe each employment or business relationship with the local government officer name in this section.</p>	
<p>4</p> <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div style="width: 60%; text-align: center;"> <p>_____</p> <p>Signature of person doing business with the governmental entity</p> </div> <div style="width: 30%; text-align: center;"> <p>_____</p> <p>Date</p> </div> </div>	

6 FELONY CONVICTION NOTICE

State of Texas Legislative Senate Bill No.1, Section 44.034, Notification of Criminal History, Subsection (a) states "a person or business entity that enters into a contract with a school district shall give advance notice to the district if the person or an owner or operator of the business entity has been convicted of a felony. The notice shall include a general description of the conduct resulting in the conviction of a felony."

Subsection (b) states "a school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district shall compensate the person or business entity for services performed before the termination of the contract."

This notice is not required of a Publicly-held Corporation.

I, the undersigned agent for the firm named below, certify that the information concerning notification of felony convictions has been reviewed by me and the following information furnished is true to the best of my knowledge.

Vendor's Name: _____

Authorized Company Official's Name (Printed): _____

a. My firm is a publicly held corporation; therefore, this reporting requirement is not applicable:

Signature _____ of _____ Company
Official _____

b. My firm is not owned nor operated by anyone who has been convicted of a felony.

Signature _____ of _____ Company
Official _____

c. My firm is owned or operated by the following individual(s) who has/have been convicted of a felony:

Name _____ of _____
Felon(s) _____

Details _____ of _____
Conviction(s) _____

Signature _____ of _____ Company
Official _____

7 SENATE BILL 9 AND INSTRUCTIONS**INSTRUCTIONS TO SCHOOL DISTRICT CONTRACTORS
Regarding Criminal History Background Searches****Under Senate Bill 9**

Senate Bill 9 directs school district Contractors (i.e., Company) to obtain state and national criminal history background searches on their employees who will have direct contact with students, and to receive those results through the DPS criminal history clearinghouse (Fingerprint-based Applicant Clearinghouse of Texas – FACT). In order for Contractors to receive the information through FACT, they shall first establish an account with the DPS for FACT clearinghouse access. The Company owner shall sign a user agreement with the DPS. To obtain the user agreement and more information, Company shall contact:

Access and Dissemination Bureau
Texas Department of Public Safety
Crime Records Service
P. O. Box 149322
Austin, Texas 78714-9322
Email: FACT@txdps.state.tx.us
Phone: (512) 424-2365

For fastest service, please email or call. State in the message that Company is a school district Contractor and needs to have an account established for DPS FACT clearinghouse access. Please include:

Company Name
Company Address
Company Phone
Name of Company point of contact
Phone of Company point of contact
Company email to be used for notification of FACT records and messages

The information in the DPS FACT Clearinghouse is confidential, and access shall be restricted to the least number of persons needed to review the records. The account shall include at least one designated supervisor to make necessary changes and to monitor the site's security and the access to the criminal history data retrieved. Additional users shall be limited to those who need to request, retrieve, or evaluate data regarding the individual applicants.

PLEASE NOTE: After the Company signs the DPS User Agreement for FACT, DPS will provide the Company with a revised **FAST Fingerprint Pass** that Company will have to provide to its employees and applicants. Company's employees and applicants will use that **FAST Fingerprint Pass** when scheduling their FAST fingerprinting.

Contractor Criminal Background Certification

Introduction: Texas Education Code Chapter 22 requires service Contractors to obtain criminal history record information regarding covered employees and to certify that fact to the District. Covered employees with disqualifying convictions are prohibited from serving at a school district.

Definitions:

Covered employees: All employees of a Contractor who have or will have continuing duties related to the service to be performed at the District and have or will have direct contact with students. The District will be the final arbiter of what constitutes direct contact with students.

Disqualifying conviction: One of the following offenses, if at the time of the offense, the victim was under 18 or enrolled in a public school: (a) a felony offense under Title 5, Texas Penal Code; (b) an offense for which a defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; or (c) an equivalent offense under federal law or the laws of another state; or (d) the conviction of a felony or misdemeanor that would disqualify a person from obtaining certification as an educator under Texas Education Code 21.060.

On behalf of _____ (“Contractor”), I certify that [check one]:

None of Contractor’s employees are *covered employees*, as defined above.

Or

Some or all of Contractor’s employees are *covered employees*. If this box is selected, I further certify that:

(1) Contractor has obtained all required criminal history record information, through the Texas Department of Public Safety, regarding its covered employees. None of the covered employees has a disqualifying conviction. Contractor has taken reasonable steps to ensure that its employees who are not covered employees do not have continuing duties related to the contract services or direct contact with students.

(2) If Contractor receives information that a covered employee has a disqualifying conviction, Contractor will immediately remove the covered employee from contract duties and notify the District in writing within three (3) business days.

(3) Upon request, Contractor will make available for the District’s inspection the criminal history record information of any covered employee. If the District objects to the assignment of a covered employee on the basis of the covered employee’s criminal history record information, Contractor agrees to discontinue using that covered employee to provide services at the District.

Noncompliance by Contractor with this certification may be grounds for contract termination.

Company Name: _____/Submitter's Name/Title: _____

Email Address: **(PLEASE TYPE EMAIL ADDRESS)** _____

Submitter's Signature: _____ Telephone No. _____

Fax No. _____ Date: _____

Address: _____ City, State and Zip Code: _____

This form is required to be completed and signed however, only the successful Contractors will be required to comply with requirement set forth in Act of May 28, 2007, 80th Leg., R.S., S.B. 9, § 30. All related costs including background checks/fingerprinting shall be at the Contractor's expense.

This sheet shall be completed, signed, and returned with Respondent's submittal

8 STATEMENT OF DEBARMENT

I have read the conditions and specifications provided in the proposal document attached.

I affirm, to the best of my knowledge, the company I represent has not been debarred or suspended from conducting business with any school districts in the State of Texas. This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 7 CFR Part 3017, Section 3017.510, Participants responsibilities. The regulations were published as Part IV of the January 30, 1989, Federal Register (pages 4722-4733). Copies of the regulation may be obtained by Contacting the Department of Agriculture Agency with which the transaction originated.

NAME OF COMPANY: _____

MAILING ADDRESS CITY STATE ZIP CODE: _____

PREPARED BY: _____

SIGNATURE TITLE: _____

TELEPHONE NUMBER: _____

FAX NUMBER DATE: _____

9 CERTIFICATE OF RESIDENCY

The State of Texas has passed a law concerning non-resident Contractors. This law can be found in Texas Education Code under Chapter 2252, Subchapter A. This law makes it necessary for the District to determine the residence of its Contractors. In part, this law reads as follows:

Section: 2252.001

(3) 'Non-resident' proposer refers to a person who is not a resident

(4) 'Resident proposer' refers to a person whose principal place of business is in this state, including a Contractor whose ultimate parent company or majority owner has its principal place of business in this state.

Section: 2252.002

"A governmental entity may not award a governmental contract to a nonresident Contractor unless the nonresident underbids the lowest proposal submitted by a responsible resident Contractor by an amount that is not less than the amount by which a resident proposer would be required to underbid the nonresident proposer to obtain a comparable contract in the state in which the nonresident's principal place of business is located.

I certify that _____
(Name of Company Proposing)

Is, under Section: 2252.001(3) and (4), a

_____ Resident Contractor _____ Non-resident Contractor (CHECK ONE)

I further certify that the principal place of business for the above-named company under Section: 2252.001 (3) and (4), is in the city of _____, State of _____

Signature of authorized company representative

Print Name

Title Date

10 AFFIDAVIT OF NON-DISCRIMINATION

Affidavit of Non-Discriminatory Employment

STATE OF TEXAS

COUNTY OF _____

AFFIDAVIT

Contractor or any subcontractors hired by contractor agrees to refrain from discrimination in terms and conditions of employment on the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and rules and regulations issued pursuant thereto in order to maintain and insure non-discriminatory employment practices.

Signature

Printed Name

Title

11 STATEMENT OF NON-COLLUSIONS

STATEMENT OF NON-COLLUSION

This is to certify that the undersigned proposer has neither directly nor indirectly, entered into any agreement, participated in any collusion, nor otherwise taken any action in restraint of free competitive RFP in connection with this proposal.

It is agreed by the undersigned proposer that the signed delivery of this proposal represents the proposer’s acceptance of the terms and conditions of this invitation to submit a proposal including all specifications and special provisions.

Note: Signature of the authorized representative MUST be of an individual who legally may enter his/her organization into a formal contract with the Prosper Independent School District.

FIRM’S NAME

NAME OF AUTHORIZED INDIVIDUAL (printed or typed)

AUTHORIZED SIGNATURE DATE

POSITION WITH COMPANY

12 PROPOSAL BOND

THE STATE OF TEXAS, COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

THAT we, _____

as Principal, and _____

as Surety, are hereby held and firmly bound unto Prosper ISD/Owner, hereafter called Obligee, in the penal sum of \$ _____ which is the full amount of Principal's contract with the named Obligee, for the payment of which sum the said Principal and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally firmly by these presents.

WHEREAS, the principal has entered into a written contract dated _____ with Obligee named, to do and perform certain construction work as provided in said contract and the related plans, specifications, general conditions and other contract documents, all of which are by reference made a part hereof.

NOW, THEREFORE, the conditions of this Obligation is such that if the Principal shall faithfully perform all of the work in accordance with the plans, specifications general conditions and contract documents, and shall faithfully perform each, every and all other obligations incumbent upon him under the terms of said written contract referred to, and shall fully indemnify and save harmless the Obligee from all costs, expense and damage which it may suffer or incur because of Principal's default, or failure so to do, then this obligation shall be void, otherwise it shall remain in full force and effect.

In the event Principal shall default in the faithful performance of the work called for by said written contract, plans, specifications and contract documents, the Surety shall within 15 days of the determination of default (determined as provided in said contract, general conditions and contract documents) take over and assume completion of said contract, or within such 15-day period make other arrangements satisfactory with the Obligee for completion of the contract, and said Surety shall become entitled thereupon to the payment or benefit of the balance of the contract price as the same matures according to its terms.

The Surety, for the protection of the Obligee herein, waives notice of, and hereby consents to any subsequent modification or alteration both in the work to be performed by the Principal, and the consequent price or sums to be paid by the Obligee, as well as any other change, or amendment, addition or deletion in the contract documents during the progress of the work, including but not limited to all extensions of time or other indulgences permitted the Principal.

Notwithstanding any other provision, the liability of the Surety on this bond shall never exceed the penal sum stated in first paragraph.

This Performance Bond is given in compliance with the terms and provisions of the Civil Statutes of the State of Texas, and this bond and all of the provisions herein contained shall be solely for the protection of the named Obligee, which has awarded the contract referred to.

The undersigned, corporate Surety, does by the execution of this Bond solemnly warrant and represent that it is duly authorized to do business in Texas.

Executed this _____ day of _____, 2017.

(Business Address)

(Individual Principal)

(Business Address)

(Corporate Principal)

ATTEST:

(Secretary)

(President)

(Surety Business Address)

(Corporate Surety)

ATTEST: _____

BY:

NOTE:

1. This bond must be payable to the awarding authority, Prosper ISD/Owner, as the named obligee, and it must be approved as to form by such awarding authority.
2. This bond must be furnished before any work is commenced.
3. Surety must be a corporate surety duly authorized to do business in Texas.
4. This PERFORMANCE BOND must be in the full amount of the contract, which it secures.
5. Attach Power of Attorney from Corporate Surety to this Performance Bond.

END OF SECTION

13 PERFORMANCE BOND FORM

THE STATE OF TEXAS

COUNTY OF _____)

THAT we, _____

As Principal, and _____

as Surety, are hereby held and firmly bound unto Prosper ISD/Owner, hereafter called Obligee, in the penal sum of \$ _____ which is the full amount of Principal's contract with the named Obligee, for the payment of which sum the said Principal and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally firmly by these presents.

WHEREAS, the principal has entered into a written contract dated _____ with Obligee named, to do and perform certain construction work as provided in said contract and the related plans, specifications, general conditions and other contract documents, all of which are by reference made a part hereof.

NOW, THEREFORE, the conditions of this Obligation is such that if the Principal shall faithfully perform all of the work in accordance with the plans, specifications general conditions and contract documents, and shall faithfully perform each, every and all other obligations incumbent upon him under the terms of said written contract referred to, and shall fully indemnify and save harmless the Obligee from all costs, expense and damage which it may suffer or incur because of Principal's default, or failure so to do, then this obligation shall be void, otherwise it shall remain in full force and effect.

In the event Principal shall default in the faithful performance of the work called for by said written contract, plans, specifications and contract documents, the Surety shall within 15 days of the determination of default (determined as provided in said contract, general conditions and contract documents) take over and assume completion of said contract, or within such 15-day period make other arrangements satisfactory with the Obligee for completion of the contract, and said Surety shall become entitled thereupon to the payment or benefit of the balance of the contract price as the same matures according to its terms.

The Surety, for the protection of the Obligee herein, waives notice of, and hereby consents to any subsequent modification or alteration both in the work to be performed by the Principal, and the consequent price or sums to be paid by the Obligee, as well as any other change, or amendment, addition or deletion in the contract documents during the progress of the work, including but not limited to all extensions of time or other indulgences permitted the Principal.

Notwithstanding any other provision, the liability of the Surety on this bond shall never exceed the penal sum stated in first paragraph.

This Performance Bond is given in compliance with the terms and provisions of the Civil Statutes of the State of Texas, and this bond and all of the provisions herein contained shall be solely for the protection of the named Obligee, which has awarded the contract referred to.

The undersigned, corporate Surety, does by the execution of this Bond solemnly warrant and represent that it is duly authorized to do business in Texas.

Executed this _____ day of _____, 2017.

(Business Address) (Individual Principal)

(Business Address) (Corporate Principal)

ATTEST:

(Secretary) (President)

(Surety Business Address) (Corporate Surety)

ATTEST: _____

BY:

NOTE:

1. This bond must be payable to the awarding authority, Prosper ISD/Owner, as the named obligee, and it must be approved as to form by such awarding authority.
2. This bond must be furnished before any work is commenced.
3. Surety must be a corporate surety duly authorized to do business in Texas.
4. This PERFORMANCE BOND must be in the full amount of the contract, which it secures.
5. Attach Power of Attorney from Corporate Surety to this Performance Bond.

14 SCOPE OF SERVICES

14.01 The District plans to seek ERate 2 funding for eligible services as indicated below:

- A. Category 2 – Campus level cabling, switching, and wireless networking.

14.02 Buildings include:

- A. Baker Elementary School – 3125 Bluewood Drive, McKinney, TX 75071
- B. Cockrell Elementary School – 1075 Escalante Trail, Prosper, TX 75078
- C. Folsom Elementary School – 800 Sommerville Drive, Prosper, TX 75078
- D. Hughes Elementary School – 1551 Prestwick Hollow Drive, McKinney, TX 75071
- E. Light Farms Elementary School – 1100 Cypress Creek Way, Celina, TX 75009
- F. Rucker Elementary School – 402 S. Craig Road, Prosper, TX 75078
- G. Rogers Middle School – 1001 South Coit Road, Prosper, TX 75078
- H. Reynolds Middle School – 700 North Coleman, Prosper, TX 75078
- I. Windsong Elementary School – 800 Copper Canyon Drive, Prosper, TX 75078

14.03 The District expects this project will be a turn-key implementation. “Turn-key” is defined to include: shipping, delivery and provision of materials and equipment; installation; configuration; testing; provision of documentation; and training District to use, monitor, and make minor adjustments to system as needed.

- A. The selected Respondents shall provide additional system components typically and reasonably required to make the system operational even though not specifically indicated in drawings, appendices, or specifications, including but not limited to patch cables, connectors, connecting accessories, power supplies, power cords, rack mounting adapters and shelves, cover plates and related connector and termination hardware required by but not supplied with the equipment

14.04 Existing Infrastructure

- A. Wireless – The District’s existing wireless infrastructure consists of Cisco on-premise wireless access points and controllers.
- B. LAN Electronics – The District’s existing local area network switches are Cisco 3850 on-premise series switches. Switches in the specified buildings will be replaced and or supplemented via this RFP. However, the current network shall be kept operational until the new network is in production. In cases where existing equipment shall be physically moved to make space for the

new equipment, a cutover shall be scheduled at least two weeks in advance. Downtime shall be coordinated and limited to after hours.

- C. UPS – The District’s existing UPS systems are Tripplite.
- D. Horizontal Cable – The District’s primary cabling system is Commscope Uniprise. Some building’s existing cable will be utilized. Some locations will be new Category 6 cable installed by the Contractor.

14.05 Reference to Existing Equipment and Brands

- A. Existing Manufacturers – The listing of existing brands, makes, and models of equipment is for the sole purpose of describing the current environment and providing details for trade-in consideration. All comparable and compatible solutions for ERate eligible services, that meet the required specifications, will be considered on the basis of the evaluation criteria set herein. Items not being considered for ERate funding may not be substituted.

14.06 Warranty

- A. Warranty – In all instances except where noted, please include 1 year of manufacturer’s maintenance. The terms except where noted, should be 8x5xNBD (Next Business Day).

15 GENERAL ROLES AND RESPONSIBILITIES

15.01 Permission to Proceed

- A. Within 10 days of contract execution the Contractor shall submit a Statement of Work with an estimate of schedules and benchmarks. The document should identify in detail the exact tasks that the District and Contractor shall perform and/or be responsible for in order to accomplish the delivery and installation of the system. The Contractor shall project the delivery dates and installation periods by function (cable, under-carpet wiring, switch, stations, etc.), which shall allow the Contractor to meet the required completion date.
- B. The Contractor shall provide the District with shop drawings of the proposed equipment placement for each location prior to the procurement of equipment or commencement of work. The Contractor shall make corrections and additions as necessary to the design documents. Equipment lists, data sheets, etc., shall be provided in MS Word, MS Excel, and MS Visio.
- C. The submittals shall be received and approved by the District prior to the procurement of material or the commencement of work. Any procurement or work performed prior to this approval is at the Contractor's own risk.
- D. The project timeline shall not be altered due to lateness of submittals. The Contractor shall remain bound to deliver a timely, complete, and finished project as stipulated in its contract.
- E. The failure of the Contractor to provide submittals as required herein may result in the cancellation of the contract.
- F. Contractor shall obtain the District's permission before proceeding with any work necessitating cutting into or through any part of a building structure.
- G. Prior to ordering, furnishing, or installing any equipment, the Contractor shall obtain the District's written approval of equipment, locations, layout, and installation.

15.02 The Contractor shall re-verify closet locations with the District's Project Manager prior to installation.

15.03 Damage and Cleanup

- A. Existing floors, walls, ceilings, or any structural piece shall not be drilled or cut without prior approval of the District. The Contractor shall be held responsible for and make payment on any damage caused from the delivery and/or installation of its work.
- B. The Contractor shall keep the premises clean from debris and rubbish. After each workday, the Contractor will be required to properly dispose of any refuse or packing materials by their own means and at their expense. Trash receptacles located on the District's property shall not be used to dispose of

the refuse or packing materials. If Contractor is found to be using District trash receptacles, Contractor will be charged the current contracted price to have the receptacle picked up and replaced with an empty one.

15.04 Project Manager

- A. The Contractor shall appoint a Project Manager who shall be the main point of contact regarding the project for the District. The Project Manager is responsible for the following:
1. Ensuring the contract is completed successfully in a timely manner.
 2. Guaranteeing the work and performance of all employees that have been hired by the Contractor.
 3. Completing and submitting all required submittals and documentation.
 4. Attending all project coordination and/or construction meetings as required by the District, plus chairing a weekly project status meeting throughout the duration of the project.
 5. Maintaining the project status meeting minutes and distributing them to all participants within two days following the meeting.
 6. Providing written status reports to the District Project Manager monthly.
 7. Informing the District of all unexpected conditions and problems that may result in delay or expense. The Contractor shall report issues immediately upon discovery and shall provide the District with the option(s) for resolving them.
 8. The Contractor and/or District may require changes during the project(s). Any changes shall be accompanied by a formal Change Order Request form that will be provided by the District. Change Order Request forms will be submitted to the Consultant or Owner for initial review and approval. Once approved, the Change Order Request form will be submitted to the District by the Consultant for review and approval. Once approved, the fully executed Change Order Request form will be sent to the Contractor. Any deviations from this process will not constitute an approved contract change.
- B. If the Contractor seeks to change the Project Manager during the course of the project, such change is subject to prior written approval from the District.
- C. The District reserves the right to request a new Project Manager during the course of the project if the Project Manager does not perform to the District's satisfaction.

15.05 Respondents may assume rack space is available for all components.

15.06 If other Contractors' work delays this Contractor, that information shall immediately be communicated to the District's Project Manager and

appropriate extra time may be allowed. Shipping delays are the sole responsibility of the Contractor.

15.07 Installation Requirements

- A. The Contractor shall host a kick-off meeting(s) to review, discuss, and plan configuration and installation details. Prior to the kick-off meeting, the Contractor shall review existing configuration files and look for opportunities to increase functionality, security, and manageability. At the conclusion of the kick-off meeting(s), findings, recommendations, and all implementation details shall be documented and provided as part of the submittal process.
- B. The Contractor shall be responsible for storing all equipment prior to implementation at its own facility. Upon each delivery, the Contractor shall provide an inventory sheet of what was delivered. This sheet shall include the brand, make, and model of all components. The District shall verify the inventory sheet. Only upon both parties signing the inventory sheet upon delivery shall constitute agreement that equipment was delivered to the District. It shall remain the Contractor's sole responsibility to inventory and track equipment.
- C. The Contractor shall perform the upgrades, installation, configuration, training for the District's personnel, and support of the proposed systems.
- D. Contractor and/or its subcontractors shall be fully authorized/certified to supply, upgrade, install, configure, provide warranty service, and troubleshoot/support the proposed equipment.
- E. All installation and maintenance personnel shall have completed certified manufacturer training, or the Contractor shall contract with manufacturer for installation of all proposed components.
- F. For any equipment items/systems accepted by the District and made part of the contract, the following shall be included: shipping, delivery, installation, configuration, testing, user training, afterhours cutover, documentation, day one support and first year parts and labor warranty.
- G. The Contractor shall take responsibility for proper ordering, shipping charges and delivery of all component parts. This includes any components to be ordered from any third-party companies. The Contractor shall be responsible for proper storage of delivered equipment.
- H. The personnel listed in the Contractor's proposal shall be the personnel assigned to this project. If changes are required, the Contractor shall gain written approval from the District's Project Manager prior to assignment of substitutes.
- I. Manufacturer(s) or a certified training agency thereof shall be offered to the District employees on products supplied.

- J. The Contractor certifies that it has, with staff employees, previously configured and operated a system with components as quoted.
- K. Any technician(s) dispatched to install or fix a failed component shall have been factory trained and certified by the manufacturer of the proposed equipment. The Contractor is responsible for following industry standards and all manufacturer installation and maintenance practices.
- L. The Contractor is responsible for working with the District to understand its IP addressing scheme and for implementing this scheme in the furnished devices.
- M. The Contractor is responsible for ensuring all equipment installed is running the latest, generally available version of software or firmware. All equipment shall be running the same version of software or firmware, including minor train releases. During the life of the project, if a new version of software is released, it shall be the Contractor's responsibility to upgrade all previously installed components to that version of software. The Contractor may use any tools available to push out software updates.
- N. The Contractor shall install hardware in a secure manner. Screws shall be tightened to a torque just sufficient to secure equipment without deforming washers beyond their original diameter.
- O. All rack-mount equipment shall be secured as recommended by the manufacturer with consideration to airflow, power, and patch cable connections.
- P. The Contractor shall make the system properly operational and physically secure by mounting equipment and related accessories into furniture, consoles, and racks as required. Manufacturer's guidelines for installation shall be followed.
- Q. Discrepancies in installation procedure or an inability to complete a given task due to a shortage of materials or malfunctioning equipment shall be reported to the District immediately upon discovery
- R. The Contractor shall be responsible to label all cables and equipment components installed as part of this project. In doing so, make the labeling of each component:
 - 1. Unique, to prevent it from being confused with other similar components; and
 - 2. Legible and permanent enough to last the life of the component. Handwritten labels shall not be permitted.
 - 3. Appropriate labeling schemes and the information to be included on the labels shall be reviewed during the kick-off meeting. It is the Contractor's responsibility to collect this information prior to implementation.

- S. Velcro straps shall be installed snugly without deforming cable insulation. Straps shall be spaced appropriately and is not to exceed four (4) feet.
- T. Systems described in this document, once configured by the Contractor, shall be delivered to the customer installation location and installed by the Contractor without any additional cost or expense to the District, and the District shall not be deemed to have accepted any equipment until the date of acceptance.
- U. The Contractor shall unpack equipment from shipping material and organize equipment into the kits from which it shall be used. This includes checking to ensure that all equipment is complete and fully functional. Empty boxes and packaging shall be neatly organized per the District's instructions and/or removed if requested. If requested to remove by the District, the Contractor will not be allowed to use District trash containers or dumpsters. It will be the sole responsibility of the Contractor to properly dispose of boxes and packaging away from any District property.
- V. All cutovers that will impact any services shall take place outside of normal business hours to avoid any disruption of service. The Respondent shall include the cost (hours) to cutover all proposed systems after normal business hours.
- W. The Contractor shall be responsible for the removal of existing equipment not incorporated. That equipment shall be inventoried, boxed, and removed by Contractor and placed in specified location as designated by the District. The boxes shall clearly show the inventoried contents. The District shall be responsible for disposal of equipment.
- X. The Contractor shall provide a weekly update to the District Project Manager on the project status.
- Y. Quantities included in this RFP are estimates. The Contractor shall be required to perform campus surveys to verify quantities. Any increases in components during the life of the contract shall be at proposed unit costs included in the Respondent's proposal, and deletions shall not be charged restocking fees.
- Z. The Contractor shall supply one complete set of hardware and software documentation/manuals for all provided items at no additional cost.

15.08 Security

- A. When deploying any product, software, or application associated with this RFP, the Contractor shall secure the resulting system(s). Securing includes the following actions:
 - 1. Determining the purpose of the system and minimum software and hardware requirements;

2. Documenting the minimum hardware, software, and services to be included on the system;
3. Installing the minimum hardware, software, and services necessary to meet the requirements using a documented installation procedure;
4. Installing necessary patches;
5. Installing the most secure and up-to-date versions of applications;
6. Configuring privilege and access controls;
7. Configuring security settings as appropriate, enabling allowed activity and disallowing other activity;
8. Enabling logging sufficient for the District staff to determine equipment faults or configuration problems in the telephony equipment;
9. Archiving the configuration in secure storage prior to system deployment;
10. Testing the system to ensure a secure configuration;
11. Changing all default passwords; and
12. Testing the resulting systems.

15.09 Project Closeout and Acceptance

- A. Punch List – Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in the RFP package and resulting contract, and/or unacceptable to the District shall be documented in a punch list by the District and provided to the Contractor to rectify.
- B. Punch List Approval – The punch list shall be considered complete only after having been signed by the District.
- C. Acceptance – Acceptance shall occur after all of the following conditions have been met:
 1. All items/systems have been delivered, installed, configured, tested, and transitioned into service.
 2. The system, including all ancillary devices, applications, and options made part of the contract, has had 30 consecutive days with 100 percent availability.
 3. All of the work has been completed in accordance with the contract and RFP specifications (including testing procedures as outlined in the accepted response).
 4. Training as specified is complete.
 5. The system operates in conformance with manufacturer's published specifications.
 6. The system is transitioned to service.

7. All of the documentation requirements have been met.
 - a. Network diagram in Visio format as required by the District.
 - b. Inventory spreadsheets.
 - c. Test results.
8. All outstanding punch list items have been corrected.
9. The system post-cutover requirements have been completed.
10. The Contractor has supplied test results needed to verify compliance with the specifications found in this RFP package.
11. The Contractor has certified in writing to the District that the system is installed and operational in accordance with these specifications and is ready for use.
12. The District or the District's designated representative has inspected the installation and provided written approval.
13. Software refresh has been completed (to ensure all systems operate on the latest software).

At this time, upon the District's written acceptance, operational control becomes the responsibility of the District. This constitutes Date of Acceptance. The warranty for the entire system and all components begins as of this date.

15.10 Warranty Period

- A. The Contractor, by entering into a contract with the District, warrants and represents that all materials, equipment, and services delivered to the District pursuant to the contract conforms to all of the specifications contained or referred herein. The Contractor further guarantees to replace all materials, equipment, software, or services that may be rejected by the District due to defective materials or workmanship for a minimum of one year following acceptance. Failure or neglect of the District to require compliance with any term or condition of the contract specifications shall not be deemed a waiver of such term or condition.

16 TECHNOLOGY SYSTEMS REQUIREMENTS

16.01 Proposal Response

- A. Respondents shall respond to any or all sections of this RFP. Any unclear proposals may be disqualified as unresponsive.
- B. Technical specifications (data sheets/cut sheets) for all proposed items (including software) are to be included in response.
- C. Individual components and line item pricing are to be included in Bills of Materials. Software version numbers shall be included. **Responses that fail to include Bills of Materials and technical specifications may be disqualified.**

16.02 Definitions

- A. Core switches: the device or devices centrally located within the District to provide connectivity to the wide area network (WAN), interconnecting each Campus Core switch together.
- B. Campus Core switches: the devices located in the campus main distribution frame (MDF) to provide fiber connectivity to each campus intermediate distribution frame (IDF).
- C. Access switches: devices to be located in each campus MDF and IDF to provide connectivity to endpoints.
- D. Respondent: the entity responding to the RFP.
- E. Contractor: the entity contracted by the District to provide and implement the systems specified within the RFP.
- F. WAN: wide area network; fiber optic cabling for telecommunication services between District-owned facilities.
- G. WLAN: wireless local area network – internal building 802.11 WiFi network systems.

16.03 Provided by Others (Not in Contract)

- A. High voltage (110v/208v) electrical power outlets.

16.04 Scope of Technology Systems Contract

- A. The vendor to whom the District awards this contract shall provide the following within 10 days of contract execution:
 - 1. Required insurance certificates
 - 2. Required Performance and Payment bonds

3. The name and contact information for the Respondent's assigned Project Manager
 4. A project schedule showing milestones for equipment ordering, equipment delivery, installation at each site, and testing.
 5. A testing plan outlining the tasks that will be accomplished during testing and the amount of involvement required from the Owner
- B. The Category 2 portion of the contract includes the following: (additional specifications for each of these systems are supplied later in this document.)
1. Provide, configure, install, test and document new access points.
 2. Provide new Category 6 cables for access point additions (**two network drops per added access point**).
 3. Provide, configure, install, test and document new switches in the specified buildings. The new switches shall be configured to support typical network applications such as VoIP, wireless, security systems, building automation, etc., at each facility.
 4. Provide equipment as specified in table below:

CAMPUS NAME	CAMPUS CORE SWITCH	CAMPUS ACCESS SWITCH	ACCESS POINTS	WIRELESS LICENSES
BAKER		2	4	4
COCKRELL		1	2	2
FOLSOM		2	4	4
HUGHES		3	6	6
LIGHTFARMS		1	2	2
RUCKER		1	2	2
WINDSONG		3	6	6
REYNOLDS	1	5	10	10
ROGERS		5	10	10
TOTALS	1	23	46	46

16.05 External transceivers or media converters shall not be used.

16.06 All proposed products must be authentic and genuine product from the manufacturer and shall be clearly identified as such with special markings or holographic images.

16.07 Patch Cables/Cords specifications

A. Single Mode Patch Cords

1. Provide sufficient OS2 grade (yellow) quantity to connect one (1) port at each site to a fiber optic wide area network, plus any quantities necessary for 10 Gigabit backbone connections between each MDF and that building's IDFs that is using multimode mode fiber optic cabling.

2. Patch cord connectors shall be measured for insertion loss with the following values for each connector: typical of 0.3 dB and maximum of 0.5 dB and guaranteed reflectance of ≤ -55 dB for UPC.
3. Manufacturer shall be ISO 9001 and TL 9000 registered.
4. Manufacturer shall manufacture both cable and connectors used to manufacture the patch cords.
5. Connector ferrule material shall be ceramic.
6. Optical fiber cable type shall be zipcord construction suitable for use in indoor spaces and shall include a non-plenum-rated jacket.
7. Patch cord shall be constructed with reverse-pair positioning as per TIA TSB-125.
8. Patch cord shall contain single-mode fibers compliant with TIA/EIA-568B.3 and applicable TIA/EIA-604 document.
9. Patch cord jacket color shall be yellow.
10. Length of patch cord should be appropriate to be properly routed and cable managed.

B. Multimode Fiber Patch Cords (50 micron OM3)

1. Provide multimode fiber patch cords in sufficient quantity to interconnect switches provided under this contract within IDFs and/or between switches in each building MDF and that building's IDFs (quantity to be determined by Contractor).
2. Patch cord shall contain 50 micron 850 nm laser-optimized multimode fiber and shall comply with TIA/EIA-568B.3 and applicable TIA/EIA-604 document.
3. Manufacturer shall manufacture both cable and connectors used to manufacture patch cord.
4. Multimode patch cord jacket shall be aqua.
5. Manufacturer shall be ISO 9001 and TL 9000 registered.
6. Length of patch cord should be appropriate to be properly routed and cable managed.

16.08 Network Equipment General Requirements

- A. All provided systems shall be new and be an active product (no end of sale, end of life, or end of support announcements for proposed equipment).
- B. Proposal pricing shall include shipping, delivery, configuration, and installation within MDF and IDF rooms, testing, and documentation (including all labor).

- C. All equipment shall be warranted by the manufacturer for 12 months, including but not limited to technical support, hardware replacement, and software updates. Further, installation services shall be warranted by the Contractor for 12 months. If this requires purchase of a maintenance program, then cost for such shall be included in the base proposal. The Contractor shall not substitute manufacturer's warranty or maintenance programs with their own warranty.
- D. Contractor shall provide a post-installation campus inventory spreadsheet sorted by telecommunications room (TR or IDF) for all equipment. It is the Contractor's responsibility to coordinate format of spreadsheet and data to include.
- E. Contractor will verify shipping instructions with the Owner prior to ordering any electronic equipment.
- F. All equipment, except access points, shall be rack mounted (19" racks and cabinets provided by Owner). All equipment shall have the maximum number of screws installed in a manner so that the equipment does not sag.
- G. All hardware components shall be "UL" approved and FCC certified, as applicable.
- H. Equipment that has been announced but is not yet shipping will be considered, providing the following:
 - 1. That the announced delivery date is on or before the installation dates of this project, and
 - 2. That the Contractor allows a 60-day test period to ensure that equipment performs according to specifications.
- I. The Contractor shall have as a part of its implementation team a network engineer fully capable of analyzing and implementing proper Quality and Class of Service (QoS/CoS) configurations necessary to support multiple classes of traffic and queue prioritization based on the manufacturer's recommendations and documented best practices.
- J. The Contractor shall provide detailed LAN configuration specifications and best practices required to support all installed components. This should align with the outcomes from the configuration kick-off meeting.
- K. The Contractor shall provide and install all necessary cables with appropriate connector ends to interconnect all the switches provided under this contract. Manufacturer-specific stacking cables shall be used when available for switches within a single MDF or IDF.
- L. The Contractor shall provide and install new fiber optic patch cables at the MDF/IDF as needed for 10 Gbps connections.

- M. The Contractor is responsible to install all copper and fiber patch cords (regardless of provider) between the network switches and patch panels, with the exception of additions after the initial implementation.
- N. The Contractor is responsible to install all copper and fiber patch cables (regardless of provider) that interconnect core, campus core, and access switches provided within this contract.
- O. The Contractor is responsible to work with the District to create a VLAN plan and to implement this plan in the furnished system. At a minimum five (5) VLANs shall be configured, regardless of whether all will be used immediately.
- P. The Contractor is responsible to work with the District to develop SNMP configurations, community strings, and passwords for all devices and to implement these in the furnished system.
- Q. The Contractor is responsible to work with the District to implement security features as required by the District.
- R. The Contractor is responsible to work with the District to understand its IP addressing scheme and for implementing this scheme to support all applications provided under the RFP.
- S. The Contractor is responsible to work with the District to ensure the proper VLAN and QoS configurations are implemented to support all applications provided under this RFP.
- T. The Contractor is responsible to understand the District's device naming convention and implement device names on all new devices.
- U. The Contractor shall supply all materials and labor necessary to mount network devices in racks/cabinets.
- V. Requirements for all switches:
 - 1. All switches shall be installed with the most current software version, unless otherwise requested by Owner.
 - 2. Identical software images shall be loaded on all switches of the same type (e.g., all access switches shall have the same software load.)
 - 3. All switch devices shall be capable of supporting IPv6, either as configured or via a software upgrade.

16.09 Campus Core MDF Electronics – Local Area Network Telecommunications Services (ERate Category 2)

- A. The purpose of the Core MDF Electronics is to provide connectivity between the MDF (main distribution frame) and campus IDFs (intermediate distribution frame) as required for telecommunications services.
- B. Provide Campus Core switches as indicated in the table in section 16.04. Each Campus MDF shall have at least one Campus Core Switch. Campuses that do not receive new access switches shall still include the required Core MDF electronics to be integrated with existing switches.
- C. Campus core switches shall be Cisco 4500X, or equivalent SFP+ based aggregation switch.
- D. Campus core switches shall have at a minimum 32 SFP+ ports.
- E. Campus core switches shall connect MDF to Campus WAN switch using two SFP+ 10Gb SR modules.
- F. Campus core switches shall connect MDF to each IDF using two SFP+ 10Gb LRM modules.
- G. Include all necessary fiber optic patch cords.
- H. Core switches shall be licensed for enterprise feature sets and fully support OSPF routing protocols (non-stub).
- I. Core switches shall contain multiple power supplies that continue to operate in the event of a single power supply failure.
- J. Respondent shall include professional services for all items contained in this section.
- K. One (1) year maintenance with Next Business Day (8x5xNBD) replacement.

16.10 Campus Access LAN Electronics – Local Area Network Telecommunications Services (ERate Category 2)

- A. The purpose of the Access switches is to provide network access to campus endpoints.
- B. Each Access switch shall be an Cisco Catalyst 3850, or equivalent.
- C. Each Access switch shall support no less than 12 ports of mGig for access point connectivity.
- D. Each Access switch shall be equipped with 48 PoE+ 10/100/1000BaseT ports and 2 SFP+ 10GB GE ports in the top of stack switch in IDFs only. Access switches in the MDF will be stacked with the Campus Core switch.

- E. Each Access switch shall have 48 ports in no more than one (1) rack unit of vertical space.
- F. Each Access switch shall be capable of delivering 15.4W of PoE across all 48 ports simultaneously and 30W of PoE+ across 24 ports simultaneously. Provide the PoE budget allocated from the switch's power supply.
- G. Each Access switch shall have a forwarding bandwidth of at least 176Gbps.
- H. Each Access switch shall have dedicated stacking ports and provide at least 160Gb across the stack, allowing for at least 8 switches per stack.
- I. Each Access switch shall support a minimum of 1023 ACTIVE VLANs.
- J. Within each portable IDF, provide and configure switch stack with a total of one (1) 10-Gigabit ports (10GE SR) to the campus MDF. Respondent shall supply both SFP modules for both sides of the connection.
- K. Include all necessary fiber optic patch cords.
- L. If more than one access switch is required in an IDF, the devices shall be stacked, and the two uplinks must be connected to different devices within the stack.
- M. Respondent shall include professional services for all items contained in this section, including configuration of MDF switch for IDF connectivity.
- N. Switches installed in portable buildings will be installed in a 2' x 4' ceiling enclosure provided the awarded cabling Respondent.

16.11 Wireless LAN (WLAN) Systems

- A. The District currently has Cisco on-premise access points throughout the District.
- B. The Contractor shall be responsible for physical installation (mounting, labeling, connecting cables and antenna, et cetera) of each access point.
- C. The Contractor shall be responsible for installing **two new data drops per added access point**. See equipment table and division 27 specifications contained at the end of this RFP.
- D. Prior to beginning installation, the Contractor shall submit AP placement maps to the District for approval after conducting site visits.
- E. Pricing for wireless LAN system shall include shipping and delivery.
- F. Pricing shall include all licenses, access points, cabling, connectors, and antenna necessary to provide a complete, functioning wireless LAN system.
- G. Physical installation of access points by the Contractor at all building/campus sites shall be included in pricing. Physical installation includes securely

affixing the APs to ceilings or walls as appropriate, connection to local area network jacks, installation of any cabling, and installation of any external antennas. See cabling specification for all cabling requirements required for this wireless section.

H. The Contractor shall be responsible for access point configuration, including switchport VLAN assignment.

I. Contractor shall provide a post-installation campus inventory spreadsheet sorted by telecommunications room (TR or IDF) for all equipment. It is the Contractors responsibility to coordinate format of spreadsheet and data to include.

J. Access Points

1. Access points shall be installed below the ceiling grid. The District intends for all access points to be reachable with a standard 8' ladder. However, include the daily price for a lift for any locations that may require to be mounted higher.
2. Indoor access points shall be Cisco 3802I or equivalent and compatible with the District's current inventory of access points, licenses, connectors, cabling, and network management.
3. Access points (APs) shall be IEEE 802.11AC wave 2 compliant.
4. Access points shall have two (2) active radios (operates concurrently). These radios shall be one (1) 2.4GHz radio and one (1) 5GHz radio.
5. Access points shall provide at a minimum 4x4 multiple input, multiple output (MIMO) and support single user four (4) spatial streams.
6. Access points shall support beamforming.
7. Access points shall support maximal ratio combining (MRC).
8. Access points shall support 20, 40, and 80 MHz channels for 801.11AC.
9. Access points shall be fully functional with 802.3at PoE+.
10. Access points shall up to 5Gbps (mGig) for LAN connectivity.
11. Access points shall include mounting hardware for ceiling grid mounting (tile rail).
12. Provide the quantity of access points and installation services as indicated in the drawings in the exhibit contained herein.
13. The quantity may change prior to implementation based on site surveys. The District expects to pay the quoted unit price (including labor) for each additional AP required, or to be credited the quoted unit price (including labor) for each unneeded AP.

K. Wireless Controller/Management Systems

1. The District currently has two Cisco 5520 series controllers.
 2. Respondent shall be responsible for configuring controllers and management systems to support access point additions to match the configuration standards already in production by the District.
- L. Respondent shall include professional services for all items contained in this section.

16.12 Category 6 Horizontal Cabling

- A. The Contractor shall be responsible for installing sixteen (16) **new data drops per portable** as indicated in the table below. See specifications, tables, and requirements below and referenced in division 27 specifications contained at the end of this RFP.
- B. See Sections 270000, 270500, 271300 271500, 271600, and 271800 located at the end of this RFP in Exhibit A.
- C. Portable building requirements:
1. Portable dimensions are 24' x 64'
 2. Each portable has two classrooms
 3. Contractor shall provide a 2' x 4' ceiling enclosure mounted at the far end of one of the classrooms for cabling and switch support. Chatsworth or equivalent A1224-HR including door locking kit. All kits shall be keyed the same. The contractor shall support enclosure to structural ceiling above per manufacturer recommendations.
 4. Pathways to teacher station is provided by the portable manufacture and includes conduit and a single gang box
 5. All other pathways are the responsibility of the cabling contractor
 6. All drops will be <100'
 7. All above ceiling drops shall use Handy Box and sweeping 90 degree conduit such Carlon B112HBR and UA9AEB-CTN or equivalent.
 8. Provide new drops as indicated below for **each portable (see list of portables)**:
 - a. Teacher station – 6 (2 locations of 3 drops each)
 - b. Access point – 4 (2 locations of 2 drops each)
 - c. IP cameras – 4 (4 locations of 1 drop each)
 - d. Smartboard – 2 (2 locations of 1 drop each)

List of Portables:

Campus Name	Portables
Baker ES	2
Cockrell ES	1
Folsom ES	2
Hughes ES	3
Lightfarms ES	1
Rucker ES	1
Windsong ES	3
Reynolds MS	5
Rogers MS	5
Totals	23

16.13 Communication Backbone Cabling

- A. The Contractor shall be responsible for installing communication backbone cabling to the portables as described below:
1. Reynolds MS – 24 strand multi-mode interior armored cable from the MDF to the Band Hall NEMA enclosure, not to exceed 400’.
 2. Reynolds MS – 6 strand multi-mode interior/exterior armored cable to each of five (5) portables from the Bank Hall NEMA enclosure, each not to exceed 250’.
 3. Rogers MS – 12 strand multi-mode interior armored cable from the MDF to Room 635 NEMA enclosure, not to exceed 175’.
 4. Rogers MS – 6 strand multi-mode interior/exterior armored cable to each of five (5) the portables from the Room 635 NEMA enclosure, each not to exceed 300’.
 5. Elementary Schools – For each of portables listed in the table in 16.11, 6 strand multi-mode interior/exterior armored cable to the portable, not to exceed 300’.
- B. See Sections 270000, 270500, 271300, 271500, 271600, and 271800 located at the end of this RFP in Exhibit A.

16.14 Physical Installation

- A. All devices are to be labeled on the side facing outwards with hostname and IP address assigned. Labeling/naming scheme shall be discussed with and pre-approved by Owner prior to beginning labeling procedures.
- B. All ports (physical and logical) capable of having descriptions configured within the system shall have a clear identification of that connection. This applies to all elements including but not limited to access points, switch uplinks, VLANs, compute components, and UPS systems. This does not apply to user stations, IP phones, printers, and other user-oriented devices. If a

question of whether a device should be labeled, it is the sole responsibility of the Contractor to seek clarification. Scheme shall be discussed with and pre-approved by Owner prior to beginning configuration procedures.

- C. When “hot” cutovers from existing systems to new systems are required, Contractor shall schedule each cutover with the District at least two weeks prior to occurrence.
- D. Existing racks or cabinets in MDF/IDF rooms throughout the District are to be utilized. If there appears to be insufficient space in any rack or cabinet, the Contractor shall notify the District’s Project Manager immediately and wait for a decision before proceeding with installation at that location.
- E. For installation of patch cables – NEATNESS COUNTS. The finished installations shall be tidy and the cabling well supported. No plastic tie wraps may be used. Hook and loop type material (e.g., Velcro) ties may be used to bundle cables. Patch cables may not be twisted, bent or otherwise deformed beyond standard allowable bend radius.
- F. When cutover is completed, existing equipment is to be removed from racks/cabinets/shelves by the Contractor and provided to the District’s Project Manager for disposition, or if required by trade-in policy, packed up and shipped as necessary.
- G. All rubbish, debris, and dirt resulting from the Contractor's work shall be cleaned up and removed from the building daily. The premises shall at all times be kept in a clean, safe, and professional manner.
- H. To facilitate routine in-house maintenance of the system after acceptance, up to two District personnel are to be observers during and assist with all facets of the installation process. The Contractor shall allow for the training/assistance of these people during installation.
- I. Work shall be performed during normal hours of operation for the building where the work is taking place. Any deviations shall be discussed with and approved by the District’s Project Manager or agent prior to work occurring.

16.15 Documentation: When installation is complete, the Contractor shall furnish the District with two complete sets (in three-ring binders, each with an accompanying electronic copy) of data network project documentation. Contractor shall provide documentation as follows:

- A. Logical diagrams showing all installed equipment, including locations (MDF or IDF). Diagrams shall be submitted in MS Visio 2010 or later. Equipment stencils shall accurately represent the equipment installed.
- B. Hostnames, model numbers, serial numbers, asset tag identification numbers, and IP addresses assigned to all equipment shall be noted both on

diagrams and on a separate table/spreadsheet. Spreadsheet shall be submitted in MS Excel 2010 or later.

- C. A thorough list of all passwords and SNMP community strings configured on each device. This list shall be organized by device type. Description of warranty and servicing procedures for all components.
- D. Technical data sheets/cut sheets for all equipment provided. If data sheets are publicly available, the Contractor may provide hyperlinks in a MS Word format to data sheets for all equipment supplied. Links shall be tested prior to submittal of documentation.
- E. Finalized configuration details as determined in the kick-off meeting.

17 COST & BILL OF MATERIALS

- 17.01** Provide all costs requested in *Proposal Form and Cost Detail* in the RFP. Insert a hard copy of the completed form in this section of the response and a **SOFT COPY IN PDF** format with the original copy of the response.
- 17.02** Provide bill of materials (BOM) showing model number/description, list price, discounted unit cost, quantity, and extended discounted cost for all components proposed. Respondent shall provide this BOM in a MS Excel format.
- 17.03** Base prices requested in *Proposal Form and Cost Detail* shall be all inclusive of all specified components. Respondent shall not include optional items in base prices. Provide optional pricing as separate line items outside of totals. Clearly notate optional items with the header "Optional _____". For example, "Optional 5 Year Maintenance"
- 17.04** Optional components shall have configuration and installation clearly identified. **If it is not, the District will assume the price for configuration and installation is in the base price.**
- 17.05** Include a detailed Scope of Work for each associated price for installation and configuration. Respondents are encouraged to be as thorough as possible.

18 RESPONDENT ASSUMPTIONS

- 18.01** Provide a complete list of any equipment that the District will need to provide, such as hardware, software, and servers required to support the proposed systems. The list shall include detailed specifications and be organized to allow the District to determine which alternate or option the equipment shall support.
- 18.02** The Respondent shall provide all equipment, including but not limited to hardware, software, servers, and labor required to support and install the proposed systems and all optional equipment/applications proposed, unless it has been identified in this section.
- 18.03** Provide details of any other assumptions taken in preparing your response to the RFP.

19 INSTALLATION METHODOLOGY AND DRAWINGS

19.01 Installation Methodology

- A. Provide a detailed description with diagrams of how the proposed systems would be deployed. Include the following:
 1. Detailed Scope of Work clearly outlining the steps involved in deploying the systems. **A SOW shall accompany every price for installation and configuration so that the District clearly understands what is included with each price for installation and configuration.**
 2. Timeline of implementation with the number of resources that would be assigned to the project.
 3. Quality control methodology and systems used.
 4. Project management methodology and systems used.
 5. Escalation process with names and contact information.

20 ACCEPTANCE TESTING

20.01 Provide the recommended acceptance test plan for all proposed products and applications.

21 RESPONDENT AND SUBCONTRACTOR QUALIFICATIONS, SUPPORT CAPABILITIES, AND REFERENCES**21.01** Information about the Respondent

- A. Company name
- B. Legal name (if different)
- C. Years in business
- D. Number of years selling systems similar to this Proposal
- E. Contact person
- F. Full mailing address
- G. Telephone number
- H. Fax number
- I. E-mail address
- J. Name and phone number of bonding company
- K. Number of full-time employees
- L. Number of technical/installation personnel (minimum of four dedicated to this project)
- M. Names and titles of personnel who would be providing the training for the equipment in this project (Attach listing of experience with similar projects.)
- N. Name of person who would be project manager for this project (Attach listing of experience with similar projects.)
- O. Dunn and Bradstreet Number

21.02 Qualification and Requirements

- A. If more than one (1) company is involved in the installation, training, and/or support after installation, there shall be a Prime Contractor. This Prime Contractor assumes responsibility for all other entities involved.

List Prime Contractor here: _____

- B. The response shall include a statement from all involved Respondents agreeing that the configuration shall work as specified and that all Respondents shall work under the Prime Contractor to resolve any configuration or interoperability problems during the installation process at no additional cost to the District. Write statement below.

21.03 Experience and Existing Customers – How many similar systems has the Respondent sold/installed?

- A. In the area (within 50 miles of PISD): _____
- B. Statewide: _____
- C. Nationwide: _____

21.04 All Respondents shall provide a minimum of six (6) references using the reference format provided below. The references shall be similar in scope and size to the District's project and shall demonstrate the following:

- A. Experience in wireless networking in a 1:1 and BYOD environment.
- B. Experience in structured cabling, including fiber optic cabling.
- C. References shall demonstrate that the Respondent has extensive knowledge of all equipment proposed and has at least five (5) years of experience with the same system(s).

D. References will be contacted – please verify information before submitting.

Use the format below for all references. All references will be called. Please inform your contacts that a 10 to 15 minute call may be anticipated.

Wireless Reference 1:

Organization Name _____

Address _____

Type of Business _____

Contact Person _____

Telephone Number _____

Fax Number _____

Date of Installation _____

Description of System _____

Number of Access Points _____

Wireless Reference 2:

Organization Name _____

Address _____

Type of Business _____

Contact Person _____

Telephone Number _____

Fax Number _____

Date of Installation _____

Description of System _____

Number of Access Points _____

Data Network Reference 1:

Organization Name _____

Address _____

Type of Business _____

Contact Person _____

Telephone Number _____

Fax Number _____

Date of Installation _____

Description of System _____

Number of Switches _____

Number of Networked Locations _____

Data Network Reference 2:

Organization Name _____

Address _____

Type of Business _____

Contact Person _____

Telephone Number _____

Fax Number _____

Date of Installation _____

Description of System _____

Number of Switches _____

Number of Networked Locations _____

Cabling Reference 1:

Organization Name _____

Address _____

Type of Business _____

Contact Person _____

Telephone Number _____

Fax Number _____

Date of Installation _____

Description of System _____

Number of Drops _____

Cabling Reference 2:

Organization Name _____

Address _____

Type of Business _____

Contact Person _____

Telephone Number _____

Fax Number _____

Date of Installation _____

Description of System _____

Number of Drops _____

E. Subcontractors

1. The use of subcontractors is permitted. The Respondent and its subcontractors are responsible for understanding the full scope of the project and determining its ability to perform under all requirements set herein.
2. Please acknowledge full understanding of the systems and scope of project specified herein.

21.05 Service after Installation

- A. How many service personnel trained in maintaining the proposed systems does Respondent employ in the District's area? Please indicate location closest to the District.
1. Trained Service Personnel: _____
 2. Location: _____
- B. Provide the address of Respondent's service center(s) closest to the District:
1. Company _____
 2. Address _____
 3. Telephone Number _____

21.06 Financial statements – Provide financial statements inclusive of cash flow sheet, income sheet, balance sheet, and asset liability statement for the last three (3) years (2014-2016). If the previous year's financial statements have not been audited or reviewed, the Responder shall notate this clearly. If the Responder is a publicly held corporation, the Responder may provide valid links to these reports. **The District reserves the right to require further information to assist it in making a decision based on financial stability.**

22 PROJECT AND MAINTENANCE TEAM

- 22.01** Resumes of key members of the team, including Project Manager, that will be assigned to the project (include previous projects, certifications, and number of years employed).
- 22.02** Provide proof of manufacturer's certification/specialization for the company. All certifications shall be current and valid.
- 22.03** Provide proof of manufacturer's certification for individuals listed above. All certifications shall be current and valid.

23 EXCEPTIONS AND CLARIFICATIONS

23.01 Please provide detailed information on any exceptions or clarifications to this RFP that the Respondent is taking. If no exceptions or clarifications are specifically listed, then it the Respondent explicitly and knowingly accepts all terms, conditions, and requirements set forth in this RFP.

24 VALUE-ADD

- 24.01** Please provide a detailed description of any value-added services the Respondent is providing as a part of this RFP.
- A. For example, a respondent may propose to provide wireless site surveys before and after the wireless implementation at no additional cost.
 - B. For example, a respondent may propose to have the project manager present at monthly board meetings or when requested by the District to provide updates if necessary.
 - C. The District is seeking creative and innovative ideas that may bring additional value to the District.

25 EXHIBIT A**Section 27 00 00 – General Technology Requirements****Part 1 - GENERAL**

1.01 Project Summary

- A. Scope: Successful proposer shall provide, install, configure, and provide warranty service for technology systems described herein.

1.02 Related Documents

- A. Documents: Provisions of General Conditions, Supplementary Conditions, and the sections included under Procurement & Contract Requirements are included as part of this section as though bound herein.

1.03 Related Work

- A. Section 27 05 00 – Communications Cabling General Requirements
- B. Section 27 13 00 – Communications Backbone Cabling

Part 2 - General

2.01 Scope

- A. This section describes the products and execution requirements relating to telecommunications voice, and data backbone cabling and termination components.
- B. Backbone Cabling is the cable and hardware interconnecting telecommunication rooms (TRs), building demarcation rooms, equipment rooms and server rooms. The backbone cabling shall consist of the following cable type:
 - 1. 50-micron Multimode Fiber Optic Cable

2.02 Test Data – Fiber Optic Media

- A. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
- B. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.
- C. The database for the completed job shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

- D. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - 1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - 2. The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value as defined in this document).
 - 3. The date and time the test results were saved in the memory of the tester.
- E. The following general information is to be provided in the electronic database containing the test result information for each link:
 - 1. The identification of the customer site as specified by the end user.
 - 2. The overall Pass/Fail evaluation of the link-under-test.
 - 3. The name of the standard selected to execute the stored test results.
 - 4. The cable type and the value of the 'index of refraction' used for length calculations.
 - 5. The date and time the test results were saved in the memory of the tester.
 - 6. The brand name, model, and serial number of the tester.
 - 7. The revision of the tester software and the revision of the test standards database in the tester.
- F. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:
 - 1. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
 - 2. The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength, and the margin (difference between the measured attenuation and the test limit value).
- G. The link length shall be reported for each optical fiber for which the test limit was calculated.
- H. Contractor shall provide accurate as-built Construction Drawings at the site during construction.
- I. The Drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (Visio or PDF) formats on which as-built construction information can be added.

These documents will be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Owner.

- J. The Contractors shall annotate the base Drawings and return to the Consultant in hard copy (same plot size as originals) and electronic (Visio or PDF) form.

Part 3 - Products

3.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

3.02 Optical Fiber Cables Specifications

A. Reference:

1. See Sections 16.11 & 16.12 for locations, sizing, strand count and general requirements

B. General Considerations

1. The cable shall meet the requirements of the National Electrical Code (NEC) Section 770.
2. For plenum applications, the cable shall meet applicable flame tests: ANSI/UL 910 (NFPA 262-1994).
3. Cables shall be Non-plenum (CMR) Rated.
4. Finished cables shall conform to the applicable performance requirements of Tables 8-6 and 8-7 of the Insulated Cable Consultants Association, Inc. (ICEA) *Standard for Fiber Optic Premises Distribution Cable* (ICEA S-83-596).

C. Cable Construction

1. The coated fiber shall have a layer of Teflon placed between the acrylate coating of the optical fiber and the thermoplastic buffer. The diameter of the thermoplastic buffer coating shall be $900 \pm 50\mu\text{m}$. The fiber coating and buffer shall be removable with commercially available stripping tools in a single pass for connectorization or splicing.
2. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal.
3. The fibers shall be stranded around a dielectric central member.
4. The central member shall be over coated with a thermoplastic, when required, to achieve dimensional sizing to accommodate and support the $900 \mu\text{m}$ buffered fibers.

5. The buffered fibers shall be grouped in six-fiber subunits.
 6. The fibers shall be stranded around a dielectric central member in the subunit.
 7. A ripcord may be applied between the aramid yarns and the subunit jacket to facilitate jacket removal.
 8. The subunit jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
 9. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the subunits. The strength members shall be of a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the subunit jacket.
- D. Outer Cable Jacket
1. Indoor Cabling:
 - a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.
 - b. The indoor distribution cable specified herein shall have an interlocking armor made of steel or aluminum. The interlocking armor for plenum cables shall have a PVC jacket.
 - c. The color of the armor jacket shall match the jacket color of the optical fiber cable located inside of the armor. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed, or flexible metal conduit.
 2. Indoor/Outdoor Cabling to Portables:
 - a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand

stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.

- b. The indoor/outdoor cable specified herein shall have an armor protective construction intended for indoor plenum or outdoor underground installations.

E. Fiber Identification

1. The individual fibers shall be color-coded for identification. The optical fiber color-coding shall be in accordance with ANSITIA/EIA-598-B "Optical Fiber Cable Color Coding." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another.
2. When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The number shall be repeated at regular intervals. The subunit jacket color shall be orange for subunits containing multimode fibers, yellow for subunits containing singlemode fibers, and white for filler subunits.
3. The outer jacket for all dielectric cable shall be marked with the manufacturer name or UL file number, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket.

F. Cable Specifications

1. Temperature Range
 - a. Non-Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for riser cables shall be -20 to +70 °C. Testing shall be in accordance with FOTP-3.
 - b. Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for plenum cables shall be 0 to +70°C. Testing shall be in accordance with FOTP-3.
2. Cyclic Flexing
 - a. When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycle per minute. The fiber shall not experience an attenuation change

greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).

3. High and Low Temperature Bend
 - a. When tested in accordance with FOTP-37, Fiber Optic Cable Bend Test, Low and High Temperature, the cable shall withstand four full turns around a mandrel at test temperatures of 0 °C and +50 °C. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.5 dB at 1300 nm (multimode).
4. Impact Resistance
 - a. When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, the cable shall withstand a minimum of 20 impact cycles for riser cables and 10 impact cycles for plenum cables. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).
5. Temperature Cycling
 - a. When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, the change in attenuation at extreme operational temperatures (0 to +50 °C) shall not exceed 0.3 dB/km at 1550 nm (singlemode) or 0.6 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling.
6. Twist-Bend
 - a. When tested in accordance with FOTP-91, Fiber Optic Cable Twist-Bend Test, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting and bending around a mandrel 20 times the cable outer diameter. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or 0.4 dB at 1300 nm (multimode).
- G. Multimode (50/125 μm)
 1. The multimode fiber utilized in the optical fiber cable shall meet EIA/TIA-492AAAA-A-1997, Detail Specification for 50μm Core Diameter/125μm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers (OM3 type). Cable shall have the following specifications:
 - a. Core Diameter: $50 \pm 3 \mu\text{m}$
 - b. Core Non-Circularity: $\leq 5\%$
 - c. Cladding Diameter: $125 \pm 2 \mu\text{m}$
 - d. Cladding Non-Circularity: $< 2.0\%$

- e. Core-to-Cladding Concentricity: $\leq 3 \mu\text{m}$
 - f. Coating Diameter: $245 \pm 2 \text{ mm}$
 - g. Refractive Index Profile: Graded index
 - h. Numerical Aperture: 0.275 ± 0.015
 - i. Maximum Attenuation: less than 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm.
2. IEEE 802.3z Performance: The fiber shall support laser-based 10 Gigabit Ethernet (10GbE) operation for up to 300 meters.
 3. Attenuation at the Water Peak: The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 1.0 dB/km.
 4. Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75 ± 2 mm diameter mandrel shall not exceed 0.5 dB at 850 nm or 1300 nm.
- H. Fiber optic cabling shall be manufactured by Commscope.
- 3.03 Fiber Optic Connector
- A. The optical connector shall be LC-type.
 - B. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive.
 - C. The attenuation per mated pair shall not exceed 0.35 dB (individual) and 0.2 dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.
 - D. The connector shall meet the following performance criteria:

1. Cable Retention (FOTP-6)	0.2 dB
2. Durability (FOTP-21)	0.2 dB
3. Impact (FOTP-2)	0.2 dB
4. Thermal Shock (FOTP-3)	0.2 dB
5. Humidity (FOTP-5)	0.2 dB
 - E. Connectors shall be manufactured by Commscope.
- 3.01 Fiber Optic Patch Panels
- A. The Contractor shall provide a fiber optic patch panel at each location where a fiber optic cable terminates.

- B. All terminated fibers shall be mated to duplex LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.
- C. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and Drawings, including those not terminated (if applicable), PLUS 50% future growth.
- D. Patch panels shall be designed for easy installation, front removal, and expansion of snap-in adapter panels.
- E. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.
- F. The patch panel's enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer's recommended minimums or 1.2", whichever is larger.
- G. Access to the inside of the patch panel enclosure during installation shall be from the front and rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.
- H. All patch panels shall provide protection to both the "facilities" and "user" side of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (backbone, riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access of such cables.
- I. Fiber optic patch panels shall be manufactured by Commscope.

Part 4 - Execution

4.01 Testing

- A. Field Test Requirements for Fiber Optic Cabling System
 1. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, the Contractor shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include the manufacturer's on reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
 2. Factory data shall be provided upon request, showing on-the-reel bandwidth performance results as tested at the factory.

3. Every fiber optic backbone link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-C or by the appropriate network application standard(s), whichever is more demanding.
4. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
5. 100% of the installed cabling links shall be tested and shall pass the requirements of the standards mentioned above and as further detailed in this document. Any failing link shall be diagnosed and corrected at no additional cost to the Owner. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with RFP.
6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
 - b. The manufacturer of the test equipment used for the field certification
 - c. Training organizations authorized by BICSI
7. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-C.1) with a Category 1 light source.
8. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
9. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
10. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
11. Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.

12. A representative of the Owner shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing begins.
13. A representative of the Owner will select a random sample of 5% of the installed links. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the Pass/Fail determination, the installation Contractor, under supervision of the Owner representative, shall repeat 100% of the testing. The cost of retesting shall be borne by the installation Contractor.

B. Fiber Performance Test Parameters

1. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B.
 - a. $\text{Link Attenuation} = \text{Cable_Attn} + \text{Connector_Attn} + \text{Splice_Attn}$
 - b. $\text{Cable_Attn (dB)} = \text{Attenuation_Coefficient (dB/km)} * \text{Length (Km)}$
 - c. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Multimode 50/125 μm	850	3.5
	1300	1.5

- d. $\text{Connector_Attn (dB)} = \text{number_of_connector_pairs} * \text{connector_loss (dB)}$
 - e. Maximum allowable mated connectors_loss = 0.50 dB
 - f. $\text{Splice_Attn (dB)} = \text{number of splices (S)} * \text{splice_loss (dB)}$
 - g. Maximum allowable splice_loss = 0.1 dB (when tested bidirectionally)
2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices—i.e., it does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 3. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is preferred.
 4. The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
 5. The backbone link shall be tested in two directions at both operating wavelengths to account for attenuation deltas associated with wavelength.

6. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.
7. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.
8. Multimode backbone links are designed to be used with network applications that use laser light sources (underfilled launch conditions). However, the link attenuation equation has been based upon the use of a light source categorized as Category 1, Overfilled.

4.02 Fiber Optic Cable Installation Requirements

- A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.
- B. A minimum of 15 feet of slack cable (each cable) shall be coiled and secured at each end.
- C. Exact cable termination locations shall be field verified with Owner.

End of Section

- D. Section 27 15 00 – Communications Horizontal Cabling
- E. Section 27 16 00 – Communications Connecting Cords
- F. Section 27 18 00 – Communications Labeling and Identification

4.03 Definitions

- A. **Approved or Approval:** Where approval is called for, only persons with the authorized authority may grant approval. Owner reserves all rights to govern over and grant approval and will appoint authority of agents acting on their behalf.
- B. **As Required:** Contractor shall provide the quantity of said item that is necessary. Owner and Consultant reserve the right to make the final determination of necessary quantities to provide for a complete system.
- C. **Basis of Design:** The documentation of the concepts, calculations, decisions, and product selections used to meet the Owner's project requirements. These Consultant produced documents are not shop drawings. Product selections depict minimum functionality and overall quality and are open to substitution requests.
- D. **Consultant:** True North Consulting Group.

- E. Contractor: The qualified party responsible to provide all items and perform services as described within these documents. The Contractor referred to within a specific specification section shall be the successful qualified party contracted to perform and complete that work.
- F. Documents: The complete package of Proposal and Contract Requirements, General Technology Requirements, related Division 27 sections, drawings, schedules, and addenda that make up this Request for Proposal.
- G. End-User: Individual(s) who will ultimately operate the completed system.
- H. ETR: Existing to Remain. Item is to remain in current location and maintain current functionality.
- I. Furnish: To supply and deliver to project site, ready for installation.
- J. Install: To place in a position of service or use.
- K. NIC: Not in Contract. Item will be the responsibility of others.
- L. Notice to Proceed: Formal communication from Owner to Contractor stating the date the Contractor can begin work subject to the conditions of the contract. The performance time of the contract starts from the Notice to Proceed date.
- M. OFCI: Owner Furnished Contractor Installed. Item will be provided by Owner and shall be installed by Contractor.
- N. OFE: Owner Furnished Equipment. Item will be provided and integrated by Owner.
- O. OFOI: Owner Furnished Owner Installed. Item will be provided and installed by Owner.
- P. Owner: The party named in the Procurement and Contract Requirements as the advertising party.
- Q. Provide: To furnish and install, complete and ready for intended use.
- R. Turnkey: Of or involving the provision of a complete product or service that is ready for immediate use.
- S. Work: The provision of products and/or services to meet the requirements specified in these documents.

4.04 Reference Standards and Codes

- A. Standards and other procedures referenced by this proposal package are as follows:
 - 1. ADA – Americans with Disabilities Act of 2010
www.ada.gov/2010ADASTandards_index.htm

2. AIA – American Institute of Architects
www.aia.org
3. ANSI – American National Standards Institute
www.ansi.org
4. ASHE – American Society of Healthcare Engineering
www.ashe.org
5. ASTM – American Society of Testing and Materials
www.astm.org
6. BICSI – Building Industry Consulting Service International, Inc.
(RCDD Standards)
www.bicsi.org
7. CFR – Code of Federal Regulations
www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR
(Available from the Government Printing Office)
(Material is usually first published in the Federal Register)
8. IEC – International Electrotechnical Commission
www.iec.ch
9. IEEE – Institute of Electrical and Electronics Engineers
standards.ieee.org
10. ISO – International Organization for Standardization
www.iso.org
11. NEC – National Electrical Code (NFPA 70)
maintained by NFPA – National Fire Protection Association
www.nfpa.org
12. NECA – National Electrical Contractors Association
www.necanet.org
13. NEMA – National Electrical Manufacturers’ Association
www.nema.org
14. OSHA – Occupational Safety and Health Administration
(U.S. Department of Labor, OSHA)
www.osha.gov
15. TIA – Telecommunications Industry Association
www.tiaonline.org/standards
16. UL – Underwriters’ Laboratories
www.ul.com

- B. Standards: Referenced standards and/or procedures shall be binding on the Contractor and work shall be judged against such standards and procedures unless otherwise stated in writing.
- C. Local/State Codes: Contractor shall comply with all local and state code requirements as determined by the authority having jurisdiction (AHJ).
- D. Owner Standards: Contractor shall obtain and abide by all published Owner standards as they pertain to the work described herein.
- E. Contractor shall use the latest versions of all standards and codes unless otherwise directed by the authority having jurisdiction (AHJ) or expressly noted herein.

4.05 Permits and Inspections

- A. Responsibility: Obtain permits and inspections required for the work. Contractor is responsible for all permit and inspection costs.
- B. Performance: Perform tests required herein, or as may be reasonably required to demonstrate conformance with the specifications or with the requirements of any legal authority having jurisdiction.
- C. Review: Obtain approvals from authorities responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with all requirements of reference codes indicated herein and required by the appropriate jurisdiction. Make corrections, changes or additions as required and deliver certificates of acceptance, operation, and/or compliance with the Operation and Maintenance Manuals described herein.

4.06 Drawings and Basis of Design

- A. General: Work, equipment, or material delineated on any drawing in this package is expected to be provided by Contractor unless noted otherwise.
- B. Interpretation: Work shall be installed in accordance with the basis of design diagrammatically expressed on the drawings and described in the written specifications and equipment schedule(s). Contractor shall not make limiting interpretation that provides for incomplete work or a non-functioning system.

4.07 Product Substitution Procedures

- A. Requests for Substitutions: Should the Contractor request a change in the material that is to be supplied, from that which was specified in the contract, the Contractor shall provide the Owner and the Consultant with a written request for said change.
- B. Substitutions for Non-specified Products: Where no product specification is provided, Contractor may use manufacturer's specification for the identified product as a guide for suggesting appropriate substitutions.

- C. Requirements: The Request for Substitution shall include:
 - 1. Reason for substitution.
 - 2. Material data sheets for both the proposed item(s) and the item(s) to be replaced.
 - 3. Any cost impact to the Owner.
- D. Changes: Proposed changes to Contract Documents shall be clearly identified in the pre-construction submittals.
- E. Approval: The Owner may approve or deny any Requests for Substitution. The Owner reserves the right to govern over and proclaim whether proposed products are equal to the specifications. The Contractor shall not procure any substitute materials until the Owner has approved and signed the Request for Substitution and passed copies to the Contractor and the Consultant. Any procurement or work performed prior to this approval is at the Contractor's own risk.
- F. Deviation: Products provided or installed that deviate from the products specified in make, model, color, or other significant characteristic (i.e., non-approved substitutions) shall be removed and replaced with specified products at no additional expense to Owner.

4.08 Submittal Conditions

- A. The Contractor shall not consider the Consultant or Owner's review of submittals to be exhaustive or complete in every detail. Approval of shop drawings or submittals including substitutions indicates only the acceptance of the Contractor's apparent intent to comply with general design or method of construction and quality as specified. The finished product shall meet functional requirements, operations, arrangements, and quantities and comply with the contract documents unless specifically approved otherwise.
- B. The Contractor shall be held responsible for delivery of systems as specified. Any errors or omissions in the submittals shall not relieve Contractor of responsibility to deliver complete systems as specified.

4.09 Pre-Construction Procedures

- A. Pre-Construction Submittal Meeting: Contractor shall schedule web conference (WebEx or similar) with Consultant to review basis of design and submittal expectations.
- B. Prior to Work: Pre-construction submittals shall be provided to Consultant with appropriate promptness as to cause no delay to the work.

- C. Project Timeline: Project timeline will not be altered due to lateness of submittals. Contractor is bound to deliver a timely, complete, and finished project as stipulated in their contract and specified herein.
- D. Format and Distribution: Contractor shall provide one (1) electronic copy in PDF format to Consultant of all pre-construction submittals. The Contractor shall provide hard copies sets as required up to five (5) sets.
- E. Provision: Contractor shall submit pre-construction submittals including any corrections or additions to Consultant prior to the procurement of equipment or commencement of work.
- F. Review: Pre-construction submittals shall be received and formally approved by Consultant prior to the procurement of material or the commencement of work. Any procurement or work performed prior to this approval is at Contractor's own risk.
- G. Failure to Provide: The failure of Contractor to provide pre-construction submittals as required herein may result in the withholding of payment for work and/or the cancellation of the contract.

4.10 Pre-Construction Submittals

- A. Pre-construction submittals are intended to document the details of installation. Exact copies of original drawings and specifications are not acceptable as pre-construction submittal drawings. Consultant schematic diagrams describe the basis of design as defined herein.
- B. Contractor shall provide to Consultant the following pre-construction submittals for approval in addition to specific requirements identified in subsequent sections.
 - 1. Qualifications: Shall include documentation of all required qualifications.
 - 2. Shop Drawings:
 - a. Title: Each drawing shall have a descriptive title and all subparts of each drawing shall have unique identifiers.
 - b. Equipment Rack and Cabinet Elevations: Shall include placement of all mounted equipment.
 - 3. Product Data:
 - a. Equipment Schedules: Shall include manufacturers, part numbers, quantities and unit pricing.
 - b. Product Cut Sheets: Shall identify (highlight, arrow, etc.) actual part numbers to be utilized including but not limited to equipment, mounting hardware, cabling, connectors, software and power distribution equipment.
 - 4. Manufacturer's Recommendations:

- a. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, copies of these recommendations shall be provided prior to installation. Installation of the items will not be allowed to proceed until the recommendations are received and approved.

4.11 Construction Progress Procedures

- A. Meeting Attendance: Contractor is required to attend job progress meetings in accordance with requirements set by Owner or Consultant.
- B. Additional Coordination: Contractor shall request additional job construction coordination meetings it deems to be necessary to ensure coordination of their responsibilities with other parties.
- C. Progress Inspection: Consultant may perform periodic progress inspections. At Consultant's request, Contractor shall make Project Manager and/or Lead Technician available.
- D. Test Plan: Ten (10) business days prior to the proposed Contractor test date, Contractor shall provide a test plan defining the tests required.
 1. The test plan shall be approved by Consultant prior to any testing.

4.12 Construction Progress Submittals

- A. Completion: Contractor shall complete and submit via email all construction progress documentation in PDF format as requested by Owner and Consultant.
- B. Contractor shall provide to Consultant the following construction progress submittals in addition to specific requirements identified in subsequent sections.
 1. Weekly Report: Weekly written report to be submitted to Consultant through appropriate project channels in PDF format outlining progress from previous week, plans for progress in the current week, and any coordination issues that may require Consultant or Owner attention.

4.13 Closeout Procedures

- A. Notification: Contractor shall provide written notification to Consultant and Owner when Contractor is satisfied that the work has reached Substantial Completion and is ready for inspection.
- B. Pre-Inspection Submittals: Contractor shall submit an electronic copy of all closeout submittals to Consultant in accordance with the requirements found in these documents no less than ten (10) business days prior to the scheduled Final Inspection.
 1. Test Results

2. As-built drawings (full-size sheets)
 3. Operation and Maintenance Manuals
 4. End User Software
- C. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in these documents, and/or unacceptable to Consultant or Owner shall be documented by Consultant and provided to Contractor to rectify at no additional cost. Contractor shall provide written notification to Consultant and Owner when all punch list items have been completed.
- D. Final Inspection: At Consultant's request, Contractor shall make Project Manager and/or Lead Technician available.
- E. Punch List Approval: Once all punch list items are complete, the Contractor shall return an initialed punch list to the Consultant and Owner for verification. Punch list shall be considered complete only after having been signed by Owner and Consultant.
- F. Closeout Submittals: Upon approval of closeout submittals and prior to final acceptance, Contractor shall provide three (3) electronic copies to Owner and Consultant in format(s) noted below.
1. Record Drawings - PDF– USB Flash Drive
 2. Operation and Maintenance Manuals – USB Flash Drive.
 3. End User Software – USB Flash Drive
 4. Documentation of testing and system certification.
- G. All documentation prepared by the Contractor, including hard copy and electronic forms, shall become the property of the Owner.
- H. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by Owner and Consultant, including punch list(s) and/or re-inspection(s) and delivery of closeout deliverables.
- 4.14 Closeout Submittals
- A. Closeout submittals are intended to document the details of the final installation that substantially conforms to the construction documents and functions as intended to meet the Owner's needs.
- B. Contractor shall provide to Consultant the following closeout submittals for approval in addition to specific requirements identified in subsequent sections.
1. As-built drawings: As-built drawings are prepared by the Contractor. They show, in red ink, on-site changes to the Consultant-approved pre-construction

submittal documents. As-built drawings shall be submitted to Consultant for approval prior to submitting record drawings and include:

- a. Changes made by Addenda, Change Orders, Requests for Information (RFIs), Architect's Supplemental Instruction (ASIs), or Requests for Proposal (RFPs) in addition to any other changes to the original documents.
 - b. Actual device locations, conduit routing, wiring and relationships as they were constructed.
 - c. Nomenclature showing as-built wire designations and colors.
 - d. Room numbers coinciding with Owner space planning numbering.
2. Record drawings: Record drawings are the final drawings prepared by the Contractor and incorporate all as-built drawing changes previously approved by Consultant. Record drawings should be electronically produced without any handwritten, red ink, or clouded changes.
 3. Local Reference Diagrams: Within each equipment rack, enclosure, or cabinet, the Contractor shall place a functional diagram of the system(s) in a clear plastic sleeve secured to the equipment rack, cabinet, or enclosure.
 4. Intellectual Property: Provide all required items and written release as described herein.
 5. Training Program: Proposed training materials and program outline.
 6. Spare Parts and Remote Controls: Contractor shall submit record of Owner sign-off of turnover of spare parts and remote controls.

4.15 Project Management

- A. Project Manager: Contractor shall appoint a Project Manager who will be the main point of contact for Owner and Consultant regarding the project.
- B. Responsibility: Project Manager is responsible for the following:
 1. Successfully completing the contract in a timely manner.
 2. Overseeing work and performance of all employees and Subcontractors who have been hired by Contractor and ensuring compliance with specification.
 3. Completing and submitting required documentation.
 4. Attending project coordination meetings as required by Owner, Consultant, and Contractor. Contractor is responsible for taking minutes of these meetings and distributing copies to all participants.
 5. Coordinating with Owner, Consultant, Architect, General Contractor, and other Contractors involved in the project to ensure smooth flow of work and on-time project completion.

6. Providing a written weekly progress update to the Owner and Consultant in a PDF format emailed to the project team.
 7. Reporting all unexpected conditions and problems that may result in delay or expense to Owner and Consultant immediately upon discovery.
- C. Change of Project Manager: If Contractor seeks to change Project Manager during the course of the Project, such change is subject to prior written approval from Owner.
- D. The Owner reserves the right to request a change of project manager at any time for any reason.

4.16 Examination of Existing Conditions

- A. Examination: Contractor shall examine the facility and construction documents to the extent necessary to plan for efficient installation strategies prior to the delivery of materials to the site or the commencement of work. Other documents (Architectural Drawings, hardware schedules...) may be made available upon request. Failure to adequately complete the examination shall not result in change order requests.
- B. Acceptance of Conditions: Commencement of work by Contractor shall indicate acceptance of existing conditions, unless a written notice of exceptions has been provided to Owner prior to commencement.
- C. Observation: If Contractor observes—during preliminary examinations or subsequent work—existing violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, Contractor shall report these to Owner in a timely manner.
- D. Pre-Existing Damage: If Contractor observes damage to finished surfaces before they begin installation in any area, Contractor shall document by taking digital photos of the damaged area(s) and immediately notifying Construction Manager and Consultant via email, with attached photos.
- E. Damage during Installation: Any damage caused by, or reasonably believed by the Construction Manager to be caused by the Contractor shall result in back-charges for said damages. Repairs shall match preexisting color and finish of walls, floors, and ceilings. Any Contractor damaged ceiling tiles, floor, and carpet shall be replaced to match color, size, style, and texture.

4.17 Contract Modification Procedures

- A. Changes: Changes to the contract may be initiated by Owner, Consultant or Contractor.

- B. Request for Information (RFI): If a change originates with Contractor, the Contractor shall submit an RFI for Consultant review. If it is deemed a change is necessary, the Consultant shall issue a PR to address the change.
 - C. Proposal Request (PR): If a change originates with Owner or Consultant, Consultant shall issue a Proposal Request to Contractor.
 - D. Change Proposal (CP): If a change originates with Contractor, or if Contractor receives a Proposal Request from Consultant, Contractor shall submit a Change Proposal to Consultant to review.
 - 1. References: A Change Proposal shall reference the work to be performed, and shall include the cost change to the Project (if any) and the time change to the scheduled completion (if any)
 - E. Cost/Time Changes: A Change Proposal shall reference the work to be performed, and shall include the cost change to the project (if any) and the time change to the scheduled completion (if any).
 - F. Additional Information: Consultant may request additional information to be supplied with the Change Proposal for consideration.
 - G. Acceptance: Owner reserves the right to accept or reject Change Proposals.
 - H. Change Order: A Change Order is a modification of the contract:
 - 1. If a Change Order is approved, Owner will issue a Change Order that references PR and/or CP. Change Order is not valid until it has been signed by Owner.
 - 2. Work performed or equipment supplied outside of contract without a valid Change Order is done at Contractor's own risk.
- 4.18 Product Storage and Handling Requirements
- A. Storage: Storage of materials shall remain the full responsibility of Contractor until Acceptance.
 - B. Protection: Contractor shall take all necessary precautions to protect materials from the following:
 - 1. Theft
 - 2. Vandalism/Tampering
 - 3. Dents
 - 4. Scratches
 - 5. Dust
 - 6. Temperature

7. Weather
 8. Cutting
 9. Paint
 10. Other hazardous conditions
- C. Replacement: Contractor shall replace any damaged or lost material as required by Owner or Consultant.
- D. Installed Materials: Installed materials remain the responsibility of the Contractor until Acceptance. Contractor shall take necessary precautions to ensure the safety and security of installed materials.
- 4.19 Interference with the Facility
- A. Transportation and storage of materials at the facility, work involving the facility, and other matters affecting the habitual use by the Owner of the Owner's buildings, shall be conducted to minimize interference, and at times and in a manner acceptable to the Owner.
- 4.20 On-Site Conduct
- A. Conduct: Any demonstration of rudeness, use of profanity, or lack of respect by Contractor Personnel to a building tenant will be cause for immediate removal from the premises, and such Personnel will not be allowed to return. Contractor and Contractor's Personnel are to remain in project area.
- B. Vandalism: Graffiti or vandalism will not be tolerated. Any Contractor/Personnel caught in the act shall be immediately removed from the premises and will not be allowed to return.
- C. Hazardous Conditions: No one shall be allowed to endanger the building, its premises, and its occupants in any manner whatsoever. In the event that a situation occurs which threatens the building or its occupants in any manner, Contractor, Contractor Personnel, Subcontractor, etc. shall take steps to correct hazardous condition. In the event that Contractor's Personnel fail to correct hazardous condition, Owner reserves the right to immediately take steps to correct the situation at Contractor's expense.
- 4.21 Safeguards and Protection
- A. Barriers: Provide and maintain suitable barriers, guards, fences and signs where necessary to accommodate the safety of others relative to and/or for the protection of this work.
- B. Regulations: Comply with OSHA, Federal, State, Local, and Owner regulations and standards pursuant to this work.

- C. Protection: Protect all materials and equipment to prevent the entry or adhesion of any and all foreign material. If necessary, cover equipment with temporary protective material suitable for this purpose.
- D. Finishing: Check, clean and remove defects, scratches, fingerprints and smudges if necessary from all equipment and devices immediately prior to Acceptance of the Installation.
- E. Damage: Replace all damaged or defective material or work at no additional cost prior to Final Acceptance.
- F. Documentation: Provide written description of accidents by workers, staff, and general public of any incident occurring on the project. Report incident in writing to Owner's representative immediately and to the Project Manager for follow up.

4.22 Quality Assurance

- A. Assurance: It is the intent of these specifications to describe and provide for a complete, professional, and reliable installation.
- B. Qualifications: Contractor employees who are engaged in installation shall be properly trained in the tasks they are expected to perform.
- C. Acceptability: Owner shall determine the acceptability of work.
- D. Regulatory Requirements: Contractor shall comply with code requirements that apply to the work being performed.
- E. Certifications: Where manufacturer certifications are required for warranty or for authorized resale, installation personnel shall have received such certification prior to the start of installation of those manufacturers' materials.

Part 5 - PRODUCTS

5.01 Basic Equipment and Materials Requirements

- A. Standards: Equipment and materials used to accomplish the goals of this project shall meet standards for good engineering practice as defined within this document.
- B. Quality: Products specified in these documents are intended to establish a baseline or operational, functional, and performance-based standards that all proposed products shall meet or exceed by functionality and quality.

5.02 Fire Stopping Materials

- A. All penetrations of walls shall be approved by the General Contractor before any penetrations are made. Should the Contractor find it necessary to penetrate any walls extending to the slab, it will be the responsibility of that Contractor to provide satisfactory sleeving and fire caulking both inside and outside of that sleeving. If

- existing sleeving is to be utilized, it will be the responsibility of the Contractor to fire caulk inside the sleeving.
- B. The Contractor is responsible for adhering to the following standards:
1. Conduit penetrations through fire-rated or smoke walls: Completely seal around the conduit penetration with Hilti FS 601 fire-rated sealant Tremco or 3M or equal.
 2. Conduit sleeves through fire-rated or smoke wall: Completely seal around the conduit penetration with Hilti FS 601 fire-rated sealant Tremco or 3M or equal. Completely seal inner opening of the conduit sleeve with fire wool packing and Hilti FS 611A intumescent firestop sealant.
 3. Cable bundles through fire-rated or smoke walls (without sleeves): Completely seal openings with Hilti FS 611A intumescent firestop sealant, Tremco or 3M or equal.
 4. Cable tray penetrations through fire-rated or smoke walls: Completely seal openings with Hilti FS 635 (trowelable type) Tremco or 3M or equal.
- C. A submitted response to this specification assumes that all firestopping will be provided as specified. The firestop manufacturer's specifications and instructions shall be submitted with the final documentation.

Part 6 - EXECUTION

6.01 General

- A. Contractor shall provide, furnish, deliver, transport, erect, install, connect and configure all of the material and equipment described herein or depicted on any proposal package document or drawing, as required for a turnkey solution.

6.02 Coordination

- A. General: Contractor shall cooperate with other Contractors for proper provisioning, anchorage, placement, and execution of all work. Interference between the work of various Contractors shall be resolved before installation. In the event of conflict on space requirements or location of devices, refer the matter to Owner and Consultant for decision.
- B. Related Work: References to the following related work do not limit or release Contractor from the responsibility of coordination with other trades or from having the necessary knowledge of other non-referenced work.
1. Work by General Contractor.
 2. Work by other Technology Contractors.

3. Work by Electrical Contractor, including electrical rough-ins and surface-mounted raceway.
- C. Delays: Contractor shall coordinate with all other trades to avoid causing delays in the installation schedule.
 - D. Low Voltage Sleeving: Contractor shall provide openings through walls as necessary, with sleeving and fire-stopping materials installed in a professional manner to meet local and national codes.
- 6.03 Basic Execution Requirements
- A. General: Contractor is responsible for following industry standards of good practice for telecommunications and networking equipment.
 - B. Aesthetic Factors: With the installation of equipment and cables, consideration shall be given not only to operation efficiency but also to overall aesthetic factors. Contractor shall redo, at no cost to Owner, any work deemed by Owner to appear sloppy, hastily done, or unprofessional. Owner shall make final decision over whether work shall be redone.
 - C. Manufacturers' Recommendations: Manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers or as indicated in their published literature unless otherwise noted herein.
 - D. Protection of Work Area: Work shall be properly protected during construction, including the shielding of soft or fragile materials, protecting against dust and dirt, protecting and supporting cable ends off of the floor and from other traffic, protecting floor box lids, and temporarily plugging open conduits during construction. Upon completion, installation shall be thoroughly cleaned and all tools, equipment, obstructions, or debris present as a result of work shall be removed from the premises.
 - E. Protection of Cable and Equipment: Contractor shall make appropriate preparations to protect all cabling and equipment from foreign material. Foreign material is defined as any substance or material that would void the manufacturer's performance warranty, impact ratings (UL, Plenum, etc.), or cover up markings needed for inspection. Foreign material includes, but is not limited to, paint overspray (intentional or not), fire-stopping material, drywall compound, or any other chemical, liquid, or compound that could come in contact with cables, cable jackets, cable termination points, or other equipment.
 1. Cleaning of cables or equipment with harsh chemicals from a failure to comply with Protection of Cable and Equipment clause is unacceptable. Contractor shall replace any affected cable, cable components, or equipment in their entirety at no additional cost to the project.

- F. Waste Materials: Contractor shall keep work area neat, orderly, and free from accumulation of waste materials. Remove trash and debris from the building and job site as required to maintain a clean work environment at all times. Rubbish shall be moved to a common trash point or receptacle on the job site as determined and directed by General Contractor or Owner.
- G. Dumpsters: No construction debris shall be placed in building's dumpsters. Contractor shall provide a dumpster for construction waste and debris at own expense. Said dumpster shall be emptied on a regular schedule. Location of dumpster shall be arranged through Building Management.

6.04 Cleaning

- A. Tool Clean-up: Contractor is not permitted to use restrooms for tool clean-up. A slop-sink may be provided in janitorial closet on each floor for cleaning of tools and equipment and as a source of water. Janitorial closet or maintenance area or shop shall be kept clean at all times. Contractor or Contractor's Personnel found using restrooms for clean-up or other similar purposes shall be subject to removal from building.
- B. Daily: At the end of each work period or day, Contractor shall remove excess packing, drilling remnants, and other non-equipment related parts, materials, or debris to ensure a clean, safe, and professional working environment.
- C. Carpet: Contractor shall ensure that no damage to carpeting occurs as a result of their work. Contractor shall cover carpets in areas of work to prevent wire debris from entering the carpet.

6.05 Fire Stopping

- A. Contractor is responsible for applying fire-stopping material in and around all openings that it creates or are created for it, whether or not specifically indicated in specifications or project drawings, where code requires the use of fire stopping material.
- B. Contractor shall ensure that all fire-stopping materials meet appropriate codes and are installed in a neat and workman like manner.

6.06 Installation Requirements

- A. All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to ensure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a "break-away", or other approved method.
- B. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation, an adequate number of

workers shall be present to allow cable observation at all points of pathway entry and exit.

- C. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed.
- D. All cable shall be free of tension at both ends.
- E. PLENUM rated cable shall be used in areas used for air handling.
- F. Contractor shall replace any cables that have been damaged or abraded during installation.
- G. Pulling lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.
- H. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit or surface mount raceway.

6.07 Cable

- A. Cable treatment: Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the rating of the manufacturer.
- B. Splicing
 - 1. Voice, data, and other twisted pair cables: No splices shall be installed in any voice, data or twisted pair cables.
 - 2. Technology systems: No splices shall be installed in any cable less than five hundred (500) feet in length.
- C. Lengths
 - 1. Variations: Where cables are to be of the same length, variations in the length shall be less than plus or minus ½ inch. Lengths of cables are based on the length of the unterminated signal conductors.
 - 2. Labeling: Cables, regardless of length, shall be marked with a labeling scheme approved by Consultant.
 - 3. Grouping: Cables shall be separated into like groups according to signal or power levels.

4. Power cables: Power cables shall be grouped to one side of the equipment rack while low-level cables to the other side.
 5. Equipment Racks: Equipment rack wiring and cabling shall be neatly dressed.
 6. Fastening: Rack cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame.
 7. Wire Support outside MER/TR Spaces: Wire and cables shall be supported at least every 5 feet from the structure or as required to maintain not more than a 12 inch cable sag between supports and without over tensioning the cables.
 8. Support Hardware: Cables shall be supported by J-hooks, cable tray, or ladder rack. Hardware shall be secured to building structure using 3/8" threaded rod supports.
 9. Right Angles: Cables are to run at right angles to the structure, placed above ceiling in halls or corridors.
 10. Height: Cables shall not run above red iron joist.
- D. Concealment: Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests. Cabling systems installed in public areas shall be installed within walls, ceiling, or floors or within surface wiring pathways, as dictated by codes and good engineering practice.
- E. Velcro Straps for Horizontal Cabling: Straps shall be installed snugly without deforming cable insulation. Straps shall be spaced at uneven intervals not to exceed 4 feet.
- F. Cable Ties and Velcro Straps within Equipment Racks and Cabinets: Ties and straps shall be installed snugly without deforming cable insulation at uneven intervals not to exceed 8 inches. Cable ties shall only be used for non-signal carrying cables. No sharp burrs shall remain where excess length of the cable tie has been cut.
- G. Obstruction: Contractor shall notify Owner immediately if any obstruction or hazard is discovered in a pathway provided by others.
- 6.08 Equipment Installation
- A. General: Contractor shall make system properly operational and physically secure by mounting equipment and related accessories into furniture, consoles, and racks as required. Manufacturer's guidelines for installation shall be followed. Discrepancies in installation procedure or inability to complete a given task due to a shortage of materials or malfunctioning equipment shall be reported to Consultant immediately upon discovery.
- B. Equipment Placement: Contractor shall locate equipment as indicated on drawings and as specified herein. Where such information is not provided, follow industry

best practices and locate operable devices at convenient positions; heat generating devices at the top and seldom-accessed equipment below.

1. Unless otherwise specified, end user-operable devices shall be positioned within the range of front wheelchair access per ADA standards.

C. Equipment Installation: Equipment shall be installed as directed by the manufacturer using equipment manufacturer's desktop mounting frames, equipment tubs, installation hardware, and techniques. Contractor shall be responsible for moving equipment from storage and for providing necessary personnel or devices to carry and lift equipment around obstacles and into operating position.

6.09 Cutting, Drilling, Patching, and Painting

A. Coordination: Contractor is responsible for coordinating the work when any cutting or drilling is required in the performance of installing the specified systems.

B. Restoration: Contractor is responsible for returning all surfaces (including walls, floors, and ceilings) to their previous condition after any cutting.

6.10 Labeling

A. General: Rack-mounted equipment and hardware shall be labeled as required herein. Connectors, jacks, receptacles, outlets, cables, cable terminations, terminal blocks, rack mounted equipment, active slots of card frame systems, etc. shall be clearly, logically, and permanently labeled in a manner acceptable to Consultant.

B. Approval: Proposed wording and/or numbering schemes for labeling shall be provided to Consultant for review and written approval prior to procurement or installation.

C. Labels used shall be permanent and secure. Provide labeling as follows unless otherwise noted in a specific section:

1. Like Size: Labels shall be sized to match other labels used for same purpose. Similarly, provide engraved labels of like size in other locations.

2. Equipment Racks: For enclosed racks containing equipment, provide labels on each equipment rack rear door or console rear panel reading "No user serviceable parts. Refer service to qualified technician."

3. Installer and Consultant Identification: Position at the front top center section of each equipment rack a label that states the names of system Installer and Consultant.

4. Custom Panels: Custom panel nomenclature shall be engraved, etched, or screened. Markings are to be designed to ensure consistency and clarity within and without of system. Verify markings and placements by submitting label sample layouts to Consultant for approval prior to procurement.

5. Documentation: Labeling information shall appear on the as-built drawings.

6.11 Fire-Stopping

- A. If Contractor removes anything from an opening in a fire-rated wall, Contractor shall restore the fire-rating condition of the wall to the same condition as before Contractor started its work. Depending on the size of the opening, this may involve sheetrock patching, in addition to use of other appropriate fire-stopping materials

6.12 Additional Engineering Services

- A. General: Contractor is responsible for securing necessary engineering services where needed to meet the needs of the installation.
- B. Change Orders: Only when Contractor can show that additional engineering services are needed as a result of changes to the scope of the services being requested will Owner entertain a Change Order for these services.

6.13 General Testing

- A. See more specific/detailed testing requirements listed in each system subsection.
- B. Supplies: Contractor shall supply testing equipment needed to verify compliance with specifications found in these documents.
- C. Program: Contractor shall complete required testing prior to the inspection by Owner and Consultant.
- D. Data: Test data shall be properly documented and recorded so that it is available for final inspection.
- E. Quality Control: Testing may be repeated during the inspection process at the request of Owner or Consultant.
- F. Prior to energizing or testing any active systems, ensure the following:
 - 1. Installation: Products are installed in a proper and safe manner per the manufacturer's instructions.
 - 2. Cleanliness: Products are neat, clean, and unmarred and parts securely attached. Dust, debris, solder, splatter, etc., is removed.
 - 3. Cables and Connections: Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
 - 4. Grounding: Electronic devices are properly grounded.
 - 5. AC Power: Each AC power receptacle is tested with a circuit checker for proper hot, neutral, and ground connections prior to plugging in equipment.

END OF SECTION

Section 27 05 00 – Communications Cabling General Requirements

Part 1 - GENERAL

1.01 Scope

- A. This section describes the products and execution requirements related to furnishing and installing Category 6 Cabling and Termination Components and related subsystems as part of a Structured Cabling System.
- B. Backbone system comprising copper, and fiber optic cabling and horizontal (station) cabling is covered under this document.
- C. This Contractor, shall supply Category 6 patch cords. The Contractor shall be available on site during the crossover to assist with any cabling issues that may occur during the connection.
- D. The Cabling Contractor shall provide and install all sleeves through the wall penetrations as required whether or not specifically marked on Project Drawings, unless otherwise noted.
- E. All cables and related terminations support, and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in the following section(s).
- F. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the TX Electrical Code, and present manufacturing standards.
- G. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

1.02 Related Work

- A. Section 27 00 00 – General Technology Requirements
- B. Section 27 05 00 – Communications Cabling General Requirements
- C. Section 27 13 00 – Communications Backbone Cabling

Part 2 - General

2.01 Scope

- A. This section describes the products and execution requirements relating to telecommunications voice, and data backbone cabling and termination components.

B. Backbone Cabling is the cable and hardware interconnecting telecommunication rooms (TRs), building demarcation rooms, equipment rooms and server rooms. The backbone cabling shall consist of the following cable type:

1. 50-micron Multimode Fiber Optic Cable

2.02 Test Data – Fiber Optic Media

A. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.

B. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.

C. The database for the completed job shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.

D. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:

1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
2. The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value as defined in this document).
3. The date and time the test results were saved in the memory of the tester.

E. The following general information is to be provided in the electronic database containing the test result information for each link:

1. The identification of the customer site as specified by the end user.
2. The overall Pass/Fail evaluation of the link-under-test.
3. The name of the standard selected to execute the stored test results.
4. The cable type and the value of the ‘index of refraction’ used for length calculations.
5. The date and time the test results were saved in the memory of the tester.
6. The brand name, model, and serial number of the tester.
7. The revision of the tester software and the revision of the test standards database in the tester.

- F. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:
 - 1. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
 - 2. The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength, and the margin (difference between the measured attenuation and the test limit value).
- G. The link length shall be reported for each optical fiber for which the test limit was calculated.
- H. Contractor shall provide accurate as-built Construction Drawings at the site during construction.
- I. The Drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (Visio or PDF) formats on which as-built construction information can be added. These documents will be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Owner.
- J. The Contractors shall annotate the base Drawings and return to the Consultant in hard copy (same plot size as originals) and electronic (Visio or PDF) form.

Part 3 - Products

3.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

3.02 Optical Fiber Cables Specifications

- A. Reference:
 - 1. See Sections 16.11 & 16.12 for locations, sizing, strand count and general requirements
- B. General Considerations
 - 1. The cable shall meet the requirements of the National Electrical Code (NEC) Section 770.
 - 2. For plenum applications, the cable shall meet applicable flame tests: ANSI/UL 910 (NFPA 262-1994).

3. Cables shall be Non-plenum (CMR) Rated.
4. Finished cables shall conform to the applicable performance requirements of Tables 8-6 and 8-7 of the Insulated Cable Consultants Association, Inc. (ICEA) *Standard for Fiber Optic Premises Distribution Cable* (ICEA S-83-596).

C. Cable Construction

1. The coated fiber shall have a layer of Teflon placed between the acrylate coating of the optical fiber and the thermoplastic buffer. The diameter of the thermoplastic buffer coating shall be $900 \pm 50 \mu\text{m}$. The fiber coating and buffer shall be removable with commercially available stripping tools in a single pass for connectorization or splicing.
2. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal.
3. The fibers shall be stranded around a dielectric central member.
4. The central member shall be over coated with a thermoplastic, when required, to achieve dimensional sizing to accommodate and support the $900 \mu\text{m}$ buffered fibers.
5. The buffered fibers shall be grouped in six-fiber subunits.
6. The fibers shall be stranded around a dielectric central member in the subunit.
7. A ripcord may be applied between the aramid yarns and the subunit jacket to facilitate jacket removal.
8. The subunit jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
9. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the subunits. The strength members shall be of a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the subunit jacket.

D. Outer Cable Jacket

1. Indoor Cabling:
 - a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide

the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.

- b. The indoor distribution cable specified herein shall have an interlocking armor made of steel or aluminum. The interlocking armor for plenum cables shall have a PVC jacket.
 - c. The color of the armor jacket shall match the jacket color of the optical fiber cable located inside of the armor. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed, or flexible metal conduit.
2. Indoor/Outdoor Cabling to Portables:
- a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.
 - b. The indoor/outdoor cable specified herein shall have an armor protective construction intended for indoor plenum or outdoor underground installations.

E. Fiber Identification

1. The individual fibers shall be color-coded for identification. The optical fiber color-coding shall be in accordance with ANSITIA/EIA-598-B "Optical Fiber Cable Color Coding." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another.
2. When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The number shall be repeated at regular intervals. The subunit jacket color shall be orange for subunits containing multimode fibers, yellow for subunits containing singlemode fibers, and white for filler subunits.
3. The outer jacket for all dielectric cable shall be marked with the manufacturer name or UL file number, date of manufacture, fiber type, flame rating, listing

symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket.

F. Cable Specifications

1. Temperature Range

- a. Non-Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for riser cables shall be -20 to +70 °C. Testing shall be in accordance with FOTP-3.
- b. Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for plenum cables shall be 0 to +70°C. Testing shall be in accordance with FOTP-3.

2. Cyclic Flexing

- a. When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycle per minute. The fiber shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).

3. High and Low Temperature Bend

- a. When tested in accordance with FOTP-37, Fiber Optic Cable Bend Test, Low and High Temperature, the cable shall withstand four full turns around a mandrel at test temperatures of 0 °C and +50 °C. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.5 dB at 1300 nm (multimode).

4. Impact Resistance

- a. When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, the cable shall withstand a minimum of 20 impact cycles for riser cables and 10 impact cycles for plenum cables. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).

5. Temperature Cycling

- a. When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, the change in attenuation at extreme operational temperatures (0 to +50 °C) shall not exceed 0.3 dB/km at 1550 nm (singlemode) or 0.6 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling.

6. Twist-Bend

- a. When tested in accordance with FOTP-91, Fiber Optic Cable Twist-Bend Test, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting and bending around a mandrel 20 times the cable outer diameter. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or 0.4 dB at 1300 nm (multimode).

G. Multimode (50/125 μ m)

1. The multimode fiber utilized in the optical fiber cable shall meet EIA/TIA-492AAAA-A-1997, Detail Specification for 50 μ m Core Diameter/125 μ m Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers (OM3 type). Cable shall have the following specifications:
 - a. Core Diameter: 50 \pm 3 μ m
 - b. Core Non-Circularity: \leq 5%
 - c. Cladding Diameter: 125 \pm 2 μ m
 - d. Cladding Non-Circularity: $<$ 2.0%
 - e. Core-to-Cladding Concentricity: \leq 3 μ m
 - f. Coating Diameter: 245 \pm 2 mm
 - g. Refractive Index Profile: Graded index
 - h. Numerical Aperture: 0.275 \pm 0.015
 - i. Maximum Attenuation: less than 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm.
2. IEEE 802.3z Performance: The fiber shall support laser-based 10 Gigabit Ethernet (10GbE) operation for up to 300 meters.
3. Attenuation at the Water Peak: The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 1.0 dB/km.
4. Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75- \pm 2 mm diameter mandrel shall not exceed 0.5 dB at 850 nm or 1300 nm.

H. Fiber optic cabling shall be manufactured by Commscope.

3.03 Fiber Optic Connector

- A. The optical connector shall be LC-type.
- B. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive.

- C. The attenuation per mated pair shall not exceed 0.35 dB (individual) and 0.2 dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.
- D. The connector shall meet the following performance criteria:
 - 1. Cable Retention (FOTP-6) 0.2 dB
 - 2. Durability (FOTP-21) 0.2 dB
 - 3. Impact (FOTP-2) 0.2 dB
 - 4. Thermal Shock (FOTP-3) 0.2 dB
 - 5. Humidity (FOTP-5) 0.2 dB
- E. Connectors shall be manufactured by Commscope.

3.04 Fiber Optic Patch Panels

- A. The Contractor shall provide a fiber optic patch panel at each location where a fiber optic cable terminates.
- B. All terminated fibers shall be mated to duplex LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.
- C. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and Drawings, including those not terminated (if applicable), PLUS 50% future growth.
- D. Patch panels shall be designed for easy installation, front removal, and expansion of snap-in adapter panels.
- E. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.
- F. The patch panel's enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer's recommended minimums or 1.2", whichever is larger.
- G. Access to the inside of the patch panel enclosure during installation shall be from the front and rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.

- H. All patch panels shall provide protection to both the “facilities” and “user” side of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (backbone, riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access of such cables.
- I. Fiber optic patch panels shall be manufactured by Commscope.

Part 4 - Execution

4.01 Testing

A. Field Test Requirements for Fiber Optic Cabling System

1. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, the Contractor shall provide cable manufacturer’s test report for each reel of cable provided. These test reports shall include the manufacturer’s on reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
2. Factory data shall be provided upon request, showing on-the-reel bandwidth performance results as tested at the factory.
3. Every fiber optic backbone link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-C or by the appropriate network application standard(s), whichever is more demanding.
4. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
5. 100% of the installed cabling links shall be tested and shall pass the requirements of the standards mentioned above and as further detailed in this document. Any failing link shall be diagnosed and corrected at no additional cost to the Owner. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with RFP.
6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
 - b. The manufacturer of the test equipment used for the field certification

c. Training organizations authorized by BICSI

7. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-C.1) with a Category 1 light source.
8. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
9. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
10. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
11. Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
12. A representative of the Owner shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing begins.
13. A representative of the Owner will select a random sample of 5% of the installed links. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the Pass/Fail determination, the installation Contractor, under supervision of the Owner representative, shall repeat 100% of the testing. The cost of retesting shall be borne by the installation Contractor.

B. Fiber Performance Test Parameters

1. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B.
 - a. $\text{Link Attenuation} = \text{Cable_Attn} + \text{Connector_Attn} + \text{Splice_Attn}$
 - b. $\text{Cable_Attn (dB)} = \text{Attenuation_Coefficient (dB/km)} * \text{Length (Km)}$
 - c. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Multimode 50/125 μm	850	3.5
	1300	1.5

- d. $\text{Connector_Attn (dB)} = \text{number_of_connector_pairs} * \text{connector_loss (dB)}$

- e. Maximum allowable mated connectors_loss = 0.50 dB
 - f. Splice_Attn (dB) = number of splices (S) * splice_loss (dB)
 - g. Maximum allowable splice_loss = 0.1 dB (when tested bidirectionally)
2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices—i.e., it does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 3. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is preferred.
 4. The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
 5. The backbone link shall be tested in two directions at both operating wavelengths to account for attenuation deltas associated with wavelength.
 6. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.
 7. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.
 8. Multimode backbone links are designed to be used with network applications that use laser light sources (underfilled launch conditions). However, the link attenuation equation has been based upon the use of a light source categorized as Category 1, Overfilled.
- 4.02 Fiber Optic Cable Installation Requirements

- A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.
- B. A minimum of 15 feet of slack cable (each cable) shall be coiled and secured at each end.
- C. Exact cable termination locations shall be field verified with Owner.

End of Section

- D. Section 27 15 00 – Communications Horizontal Cabling

- E. Section 27 16 00 – Communications Connecting Cords
- F. Section 27 18 00 – Communications Labeling and Identification

4.03 Reference Standards and Codes

- A. All references relate to the current version adopted by the city/county according to the authority having jurisdiction (AHJ). If the city/county has not adopted a version the latest version shall be utilized.
- B. ASTM B633: Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- C. ASTM A653: Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process
- D. ASTM A123: Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel
- E. ASTM A510: Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- F. ANSI/TIA 569-C: Telecommunications Pathways and Spaces
- G. ANSI/TIA 568-C.0, 1, 2, 3, 4: Commercial Building Telecommunications Standard
- H. ANSI/TIA-598-C-2005 – Optical Fiber Cable Color Coding
- I. ANSI/TIA 606-B: Administration Standard for Telecommunications Infrastructure
- J. ANSI/TIA 942-A: Telecommunications Infrastructure Standard for Data Centers
- K. ANSI/TIA 607-B: Generic Telecommunications Grounding (Earthing) and Bonding for Customer Premises
- L. IEEE: National Electrical Safety Code® (NESC®)
standards.ieee.org/about/nesc

4.04 Qualifications

- A. Premises Distribution System: Written certification that the premises distribution system complies with the EIA ANSI/TIA/EIA-568-C.0,1, 2, 3, EIA ANSI/TIA/EIA-569-B, and ANSI/TIA/EIA-606-A.
- B. Materials and Equipment: Where materials or equipment are specified to conform, be constructed, or be tested to meet specific requirements, certification that the items provided conforms to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

C. Installers

1. The Contractor shall have an RCDD (Registered Communication Distribution Designer) on staff assigned to manage this Project; documented proof shall accompany the proposal response.
2. All installing personnel shall have completed and be certified in manufacturer training or BICSI (Building Industry Consulting Service International) installation training for UTP infrastructure systems, or the Contractor shall contract with manufacturer for installation of all proposed components. Company Certifications shall accompany the proposal response.
3. The Contractor's technicians shall be certified and trained in the connectivity hardware that is being installed.
4. The Contractor shall submit certification that installers are factory certified to install and test the provided products. No less than half of the crew to be used for the telecommunications installation shall be trained by that manufacturer for the work.

4.05 Pre-Construction Submittals

A. Shop Drawings in addition to requirements in Section 27 00 00:

1. Equipment rack elevation details
2. Elevations of telecommunication room walls mounted equipment
3. Outlet faceplate details for all outlet configurations, sizes, and cable types
4. Overhead telecommunication room enlargements, provide dimensions of room and clearance for maintenance and operation

4.06 Construction Progress Submittals

A. Refer to Section 27 00 00 for requirements.

4.07 Closeout Submittals

A. Refer to Section 27 00 00 for requirements. In addition provide three (3) sets of the following:

1. Data cable test results
2. USB Drive containing:
 - a. As-built drawings (PDF format)
 - b. Detailed test results in original tester format (Fluke Linkware)
 - c. Detailed cable test results in PDF format
3. Warranty certification from connectivity manufacturer

4.08 Delivery, Storage, and Handling

- A. Vendor shall be responsible for all materials until completion of Project.
- B. Cable shall be stored according to manufacturer's recommendations at minimum. In addition, cable shall be stored in a location protected from vandalism and weather.
- C. If cable is stored outside, it shall be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees Fahrenheit, the cable shall be moved to a heated (minimum 50 degrees Fahrenheit) location. If necessary, cable shall be stored off site at the Contractor's expense.
- D. If the Contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner.
- E. Commercial off-the-shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

Part 5 - PRODUCTS

5.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

Part 6 - EXECUTION

6.01 Warranty

- A. Refer to Section 27 00 00 for additional requirements.
- B. The Contractor shall provide to the Owner a 1-year minimum warranty for all materials, equipment, etc.
- C. Upon successful completion of the installation and subsequent inspection, the Owner shall receive a numbered certificate, from the manufacturing connectivity hardware (patch panels, jacks, patch cords 110 blocks, etc.) company, registering the installation. This warranty shall include all labor, materials, and travel time.
- D. The warranty shall ensure against product defects and guarantee that all approved cabling components exceed the specifications of TIA/EIA-568-C, and ISO/IEC IS 11801 for cabling links/channels, and that the installation will exceed the loss and bandwidth requirements of TIA/EIA 568-C ISO/IEC IS 11801 for fiber links/channels, for a fifteen (15) year period. The warranty shall apply to all passive structure cabling system components.

- E. The warranty shall cover the failure of the wiring system to support the application that it was designed to support, as well as additional application(s) introduced in the future by recognized standards or user forums that use the TIA/EIA 568-C or ISO/IEC IS 11801 component and link/channel specifications for cabling, for a minimum of a fifteen (15) year period.
- F. The warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective products(s), labeling of the new components, and testing of the circuit(s) at no cost to the Owner.

6.02 Examination

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper and timely completion.
- B. Verify cable lengths comply with published standards.
- C. Notify Owner of installation that would exceed maximum lengths prior to installation of cable.
- D. Contactor shall consult with Owner regarding alternative routing or location of cable.
- E. Do not proceed until unsatisfactory conditions have been corrected.

6.03 Installation Requirements

- A. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment shall include, but not be limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge, and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices that may move or wear in a manner to pose a hazard to the cable shall not be used.
- B. Service Loops: A surplus of cable, typically located at or near the point of termination to facilitate potential future changes. Cables shall have a minimum cable slack of 10ft (3m) at the telecommunication room(s) and 3.28ft (1m) at each telecommunications outlet in the suspended ceiling unless noted otherwise. Service loops shall be stored in an extended loop or in a figure-eight configuration, not in bundled loops.
- C. Cable Support (TIA 569-C.9.7):
 - 1. Non-continuous supports shall be located at intervals not to exceed 1.5 m (5 ft). Non-continuous supports shall be selected to accommodate the immediate and anticipated quantity, weight, and performance requirements of cables.
 - 2. It is recommended not to make long runs exactly 5 ft apart due to "harmonics" issues per cable manufacturers

3. Non-continuous pathways do not need to be bonded together or grounded (see 2011 NEC 250.92.A.1)
- D. Maximum pulling tension (TIA 568-C.5.3.1):
1. The pulling tension for a 4-pair balanced twisted pair cable shall not exceed 110 N (25 lbf) during installation. For multipair cable (12-pair and above), manufacturer's pulling tension guidelines shall be followed.
 2. Sags between supports shall be a maximum of 300 mm (12 inches).
- 6.04 Cooperation
- A. The Contractor shall cooperate with other trades and General Contractor's personnel in locating work in a proper manner.
 - B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.
- 6.05 Testing and Acceptance
- A. The Contractor shall perform acceptance tests as indicated below for each subsystem (backbone, station, etc.) as it is completed.
 - B. The Contractor shall supply all equipment and personnel necessary to conduct the acceptance tests. Prior to testing, the Contractor shall provide a summary of the proposed test plan for each cable type, including equipment to use, setup, test frequencies or wavelengths, results format, etc. The Consultant will approve the method of testing.
 - C. The Contractor shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. The Contractor shall provide the Consultant with a written certification that this inspection has been made.
 - D. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Consultant. Representatives of the Owner may be in attendance to witness the test procedures. The Contractor shall provide a minimum of one (1) week advance notice to the Consultant and Owner to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
 - E. Tests related to connected equipment of others shall be done only with the permission and presence of Contractor involved. The Contractor shall ascertain that testing only as required to prove the wiring connections are correct.

- F. The Contractor shall provide test results and describe the conduct of the tests, including the date of the tests, the equipment used, and the procedures followed. At the request of the Consultant, the Contractor shall provide copies of the original test results.
- G. All cabling shall be 100% fault free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the Contractor's expense. The applicable tests shall then be repeated.
- H. The Consultant or Owner may request that a 10% random field re-test be conducted on the cable system to verify documented findings.
 - 1. If requested, the Contractor shall test up to 10% of cable links at no cost to the Owner.
 - 2. Tests shall be a repeat of those defined above and under Testing and Acceptance. If findings contradict the documentation submitted by the Contractor, additional testing shall be performed to the extent determined necessary by the Consultant, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

6.06 Fire Stopping

- A. Contractor shall seal any openings created for cable pass-through between floors or through fire rated walls. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.
- B. Creation of such openings as are necessary for cable passage between locations as shown on the Drawings shall be the responsibility of the Contractor. Any openings created by or for the Contractor and left unused shall also be sealed as part of this work.

END OF SECTION

Section 27 13 00 – Communications Backbone Cabling

Part 1 - GENERAL

1.01 Scope

- A. This section describes the products and execution requirements relating to telecommunications voice, and data backbone cabling and termination components.
- B. Backbone Cabling is the cable and hardware interconnecting telecommunication rooms (TRs), building demarcation rooms, equipment rooms and server rooms. The backbone cabling shall consist of the following cable type:
 - 1. 50-micron Multimode Fiber Optic Cable

1.02 Test Data – Fiber Optic Media

- A. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
- B. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.
- C. The database for the completed job shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.
- D. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - 1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - 2. The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value as defined in this document).
 - 3. The date and time the test results were saved in the memory of the tester.
- E. The following general information is to be provided in the electronic database containing the test result information for each link:
 - 1. The identification of the customer site as specified by the end user.
 - 2. The overall Pass/Fail evaluation of the link-under-test.
 - 3. The name of the standard selected to execute the stored test results.

4. The cable type and the value of the 'index of refraction' used for length calculations.
 5. The date and time the test results were saved in the memory of the tester.
 6. The brand name, model, and serial number of the tester.
 7. The revision of the tester software and the revision of the test standards database in the tester.
- F. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:
1. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
 2. The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength, and the margin (difference between the measured attenuation and the test limit value).
- G. The link length shall be reported for each optical fiber for which the test limit was calculated.
- H. Contractor shall provide accurate as-built Construction Drawings at the site during construction.
- I. The Drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (Visio or PDF) formats on which as-built construction information can be added. These documents will be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Owner.
- J. The Contractors shall annotate the base Drawings and return to the Consultant in hard copy (same plot size as originals) and electronic (Visio or PDF) form.

Part 2 - PRODUCTS

2.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 Optical Fiber Cables Specifications

- A. Reference:

1. See Sections 16.11 & 16.12 for locations, sizing, strand count and general requirements
- B. General Considerations
1. The cable shall meet the requirements of the National Electrical Code (NEC) Section 770.
 2. For plenum applications, the cable shall meet applicable flame tests: ANSI/UL 910 (NFPA 262-1994).
 3. Cables shall be Non-plenum (CMR) Rated.
 4. Finished cables shall conform to the applicable performance requirements of Tables 8-6 and 8-7 of the Insulated Cable Consultants Association, Inc. (ICEA) *Standard for Fiber Optic Premises Distribution Cable* (ICEA S-83-596).
- C. Cable Construction
1. The coated fiber shall have a layer of Teflon placed between the acrylate coating of the optical fiber and the thermoplastic buffer. The diameter of the thermoplastic buffer coating shall be $900 \pm 50 \mu\text{m}$. The fiber coating and buffer shall be removable with commercially available stripping tools in a single pass for connectorization or splicing.
 2. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal.
 3. The fibers shall be stranded around a dielectric central member.
 4. The central member shall be over coated with a thermoplastic, when required, to achieve dimensional sizing to accommodate and support the $900 \mu\text{m}$ buffered fibers.
 5. The buffered fibers shall be grouped in six-fiber subunits.
 6. The fibers shall be stranded around a dielectric central member in the subunit.
 7. A ripcord may be applied between the aramid yarns and the subunit jacket to facilitate jacket removal.
 8. The subunit jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
 9. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the subunits. The strength members shall be of a high modulus aramid yarn. The aramid yarns shall be helically stranded around

the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the subunit jacket.

D. Outer Cable Jacket

1. Indoor Cabling:

- a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.
- b. The indoor distribution cable specified herein shall have an interlocking armor made of steel or aluminum. The interlocking armor for plenum cables shall have a PVC jacket.
- c. The color of the armor jacket shall match the jacket color of the optical fiber cable located inside of the armor. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed, or flexible metal conduit.

2. Indoor/Outdoor Cabling to Portables:

- a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.
- b. The indoor/outdoor cable specified herein shall have an armor protective construction intended for indoor plenum or outdoor underground installations.

E. Fiber Identification

1. The individual fibers shall be color-coded for identification. The optical fiber color-coding shall be in accordance with ANSITIA/EIA-598-B "Optical Fiber Cable Color Coding." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the

transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another.

2. When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The number shall be repeated at regular intervals. The subunit jacket color shall be orange for subunits containing multimode fibers, yellow for subunits containing singlemode fibers, and white for filler subunits.
3. The outer jacket for all dielectric cable shall be marked with the manufacturer name or UL file number, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket.

F. Cable Specifications

1. Temperature Range

- a. Non-Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for riser cables shall be -20 to +70 °C. Testing shall be in accordance with FOTP-3.
- b. Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for plenum cables shall be 0 to +70°C. Testing shall be in accordance with FOTP-3.

2. Cyclic Flexing

- a. When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycle per minute. The fiber shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).

3. High and Low Temperature Bend

- a. When tested in accordance with FOTP-37, Fiber Optic Cable Bend Test, Low and High Temperature, the cable shall withstand four full turns around a mandrel at test temperatures of 0 °C and +50 °C. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.5 dB at 1300 nm (multimode).

4. Impact Resistance

- a. When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, the cable shall withstand a minimum of 20 impact cycles for riser cables and 10 impact cycles for plenum cables. The

fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).

5. Temperature Cycling
 - a. When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, the change in attenuation at extreme operational temperatures (0 to +50 °C) shall not exceed 0.3 dB/km at 1550 nm (singlemode) or 0.6 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling.
6. Twist-Bend
 - a. When tested in accordance with FOTP-91, Fiber Optic Cable Twist-Bend Test, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting and bending around a mandrel 20 times the cable outer diameter. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or 0.4 dB at 1300 nm (multimode).
- G. Multimode (50/125 μm)
 1. The multimode fiber utilized in the optical fiber cable shall meet EIA/TIA-492AAAA-A-1997, Detail Specification for 50μm Core Diameter/125μm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers (OM3 type). Cable shall have the following specifications:
 - a. Core Diameter: $50 \pm 3 \mu\text{m}$
 - b. Core Non-Circularity: $\leq 5\%$
 - c. Cladding Diameter: $125 \pm 2 \mu\text{m}$
 - d. Cladding Non-Circularity: $< 2.0\%$
 - e. Core-to-Cladding Concentricity: $\leq 3 \mu\text{m}$
 - f. Coating Diameter: $245 \pm 2 \text{ mm}$
 - g. Refractive Index Profile: Graded index
 - h. Numerical Aperture: 0.275 ± 0.015
 - i. Maximum Attenuation: less than 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm.
 2. IEEE 802.3z Performance: The fiber shall support laser-based 10 Gigabit Ethernet (10GbE) operation for up to 300 meters.
 3. Attenuation at the Water Peak: The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 1.0 dB/km.

4. Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75-± 2 mm diameter mandrel shall not exceed 0.5 dB at 850 nm or 1300 nm.
- H. Fiber optic cabling shall be manufactured by Commscope.
- 2.03 Fiber Optic Connector
- A. The optical connector shall be LC-type.
- B. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive.
- C. The attenuation per mated pair shall not exceed 0.35 dB (individual) and 0.2 dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.
- D. The connector shall meet the following performance criteria:
- | | |
|-----------------------------|--------|
| 1. Cable Retention (FOTP-6) | 0.2 dB |
| 2. Durability (FOTP-21) | 0.2 dB |
| 3. Impact (FOTP-2) | 0.2 dB |
| 4. Thermal Shock (FOTP-3) | 0.2 dB |
| 5. Humidity (FOTP-5) | 0.2 dB |
- E. Connectors shall be manufactured by Commscope.
- 2.04 Fiber Optic Patch Panels
- A. The Contractor shall provide a fiber optic patch panel at each location where a fiber optic cable terminates.
- B. All terminated fibers shall be mated to duplex LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.
- C. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and Drawings, including those not terminated (if applicable), PLUS 50% future growth.
- D. Patch panels shall be designed for easy installation, front removal, and expansion of snap-in adapter panels.
- E. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a

- hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.
- F. The patch panel's enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer's recommended minimums or 1.2", whichever is larger.
 - G. Access to the inside of the patch panel enclosure during installation shall be from the front and rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.
 - H. All patch panels shall provide protection to both the "facilities" and "user" side of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (backbone, riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access of such cables.
 - I. Fiber optic patch panels shall be manufactured by Commscope.

Part 3 - EXECUTION

3.01 Testing

- A. Field Test Requirements for Fiber Optic Cabling System
 1. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, the Contractor shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include the manufacturer's on reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
 2. Factory data shall be provided upon request, showing on-the-reel bandwidth performance results as tested at the factory.
 3. Every fiber optic backbone link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-C or by the appropriate network application standard(s), whichever is more demanding.
 4. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
 5. 100% of the installed cabling links shall be tested and shall pass the requirements of the standards mentioned above and as further detailed in this document. Any failing link shall be diagnosed and corrected at no additional cost to the Owner. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and

passing result of the tests for all links shall be provided in the test results documentation in accordance with RFP.

6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
 - b. The manufacturer of the test equipment used for the field certification
 - c. Training organizations authorized by BICSI
 7. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-C.1) with a Category 1 light source.
 8. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
 9. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
 10. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
 11. Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
 12. A representative of the Owner shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing begins.
 13. A representative of the Owner will select a random sample of 5% of the installed links. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the Pass/Fail determination, the installation Contractor, under supervision of the Owner representative, shall repeat 100% of the testing. The cost of retesting shall be borne by the installation Contractor.
- B. Fiber Performance Test Parameters
1. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B.
 - a. $\text{Link Attenuation} = \text{Cable_Attn} + \text{Connector_Attn} + \text{Splice_Attn}$

- b. $\text{Cable_Attn (dB)} = \text{Attenuation_Coefficient (dB/km)} * \text{Length (Km)}$
- c. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Multimode 50/125 μm	850	3.5
	1300	1.5

- d. $\text{Connector_Attn (dB)} = \text{number_of_connector_pairs} * \text{connector_loss (dB)}$
- e. Maximum allowable mated connectors_loss = 0.50 dB
- f. $\text{Splice_Attn (dB)} = \text{number of splices (S)} * \text{splice_loss (dB)}$
- g. Maximum allowable splice_loss = 0.1 dB (when tested bidirectionally)
2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices—i.e., it does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 3. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is preferred.
 4. The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
 5. The backbone link shall be tested in two directions at both operating wavelengths to account for attenuation deltas associated with wavelength.
 6. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.
 7. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.
 8. Multimode backbone links are designed to be used with network applications that use laser light sources (underfilled launch conditions). However, the link attenuation equation has been based upon the use of a light source categorized as Category 1, Overfilled.

3.02 Fiber Optic Cable Installation Requirements

- A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment

relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

- B. A minimum of 15 feet of slack cable (each cable) shall be coiled and secured at each end.
- C. Exact cable termination locations shall be field verified with Owner.

END OF SECTION

Section 27 15 00 – Communications Horizontal Cabling

Part 1 - GENERAL

1.01 Scope

- A. This section describes the products and execution requirements relating to telecommunications voice, and data horizontal (station) cabling and termination components.
- B. Horizontal cabling is the cabling between the work area telecommunications outlet and the telecommunications room (TR). Horizontal cabling is often referred to as “station cabling”.
- C. The horizontal cabling system will consist of the following:
 - 1. Horizontal Unshielded Twisted Pair (UTP) Cable
 - 2. Outlet Termination Modules (jacks)
 - 3. Outlet Termination Plates
 - 4. Above Ceiling Cable Support Systems
 - 5. Horizontal Cable Testing Requirements
 - 6. Cable Pathway/Sleeve Requirements

1.02 Related Work

- A. Section 27 00 00 – General Technology Requirements
- B. Section 27 05 00 – Communications Cabling General Requirements
- C. Section 27 16 00 – Communications Connecting Cords
- D. Section 27 18 00 – Communications Labeling and Identification

Part 2 - PRODUCTS

2.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

2.02 Category 6 Horizontal Copper Cables

- A. All cables and equipment shall be furnished, tested, installed and wired by the Contractor.

- B. All horizontal data cables shall terminate on modular patch panels in the telecommunications closet as specified on the Drawings.
- C. This specification defines the requirements for commercially available high performance Category 6 cable.
- D. This cable shall be suitable for installation free-air, in building risers, in conduit, and/or in cable tray and shall carry CMP rating.
- E. The cable design described herein shall exceed transmission performance of Category 6 cables.
- F. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code, and meet the specifications of NEMA (low loss), UL 444, and ICEA. Conductor shall also conform to the requirements for solid annealed copper wire in accordance with ASTM B 3.
- G. All cables, termination components, and support hardware shall be furnished, tested, installed, and wired by the Contractor.
- H. The jacket color for data cables shall be BLUE.
- I. **IMPORTANT:** Cable and termination components (jack, patch panel, wiring blocks) are specified to function as a system. The compatibility of the cable to be installed with the proposed termination components shall be recognized and documented by the termination component manufacturer.
- J. Approved Manufacturers: Commscope Uniprise Media 6 #8471514/10 (65N4+).

2.03 Information Outlet

A. General

1. Station cables shall each be terminated at their designated workstation location in the connector types described in the subsections below. Included are modular jacks, faceplates, and surface mount raceway. The combined assembly is referred to as the Standard Information Outlet (SIO). These connector assemblies shall snap into a mounting frame.
2. SIOs shall be mounted (1) where existing boxes are in place, (2) on surface mount raceway typically in surface raceway with barrier, (3) on floor mount interface boxes, or (4) on power poles either currently owned or new.
3. The telecommunications outlet frame shall accommodate or incorporate the following:
 - a. A minimum of four (4) modular jacks, when installed on a wall-mounted assembly.
 - b. A mechanism for adjusting the surface plate to a plumb position.

4. Multiple jacks are identified in close proximity on the Drawings. The Contractor shall determine the optimum compliant configuration based on the products proposed.
5. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each SIO type for review by the Consultant.

B. Modular Jack

1. Data jacks shall be non-keyed 8-pin modular jacks.
2. Termination components shall be designed to maintain the cable's pair twists as closely as possible to the point of mechanical termination.
3. Jacks shall utilize a four-layer printed circuit board to control NEXT.
4. Jack housings shall fully encase and protect printed circuit boards and IDC fields.
5. Modular jack contacts shall accept 2500 plug insertions.
6. Modular jack contacts shall be formed flat for increased surface contact with mated plugs. These contacts shall be arranged on the PC board in two staggered arrays of four to maximize contact spacing and minimize crosstalk.
7. Modular jack contacts shall be constructed of Beryllium copper for maximum spring force and resilience.
8. Contact Plating shall be a minimum of 50 micro inches of gold in the contact area over 50 micro-inch of nickel, compliant with FCC part 68.5.
9. Jack termination shall be 110 IDC, integral to the jack housing, laid out in two arrays of four contacts.
10. Jacks shall utilize a paired punch down sequence. Cable pairs shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.
11. Jacks shall utilize tin lead plated (60% tin/40%lead) phosphor bronze 110 insulation displacement contacts.
12. Jacks shall terminate 22-26 AWG stranded or solid conductors.
13. Jacks shall terminate insulated conductors with outside diameters up to .050".
14. Jacks shall be compatible with single conductor 110 impact termination tools.
15. Jacks shall be compatible with EIA/TIA 606 color code labeling and accept snap on icons for identification or designation of applications.
16. Jacks shall be BLUE in color.
17. Jacks shall be marked as either T568A or T568B wiring.

18. Category 6 jacks shall be CommScope Uniprise UNJ600-BL.

C. Outlet Faceplates

1. Faceplates shall be stainless steel and incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
2. Any unused jack positions shall be fitted with a removable blank inserted into the opening.
3. Modular jacks shall have capability to incorporate a dust cover that fits over and/or into the jack opening. The dust cover shall be designed to remain with the jack assembly when the jack is in use. No damage to the jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the jack pinning shall not be accepted.
4. Faceplates shall be CommScope M14L-262 with M20AP-262 (107067928) blank inserts.

D. Surface Mount Interface Box

1. Low profile, surface mount boxes shall incorporate recessed designation strips at the top for identifying labels. Designation strips shall be fitted with clear plastic covers.
2. The box shall feature built-in cable management for both fiber and copper applications.
3. Any unused jack positions shall be fitted with a removable blank inserted into the opening.
4. Modular jacks shall have capability to incorporate spring-loaded shutter door for added protection from dust and other airborne contaminants. The dust cover shall be designed to remain with the jack assembly when the jack is in use.
5. The box shall have the capability to incorporate optional magnets that can be internally mounted.
6. Surface mount box shall be manufactured by modular jack manufacturer.

2.04 Cable Hook Systems

- A. In the areas where the cables are required to be run in a "free-air" plenum, a cable hook system shall be used.
- B. Cable hooks shall be capable of supporting a minimum of 30 lbs with a safety factor of 3.
- C. Hooks shall be capable of supporting a minimum of 100 lbs with a safety factor of 3 where extra strength is required.

- D. Follow manufacturer's recommendations for allowable fill capacity for each size of cable hook.
- E. Installation and configuration shall conform to the requirements of the ANSI/EIA/TIA Standards 568A & 569, NFPA 70 (National Electrical Code), and applicable local codes.
- F. Cable hooks shall:
 - 1. Have a flat bottom and provide a minimum of 1 5/8" cable bearing surface.
 - 2. Have 90-degree radiused edges to prevent damage while installing cables.
 - 3. Be designed so the mounting hardware is recessed to prevent cable damage.
 - 4. Have a latch retainer to provide containment of cables within the hook.
 - 5. Have a retainer that shall be removable and reusable.
 - 6. Be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, and floor posts, to meet job conditions.
- G. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.
- H. Cable hooks for non-corrosive areas shall be pre-galvanized steel, ASTM A653 G90. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish, ASTM B633, SC3.
- I. Cable hooks for corrosive areas shall be stainless steel, AISI type 304.
- J. Cable hooks shall be B-Line series BCH32 or CEAS Series 200.

2.05 Surface Raceway

- A. For pricing purposes, proposer shall anticipate up to 15' of raceway may be required in Gymnasiums.
- B. In areas where surface raceway will be used as a cable path, no exposed cable shall be permitted.
- C. With the agreement of the Consultant and Owner, where telecommunications outlets are to be located in areas where the walls cannot be fished, the station wire serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, laboratories, and conference rooms or like facilities. Contractor shall attempt to fish hollow walls, use existing conduit, or exhaust all other options to conceal cabling prior to installing surface raceway.
- D. The raceway shall originate from a surface mounted box located off the floor and be attached to the wall and terminate above the ceiling. The outlet box height shall match existing electrical receptacle height. Raceway for wall-mounted phone

- locations shall originate from a surface mounted box with the top of the box located 48" off the floor.
- E. The color of this raceway shall be electrical ivory. All fittings including but not limited to extension boxes, elbows, tees, and fixture boxes shall match the color of the raceway. Telecommunication outlet faceplates shall be gray.
 - F. The raceway and all system devices shall be UL listed, exhibit nonflammable self-extinguishing characteristics, tested to specifications of UL94V-0 and be Category Compliant as defined by TIA/EIA 568.
 - G. Minimum bend radius shall be adhered to for UTP and fiber optic cable.
 - H. Non-Metallic raceway systems:
 - 1. Non-metallic surface raceway shall have an adhesive-applied base and have a hinged snap-on cover. The raceway shall be manufactured of natural PVC compounds.
 - 2. The raceway system shall be made up of the following components:
 - a. Raceway channel shall be Panduit LD5 and be Electric Ivory in color.
 - b. Surface mount outlet boxes shall be Panduit JBX3510EI-A.
 - c. Dropped ceiling connectors shall be Panduit DCF5EI-X or DCEFXEI-X.
 - d. Right angle fittings shall be Panduit RAFC5EI-X.
 - e. Coupler fittings shall be Panduit CFX5EI-X.
 - I. All raceway systems shall be installed complete as specified herein and in manufacturer recommendations.
- 2.06 Cable Pathway Sleeves
- A. The Contractor shall provide all necessary wall penetration for cable pathways whether or not specifically shown on Project Drawings.
 - B. All wall penetrations shall have a metallic sleeve(s) as required to maintain a maximum 40% fill ration.
 - C. All sleeves shall be properly firestopped by this Contractor.
 - D. Provide all core holes, pathways and sleeves (minimum 1.25" c).
 - E. Install non-metallic threadless insulating bushings on end of all conduits.
 - F. Conduit Core Holes and Sleeves thru Floor: For all floor penetrations, provide IMC conduits with threaded steel couplings set flush with finish floor. Extend 6-feet above finish floor with IMC before any termination.

Part 3 - EXECUTION**3.01 Twisted Pair Test Equipment**

- A. Test equipment used under this contract shall be from a manufacturer who has a minimum of five years' experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
- B. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output. Test adapter cable shall be approved by the manufacturer of the test equipment. Baseline accuracy of the test equipment shall exceed TIA Level III, as indicated by independent laboratory testing.
- C. Test equipment shall:
 - 1. Be capable of certifying Category 5E, 6 and 6A permanent links.
 - 2. Have a dynamic range of at least 100dB to minimized measurement uncertainty.
 - 3. Be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
 - 4. Include S-band time domain diagnostics for NEXT and return loss.
 - 5. Be capable of running individual NEXT, return loss, etc., measurements in addition to AutoText.
 - 6. Include a library of cable types, stored by major manufacturer.
 - 7. Store at least 1000 Category 5e, 6 or 6A autotests in internal memory.
- D. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurements.
- E. The approved manufacturer of the test equipment is Fluke.

3.02 Cable Support

- A. J-hooks fabricated to contain data/voice cables may be used to support 25 or fewer cables in each hook. J-hooks are to be fastened to building steel with beam clamps, suspended from ceiling slab with threaded rod, or anchored to the wall. All J-hooks shall be hung straight and level. No other installation technique will be authorized unless pre-approved.
- B. Three tiered double-sided J-hook configurations shall contain a maximum of 25 cables per hook or 150 cables. Smaller configurations may be used as bundles decrease in size, maintaining no more than 25 cables per hook.

- C. Bundles surpassing 150 cables shall be supported by hangers, fabricated of 3/8" threaded rod and 24" Unistrut. Hangers shall also be installed where the installation of a three-tiered J-hook system is not appropriate for the ceiling space, or where blocked by other trades' work.
- D. Cable bundles consisting of fewer than 10 cables may be supported by single J hooks.
- E. All cable support in the main cable path shall be installed every four feet. Small cable bundles (under 25) not in the main path may be supported every five feet.
- F. A sag shall be maintained between supports of 6", to reduce cable strain. Velcro is an appropriate method of securing cables, when properly used and not over tightened.
- G. Proper cable support is extremely important to the Owner, and care shall be taken by the Contractor to provide and install the appropriate supports. Supports found to be inadequate will be replaced.
- H. Cable bundles including voice/data cabling shall not have plastic cable ties.
- I. All cable trunks shall have radius controlled cable waterfalls where trunk drops from conduit, sleeve or tray from horizontal path to vertical path.

3.03 Station Cabling

- A. Information outlet cables with copper media (voice & data UTP) shall be located as detailed on the Project Drawings.
- B. The Contractor shall utilize these documents in determining materials quantities and routing.
- C. Station cables shall be run to the information outlet from the MER/TR serving each area in conduit, free-air above drop ceiling, in cable tray, and/or in modular furniture.
- D. The maximum station cable drop length for UTP cables shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and shall include any slack required for the installation and termination. The Contractor shall install station cabling in a fashion to avoid unnecessarily long runs.
- E. Contractor shall verify cable lengths comply with published standards; prior to installation of any horizontal cabling, this Contractor shall verify cable paths and confirm no horizontal cable will exceed 295 total feet. If it is determined that the cable will exceed 295', this Contractor shall route the cabling to another MER/TR or determine shorter path so cables are under 295'. If this is not possible, the Contractor shall notify the Consultant prior to installation. Failure to do this step will not result in a change order from the Contractor.

- F. All cables shall be installed splice-free unless otherwise specified.
- G. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.
- H. Avoid abrasion and other damage to cables during installation.
- I. All cable shall be free of tension at both ends. In cases where the cable shall bear some stress, Kellom grips may be used to spread the strain over a longer length of cable.
- J. Where installed free-air, installation shall consider the following:
 - 1. Cable shall run at right angles and be kept clear of other trades' work.
 - 2. Cables shall be supported according to code, using "J-hooks" anchored to ceiling concrete, walls, piping supports, or structural steel beams.
 - 3. Hooks shall be designed to maintain cable bend to larger than the minimum bend radius (typically 4 x cable diameter).
 - 4. Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 6 inches, another support shall be used.
- K. Cable shall never be laid directly on the ceiling grid.
- L. Cables shall not be attached to existing cabling, plumbing, or steam piping, ductwork, ceiling supports, or electrical or communications conduit.
- M. Manufacturers' minimum bend radius specifications shall be observed in all instances. Use of plastic cable ties is not acceptable. Cable bundles shall be neatly dressed with use of Velcro type straps.
- N. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.
- O. A coil of one foot in each cable shall be placed in the ceiling at the last support (e.g., J-hook) before the cables enter a fishable wall, conduit, surface raceway, or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15 feet of slack shall be left in each station cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
- P. To reduce or eliminate EMI, the following minimum separation distances from $\leq 480V$ power lines shall be adhered to:

1. Twelve (12) inches from power lines of <5-kVa
 2. Eighteen (18) inches from high voltage lighting (including fluorescent)
 3. Thirty-nine (39) inches from power lines of 5-kVa or greater
 4. Thirty-nine (39) inches from transformers and motors
- Q. All openings shall be sleeved and firestopped per prevailing code requirements upon completion of cable installation.

3.04 Information Outlet

- A. Information outlets shall be flush mounted on wall-mounted boxes, in floor-mounted boxes, on surface raceway, or on modular furniture.
- B. Any outlets to be added where these conditions are not met shall be positioned at a height matching that of existing services or as directed otherwise by the Site Coordinator and the Consultant. Nominal height (from finished floor to center line of outlet) in new installation shall be as follows:
 1. Standard Voice & Data Outlet (SIO) shall match adjacent electrical outlets.
- C. The Contractor shall coordinate the style of the telecommunication outlets to be installed in the floor mount boxes and surface mount raceways with the Owner.

3.05 Cable Termination

- A. At the telecommunication closet, all data and voice cables shall be positioned on termination hardware in sequence of the outlet ID, starting with the lowest number.
- B. Termination hardware (blocks and patch panels) positioning and layout will be reviewed and approved by the Consultant prior to construction. The review does not exempt the Contractor from meeting any of the requirements stated in this document.
- C. Cable Termination – Data/Voice UTP
 1. Data/voice patch panels shall be designed and installed in a fashion as to allow future station cabling to be terminated on the panel without disruption to existing connections.
 2. Data patch panels shall be sized to accommodate a minimum of 20% growth in the quantity of stations relative to the initial installation.
 3. At information outlets and data/voice patch panels, the installer shall ensure that the twists in each cable pair are preserved to within 0.5 inch of the termination for data/voice cables. The cable jacket shall be removed only to the extent required to make the termination.

3.06 Test Data – Copper Media

- A. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test. Comma separated value (CSV) format is not acceptable.
- B. The database for the completed job – including twisted-pair copper cabling links, if applicable –shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.
- C. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - 1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - 2. The overall Pass/Fail evaluation of the copper channel-under-test, including the NEXT worst-case margin (margin is defined as the difference between the measured value and the test limit value).
 - 3. The overall Pass/Fail evaluation of the fiber link-under-test, including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value).
 - 4. The date and time the test results were saved in the memory of the tester.

3.07 Copper Station Cables

- A. Station cabling testing shall be from the jack at the outlet in the work area to the termination block on which the cables are terminated at the MDF or IDF.
- B. Testing shall be of the permanent link. Contractor shall warrant performance, however, based on channel performance and provide patch cords that meet channel performance criteria. All cabling not tested strictly in accordance with these procedures shall be retested at no cost to the Owner.
- C. Testing shall be from the jack at the SIO to the patch panel on which the cables are terminated at the wiring hub.
- D. Horizontal “station” cables shall be free of shorts within the pairs and shall be verified for continuity, pair validity and polarity, and wire map (conductor position on the modular jack). Any defective, split, or mispositioned pairs shall be identified and corrected.
- E. Testing of the cabling systems rated at TIA Category 5e/6/6a and above shall be performed to confirm proper functioning and performance.

- F. Testing of the transmission performance of station cables (Category 5e/6/6a) shall include the following:
1. Length
 2. Attenuation
 3. Pair to Pair NEXT
 4. ACR
 5. PSNEXT Loss
 6. Return Loss
 7. Pair to Pair ELFEXT Loss or ACRF
 8. PSEFEXT Loss or PS-ACRF
 9. Propagation Delay
 10. Delay Skew
 11. Return Loss
- G. The maximum length of station cable shall not exceed 90 meters, which allows 10 meters for equipment and patch cables.
- H. Worst case performance at 20°C, based on a horizontal cable length of 90 meters and equipment cord length of 4 meters, shall be as follows:
1. CATEGORY 6 (Permanent LINK)

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ELFEXT Loss Pair to Pair (dB)	PSELFEXT loss (dB)
1.0	1.9	65.0	62.0	64.2	61.2
4.0	3.5	64.1	61.8	52.1	49.1
8.0	5.0	59.4	57.0	46.1	43.1
10.0	5.5	57.8	55.5	44.2	41.2
16.0	7.0	54.6	52.2	40.1	37.1
20.0	7.8	53.1	50.7	38.2	35.2
25.0	8.8	51.5	49.1	36.2	33.2
31.25	9.8	50.0	47.5	34.3	31.3

Frequency (MHz)	Insertion Loss (Maximum dB)	NEXT Loss Pair to Pair (dB)	PS-NEXT Loss (dB; Worst Case)	ELFEXT Loss Pair to Pair (dB)	PSELFEXT loss (dB)
62.5	14.1	45.1	42.7	28.3	25.3
100.0	18.0	41.8	39.3	24.2	21.2
200.0	26.1	36.9	34.3	18.2	15.2
250.0	29.5	35.3	32.7	16.2	13.2

- I. In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation method. The Contractor shall make additional tests as the Consultant deems necessary at no additional expense to the Owner or Consultant.
- J. All data shall indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combination and in both directions when required by the appropriate standards.
- K. Cables shall be tested to the maximum frequency defined by the standards covering that performance category. Transmission Performance Testing shall be performed using a test instrument designed for testing to the specified frequencies. Test records shall verify "PASS" on each cable and display the specified parameters—comparing test values with standards-based "templates" integral to the unit.

3.08 Surface Raceway System

- A. In areas where surface raceway will be used as a cable path, no exposed cable shall be permitted. Contractor shall anticipate some raceway may be required in Gymnasiums.
- B. With the agreement of the Consultant and Owner, if a telecommunications outlet is required in an area where the walls cannot be fished, the station cable serving these outlets shall be covered with raceway. No exposed cable shall be permitted within offices, laboratories, and conference rooms, or like facilities. Contractor shall attempt to fish hollow walls, use existing conduit, or exhaust all other options to conceal cabling prior to installing surface raceway.
- C. The raceway shall originate from a surface mounted box located off the floor and be attached to the wall and terminate above the ceiling. The outlet box height shall match existing electrical receptacle height. Raceway for a wall-mounted location

- shall originate from a surface mounted box with the top of the box located 48" off the floor.
- D. Minimum bend radius shall be adhered to for UTP and fiber optic cable.
 - E. Where raceway is to be installed on painted, smooth, finished surfaces, the Contractor shall clean surface prior to installing raceway.
 - F. Where non-metallic raceway is to be installed on non-smooth surfaces such as wallpaper, unpainted brick, concrete, etc., the Contractor shall use flat-head screws in addition to the adhesive backing to fasten channel to surfaces.
 - G. Where Contractor is required to install metallic raceway, the raceway base shall be installed using flat-head screws and following all manufacturer's recommendations.
 - H. Where new outlet locations are indicated on Project Drawings as having existing Wiremold™ type raceway, the Contractor shall remove existing raceway from wall and install new specified raceway to cover any damage or markings caused from removing existing raceway product.
 - I. All surface raceway shall be mounted level and plumb. Where the Owner considers raceway channels to be installed unsatisfactorily, the Contractor shall remove and replace necessary channels at no additional cost to the Owner.
 - J. Suitable insulating bushings and inserts shall be used at connections to outlets and corner fittings. Dropped ceiling end fittings shall be utilized where raceway channel connects to dropped accessible ceiling tile. In rooms with drywall ceilings, open ceilings, or non-accessible ceilings, the Contractor shall extend raceway to the nearest location, hallway, or corridor that has accessible ceiling cavity. All cables shall be concealed.

END OF SECTION

Section 27 16 00 – Communications Connecting Cords

Part 1 - GENERAL

1.01 Scope

- A. This section describes the products relating to high quality Category 6 voice and data patch cords.
- B. In this section the term patch cords refers to the cords that connect Owner provided data network electronics to the horizontal cable infrastructure.
- C. It is important that the horizontal cable system and the provided patch cords work as one complete system for guaranteed channel performance. Patch cords shall be manufactured by the same manufacturer as the jack and patch panels.
- D. The Contractor shall provide and deliver all cords as listed in this section. The Owner will be responsible for installation of cords.

1.02 Related Work

- A. Section 27 00 00 – General Technology Requirements
- B. Section 27 05 00 – Communications Cabling General Requirements
- C. Section 27 13 00 – Communications Backbone Cabling

Part 2 - General

2.01 Scope

- A. This section describes the products and execution requirements relating to telecommunications voice, and data backbone cabling and termination components.
- B. Backbone Cabling is the cable and hardware interconnecting telecommunication rooms (TRs), building demarcation rooms, equipment rooms and server rooms. The backbone cabling shall consist of the following cable type:
 - 1. 50-micron Multimode Fiber Optic Cable

2.02 Test Data – Fiber Optic Media

- A. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
- B. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.

- C. The database for the completed job shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.
- D. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - 1. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - 2. The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value as defined in this document).
 - 3. The date and time the test results were saved in the memory of the tester.
- E. The following general information is to be provided in the electronic database containing the test result information for each link:
 - 1. The identification of the customer site as specified by the end user.
 - 2. The overall Pass/Fail evaluation of the link-under-test.
 - 3. The name of the standard selected to execute the stored test results.
 - 4. The cable type and the value of the 'index of refraction' used for length calculations.
 - 5. The date and time the test results were saved in the memory of the tester.
 - 6. The brand name, model, and serial number of the tester.
 - 7. The revision of the tester software and the revision of the test standards database in the tester.
- F. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:
 - 1. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
 - 2. The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength, and the margin (difference between the measured attenuation and the test limit value).
- G. The link length shall be reported for each optical fiber for which the test limit was calculated.
- H. Contractor shall provide accurate as-built Construction Drawings at the site during construction.

- I. The Drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (Visio or PDF) formats on which as-built construction information can be added. These documents will be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Owner.
- J. The Contractors shall annotate the base Drawings and return to the Consultant in hard copy (same plot size as originals) and electronic (Visio or PDF) form.

Part 3 - Products

3.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

3.02 Optical Fiber Cables Specifications

A. Reference:

1. See Sections 16.11 & 16.12 for locations, sizing, strand count and general requirements

B. General Considerations

1. The cable shall meet the requirements of the National Electrical Code (NEC) Section 770.
2. For plenum applications, the cable shall meet applicable flame tests: ANSI/UL 910 (NFPA 262-1994).
3. Cables shall be Non-plenum (CMR) Rated.
4. Finished cables shall conform to the applicable performance requirements of Tables 8-6 and 8-7 of the Insulated Cable Consultants Association, Inc. (ICEA) *Standard for Fiber Optic Premises Distribution Cable* (ICEA S-83-596).

C. Cable Construction

1. The coated fiber shall have a layer of Teflon placed between the acrylate coating of the optical fiber and the thermoplastic buffer. The diameter of the thermoplastic buffer coating shall be $900 \pm 50\mu\text{m}$. The fiber coating and buffer shall be removable with commercially available stripping tools in a single pass for connectorization or splicing.
2. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal.

3. The fibers shall be stranded around a dielectric central member.
 4. The central member shall be over coated with a thermoplastic, when required, to achieve dimensional sizing to accommodate and support the 900 μm buffered fibers.
 5. The buffered fibers shall be grouped in six-fiber subunits.
 6. The fibers shall be stranded around a dielectric central member in the subunit.
 7. A ripcord may be applied between the aramid yarns and the subunit jacket to facilitate jacket removal.
 8. The subunit jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
 9. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the subunits. The strength members shall be of a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the subunit jacket.
- D. Outer Cable Jacket
1. Indoor Cabling:
 - a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.
 - b. The indoor distribution cable specified herein shall have an interlocking armor made of steel or aluminum. The interlocking armor for plenum cables shall have a PVC jacket.
 - c. The color of the armor jacket shall match the jacket color of the optical fiber cable located inside of the armor. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed, or flexible metal conduit.
 2. Indoor/Outdoor Cabling to Portables:

- a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.
- b. The indoor/outdoor cable specified herein shall have an armor protective construction intended for indoor plenum or outdoor underground installations.

E. Fiber Identification

1. The individual fibers shall be color-coded for identification. The optical fiber color-coding shall be in accordance with ANSITIA/EIA-598-B "Optical Fiber Cable Color Coding." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another.
2. When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The number shall be repeated at regular intervals. The subunit jacket color shall be orange for subunits containing multimode fibers, yellow for subunits containing singlemode fibers, and white for filler subunits.
3. The outer jacket for all dielectric cable shall be marked with the manufacturer name or UL file number, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket.

F. Cable Specifications

1. Temperature Range
 - a. Non-Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for riser cables shall be -20 to +70 °C. Testing shall be in accordance with FOTP-3.
 - b. Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for plenum cables shall be 0 to +70°C. Testing shall be in accordance with FOTP-3.
2. Cyclic Flexing

- a. When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycle per minute. The fiber shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).
3. High and Low Temperature Bend
 - a. When tested in accordance with FOTP-37, Fiber Optic Cable Bend Test, Low and High Temperature, the cable shall withstand four full turns around a mandrel at test temperatures of 0 °C and +50 °C. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.5 dB at 1300 nm (multimode).
4. Impact Resistance
 - a. When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, the cable shall withstand a minimum of 20 impact cycles for riser cables and 10 impact cycles for plenum cables. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).
5. Temperature Cycling
 - a. When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, the change in attenuation at extreme operational temperatures (0 to +50 °C) shall not exceed 0.3 dB/km at 1550 nm (singlemode) or 0.6 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling.
6. Twist-Bend
 - a. When tested in accordance with FOTP-91, Fiber Optic Cable Twist-Bend Test, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting and bending around a mandrel 20 times the cable outer diameter. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or 0.4 dB at 1300 nm (multimode).
- G. Multimode (50/125 μm)
 1. The multimode fiber utilized in the optical fiber cable shall meet EIA/TIA-492AAA-A-1997, Detail Specification for 50 μm Core Diameter/125 μm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers (OM3 type). Cable shall have the following specifications:
 - a. Core Diameter: $50 \pm 3 \mu\text{m}$
 - b. Core Non-Circularity: $\leq 5\%$

- c. Cladding Diameter: $125 \pm 2 \mu\text{m}$
 - d. Cladding Non-Circularity: $<2.0\%$
 - e. Core-to-Cladding Concentricity: $\leq 3 \mu\text{m}$
 - f. Coating Diameter: $245 \pm 2 \text{ mm}$
 - g. Refractive Index Profile: Graded index
 - h. Numerical Aperture: 0.275 ± 0.015
 - i. Maximum Attenuation: less than 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm.
- 2. IEEE 802.3z Performance: The fiber shall support laser-based 10 Gigabit Ethernet (10GbE) operation for up to 300 meters.
 - 3. Attenuation at the Water Peak: The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 1.0 dB/km.
 - 4. Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75 ± 2 mm diameter mandrel shall not exceed 0.5 dB at 850 nm or 1300 nm.
- H. Fiber optic cabling shall be manufactured by Commscope.

3.03 Fiber Optic Connector

- A. The optical connector shall be LC-type.
- B. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive.
- C. The attenuation per mated pair shall not exceed 0.35 dB (individual) and 0.2 dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.
- D. The connector shall meet the following performance criteria:

1. Cable Retention (FOTP-6)	0.2 dB
2. Durability (FOTP-21)	0.2 dB
3. Impact (FOTP-2)	0.2 dB
4. Thermal Shock (FOTP-3)	0.2 dB
5. Humidity (FOTP-5)	0.2 dB
- E. Connectors shall be manufactured by Commscope.

3.04 Fiber Optic Patch Panels

- A. The Contractor shall provide a fiber optic patch panel at each location where a fiber optic cable terminates.
- B. All terminated fibers shall be mated to duplex LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.
- C. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and Drawings, including those not terminated (if applicable), PLUS 50% future growth.
- D. Patch panels shall be designed for easy installation, front removal, and expansion of snap-in adapter panels.
- E. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.
- F. The patch panel's enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer's recommended minimums or 1.2", whichever is larger.
- G. Access to the inside of the patch panel enclosure during installation shall be from the front and rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.
- H. All patch panels shall provide protection to both the "facilities" and "user" side of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (backbone, riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access of such cables.
- I. Fiber optic patch panels shall be manufactured by Commscope.

Part 4 - Execution

4.01 Testing

- A. Field Test Requirements for Fiber Optic Cabling System
 - 1. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, the Contractor shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include the

manufacturer's on reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.

2. Factory data shall be provided upon request, showing on-the-reel bandwidth performance results as tested at the factory.
3. Every fiber optic backbone link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-C or by the appropriate network application standard(s), whichever is more demanding.
4. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
5. 100% of the installed cabling links shall be tested and shall pass the requirements of the standards mentioned above and as further detailed in this document. Any failing link shall be diagnosed and corrected at no additional cost to the Owner. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with RFP.
6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
 - b. The manufacturer of the test equipment used for the field certification
 - c. Training organizations authorized by BICSI
7. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-C.1) with a Category 1 light source.
8. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
9. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
10. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.

11. Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
12. A representative of the Owner shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing begins.
13. A representative of the Owner will select a random sample of 5% of the installed links. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the Pass/Fail determination, the installation Contractor, under supervision of the Owner representative, shall repeat 100% of the testing. The cost of retesting shall be borne by the installation Contractor.

B. Fiber Performance Test Parameters

1. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B.
 - a. $\text{Link Attenuation} = \text{Cable_Attn} + \text{Connector_Attn} + \text{Splice_Attn}$
 - b. $\text{Cable_Attn (dB)} = \text{Attenuation_Coefficient (dB/km)} * \text{Length (Km)}$
 - c. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Multimode 50/125 μm	850	3.5
	1300	1.5

- d. $\text{Connector_Attn (dB)} = \text{number_of_connector_pairs} * \text{connector_loss (dB)}$
 - e. Maximum allowable mated connectors_loss = 0.50 dB
 - f. $\text{Splice_Attn (dB)} = \text{number of splices (S)} * \text{splice_loss (dB)}$
 - g. Maximum allowable splice_loss = 0.1 dB (when tested bidirectionally)
2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices—i.e., it does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
3. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is preferred.
4. The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

5. The backbone link shall be tested in two directions at both operating wavelengths to account for attenuation deltas associated with wavelength.
6. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.
7. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.
8. Multimode backbone links are designed to be used with network applications that use laser light sources (underfilled launch conditions). However, the link attenuation equation has been based upon the use of a light source categorized as Category 1, Overfilled.

4.02 Fiber Optic Cable Installation Requirements

- A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.
- B. A minimum of 15 feet of slack cable (each cable) shall be coiled and secured at each end.
- C. Exact cable termination locations shall be field verified with Owner.

End of Section

- D. Section 27 15 00 – Communications Horizontal Cabling
- E. Section 27 18 00 – Communications Labeling and Identification

Part 5 - PRODUCTS

5.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

5.02 Category 6 Patch Cords

- A. The Owner has the right to determine the final length of the patch cords after the contract is awarded.
- B. All Category 6 UTP patch cords shall be round and consist of eight insulated 23 AWG, stranded copper conductors, arranged in four color-coded twisted pairs within a flame retardant jacket and be backwards compatible with lower performing

categories. Modular patch cords shall utilize ISO termination method that is designed to reduce and control near-end cross talk (NEXT) and far end cross talk (FEXT) without compromising signal impedance.

- C. Both ends of the cord shall be equipped with modular 8-position (RJ45 style) plugs wired straight through with standards compliant wiring. All modular plugs shall exceed FCC CFR 47 part 68 subpart F and IEC 603.7 specifications, and have 50 micro inches of gold plating over nickel contacts. Cable shall be label-verifiable. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Category 6 cords shall have color-coded insert molded strain relief boot with a latch guard to protect against snagging. Additional color-coding shall be available by the use of snap-in icons.
- D. Patch cords shall be wired straight through. Pin numbers shall be identical at each end and shall be paired to match T568B patch panel jack wiring per ANSI/TIA/EIA-568-B. Patch cords shall be unkeyed.
- E. The manufacturer of the cords shall be the same as the manufacturer for UTP termination hardware (jacks & patch panels). Cords shall be highest quality Category 6 cords available by connectivity manufacturer.**
- F. This Contractor shall provide the following patch cords (for pricing purposes only; see section below):

Qty	Length	Notes
92	5 feet White	Non-Plenum – MDF/IDFs (Switch side IP Cameras)
276	5 feet Blue	Non-Plenum – MDF/IDFs (Switch side)
92	10 feet White	Non-Plenum MDF/IDF (Station side IP Cameras)
276	7 feet Blue	Non-Plenum MDF/IDF (Station side Workstations and Access Points)

Part 6 - EXECUTION

6.01 Ordering and Delivery

- A. Prior to ordering patch cords the Contractor shall schedule meeting with Owner and Consultant to verify patch cord lengths, colors and quantities.
- B. Contractor shall coordinate delivery of patch cords with Owner. Contractor shall have list of delivered cords and shall have Owner sign delivery sheet at time of delivery.

END OF SECTION

Section 27 18 00 – Communications Labeling and Identification

Part 1 - GENERAL

1.01 Scope

- A. This section describes the products and execution requirements relating to labeling of telecommunications cabling, termination components, and related subsystems. Covered systems include the following:
 - 1. Station cable and terminating equipment

1.02 Related Work

- A. Section 27 00 00 – General Technology Requirements
- B. Section 27 05 00 – Communications Cabling General Requirements
- C. Section 27 13 00 – Communications Backbone Cabling

Part 2 - General

2.01 Scope

- A. This section describes the products and execution requirements relating to telecommunications voice, and data backbone cabling and termination components.
- B. Backbone Cabling is the cable and hardware interconnecting telecommunication rooms (TRs), building demarcation rooms, equipment rooms and server rooms. The backbone cabling shall consist of the following cable type:
 - 1. 50-micron Multimode Fiber Optic Cable

2.02 Test Data – Fiber Optic Media

- A. The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
- B. The test result records saved by the tester shall be transferred into a Windows-based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee shall be made that these results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test.
- C. The database for the completed job shall be stored and delivered on CD-ROM. This CD-ROM shall include the software tools required to view, inspect, and print any selection of test reports.
- D. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - 1. The identification of the link in accordance with the naming convention defined in the overall system documentation.

2. The overall Pass/Fail evaluation of the link-under-test including the Attenuation worst-case margin (margin is defined as the difference between the measured value and the test limit value as defined in this document).
 3. The date and time the test results were saved in the memory of the tester.
- E. The following general information is to be provided in the electronic database containing the test result information for each link:
1. The identification of the customer site as specified by the end user.
 2. The overall Pass/Fail evaluation of the link-under-test.
 3. The name of the standard selected to execute the stored test results.
 4. The cable type and the value of the 'index of refraction' used for length calculations.
 5. The date and time the test results were saved in the memory of the tester.
 6. The brand name, model, and serial number of the tester.
 7. The revision of the tester software and the revision of the test standards database in the tester.
- F. The detailed test results data to be provided in the electronic database for each tested optical fiber shall contain the following information:
1. The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
 2. The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength, and the margin (difference between the measured attenuation and the test limit value).
- G. The link length shall be reported for each optical fiber for which the test limit was calculated.
- H. Contractor shall provide accurate as-built Construction Drawings at the site during construction.
- I. The Drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (Visio or PDF) formats on which as-built construction information can be added. These documents will be modified accordingly by the Contractor to denote as-built information as defined above and returned to the Owner.
- J. The Contractors shall annotate the base Drawings and return to the Consultant in hard copy (same plot size as originals) and electronic (Visio or PDF) form.

Part 3 - Products

3.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

3.02 Optical Fiber Cables Specifications

A. Reference:

1. See Sections 16.11 & 16.12 for locations, sizing, strand count and general requirements

B. General Considerations

1. The cable shall meet the requirements of the National Electrical Code (NEC) Section 770.
2. For plenum applications, the cable shall meet applicable flame tests: ANSI/UL 910 (NFPA 262-1994).
3. Cables shall be Non-plenum (CMR) Rated.
4. Finished cables shall conform to the applicable performance requirements of Tables 8-6 and 8-7 of the Insulated Cable Consultants Association, Inc. (ICEA) *Standard for Fiber Optic Premises Distribution Cable* (ICEA S-83-596).

C. Cable Construction

1. The coated fiber shall have a layer of Teflon placed between the acrylate coating of the optical fiber and the thermoplastic buffer. The diameter of the thermoplastic buffer coating shall be $900 \pm 50\mu\text{m}$. The fiber coating and buffer shall be removable with commercially available stripping tools in a single pass for connectorization or splicing.
2. A ripcord shall be applied between the aramid yarns and the outer jacket to facilitate jacket removal.
3. The fibers shall be stranded around a dielectric central member.
4. The central member shall be over coated with a thermoplastic, when required, to achieve dimensional sizing to accommodate and support the $900 \mu\text{m}$ buffered fibers.
5. The buffered fibers shall be grouped in six-fiber subunits.
6. The fibers shall be stranded around a dielectric central member in the subunit.
7. A ripcord may be applied between the aramid yarns and the subunit jacket to facilitate jacket removal.

8. The subunit jacket shall be extruded over the aramid yarns for physical and environmental protection. The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness. The jacket shall be smooth, as is consistent with the best commercial practice.
9. The subunits shall be stranded around a dielectric central member. A ripcord shall be inserted beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the subunits. The strength members shall be of a high modulus aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Non-toxic, non-irritant talc shall be applied to the yarns to allow them to be easily separated from the fibers and the subunit jacket.

D. Outer Cable Jacket

1. Indoor Cabling:

- a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.
- b. The indoor distribution cable specified herein shall have an interlocking armor made of steel or aluminum. The interlocking armor for plenum cables shall have a PVC jacket.
- c. The color of the armor jacket shall match the jacket color of the optical fiber cable located inside of the armor. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed, or flexible metal conduit.

2. Indoor/Outdoor Cabling to Portables:

- a. 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 smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand stresses. The nominal thickness of the cable outer jacket shall be sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.

- b. The indoor/outdoor cable specified herein shall have an armor protective construction intended for indoor plenum or outdoor underground installations.

E. Fiber Identification

1. The individual fibers shall be color-coded for identification. The optical fiber color-coding shall be in accordance with ANSITIA/EIA-598-B "Optical Fiber Cable Color Coding." The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers. Color-coded buffered fibers shall not adhere to one another.
2. When buffered fibers are grouped into individual subunits, each subunit jacket shall be numbered for identification, with the exception of filler subunits where used. The number shall be repeated at regular intervals. The subunit jacket color shall be orange for subunits containing multimode fibers, yellow for subunits containing singlemode fibers, and white for filler subunits.
3. The outer jacket for all dielectric cable shall be marked with the manufacturer name or UL file number, date of manufacture, fiber type, flame rating, listing symbol, and sequential length markings every two feet. The marking shall be in contrasting color to the cable jacket.

F. Cable Specifications

1. Temperature Range
 - a. Non-Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for riser cables shall be -20 to +70 °C. Testing shall be in accordance with FOTP-3.
 - b. Plenum Applications: The storage temperature range for the cable on the original shipping reel shall be -40 to +70°C. The installation/operating temperature range for plenum cables shall be 0 to +70°C. Testing shall be in accordance with FOTP-3.
2. Cyclic Flexing
 - a. When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycle per minute. The fiber shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).
3. High and Low Temperature Bend
 - a. When tested in accordance with FOTP-37, Fiber Optic Cable Bend Test, Low and High Temperature, the cable shall withstand four full turns around a mandrel at test temperatures of 0 °C and +50 °C. The fibers shall not

experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.5 dB at 1300 nm (multimode).

4. Impact Resistance
 - a. When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, the cable shall withstand a minimum of 20 impact cycles for riser cables and 10 impact cycles for plenum cables. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or greater than 0.4 dB at 1300 nm (multimode).
 5. Temperature Cycling
 - a. When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, the change in attenuation at extreme operational temperatures (0 to +50 °C) shall not exceed 0.3 dB/km at 1550 nm (singlemode) or 0.6 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling.
 6. Twist-Bend
 - a. When tested in accordance with FOTP-91, Fiber Optic Cable Twist-Bend Test, a length of cable no greater than 2 meters shall withstand 10 cycles of mechanical twisting and bending around a mandrel 20 times the cable outer diameter. The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm (singlemode) or 0.4 dB at 1300 nm (multimode).
- G. Multimode (50/125 μm)
1. The multimode fiber utilized in the optical fiber cable shall meet EIA/TIA-492AAAA-A-1997, Detail Specification for 50μm Core Diameter/125μm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers (OM3 type). Cable shall have the following specifications:
 - a. Core Diameter: $50 \pm 3 \mu\text{m}$
 - b. Core Non-Circularity: $\leq 5\%$
 - c. Cladding Diameter: $125 \pm 2 \mu\text{m}$
 - d. Cladding Non-Circularity: $< 2.0\%$
 - e. Core-to-Cladding Concentricity: $\leq 3 \mu\text{m}$
 - f. Coating Diameter: $245 \pm 2 \text{ mm}$
 - g. Refractive Index Profile: Graded index
 - h. Numerical Aperture: 0.275 ± 0.015
 - i. Maximum Attenuation: less than 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm.

2. IEEE 802.3z Performance: The fiber shall support laser-based 10 Gigabit Ethernet (10GbE) operation for up to 300 meters.
 3. Attenuation at the Water Peak: The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 1.0 dB/km.
 4. Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75-± 2 mm diameter mandrel shall not exceed 0.5 dB at 850 nm or 1300 nm.
- H. Fiber optic cabling shall be manufactured by Commscope.

3.03 Fiber Optic Connector

- A. The optical connector shall be LC-type.
- B. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive.
- C. The attenuation per mated pair shall not exceed 0.35 dB (individual) and 0.2 dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.
- D. The connector shall meet the following performance criteria:

1. Cable Retention (FOTP-6)	0.2 dB
2. Durability (FOTP-21)	0.2 dB
3. Impact (FOTP-2)	0.2 dB
4. Thermal Shock (FOTP-3)	0.2 dB
5. Humidity (FOTP-5)	0.2 dB
- E. Connectors shall be manufactured by Commscope.

3.04 Fiber Optic Patch Panels

- A. The Contractor shall provide a fiber optic patch panel at each location where a fiber optic cable terminates.
- B. All terminated fibers shall be mated to duplex LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the enclosure. The proposed enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.
- C. The patch panel enclosure shall be sized to accommodate the total fiber count to be installed at each location as defined in the specifications and Drawings, including those not terminated (if applicable), PLUS 50% future growth.
- D. Patch panels shall be designed for easy installation, front removal, and expansion of snap-in adapter panels.

- E. Patch panels shall be enclosed assemblies affording protection to the cable subassemblies and to the terminated ends. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.
- F. The patch panel's enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturer's recommended minimums or 1.2", whichever is larger.
- G. Access to the inside of the patch panel enclosure during installation shall be from the front and rear. Panels that require any disassembly of the cabinet to gain entry will not be accepted.
- H. All patch panels shall provide protection to both the "facilities" and "user" side of the coupling. The patch panel enclosure shall be configured to require front access only when patching. The incoming cables (backbone, riser, etc.) shall not be accessible from the patching area of the panel. The enclosure shall provide a physical barrier to access of such cables.
- I. Fiber optic patch panels shall be manufactured by Commscope.

Part 4 - Execution

4.01 Testing

- A. Field Test Requirements for Fiber Optic Cabling System
 - 1. The fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, the Contractor shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include the manufacturer's on reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
 - 2. Factory data shall be provided upon request, showing on-the-reel bandwidth performance results as tested at the factory.
 - 3. Every fiber optic backbone link in the installation shall be tested in accordance with the field test specifications defined by the Telecommunications Industry Association (TIA) standard ANSI/TIA/EIA-568-C or by the appropriate network application standard(s), whichever is more demanding.
 - 4. The test shall include the representative connector performance at the connecting hardware associated with the mating of patch cords. The test does not, however, include the performance of the connector at the interface with the test equipment.
 - 5. 100% of the installed cabling links shall be tested and shall pass the requirements of the standards mentioned above and as further detailed in this document. Any failing link shall be diagnosed and corrected at no additional cost to the Owner. The corrective action shall be followed with a new test to prove

that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with RFP.

6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - a. The manufacturer of the fiber optic cable and/or the fiber optic connectors
 - b. The manufacturer of the test equipment used for the field certification
 - c. Training organizations authorized by BICSI
 7. Field test instruments for multimode fiber cabling shall meet the requirements of ANSI/TIA/EIA-526-14-A. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause 11 of ANSI/TIA/EIA-568-C.1) with a Category 1 light source.
 8. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
 9. The fiber optic launch cables and adapters shall be of high quality and the cables shall not show excessive wear resulting from repetitive coiling and storing of the tester interface adapters.
 10. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
 11. Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
 12. A representative of the Owner shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing begins.
 13. A representative of the Owner will select a random sample of 5% of the installed links. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the Pass/Fail determination, the installation Contractor, under supervision of the Owner representative, shall repeat 100% of the testing. The cost of retesting shall be borne by the installation Contractor.
- B. Fiber Performance Test Parameters
1. The link attenuation shall be calculated by the following formulas specified in ANSI/TIA/EIA standard 568-B.
 - a. $\text{Link Attenuation} = \text{Cable_Attn} + \text{Connector_Attn} + \text{Splice_Attn}$
 - b. $\text{Cable_Attn (dB)} = \text{Attenuation_Coefficient (dB/km)} * \text{Length (Km)}$

- c. The values for the Attenuation_Coefficient are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation_Coefficient (dB/km)
Multimode 50/125 μm	850	3.5
	1300	1.5

- d. $\text{Connector_Attn (dB)} = \text{number_of_connector_pairs} * \text{connector_loss (dB)}$
- e. Maximum allowable mated connectors_loss = 0.50 dB
- f. $\text{Splice_Attn (dB)} = \text{number of splices (S)} * \text{splice_loss (dB)}$
- g. Maximum allowable splice_loss = 0.1 dB (when tested bidirectionally)
2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices—i.e., it does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 3. Test equipment that measures the link length and automatically calculates the link loss based on the above formulas is preferred.
 4. The above link test limits attenuation are based on the use of the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
 5. The backbone link shall be tested in two directions at both operating wavelengths to account for attenuation deltas associated with wavelength.
 6. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A.
 7. Because backbone length and the potential number of splices vary depending upon site conditions, the link attenuation equation shall be used to determine limit (acceptance) values.
 8. Multimode backbone links are designed to be used with network applications that use laser light sources (underfilled launch conditions). However, the link attenuation equation has been based upon the use of a light source categorized as Category 1, Overfilled.

4.02 Fiber Optic Cable Installation Requirements

- A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

- B. A minimum of 15 feet of slack cable (each cable) shall be coiled and secured at each end.
- C. Exact cable termination locations shall be field verified with Owner.

End of Section

- D. Section 27 15 00 – Communications Horizontal Cabling
- E. Section 27 16 00 – Communications Connecting Cords

Part 5 - PRODUCTS

5.01 Substitutions

- A. Unless noted otherwise, products in this section are intended as a basis of design and are open to substitutions per the product substitution procedures defined in Section 27 00 00.

5.02 Labels

- A. All labels shall be permanent and be machine generated (e.g., Brady or Panduit). No handwritten or non-permanent labels shall be allowed. Labels shall be Brady “I.D. Pro” or XC-Plus or equivalent. Labeling on backboards and/or equipment racks may be pre-cut adhesive type.
- B. Characters on all labels shall be black printed on a white background.
- C. Label size shall be appropriate to the cable size(s), outlet faceplate layout, patch panel design, or other related equipment sizes and layouts.
- D. All labels to be used on cables shall be self-laminating, white/transparent vinyl, and be wrapped around the cable sheath. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminated over the full extent of the printed area of the label.
- E. Labels used to identify innerduct carrying fiber optic cable shall be labeled with a durable yellow polyethylene tag that reads “CAUTION Fiber Optic Cable” and includes blank spaces for adding (1) fiber count and (2) destination information. An example of a compliant product is VIP Products’ “Caution Write-On Coverall Tag.”

Part 6 - EXECUTION

6.01 General

- A. Clean surfaces before attaching labels.
- B. Install all labels firmly. Labels attached to terminating equipment such as backboards, faceplates and patch panels shall be installed plumb and neatly on all equipment.

6.02 Labeling of Cabling and Termination Components

A. Backboard and Equipment Racks

1. Backboards and equipment racks shall be labeled by the Contractor identifying the telecommunication room. Additionally, equipment racks shall have an alpha character after the room number unique to that particular communications closet. For example, TR1-A would be the first rack in TR1.
2. Character height shall be 1-inch (minimum).

B. Cabling

1. Horizontal cables shall have a machine generated wrap around cable label within 4" of each end of the cable. Label shall be clearly legible and meet TIA-EIA 606 standards. Character height shall be .25" (minimum).
2. Voice/data backbone cables shall have a machine generated wrap around cable label within 12" of each end of the cable. Label shall be clearly legible and meet TIA-EIA 606 standard. Character height shall be .5" (minimum).

6.03 Fiber Optic Backbone, Riser Cables, and Termination Components

- A. All fiber optic backbone and copper (inter-building, riser, and tie) cables shall be identified AT BOTH ENDS with a designation that identifies where the opposite end of the same cable terminates (e.g., equipment room or telecommunications room I.D.). In addition, labeling of all fiber optic cables shall include the number of fibers in the cable.
- B. Each fiber optic termination panel shall be clearly labeled indicating the destination of the cable(s) and the fiber number of each fiber position. The cable identifiers are to be secured to (1) the side and (2) the front cover of the panel enclosure.

6.04 Standard Information Outlet (SIO) Faceplates

- A. All faceplates shall be clearly labeled indicating the destination of the cable(s) (telecommunication room number), the data patch panel(s) letter designation, the data port number(s) on the data patch panel(s), and the voice cable number(s).
- B. Telecommunications outlets are to be labeled (1) on the cover of the assembly and (2) on each cable terminated at that location.
- C. Station cables shall be labeled within 4 inches of the cable end.

6.05 Data Patch Panels

- A. All data patch panels shall be clearly labeled indicating the telecommunication room number, the data patch panel letter designation, and the data port number on the data patch panel (ports 1 through 48). Each telecommunication room shall start with data patch panel 'A' and continue through the alphabet.

- B. A data port schedule for each telecommunication room shall be created in spreadsheet format (Excel) with the telecommunication room number, data patch panel letter designations, data port numbers, and room numbers identified in the spreadsheet. In addition, for each data patch panel port, a field shall be provided in the spreadsheet for the Owner to manage the cabling infrastructure.

6.06 Fiber Optic Cables and Termination Components

- A. All fiber optic cables, termination enclosures and connector panels, and splice closures shall be clearly labeled. In addition, labeling of all fiber optic cables shall include the number of fibers in the cable.
- B. Each fiber optic termination panel shall be clearly labeled indicating (1) the destination(s) of the cable(s) and (2) fiber number of each fiber position. The cable identifiers are to be secured to (1) the side and (2) the front cover of the panel enclosure.

6.07 Ground System Labeling

- A. All grounds shall be labeled as close as practical to the point of termination (for ease of access to read the label). Labels shall be nonmetallic and include the following statement: "WARNING: If this connector or cable is loose or must be removed, please call the building telecommunications manger." Refer to ANSI/TIA/EIA 606 for additional labeling requirements.

END OF SECTION