PART 1 - GENERAL

1.1 SCOPE

A. Work Included

1. Furnishing and installation of a complete structured cabling system utilizing 100 OHM, 4-pair CAT 6 [CAT 6A] copper station cabling for data and for voice (telephone). Contractor shall provide all cable, terminations, connectors, hardware, racks, labeling, and testing as required to meet the performance requirements of the system as part of the bid. The system shall be implemented using ANSI/TIA standards and BICSI practices.

2. All work within the telecommunications equipment room and backbone and horizontal distribution, including but not limited to:

   a. Installation of fiber backbone and copper UTP station wiring as indicated, and provision of all patch cords and instrument cords for connection to voice and data equipment at the workstation.

   b. Installation of equipment racks, patch panels, and associated grounding.

   c. Termination, labeling, and testing of all cables patch cords, outlets, ports, etc., as prescribed in the College Structured Cabling Guidelines.

   d. The Owner will provide all patch cords and voice system cross-connection cables as required to populate 100% of the ports installed. The contractor shall provide all pertinent information to the Owner for the patch cords to be provided which will comply with the system warranty.

   e. Network electronics will be provided and installed by the Owner’s system integrator. Confirm with the integrator for the type of backbone cable to provide.

A. Coordination with Owner Provided Items:

1. The Owner’s system integrator will be providing and installing all network switching equipment, and providing all programming and start-up of Local Area Networks (LAN). This contractor shall coordinate with the Owner’s vendor performing this work, so as to provide a complete operating system at the completion of the work.

2. The TDS installer shall coordinate with the local utility or service provider representative for connection and activation of telephone service to the building.
3. Telephone system “remote” switch and data system network electronics shall be provided and installed by the Owner. This contractor shall coordinate with the Owner’s vendor(s) to provide a complete operating system at the completion of the work (example: Data patch cables and backbone cables shall be provided and installed by this contractor, and must terminate into network switches provided and installed by the Owner).

B. Work provided by Division 26 Subcontractor:

1. All conduit, boxes, and trim rings for telecommunication cabling and outlets.

2. All cable tray and runway.

3. Grounding bus-bars and grounding conductors to equipment in telecommunications and data rooms, and to building electrical ground.

1.2 RELATED WORK

A. Division 1 - Drawings and general provisions of Contract, including but not limited to, general, Special and Supplementary Conditions and other Division 1 Specification Sections, apply to the work of this section.

B. Division 26 - all applicable sections.

1.3 DEFINITIONS

A. Entrance Facility (EF) – Room in building where local exchange carrier enters and contains cross-connect to building distribution.

B. Telecommunications Room (TR) - Room in building that shall serve as distribution point to station wiring, is connected to other T.R.’s via fiber optic backbone cable, and houses network electronics.

C. Telecommunications Outlet (TO) - Otherwise known as workstation or user outlet, consisting of user “Jacks” for connection to workstations.

1.4 REFERENCES, CODES, STANDARDS


C. Florida Accessibility Code, Dept. of Consumer Affairs.

D. Palm Beach State College Structured Cabling Guidelines.

E. Title 4A, FAC. Uniform Fire Safety Rules and Standards of State of Florida and its Adapted NFPA Codes.

G. ANSI/TIA-569-Commercial Building Standard for Telecommunications Pathways and Spaces.


I. TIA-492 AAAA - Detail Specification for 62.5 Micrometer Core Diameter/125 Micrometer Cladding Diameter Class 1a Multimode, Graded Index Optical Waveguide Fibers.


K. Florida DMS/DOC General Facility Requirements for Telecommunications Systems.

L. NFPA 262 – Test for flame travel and smoke of wires and cables for use in air handling spaces.

M. IEEE 802.3 Institute of Electrical and Electronics Engineers LAN Standard for Ethernet.

IEEE Service Center
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331

N. UL Listed - Underwriters Laboratories Listed.

O. UL 910 - Test for Flame Propagation and Smoke Density Values for Electrical and Optical Fiber Cables used in Spaces Transporting Environmental Air.

P. UL 1666 - Test for Flame Propagation Height of Electrical and Optical Fiber Cables Installed Vertically in Shafts.


1430 Broadway
New York, NY 10018

R. NEMA - National Electrical Manufacturer’s Association.


1.5 SUBMITTAL

A. Submit the following for review and approval:

1. Provide complete front panel equipment fabrication drawings with locations of patch panels, wire management, and Owner-supplied electronics. Show
mounting locations of each system component in each rack and interrelationships for each rack.

2. Provide dB loss budget calculation for entire system.

3. Submittal information shall include complete manufacturer’s published data and specific data for the system equipment or submittal for approval.

4. The Contractor is specifically cautioned that the Owner is entitled to all operating and instruction manuals, wiring and schematic diagrams, and other technical documentation whereby repairs and maintenance by the Owner or its designated representative may be performed. Unwillingness to comply with this requirement shall be grounds for rejection of the use of that manufacturer. Acceptance of a contract by the wiring systems contractor is acknowledgment that complete operating and maintenance data documents will be provided to the Owner.

1.6 QUALITY

A. Submitted Materials:

1. The TDS Contractor is expected to base his bid on materials and equipment complying fully with the drawings and specification. In the event he bases his bid on materials or equipment which do not conform, he will be responsible for furnishing materials and equipment which fully conform at no change in his contract price. In any case, where a specific specification for any item that is required is not shown, the Contractor shall furnish only the best quality equipment or material consistent with the quality of other specified equipment and material. The items of equipment shall be furnished in the quantity as shown or implied by the drawings, or in the quantity as specified herein.

2. The use of acceptable equipment does not relieve the Contractor of responsibility for the submitted equipment. The Contractor, at no cost to the Owner, shall remove and replace with the specified equipment any equipment or system that shows evidence of improper operation, function, or size. Contractor may provide approved equivalent selections subject to meeting the basis for design criteria and all project requirements.

3. It is the responsibility of the Contractor to supply a working overall system. All equipment and material as well as labor must be furnished whether or not specifically mentioned in the specification or shown by the drawings.

4. All submittals of material shall comply with the conditions outlined in the project specifications.

5. Vendor/manufacturer names in this specification have been pre-approved by the Owner and authorized for use. Owner shall review and approve selected manufacturers per contract document procedures.
1.7 QUALIFICATIONS

A. Contractor:
Contractor Qualifications: The Contractor directly responsible for this work shall be a “Telecommunications Distribution Systems Contractor” who is, and who has been, regularly engaged in the furnishing and installation of similar systems of this type and size for a minimum of five (5) years.

The TDS contractor shall be located within a fifty (50) mile radius of the job site.

All equipment shall be installed by a technician trained by the equipment manufacturer or a recognized training school or course for the installations of this type system. The Contractor shall submit resumes of those individuals, (Project Manager, Foreman, etc.) that will be responsible for this project installation at time of bid opening for review. Only resumes of staff that have working comparable experience with Data/Voice/Networking will be considered. Provide references, company background, resources with bid proposal. Provide a list of similar installations, with the bid proposal, for which the individual installers have project experience. Provide a minimum of three (3) similar installations including end user contact, telephone/fax number, address, work description and contract value.

The TDS Contractor shall directly employ a minimum of three (3) skilled systems “Installers”, who have completed an organized training program based on BICSI Standards, whose normal work is premise wiring systems installation, who shall directly supervise or, connect, terminate, test and document the systems installed.

As part of the project submittal, it shall be demonstrated to the satisfaction of the Owner/Engineer that the TDS Contractor has:

1. Adequate plant and equipment to do the work properly and expeditiously. Describe in a written narrative for the Owner’s review.

2. Adequate staff and technical experience. Describe in a written narrative for the Owner’s review.

1.8 WARRANTY, SERVICE AND INSTRUCTION

A. Performance based structured cabling systems such as CAT 6 [CAT 6A] rated systems, shall be provided with a manufacturer backed warranty for both performance characteristics, as well as product reliability, in the horizontal segment. Systems shall be based on a channel-type solution that consists of an integrated assembly of components from a manufacturer, or manufacturers, to warranty the system when assembled using their products. In no case shall any channel be provided that contains a component that is not approved for use in the channel, by the other components manufacturers.

The system warranty shall be based on a single point of contact. Minimum length of warranty period shall be fifteen (15) years. The entire warranty including cable, connecting hardware, installation and performance shall be held by one manufacturer. Other manufacturers of components within the system shall be warranty program partners of the manufacturer holding the warranty.
Warranty shall be industry standards based, with requirements for the installers to be certified by the manufacturer holding the warranty. Written documentation of the certification of system performance, along with guarantee provided under the warranty, shall be provided by the Contractor at the closeout of the project.

B. Training: The Contractor shall comply with all conditions of the Contract Documents. Provide training for a minimum of 2 Owner’s personnel, min. of 6 hours. Training shall include review of as-built drawings, location labeling scheme, documentation structure, contents, system orientation, reconfigurations (patching), testing of UTP, and troubleshooting.

1.09 SUBSTITUTIONS OF EQUIPMENT

A. Substitutions will not be considered. Only those manufacturer’s listed will be considered acceptable for this project.

1.10 EQUIPMENT CERTIFICATION

A. Underwriters Laboratories, Inc.:

1. All equipment, including accessories to the system and including all wire and cable, shall be listed by the Underwriter’s Laboratories product directory.

1.11 EXECUTION OF THE WORK

A. Drawings:

1. The drawings are diagrammatic and are not intended as wiring diagrams. The Contractor shall provide coordination as required for the installation of the system in a neat and workmanlike manner.

B. Coordination with Work by Others:

1. The TDS Contractor shall provide all required coordination and supervision where work connects to or is affected by work of others, and comply with all requirements affecting this Division. Work required under other divisions, specifications, or drawings to be performed by this section shall be coordinated by the TDS Contractor.

C. Connections:

1. No splices shall be permitted within a cable run. All cable runs shall be continuous home runs from patch panels to wall outlets.

2. All non-terminal block connections shall be made with mechanical connectors with insulation equal to conductor insulation and as approved by the Engineer.

3. Wire shall be guided on terminal boards by wire management/cable supports. All cables shall be neatly led to terminations.
D. Equipment Installation:

1. Installation shall conform to the latest edition of the National Electrical Code, BICSI, and TIA Standards. Workmanship shall be of the highest quality. All connections and equipment installation and adjustment shall be made by or supervised by a Technician who has completed the warranty manufacturer’s required training classes.

2. The systems upon completion, shall be complete in every respect, clean, operating, properly adjusted, properly labeled and in proper operating condition.

1.12 FINAL INSPECTION

A. Scheduling:

1. When the system and all equipment is in place and is operating properly, the manufacturer’s representative shall complete the check-out and have all equipment ready for final inspection. Final as-built drawings and brochures shall be provided to the Engineer one week prior to final inspection.

2. Contractor shall submit a testing schedule which shall be agreed upon beforehand so Owner’s staff and engineer may observe. Submit minimum of 4 weeks prior to start date of testing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backbone Cabling

1. Backbone Optical Fiber
   a. Single mode cable shall be used in outdoor inter-building applications. Multi-mode cables shall be used in indoor intra-building applications. Provide in accordance with TIA-568-C.3, UL 1666 and NFPA 70. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40-inches.
   b. Approved Manufacturer: Corning

2. Multi-Mode Optical Fiber
   a. Multi-mode, 50/125-µm diameter (laser optimized), loose tube fiber optic cable. Provide multi-mode fiber optic cable of counts as indicated on drawings. Provide nonconductive optical fiber riser cable (OFNR) flame retardant, indoor/outdoor suitable for use in aerial, duct and riser application rated cable in accordance with NFPA 70. Cable shall utilize water sealable yarns, both inside and surrounding buffer tubes and water swellable tape for fully blocking without the use of gels. The cable cordage jacket, fiber, unit, and group color shall be in accordance with
TIA 598-B. Optic fiber shall not exceed 2.0 dB loss per km and an optical return and loss (ORL) 20 dB or better.

b. Approved Manufacturer: Corning

3. Optical Single Mode

a. Single mode, 8.3/125 µm diameter loose tube fiber optic cable. Cable characteristics shall be same as those specified in the multi-mode optical fiber.

b. Single mode cable shall not exceed 1.0 dB/km and an optical return loss (ORL) of 30 dB or better.

c. Approved Manufacturer: Corning SMF-28e.

4. Optical fiber connectors shall be small form factor ‘LC’ type with ceramic ferrules and Corning glass cores. Insertion loss shall be less than or equal to 0.2 dB. Core and cladding 50 microns/125.0 microns (MM) and 9 microns/125.0 microns (SM).

a. Approved Manufacturer: Corning Unicam.

B. Station Cable

1. Network: Category 6 [6A], 4-pair, copper unshielded twisted pair (UTP), 24 AWG, blue jacket.
Voice: Category 6 [6A], 4-pair, copper unshielded twisted pair (UTP), 24 AWG, yellow jacket.
Wireless Access Point: Category 6 [6A], 4-pair, copper unshielded twisted pair (UTP), 24 AWG, orange jacket.
Facilities: (Alarm, EMS) (Implies Cat 6[6A], 4-pair, copper unshielded twisted pair (UTP) 24 AWG, red jacket.
Printers: (PC-Student/Staff, MTIS) (Implies Cat 6[6A], 4-pair, copper unshielded twisted pair (UTP), 24 AWG, pink jacket.
Security: (Valcom, Cameras) (Implies CAT 6[6A], 4-pair, copper unshielded twisted pair, 24 AWG, brown jacket.

2. The cable jacket shall comply with Article 800 NEC for use as a plenum cable and bear the CMP marking.

3. Four cables shall be routed to each faceplate. (Confirm with the Owner if any of the station cables shall be fiber.)

4. The balanced twisted-pair cabling system shall support Gigabit [10 Gigabit if Category 6A] Ethernet networking and shall provide additional performance margin up to 250 MHz for a 4-connector, 100-m (328-ft.) channel.

5. At a minimum, the balanced twisted-pair cabling system shall exceed the key performance parameters for Cat. 6 found in TIA-568-C.2 (2009) Category 6 standard over the specified frequency ranges by the values listed below. The balanced twisted-pair cabling system shall also meet all the requirements of ISO/IEC 11801 Edition 2.0 2002-09.
Values represent System 2400 channel margin against TIA-568-C.2 Category 6 standard. The margin is the additional headroom (in dB) compared to the minimum specified value for Category 6 at each frequency point over the specified frequency range.

The worst case margin is determined at the frequency where the measured data point is closest to the limit line. This margin applies for a worst-case, 4-connector, 100-meter channel configuration.

PSNEXT = Power-sum near-end crosstalk  
PSACR-F = Power-sum attenuation –to-crosstalk ratio far-end  
PSACRN = Power-sum attenuation-to-crosstalk ratio near-end  
(a) = applies to bonded-pair cables and cords

[The CAT 6A balanced twisted-pair cabling system shall exceed the key performance parameters for Augmented Category 6A found in TIA-568-C.2 (2009) – Balanced Twisted-Pair Telecommunications Cabling and Components Standards over the specified frequency ranges by the values listed below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Worst Case Margin (1-500 MHz)</th>
<th>Worst Case Margin (500-625 MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>3%</td>
<td>Beyond Standard (*)</td>
</tr>
<tr>
<td>Return Loss</td>
<td>2.0 dB</td>
<td>Beyond Standard (*)</td>
</tr>
<tr>
<td>NEXT</td>
<td>2.5 dB</td>
<td>Beyond Standard (*)</td>
</tr>
<tr>
<td>PSNEXT</td>
<td>3.5 dB</td>
<td>1.5 dB (*)</td>
</tr>
<tr>
<td>PSANEXT</td>
<td>2.0 dB</td>
<td>2.0 dB (*)</td>
</tr>
<tr>
<td>PSACRF</td>
<td>10.0 dB</td>
<td>8.0 dB (*)</td>
</tr>
<tr>
<td>PSAACRF</td>
<td>Beyond Standard</td>
<td>Beyond Standard (*)</td>
</tr>
</tbody>
</table>

Note: The margin is the additional headroom (in dB or %) compared to the minimum specified value for Category 6A at each frequency point over the specified frequency range. The Worst Case Margin is determined at the frequency where the measured data point is closest to the limit line. The Category 6A limit line equations are used to determine the Worst Case Margin over the frequency range from 500 MHz to 625 MHz.

NEXT = Near-end crosstalk  
PSACRF = Power-sum attenuation –to-crosstalk ratio far-end
PSAACRF = Power-sum alien attenuation-to-crosstalk ratio far-end
PSANEXT = Power-sum alien near-end crosstalk
PSNEXT = Power-sum near-end crosstalk

6. The cable conductors shall be 23 AWG solid copper.

7. The effective cable OD shall be 0.225 in. The effective cable OD is the diameter of a six-around-one cable bundle divided by 3.

8. The minimum bend radius shall be 25 mm (1 in.) for CMR-rated cable and CMP-rated cable.

9. The guaranteed values for the primary transmission characteristics of the cable are as follows:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum DC resistance (at 20°C)</td>
<td>9.38 ohms/100 m (328 ft.)</td>
</tr>
<tr>
<td>Maximum DC resistance unbalance</td>
<td>5%</td>
</tr>
<tr>
<td>Maximum mutual capacitance</td>
<td>5.6nF/100 m (328 ft.)</td>
</tr>
<tr>
<td>Maximum capacitance unbalance (pair to ground)</td>
<td>330 pF/100 m (328 ft.)</td>
</tr>
<tr>
<td>Maximum propagation delay skew</td>
<td>25 ns/100 m (328 ft.)</td>
</tr>
<tr>
<td>NVP – plenum</td>
<td>72% @ 10 MHz</td>
</tr>
<tr>
<td>NVP – non-plenum</td>
<td>68% @ 10 MHz</td>
</tr>
</tbody>
</table>

DC = Direct current
NVP = Nominal velocity of propagation

10. Approved Manufacturer: Belden or other approved strategic cabling partners.

C. Station Outlets

1. Station outlets shall consist of single-gang faceplates mounted vertically with 2-voice and 2-data ports. All ports shall be “front loading” and shall be 8-pin modular connector type, as required by the terms of the warranty. Connector wiring shall be as indicated on the drawings.

   Voice: White, punched-down 568B

   Data: White, punched-down 568B

   Wireless Access Point: White, punched-down 568B

2. All outlet faceplates shall be identified with clear permanent typewritten labels matching the numbering plan indicated on the drawings. All labeling must be permanent. All labeling shall be a minimum 12 pt. in size. All labeling systems shall be submitted to the Engineer for approval prior to fabrication.
3. Approved Manufacturers:
   a. Panduit
   b. Siemon
   c. CS Systimax

D. Patch Panel

1. Patch panel shall employ high density design – 48 or 24 port. Provide the number of panels required to terminate all station cables, plus 30% spare.

2. Shall comply with all performance criteria for Category 6 [6A] rating.

3. Shall have removable port identification strip.

4. Shall have integral D-rings for strain relief and station cable management.


6. Patch panels shall be properly grounded.

7. Voice Ports: White
   Data Ports: White
   Wireless Ports: White.

8. Provide labeling for ports on patch panel using project scheme.

9. Approved Manufacturer: Panduit
   CAT 6 48 Port #DP48688T6
   CAT 6 24 Port #DP24688T6
   [CAT 6A – 48 Port #DP48688T6A]
   [CAT 6A – 24 Port #DP24688T6A]

E. Fiber Terminal

1. Optical Fiber Terminal Enclosure
   a. Rack mounted optical fiber panel shall be constructed utilizing 16 gauge steel minimum. Panel shall be divided into two sections, distribution and user. Distribution section shall have strain relief, routing guides, splice tray and shall be lockable, user section shall have a cover for patch cord protection. Each panel shall provide multi-mode, single-mode pigtails and adapters. Provide adapters as LC with metallic alignment sleeves. Provide dust covers for adapters. Provide patch cords as specified in the paragraph, “Patch Panels”.

2. Approved Manufacturer: Panduit FRME22RMU
F. Equipment Rack

1. Shall be suitable to support CAT 6 [6A] patch panels and Owner provided equipment. Coordinate with Owner’s vendor to verify requirements.

2. Shall be provided as complete unit. Include rack, shelving, cable management, etc. as required.

3. Rack shall be constructed of bare aluminum. Tapped panel mounting holes shall be provided on both front and rear flanges.

4. Provide floor-mounted as indicated on the drawings.

5. Cable Management: Panduit
   7-Foot: #PRV6
   Door: #PED6B1

6. Approved Manufacturer: Chatsworth Equipment Rack
   7-Foot: #55053-703

G. Grounding System and Conductors

1. Provide copper ground bus, wall mounted on stand-off insulators in EF and each TR.

2. A #4 AWG copper cable shall be extended between new equipment ground bus located in data and telephone rooms, to the building electrical service ground electrode bus connected to building steel and driven ground rod.

3. Ground all metal components in the EF and TR’s using a #6 AWG grounding conductor.

H. Cable Runway

1. Shall be 2"H x 12"W, 3/8" steel bar construction, painted black.

2. Provide complete with approved mounting hardware and accessories such as “fences” to contain cables.

3. To be installed only in EF and TR’s.

4. Approved Manufacturer: Chatsworth 10250-712
I. Patch Cords and Instrument Cords

1. The Owner will provide color-coded, Category 6 [6A] pre-connectorized patch cords, and instrument cords. Contractor shall provide to the Owner all pertinent information so that the patch cords will be compliant with the system warranty.

2. Patch cords are intended to meet the requirements of the channel-type solution covered in the system warranty.

J. Cable Supports

1. Shall be J-hook or velcro-strap style.

2. Approved Manufacturers: Erico - Caddy Ortronics

K. 110 Type Termination System

1. Voice system shall be based on 110 type termination blocks. Provide the number of blocks required to terminate all station cables, plus 30% spare.

2. Blocks shall be provided with mounting legs.


4. Blocks shall be available in 50, 100, and 300 pair sizes.

5. Provide complete with connecting blocks as required.

6. Approved Manufacturer: Panduit

L. Inner-Duct

1. Shall be plenum rated.

2. Shall be flexible, corrugated PVC UL listed raceway.

3. Shall be orange in color.

4. Shall be 1-1/2" complete with pull-tape.

5. Approved Manufacturer: Carlon “PlenumGard”.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Components of the premise distribution system shall be installed in a neat, workmanlike manner consistent with the best and telecommunication wiring practices.
B. Wiring color codes shall be strictly observed and terminations shall be uniform throughout the building and as specified herein.

C. Identification markings and systems shall be uniform. Each cable and each port shall be labeled with the corresponding room no., outlet no., and port no., as shown on the drawings and as specified herein.

D. ANSI/TIA preferred wiring codes as shown on the drawings shall standardize all wiring.

E. Contractor shall route all UTP cables above ceilings in a concealed manner, in conduit, supported on j-hooks or approved cable straps in accordance with the project design.

F. “Permanent links” for station cabling shall not exceed 90m (295 ft.). Basic channels shall not exceed 100m (328 ft.).

3.2 SUPPORT AND ROUTING OF CABLES AND CONDUIT FOR TELECOMMUNICATIONS

A. Any station cables used in this system that are to be installed within return air ceiling spaces, shall be routed through these spaces at right angles to and a minimum of 12” from electrical power circuits and supported only from the structure.

B. Use of ceiling tiles, grid or hanger wires for support for telecommunications cables shall be prohibited.

C. The TDS contractor shall install a complete set of cable supporting devices, and other supporting hardware for this system as part of this contract. All supporting hardware shall be submitted to the engineer for approval prior to installation.

D. Conduit shall be as specified in respective section, and installed by the electrical subcontractor.

E. Conduit runs between pull boxes shall not exceed 100 feet or contain more than 3 – 90-degree bends.

F. Minimum size conduit shall be equivalent to 1”, unless otherwise specified.

G. Underground communications conduit shall be separated by a minimum of 3” of concrete or 12” of earth.

H. Minimum bend radius shall be 10 times internal diameter of conduit, and no less than cable manufacturer’s recommended minimum bend radius and EIA/TIA standards.

I. Size of conduit shall be such that 40% of cross-sectional fill is not exceeded.

J. Provide cabling supports with no more than 25 cables per support. Provide cable supports with structural supports, 60" on center, with an additional support placed adjacent (12") from each stub up.

K. All cable must be pulled with a ninety degree angle or sweep at all turns.
L. All cable must be pulled down hallways and over doorways whenever possible.

M. No cable should droop more than four inches and shall not touch any light fixtures or drop ceiling in any way.

N. No cable shall be spliced or otherwise re-terminated to fulfill the requirements of the job other than at the wall outlet and communications closet.

O. All cable must be run as high and above as many obstructions as possible such as ducts, other cabling, conduit, piping, etc.

P. No cable shall be tie wrapped closely parallel or directly on electrical conduit.

Q. All station cable shall be home run from T.R. or data center room running through ceilings in neatly tie wrapped, bundles, and secured to structural members at a minimum of 5 ft. intervals, unless otherwise stated on the design documents. A minimum of 3" conduit sleeve shall be installed at all locations where cables must pass through drilled openings. Appropriate fire caulk shall be installed per local code.

R. This contractor shall provide and install all cable runway as required in the data and telephone rooms.

S. A walk through shall be conducted prior to installation to examine installation conditions. Replacement of any tiles or other materials damaged during installation shall be the responsibility of the installing Contractor.

T. Cables shall be terminated in order, lowest room or floor box number first, station A first, and ports 1-4 in order.

U. Provide all backbone cabling in conduit. Provide horizontal cabling, above accessible ceilings, in cable supports or conduit as per design details.

V. Above each station drop and in the telecommunications room, provide a coil of “slack” cable approximately 20 feet in length, to allow for future removal of existing termination, and re-termination at outlet device below.

W. This contractor shall provide and install a complete run of inner-duct to be used for fiber optic cable, from the data and telephone rooms, up to the rooms on the upper floors. Duct shall be routed on cable tray and through conduits as necessary to provide a complete raceway from end-to-end. (Cable tray and conduits to be provided and installed by the electrical subcontractor. Conductors to be provided and installed by the Owner’s selected vendor.)

3.3 PULL AND SPLICE BOXES

A. Boxes shall be as specified in Division 26.

B. Boxes shall be placed in accessible locations.

C. Boxes in conduit larger than 3/4" shall:
1. For straight pulls, the length shall be 8 times diameter of conduit.

2. For angle pulls, the distance between sides shall be 6 times diameter of largest raceway.

D. Splice boxes shall be sized in accordance with Standard ANSI/TIA-569.

3.4 FIRE AND SMOKE PARTITION PENETRATIONS

A. Conduit sleeves shall be provided as a means of routing cables between various IDF rooms and multi floor buildings. Openings in sleeves and conduits used for the Telecommunications system cables and those which remain (empty) spare shall be sealed with an approved fireproof, removable safing material.

B. Sleeves which pass vertically from floor to floor shall be sealed in a similar manner using an approved re-enterable system.

C. Additional penetrations through rated assemblies necessary for passage of telecommunications wiring shall be made using an approved method and permanently sealed after installation of cables.

3.5 LABELING

A. Labeling shall comply with PBSC Structure Cabling Guidelines, and ANSI/TIA 606.

1. Each port in the outlet faceplates and all cables shall be labeled at all termination points using 6-digit numbers, as per the following examples.

   Room 203.1:

   203.1 01  203.1 02  203.1 03
   (Voice)   (Data)   (Wireless)

   Room 108:

   108.0 01  108.0 02  108.0 03
   (Voice)   (Data)   (Wireless)

   Each port on the data patch panels shall be numbered sequentially starting with 001.

   Voice cable terminations on 110 blocks in the T.R., shall be as per the Owner’s convention. Verify prior to terminating any cables.

B. Labels shall not be handwritten but shall be made using a device which produces type written print on a permanent marker to secure around cable in a permanent manner.

C. In all cases, always coordinate and confirm numbering convention with PBSC prior to labeling any cabling or components. See also PBSC Structure Cabling Guidelines.
3.6 TESTING OF WIRING ACCURACY

A. Testing for the data circuits shall meet standards for Category 6 [6A] operation, or be considered unacceptable. **100% of the installation shall be tested.** All voice cabling shall be tested for continuity, opens, shorts, reversals, and pair-testing only.

B. Each outlet shall be tested post-termination using an appropriate instrument to verify both the integrity of all conductors and correctness of the termination sequence. Testing shall be performed between modular jacks at the outlets and modular jacks at the cross-connect.

C. Approved test equipment shall be:

1. Agilent Technologies (Formerly HP)
2. Datacom Textron
3. Fluke
4. Microtest
5. Wavetek

D. The following test model cordage constraints shall apply:

1. There shall be no more than 6.5 ft. of tester cords at each end for a **Horizontal Basic Link Test.**

2. There shall be no more than 6.5 ft. of test cords at each end for a **Backbone Basic Link Test.**

3. The combined length of equipment cords, patch cords, or jumpers shall not exceed 89 ft. in the **Horizontal Channel Test**

4. The combined length of equipment cords, patch cords, or jumpers shall not exceed 50 ft. in the **Backbone Channel Test.**

E. Testing of Station Wiring

1. Each data outlet shall be post-installed tested using an appropriate Category 6 [6A] instrument to verify both the integrity of all conductors and the correctness of the termination sequence. Testing shall be performed between the modular jack at the outlet and the modular jack at the patch panel. Documentation of the cable tests shall be provided with the as-built drawings. The test reports shall include for all pairs:

   CAT 6:
   a. Wire map
   b. Length
   c. Propagation delay
   d. Delay skew
   e. DC Loop Resistance – recorded for information only
   f. DC Resistance Unbalance – recorded for information only
   g. Insertion loss
h. NEXT (Near-End Crosstalk)
i. PS NEXT (Power-Sum Near-End Crosstalk)
j. ACR-N (Attenuation to Crosstalk Ratio Near-End) – recorded for information only
k. PS ACR-N (Power-Sum Attenuation to Crosstalk Ratio Far-End)
l. ACR-F (Attenuation to Crosstalk Ratio Far-End)
m. PS ACR-F (Power-Sum Attenuation to Crosstalk Ratio Far-End)
n. Return Loss
o. TCL (Transverse Conversion Loss) – recorded for information only
p. ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only.

[CAT 6A
a. Wire map
b. Length
c. Propagation delay
d. Delay skew
e. DC Loop Resistance – recorded for information only
f. DC Resistance Unbalance – recorded for information only’
g. Insertion loss
h. NEXT (Near-End Crosstalk)
i. PS NEXT (Power-Sum Near-End Crosstalk)
j. ACR-N (Attenuation to Crosstalk Ratio Near-End) – recorded for information only
k. PS ACR-N (Power-Sum Attenuation to Crosstalk Ratio Far-End)
l. ACR-F (Attenuation to Crosstalk Ratio Far-End)
m. PS ACR-F (Power-Sum Attenuation to Crosstalk Ratio Far-End)
n. Return Loss
o. TCL (Transverse Conversion Loss) – recorded for information only
p. ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only.
q. PS ANEXT (Power-Sum Alien Near-End Crosstalk) – sampled per section 3.2
r. Average PS ANEXT (Average Power-Sum Alien Near-End Crosstalk) – sampled per section 3.2
s. PS AACR-F (Power-Sum Alien Attenuation to Crosstalk Ratio Far-End) – sampled per section 3.2.
t. Average PS AACR-F (Average Power-Sum Alien Attenuation to Crosstalk Ratio Far-End) – sampled per section 3.2.]

2. The results of each test shall be recorded on a standard form showing location, date of test, results of test, and name of person performing the test. Two (2) printed copies of the test results shall be furnished to the Owner.

F. Optical Fiber Tests

1. For optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568-C.3 and TIA-526-14 using Method A, Optical Power Meter and Light Source for multi-mode optical fiber. Perform verification acceptance tests. Perform Method B, OTDR if testing using Method A yields discrepancies in results.
2. Optical Fiber Links – Perform optical fiber end-to-end link tests in accordance with TIA-568-C.3.

G. System Commissioning/Acceptance

1. A testing schedule shall be planned and agreed upon beforehand so that the Owner’s representatives may attend.

2. System test and performance verification shall be provided by the Contractor following system installation.

H. Contractor shall provide actual test equipment hard copy output for Owner. In addition to the actual machine output results, the Contractor shall tabulate for all cables, all results in spreadsheet format and provide the industry or manufacturer testing acceptable ranges for each test variable, for each individual cable and result. This will allow the Owner to identify trends and actual results versus acceptable ranges.

3.7 AS-BUILT DOCUMENTATION/CLOSE OUT DOCUMENTS

A. As-built documentation shall be provided as part of the TDS contract. As-built drawings shall be a complete set of floor plans with all outlets shown and numbered as installed. All drawings and schedules shall be computer generated using CAD. Provide all files in “.DXF” format. Drawings shall include a legend describing all symbols used on the documents. All cable routings to each outlet shall be required, along with elevation drawings of the equipment racks. Cable routing diagrams of the cable plant shall indicate end points, patch panel locations, terminations, and cable lengths. All termination sequences shall be in schedule form (spreadsheet) affixed to the associated floor plan sheet with the equipment rack elevation detail. All cable test results along with documented testing procedures shall be included in this information. All addendum information or project revisions resulting in drawing changes that occur during the construction period shall be documented and included in the as-built material. All required as-built documentation is mandatory and shall be required prior to project closeout.

B. Detailed as-built drawings shall be adapted from the original prints provided. Revised rack and equipment cabinet elevations shall be provided. Obtain electronic files of the building floor plan from the Engineer.

C. Six (6) copies of complete project drawings shall be provided to the Owner.

END OF SECTION