I. GENERAL

A. RELATED DOCUMENTS
   1. All Final Construction Documents, and all Contract Documents defined in the Design Build Agreement shall apply to this Section, including general provisions of the Design Build Agreement and any Supplementary Conditions and Division 1 Specification Sections of the Design Criteria Package. All parties shall responsible for attaining this specification from the General Contractor for each project.
   2. Section 16010 – Electrical Requirements, applies to work in this section.
   3. Section 16050 – Electrical Methods and Materials, applies to work in this section.

B. SCOPE
   1. Furnish and install a complete and properly functioning communication network for voice and data to include all cabling, distribution equipment and associated electronics as specified and/or required. Internal building wiring shall be Unshielded Twisted Cable (UTP) as specified for data, voice, and auxiliary applications. Network termination and connections shall be in compliant of Category 6 requirements for gigabit data transmission and in accordance with EIA/TIA 568-B and EIA/TIA 569-A. The basis of design shall be Panduit Copper TX Cabling System subject to Owner and Engineer approval.
   2. Furnish complete as-built drawing documentation on blue-line drawings.

C. QUALITY ASSURANCE
   1. All equipment and materials used on this project shall be new and shall be manufactured by Panduit, of good reputation normally engaged in the manufacture if this type of equipment. Equipment and materials used on this project shall be approved by the Owner and Engineer prior to installation. Any unapproved equipment installed shall be removed and replaced with approved equipment at no additional cost to the Owner.
   2. The installation of the Panduit Network Cabling and equipment shall be completed by a Panduit Certified Cable Contractor (PCI) normally engaged in the installation of such systems. The network installation company shall be required to meet the following requirements and submit for approval prior to bid.
      a) Pre-Qualification Certificate: Submit a letter of approval from the manufacturer indicating completion of prequalification requirements.
      b) Training certificates for design, engineering and installation personnel of the Panduit TX Solution shall be submitted with the proposal. This will also include the company certificate.
      c) Maintain a service department capable of responding within 24 hours for maintenance and minor services, and 4 hours for major outages.
      d) Have a registered (BICSI) communications distribution designer (RCDD) on staff and assigned as project manager. Project manager shall inspect site(s) weekly, be responsible for supervising installation, and shall be available to address questions and difficulties that may arise. In addition, a BICSI Certified Technician must be on site on the project at all times.
      e) Provide a list of previous projects of similar installation and size. Installer shall be required to have successfully completed three (3) similar type installations and provide owner name and point of contact for verification.
      f) A construction supervisor shall be assigned to the project through its entirety. The construction supervisor shall have a minimum five (5) years of experience installing LAN systems and be on site while communications work is being performed. Submit resume and qualifications.
3. It is the Cable Contractor’s responsibility to verify that he/she is approved prior to bid. Provide documents demonstrating compliance with the above requirements again at bid submission. All bidders must be a current Panduit PCI and approved by the owner and engineer prior to initiation of work.

4. Cable Contractor Qualifications
   a) Cable Contractor Selection: The Cable Contractor selected for this Project must be Panduit Certified and will adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
   b) Cable Contractor Experience and Training: The Cable Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Cable Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and Category 5E and Category 6 metallic premise distribution systems and have personnel who are adequately trained in the use of such tools and equipment.
   c) Cable Contractor Resume: A resume of qualification shall be submitted with the Cable Contractor’s proposal indicating the following:
      (1) A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
      (2) A list of test equipment proposed for use in verifying the installed integrity of metallic and fiber optic cable systems on this project.
      (3) A technical resume of experience for the Cable Contractor’s Project Manager and on-site installation supervisor who will be assigned to this Project.
   d) Equipment or materials listed herein represent the minimum standard of quality and performance that will be accepted on this project. Equipment or materials that do not meet the minimum guidelines of these specifications shall be replaced at the installing Cable Contractor’s expense with equipment or materials that do meet the standards of these specifications.

D. INSTALLATION STANDARDS

1. Where applicable, the standards and specifications of the following publications shall be used as a guideline for the installation of the specified communications network. The Cable Contractor shall be knowledgeable of the requirements, standards, and specifications of each publication.
   a) National Electrical Code – Latest Edition
   b) EIA/TIA 568B and 569A – Current Edition.
   c) IEEE Standards 802.3 and 802.5.
   e) UL Labels: All items of equipment and individual components where applicable standards have been established shall be listed by the Underwriter’s Laboratories, Inc., and shall bear the UL label when delivered and installed on the job.
   f) NFPA Compliance: Comply with National Fire Protection Code (NFPA) as applicable to installation and construction of equipment.
   g) NEMA Compliance: Comply with the standards of the National Electrical Manufacturers Association pertaining to components of the equipment.
   h) ANSI Compliance: Provide equipment which complies with ANSI construction and ratings standards.
2. The installing Cable Contractor shall review plans and notify the engineer prior to the installation of any conflict between the plans/specifications and the above listed standards.

3. All equipment and cabling installed shall meet the following applicable standards:
   a) UL Labels: All items of equipment and individual components where applicable standards have been established shall be listed by the Underwriters’ Laboratories, Inc. and shall bear the UL label when delivered and installed on the job.
   b) NFPA Compliance: Comply with National Fire Protection Code (NFPA) as applicable to installation and construction of equipment.
   c) NEMA Compliance: Comply with the standards of the National Electrical Manufacturers Association pertaining to components of the equipment.
   d) ANSI Compliance: Provide equipment which complies with ANSI construction and ratings standards.

4. Material Provided: The successful Cable Contractor shall be certain that all correct parts are ordered per Products Selection of this document and installed in accordance with manufacturer’s design and installation guidelines. Vendor shall submit complete parts and part numbers to the Owner prior to installation of equipment.

E. PRODUCT WARRANTY AND APPLICATION ASSURANCE

1. Additional Warranty: The cable installer shall state any additional warranty requirements.

2. Manufacturer Warranty: Cable Contractor shall provide a Twenty (25) year Manufacturer Panduit Structured Connectivity Solution (SCS) Extended Product Warranty and Application Assurance.

3. Extended Product Warranty: The Extended Product Warranty shall cover defects for all passive manufactured components and shall include labor and material replacement costs, and re-testing/re-certification of the cable system. Passive components are defined as those exhibiting no gain or contributing no energy. The Manufacturer shall warrant, from the date a Registration Certificate is issued by the Manufacturer to the end-user, the following:
   a) The passive products that comprise the registered solution will be free from manufacturing defects in material or workmanship under normal and proper use;
   b) All approved passive cabling products that comprise the registered solution exceed the specification of TIA 568-B.1, B.2, B.3 and exceed ISO/IEC 11801 standards and will conform to the performance specifications in section 2.3.A of this document;
   c) The installation will exceed the insertion and return loss, attenuation and near end crosstalk (NEXT) requirements of TIA 568-B and the ISO/IEC 11801 standards for cabling links/channel configurations specified in these standards;
   d) Each channel comprised exclusively of the Panduit’s passive products, end-to-end, is capable of delivering 1.0 Gbps to the workstation in accordance with application standards

4. Application Assurance: Application Assurance covers failure of the applications, which the system was designed to support, as well as additional application(s) defined below. The Manufacturer shall warrant that the registered SCS solution will be free from failures, which prevent operation of the specific applications for which the SCS was designed.
   1) The Application Assurance Program also covers the following additional applications:
   b) Those identified in the current (at the time of installation) Panduit TX Performance Specifications; and
   c) In accordance with application standards specifications, any applications introduced in the future by recognized standards or user forums that use TIA/EIA 568-B.2 or ISO/IEC 11801 components and link/channel specifications for cabling.
5. Term of Warranty: For twenty (25) years from the date of issuance of the Registration Certificate or installation, whichever is earlier.

6. Persons/Entity Covered:
   a) This Limited Warranty shall be for the benefit of Hillsborough Community College to whom the Panduit Registration Certificate is issued and any successor (Transferable) in interest to the site in which such System was originally installed by an Authorized Manufacturer’s Reseller.

   b) If the Panduit repairs the product, it may use new replacement parts. If Manufacturer chooses to replace the product, they may replace it with new product of the same or similar design. Any such repair or replacement will be warranted for either (a) 90 days or (b) the remainder of the original 25-year warranty period, whichever is longer.

F. SHOP DRAWING REVIEW AND APPROVAL

1. Comply with pertinent provisions of the general specifications.

2. Requirements of submittal for this section are supplementary to the requirements of Section 01300, Section 16010 and Section 16050.

3. Product data: At time of submittal, submit:
   a) Product data and Materials list of items to be provided under this Section.
   b) Panduit’s specifications and other data needed to prove compliance with the specified requirements, including but not limited to: (a) dimensions, (b) colors, and (c) configurations.
   c) Panduit’s recommended installation procedures which, when approved by the Engineer, will become one of the standards for accepting or rejecting actual installation procedures used on the work, including but not limited to:
      (1) Panduit’s Instructions:
         (a) Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
         (b) Include instructions for storage, handling, protection, examination, preparation, operation and installation of Product.
         (c) A technical data sheet from Panduit should be included with the response for each product proposed. This data sheet shall include the physical specifications as well as the following electrical and transmission characteristics:
            (i) Mutual Capacitance
            (ii) Impedance
            (iii) DC Resistance
            (iv) Attenuation
            (v) Worst Pair-to-Pair Near End Cross Talk
            (vi) Power Sum Near End Cross Talk
         (d) Test Results - copies provided to Hillsborough Community College and Panduit for warranty application.
   d) Shop drawings required for the following:
      (1) All Cabling, including UTP, Fire Optic Cable, and Voice Backbone Cable;
      (2) Network Electronics, where applicable;
      (3) Patch Panels, Fire Connector Panels;
      (4) Connectors, Crimps, Blocks;
      (5) Patch Cords;
      (6) Equipment Racks and Enclosures;
      (7) “J” hooks for ceiling cabling routing
      (8) Communications Outlets;
      (9) Surge/Lightning Protection Devices;
      (10) Cable management plan coordinated with all other cable routing.
e) Provide the names of employees that will be on the job site. This list shall be updated throughout the project. If any work is performed after normal working hours (8am-5pm), a photo ID must be submitted.

f) Warranty Documentation:
   (1) Warranty Documentation shall be for 25 years.
   (2) Complete documentation regarding the Panduit’s warranty shall be submitted as part of the proposal. This shall include, but is not limited to: a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues.
   (3) A systems application assurance manual documenting the vendor supported applications and application guidelines shall be provided as part of the submittals.

g) The Communications equipment room layout shall be agreed upon prior the start of the project. This will include an elevation drawing of the equipment rack(s) indicating all components and elements of the equipment, referenced to the catalog/data sheets including in the submittal.

h) Hillsborough Community’s College color coding scheme and labeling scheme shall be adhered to throughout the entire project. All corresponding faceplate numbering shall be submitted for approval. As-built record drawings shall document the exact color coding and faceplate and patch panel numbering as per the approved scheme. Including proposed label method complete with catalog cut sheet and the labeling of materials.

G. PRODUCT DELIVERY, STORAGE, AND HANDLING
1. The installing Panduit Certified Installer shall handle equipment and cabling carefully to prevent breakage, denting and scoring of finishes. Damaged equipment and cabling shall be replaced or returned to equipment manufacturers prior to installation.
2. The installing PCI shall store equipment and cabling in clean dry spaces. Store in original cartons and protect from public, dirt, physical damage, weather, and construction traffic. Equipment cartons shall be labeled on outside in such a manner that the engineer may easily review and count equipment on site. Housekeeping on the jobsite shall be performed on a daily basis.

H. RECORD DRAWINGS
1. Provide and maintain at the site a set of construction prints which accurately reflect the installation of all work under this section. The record-drawing-construction prints shall indicate any variation from Cable Contractor drawings including additions, deletions, and changes in sizes, locations and dimensions. Corrections shall be clearly and completely indicated as work progresses. Changes shall be updated daily. PCI shall also indicate lengths of all cables installed and addresses of all communications drops.
2. Record-drawing-construction prints shall be available for inspection by the Engineer and shall be used to determine the progress of electrical work.
3. At the completion of the project: The PCI shall prepare Visio record drawings of the project. Transcribe the information on the construction prints and the drawing files, and provide one (1) reproducible set of drawings, and two (2) CD-versions of the record drawings. Record drawings shall be approved by the Engineer prior to the submittal of the above sets. Electronic AutoCAD drawings of all cable routing and the following requirements listed below shall be provided:
   a) Drawings and Diagrams: Upon completion of final engineering and incorporation of the Engineer and Owner review comments, Cable Contractor shall provide to the Owner for its records, the following:
      (1) MC/MDF and TR/IDF Diagrams – Includes:
         (a) cable routing- Home runs and cable raceways
         (b) position of all components and apparatus;
         (c) detailed layout of the wall field;
         (d) Labeling plan.
      (2) Work Area Floor Plans – Includes:
(a) detailed cable routes;
(b) Approved labeling plan for all work areas.

(3) Riser Distribution Plan
(4) Documentation should be in the following format:
   (a) Four (4) CD-electronic copies and one (1) reproduced copy of all diagrams and drawings
   
b) Additional Records: In addition to the engineering diagrams, the following items shall be provided by the Cable Contractor:
   (1) Cable Records and Assignments along with test results.

I. ELECTRICAL COORDINATION
   1. Field coordinate work with all trades to avoid interferences and conditions which will effect installation of the project as indicated. It shall be the total responsibility of the various trade contractors to accomplish these installations without additional charges to the Owner. If, in the opinion of the combined trades, an installation cannot be made as shown, the Engineer shall be notified before installation. If interferences are allowed to develop, the Engineer shall decide which equipment must be moved, regardless of which was installed first.

J. MAINTENANCE MANUALS
   1. Upon completion of this portion of the work, and as a condition of its acceptance, delivery to the Engineer two (2) copies of operation and maintenance manuals compiled in accordance with the provisions of the closeout requirements and General Conditions. Include within each manual:
      a) One half-size copy of approved record documents.
      b) Copy of site plan indicating backbone cabling installed to include lengths.
      c) Copies of all warranties and guarantees.
      d) Copies of all operating and maintenance manuals for equipment supplied. Manuals shall contain a parts list for any replacement parts and cables.
      e) Copies of all test results for cable acceptance.

K. TRAINING
   1. See Part 3 of this specification for training requirements. All technicians’ training must be up to date and certificates must be submitted with the bid package.

II. PRODUCTS
A. GENERAL
   1. Provide only materials that are new, and the type and quality specified. Where Underwriter’s Laboratories, Inc. has established standards for such materials, provide only materials bearing the UL label.
   2. All equipment shall meet or exceed the specifications listed herein.
   3. Panduit TX Cabling System shall be the basis of design and the approved manufacturer for Fiber Interconnection Cabinets and Communications Patch Panels. Other manufacturers may be acceptable provided they successfully demonstrate full compliance of specification requirements, subject to approval by the Owner and Engineer.

B. NETWORK ELECTRONICS (BY OWNER)
   1. All active and existing electronic equipment will be Owner supplied and configured, but shall be installed and linked by the network equipment provider/manufacturer.

C. HORIZONTAL CABLING AND NETWORK DISTRIBUTION
   1. All satellite hubs shall be connected to the main hub via fiber optic cable, unless specifically indicated otherwise on the drawings.
   2. All communications outlets within the building shall be connected to their respective patch panel via Panduit TX Category 6 compliant Unshielded Twisted Pair copper cabling. UTP cabling lengths shall not exceed 295 feet from the patch panel to the communications outlet.
   3. Routing: Cabling should be installed over corridor areas or along lines that are parallel to the corridors of the building. Deviations from straight should be made at sweeping right angles. Wall
penetrations or floor penetrations shall be fire wall penetrations with fire stop which will be designed to support and protect the cable.

4. Category 6 Network Cable
   a) Manufacturer: The products SHALL BE SUPPLIED by Panduit, with the exception of hardware that is not defined as part of the channel test configuration by TIA/EIA 568-B. Manufacturer shall be ISO 9001 certified.
   b) The Horizontal Channel SHALL meet the installed performance criteria stated in TIA/EIA-568-B.2-1-2002.
   c) The guaranteed performance parameters must be supplied in writing before initiation of work.

5. Station Cable
   a) Category 6 UTP, 4 Pair:
      (1) Category 6 UTP, 4 Pair (High Performance) cables shall extend between the station location and its associated TR and consists of 4 pair, 23 gauge, UTP, and shall terminate on eight (8) pin modular jacks provided at each outlet. Cable jacket shall comply with Article 800 NEC for use as a plenum. The 4 Pair UTP cable shall be UL® and c (UL®) Listed Type CMP (plenum).
      (2) The high performance Category 6 UTP Panduit PUP6004BU-U Blue plenum cable and shall be of the traditional round design with 4-way separator each pair. The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE – T Ethernet, Token Ring, 100 Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 MHz) of analog broadband video.
      (3) All UTP cable runs shall be provided with a minimum 10-foot service loop at both ends per BICSI standards in a concentric loop. Service loops shall be secured, supported and protected above the ceiling or in the Wyr-Grid.
      (4) Panduit PUP6004BU-U plenum, Blue Category 6- 4 pair UTP cable.

6. Fiber Optic Cable
   a) Fiber optic cable from the main hub to each intermediate hub shall be a 12 fiber, 62.5/125 specified, tight buffer, premises distribution type, unless otherwise specified. Must be suitable for use indoors, exterior in conduit and underground in conduit. Impact resistance shall be 1500 impacts minimum. Crush resistance shall be 2200 N/cm minimum. Panduit Opti-Core FSDR612, FSDP612.
   b) All fiber optic cable installed in exterior or below grade raceways, or otherwise installed outside of the building shall be rated for outdoor applications. Fiber optic cable installed indoors shall be rated for plenum use. If required, fiber optic cable shall be installed in conduit when routed outdoors or below grade and also where indicated to be installed in conduit in the interior of the building in inner-duct.
   c) Cable installed shall not exceed the manufacturer and industry-recommended minimum bending radius and maximum tensile load.
   d) A minimum 10-foot service loop shall be provided at both ends of all fiber optic cable runs per BICSI standard. Service loops shall be secured and supported above the ceiling or in the cable tray.
   e) Terminate all fiber on PANDUIT “LC” connectors mounted in fiber interconnect panels located in the rack or cabinet at the main and satellite patch location. Fiber backbone cable shall not be spliced.
   f) 50 Micron Fiber – 10 GB/S Riser and Campus Backbone Cable: The 50-micron MM fiber shall support single-channel serial transmission, in both the building riser and building backbone to 10 gigabits per second (Gbps) for a distance of 300 meters with four connections.
g) The 50 micron fiber shall be backward compatible with legacy applications such as: Ethernet, Token Ring, FDDI, Fast Ethernet and ATM for in-building network distances, ensuring a smooth migration path from 10 Mb/s to 10 Gbps using achievable technology.

h) It shall support 10 Gb/s short wavelength (850 nm) emerging technology applications using vertical cavity surface emitting lasers (VCSELs) and low bit rate LED applications for legacy systems.

i) The 50 micron fiber shall be optimized to control differential mode delay (DMD) so that “pulse splitting” at 10 Gbps is eliminated.

j) The high performance fiber shall use the same termination and test procedures that are currently used for the existing industry’s lower performance 50-micro fiber. Fibers shall be manufactured with D-LUX® 100 coating for maximum color retention and protection.

k) The 50 micron fiber shall meet or exceed the following standards, as applicable, for OSP or Plenum cables: ICEA S-83-596, ISO/IEC-794, GR-409, EIA/TIA 455, EIA/TIA 492, EIA/TIA 568-B, ANSI-FDDI, IEEE 802, UL 910, OFNP classification as described in the National Electric Code (NEC2), OFN-LS Low Smoke Cables, CSA Certified (OFN FT4/FT6) and approved component industry standards.

(1) Building Riser Cable: The 50-micro multimode plenum building riser fiber shall meet the following specifications:

<table>
<thead>
<tr>
<th>Specification</th>
<th>50 micron multimode (10 Gigabit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical fiber</td>
<td>50 micron multimode (10 Gigabit)</td>
</tr>
<tr>
<td>Fiber dimension</td>
<td>125 micron cladding</td>
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<tr>
<td></td>
<td>250 micron coating</td>
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<tr>
<td></td>
<td>900 micron buffering</td>
</tr>
<tr>
<td>Fiber proof stress</td>
<td>100 kpsi (689 N/mm²)</td>
</tr>
<tr>
<td>Fiber core</td>
<td>50 µm (±2 µm)</td>
</tr>
<tr>
<td>Core non-circularity</td>
<td>≤ 5%</td>
</tr>
<tr>
<td>Core/cladding concentricity error</td>
<td>≤ 1.5 µm</td>
</tr>
<tr>
<td>Numerical aperture</td>
<td>0.200 ±0.015/-0.010</td>
</tr>
<tr>
<td>Cladding diameter</td>
<td>125 µm (± 1 µm)</td>
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<tr>
<td>Cladding non-circularity</td>
<td>≤ 1%</td>
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<tr>
<td>Colored fiber diameter</td>
<td>245 µm (± 10 µm)</td>
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<tr>
<td>Buffering diameter</td>
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<tr>
<td>Minimum tensile strength</td>
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<tr>
<td>Fiber minimum bending radius</td>
<td>0.75 inch (1.19 cm)</td>
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<tr>
<td>Cable minimum bending radius</td>
<td>20 times cable diameter during installation</td>
</tr>
<tr>
<td></td>
<td>10 times cable diameter after installation</td>
</tr>
<tr>
<td>Maximum fiber loss</td>
<td>3.5 dB/km at 850 nm</td>
</tr>
<tr>
<td></td>
<td>1.5 dB/km at 1300 nm</td>
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</tbody>
</table>
### Minimum Bandwidth

<table>
<thead>
<tr>
<th></th>
<th>500 MHz-km at 850 nm (overfilled)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500 MHz-km at 1300 nm (overfilled)</td>
</tr>
<tr>
<td></td>
<td>2200 MHz-km at 850 nm (laser)</td>
</tr>
<tr>
<td></td>
<td>500 MHz-km at 1300 nm (laser)</td>
</tr>
</tbody>
</table>

### Fiber Identification

Individually color coded buffering

### Buffer Material

Plenum – Low Smoke PVC Color Coded

### Jacket Material

Plenum – Low Smoke PVC Aqua Color

### Strength Material

Aramid yarn

### Operating Temperature

- (0dB added) -4°F to +158°F (-20°C to +70°C)
- (less than 0.5dB added) -40°F to +185°F (-40°C to +85°C)
- -60°C to +85°C

### Normal Reel Length

Approx. 12,000 feet (3,650m)

(Other lengths available)

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**D. RACEWAY AND CABLE SUPPORT REQUIREMENTS**

1. All cabling shall be properly supported and protected in accordance with these guidelines. Refer to the accompanying figures for additional raceway requirements.

2. UTP cabling installed inside the building shall be installed in a raceway from the communications outlet up to the ceiling space where a dropped ceiling is installed. In new buildings, this raceway shall be a concealed conduit in the wall, minimum ¾ inch.

3. UTP cabling may be “free-wired” where it is routed concealed above an accessible ceiling. Free run cables shall be bundled and loosely wrapped 24 inches on center (maximum). Use plenum rated Velcro in air plenums. Cabling shall be supported to the building structure at a minimum of four (4) foot intervals. Cabling shall not be supported from the ceiling, ductwork, conduits, piping, or any other non-structural building member. Cable shall be supported by Panduit “J” hooks above ceiling, when not routed in cable trays.

4. Conduit sleeves, minimum four inches unless otherwise indicated, shall be provided at all fire wall penetrations. All fire wall penetrations shall be fire stopped in accordance with an applicable UL listed fire wall penetration detail using UL listed fire stopping materials and methods.

5. Fiber optic cabling shall be installed in raceway, with the exception of inside the CER, where it shall be routed in the cable tray, or where specifically noted to be free-wired.
   a) Conduits for fiber optic cable shall be a minimum two (2) inches.
   b) Conduit installed indoors shall be EMT with compression fittings.
   c) Outdoor installations shall consider the specific installation. Raceways installed in a protected area, such as underneath walkway canopies, may be Schedule 40 heavy wall PVC listed for exposed use. Raceways installed underground may be direct burial rated Schedule 40 PVC or galvanized rigid steel. Raceways installed in exposed areas subject to potential damage or harsh conditions shall be galvanized rigid steel. All raceways shall be run straight and level and shall be concealed as much as possible. Exposed raceways shall be approved by the Office of Planning and Construction. All PVC conduits shall have expansion fittings in accordance with the National Electric Code.
   d) The inside radius of conduit bends shall be at least 10 times the inner diameter of the conduit. The fiber optic cable manufacturer’s minimum bending radius requirements shall be observed.
e) Provide Panduit J-Pro cable supports every four (4) feet where free-wired cable is permitted.

E. PATCH PANELS AND INTERCONNECTION CABINETS

1. UTP patch panels shall be Category 6 rated, minimum 24 port, rack mounted and approved prior to installation.
   a) Patch panels shall be High Performance Panduit GP6 Plus punch down connecting blocks to RJ-45 type jacks with no exposed PC boards or they can accept Panduit TX snap in modules. Patch Panels shall include universal labels color coded for T568Aor T568B wiring. Patch panels shall be provided with individual port and patch panel labeling identification areas and shall be labeled with an encoded identification method.
      (1) Panduit DP6 DP24688TG, DP48688TG, DPA2468TG, or DPA48688TG for punch down applications.
      (2) Panduit Mini-Com CPPL24WBL, CPPL48WBL, CPPLA24WBL or CPPLA48WBL patch panels for modular applications.
      (3) For data center applications, QAPP48HDBL OR QPP48HDVNSBL. Quicknet pre-terminated assemblies will be used with the patch panels. Lengths to be determined.

2. Fiber optic cable interconnect cabinets shall be rack mounted enclosures with top, bottom and side cable entry accepting a minimum of 3 OPTICOM Fiber Adapter Panels. Enclosures shall have a slide out/tilt tray for easy access. Provide a protective cover for front enclosure access. Fiber cabinets shall be provided with individual port and patch panel labeling identification areas and shall be labeled with an encoded identification method.
   a) Panduit Fiber Enclosures and adapter panels shall be approved prior to installation.
      (1) .Rack mounted enclosures: FRME1, FRME2, FRME3, and FRME4 are approved. For Pre-terminated projects – FCE1U, FCE2U, FCE4U
      (2) Fiber adapter panels: FAP6WEIDLC, FAP6WBUDLCZ, FAP12WEIDLC and FAP12WBUDLCZ Approved.
      (3) Panduit MTP fiber Cassettes for data center projects.

F. CABLE CONNECTORS

1. UTP cable 8 PIN connector RJ-45 jacks shall be printed circuit board (PCB) requiring no punch down tool and be designed to maintain cable pair twists to within 1/8 inch of termination.
2. Panduit Copper TX CJ688TPEI or CJ688TEGI modules approved. Electric ivory will be the color of the jack.
3. LC type connectors shall be utilized for fiber optic connections. Panduit Opti-Com FLCDMEI (multimode duplex field polish) and FLCSMEI (Single mode duplex field polish) FLCSM5BLY – (multimode duplex Pre-terminated) and connectors approved.
4. Voice station cabling shall be Category 6 terminated on DP24688TGY, DP48688TGY, DPA24688TGY, DPA48688TGY Category 6 punch down straight and angled patch panels, Modular Patch Panels and CJ688TP or CJ688TG modules.

G. DATA RACKS, CABINETS/ENCLOSURES

1. Rack installation shall be determined prior to installation. Open freestanding racks shall be 19 inches wide, 84 inches high, with floor mounted base support angle and overhead cross member. Racks shall be anodized aluminum with pre-drilled EIA standard universal hold pattern panel mounting holes. Proper clearance shall be provided around all racks. All racks shall be bolted together and bonded and grounded. All racks shall be labeled with a rack number identification and capable of supporting 800 lbs.
2. All racks shall be installed with vertical cable management, front and rear and will be attached or integrated as part of the design. Must be approved prior to installation.
3. All racks and cabinets shall be grounded to the building steel or supplemental grounding electrode.
4. Data racks and vertical cable management shall be:
a) Data racks approved: Panduit CMR19X84, NF4PR84, and NFR84. 4 post racks will be ~R4P. For Data Center applications, the CN1 (Net-Access Switch Cabinet) or CS1 (Net-Access Server Cabinet) will be used to house the hardware and switchgear.

b) Vertical cable management panels approved: Panduit NF4PVD2X5, PRV12, PRV8, PRV6, and WMPVHC45.

H. COMMUNICATIONS OUTLETS
   1. Duplex (two jacks), quad (four jacks) and six position (six jacks) label-type outlets will be used, depending the project. The faceplates must be approved prior to installation. The outlets shall be modular consisting of the wall plate and snap-in jack. Outlets shall contain a labeling identification area for each jack and shall be labeled with an encoded identification method.
   2. Each outlet shall be within six (6) feet of a power receptacle which is suitable for use.
   3. Panduit faceplates – CFPE2EI, CFPE4EI, CFPE6EI CFPSL2EI CFPSL4EI, CFPSL6EI, unless otherwise specified.

I. FIBER PATCH CORD
   1. The 10 Gbps 50 micro multimode fiber optic solution shall utilize factory made patch cords. The patch cords shall be available in 1,2,3,5, and 10 meter lengths.
   2. Panduit OPTI-CORE 10 GIG Fiber Patch Cords shall be:
      a) LC to LC 1.6mm jacketed Patch Cord FXE10-10Mxx

J. PATCH CORDS
   1. Provide Category 6 Patch Cords for each assigned port on the patch panel. All cords shall conform to the requirements of the proposed Category 6 Standard for Commercial Building Telecommunications Horizontal Cabling and be part of the UL LAN Certification and Follow-up Program. Backward compatible with Category 5 systems.
   2. Patch cords shall be: Panduit TX6 Plus Category 6. – UPTSPXXYL (XX is determined length), Yellow in color unless otherwise specified.

K. MISCELLANEOUS EQUIPMENT
   1. As per the requirements of the installation, miscellaneous equipment shall be supplied by the Cable Contractor under the base bid, including but not limited to, patch cords, cabinets, pull boxes, hand holes, patch panels, connectors, etc. It is the Cable Contractor’s responsibility to identify and bid all miscellaneous equipment necessary to provide a complete and properly functioning system. Any identified equipment shall be subject to approval.
   2. Provide static grounding straps at approved locations in Telecommunications Closets.

L. OWNER PROVIDED MATERIALS
   1. The system hardware electronics shall be provided by the Owner and installed by the Owner or Owner’s trade contractor under separate contract. All other equipment, materials, hardware, and incidentals required to complete the installation shall be provided by the Cable Contractor. See equipment schedule for anticipated system electronics.
   2. Owner provided equipment shall be installed, connected, and tested by Owner’s supplier, independently of the system infrastructure. In addition, Owner’s supplier shall warrant Owner provided material.

III. EXECUTION
   A. GENERAL
      1. Cable Contractor is to follow established guidelines for installation and termination of all cabling and equipment as established in EIA/TIA-568B, EIA/TIA-569A, BICSI Communications Manual, and the National Electric Code (NEC).
      2. Work shall be of professional quality, and shall not detract from the aesthetic qualities of the facility.

   B. CABLING
      1. Horizontal cable: The Cable Contractor shall install all horizontal cable in conduit, Wyr Grid, duct, or free in the ceilings per the contract documents and industry standards as outlined in the BICSI Communication Manual, EIA/TIA 568B, EIA/TIA 569A, and the following:
a) All communications cabling used throughout this project shall comply with the requirements as outlined in the National Electric Code (NEC®) Articles 725, 760, 770, and 800 and the appropriate local codes. All copper cabling shall bear CMP (Plenum Rated), CM/CMR (Riser Rated) and/or appropriate markings for the environment in which they are installed. All fiber optic cabling shall bear OFNP (Plenum Rated), PFNR (Riser Rated) and/or appropriate markings for the environment in which they are installed.

b) Separation from sources of EMI: Special care shall be taken in the open ceiling installation of any cabling as to avoid any EMI generating devices. Avoid communications wiring located in spaces with electrical panels, transformers, or other high voltage equipment.

c) Cable Support: Exposed cable installed above ceilings shall be supported by tray or cable hangers. Cable hanger spacing shall not exceed 48 inches on center. Approved cable hangers shall be “J” hooks, Panduit: J Pro Mod or J-Pro. Cable hangers shall be attached to roof support structure (Bar joist, Truss, T-Beam, etc.), with appropriate fasteners and shall not be supported from non-structural supports such as ductwork, mechanical piping, conduit, ceiling grid, etc. Type of fastener shall be coordinated in the field.

(1) In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Cable Contractor shall bundle, in bundles of 50 or less, station wiring with Velcro ties snug, but not deforming the cable geometry. Cable bundles shall be supported via “J” hooks attached to the existing building structure and framework at a maximum of four (4) foot intervals. Plenum rated Velcro ties will be used in all appropriate areas. The Cable Contractor shall adhere to the manufacturer’s requirements for bending radius and pulling tension of all data and voice cables.

(2) Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.

(3) Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space.

(4) Cable Contractor Responsibility: The Cable Contractor shall be responsible for damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.

d) Familiarity with Installation Standards: It is the Cable Contractor’s responsibility to be familiar with the installation practices for the telecommunication industry.

e) Routing: Cabling should be installed over corridor areas or along lines that are parallel to the corridors of the building. Deviations from straight should be made at right angles. Wall penetrations or floor penetrations shall be made via pre-constructed distribution systems designed to support and protect the cable.

f) Velcro Wraps: In addition to cable supports, free run cables shall be bundled and loosely wrapped 24 inches on center (minimum). Use plenum rated Velcro wraps in air plenums. Velcro wraps shall be Panduit.

g) Fire Penetrations: Fire stop free run cable through fire rated walls in accordance with UL standards and EIA/TIA 569. All fire wall penetrations shall be sealed with a UL listed fire rated assembly and must be resealed.

h) Tension: Cable shall be free from tension at both ends, as well as over the length of each run.

i) UTP Splices and Bridge Taps: Shall not be permitted.

j) UTP Cable Bends: Bend radii shall be greater than four times the cable diameter but a minimum of 25.4mm. Runs shall be free from kinks and twists.

k) Harsh, Hazardous, or Corrosive Environments: Cabling shall not be installed where vapors, fumes, corrosives, dust or other industrial byproducts are present without taking appropriate precautions to protect the cables. Protection shall be in accordance with the manufacturer’s recommendations and NFPA standards and specifications.
l) Penetrations through walls shall be sleeved. Sleeves shall be sized such that fill ratios will not exceed 50% of maximum.
m) Provide raceway out of cabinet to ceiling space. Raceway shall be conduit or wire trough. Raceway shall be sized such that fill ratios will not exceed 50% of maximum.
n) Cabling shall not be run exposed to general public. Surface mounted raceway is permitted.

C. GROUNDING

1. The campus power system should be grounded such that the maximum resistance to ground is 5 ohms. Grounding resistance at computer panels should be minimized and preferably less than 5 ohms.
2. All power circuits shall have a separate copper equipment grounding conductor. Isolated ground conductors are not required.
3. All equipment racks, cable trays, surge suppressors, and cabinets shall be bonded to the building grounding system. No daisy chain of multiple racks in a telecommunication room. All rack must be grounded and bonded separately. Cable tray must be grounded and each piece must be bonded to the next piece. Approved product – Panduit StructuredGround™ Kits for Racks.
4. All grounding connections shall be tested for resistance to ground. The Cable Contractor shall provide a certification letter stating the tests have been performed and meet the requirements.

D. FIRE WALL PENETRATIONS

1. Fire stopping of fire wall penetrations shall meet the requirements of UL, NFPA, and all applicable building codes.

E. LABELING AND IDENTIFICATION

1. Each cable shall be labeled with a unique identifier standard to Hillsborough Community College. All network system components shall be labeled, including rooms, racks, cabinets, patch panels, individual ports in each patch panel, communication outlets, etc. The system identification administration shall meet the requirements of TIA/EIA-606A. All color coding shall meet the TIA-606A standard. No labels are to be written by hand. Each cable, faceplate jack, and/or Patch panel ports, shall be labeled at each end and referenced on the as-built cable map and database. It shall be a 6-digit code as follows: 3-digit room number (Note some room numbers may be followed by a letter), 1-character faceplate letter, and 1-digit jack number (examples:"226-A-1,2,3,4" indicates room "226", faceplate "A", jack "1". Room 23 would be designated "023")

2. Each patch panel shall be labeled sequentially left-to-right, top-to-bottom, with the room number and port letter, such that the ports can be located easily on the panel.
3. All fibers in each fiber optic cable shall be identified at each end on the interconnect cabinet. Fibers shall be identified in accordance with TIA-606A standard.

F. TESTING

1. Copper Cable testing: Testing of all copper wiring shall be performed prior to system cutover by the cable contractor and a report shall be generated and a copy forwarded to the Engineer and Owner. 100 percent of the horizontal and riser wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage. Voice and data horizontal wiring pairs shall be tested from the information outlet to the TR. Category 6 horizontal cables shall be tested according to test set manufacturer’s instructions utilizing the latest firmware and software. Testing shall include all of the electrical parameters as specified in the Products Section of this document. Any pairs not meeting the requirements of the standard shall be brought into compliance by the Cable Contractor, at no charge to the Owner. Complete, end-to-end test results must be submitted to the Engineer and Owner.

2. Optical Fiber Cable Testing: All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in Section 3 of this RFP. Testing shall consist of a bi-directional end to end OTDR trace performed per EIA/TIA 455-61 or a bi-directional end to end power meter test performed per EIA/TIA 455-53A. The system loss measurements shall be
provided at 850 and 1310 nanometers for multimode fibers and 1310 and 1550 for single mode fibers.

a) Loss Budget: Fiber links shall have a maximum loss of:
   (1) (allowable cable loss per km) (km of fiber in link) + (0.5dB) (number of connectors) = maximum allowable loss.
   (a) A mated connector to connector interface is defined as a single connector for the purpose of this RFP;
   (b) Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.

b) Any link not meeting the requirements of the standard shall be brought into compliance by the Cable Contractor, at no charge to the Owner.

c) Documentation shall be provided in both hard copy and CD ROM to the point of contact.

3. Additional Warranty: Cable Contractor shall state any additional Cable Contractor supplied warranty.

4. Documentation:
   a) Provide printed copies of all test results for each port and each fiber.
   b) UTP data test results shall include:
      (1) Port identification number
      (2) Cable type
      (3) Clear identification of “pass” or “fail” with limits
      (4) Cable number
      (5) Test equipment model and serial numbers
      (6) Date
      (7) Reference setup (including UL verified VP settings)
      (8) Operator (crew members)
      (9) Cable capacitance
      (10) Loop resistance
      (11) Near-end crosstalk (ten test frequencies min. 0.772 MHz – 250 MHz)
      (12) Attenuation
      (13) Line map
      (14) Cable length
   c) Fiber results shall include:
      (1) Cable type and identification number.
      (2) Manufacturer’s published attenuation level. In no case shall the attenuation exceed 2.5dB end-to-end.
      (3) Tested attenuation result and clear indication of “pass” or “fail” with limits.
   d) Cable Contractors RCDD shall provide written certification of the network’s TIA/EIA-568B-2.1 compliance.

G. SYSTEM COMMISSIONING
   1. Upon completion of the aforementioned tests and before system acceptance. Owner certification tests may be performed on a sample basis (10% of installed channels) on various portions of the network as determined by the Owner. The tests shall be witnessed by the Cable Contractor, Engineer and the Owner or Owner’s designated representatives.
   2. If, in the opinion of the Engineer, failure rates are excessive, then the Owner shall have the option to have the complete system tested independently at no additional cost to the Owner.

H. INSPECTION
   1. On-going inspections every two weeks shall be performed during construction by the installing contractor with the local Panduit Representative and a written report generated addressing all issues noted below. All work shall be performed in a high quality manner and the overall appearance shall be clean, neat and orderly. The following points will be examined and must be satisfactorily complied with:
      a) Is the design documentation complete? Are all cables properly labeled, from end-to end?
b) Have all terminated cables been properly tested in accordance with the specifications for the specific category as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage?

c) Is the cable type suitable for its pathway? Are the cables bundled in parallel?

d) Have the pathways manufacturer’s guidelines been followed? Are all cable penetrations installed properly and fire stopped according to code?

e) Have the Cable Contractors avoided excessive cable bending?

f) Have potential EMI and RFI sources been considered?

g) Is Cable Fill correct?

h) Are hanging supports within 1.25 meters (four feet)?

i) Does hanging cable exhibit some sag?

j) Are telecommunications closet terminations compatible with applications equipment?

k) Have Patch Panel instructions been followed?

(1) jacket removal point;

(2) termination positions;

(3) all pair terminations tight with minimum pair distortions;

(4) Twists maintained up to ½ inch.

l) Have Modular Panel instructions been followed?

(1) cable dressing first;

(2) jackets remain up to the Connecting Block;

(3) all pair terminations tight and undistorted;

(4) Twists maintained up to 1/8 inch.

m) Are identification markings uniform, permanent and readable?

I. LABELING AND IDENTIFICATION

1. All UTP cables shall be labeled at each end with permanent plastic labels.

2. All active and passive ports on patch panels, workstation faceplates, and termination panels shall be labeled with permanent labels for identification. It is the responsibility of the Cable Contractor to adhere to Hillsborough Community Collage labeled requirement proposed numbering system prior to the installation of the wiring and cable.

3. Communications cabinets, racks, panels, and equipment rooms shall be identified with engraved plastic labels glued and riveted/screwed to equipment enclosure.

4. Server patch cord outer covering shall be fiber.