

SECTION C: TECHNICAL SPECIFICATIONS

C1. STANDALONE DATA TRANSMISSION SERVICE SPECIFICATIONS

- C1.1. Any reference to "fiber" relative to special construction specifications in any related procurement documents should be understood to be a general industry-accepted reference and not an indication of preference for fiber by the APPLICANT. In accordance with E-Rate Program rules, the APPLICANT will evaluate services delivered by any mode that also meets the stated specifications.

C2. LEASED LIT TECHNOLOGY SPECIFICATIONS

- C2.1. OFFEROR shall provide an OSI Layer 2 handoff that supports IEEE 802.1ad Q-in-Q Tunneling to all SITES for the APPLICANT'S tagged and untagged frames.
- C2.2. SITE connections shall be IEEE 1000 Base-SX (For transmission rates of 1 Gbps or less) **or** IEEE 10GBase-SR (For transmission rates > 1 Gbps) via LC connections. Wavelength of Optical media SFP / SFP+ modules shall be specified by OFFEROR prior to installation and verified for compatibility with APPLICANT equipment.
- C2.3. At OFFEROR'S discretion, each CONNECTION may be identified physically on their own port of an edge device owned and installed by OFFEROR at the APPLICANT'S HUB SITE for the purpose of providing handoff to the APPLICANT.
- C2.3.1. Space and power at each SITE is limited and OFFERORS are encouraged to consolidate as much equipment as possible to provide the greatest density to meet the requirements specified.
- C2.4. The OFFEROR will make all reasonable efforts to ensure 99.99% network availability of each circuit.
- C2.5. Commitment of 0.25% frame/packet loss or less.
- C2.6. Commitment of 3ms network latency or less.
- C2.7. Commitment of 4ms network jitter or less.
- C2.8. There is no right of the OFFEROR to limit, throttle, or filter the capacity of the subscribed circuit at any time for any reason.
- C2.9. Ethernet frames must remain intact end-to-end with no packet disassembly or reassembly (fragmentation). The Maximum Transmission Unit (MTU) of the overall

packets should be 1522 bytes or greater.

- C2.10. The proposed SOLUTION must be compatible with IEEE hardware standards. IPv4 and IPv6 are processed in hardware and not software.
- C2.11. SOLUTION shall be compatible with IP routing protocols including RIP, OSPF, and BGP, etc.
- C2.12. SOLUTION must support VLAN services, Link Aggregation, Link Layer Discovery Protocols, and Quality of Service (QoS).
 - C2.12.1. 802.3ad (Link Aggregation via LACP)
 - C2.12.2. 802.1Q (VLAN Tagging and Q-in-Q Tunneling)
 - C2.12.3. 802.1p (Quality of Service)
 - C2.12.4. 802.1ab (Link Layer Discovery Protocol) LLDP
 - C2.12.5. Multicast Forwarding Support
- C2.13. SOLUTION shall not limit the number of MAC addresses registered in the MAC address tables of the respondent's WAN hardware.

C3. LEASED DARK FIBER SPECIFICATIONS

C3.1. Excess Strands for Applicant's Future Use

If the OFFEROR installs excess strands for the APPLICANT'S exclusive future use in a leased dark fiber or leased lit fiber special construction project where the excess strands will remain dormant until they are lit for the APPLICANT in the future, the OFFEROR must cost-allocate the costs associated with the excess strands only. No other special construction charges need to be cost-allocated.

C3.2. Excess Strands for OFFEROR'S Future Use

For lit services special construction and leased dark fiber special construction, if the OFFEROR wishes to place extra strands in the build for its own use, the OFFEROR must cost-allocate the cost of the service-provider-owned extra strands, as well as all incremental costs of those extra strands from the special construction E-rate funding request. It is not a pro-rata share, but an incremental cost calculation that must be backed by detailed documentation.

- C3.3. APPLICANT should seek documentation from the OFFEROR which outlines the added incremental costs attributable to designing, managing, and constructing a fiber system with a 48-strand cable instead of a 12-strand cable. Such costs should include (but are not limited to):
- C3.3.1. Splice Labor. If any fibers over the APPLICANT'S fibers are spliced, the labor for these additional splices must be cost-allocated.
 - C3.3.2. Splice Enclosures are placed to protect splices. If any fibers over the APPLICANT'S fibers are spliced and require an enclosure, the enclosures for these additional splices must be cost-allocated.
 - C3.3.3. Fiber Installation Labor. This represents the incremental cost of pulling a larger cable through the buried conduit.
 - C3.3.4. Structured materials installation. This represents the additional cost of burying a larger conduit to support the additional fibers.
- C3.4. Note that the costs associated with excess strands of fiber that will not be lit in the first year are ineligible and the OFFEROR should not include such costs in their special construction billing to the APPLICANT but should be prepared to show evidence during PIA review that it did not charge the APPLICANT for the incremental costs.
- C3.5. APPLICANT must have a minimum of two (2) strands (1 pair) of fiber optic cable between SITES.
- C3.5.1. OFFEROR shall indicate whether they are able and willing to provide the following if so requested by APPLICANT:
 - C3.5.1.1. Four (4) strands / two (2) pairs of additional fiber optic cable.
 - C3.5.1.2. Ten (10) strands / five (5) pairs of additional fiber optic cable.
- C3.6. OFFERORS are free to bid the minimum and/or both strand options. It is not required to bid all strand count options.

C4. SERVICES PROVIDED OVER THIRD-PARTY NETWORKS SPECIFICATIONS

- C4.1. OFFERORS must have dedicated bandwidth between the designated endpoints.
- C4.2. A minimum 1Gbps, upgradeable to 10Gbps.
- C4.3. Minimum Circuit uptime of 99.99%; 99.999% preferred

- C4.4. Frame/packet loss .25% commitment or less preferred
- C4.5. 25ms network latency or less commitment is preferred
- C4.6. 10ms network jitter or less commitment preferred
- C4.7. There is no right of the provider to limit or throttle the capacity of the circuit at any time for any reason preferred

C5. SELF-PROVISIONED DATA TRANSPORT SPECIFICATIONS

C5.1. Self-Provisioned Data Transport Solutions

C5.1.1. The following technical specifications apply to any OFFEROR that is proposing a Self-Provisioned SOLUTION.

C5.1.2. APPLICANT will accept proposals for any SOLUTION architecture but shall score, preferentially, a SOLUTION that adheres to the following example design outlined in (SECTION F)

C5.1.2.1. Any reference to "fiber" relative to special construction specifications should be understood to be a general industry-accepted reference and not an indication of preference for fiber by the APPLICANT. In accordance with E-Rate Program rules, the APPLICANT will evaluate Self-Provisioned Solutions delivered by any mode that also meets the stated specifications.

C5.1.2.2. APPLICANT desires **twelve (12) strands (6 pairs)** of SM/SA/SJ/LT fiber using OS2 (Specifically G.652C, D – 9/125 – IEC60793-2-50 B1.3) along each SEGMENT.

C5.1.2.3. APPLICANT intends to light two (2) strands / one (1) pair along each SEGMENT in the first Funding Year.

C5.1.2.4. APPLICANT intends to utilize DWDM technology along each segment.

C5.1.2.4.1. A 4-Channel Bi-Directional Passive DWDM Add-Drop Multiplexer shall be installed at the demarcation point for each SITE.

C5.1.2.4.2. APPLICANT shall discuss and negotiate with OFFEROR prior to equipment acquisition the desired DWDM channels on each segment.

C5.1.2.4.3. OFFEROR shall provide OTDR traces in Bell core standard or format and PDF format, including 2-point loss, and verify a minimum 0.2dB or less loss per segment.

C5.1.3. Cost Allocation Scenarios:

C5.1.3.1. A single, eligible entity (school or library)

C5.1.3.1.1. If the APPLICANT installs the exact number of fiber strands that they will light in the first year, and no extra fibers are installed, all fiber strands and special construction charges **are eligible** and no cost allocation is required.

C5.1.3.1.2. If the APPLICANT installs more fiber strands than it will light in the first year, E-rate will pay **only** for the number of strands being lit in the first year of service and additional strands **are ineligible**. No cost allocation is required for the special construction charges. E-rate APPLICANTS may only receive E-rate funding for self-provisioned or dark fibers that are lit within the funding year. If the APPLICANT requests excess strands that will remain dormant until the APPLICANT lights the excess strands for their exclusive future use, the OFFEROR would need to cost-allocate the unlit stands in the applicable funding year.

An **Example** where APPLICANT has indicated that they will be using 12-strands during the Funding Year Applied for, but requested 48-Strands for installation:

Item	12 Strand Cable	48 Strand Cable	Cost Allocation Amount that APPLICANT should remove from the one-time special construction reimbursement request
Fiber Cable	\$.38 per foot	\$1.04 per foot	\$.66 per foot

C5.1.3.2. A consortium of all eligible entities

C5.1.3.2.1. As with the example above, all fiber (lit and unlit in the first year) must be dedicated to only eligible entities and the cost of strands not lit in the first year must be cost-allocated.

- C5.1.3.3. A consortium of eligible and ineligible “NON-public sector, municipal entities”
- C5.1.3.3.1. If the APPLICANT purchases and installs fiber for the usage of the eligible entities and ineligible (non-public sector) entities, the funding request will not be funded. E-rate funded self-provisioned fiber is exclusively owned by the E-rate APPLICANT consortium and is for the exclusive use of the E-rate eligible APPLICANT.
- C5.1.3.4. A consortium of eligible and ineligible “public sector, municipal entities”
- C5.1.3.4.1. For E-rate, “public sector partner” is defined as health care and public sector (governmental) entities, including, but not limited to state colleges and universities, state educational broadcasters, counties, and municipalities.
 - C5.1.3.4.2. For a self-provisioning consortium that includes a public-sector partner, the special construction cost-allocation rules are the same as the Leased Lit Fiber services with special construction or Leased Dark Fiber services with special construction. The cost of the ineligible fibers must be deducted from the funding request, but only the incremental costs related to labor, materials, engineering, project management, and design must be cost-allocated.
 - C5.1.3.4.3. **Note:** An APPLICANT is warned they should be prepared to show evidence during PIA review that the deduction of all incremental costs associated with design, engineering, project management, construction, procurement of fiber, and procurement of structured materials of the larger strand cable has occurred when compared to the costs associated with design, engineering, project management, construction, procurement of fiber and procurement of structured materials of the fiber strand cable only used by the eligible Applicant. The OFFEROR should be prepared to provide all documents required to support the APPLICANT during PIA review.
- C5.1.3.5. USAC rules stipulate the following when any constructed strands will remain dormant in the first funding year in which they are constructed:
- C5.1.3.5.1. Cost allocation must be performed to remove the cost of fiber strands that will remain unlit as ineligible charges.

C5.2. OSP INSTALLATION SPECIFICATIONS

C5.2.1. Material Requirements

- C5.2.1.1. Material will comply with those standards as established by UL or NEMA and shall be commercial grade. All materials will be new and free from defects.
- C5.2.1.2. Selected OFFEROR and its SUB-OFFERORS will provide all material management to ensure that the project remains on track according to the project milestones.
- C5.2.1.3. All due caution will be exercised in transporting and off-loading all materials to prevent any damage during shipping or placement. Any damage to any materials after their initial receipt and inspection by the OFFEROR will be the sole responsibility of the OFFEROR, who will replace such damaged material at no additional expense to the APPLICANT.
- C5.2.1.4. The buried conduit shall be **High-density polyethylene (HDPE)** with appropriate clamps. All fittings for HDPE pipe shall meet or exceed the following specifications:
 - C5.2.1.4.1. **ASTM F714** Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR), based on outside diameter.
 - C5.2.1.4.2. **ASTM D1248** Standard Specification for Polyethylene Plastic Molding and Extrusion.
 - C5.2.1.4.3. **ASTM D3350** Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
 - C5.2.1.4.4. **ASTM D3035** Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR). Based on controlled outside diameter.
 - C5.2.1.4.5. **ASTM D3261** Standard Specification for Butt Heat Fusion PE Plastic Fittings for PE Plastic Pipe and Tubing.
 - C5.2.1.4.6. **ASTM F2206** Standard Specification for Fabricated Fittings of Butt-fused Polyethylene Plastic Pipe, Fittings, Sheet Stock Plate Stock or Block stock.
 - C5.2.1.4.7. **ASTM F2620** Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

- C5.2.1.5. The exact requirements for location and type of conduit for building entrances and within the building shall be verified with the building owner.
- C5.2.1.6. All Hand Holes shall be Michigan DOT approved, 45,000 lb. load-rated CDR or comparable enclosures on roadways and railways, and pedestrian-rated hand holes for non-roadways and railways.
- C5.2.1.7. Large-radius sweeps shall be provided where required for offset or change in direction of conduit. Bend radius rating of the cable must be adhered to for all conduit bends, pull boxes, and hand holes.
- C5.2.1.8. Unless specified by right-of-way owner, crossings will be two conduits, PVC-Sch 40 or better
- C5.2.1.9. Fiber must be SM/SA/SJ/LT with the following specifications and/or standards:
 - C5.2.1.9.1. TU-T G.652.C/D compliant
 - C5.2.1.9.2. The average bi-directional loss for an individual splice shall not exceed 0.15db.
 - C5.2.1.9.3. The acceptable average bi-directional loss for a segment shall be calculated using the following formula:

Span Loss = a (span distance in kilometers) + b(0.15 dB/splice) + c(0.50 db/connector)

Where:

a = maximum Fiber loss in dB per kilometer for the specific Fiber type/manufacturer at 1550nm or 1310nm (depending upon IRU Grantee)

b = number of splice locations for the span

c = number of connectors for the span
- C5.2.1.10. All connector splices shall be protected with heat shrinks. Connector Types shall be SC.
- C5.2.1.11. Any warranties associated with the fiber and any other outside plant materials must revert to the APPLICANT as the fiber owner upon completion of construction.

C5.2.2. Specifications

C5.2.2.1. Survey

- C5.2.2.1.1. Comply with all ordinances and regulations. Where required, secure permits before placing or excavating on private property, crossing streams, pushing pipe or boring under streets and railways. Pre-survey shall be done prior to each job.
- C5.2.2.1.2. OFFEROR will locate underground lines of third parties in the cable route area prior to construction.

C5.2.2.2. Permits and Traffic Control

- C5.2.2.2.1. OFFEROR must adhere to all applicable Federal, State and local laws, rules and requirements and must apply for permits to place infrastructure per specification per county or city ordinance applicable to where the infrastructure is being placed.
- C5.2.2.2.2. All traffic control, in accordance with local, state, county, or permitting agency laws, regulations, and requirements, will be the OFFEROR'S responsibility. The respondent's construction schedule will take into consideration sufficient time for the development and approval of a traffic control plan.

C5.2.2.3. Tracer Wire Installation

- C5.2.2.3.1. Tracer wire of a minimum of 18 gauge shall be placed with all conduit. OFFEROR shall provide the tracer wire and shall install, splice, and test the tracer wire (for continuity). If the tracer wire is broken during installation, the wire shall be repaired at OFFEROR'S expense and shall be tested after installation.
- C5.2.2.3.2. For multi-duct installation, install a 5/8" X 8" copper clad ground rod in the hand-hole located on the public right-of-way. Place a #12 insulated copper locate wire from the ground rod to the fiber optic termination room or to the outside of the building directly below the pull box and terminate on one side of an insulated indoor/outdoor terminal block to the master ground bar in the fiber optic termination room or place a ground rod on the outside of the building. Locate block in an accessible location. This is for "locate purposes only," not for grounding purposes. Note on as-built where ground is placed and tag located wire as "locate wire."

C5.2.2.4. Conduit Pull Tape

C5.2.2.4.1. For all conduits utilized, interior or exterior, a 1250 lbs polyester pull tape must be left in the conduit for future fiber installations. The ends should be safely secured to prevent the pull tape from being pulled into the conduit rendering it unusable. At least 10 feet extra pull tape should be left available at each end of the conduit.

C5.2.2.5. Depth of Burial

C5.2.2.5.1. Except where otherwise specified, the cable shall be placed to a minimum depth of 36" along roadways and 24" on private property. Greater cable depth will be required at the following locations:

C5.2.2.5.1.1. Where the cable route crosses roads, the cable shall be placed at a minimum depth of 48" below the pavement or 36" below the parallel drainage ditch, whichever is greater, unless the controlling authority requires additional depth, in which case the greatest depth will be maintained.

C5.2.2.5.1.2. Where cable crosses existing subsurface pipes, cables, or other structures: at foreign object crossings, the cable will be placed to maintain a minimum of 12" clearance from the object or the minimum clearance required by the object's owner, whichever is greater.

C5.2.2.6. Highway, Railroad, and Other Border Crossings

C5.2.2.6.1. All crossings of state or federal highways and railroads right-of-way shall be made by boring and placing a pipe casing. The cable shall be placed through the pipe casing. Country road and other roadways shall be bored, trenched, or plowed as approved by the appropriate local authority.

C5.2.2.6.2. All work performed on public right-of-way or railroad right-of-way shall be done in accordance with requirements and regulations of the authority having jurisdiction there under.

C5.2.2.6.3. OFFEROR shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work as drawn.

C5.2.2.6.4. Where the cable route crosses railroad right-of-way, the cable shall be placed at a minimum depth of 60" below the railroad

surface or 36" below the parallel drainage ditch, whichever is greater, unless the controlling authority requires additional depth, in which case the greatest depth will be maintained.

C5.2.2.7. Cable Markers

- C5.2.2.7.1. Cable markers shall be placed within 48 hours of cable installation. Unless the right-of-way or property owner specifies otherwise, cable markers shall be placed at all changes in directions, splices, fence line crossings, at road and stream crossings, and other points on the route not more than 1,000 feet apart.
- C5.2.2.7.2. In addition, on highway right-of-way, the markers shall be located at the highway right-of-way line. Markers shall always be located so that they can be seen from the location of the cable.

C5.2.2.8. Hand Holes

- C5.2.2.8.1. Hand holes will be placed in accordance with industry best practice following the specifications provided in the construction plans, typical drawings, and detail drawings. Special attention and planning must be exercised to ensure accessibility by other groups after construction has been completed.
- C5.2.2.8.2. All hand holes unless otherwise stipulated by the drawings will be buried with 12" to 18" of cover at final grade.
- C5.2.2.8.3. Where possible, hand holes shall have 1-2 inches of gravel or other aggregate placed in the bottom of the cabinet to assist with moisture absorption.
- C5.2.2.8.4. Immediately after placement, the soil around and over the hand hole will be tamped and compacted. Should any washouts occur, the OFFEROR will be responsible for correcting the problem immediately without additional cost to the APPLICANT.
- C5.2.2.8.5. After cable placement, all ducts will be sealed.
- C5.2.2.8.6. All splice hand holes/manholes shall contain a ground rod with test leads.
- C5.2.2.8.7. A minimum of 100' coil of cable shall be left in each hand hole/building for splicing use. An appropriately sized cabinet

shall be installed to allow for required cable length.

C5.2.2.9. Splicing

- C5.2.2.9.1. All splices at each SITE shall be performed with an industry-accepted fusion splicing machine (no mechanical splicing) and protected with heat shrinks. Fiber-to-fiber fusion splicing of optical fibers at each SITE is required.
- C5.2.2.9.2. Complete testing services, such as end-to-end, reel testing, splice loss testing, ORL, power meter/laser source testing, and WDM testing, are required.
- C5.2.2.9.3. Individual splice loss will be 0.10 dB for single-mode unless after 3 attempts these values cannot be achieved, then the fibers will be re-spliced until a splice loss within 0.05 dB of the lowest previous attempts is achieved. Splice loss acceptance testing will be based on the fusion splicer's splice loss estimator.
- C5.2.2.9.4. All cables to Demarcation Points shall be fusion spliced within a minimum of 50' of entering a building at a location to be determined by the owner and terminated at APPLICANT'S rack.

C5.2.2.10. Aerial Plant

- C5.2.2.10.1. District is open to aerial fiber runs using existing utility poles, but OFFEROR must adhere to pole owners' requirements for clearances, spans, grounding, guys, and attachments.

C5.2.2.11. Testing Cable

- C5.2.2.11.1. The OFFEROR shall be responsible for on-reel verification of cable quality prior to placement.
- C5.2.2.11.2. Completed test forms on each reel shall be submitted to the APPLICANT.
- C5.2.2.11.3. OFFEROR assumes responsibility for the cable after testing. This responsibility covers all fibers in the cable.
- C5.2.2.11.4. The OFFEROR shall supply all tools, test equipment, consumables, and incidentals necessary to perform quality testing.

- C5.2.2.11.5. The cable ends shall be sealed upon completion of testing.
- C5.2.2.11.6. In addition to splice loss testing, selected OFFEROR will perform end-to-end insertion loss testing of single-mode fibers at 1310 nm and 1550 nm from one direction for each terminated fiber span in accordance with ANSI/TIA-526-7 (OFSTP 7). For spans greater than 300 feet, each tested span must test to a value less than or equal to the value determined by calculating a link loss budget.

C5.2.2.12. Restoration

- C5.2.2.12.1. All work sites will be restored to as near their original undisturbed condition as possible, all cleanup will be to the satisfaction of the APPLICANT and any permitting agencies.
- C5.2.2.12.2. OFFEROR shall provide a brief description of the restoration plan in the response, with the expectation that a more detailed restoration plan will be delivered prior to construction beginning.
- C5.2.2.12.3. Work site restoration will include the placement of seed, mulch, sod, water, gravel, soil, sand, and all other materials as warranted.
- C5.2.2.12.4. Backfill material will consist of clean fill. Backfilling, tamping, and compaction will be performed to the satisfaction of the APPLICANT, the representative of any interested permitting agency, and/or the railroad representative.
- C5.2.2.12.5. OFFEROR will be responsible for any restoration complaints arising within one year after the APPLICANT'S final acceptance.
- C5.2.2.12.6. Excess material will be disposed of properly.
- C5.2.2.12.7. Debris from clearing operations will be properly disposed of by the OFFEROR / SUB-OFFERORS as required by permitting agencies or the railroad. Railroad ties, trees, stumps or any foreign debris will be removed, stacked, or disposed of by the OFFEROR as per requirements by other interested permitting agencies, and/or the APPLICANT.
- C5.2.2.12.8. Road shoulders, roadbeds, and railroad property will be dressed up at the end of each day. No payment for installation will be permitted until cleanup has been completed to the satisfaction

of any permitting agencies, and/or the APPLICANT.

C5.2.2.12.9. Site clean-up will include the restoration of all concrete, asphalt, or other paving materials to the satisfaction of the other interested permitting agencies, and/or the APPLICANT.

C5.2.2.13. Documentation

C5.2.2.13.1. As-built drawings will include paper and digital copies of the following:

C5.2.2.13.1.1. Fiber cable routes; digital map preferred in KMZ/KML (Google Earth) format.

C5.2.2.13.1.2. Drawings, site drawings, permit drawings, and computerized design maps and electronically stored consolidated field notes for the entire route must include:

C5.2.2.13.1.2.1. Verification of as-built and computerized maps

C5.2.2.13.1.2.2. Splicing locations

C5.2.2.13.1.2.3. Optical fiber assignments at patch panels

C5.2.2.13.1.2.4. Optical fiber assignments at splice locations

C5.2.2.13.1.2.5. OFFEROR shall provide OTDR traces in Bell core standard or format and PDF format, including 2-point loss, and verify a minimum 0.2dB or less loss per segment. Documentation shall also include EOC numbers, cable footages, INs and Outs on storage loops.

C5.2.2.13.1.2.6. Date of installation

C5.2.2.13.1.2.7. Aerial installation documents should include

C5.2.2.13.1.2.7.1. Pole attachment inventories

C5.2.2.13.1.2.7.2. Pole attachment applications

C5.2.2.13.1.2.7.3. Pole attachment agreements between respondent and other utilities

- C5.2.2.13.1.2.7.4. GPS points of reference for utility poles
- C5.2.2.13.1.2.7.5. Photo images of poles to which fiber is attached
- C5.2.2.13.1.2.8. Underground installation documents should include
 - C5.2.2.13.1.2.8.1. Conduit design and detailing
 - C5.2.2.13.1.2.8.2. Manhole detailing
 - C5.2.2.13.1.2.8.3. Preparation of all forms and documentation for approval of conduit construction and/or installation
 - C5.2.2.13.1.2.8.4. Digital Proof of Registration within MISS DIG for all underground plant.
- C5.2.2.13.1.3. Fiber details will include:
 - C5.2.2.13.1.3.1. Manufacturer
 - C5.2.2.13.1.3.2. Cable type and diameter
 - C5.2.2.13.1.3.3. Jacket type: armored single-mode
 - C5.2.2.13.1.3.4. Fiber core and cladding diameter
 - C5.2.2.13.1.3.5. Fiber attenuation per kilometer
 - C5.2.2.13.1.3.6. Fiber bandwidth and dispersion
 - C5.2.2.13.1.3.7. Index of refraction
 - C5.2.2.13.1.3.8. Manufactured date
- C5.2.2.13.1.4. OTDR documentation will include:
 - C5.2.2.13.1.4.1. Each SEGMENT shall be tested bi-directionally from SITE to SITE with a recently calibrated OTDR.
 - C5.2.2.13.1.4.2. Each span's traces shall be recorded and mapped. Each splice loss from each direction and the optical length between splices as well as any of the

information required by Span Map.

- C5.2.2.13.1.4.3. Reel acceptance
- C5.2.2.13.1.4.4. Individual fiber traces for complete fiber length
- C5.2.2.13.1.4.5. Paper and computer disk records of all traces
- C5.2.2.13.1.4.6. Losses of individual splices
- C5.2.2.13.1.4.7. Anomalies
- C5.2.2.13.1.4.8. Wavelength tests and measurement directions
- C5.2.2.13.1.4.9. Manufacturer, model, serial number, and date of last calibration of OTDR

C5.2.2.13.1.5. Power Meter documentation will include:

- C5.2.2.13.1.5.1. Total link loss of each fiber
- C5.2.2.13.1.5.2. Wavelengths tested and measurement directions
- C5.2.2.13.1.5.3. Manufacturer, model, serial number, and date of last calibration for all equipment used

C5.2.3. Project Closeout and Warranty

- C5.2.3.1. The fiber optic cabling system installed shall be eligible for coverage by a manufacturer's Limited Lifetime Warranty to the Applicant.
- C5.2.3.2. OFFEROR shall provide labor, materials, and documentation in accordance with the manufacturer's requirements necessary to ensure that the APPLICANT will be furnished Manufacturer's Warranty.
- C5.2.3.3. OFFEROR shall ensure that the APPLICANT receives the manufacturer-issued project warranty certificate within 60 calendar days of warranty registration.
- C5.2.3.4. Test Reports shall be delivered to the APPLICANT within 30 days upon completion of the project. Color test reports for individual cable tests shall be delivered to APPLICANT in (1) hard copy and one (1) electronic copy in PDF format on a thumb drive. Summary sheets are not acceptable.

C5.2.3.5. As-Built Drawings shall be delivered to the APPLICANT within 30 days upon project completion. Provide (1) hard copies to APPLICANT and (1) electronic copy in PDF format on a thumb drive. Drawings shall include all cable pathway routes and work area outlets nomenclature. Provide a laminated copy for each closet Work Area Space. Install the laminated copy in each consortium district's Data Center/MDF where the fiber is terminated.

C5.2.4. **Installer Qualifications**

C5.2.4.1. The selected OFFEROR will provide the APPLICANT with proof of qualified BICSI (and/or) FOA certifications as well as all product manufacturers' certifications. All certifications shall be maintained throughout the life of the contract. These individuals will be ultimately responsible for district projects as assigned:

C5.2.4.1.1. The project designer shall have a current BICSI RCDD and/or FOA CFOS/D Certification.

C5.2.4.1.2. On-site installer team leads shall have current BICSI Installer 2, Optical Fiber (INSTF), preferably a BICSI Technician (TECH) certification.

C5.2.4.1.3. A minimum of one (1) on-site technician for inside plant and outside plant installation shall have a current BICSI Installer 2, Optical Fiber (INSTF) certification.

C5.2.4.2. Should the RCDD assigned to district projects change during the life of this contract, the new RCDD assigned shall also submit proof of these certifications.

C5.2.4.3. The Respondent will be responsible for all fees and expenses associated with this training and certification.

C5.2.4.4. **The APPLICANT has the right to waive all or some of the installer qualification requirements if it so chooses, this is solely based on the APPLICANT'S discretion.**

C5.2.5. **References, Standards, and Codes**

C5.2.5.1. Specifications in this document are not meant to supersede state law or industry standards. OFFERORS shall note in their response where their proposal does not follow the requested specification to comply with state law or industry standard. The following standards are based upon the *Telecommunications Distribution Methods Manual (TDMM)* by

BICSI, ANSI/TIA/EIA and ISO/IEC standards, and NEC codes, among others.

- C5.2.5.2. It is required that the OFFEROR be thoroughly familiar with the content and intent of these references, standards, and codes and that the respondent be capable of applying the content and intent of these references, standards, and codes to all outside plant communications system designs executed on the behalf of the Applicant.
- C5.2.5.3. Listed in the table below are references, standards, and codes applicable to outside plant communications systems design. If questions arise as to which reference, standard, or code should apply in a given situation, the more stringent shall prevail. As each of these documents are modified over time, the latest edition and addenda to each of these documents is considered to be definitive.

C6. CATEGORY 1 NETWORK EQUIPMENT SPECIFICATIONS

C6.1. SELF-PROVISIONED, LEASED DARK, OR IRU NETWORK EQUIPMENT REQUIREMENTS

- C6.1.1. Network equipment shall be **Aruba Networks / HPE** or 100% equivalent and must include all necessary licenses, software, and operating systems.
- C6.1.2. All specified switches must be 10Gb+ fiber capable, have resilient power supplies, distance appropriate 10Gb SFP+ modules (all distances are over 10km) and IP services Licenses included. To keep the switches affordable, they should be specified with the fewest copper ports available and do not need POE capabilities.
- C6.1.3. All switches bid shall be Layer 3 capable.

C6.2. Any proposals for equivalent equipment must include an explanation outlining how the proposed equipment offers the same functionality as the example make and model.

C7. REFERENCES, STANDARDS, AND CODES

Standard/Reference	Name/Description
BICSI TDMM	Telecommunications Distribution Methods Manual 15th edition
National Electrical Code (NEC) 2023	National Electric Code
NEC - NFPA 70E 2023	National Electric Code - National Fire Protection Association Code

NESC	National Electrical Safety Code, IEEE
OSHA Codes	Occupational Safety and Health Administration
IEEE 802.3 (series)	Local Area Network Ethernet Standard, including the IEEE 802.3z Gigabit Ethernet Standard
ANSI/TIA-526-7-A	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
ANSI/TIA-568.0-D	Generic Communications Cabling for Applicant Premises.
ANSI/TIA-568.1-D	Commercial Building Telecommunications Cabling
ANSI/TIA-568.2-D	Balanced Twisted-Pair Telecommunications Cabling and Components
ANSI/TIA-568.3-D	Optical Fiber Cabling Components
ANSI/TIA-569-D	Commercial Building Standard for Telecommunications Pathways and Spaces.
ANSI/TIA-606-B	Administration Standard for Telecommunications Infrastructure
ANSI/TIA-606-C	Administration Standard for the Commercial Telecommunications Infrastructure.
ANSI/TIA-607-C	Commercial Building Bonding and Grounding (Earthing) Requirements for Telecommunications.
ANSI/TIA-758-B	Applicant-Owned Outside Plant Telecommunications Infrastructure Standard.
ANSI/TIA-942-A	Telecommunications Infrastructure Standard for Data Centers
ANSI/TIA-440-C	Fiber Optic Terminology
ANSI/TIA-1152-A	Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
ANSI/TIA-4966	Telecommunications Infrastructure Standard for Educational Facilities
TSB-140	Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
TSB-184-A	Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
TSB-190	Guidelines on Shared Pathways and Shared Sheaths