SECTION 270000 - COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. The scope of work specified by these documents shall result in the provision, installation and testing of the following IT Communications infrastructure, systems and equipment.

1. All Voice and Data System Wiring
2. Video/CATV Control and Distribution Systems
3. Wiring for the ceiling mounted projectors
4. Projectors and Projector Ceiling Mounts
7. Paging/Intercom System (including wiring)
8. Clock System (including wiring)
8. Audio equipment and speakers in classrooms, Gymnasium, Cafeteria and other spaces of the building
9. Security Access and Surveillance/CCTV Cameras (including wiring)
10. Intrusion Alarm/Detection System (including wiring)
11. Conduit and raceways. Cable ladders in MDF and IDFs shall be provided by Electrical Contractor
12. Cabling and Terminations for Wireless Data Communication System (Wireless Access Points, WAPs, furnished by others)

B. Systems shall utilize digital technology to integrate the following systems into a single network linking them to a central site:

1. LAN System (Refer to Drawings IT-101and IT-102)
   a. For data communications, the existing Wide Area Network will be the central means of communicating throughout for Authority-wide email, network access to shared files and Internet Access.
   b. Locally, the facility will be provided with wiring for a Local Area Network for all local voice/data and video connectivity.
   c. Data Network Backbone shall be comprised of 50/125-micrometer, optical fiber cabling.
   d. Voice Backbone shall be 100 Pair Category 3 UTP cable.
2. Wireless Data Communication System consisting of Category 6 horizontal cabling infrastructure.
   a. Wireless Data Communications Network infrastructure shall be provided as per the specifications herein. Wireless Access Points (WAPs) shall be furnished by others. WAP symbols on drawings indicate termination points were WAPs are to be installed.
   b. Topology
      1) The Wireless Data Communications Network specified herein will use a star Topology.

2) The network in which this system shall be integrated will consist of a Main Distribution Frame (MDF) and several Intermediate Distribution Frames (IDF's) connected to the MDF via two (2) 1GB EtherChannel fiber connections. The MDF contains the network servers and the network core. All IDF's will terminate horizontal workstation runs. The runs will connect to 10/100/1000 Ethernet switches (Furnished By Others) that are connected to the multi-mode fiber backbone that feeds the core switch that shall service both wired and wireless data networks.
3) The network backbone shall consist of gigabit Ethernet over multi-mode fiber.
4) The horizontal cabling to the desktop from the wiring closets shall consist of Fast Ethernet 100BASE-TX
5) Refer to Division 27 for detailed cabling requirements:

c. This section includes the minimum requirements for termination hardware and cable for a Wireless Data Communication System.

d. Quality Assurance
1) All equipment shall be installed in a neat and workmanlike manner.
2) All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Authority's representative.
3) Materials shall be of the quality and manufacturer indicated. Only equipment and materials manufactured by major manufacturing companies are acceptable. No generic equipment or materials shall be allowed, unless otherwise approved in writing by the Design Consultant.
4) Separation from sources of EMI shall be as specified in section.
5) Communication grounding/earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of IEC 1000-5-2, ANSI/TIA/EIA-607, or both be observed throughout the entire cabling system.
6) Materials and work specified herein shall comply with the applicable requirements of:
a) EIA/TIA-568-A.
b) EIA/TIA-569-A
c) EIA/TIA-606
d) EIA/TIA-607
e) Underwriters Laboratory
f) FCC (including CFR 47 and Part 68 - subpart F)
g) National Electric Code
h) Local and State Codes
i) ISO/IEC 11801
j) IEC 1000-5-2
k) CSA C22.2
l) IEC 60603-7

3. Video Control and Distribution System

a. Each designated room in the school will have a CATV outlet connected via the data network to the MDF/IDF, one (1) speaker that is connected to the amplifier serving the ceiling mounted projector outlet, and paging speakers that will be operated through the paging system.

b. The CATV / video system will allow teacher initiated playing of instructional

DVDs and CDs as well as provide the capability to originate a video program material.

4. Audio - Video Systems
   a. Designated rooms (refer to IT-Drawings) shall be equipped with Local Sound Enhancement Systems that will have the capability to interface with a CD/DVD, MP3, WMA and LCD Projectors.
   b. Audio/Video System shall be provided in designated locations that will allow for presentations, recording of performances and assemblies which require either PC based presentations or films and ADA compliant systems that shall provide assistance to the hearing impaired. The systems shall support both wired and wireless microphones. The Systems shall be provided in the following locations:
      1) Pre-K Gross Area
      2) OT/PT
      3) Cafeteria/Stage/Instrumental Music Room
5. Intra-Building Communications
   a. Intra-Building communications will be done through a Paging/Intercom System.
      1) Each designated room (refer to IT-Drawings) in the school will have paging speakers one (1) of which will be operated through the paging system.
   b. Clock and Paging System
      1) The Clock and Paging System in the school will be locally managed and controlled by the local administration. However, in the event or need for access into any one of the facilities, the WAN systems must be able to interoperate so that a paging call from the Board Offices or other pre- identified location, can page to all locations or an individual school location across the network.
      2) The Clock, Paging and Telephone/Intercom systems will be interconnected so that control of the time and paging system is determined through the Telephone system.

C. These systems shall be integrated by means of an in building Network of cables.

1. Cable Infrastructure
   a. All horizontal technology cabling for the new school will be integrated with the data network, telephone, intercom, and security systems, utilizing Category 6; Fiber Optic and coaxial cables.
2. Backbone cabling for data shall utilize laser optimized Fiber Optics cable as specified.
3. Cabling for data and telecommunications between the jack plate and either MDF or IDF shall be category 6 (minimum).
4. Based on distance limitations from MDF/IDF's to the classroom, the cabling distance standard of 290' for data networks shall be adhered to.
5. Backbone cabling for the telephone system shall be multi-pair category 6 UTP sufficient to extend all telephone jacks and shall be run from the MDF/IDF to the Telco DeMarc.
6. All designated spaces will be wired extensions off the clock and paging system.
7. All wiring will be in conduit.

1.2 REGULATIONS AND CODE COMPLIANCE

A. All work and materials shall conform to and be installed, inspected and tested in accordance

with the most current governing rules and regulations of federal, state and local governmental agencies.

B. The following is a list of codes and standards that will apply to this project:

1. New Jersey Uniform Fire Prevention and Building Code.
2. New Jersey Department of Labor Rules and Regulations.
3. New Jersey Department of Health.
4. Federal Occupational Safety and Health Administration - OSHA.
5. National Life Safety Code, NFPA 101.
6. National Electrical Code (NEC), NFPA 70
7. Underwriters Laboratory (UL).
8. ANSI/TIA/EIA - Telecommunications Building Wiring Standards (Most current addition, revision and addenda), including, but limited to, the following compilation series of documents: 568, 570, 598, 606, 607, 758, TSB 67, TSB 72, TSB 75, FIP 174, FIP175, FIP176,
9. BICSI Telecommunications Distribution Methods Manual, Telecommunications Cabling Installation Manual, Customer-Owned Outside Plant Manual, LAN and Internetworking Design Manual.
10. IEEE Standards.
11. IEEE-SA - National Electrical Safety Code (NESC)
12. Federal Communications Commission.
13. NEMA – National Electrical Manufacturers' Association
14. CSA – Canadian Standards Association
15. ADA, Americans with Disabilities Act.

1.3 GLOSSARY

A. ANSI: American National Standards Institute

B. ASME: American Society of Mechanical Engineers

C. ASTM: American Society for Testing Materials

D. BICSI: Building Industry Consulting Services International

E. CSA: Canadian Standards Association

F. EIA: Electronic Industries Association

G, FCC: Federal Communications Commission

H. FM: Factory Mutual Insurance Company

I. IEEE: Institute of Electrical and Electronics Engineers

J. IRI: Industrial Rick Insurers

K. ISO: International Standards Organization

L. NEC: National Electrical Code

M. NEMA: National Electrical Manufacturers' Association

N. NESC: National Electrical Safety Code

O. NFPA: National Fire Protection Association

P. New Jersey BFU: New Jersey Board of Fire Underwriters

Q. New Jersey /DEC: New Jersey Department of Environmental Conservation

R. New Jersey /UFBC: New Jersey Uniform Fire Prevention and Building Code

S. OSHA: Occupational Safety and Health Administration

T. TIA: Telecommunications Industry Association

U. UFPO: Underground Facilities Protective Organization

V. UL: Underwriter's Laboratories, Inc.

1.4 DEFINITIONS

A. Approved / Approval: Written permission to use a material or system.

B. As Called For: Materials, equipment including the execution specified/shown in the contract documents.

C. Code Requirements: Minimum requirements.

D, Concealed: Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.

E. Design Equipment: Refer to the article, BASIS OF DESIGN.

F. Design Make: Refer to the Article, BASIS OF DESIGN.

G. Equal or Equivalent: Equally acceptable as determined by Design Consultant.

H. Exposed: Work not identified as concealed.

I. Final Acceptance: The Authority's acceptance of the project from Contractor upon certified by the Authority's Representative.

J. Furnish: Supply and deliver to installation location.

K. Furnished by Others: Receive delivery at job site or where called for and installed.

L. Inspection: Visual observations by the Authority's site Representative.

M. Install: Mount and connect equipment and associated materials ready for use.

N. Labeled: Refers to classification by a standards agency.

O. Make: Refer to the article, BASIS OF DESIGN.

P. Or Approved Equal: Approved equal or equivalent as determined by Design Consultant.

Q. Authority's Representative: The Prime Professional

R. Prime Professional: Design Consultant having a contract directly with the Authority for professional services.

S. Provide: Furnish, install and connect ready for use.

T. Relocate: Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.

U. Replace: Remove and provide new item.

V. Review: A general contractual conformance check of specified products.

W. Roughing: Pipe, duct, conduit, cabling, equipment layout and installation.

X. Satisfactory: As specified in contract documents.

Y. Site Representative: Construction Manager at the work site.

Z. Refer to General Conditions of the Contract for additional definitions.

1.5 INTENT OF DRAWINGS

A. The drawings are diagrammatic, unless detailed dimensioned drawings are included. Drawings show approximate locations of equipment, and fixtures. Exact locations are subject to the approval of the Authority's Representative.

B. The Contractor should verify all dimensions locating the work and its relation to existing work, all existing conditions and their relation to the work and all man made obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in the Contract Documents.

PART 2 – PRODUCTS

2.1 Equipment and Materials Minimum requirements:

A. Materials requirements:

1. All equipment and material for which there is a listing service shall bear a UL label.
2. Electrical equipment and systems shall meet UL Standards and requirements of the NEC and CSA. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
3. Equipment shall meet all applicable FCC Regulations
4. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material will be rejected.

5. The listing of a manufacturer as “acceptable” does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications and meet the quality of the design make.
6. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory of Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Proprietary Specifications:

1. The following product/manufacturer has been approved by the Authority for proprietary specifications and use in this project.
   a. Wireless Access Points: Meru
2. Subject to compliance with codes and all project requirements, the Contractor is required to use the indicated product/manufacturer and to verify compatibility with the project School District’s existing systems.

C. Proprietary Specifications:

1. The following product/manufacturer has been approved by the Authority for proprietary specifications and use in this project.
   a. Call Manager: Cisco Unity
2. Subject to compliance with codes and all project requirements, the Contractor is required to use the indicated product/manufacturer and to verify compatibility with the project School District’s existing systems.

D. Proprietary Specifications:

1. The following product/manufacturer has been approved by the Authority for proprietary specifications and use in this project.
   a. WAN and Internet Service: Cablevision
2. Subject to compliance with codes and all project requirements, the Contractor is required to use the indicated product/manufacturer and to verify compatibility with the project School District’s existing systems.

2.2 CABLES

A. Any cable associated with this Contract, passing through two or more floors shall be suitable, listed and marked for use in a riser or plenum application. Riser cable shall minimally be CMR or OFNR rated per the National Electrical Code and shall meet all local and state codes.

B. Any cable associated with this Contract shall be rated, listed and marked for use in a plenum application, regardless if the ceiling is a ducted return air plenum or not. Cable shall meet all local and state codes.

C. Voice copper backbone cables, if required, shall be twisted 24 AWG, contain a corrugated aluminum shield, be of the size indicated on the drawings and have the proper jacket classification per the NEC.

D. All copper underground feeder cable associated with this Contract, if required, shall be suitable, listed and marked for use in a duct application per the National Electrical Code article 800 and shall meet all local codes. Copper underground cables shall be jell-filled, twisted 24 AWG., contain a overall corrugated shield, be of the size indicated on the drawings, shall have footage indicators imprinted on the cable jacket and shall meet

REA/RUS specification PE-39 or PE-89.

2.3 FACTORY ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts, which are alike, shall be product of a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.

C. Components of equipment shall bear manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model. Exception will be permitted if performance requirements cannot be met.

2.4 COMPATABILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

B. Provide maximum standardization of components to reduce spare part requirements.

C. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer.
2. Constituent parts that are alike shall be product of a single manufacturer.
3. Components of equipment shall bear manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

2.5 LIFTING ATTACHMENTS

A. Equipment should have suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 MISCELLANEOUS SUPPORTS

A. Metal bars, plates, tubing, etc. shall conform to the following ASTM standards:

1. Steel plates, shapes, bars, and grating - ASTM A 36
2. Cold-Formed Steel Tubing - ASTM A 500
3. Hot - Rolled Steel Tubing - ASTM A 500

4. Steel Pipe - ASTM A 53, Schedule 40, welded

B. Metal Fasteners shall be Zinc-coated (type, grade and class as required)

2.7 FIRESTOPPING

A. Firestopping for Openings through Fire and Smoke Rated Walls and Floor Assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Firestop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Firestops" designated ASTM E814.

B. Inside of all conduits, the firestop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

C. All conduit and sleeve openings shall be waterproofed or fireproofed in compliance with New Jersey Building and Fire Codes. Strict adherence to National and State Fire Codes, particularly firestopping will be required.

D. All openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. shall be patched.

E. All building conduits and sleeves installed and/or used under this contract shall be firestopped or re-firestopped upon cable placement through such passageways.

F. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

G. Provide firestop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide firestop seal between sleeve and wall for drywall construction.

H. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the firestop system. The installation shall provide an air and watertight seal.

I. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:

1. Floors - 3 hours
2. Corridor walls - 2 hours
3. Offices - ¾ hour
4. Smoke partitions - ¾ - 1 hour

J. Provide firestop pillows for existing cable tray penetrations through firewalls.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, etc. Verify final locations for installation with field measurements and with the equipment being connected. Verify exact location and elevations at work site prior to any rough in work. If field conditions, details, changes in equipment or shop drawing information require a significant change to the original documents, contact the Authority's representative for approval before proceeding.

B. All equipment locations shall be coordinated with other trades, other renovation projects, and existing conditions to eliminate interference with required clearances for equipment maintenance and inspection.

1. Coordinate work with other trades, other renovation projects, and existing conditions to determine exact routing of all cable tray, hangers, conduit, etc., before fabrication and installation. Coordinate with Technology Drawings. Verify with the Authority's Representative exact location and mounting height of all equipment in finished areas, such as equipment racks, communication and electrical devices. Coordinate all work with existing architecture.
2. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Authority's Representative and approval received before such alterations are made.

C. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation.

3.2 CUTTING AND PATCHING

A. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch and/or paint openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

3.3 CONCEALMENT

A. Use existing conduit and surface raceway where possible and practicable. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify the Authority's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after the Authority's Representative reviews and comments on arrangement and appearance.

3.4 CHASES

A. General

1. Field verifies for correct size and location for all openings, recesses and chase.
2. Assume responsibility for correct and final location and size of such openings.
3. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.
4. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Cap or firestop all unused conduits and sleeves.
5. Provide angle iron frame where openings are required for contract work.
6. Seal voids in fire rated assemblies with a firestopping seal system to maintain the fire resistance of the assembly. Provide 18 gauge-galvanized sleeves at fire rated assemblies. Extend sleeves 2" above floors.
7. In wall openings, drill or cut holes to suit. Provide 18 gauge galvanized sleeves at shafts and fire rated assemblies. Provide firestopping seal between sleeves and wall in drywall construction. Provide firestopping similar to that for floor openings.

3.5 WATERPROOFING

A. The Contractor shall seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits.

B. Spare conduits shall be plugged with expandable plugs.

C. All service entrance conduits through building shall be sealed or resealed upon cable placement.

D. Conduits with cables in them shall be permanently sealed by firmly packing the void around the cable with oakum and capping with a hydraulic cement or waterproof duct seal.

3.6 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support contract work. Supports shall meet the approval of the the Authority’s Representative. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above. For precast Panels/Planks and Metal Decks, support communication work as determined by manufacturer and the Authority’s Representative. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

3.7 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate ordering and installation of all equipment with long lead times or having a major impact on work by other trades so as not to delay the job or impact the schedule.

B. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.

C. Set all equipment to accurate line and grade, level all equipment and align all equipment components.

D. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from premises when no longer required.

E. No equipment shall be hidden or covered up prior to inspection by the Authority's representative. All work that is determined to be unsatisfactory shall be corrected immediately.

F. All work shall be installed level and plumb, parallel and perpendicular to other building systems and components.

3.8 IMPLEMENTATION

A. The contractor shall provide and install all hardware, software, connections and appurtenances required for fully operational systems.

END OF SECTION 270000

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for pathways and cables.
2. Sleeve seals.
3. Grout.
4. Common communications installation requirements.

1.2 SUBMITTALS

A. Product Data: For sleeve seals.

B. Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for. 2 years from date of final acceptance.

PART 2 - PRODUCTS

2.1 TELE-POWER POLES

A. Acceptable Manufacturers:

1. Mono-Systems, Inc.
2. Panduit Corp.
3. Wiremold/Legrand
4. Or approved equal

B. Material: Aluminum with clear anodized finish.

C. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.2 SLEEVES FOR PATHWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Acceptable Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Or approved equal
2. Sealing Elements: Interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
3. Pressure Plates: Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Utilize 4” sleeves to provide clear space between sleeve and pathway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7.

K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7.

END OF SECTION 270500

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, installation equipment, and test equipment required for the complete installation of grounding and bonding for telecommunications systems within the structure.

1.2 REFERENCES

A. ANSI-J-STD-607-A-2002 – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

B. National Fire Protection Association (NFPA – 70), National Electrical Code (NEC)

C. ANSI T1.333-2001 – Grounding and Bonding of Telecommunications Equipment

1.3 QUALITY ASSURANCE

A. The materials and their installation shall conform to the requirements of ANSI-J-STD-607-A-2002 and the National Electrical Code

B. Use adequate numbers of skilled work-persons thoroughly trained and experienced on the necessary crafts and completely familiar with the specified requirements and methods needed for the proper performance of the work of this Section.

PART 2 – PRODUCTS

2.1 STANDARD

A. All materials used in the installation shall be new and shall comply in weight, size and composition as required by manufacturer and shall be labeled or listed by Underwriters Laboratories Inc. for use in electrical grounding.

2.2 ACCEPTABLE MANUFACTURES

1. Harger Lightning & Grounding
2. Or Approved Equal

2.3 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

A. The TMGB shall be ¼”T x 4”W x 12”L copper ground bar.

1. The TMGB shall be predrilled with holes for use with standard sized lugs.
2. The TMGB shall be UL listed and meet the requirements of ANSI-J-STD-607-A-2002
3. The TMGB shall be sized as above or lengthened to meet requirements of the immediate application with consideration for future growth.

2.4 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

A. The TGB shall be a ¼"T x 2"W x 12"L copper ground bar.

1. The TMGB shall be predrilled with holes for use with standard sized lugs.
2. The TMGB shall be UL listed and meet the requirements of ANSI-J-STD-607-A-2002.
3. The TMGB shall be sized as above or lengthened to meet requirements of the immediate application with consideration for future growth.

2.5 CONDUCTORS

A. Conductors shall be stranded copper conductors with green insulation

1. Minimum conductor size No. 6 AWG.
2. Conductors shall be sized at 2 kcmil per linear foot of conductor length. For example: A conductor 25 feet in length shall be No. 2 AWG (66,360 cmil). A conductor 100 feet in length shall be No. 4/0 AWG (211,600 cmil)
3. Insulation shall be rated for the environment where it is installed.

2.6 CONNECTOR LUGS

A. Lugs for connecting to the TMGB and TGB shall be UL Listed two-hole, long barrel, electro tin-plated compression lugs with inspection port.

1. Antioxidant joint compound shall be applied to the contact areas.
2. Lugs shall be secured to the ground bars with ¼" minimum stainless steel hex head cap screws with stainless steel washers, lock washers and nuts.

2.7 EXOTHERMIC WELDED CONNECTIONS

A. Exothermic Welded connections shall be.

1. Weld types BE shall be made to the ground bars using appropriate size weld metal.
2. Weld types VA, VD, or VU shall be made to structural steel framework

PART 3 – EXECUTION

3.1 INSTALLATION

A. The telecommunications main grounding bar (TMGB) is a dedicated extension of the building grounding electrode system for the telecommunications system. The TMGB should be located near the telecommunications service entrance and the electric service entrance.

1. The TMGB shall be connected to the main electric service entrance panel ground or the branch electric panel ground that serves the telecommunications equipment.
2. The TMGB shall be located to minimize the length of the bonding conductor for telecommunications from the TMGB to the electric service ground.
3. The bonding conductor for telecommunications shall be at least the same size as the telecommunications backbone (TBB) conductor.
4. The TMGB shall serve telecommunications equipment that is located in the same room

or space.

5. Connections to the TMGB shall be made by exothermic welding or by listed two-hole compression lugs.
6. All metal conduits or raceways for telecommunications cabling located within the same room or space as the TMGB shall be bonded to the TMGB.
   a. Metal conduits 1" diameter and larger shall be bonded using electro tin-plated pipe clamps.
   b. Metal conduits less than 1" diameter shall be bonded using electro tin-plated conduit bonding clamps.
   c. Metal cable trays shall be bonded using electro tin-plated cable tray bonding clamps.
   d. Bonding surface areas shall be cleaned to bare metal removing all paint, etc. The contact area shall be protected from corrosion using antioxidant joint compound.
7. Where an electric power panel for telecommunications equipment is located in the same room or space as the TMGB, the panel ground bus or panel enclosure shall be bonded to the TMGB.
8. The TMGB shall be located in an area that is accessible to telecommunications personnel

B. The telecommunications backbone (TBB) is a conductor that originates at the TMGB and extends throughout the building interconnecting all telecommunications grounding busbars (TGBs) with the TMGB.

1. The TBB shall be a copper conductor. The minimum size of the conductor shall be No. 6 AWG. The size of the conductor shall be increased 2 kcmil per linear foot as the length of the TBB increases. For example: A TBB 25 feet in length shall be No. 2 AWG (66,360 cmil). A TBB 100 feet in length shall be No. 4/0 AWG (211,600 cmil)
2. The TBB conductors should be installed without splices. Where splices are necessary, the number of splices should be minimized and located in accessible telecommunications

   spaces. Splices shall be made using exothermic welding, listed irreversible compression connectors or equivalent.
3. The building water piping system shall not be used as a TBB.
4. Metallic cable shields or metallic conduits shall not be used as a TBB.

C. A telecommunications grounding busbar (TGB) shall be provided in each area where telecommunications equipment is located. The TGB is the grounding connection point for telecommunications systems and equipment in each separate area.

1. The TGBs shall be connected to the TMGB via the TBB conductor.
2. The TBB and other TGBs within the same area shall be bonded to the TGB with a conductor the same size as the TBB.
3. The bonding conductor between the TBB and the TGB shall be continuous and routed in the shortest straight-line path possible.
4. Connections to the TGB shall be made by exothermic welding or by listed two-hole compression lugs.
5. All metal conduits or raceways for telecommunications cabling located within the same room or space as the TGB shall be bonded to the TGB.
6. Where an electric power panel for telecommunications equipment is located in the same room or space as the TGB, the panel ground bus or panel enclosure shall be bonded to the TGB.

D. Where there are multiple telecommunications rooms or spaces with multiple TBBs, the TBBs shall be interconnected with a Grounding Equalizer (GE) conductor at the TGBs.

1. Welding.
2. In structural steel frame buildings, where the steel framework is accessible The GE shall be sized as specified for the TBB.

E. Connections of the GE to the TGBs shall be made by exothermic within the room; the TMGB and each TGB shall be bonded to the structural steel frame using a minimum No. 6 AWG conductor.

1. Connections to the structural steel frame shall be made by exothermic welding. The area of contact on the steel frame shall be cleaned to bare metal removing all paint and mill scale. The contact area shall be protected from corrosion using antioxidant joint compound.
2. Where the structural steel frame is external to the room and is accessible, the structural steel should be bonded to the TGB or the TMGB using a minimum No. 6 AWG conductor.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF SPECIFICATION

A. This section includes the minimum requirements for the following: EMT conduit J-Hooks Threaded Rod Cover Stackable Cable Rack Spacers Cable Management Wireless Access Boxes Fire Stopping Materials Floor Boxes.

1.2 SUBMITTALS

A. As-Built Drawings

1.3 QUALITY ASSURANCE

A. All installation work for the interior telecommunications pathways shall be performed in a neat and workmanlike manner.

B. Equipment and materials shall be of the quality and manufactures indicated. The equipment specified is based on the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified.

C. Materials and work specified herein shall comply with the applicable requirements of:

1. ANSI/NFPA 70 – National Electrical Code including; but not limited to, the following articles:
   a. 250 – Grounding
   b. 300 – Wiring Methods
   c. 314 – Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Manholes
   d. 358 – Electrical Metallic Tubing: Type EMT
   e. 386 – Surface Metal Raceways
   f. 770 – Optical Fiber Cables and Raceways
2. ANSI/TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard – Part 1: General Requirements, including applicable addendum
3. ANSI/TIA/EIA-569-A – Commercial Building Standard for Telecommunications Pathways and Spaces, including applicable addendum
4. ANSI/TIA/EA-606 – Administration Standard for Telecommunications Infrastructure of Commercial Buildings
5. ANSI/TIA/EIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications
6. BICSI Telecommunications Distribution Methods Manual

1.4 FUNCTIONAL SYSTEM DESCRIPTION

A Refer to scaled Technology (T) drawings for lengths of cable runs.

PART 2 - PRODUCTS

2.1 EMT CONDUIT AND OUTLET BOXES

A. Electrical Metallic Tubing (EMT)

1. Electro-galvanized steel tubing 1 1/4" and larger diameter per project requirements: Conduit joint couplings and connectors: steel double set screw indenter fittings, metal bushings for 1 1/4" conduit, insulated metallic bushings for 1-1/4" and larger conduit, insulated metallic bushings with grounding lugs as required.
2. Conduit sweeps: minimum 10 times the conduit inside diameter.
3. Include required conduit straps, and hangers, heavy-duty malleable iron or steel, perforated pipe strap, j-hooks, bridle rings, or wire hangers are not permitted.
4. LB fittings and plastic fittings are not permitted
5. Nipple runs from one outlet box to another outlet box are not permitted.

B. Outlet boxes: Galvanized steel sheet metal 2" x 4" x 2-1/8" deep minimum with single gang mud ring, except for Teacher's Jack.

1. Teacher's Outlet boxes: This requires one (1) 4" x 4" gang boxes at each Teacher's Outlet location.

C. Pull-boxes: Minimum 14 gauge galvanized steel with screw fastened cover and trim for flush or surface mounting as required for the project. Dimensions as required for the project.

D. Metal Flex Conduit (1 1/4") and deep Cut-In Boxes where required.

E. Pull-rope: Polypropylene monofilament line with a minimum pull tensile strength of 200 pounds.

F. Labels for conduit and pull-boxes: 1" x 2" yellow background with 3/8" lettering to read "TELECOM"

2.2 NON-CONTINUOUS CABLE SUPPORT (J-HOOKS) SYSTEMS

A. Construction:

1. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.
2. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
3. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
4. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
5. Stainless steel non-continuous cable supports are intended for indoor and outdoor use in non- corrosive environments or where only mildly corrosive conditions apply.

B. Multi-Tiered Non-Continuous Cable Supports Assemblies:

1. Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre- packaged kits.
2. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.
3. If required, the multi-tier support bracket may be assembled to manufacturer

recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.

C. Non-Continuous Cable Support Assemblies from Beam, Flange:

1. Fastener to C to Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

D. Non-Continuous Cable Support Assemblies from C & Z Purlin:

1. Fastener to C to Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor us in non-corrosive environments, cULus Listed.

E. Non-Continuous Cable Support Assemblies from Wall, Concrete, or Joist

1. Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.

F. Non-Continuous Cable Support Assemblies from Threaded Rod:

1. Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.
2. The multi-tiered support bracket shall have a static load limit of 300 lbs.

G. Installation Accessories for Non-Continuous Cable Supports

1. Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included.
2. The pulley shall be made of plastic and be without sharp edges.
3. The pin and bail assembly must be able to be secured to the J-Hook during cable installation.
4. The pulley must remain secured while cables are being pulled.
5. The pin and roller assembly must be removed after cables are installed.

2.3 WIRELESS ACCESS BOXES

A. Wall-mounted enclosure for Wireless Access Equipment-Gymnasium

1. Vented Steel enclosure 11” x 8” x 3”
2. Finish matching wall plates
3. Continuous hinge swing door with keyed lock
4. Knockouts for cable entry/exit
5. Two 1” antenna openings 5” apart on top of enclosure
6. Include components and compatible fittings from the manufacturer as required for a complete installation

B. Ceiling Enclosure for Wireless Access Equipment – classrooms and hallways
1. Plenum-rated enclosure
2. Mounts in standard 2’ x 2’ or 2’ x 4’ ceiling tile
3. Continuous hinge swing down door with keyed lock
4. Cable entry/exit opening with approved fire-rating foam kits
5. Two 1” antenna openings 5” apart on bottom of enclosure
6. Include components and compatible fittings from the manufacturer as required for a

complete installation.

2.4 FLOOR BOXES

A. Acceptable Manufacturers:

1. Legrand
2. Wiremold
3. Or Approved Equal

B. Floor Boxes

1. Classification and Use: Floor boxes shall have been examined and tested by Underwriters Laboratories Inc. to meet UL514A and/or UL514C and Canadian Standard C22.2, No. 18.1-04 and 18.2-06 and bear the U.S. and Canadian UL Listing Mark. Floor boxes shall also have been tested by Underwriters Laboratories Inc. and classified for fire resistance and bear the U.S. and Canadian UL Classification Mark. Devices shall be classified for use in 2-hour rated, unprotected reinforced concrete floors and 2-hour rated floors employing unprotected steel floor units and concrete toppings (D900 Series Designs) or concrete floors with suspended ceilings (fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling below the floor boxes). Floor boxes shall also conform to the standards set in Section 300-21 of the National Electrical Code. Floor boxes shall meet UL scrub water requirements, but are not suitable for wet or damp locations, or other areas subject to saturation with water or other liquids such as commercial kitchens. Floor boxes shall also have been evaluated by UL to meet the applicable
U.S. and Canadian safety standards for scrub water exclusion when used on tile, bare concrete, terrazzo, wood, and carpet covered floors. Floor boxes shall be suitable for use in air handling spaces in accordance with Section 300-22 (C) of the National Electrical Code.
2. Floor Boxes, General: Evolution Series Floor Boxes for use on above grade concrete floors, raised floors or wood floors. Provide boxes with a component to permit installation in polished concrete or terrazzo floors. Boxes shall be compatible with complete line of workstation connectivity outlets and modular inserts.

   a. Floor boxes provide the interface between power, communication and audio/video (A/V) cabling in above-grade floors, on-grade concrete floors, raised floors, wood floors, and fire-classified floors and the workstation or activation location where power and communication and/or A/V device outlets are required. Boxes shall provide recessed device outlets that will not obstruct the floor area. Refer to Drawings for size and types.
   b. Floor boxes shall permit all wiring to be completed at floor level. The FC models shall be used as defined by the UL Fire Resistance Directory at a minimum spacing of two (2) ft [610mm] on center.

C. The following model floor boxes shall be used according to the appropriate connector density and architectural application.

1. Model EFB6S Floor Boxes: Manufactured from stamped steel approved for use on above grade concrete floors, raised floors and wood floors with the same product. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall have a polyester based backed enamel finished interior (white). Boxes shall be 15-3/16” L x 13-7/8” W x 4-3/16” H [385mm x 351mm x 107mm]. Provide boxes with provisions that enable

installation into concrete floors, raised floors, or wood floors without having to purchase additional components or accessories. Provide boxes with six (6) independent wiring compartments that allow for up to six (6) receptacles, communication and/or audio/video services. Boxes shall have removable and relocatable dividers to permit custom configuration of compartments as well as permit feed to adjacent compartments.
Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the four (4) outer compartments shall have a minimum wiring capacity of 32-in3 [524ml]. Each of the two (2) center compartments shall have a minimum wiring capacity of 38.5-in3 [630ml]. Each of the six (6) compartments shall have a minimum depth of 3-7/8" [98mm] behind the plate. Provide boxes with removable compartments to facilitate installation and moves, additions, and changes. The compartments shall be removable from the top and back of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. Provide boxes with removable knockout plates to allow for the maximum cable pass-through area. The cable pass- through area shall be a minimum of 6-15/16 in2 [176mm2]. The box shall contain the following number of knockouts: 10 1" trade size, six (6) 1-1/4" trade size, six (6) 3/4" trade size, and two (2) 2" trade size. Boxes shall be able to accept up to (6) six 2" trade size conduit feeds in the sides of the boxes, through the use of the EFB6S-2HUB and maintain a 4-inch deep concrete pour. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. Equip boxes with toggle clamps to allow box to be secured to raised and wood floors. The box shall be able to accept 2-3/4" x 4-1/2" standard size wall plates. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles, workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

2. Model EFB6S-OG Floor Boxes: Manufactured from stamped steel approved for use in above grade and on-grade floor applications. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall be painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and be approved for use on-grade and above grade floors. Boxes shall be 15-3/16" L x 13-7/8" W x 4-3/16" H [385mm x 351mm x 107mm]. Provide boxes with six (6) independent wiring compartments that allow for up to six (6) duplex receptacles, communication and/or audio/video services. Boxes shall have removable and relocatable dividers to permit custom configuration of compartments as well as permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the four (4) outer compartments shall have a minimum wiring capacity of 32-in^3 [524ml]. Each of the two (2) center compartments shall have a minimum wiring capacity of 38.5-in^3 [630ml]. Each of the six (6) compartments shall have a minimum depth of 3-7/8" [98mm] behind the plate.

   Provide boxes with removable compartments to facilitate installation. The compartments shall be removable from the top of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. The box shall contain the following number of knockouts: 10 1" trade size, six (6) 1-1/4" trade size, six (6) 3/4" trade size, and two (2) 2" trade size. Boxes shall be able to accept up to (6) six 2" trade size conduit feeds in the sides of the boxes, through the use of the EFB6S-2HUB and maintain a 4-inch deep concrete pour. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. The box shall be able to accept 2-3/4" x 4-1/2" standard size wall plates. Include mounting brackets with the boxes that will accommodate 15 amp,

20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles, workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

3. Model EFB6S-FC Floor Boxes: Manufactured from stamped steel approved for use in 2-hour fire- rated concrete floors. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall have a polyester based backed enamel finished interior (white). Boxes shall be 15-3/16" L x 13-7/8" W x 4-3/16" H [385mm x 351mm x 107mm]. Provide boxes with a 21-3/4" L x 17-1/4" W x 6-1/2" H [552mm x 438mm x 165mm] sheet metal concrete pan to ensure that 3-1/4 inches [83mm] of concrete surrounds the box. Provide boxes with six (6) independent wiring compartments that allow for up to six (6) receptacles, communication and/or audio/video services.

   Boxes shall permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the four (4) outer compartments shall have a minimum wiring capacity of 32-in3 [524ml]. Each of the two (2) center compartments shall have a minimum wiring capacity of 38.5-in3 [630ml]. Each of the six (6) compartments shall have a minimum depth of 3-7/8" [98mm] behind the plate. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. Provide boxes with four (4) intumescent services feed stems with a 1-1/4-inch [32mm] pass-through channel that allows the pathway to close off during a fire. Boxes shall be fully adjustable, accommodating a maximum 2-1/2-inch [64mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. The box shall be able to accept 2-3/4" x 4-1/2" standard size wall plates. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles, workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

4. Model EFB8S Floor Boxes: Manufactured from stamped steel approved for use on above grade concrete floors, raised floors and wood floors with the same product. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall have a polyester based backed enamel finished interior (white). Boxes shall be 15-3/16" L x 12-3/4" W x 6-1/16" H. Provide boxes with provisions that enable installation into concrete floors, raised floors, or wood floors without having to purchase additional components or accessories. Provide boxes with eight (8) independent wiring compartments that allow for up to eight (8) receptacles, communication and/or audio/video services. Boxes shall accept standard size single gang (2-3/4" x 4-1/2"), double gang (4-9/16" x 4-1/2"), and triple gang (6-3/8" x 4-1/2") wall plates. Boxes shall permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the four (4) outer compartments shall have a minimum wiring capacity of 28-in^3. Each of the four (4) center compartments shall have a minimum wiring capacity of 34-in^3. Each of the eight (8) compartments shall have a minimum depth of 3- 1/2" [89mm] behind the plate. Provide boxes with removable compartments to facilitate installation and moves, additions, and changes. The compartments shall be removable from the top and back of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. Provide boxes with removable knockout plates to allow for the maximum cable pass-through area. The cable pass-through area shall be a minimum of 11-5/8 in^2. The box shall contain the following number of knockouts: four (4) 3/4-inch trade size, eight (8) 1-inch trade size, six (6) 1-1/4-inch trade size, and two (2) 2-inch trade size. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a

maximum 1/2” post-concrete pour adjustment. Equip boxes with toggle clamps to allow box to be secured to raised and wood floors. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles. Boxes shall have the ability to accommodate a bracket (EFB-50A) allowing for one (1) 50-amp receptacle. Boxes shall also accommodate workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

5. Model EFB8S-OG Floor Boxes: Manufactured from stamped steel approved for use in above grade and on-grade floor applications. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall be painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and be approved for use on-grade and above grade floors. Boxes shall be 15-3/16” L x 12-5/8” W x 6-1/16” H [385mm x 321mm x 154mm]. Provide boxes with eight (8) independent wiring compartments that allow for up to eight (8) duplex receptacles, communication and/or audio/video services. Boxes shall have removable and relocatable dividers to permit custom configuration of compartments as well as permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the four (4) outer compartments shall have a minimum wiring capacity of 28-in3 [455ml]. Each of the four (4) center compartments shall have a minimum wiring capacity of 34-in3 [455ml]. Each of the eight (8) compartments shall have a minimum depth of 3- 1/2” [89mm] behind the plate. Provide boxes with removable compartments to facilitate installation. The compartments shall be removable from the top of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. The box shall contain the following number of knockouts: 12 1-inch trade size, six (6) 1-1/4-inch trade size, and four (4) 2-inch trade size. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2” [12.7mm] post-concrete pour adjustment. The box shall be able to accept standard size single gang (2-3/4” x 4-1/2”), double gang (2-3/4” x 4- 1/2”), and triple gang (6-3/8” x 4-1/2”) wall plates. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles. Boxes shall have the ability to accommodate a bracket (EFB-50A) allowing for one (1) 50-amp receptacle. Boxes shall also accommodate workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers and other open system devices.

6. Model EFB8S-FC Floor Boxes: Manufactured from stamped steel approved for use in 2-hour fire- rated concrete floors. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall have a polyester based backed enamel finished interior (white). Boxes shall be 15-3/16” L x 13-7/8” W x 4-3/16” H [385mm x 351mm x 107mm]. Provide boxes with a 21-3/4” L x 17-1/4” W x 6-1/2” H [552mm x 438mm x 165mm] sheet metal concrete pan to ensure that 3-1/4 inches [83mm] of concrete surrounds the box. Provide boxes with eight (8) independent wiring compartments that allow for up to eight (8) receptacles, communication and/or audio/video services. Boxes shall have removable and repositionable dividers to permit feed to adjacent compartments and reconfiguration of devices. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the compartments shall have a minimum wiring capacity of 53-in3 [860ml]. Each of the eight (8) compartments shall have a minimum depth of 3-1/2” [89mm] behind the plate. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. Provide boxes with removable compartments to facilitate installation. Provide boxes with four (4) intumescent services

feed stems with a 1-1/4-inch [32mm] pass- through channel that allows the pathway to close off during a fire. Boxes shall be fully adjustable, accommodating a maximum 2-1/2-inch [64mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. The box shall be able to accept standard size single gang (2-3/4" x 4-1/2"), double gang (4-9/16" x 4-1/2"), and triple gang (6-3/8" x 4-1/2") wall plates. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles. Boxes shall have the ability to accommodate a bracket (EFB-50A) allowing for one (1) 50-amp receptacle. Boxes shall also accommodate workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

7. Model EFB10S Floor Boxes: Manufactured from stamped steel approved for use on above grade concrete floors, raised floors and wood floors with the same product. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall have a polyester based backed enamel finished interior (white). Boxes shall be 15-3/16" L x 12-3/4" W x 6-1/16" H [385mm x 324mm x 154mm]. Provide boxes with provisions that enable installation into concrete floors, raised floors, or wood floors without having to purchase additional components or accessories. Provide boxes with 10 independent wiring compartments that allow for up to 10 receptacles, communication and/or audio/video services. Boxes shall permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Six (6) of the 10 compartments shall have a minimum wiring capacity of 23-1/2-in3 [597ml]. Four (4) of the 10 compartments shall have a minimum wiring capacity of 27-in3 [686ml]. Each of the 10 compartments shall have a minimum depth of 3-1/2" [89mm] behind the plate. Provide boxes with removable compartments to facilitate installation and moves, additions, and changes. The compartments shall be removable from the top and back of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. Provide boxes with removable knockout plates to allow for the maximum cable pass-through area. The cable pass-through area shall be a minimum of 11-5/8 in2 [7500mm2]. The box shall contain the following number of knockouts: four (4) 3/4-inch trade size, 10 1-inch trade size, eight (8) 1-1/4-inch trade size, and two (2) 2-inch trade size. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre- concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. Equip boxes with toggle clamps to allow box to be secured to raised and wood floors. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles. Boxes shall have the ability to accommodate a bracket (EFB-50A) allowing for one (1) 50-amp receptacle. Boxes shall also accommodate workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

8. Model EFB10S-OG Floor Boxes: Manufactured from stamped steel approved for use in above grade and on-grade floor applications. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall be painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and be approved for use on-grade and above grade floors. Boxes shall be 15-3/16" L x 12-5/8" W x 6-1/16" H [385mm x 321mm x 154mm]. Provide boxes with 10 independent wiring compartments that allow for up to 10 duplex receptacles, communication and/or audio/video services. Boxes shall have removable and relocatable dividers to permit custom configuration of compartments as well as permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a

tunnel. Six (6) of the 10 compartments shall have a minimum wiring capacity of 23-1/2-in^3 [597ml]. Four (4) of the 10 compartments shall have a minimum wiring capacity of 27-in^3 [686ml]. Each of the 10 compartments shall have a minimum depth of 3-1/2" [89mm] behind the plate. Provide boxes with removable compartments to facilitate installation. The compartments shall be removable from the top of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. The box shall contain the following number of knockouts: 14 1-inch trade size, six (6) 1-1/4-inch trade size, and four (4) 2-inch trade size. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles. Boxes shall have the ability to accommodate a bracket (EFB-50A) allowing for one (1) 50-amp receptacle. Boxes shall also accommodate workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

9. Model EFB10FC Floor Boxes: Manufactured from stamped steel approved for use in 2-hour fire-rated concrete floors. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall have a polyester based backed enamel finished interior (white). Boxes shall be 15-3/16" L x 13-7/8" W x 4-3/16" H [385mm x 351mm x 107mm]. Provide boxes with a 21-3/4" L x 17-1/4" W x 6-1/2" H [552mm x 438mm x 165mm] sheet metal concrete pan to ensure that 3-1/4 inches [83mm] of concrete surrounds the box. Provide boxes with 10 independent wiring compartments that allow for up to 10 receptacles, communication and/or audio/video services. Boxes shall have removable and repositionable dividers to permit feed to adjacent compartments and reconfiguration of devices. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the compartments shall have a minimum wiring capacity of 53-in3 [860ml]. Each of the 10 compartments shall have a minimum depth of 3-1/2" [89mm] behind the plate. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. Provide boxes with removable compartments to facilitate installation. The compartments shall be removable from the top of the floor box. Provide boxes with four (4) intumescent services feed stems with a 1-1/4-inch [32mm] pass-through channel that allows the pathway to close off during a fire. Boxes shall be fully adjustable, accommodating a maximum 2-1/2-inch [64mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles. Boxes shall have the ability to accommodate a bracket (EFB-50A) allowing for one (1) 50-amp receptacle. Boxes shall also accommodate workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

10. Model EFBFF Floor Boxes: Manufactured from stamped steel approved for use on above grade concrete floors, raised floors and wood floors with the same product. Boxes shall have the ability to accept a component (FP-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall be 7-1/16" L x 6-5/8" W x 4-1/8" H [179mm x 168mm x 105mm]. Provide boxes with provisions that enable installation into concrete floors, raised floors, or wood floors without having to purchase additional components or accessories. Provide boxes with two (2) independent wiring compartments that allow for power, communication and/or audio/video services. Each of the two (2) wiring compartments shall have a minimum wiring capacity of 64- 1/2-in^3 [1056ml]. The box shall be equipped with a metal divider to separate the services and maintain code requirements. The box shall contain the following number of knockouts:

four (4) 1/2-inch trade size, four (4) 3/4"-inch trade size, one (1) 1-inch trade size, six (6) 1-1/4-inch trade size, one (1) 1-1/2-inch trade size, and two (2) 2-inch. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2” [12.7mm] post-concrete pour adjustment. Equip boxes with toggle clamps to allow box to be secured to raised and wood floors.

11. Model EFBFF-OG Floor Boxes: Manufactured from stamped steel approved for use in above grade and on-grade floor applications. Boxes shall have the ability to accept a component (FP- CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall be painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and be approved for use on-grade and above grade floors. Boxes shall be 7-1/16” L x 6-5/8” W x 4-1/8” H [179mm x 168mm x 105mm]. Provide boxes with provisions that enable installation into concrete floors, raised floors, or wood floors without having to purchase additional components or accessories. Provide boxes with two (2) independent wiring compartments that allow for power, communication and/or audio/video services. Each of the two (2) wiring compartments shall have a minimum wiring capacity of 64- 1/2-in^3 [1056ml]. The box shall be equipped with a metal divider to separate the services and maintain code requirements.

    The box shall contain the following number of knockouts: four (4) 1/2-inch trade size, four (4) 3/4"-inch trade size, one (1) 1-inch trade size, six (6) 1-1/4-inch trade size, one (1) 1-1/2-inch trade size, and two (2) 2-inch. Boxes shall be fully adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2” [12.7mm] post-concrete pour adjustment.

D. Activation Covers: The following model covers shall be used according to the appropriate application.

1. Evolution EFB610BT and EFB610CT Series Covers: Manufactured of die-cast aluminum. Activation covers shall be available in surface mount and flush versions. Provide covers with two (2) gaskets (one (1) for carpet and one (1) for tile) to go under the trim flange to maintain scrub watertightness. Covers shall be 16-15/16” x 12-1/2” x 3/16” [430mm x 318mm x 4mm]. Covers shall be available with a carpet recess area or a solid lid. Secure the cover to the flange and enable cover to rotate greater than 180 degrees to reduce trip hazards and provide maximum amount of working space. Provide covers with spring-loaded self-closing slide egress doors to reduce egress opening when cables are exiting and reduce trip hazards. Each of the two (2) egress openings shall have a minimum of 4-in^2 [102mm^2], or a minimum of 8-in^2 [203mm^2] per cover assembly. Cover finish shall be as follows:

2. FloorPort FPFFTC Series Covers: Manufactured of die-cast aluminum or die-cast zinc, and available in brushed aluminum finish and powder-coated paint finishes (black, gray, bronze, nickel and brass). Activation covers shall be available in flanged version. Covers shall come equipped with one (1) 1-inch trade size screw plug opening and one (1) combination 1-1/4-inch and 2-inch trade size screw plug.

    a. Flanged covers shall be 7-3/4" L x 6-9/16" W [197mm x 167mm].

2.5 FIRE STOPPING

A. Fire Stopping materials used for this project shall comply with the following:

1. Products shall allow for normal expansion and contraction movement of the penetrating item without failure of the penetration seal.
2. Products shall emit no hazardous, combustible, or irritating by-products during installation or curing period.
3. Products shall not require special tools for installation.
4. Products shall provide penetration seal assemblies whose fire-resistance ratings have been determined by testing in the configurations required and which have fire-resistance ratings at least as high as that of the fire-rated assembly in which they are to be installed.
5. All fire stopping shall be manufactured by the following:
    a. Bio Fireshield, Inc.
    b. Dow Corning Corp.
    c. GE Silicones, Hilti, Inc.
    d. 3M Ceramic Materials.
    e. Or Approved Equal

PART 3 - EXECUTION

3.1 PATHWAYS

A. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations and shall have no exposed sharp edges that may come into contact with data or telecommunications cables.

B. All wall penetrations shall be installed with sleeves that shall have no exposed sharp edges that may come into contact with data or telecommunications cables.

C. Pathways shall not be located in elevator shafts unless specifically approved by the Design Consultant in writing.

3.2 CABLE PATHWAYS

A. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.

B. Cable pathways, which run parallel with electric power or lighting that is less than or approved equal to 480 Vrms, shall be installed with a minimum clearance of 6 in.

C. In the MDF/IDF(s) where cable trays or cable racking are used, the appropriate means of cable management such as reusable color-coded hook and loop cable managers (ties) shall be used to create a neat appearance and practical installation.

D. Continuous conduit runs installed by the contractor should not exceed 100 feet or contain more than two (2) 90 degree bends without utilizing appropriately sized pull boxes.

E. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.

3.3 FIRE PROTECTION

A. All wall penetrations shall require properly installed firestop systems code compliant that shall be installed to prevent or retard the spread of fire, smoke, water, and gases through the building.

B. Sheathing installed for wall penetrations must also be firestopped.

C. Fire stops shall be done to applicable code using approved materials.

END OF SECTION 270528

SECTION 270536 - CABLE TRAY FOR COMMUNICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes cable trays and accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 07 Section "Firestopping."

1.03 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each component. Show tray types, dimensions, and finishes.

C. Shop drawings detailing fabrication and installation of cable tray, including plans, elevations, sections, details of components, and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice plates connectors, expansion joint assemblies, straight lengths, and fittings.

D. Coordination drawings, including floor plans and sections drawn to accurate scale. Show accurately scaled cable tray layout and relationships between components and adjacent structural and mechanical elements.

E. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

F. Factory certified test reports of specified products, conforming to NEMA VE 1.

G. Field test reports indicating and interpreting test results relative to compliance with performance requirements specified in "Field Quality Control" Article of this Section.

H. Maintenance data for cable tray, for inclusion in "Operating and Maintenance Manual" specified in Division 1. Include detailed manufacturer's instructions on tightening connections.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Select a firm experienced in manufacturing cable trays similar to those indicated for this Project and which has a record of successful in-service performance.

B. Comply with NFPA 70, "National Electrical Code" for components and installation.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. Single-Source Responsibility: All cable tray components shall be the product of a single manufacturer.

1.05 SEQUENCING AND SCHEDULING

A. Coordination: Coordinate layout and installation of cable tray with other installations.
1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Architect.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cable trays that may be incorporated in the Work include, but are not limited to, the following:
1. B-Line Systems, Inc.
2. Chalfant Manufacturing Co.
3. GS Metals Corp.
4. Mono-Systems, Inc.
5. P-W Industries, Inc.
6. Or approved equal

2.02 MATERIALS AND FINISHES

A. Conform to NEMA VE 1.

B. Cable Trays, Fittings, and Accessories: Steel, hot-dipped galvanized after fabrication conforming to ASTM A 123, Class B2.

C. Protect steel hardware against corrosion by galvanizing conforming to ASTM B 633 or cadmium plating conforming to ASTM B 766.

D. Fabricate cable tray products with rounded edges and smooth surfaces.

2.03 SIZES AND CONFIGURATIONS

A. Conform to NEMA VE 1.

B. Ladder-Type Trays: Class 20C unless indicated.
1. Width: 24 inches (610 mm).
2. Inside Depth: 4 inches (102 mm).
3. Cross-Rung Spacing: 12 inches (229 mm) o.c.
4. Minimum Fitting Radius: 24 inches (610 mm).

2.04 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, manufactured with the same materials and finishes as the cable trays.

B. Covers: Louvered type, of same materials and finishes as cable trays.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.05 FIRESTOPPING

A. Materials: UL listed and labeled and FM approved for fire ratings consistent with penetrated barriers.

B. Materials: NRTL listed and labeled for fire ratings consistent with penetrated barriers.

C. Sleeves: Schedule 40, welded, black steel pipe sleeves. Sizes as indicated or minimum NEC size for cable or cable group to be installed.

D. Sealing Fittings: Suitable for sealing cables in sleeves or core drilled holes.

E. Sealing Mortar: Suitable for sealing cable penetration slots/openings in fire barriers.

F. Sealant: One-part compound for sealing cables, sleeves, and openings in fire barriers.

G. Two-Part Sealant: Formed-in-place sealant as specified in Division 7 Section "Firestopping."

2.06 WARNING SIGNS

A. Lettering: 1-1/2 inch (40 mm) high, black on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Materials and Fastening: Conform to Division 16, Section "Electrical Identification."

2.07 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive cable tray for compliance with installation tolerances and other required conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRING METHODS

A. Use cable tray of indicated types and sizes, complete with manufacturer's recommended covers, barrier strips, dropouts, fittings, conduit adapters, hold-down devices, grommets, and blind ends.

3.03 INSTALLATION

A. Install cable tray level and plumb according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.

B. Remove burrs and sharp edges of cable trays.

C. Fasten cable tray supports securely to the building structure as specified in Division 16 Section "Supporting Devices" unless otherwise indicated.

1. Locate and install supports according to recommendations of NEMA VE 1.

2. Design supports, including fastenings to the structure, to carry the greater of the calculated load multiplied by a safety factor of 4, or the calculated load plus 200 lbs (90 kg).

D. Make connections to equipment with flanged fittings fastened to the tray and to the equipment. Support the tray independently of fittings. Do not carry the weight of the tray on the equipment enclosure.

E. Install expansion connectors in cable tray runs that exceed 90 feet (27 m). Space connectors and set gaps according to NEMA VE 1.

F. Make changes in direction and elevation using standard fittings.

G. Make cable tray connections using standard fittings.

H. Locate cable tray above piping except as required for tray accessibility and as otherwise indicated.

I. Firestop penetrations through fire and smoke barriers according to Division 7 Section "Firestopping."

J. Firestop penetrations through fire and smoke barriers, including walls, partitions, floors, and ceilings, after cables are installed.

K. Sleeves for Future Cables: Install capped sleeves for future cables through firestopped cable tray penetrations of fire and smoke barriers.

L. Working Space: Install cable trays with sufficient space to permit access for installing cables.

M. Install barriers to separate cables of different systems, such as power, communications, and data processing, or different insulation levels, such as 600 V, 5,000 V, and 15,000 V.

N. Install covers after installation of cable is completed.

3.04 GROUNDING

A. Connect cable trays to ground as instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

3.05 WARNING SIGNS

A. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.06 FIELD QUALITY CONTROL

A. Grounding: Test cable trays to ensure electrical continuity of bonding and grounding connections.

B. Anchorage: Test pull-out resistance of one of each type, size, and anchorage material for toggle bolts and powder-driven threaded studs.

1. Furnish equipment, including jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain Architect's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener.

C. Correct malfunctioning units at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.07 CLEANING

A. Upon completion of installation of system, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.

3.08 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer to ensure that the cable tray is without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by the tray manufacturer.

2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the tray manufacturer.

END OF SECTION 270536

SECTION 271000 - STRUCTURED CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Wire, cable, and connecting devices for wiring systems to be used as signal pathway or voice, and high-speed data transmission.

B. System Diagram: Refer to T-Drawings

PART 2 - PRODUCT

2.1 MATERIALS

A. Acceptable Manufacturers

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Or approved equal.

2.2 TWISTED – PAIR CABLES, CONNECTORS AND TERMINAL EQUIPMENT

A. Voice Backbone, 100 Pair Category 6 UTP cable.

B. Conductors: Solid cooper conductors

C. Cross-connect panel rack mounted

D. Patch panel, rack mounted

E. Horizontal UTP, 4-pair Category 6

F. Workstation Outlets: Category 6 jack-connector assemblies.

2.3 FIBER-OPTIC CABLES, CONNECTORS, AND TERMINAL EQUIPMENT:

A. Cables: Factory fabricated, jacketed, glass type, multimode, graded index.

B. Backbone, Strands per cable: 12 (6 pair)

C. Patch panel Rack mounted

2.4 COAXIAL CABLES, CONNECTORS AND TERMINAL EQUIPMENT

A. Video Backbone: RG11 with double braid and tape shield.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION OF MEDIA

A. Backbone Cable for Data Service: Use multi-mode fiber-optic cable for runs between equipment rooms and wiring closets and for runs between wiring closets.

B. Backbone Cable for Voice Service: Use UTP Category 3, 100 pair, for runs between equipment rooms and wiring closets and for runs between wiring closets.

C. Horizontal Cable for Data Service: Use UTP Category 6 cable for runs between wiring closets (MDF/IDFs) and workstation outlets.

D. Horizontal Cable for Voice Service: Use UTP Category 6 cable for runs between wiring closets (MDF/IDFs) and workstation outlets.

3.3 INSTALLATION

A. Wiring Method: Install wiring and optical fiber in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

B. Install cables using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

C. Install cables without damaging conductors, shield, or jacket.

D. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

E. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips that will not damage media or raceway.

F. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

G. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

H. Wiring within Wiring Closets and Enclosures: Provide conductors of adequate length. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radio than minimums recommended by manufacturer.

I. Separation of Wires: Comply with TIA/EIA-569-A rules for separating unshielded copper voice and data communication cabling from potential EMI sources, including electrical power lines and equipment.

J. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.

K. Use splice and tap connectors compatible with media types.

3.4 GROUNDING

A. Ground cable shields, rain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.

C. Signal Ground Bus: Mount on wall of main equipment room with standoff insulators.

D. Signal Ground Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.5 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

A. Install plywood backboards (furnished by others) on walls of equipment rooms and wiring closets.

B. Mount patch panels, terminal strips, and other connecting hardware on backboards, unless otherwise indicated.

C. Group connecting hardware for cables into separate logical fields.

D. Use patch panels to terminate cables entering the space, unless otherwise indicated.

3.6 INSTALLATION STANDARDS

A. Comply with requirements in TIA/EIA-568-A and TIA/EIA-569-A.

3.7 IDENTIFICATION

A. In addition to requirements in this Article, comply with applicable requirements in TIA/EIA-606.

B. Workstation: Label cables within outlet boxes.

C. Distribution Racks and Frames: Label each unit and field within that unit.

D. Within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Cables, General: Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

F. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m)

G. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project, in software and format selected by the Authority.

H. Cable Administration Drawings: Show building floor plans with cable administration point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606. Furnish electronic record of all drawings, in software and format selected by the Authority.

3.8 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
2. Copper Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bi-directional, Category 6 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-TSB 67, "Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems." Link performance for UTP cables must meet minimum criteria of TIA/EIA-568-A.
3. Fiber-Optic Cable Procedures: Perform each visual and mechanical inspection and electrical test, including optional procedures, stated in NETA ATS, Section 7.25. Certify compliance with test parameters and manufacturer's written recommendations. Test optical performance with optical power meter capable of generating light at all appropriate wavelengths.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.9 TESTING, IDENTIFICATION AND ADMINISTRATION

A. Copper Cable

1. All Category 6 UTP cable shall be tested to a frequency of 350MHz to demonstrate compliance with the individual manufacturers advertised electrical characteristics.

2. All Category 6 UTP cable shall be field-tested with connectivity products installed to a frequency of 250MHz to demonstrate performance equal to or better than the minimum requirements as specified in ANSI/TIA/EIA-568b.2.1 and as listed in Table 1.
3. The Test Model shall be Permanent Link

TABLE 1 - Category 6 Permanent Link Limits in dB per ANSI/TIA/EIA-568B.2-1

Parameter	Performance @ 100MHz	Performance @ 200MHz	Performance @ 250MHz	Performance @ 300MHz
Insertion Loss	19.0 dB	27.4 dB	30.9 dB	34.1 dB
NEXT Loss	43.9 dB	39.3 dB	37.8 dB	36.6 dB
PS NEXT Loss	41.9 dB	37.3 dB	35.8 dB	34.6 dB
ACR	24.9 dB	11.9 dB	6.9 dB	2.5 dB
PS ACR	22.9 dB	9.9 dB	4.9 dB	0.5 dB
ELFEXT	26.3 dB	20.3 dB	18.3 dB	16.8 dB
PS ELFEXT	23.4 dB	17.3 dB	15.4 dB	13.8 dB
Return Loss	14.7 dB	11.7 dB	10.7 dB	9.9 dB
Propagation Delay	528 ns	527 ns	526 ns	526 ns
Delay Skew	40 ns	40 ns	40 ns	40 ns

4. All testing shall be performed with a UTP/ScTP field test device that has been factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing.
5. Autotest settings provided in the field tester for testing the installed cabling shall be set to the default parameters.
6. Test settings selected from options provided in the field testers shall be compatible with the installed cable under test.
7. UTP horizontal and backbone cables shall be 100 percent tested according to ANSI/TIA/EIA-TSB-67 and ANSI/TIA/EIA-568-B.2.1. Test parameters include wire map plus shield continuity (when present), length, NEXT loss (pair-to-pair), NEXT loss (power sum), ELFEXT loss (pair-to-pair), ELFEXT loss (power sum), return Loss, attenuation, propagation delay, and delay skew.

B. Fiber Optic Cable

1. Backbone
   a. Fiber backbone cables shall be 100% tested for attenuation and length.
   b. Attenuation shall be tested at 850 nm and 1300 nm for 50/125 nm multimode in at least one direction using the 2-jumper method.
   c. Acceptable attenuation test results shall be determined using the following calculation:
      1) Link attenuation = cable attenuation + connector attenuation + splice attenuation.
      2) Cable attenuation, connector attenuation and splice attenuation are determined by each of the following formulas:
         a) Cable Attenuation:
            Cable attn. (dB) = Attn. coefficient (dB/km) x length (km)
            Attenuation Coefficient = 3.0 dB/km @ 850 nm

b) Connector Attenuation:
Connector attn. (dB) = number of connector pairs x connector loss = 2 x 0.65 dB = 1.3 dB

c) Splice Attenuation:
Splice attn. (dB) = number of splices (s) x splice loss (dB) = s x 0.3 dB

d. The Backbone Channel performance guarantees are as follows:

1) Max Attenuation 850/1300 nm: 3.0/1.0 dB 2) Bandwidth 850/1300 nm: 1500/500 MHz/km

3) Min. Return Loss: 20dB

4) For each additional mated pair of connectors, add the following to the attenuation values as noted in above chart:

a) add 0.75 dB @ 850nm

b) add 0.65 dB @ 1300nm

5) For each splice, add 0.30 dB to the attenuation values as noted in above chart (applicable to both M/M and S/M).

3.10 CUTOVER

A. The contractor shall place cross connects at Telecommunication Equipment Rooms.

3.11 Training

A. Authority training shall include:

1. Physical review of installed cable plant.
2. Review of cable plant documentation and test results.
3. Instructions on industry standard termination and testing methods to enable customer personnel to successfully terminate and test cabling.

3.12 DEMONSTRATION

A. Train the Authority's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and extending wiring to establish new workstation outlets.

END OF SECTION 271000

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications pathways.
4. Grounding.

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
3. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies, and location and size of each field connection.
2. Equipment racks and cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail.

C. Qualification Data: For BICSI RCDD or experienced equivalent qualified layout technician, installation supervisor, and field inspector.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of an RCDD to be specified on the drawings.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A and NFPA 70.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames, cable trays and cabling until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.5 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
2. Neatly support cabling and brackets; utilize cable tie slots for fastening cable ties to brackets, lacing bars, spools, J-hooks, and D-rings, Straps and other devices.

a. .

B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2. Increase effective depth of 4” square boxes by adding extensions to meet depth requirements. Plaster ring depth can be used to meet depth requirement.

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2.2 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. All grounding conductors for communications shall be copper.

C. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

D. Comply with ANSI-J-STD-607-A.

2.3 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Install underground/buried/aerial pathways complying with design documents and recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

C. Install underground/buried/aerial entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems."INSTALLATION

D. Comply with NECA 1.

E. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

F. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

G. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

H. Cables shall not be installed using building steel as a cable support.

3.2 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.3 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar in each IDF with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to the grounding bus bar in the MDF.

D. Connect grounding bus bar in the MDF to the grounding electrode of the panel serving the MDF equipment with 2 minimum No. 4 AWG conductor.

E. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

C. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cable.
3. Fiber Optic cable.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Cabling identification products.

B. Related Sections:

1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics including the following:

a. Cross-connects.

b. Patch panels.
c. Patch cords.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
5. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements.

C. Qualification Data: For RCDD qualified layout technician, installation supervisor, and field inspector.

D. Warranty: Provide manufacturer's system warranty against electrical or mechanical defects for. 2 years from date of final acceptance.

E. Source quality-control reports.

F. Field quality-control reports.

G. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling detail /administration Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

E. Grounding: Comply with ANSI-J-STD-607-A and NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
2. Neatly support cabling and brackets; utilize cable tie slots for fastening cable ties to brackets, lacing bars, spools, J-hooks, and D-rings, Straps and other devices.

2.2 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden CDT Inc.; Electronics Division.
2. CommScope, Inc.
3. Leviton
4. Superior Essex Inc.
5. SYSTIMAX Solutions; a CommScope Inc. brand.

B. Description: 100-ohm, 100 -pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG
b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
c. Communications, Riser Rated: Type CMR, complying with UL 1666.
d. Communications, Limited Purpose: Type CMX.
e. Multipurpose: Type MP or MPG.
f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.3 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Premise Wiring.
2. Leviton Voice & Data Division.
3. Panduit Corp.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair Category 6 conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made (pre-fab), 4-pair cables in 36 and 48-inch lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.4 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-footlong service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Administration Class: 2
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. See Evaluations for discussion about TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements specified on drawings and/or in of this standard.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Multiuser telecommunications outlet assemblies.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Telecommunications outlet/connectors.
6. Cabling identification products.
7. Cabling administration system

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration and faceplates for color selection and evaluation of technical features.

D. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

E. Source quality-control reports.

F. Field quality-control reports.

G. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

E. Grounding: Comply with ANSI-J-STD-607-A.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cablofil Inc.
b. Cooper B-Line, Inc.
c. Chatsworth Products Inc.
d. Or Approved Equal

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.3 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.4 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden CDT Inc.; Electronics Division.
2. Leviton
3. Superior Essex Inc.
4. Or Approved Equal.

B. Description: 100-ohm, 100 -pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG
b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
c. Communications, Riser Rated: Type CMR, complying with UL 1666.
d. Communications, Limited Purpose: Type CMX.
e. Multipurpose: Type MP or MPG.
f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.5 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Leviton Voice & Data Division.
2. Hubbell Premise Wiring.
3. Panduit Corp.
4. Or Approved Equal

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair Category 6 conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made (pre-fab), 4-pair cables in 36 and 48-inch lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.6 CONSOLIDATION POINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Superior Essex
2. Chatsworth Products, Inc.
3. Leviton Inc.
4. Hubbell Premise Wiring.
5. Or Approved Equal.

B. Description: Consolidation points shall comply with requirements for cable connecting hardware.

1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Number of Connectors per Field:

    a. One for each four-pair UTP cable indicated.
    b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

3. Mounting: as indicated in construction drawings
4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.7 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.
2. Leviton Inc.
3. Hubbell Premise Wiring.
4. Or Approved Equal.

B. Description: MUTOAs shall meet the requirements for cable connecting hardware.

1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Number of Connectors per Field:

    a. One for each four-pair UTP cable indicated.
    b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

3. Mounting: as indicated in construction drawings.
4. NRTL listed as complying with UL 50and UL 1863.
5. Label shall include maximum length of work area cords, based on TIA/EIA-568-B.1.
6. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.8 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Two or Four-port-connector assemblies mounted in single or multigang faceplate as indicated in the construction drawings.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
2. Metal Faceplate: Stainless steel, complying with requirements in Division 26 Section "Wiring Devices."
3. For use with snap-in jacks accommodating any combination of UTP work area cords.

    a. Flush mounting jacks, positioning the cord at a 45-degree angle.

4. Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.
5. Legend: Machine printed, in the field, using adhesive-tape label.
6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.9 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used as specified in the construction drawings. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for UTP at least 49 feet from communications equipment room.

6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 12 inches.

3.5 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Administration Class: 2.
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

F. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

    a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

        1) Wire map.
        2) Length (physical vs. electrical, and length requirements).
        3) Insertion loss.
        4) Near-end crosstalk (NEXT) loss.
        5) Power sum near-end crosstalk (PSNEXT) loss.
        6) Equal-level far-end crosstalk (ELFEXT).
        7) Power sum equal-level far-end crosstalk (PSELFEXT).
        8) Return loss.
        9) Propagation delay.
        10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

    a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
    b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

SECTION 272000 - DATA COMMUNICATIONS

PART 1 - CODES, STANDARDS, AND REGULATIONS

1.1 Communication design shall comply with Federal and State codes, regulations, and standards with variances adopted as standards by the NJSDA. Applicable state and national standards include the latest editions of:

A. ANSI/NFPA 70 National Electrical Code with New Jersey Amendments

B. BICSI CO-OSP Customer Owned Outside Plant Manual

C. BICSI 12th Edition Telecommunications Distribution Methods Manual

D. BICSI 3rd Edition Customer Owned Outside Plant Design Manual

E. EIA Standard EIA-230 - Color Marking of Thermoplastic Wire

F. FCC Rules and Regulations:

1. J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications National Electrical Safety Code
2. NFPA 101: Life Safety Code REA Standards for Engineering, Construct
3. TIA 526-14-A Optical Power Loss Measurements for Installed Multimode Fiber Cable Plant–OFSTP-7
4. TIA 568-C Commercial Building Telecommunications Cabling
5. TIA 569-B Commercial Building Standard for Telecommunications Pathways and Spaces
6. TIA Standard ANSI/TIA/EIA-607-A - Commercial Building Grounding and Bonding Requirements for Telecommunications
7. TIA 604 Standards on Fiber Optic Connector Intermateability
8. TIA 606-A Administration Standard for Commercial Telecommunications Infrastructure Standard
9. TIA 758-A Customer Owned Outside Plant Telecommunications Cabling Standard
10. TIA Telecommunication Systems Bulletin TSB67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems
11. TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
12. In the event of a conflict between the Electrical Standards (D50, D60 and D70) and other guidance documents, the Education Specifications, the SDA's Kit of Parts, Bridging Documents also known as the Design Builder's Information Package and presiding codes shall take precedence.

1.2 Data Communications Network Equipment/Design Approach:

A. Main Distribution Frame (MDF) / Intermediate Distribution Frame (IDF) Description:

1. Main Distribution Frame (MDF) - A Main Distribution Frame shall be provided to distribute connectivity to the IDF, station cabling as required and to house the main control equipment of the following systems:
   a. Local Area Network
   b. Wide Area Network
   c. Carrier/Service Provider Interconnections

d. Telephone System
e. Paging/Intercom System
f. Clock Systems
g. Internet Protocol Digital Video Surveillance (IPDVS) System
h. Digital Video Distribution System
i. Building Management System

2. Any station cabling that does not exceed 80-Meters (262 Feet) in length shall be homerun to the Main Distribution Frame.
3. Intermediate Distribution Frame (IDF) - Intermediate Distribution Frame shall be provided to distribute core connectivity from the MDF to station cabling where cable distances exceed 80-Meters (262 Feet) to the MDF
4. The designated MDF shall have a single room UPS capable of supporting all devices within the room for up to three hundred (300) seconds (five (5) minutes) of operation at full capacity. Ability to manage and view UPS statistics via IP Based connectivity.
5. For room based UPS Systems a bypass mode shall be included and must provide an alternate path for utility power to the connected load in the event of planned maintenance activities or a UPS malfunction.
6. IDF's and Server cabinets outside of the MDF with access to building generator power shall have rack based UPS systems capable of supporting all devices within the rack/cabinet for up to three hundred (300) seconds (five (5) minutes) of operation at full capacity. Ability to manage and view UPS statistics via IP Based connectivity.
7. IDF's and Server cabinets outside of the MDF with access to building generator power shall have rack based UPS systems capable of supporting all devices within the rack/cabinet for up to three hundred (300) seconds (five (5) minutes) of operation at full capacity. Ability to manage and view UPS statistics via IP Based connectivity.
8. All server cabinets housed in the MDF shall have 48 Port Category 6 Compliant 110- type rack-mounted patch panels provided on the "rear" of the cabinet. This panel shall terminate on a 2 post telecom/network rack to supply network connectivity for devices inside the cabinets.
9. Controlled access to the Main Telecommunications Room and Intermediate Telecommunications Closet shall be provided. This can be accomplished with a lock, card reader or other approved mechanism.
10. The Main Telecommunications Room shall be built in accordance with "DCA Best Practices Standards for Schools under Construction or Planned for Construction."

B. Routing – at a Minimum Routers Must Support:

1. Open Shortest Path First (OSPF)
2. Enhanced Interior Gateway Routing Protocol (EIGRP)
3. Routing Information Protocol (RIP), and RIPv2
4. Two (2) - 10/100/1000-T Copper based
5. One (1) - Small form-factor pluggable (SFP) based slot
6. Four (4) - Enhanced High-Speed WAN Interface Cards (EHWIC)
7. Three (3) Digital Signal Processors (DSP) slots
8. One (1) Internal Services Module (ISM) slot
9. Flash: Support up to 4 GB (Gigabytes)
10. RAM: Support up to 2.5 GB (Gigabytes)
11. RJ-45 Console serial port and USB Console Serial Port
12. Management Capabilities via IP / SNMP / Telnet / SSH / HTTP(S)

C. Switching - at a Minimum Switches Must Support:

1. MDF – A core switch housed within the MDF must meet these minimum requirements:
2. Modular Chassis Switch with 7, 9 or 13 Slots
3. Supervisor engine redundancy
4. 19'' (19-inch) rack compatible
5. Redundant 4200W Power Supply
6. IEEE 802.3af/at compliant PoE/PoEP
7. Hot swappable
8. 280-Gbps (Gigabits per second) switching capacity
9. IP routing protocols: Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path
10. First (OSPF), Routing Information Protocol (RIPv2)
11. IEEE 802.1Q VLAN Encapsulation 12. 802.1s, 802.1w, 802.3ad
12. 13. 802.3af/at (PoE)
13. Ether Channel bonding across line cards
14. Port Aggregation Protocol (PAgP)
15. Voice VLAN and VLAN ID (VVID)
16. Jumbo Frames (up to 9216 bytes)
17. Traffic Storm Control and/or Broadcast/Multicast Suppression
18. Bridge Protocol Data Unit (BPDU) Guard
19. Link Layer Discovery Protocol (LLDP)
20. Switches housed in MDF and IDF rooms support 10 Gigabit Ethernet Connectivity between IDF and MDF rooms. 1-Gigabit Ethernet Connectivity to each station drop.

D. IDF - Switches Housed Within the IDF Must Meet These Minimum Requirements:

1. Stackable with each node member switch being able to serve as a master, creating a 1:N availability scheme for network control.
2. Inter-connection via a channel or bus cable
3. 1100W (minimum) Power Supply
4. Power over Ethernet (PoE) capable on all copper based ports. 802.3af and 802.3at Standards
5. All ports must support 1-Gigabit Ethernet connectivity
6. IP routing protocols: Enhanced Interior Gateway Routing Protocol (EIGRP), Routing Information Protocol (RIPv2)
7. Wireless Data (Wi-Fi) Communications System - A wireless access network shall span all occupy able spaces through the entire facility.
8. Must utilize a centralized controller that allows management of wireless network as a whole.
    a. Allow for management of individual access points.
    b. Application of site wide wireless access policies.
9. Shall be capable of providing:
    a. IEEE 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac
    b. Encryption WEP and TKIP-MIC; SSL and TLS; AES (CCM, CCMP)
    c. Authentication, Authorization, and Accounting (AAA); IEEE 802.1X; RADIUS; PPP EAP-TLS; Extensible Authentication Protocol (EAP) with RADIUS
10. Wireless Node Isolation.
11. IEEE 802.1Q VLAN tagging; intra-VLAN security; VLAN Isolation

PART 2 - VOICE COMMUNICATIONS

2.1 Telephone System Description

A. General

1. The intent is to provide a school wide Voice over IP (VoIP) Telephone System with voicemail capabilities. The Telephone System and the Data Systems shall share physical cabling mediums and strive for maximum integration.

B. Equipment and Locations

1. All processing and head end systems required for voice communications shall be housed in the Main Distribution Frame (MDF) room.
2. Telephones outlet and handset shall be provided in all administrative areas, class rooms, offices, security desks and other specified locations.
3. Wall telephone outlet without lock box and handset shall be provided in utility rooms, storage rooms greater than 200 sq. ft., mechanical rooms, elevator machine room, supply rooms and vault room.
4. Dedicated phone lines (not through the IP Private Branch Exchange (PBX)) shall be provided for the Intrusion Alarm System, Fire Pump, and Elevator Intercom System.
5. A loud Bell is to be placed in noisy areas including the auditorium, gymnasium, gymatorium, student cafeteria, kitchen and the boiler room. A loud bell may be required in other noisy areas; however, this will be addressed on a case by case basis and will be determined by the contract documents.

PART 3 - VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT

3.1 Internet Protocol Private Branch Exchange (IP PBX) Minimum Requirements

A. H.323 and SCCP protocol support

B. IP Based SIP, Digital (PRI / BRI) and POTS line carrier interface (Trunk)

C. Analog Telephone Adaptor (ATA)/ Foreign eXchange Subscriber (FXS) Adapter support up to 20 line appearances per phone

D. Support of fallback service phone auto-registration

E. IP Handsets; Software phone client.

F. Foreign eXchange Office (FXO) interface for analog systems.

G. E911 with two emergency location numbers per zone; unlimited zones per site

H. Paging: Internal through IP phones or to external paging system

I. Ad-hoc conferencing

J. Push Button intercom and Night Bell capabilities.

K. Multiple music-on-hold (MoH) streams (internal/external)

PART 4 - VOICE COMMUNICATIONS TERMINAL EQUIPMENT

4.1 Telephone Set Type: Minimum Capabilities, Requirements

A. Executive/Administrative offices

1. Six (6) Physical Lighted Line Appearance keys
2. Two way Speaker Phone
3. Support for expansion module with additional line keys
4. 802.3af Power Over Ethernet (PoE) support.
5. Integrated 10/100 switch.

B. Classroom / Shared Spaces

1. Two (2) Physical Lighted Line Appearance keys
2. Two way Speaker Phone
3. 802.3 af Power Over Ethernet (PoE) support.
4. Integrated 10/100 switch.

C. Public areas / Miscellaneous Spaces

1. 1 line (May use 0 line keys)
2. 802.3 af Power Over Ethernet (PoE) support.

D. Conference Rooms / Conference Phones

1. Support for external microphone kit
2. 802.3 af Power Over Ethernet PoE support.
3. Door Phone / Push button Intercom
4. Door Intercom w/ doorstrike release
5. Vandal resistant / Hardened
6. Phone system integrated

4.2 Elevator Intercommunication System

A. Elevator car stations shall have an auto-dialer and a time-clock switch programmable to dial primary and secondary numbers.

B. Connect the automatic dialing, hands-free station in the elevator car to a dedicated telephone line. The elevator car station shall automatically dial a programmed number to alert the school personnel that there is a problem in the elevator and identify visually which elevator is initiating the call.

C. The primary number shall ring in the General Office, while the secondary number shall ring the elevator installer. Dedicated phone lines (not through the Private Branch Exchange (PBX)) shall be provided for the Elevator Intercommunication System

D. Provide a telephone set within Elevator Machine Rooms, as part of school telephone system.

END OF SECTION 272000

SECTION 272100 - DATA COMMUNICATIONS NETWORK EQUIPMENT

PART 1 - GENERAL GUIDELINES

1.1 GENERAL

A. This Section defines the general design requirements for a uniform Data Communications Network Infrastructure

1.2 SECTION INCLUDES

A. DATA COMMUNICATIONS NETWORK EQUIPMENT

1. File/Building Server – optional.
2. Network Switches.
3. Network Core Switch.
4. Network Security Equipment.
5. Uninterruptible Power Supplies (UPSs).

1.3 QUALITY ASSURANCE

A. All equipment shall be UL listed.

B. All equipment and Installation Practices shall comply with the latest ®BICSI Telecommunications Distribution Methods Manual (TDMM).

1.4 SYSTEM WARRANTY

A. The Local Area Network Electronics and software shall be fully warranted for three (3) years from date of substantial completion by the contractor and manufacturer. If any defects are found within this warranty period, the defective system component shall be replaced at no extra cost to the Authority for parts or labor. Provide a statement of this warranty with the O&M manuals and to the Director of IT. Make available a service contract offering continuing factory authorized service of this system after the initial warranty period.

1.5 GENERAL

A. Each Building shall be provided with a Local Area Network (LAN) System.

B. Existing Facilities that are being remodeled shall be upgraded to the current requirements stated herein.

C. Single Building projects shall be compatible with the existing network infrastructure.

D. Wide Area Network (WAN) Interfaces shall be provided to interface the Authority's WAN provider. Coordinate WAN requirement with the Authority's fiber provider as applicable.

E. Buildings shall be designed as to minimize the quantity of Telecommunications Rooms and to centralize as much of the Data Network Equipment as possible.

F. Multiple buildings on the same campus should be designed to share common Data Network Electronics and equipment wherever possible.

G. The Authority should design their Data Networks to take advantage of Centralization of Common Network Equipment at a Network Operations Center(s).

H. Items that should be centralized include:

1. File/Building Servers.
2. L-3 Routing Devices.
3. Network Management Equipment.
4. Security Devices, Radius Servers, etc.
5. WAN access equipment.
6. Wireless Management Equipment.

I. As a minimum, the Network may be used to support the following applications on a Local and Wide Area basis:

1. Automation Systems.
2. Clock Systems.
3. Control Systems.
4. Data Networking
5. Security Systems.
6. Video Conferencing.
7. Video Streaming/Media Retrieval.
8. VoIP Telecommunications.
9. Wireless Access Points.

1.6 FILE/BUILDING SERVER

A. Provide Network File/Building Server for the central administration and storage of computer files and information. The Networked Server shall be of a current design criteria, utilizing SAS 10k-15k rpm RAID level 5 hard drive storage (minimum 2TB)--Quad core processor. Coordinate OS with the Authority. Min. 64-bit Windows Server 2008 if Windows based. Minimum 16 GB of RAM, 2 x 10Gig NIC. Attach to Core via 10 Gig DAC. 22" LED monitor, rack mounted.

B. Provide Operating System based on the Authority's requirements.

1.7 NETWORK SWITCHES

A. Proprietary Specifications:

1. The following product/manufacturer has been approved by the Authority for proprietary specifications and use in this project.
   a. Network Switches: Cisco
2. Subject to compliance with codes and all project requirements, the Contractor is required to use the indicated product/manufacturer and to verify compatibility with the existing systems.

B. Provide 1000 Base T Layer 2 Manageable Ethernet Switches with ports in a quantity to support all initially planned devices, including wireless access points, with 15% spare.

C. Provide a configuration of switch ports utilizing either stackable edge switches or a modular chassis with single engine and dual PS.

1. Provide dual 10GB uplinks to each switch stack or modular chassis.

D. The 1000 switches shall be “non-blocking” and support a minimum forwarding bandwidth equal to the number of switch ports x 1 Gbps.

E. Utilize 10GB uplinks for all uplinks. Switches may be stacked, but provide each stack with a minimum of two uplinks for redundancy.

F. Chassis mounted units are acceptable for Edge Switches, provided that dual power supplies and equivalent uplink bandwidth is supplied.

G. The Network switches shall support advanced services such as:

1. IP Telephony.
2. Wireless Access Points.
3. Building Management Systems.
4. Video Streaming.
5. IP CCTV/Access Control

H. POE+ switches shall be rated to provide POE+ class 3 on all ports simultaneously. Standard 30 watts per port. Reference 802.3at standard.

I. The 1000 switches shall support the following features and specifications:

1. 1000BASE-LX/LH.
2. 1000BASE-SX.
3. 1000BASE-X (SFP).
4. 1000BASE-ZX.
5. Access Control Lists (ACL).
6. Advanced QoS.
7. IEEE 802.1s.
8. IEEE 802.1D Spanning Tree Protocol.
9. IEEE 802.1p CoS Prioritization.
10. IEEE 802.1Q VLAN.
11. IEEE 802.1s.
12. IEEE 802.1w.
13. IEEE 802.1x.
14. IEEE 802.3 10BASE-T specification.
15. IEEE 802.3ab 1000BASE-T specification.
16. IEEE 802.3ad.
17. IEEE 802.3af and 802.11at POE.
18. IEEE 802.3u 100BASE-TX specification.
19. IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports.
20. IEEE 802.3z 1000BASE-X specification.
21. IPv6.
22. Rapid Spanning Tree.
23. Rate Limiting.
24. RMON I and II standards.

25. SNMPv1, SNMPv2c, and SNMPv3.

J. Provide sufficient 1000 ports to accommodate, as a minimum, the following devices as required:
1. Access Control System.
2. Admin PCs.
3. Classroom PC Devices.
4. Clock Systems.
5. Distant Learning Systems.
6. Instructor PCs.
7. Monitor/TVs, as required.
8. MPEG Encoders.
9. PABX System.
10. Printers.
11. Projectors.
12. Set Top Boxes, as required.
13. UPS Units.

K. Provide all GB POE+ ports to accommodate, as a minimum, the following devices as required:

1. IP Phones
2. IP CCTV Cameras
3. WLAN access points.

L. Switches housed in MDF and IDF rooms support 10 Gigabit Ethernet Connectivity between IDF and MDF rooms. 1-Gigabit Ethernet Connectivity to each station drop.

1.8 NETWORK CORE SWITCH

A. Provide a modular chassis-based central Layer-3 ethernet routing switch with advanced QoS to serve the entire building or campus. The Core switch shall be provided with backplane capacity to provide full non-blocking support of all installed line cards plus 15% growth.

B. Equip the Central Layer-3 switch with a minimum of two (2) Power Supplies and two (2) Redundant Central Control/Supervisor Units.

C. All Core switch Blades must support full line speed and shall not be over-subscribed.

D. Provide sufficient Ports on the Layer-3 Core Switch, as a minimum, for the following devices:

1. Provide Network Switch uplink ports to support all edge switches plus 15% spare. The switch shall have at least one spare uplink card for redundancy.
2. Building Automation Systems, as required (typically TX).
3. CCTV DVR System (typically TX).
4. File Servers (typically TX, 10GB).
5. Firewall, as required (typically TX).
6. Media Distribution Servers & Controllers (typically TX).
7. Radius Authentication Server, as required, (typically TX).
8. WAN Connectivity (typically LX or CWDM).

9. Wireless Controllers (typically TX, 10GB).
10. Wireless Phone Controller (typically TX).
11. Wireless Control Console (typically TX).

E. In addition to the above listed features and specifications for the Network Switches, the Network Core Switch shall support the following Features and Specifications:

1. 10 Gbps Support capabilities.
2. BGP4 and Multicast Border Gateway Protocol (MBGP).
3. Full Internet Control Message Protocol (ICMP) support.
4. Hot Standby Router Protocol (HSRP).
5. ICMP Router Discovery Protocol.
6. IGMP filtering.
7. IGMP v1, v2, and v3.
8. IP Multicast routing protocols.
9. IP routing protocols: EIGRP, OSPF, Routing Information Protocol (RIP), and RIP2.
10. Non-Blocking GBE Ports.
11. NSF awareness.
12. Policy-based routing (PBR).
13. Virtual Router Redundancy Protocol (VRRP).

1.9 NETWORK SECURITY EQUIPMENT

A. RADIUS SERVER

1. If the Authority does not have a Central Radius Server, provide a Radius Server for Network Authentication, VLAN Assignment and Policy Assignment for IP Network Attached Devices.

B. FIRE WALL

1. If the Authority does not have a Central Firewall and Intrusion Detection Device for connection to the Wide Area Network and Internet, provide a Firewall and Intrusion Detection Device for Protection and Security. Establish all Internet Connections via a Firewall.
2. Size the Firewall based on planned Network throughput, available WAN bandwidth and attached IP Devices.
3. Provide VPN services in the Firewall for remote access and network maintenance services.
4. Coordinate requirements with the Authority's Technology Department.

1.10 UNINTERRUPTIBLE POWER SUPPLIES (UPSs)

A. Provide Dual Conversion UPS units for ER and TR Local area Network Electronics and File Server, providing sufficient protection from power anomalies.

B. Provide Power strips, connected to the UPS Unit via twist-lock plugs. Locate the power strips in the equipment racks and on the equipment backboards for powering all electronics systems in the ER and TRs.

C. Provide multiple UPS Units based on expected power load or a single large UPS Unit. Locate the multiple UPS units in the associated equipment racks or locate a larger

central UPS unit in the Room.

D. Connect the UPS Units to Building Emergency Generator when available.

E. For buildings without a Generator, supply a two-hour (2) standby.

F. Provide shutdown connections from the UPS to servers for graceful power down in the event of a power failure.

G. Equip the UPS Units with a twist-Lock Power cable and SNMP Management Card.

H. Connect the UPS SNMP Management to the Management VLAN.

I. Coordinate UPS voltage, circuit size, and connection requirements with the Electrical Design Professional.

1.11 INSTALLATION

A. Install File Server (optional) and setup basic user accounts and network configuration.

B. Install Data Network Ethernet Switches and validate connectivity throughout. Establish all VLANs, QoS, IP Routing and IP Subnets.

C. Consult with the Authority and consider providing the following VLANs as a minimum:

1. Administration.
2. HVAC.
3. Management.
4. Point of Sale.
5. Student.
6. Video.
7. Voice.
8. Wireless.
9. Security, CCTV

D. Coordinate network installation and integration with other systems connected to the network with the Authority's and applicable DA-Site's technical and operational requirements.

E. Install and setup UPS units and establish power down procedures.

1.12 LABELING AND MARKING

A. Provide a typed schedule of all data ports according to each related room jack designation for all TRs, and ER, in accordance with the Authority's requirements.

1.13 TESTING

A. Test the system "end-to-end" (from TR to ER, and from TR to station jack) at the direction of the Design Professional and verify, in writing, that the data network system is in proper working condition.

B. Verify and demonstrate proper operation of all switches, Access Points, VLANs,

Routing, WAN Connectivity and possible ATM Connectivity with the Authority's and DA-Site representative, if applicable.

1.14 TRAINING

A. Provide a minimum of forty (40) hours of training to the Authority's personnel. Plan for multiple training trips to the site. Training session(s) shall cover the following topics at a minimum:

1. System Equipment Connectivity
2. Device Configurations
3. Operation, maintenance, and upgrade procedures.

B. Training to be arranged with Authority personnel. 40 hours should be spread out over the length of the warranty (Ex: 8 hours at project turnover/completion, 8 hours at 3 months, 8 hours at 6 months, 8 hours at 1 year, 4 hours at 2 years, 4 hours at 3 year).

C. Training to occur in maximum of 2 hour increments per personnel or groups of personnel.

D. Consider requiring Contractor to provide manufacturer training vouchers for a portion of the training, which are valid during the warranty period.

E. Training shall be by certified manufacturer instructor.

F. Training schedule shall be coordinated with Authority personnel and their needs.

G. Training plan, time line, and agenda shall be provided to Authority IT personnel and signed off by the Authority and Contractor.

H. Warranty certificate and agreement shall be provided to Authority IT personnel at initial training session.

I. Provide a digital video copy of the training sessions.

END OF SECTION 272100

SECTION 272102 - DATA SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Work include in this section shall have one system integrator to coordinate with the following specification sections.

1. 27 05 34 RACEWAYS, BOXES, AND CABINETS

2. 27 05 36 CABLE TRAY FOR COMMUNICATIONS

1.02 SUMMARY

A. This Section includes the cable, network switches, connecting devices, wireless access points, patch panels, installation, and testing for wiring systems to be used as signal pathways for video and high-speed data transmission.

B. One system integrator shall oversee all installations related to this specification and related documents listed in part 1.1.

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each component specified, including detailed manufacturer's specifications. Include data on features, ratings, and performance. Include dimensioned plan and elevation views of components. Show access and working-space requirements.

C. Samples of Data outlet connectors, jacks, jack assemblies, and faceplates and evaluation of technical features.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Provide evidence of applicable registration or certification.

E. Field test and observation reports indicating and interpreting test results relative to compliance with performance requirements of the installed systems.

F. Maintenance data for products to include in the operation and maintenance manual.

G. Final Documentation as specified in Part 3.

H. Evidence of listing of products specified to be listed in the "Quality Assurance" Article.

I. Shop Drawings:

1. Provide (3) sets of documents on cable certification results and AutoCAD files indicating cable location, labels and all connections.

J. Extra Materials: Submit one month prior to date of Substantial Completion.

K. Provide certification for Owner's maintenance personnel as verification of training.

1.04 QUALITY ASSURANCE

A. Installing Firm Must Be A Qualified Cabling Contractor With At Least Five Years Experience In The Installation, Testing And Adjustment Of Systems Similar To The System Specified Herein.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. Work Coordination: Coordinate Work of this Section with Owner's telephone switch, telephone instrument, workstation, local area network (LAN), and wide area network (WAN) equipment suppliers. Coordinate the service entrance arrangement with the local exchange carrier.

1. Meet jointly with representatives of the above organizations and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Record agreements reached in meetings and distribute record to other participants.

3. Adjust the arrangements and locations of distribution frames and patch panels in equipment rooms and wiring closets to accommodate and optimize the arrangement and space requirements of the telephone switch, LAN and WAN equipment.

1.05 WARRANTY

A. Fifteen (15) year manufacturer's product warranty and 15-year performance warranty for all wiring system components, in writing directly from the manufacturer to the customer, and copied to the engineer. The performance warranty shall warrant the installed cabling system including data cables and fiber optic cables. Copper links shall be warranted against the link performance minimum expected results defined in TIA/EIA 568, tsb-67. Fiber optic links shall be warranted against the link and segment performance minimum expected results defined in the TIA/EIA 568, Annex h.

1.06 STANDARDS

A. All data and video cabling work must comply with federal, state and local codes. Any code or requirement found to be more stringent than in these contract documents shall take precedence over the contract documents, and will become a contract requirement. Contractor must identify and report any deviations being considered from the following standards:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA):

EIA/TIA-568 -- COMMERCIAL BUILDING CABLING STANDARDS AND IEEE 802.3X.

EIA/TIA-569-- COMMERCIAL BUILDING STANDARDS FOR TELECOMMUNICATIONS PATHWAYS AND SPACES.

EIA-TSB36—(TECHNICAL SYSTEMS BULLETIN 36) FOR CABLE SPECIFICATIONS.

EIA/TIA-TSB 67-TECHNICAL SYSTEMS BULLETIN 67)-- TESTING STANDARDS.

EIA/TIA-TSB 72—(TECHNICAL SYSTEMS BULLETIN 72)--CENTRALIZED OPTICAL FIBER CABLING.

EIA/TIA-TSB 75—(TECHNICAL SYSTEMS BULLETIN 75)--OPEN OFFICE CABLING.

EIA/TIA-606 ADMINISTRATION STANDARDS FOR TELECOMMUNICATIONS INFRASTRUCTURE.

EIA/TIA-607—COMMERCIAL BUILDING GROUNDING AND BONDING REQUIREMENTS FOR

TELECOMMUNICATIONS.

EIA/TIA-TSB40A (TECHNICAL SYSTEMS BULLETIN 40A)-- ADDITIONAL TRANSMISSION SPECIFICATIONS FOR UNSHIELDED, TWISTED-PAIR CONNECTING HARDWARE.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA).

NFPA NUMBER 70.

NFPA ARTICLE 725-- REMOTE CONTROL, SIGNALING AND POWER-LIMITED CIRCUITS.

NFPA ARTICLE 800-- COMMUNICATIONS CIRCUITS.

NFPA ARTICLE 770—OPTICAL FIBER CABLES.

UNDERWRITERS LABORATORIES INC (UL).

UL 910—TEST METHOD FOR FIRE AND SMOKE CHARACTERISTICS OF ELECTRICAL AND OPTICAL-FIBER CABLE.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. Data Cable: 1000 feet size and type used for Project. Furnish on reels.

2. Patch Cords: (10) of each type and length used for Project.

3. Station Cables: (10) of each length used for Project.

4. Connecting Blocks: 1 of each type for each 100 installed, but not less than 1.

5. Faceplate./Jack Assemblies: (10) of each type for each 100 installed, but not less than 1.

1.08 DELIVERY, STORAGE AND HANDLING

A. Fiber Optical Cable Delivery:

1. No cable over one year old when delivered to the site will be accepted.

2. Keep ends of cables sealed at all times, except when making splices or terminations. Use methods approved by cable manufacturer.

3. Include the following data durably marked on each reel:

a. Facility name and address.

b. Contractor's name.

c. Project title and number.

d. Date of manufacture.

e. Manufacturer's name.

f. Linear feet.

B. Cable Storage: Store where cable will be at temperature recommended by cable manufacturer for optimum workability.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering Products that may be incorporated in the Work include, but are not limited to, the following:

1. Cable:

a. Mohawk/CDT.

b. Commscope.

c. Belden

d. Amp

e. Cisco

f. Or approved equal

2. Connecting Devices:

a. Leviton

b. Krone

c. Amp

d. Cornell

e. Or approved equal

2.02 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. Expansion Capability: Unless otherwise indicated, quantity of spare conductor pairs in cables, positions in patch panels, cross connects, spare room in equipment racks and terminal strips shall be adequate to accommodate a 10 percent future increase in active workstations.

C. Installer shall determine the quantities of station runs, distribution (backbone) runs, patch panels and all necessary equipment to install data system.

2.03 WIRING PATHWAY AND EQUIPMENT MOUNTING ELEMENTS

A. Distribution IDF Cabinets: Cabinet: Provide lockable, floor-mounted steel units designed for telecommunications terminal and equipment support and coordinated with dimensions of the units to be supported.

1. Each wiring closet is to have adequate quantities of floor standing equipment racks to house patch panels, fiber housings, wire management, data switching equipment and expansion capability. Minimum requirements (2) cabinets for MDF-1, (1) cabinet for IDF-2 and (1) cabinet for IDF-3.

2. Placement of the racks must adhere to applicable EIA/TIA standards for equipment room layout. If conflicts exist between field conditions and standards requirements, then it is the

responsibility of the cabling contractor to bring this situation to the attention of the Owner and the engineer. Final locations shall be determined by Owner.

3. Black, baked-polyester powder coat finish with smoked plexi-glass front with lock and (2) top mounted powered fans.

4. Power strip with 10 surge protected outlets.

5. Approximate Dimensions: 84 inches high by 22 inches wide (2130 mm high by 560 mm wide) overall. (For standard 19" wide rack mounted equipment).

B. Wire Management

1. Double sided horizontal wire management is to be installed above, between and below each patch panel and fiber housing.

2. Top and bottom position wire managers are to be 1.5 inches

3. Wire managers installed in between patch panels are to be 3.0 inches.

4. Double sided, vertical wire management is to be installed down one side of each equipment rack. If multiple equipment racks will be located together in the same wiring closet, then vertical wire managers should be center-mounting type.

5. For Vertical Wire Managers, Minimum Channel Size For Each Channel (Front And Back) Is To Be 4 X4 Inches.

2.04 DATA CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Listed as Complying with Category 6 of EIA/TIA-568: Provide evidence of listing for all products specified in this Article.

B. Data cables shall be 24 awg, (4) pair, unshielded twisted pair (utp) Category 6 (400mhz) cable. The cable sheath is to be blue in color for identification purposes, and labeled to reflect its Category 6 (400mhz) rating. Cable is to meet or exceed the Category 6 (400mhz) rating and be plenum rated.

C. Wireless Access Data cables shall be 24 awg, (4) pair, unshielded twisted pair (utp) Category 6 (400mhz) cable. The cable sheath is to be yellow in color for identification purposes, and labeled to reflect its Category 6 (400mhz) rating. Cable is to meet or exceed the Category 6 (400mhz) rating and be plenum rated.

D. Security Data cables shall be 24 awg, (4) pair, unshielded twisted pair (utp) Category 6 (400mhz) cable. The cable sheath is to be green in color for identification purposes, and labeled to reflect

its Category 6 (400mhz) rating. Cable is to meet or exceed the Category 6 (400mhz) rating and be plenum rated.

E. Patch Panels

1. Patch panels are to be 48 port and 96 port, Category 6 utilizing EIA/TIA 568-B terminations.

2. Panels are to be rack mounted with black anodized faceplates.

3. Patch panels shall have 110 style connectors for the termination of station wiring.

4. If A Patch Panel Port Is Not Functional, Or Cannot Pass Certification Testing, Then It shall be replaced Or The Entire Patch Panel.

F. Face Plates and inserts

1. Data Station faceplates shall be single gang and provide single, two, four, or six ports, dependant on the number of cables at the drop location. Faceplates are to house modular RJ-45 inserts as required.

2. Data modular inserts shall be Category 6 and be flush mounted in faceplate. Terminating Procedures Must Strictly Adhere To The Eia/Tia 568-B Wiring Code.

3. Faceplates shall have ample room to accommodate labeling as detailed further in this specification. Blanks shall be installed in all unused ports.

4. All faceplates shall be compatible with floor boxes.

G. Patch Cords: Red Category 6 patch cables in 24 and 36-inch lengths. Provide one for each patch panel port in the following quantities- 50% at 24 inch and 50% at 36 inch.

H. Station Cables (for connecting computers & printers) : Provide one Blue Category 6 cable for each patch panel port in the following quantities- 25% at 5 foot, 25% at 10 foot, 25% at 15 foot and 25% at 25 foot.

2.05 FIBER OPTIC CABLE CONNECTORS AND EQUIPMENT

A. Fiber Optic Connectors: Connectors shall be “ST” type, with epoxy-less crimp and ceramic ferrule . Connectors must be compatible with fiber optic cable used on the project. DB loss shall not exceed manufacturer’s specified maximum loss per connector.

1. Breakout kits shall be used for all “Loosetube” cables.

B. Fiber Optic Distribution Panels: Panels shall be compatible with a 19" equipment rack and consist of an enclosure fitted with ST style multimode adapter plates for all fiber strands. Each panel shall provide 24 ports.

C. Fiber Optic Termination Cabinet (FTC)

1. 16 gauge steel enclosure with lock by Corning or equal.

2. Adapter plate with factory mounted ST type multimode feed-thru adapters (number of adapters as required).

D. Fiber Patch Cords:

1. Duplex 50 micron/125 micron (core/clad) multimode optical fibers, with a UL rating of OFNR. Optical performance and manufacturer to be the same as specified for fiber optic cable.

2. PVC outer jacket.

3. Cable length of 1 meter.

4. Connectors: Cables shall utilize dual ST-style to SC-style factory-terminated connectors.

5. Quantity equal to the number of fiber connections in each wiring closet, plus one additional cable per closet.

E. Fiber Optic Labels:

1. One label shall be securely fastened to innerduct or fiber optic cable at all pull boxes, manholes, termination points and splice points.

2. Labels shall be plastic laminate with engraved letters of 1/4 inch minimum. Labels shall contain fiber type, size and destination.

3. Each fiber strand and ST connector shall be labeled with a printed label corresponding to an identical label at opposite end.

2.06 IDENTIFICATION PRODUCTS

A. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

2.07 INSTALLATION PRODUCTS

A. Cable Hooks: Steel hooks designed for support of cables; Arlington Industries “CH1M” series, or equal. Provide beam clamps, rods, or other hardware as needed to attach cable hooks to building structure.

B. Sleeves: Provide at least one steel conduit sleeve (minimum size 1.5”), with plastic bushings on each end of conduit from each/every room where there are data and/or video drops. Sleeve shall run from room into hallway to allow for the routing of cabling to nearest data closet. Sleeve shall be installed above accessible ceilings and be placed to avoid mechanical, electric and plumbing work. Provide additional sleeves as required to accommodate number of cables.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine pathway elements to receive cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Wiring Method: Install cables in raceway system in all areas where cable will be exposed. In slab installation, cable is to be installed in PVC. Install pull string in raceways with wiring. Conceal cables except in unfinished spaces and within data closets. In locations with accessible ceilings, cables may be bundled and run above the ceiling supported on cable hooks .

B. Back boxes: plastic insert boxes or insert rings with pressure mounts are not acceptable attachments. All cables terminated on wall plates should be contained within a metal electrical box

C. Cable Routing shall be via the shortest route, and shall be as per EIA/TIA 568 Standards. Routing is to be determined by the Cabling Contactor unless otherwise indicated .

D. Install cable without damaging conductors, shield, or jacket.

E. Do not bend cable in handling or installation to smaller radii than minimums recommended by manufacturers.

F. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously where more than one is being installed in the same raceway.

2. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage media or raceway.

G. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

H. Secure and support cable not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

I. Wiring within data closets and Enclosures: Provide adequate length of conductors. Train the conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to radii smaller than allowed.

J. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.

K. Provide conduit sleeves with protective bushing on ends required for routing of cables.

3.03 DATA CABLE INSTALLATION

A. All voice and data cables are to be terminated . Pair twist must be maintained to within .5 inch of termination point.

B. Install components as indicated, according to manufacturers' written instructions. Use techniques, practices, and methods that are consistent with EIA/TIA 568 standards.

C. All data outlets shall be cabled with individual 4-pair cable with unbroken return to punch down on back of patch panels in closets.

1. No splicing of cable will be allowed.

D. All horizontal data cables shall be independently supported of building structure above suspended ceilings, tunnels, etc. The use of “j” hooks or equivalent hangers are required.

1. Cable supports or hangers shall be placed at a minimum of 3 ½ foot intervals, or closer, to prevent sagging. Install hangers so that all cable is run in the same horizontal plane without rises and falls that cause radiuses in the cable.

2. Cables shall be bundled in groups of not greater than 40 cables in order to insure that bottom cables are not deformed.

E. Separation of Wires: Comply with EIA/TIA-569 rules for separation of unshielded copper data system cables from potential EMI sources, including electrical power lines and equipment.

1. All telecommunications cabling should be separated from a/c power cables by a minimum distance of 12”.

F. Provide 3 feet of cable Slack On The Wiring Closet Side Of The Cables To Allow For Adjustment Of Rack And Patch Panel Positions.

3.04 FIBER OPTIC CABLE INSTALLATION

A. All fiber optic cable must be installed with orange innerduct. Manufacturer’s recommendations for maximum pulling tension and bend radius shall be observed. Cable lubricant shall be applied to all pulls through innerduct.

B. All fiber optic cables must be continuous between distribution frames; no splices will be allowed.

C. Fiber optic cables passing through pull boxes and manholes shall have a service loop of not less than once the inside perimeter of pull box or manhole. Loops shall be inclusive of innerduct.

D. A service loop of no less than 20 ft. shall be fastened to building structure, in a secure location, at all termination points.

E. All Fiber Optic Cable Strands Are To Be Terminated.

3.05 GROUNDING

A. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

B. Bond shields and drain conductors to ground at only one point in each circuit.

C. Signal Ground Terminal: Locate at each equipment room and wiring closet. Isolate from power system and equipment grounding.

D. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements of Division 26 Section "Grounding."

E. Signal Ground Bus: Mount on wall of main equipment room with stand-off insulators.

F. Signal Ground Backbone Cable: Extend from signal ground bus to signal ground terminal in each wiring closet and equipment room.

3.06 INSTALLATION AT MDF/ IDF

A. Mount patch panels, network switches, terminal strips, UPS units, Fiber Termination cabinets and other connecting hardware in racks, except as otherwise indicated.

B. Group connecting hardware for cables into separate logical fields.

C. Provide fiber connectivity to owners existing MDF racks and any associated equipment to complete connectivity.

3.07 LABELING

A. Labeling shall conform to ANSI/TIA/EIA-606 standards. In addition, provide the following:

B. Label each outlet with permanent self-adhesive label with minimum 3/16 in. high characters.

C. Label each cable with permanent self-adhesive label with minimum, 1/8 in. high characters, in the following locations:

1. Inside receptacle box at the work area.

2. Behind the communication closet patch panel or punch block.

D. Use labels on face of data patch panels. Provide facility assignment records in a protective cover at each telecommunications closet location that is specific to the facilities terminated therein.

E. Use color-coded labels for each termination field that conforms to ANSI/TIA/EIA-606 standard color codes for termination blocks.

F. Labels shall be machine-printed. Hand-lettered labels shall not be acceptable.

G. Label cables, outlets and patch panels with prefix (D=Data and V=Video) and room number in which outlet is located, followed by a single letter suffix to indicate particular outlet within room, i.e., D107A, D107B, V107. Indicate riser cables by an R then pair or cable number.

H. Fiber optic labels shall be securely fastened to innerduct and fiber optic cables at all pullboxes, manholes, termination points and splice points.

I. Fiber optic labels shall be plastic laminate with engraved letters of ¼ inch minimum. Labels shall contain fiber type, size and destination.

J. Each fiber strand and ST connector shall be labeled with a printed label corresponding to an identical label at opposite end.

K. Mark up floor plans showing outlet locations, type, and cable marking of cables. Turn these drawings over to the owner two (2) weeks prior to move in to allow the owner's personnel to connect and test owner-provided equipment in a timely fashion. Obtain floor plans from Architect.

L. Three (3) sets of as-built drawing shall be delivered to the owner within four (4) weeks of acceptance of project by the owner. A set of as-built drawings shall be provided to the owner in compact disc media form and utilizing CAD software that is acceptable to the owner. The compact disc media shall be delivered to the owner within six (6) weeks of acceptance of project by owner.

3.08 TESTING

A. Copper (UTP) Testing:

1. Testing of all data cabling shall be performed prior to system cutover. 100 percent of the horizontal and riser wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage. Horizontal data cabling pairs shall be tested from the information outlet to the corresponding IDF point of termination.

2. Data cable runs shall be tested for conformance to the specifications of EIA/TIA 568B Category 6.

3. Test Equipment shall comply with TIA/EIA TSB-67 for level II, TIA/EIATSB-95 for Level IIE, and TIA/EIA 568A Level III Accuracy at basic link.

4. All Data Cables (And All Pairs) Shall Be Tested From Patch Panel to Jack and must measure network-specific channel response to provide accurate pass/fail for all major LAN networking standards.

5. Must be able to provide graphic reports with printouts of full plot data.

6. Complete, end to end test results must be submitted to the owner.

B. Optical Fiber Cable Testing:

1. Each fiber strand, including spare strands, shall be Optical Time Domain Reflectometer (OTDR) tested. Detailed testing specifications will be available after the bid award.

2. The OTDR used shall be equipped with suitable launch cables. The OTDR traces will accurately display dB loss per division and magnify to the largest scale possible, zooming in on the trace being monitored. The raw information that is gathered shall be compiled and displayed in a simple and useable manner. Test results shall be stored on a disk. Hard copy, printed results showing bandwidth (design) and dB loss shall be submitted with documentation package.

3. Horizontal Link Measurement

a. The horizontal link should be tested at 850 nm or 1300 nm in one direction in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper. The attenuation results should be less than 2.0 dB. This value is based on the loss of two (2) connector pairs, one (1) pair at the telecommunications outlet/connector and one (1) pair at the horizontal cross-connect, plus 90 m (295 ft) of optical fiber cable.

4. Backbone Link Measurement

a. The backbone optical fiber link segment will be tested in one direction at BOTH operating wavelengths to account for attenuation deltas associated with wavelength. Single-mode backbone links will be tested at 1310 nm and 1550 nm in accordance with ANSI/EIA/TIA-526-7, Method A.1, One Reference Jumper. 50/125 um backbone links will be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA -526-14A, Method A.1, One Reference Jumper.

5. Cables must pass all tests, for all stands, or shall be repaired or replaced.

C. Pre-installation Cable Testing:

1. The Contractor shall test all lightguide cable prior to the installation of the cable.

2. The Contractor shall assume all liability for the replacement of the cable should it be found defective at a later date.

3.09 FIELD QUALITY CONTROL

A. Employ job superintendent, certified manufacturer of network switches and project manager during the course of the installation to provide coordination of work of this specification and of other related specifications, and provide technical information when requested by owner.

3.010 DOCUMENTION

A. Submit project record drawings at conclusion of the project and include:

1. Approved shop drawings.

2. Plan drawings indicating locations and identification of work area outlets, nodes, IDF and backbone (riser) cable runs.

3. Cross-connect schedules including entrance point, main cross-connects, intermediate cross-connects, and horizontal cross-connects.

4. Labeling and administration documentation.

5. Warranty documents for equipment.

6. Copper certification test result printouts and loaded onto a USB thumb drive.

7. Optical fiber power meter/light source test results.

8. Operation and maintenance manuals

3.011 CLEANING

A. On completion of system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.012 TRAINING

A. The contractor shall provide one (1) man for one (1) week (40 hours) at school beginning with the first scheduled move-in date. This technician will also assist the owner in cross connecting the security, VoIP Telephone, IP CCTV and data services throughout the buildings during the move-in period. It is at this time that all owners provided connectivity schedules for voice and data services will be provided to the contractor. Patching (cross connection) of the station assignments between the owners service demarc shall also be considered part of this contractors work.

END OF SECTION 272102

SECTION 276600 - COMMUNICATIONS EQUIPMENT ROOMS AND FITTINGS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

B. Telecommunications Rooms (MDF/IDF) are generally considered to be floor serving facilities. Horizontal Cross-connects link the Horizontal cable and the Backbone Cable together. The Horizontal Cross-connects shall consist of rack or wall mounted wiring blocks or panels for termination of copper cables or rack or wall mount interconnect termination units or fiber management panels/trays for the termination of optical fibers. Cross-connect spaces include the labeling of hardware for providing circuit identification and patch cords or cross-connect wire used for creating circuit connections at the cross-connect.

1.2 SCOPE

A. This section includes the minimum requirements for equipment, termination hardware and cable installations in communication equipment rooms.

B. The telecommunications room shall be equipped to contain telecommunications equipment, cable terminations, and associated cross-connects.

C. Minimum composition requirements and installation methods for the following:

1. Floor Mounted Relay Racks
2. Wall Mounted Relay Racks and Brackets
3. Floor Mounted Cabinets
4. Cable Management Hardware
5. Cable Ladder Rack (Provided by Electrical Contractor)
6. Patch Panels - Category 6 - Voice
7. Patch Panels - Category 6 - Data
8. Fiber optic panels - Wall Mount Box
9. Fiber optic panels - rack mount (low fiber count)
10. Fiber optic panels/frames- rack mount (moderate fiber count)
11. Fiber optic frames - rack mount (high fiber count)
12. Fiber optic trays - rack mount
13. Back Boards
14. 66 System Blocks
15. Cross Connect Wire
16. Power Strips
17. Optical Fiber Patch Cords
18. Patch Cords - UTP Category 6 - Voice
19. Patch Cords - UTP Category 6 - Data
20. 66 System Patch Cords - Category 6 – Voice
22. Uninterruptable Power Supplies (UPS)

1.3 QUALITY ASSURANCE

A. All equipment rooms shall be installed in a neat and workmanlike manner.

B. All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Authority's representative.

C. Equipment and materials shall be of the quality and Manufacturer indicated.

D. The equipment specified is based on the acceptable manufacturers listed.

E. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified, and subject to approval.

F. Separation from sources of EMI shall be as specified in section.

G. Communication grounding/earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of IEC 1000-5-2, ANSI/TIA/EIA-607, or both be observed throughout the entire cabling system.

H. Materials and work specified herein shall comply with the applicable requirements of:

1. EIA/TIA-568-A.
2. EIA/TIA-569-A
3. EIA/TIA-606
4. EIA/TIA-607
5. Underwriters Laboratory
6. Federal Communications Commission (including CFR 47 and Part 68 - subpart F)
7. National Electric Code
8. Local and State Codes
9. ISO/IEC 11801
10. IEC 1000-5-2
11. CSA C22.2
12. IEC 60603-7

I. Manufacturers shall be ISO 9001 Certified, for all components that are required to have submittals provided as part of this section.

PART 2 – PRODUCTS

2.1 FLOOR MOUNTED RELAY RACKS

A. Racks shall meet the following physical specifications:

1. 19" rack mounting space.
2. 7 foot high.
3. Lightweight, high strength aluminum construction.
4. Black powder coat finish.
5. 15" deep base with four (4) ¾" bolt down holes.
6. EIA Channel width of 3.0", with #12-24 screw holes

B. Rack shall have double sided 12/24 tapped holes and EIA universal rack 5/8" to 5/8"- ½" standard hole pattern (compatible with 11/4"" – ½" hole patterns)

2.2 WALL MOUNTED RELAY RACKS

A. Wall Mounted Relay Racks shall be provided in locations designated on the drawings and shall meet the following physical specifications:

1. 19” EIA rack mounting space.
2. 48” high with 24 mounting spaces.
3. Lightweight, high strength steel construction.
4. Black powder coat finish.
5. Stationary mounting with 21” deep, 14 gauge mounting brackets and 100 lb. capacity.
6. Racks shall have double sides EIA universal rack 5/8” to 5/8”- ½” standard hole pattern (compatible with 11/4”” – ½” hole patterns)

2.3 FLOOR MOUNTED CABINET

A. Floor mounted cabinets shall meet the following specifications:

1. 16 gauge steel construction
2. Nominal 77”x21”x36”
3. Vented roof
4. Removable side panels.
5. Leveling feet

2.4 CABLE MANAGEMENT FOR RELAY RACKS

A. Cable management shall be black metal with integral wire retaining fingers.

B. Vertical cable management panels shall have front and rear channels.

C. Vertical cable management panels shall have removable front and back covers, made of black metal.

D. A horizontal crossover cable manager shall be provided at the top of each relay rack, with a minimum height of 2 rack units each.

E. A horizontal crossover cable manager shall be provided near the center and at the bottom of each relay rack, with a minimum height of 4 rack units.

2.5 LADDER RACK

A. Provide ladder rack in Telecommunications Room (MDF/IDF) as shown on drawings for horizontal cable support).

2.6 PATCH PANELS - CATEGORY 6 – VOICE

A. The termination panels shall support the appropriate Category 6 applications and facilitate cross-connection and inter-connection using modular patch cords.

B. Shall be sized to fit an EIA standard, 19-inch relay rack, or be capable of mounting to a wall.

C. Accommodate at least 24 ports for each rack mount space (1rms = 44.5 mm [1.75 in.]).

D. Have circuit boards tested in both directions as required by ANSI/TIA/EIA-568-A and ISO/IEC

11801.

E. Have patented angle left/angle right modules to provide optimum cable management.

F. Have removable six port modules to allow replacement in the field.

G. Have Category 6 jacks available in both T568A and T568B wiring schemes, with 66-style termination.

H. Allow for a minimum of 200 re-terminations without signal degradation below standards compliance limit.

I. Have modular ports compliant with FCC CFR 47 part 68 subpart F and IEC 60603-7 with 50 micro inches of gold plating over nickel contacts or equivalent.

J. Allow the use of a 4 or 5-pair 66-style impact termination tool.

K. Be fully enclosed front and provide rear plastic strips for physical for physical protection of printed circuit board.

L. Have port identification numbers on both the front and rear of the panel.

M. Provide clear label holders and white designation labels with the panel, with optional color labels available.

N. Be made by an ISO 9001 Certified Manufacturer.

O. ANSI/TIA/EIA-568-A and ISO/IEC 11801 proposed Category 6 compliant.

P. The following requirements shall also be met (NEXT Loss and FEXT tested in both Differential and Common Mode):

Parameters	Performance @ 100 MHz
NEXT Loss	43.0 dB
FEXT	35.1 dB
Insertion Loss (Attenuation)	.4 dB
Return Loss	20 dB

Q. Be UL VERIFIED for TIA/EIA Category 6 electrical performance.

R. Shall be UL Verified for Category 6 compliance and be CSA C22.2 approved.

S. Be made of a steel frame with black power coat finish 24, 48, and 96 port configurations.

T. Have mounting slots compatible with ANSI/EIA-310.

U. Allows the modular insert to accept 66-style patch plugs as a means of termination.

V. Shall be T-568A Wired.

W. Provide 48 port panels, unless otherwise noted.

X. Density must accommodate at least 24 port per single rack unit (1.75" or 44.5mm)

Y. Paired punch down sequence to allow pair twist within ½" of the termination.

Z. Shall have port identification numbers on front and rear of the panel.

AA. Support applications up to 250 MHz

BB. Have 66 style insulation displacement contacts and termination accomplished with a single conductor impact tool or 4 or 5 pair impact tool.

CC. Be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity.

DD. Have circuit identification and color-coding designation strips provided with the panel.

EE. Provide port configurations and densities as called for on drawings.

FF. Provide rear cable management bar(s) as recommended by the manufacturer.

GG. Shall be Insulation Displacement Connector 66 style terminations

HH. Provide EIA/TIA 606 compliant color-coded icons or color-coded designation label strips for all patch panels. Identify voice or data functionality as required

II. Paired punch down sequence to allow pair twist within ½" of the termination.

JJ. Provide rear stress relief components as recommended by the manufacturer.

KK. Acceptable Manufacturers

1. Siemon
2. Hubbell
3. Panduit
4. Or approved equal

2.7 PATCH PANELS - CATEGORY 6 – DATA

A. The termination panels shall support the appropriate Category 6 applications and facilitate cross-connection and inter-connection using modular patch cords.

B. Shall be sized to fit an EIA standard, 19-inch relay rack, or be capable of mounting to a wall.

C. Be made of a steel frame with black power coat finish, in 24, 48, 72 and 96-port configurations.

D. Accommodate at least 24 ports for each rack mount space (1rms = 44.5 mm [1.75 in.]).

E. Have circuit boards tested in both directions as required by ANSI/TIA/EIA-568-A and ISO/IEC 11801.

F. Have patented angle left/angle right modules to provide optimum cable management.

G. Have removable six port modules to allow replacement in the field.

H. Support applications up to 250 MHz

I. Have Category 6 jacks available in both T568A and T568B wiring schemes, with 66-style termination.

J. Have 66 style insulation displacement contacts and termination accomplished with a single conductor impact tool or 4 or 5 pair impact tool.

K. Be backwards compatible to allow lower performing categories of cables or connecting hardware to operate to their full capacity.

L. Allow for a minimum of 200 re-terminations without signal degradation below standards compliance limit.

M. Have modular ports compliant with FCC CFR 47 part 68 subpart F and IEC 60603-7 with 50 microinches of gold plating over nickel contacts or equivalent.

N. Allow the use of a 4 or 5-pair 66-style impact termination tool.

O. Be fully enclosed front and provide rear plastic strips for physical protection of printed circuit board.

P. Have port identification numbers on both the front and rear of the panel.

Q. Provide clear label holders and white designation labels with the panel, with optional color labels available.

R. Have circuit identification and color-coding designation strips provided with the panel.

S. Be made by an ISO 9001 Certified Manufacturer.

T. ANSI/TIA/EIA-568-A and ISO/IEC 11801 proposed Category 6 channel compliant.

U. The following requirements shall also be met (NEXT Loss and FEXT tested in both Differential and Common Mode):

Parameters	Performance @ 100 MHz
NEXT Loss	43.0 dB
FEXT	35.1 dB
Insertion Loss (Attenuation)	.4 dB
Return Loss	20 dB

V. Be UL VERIFIED for TIA/EIA Category 6 electrical performance.

1. Shall be UL Verified for Category 6 compliance and be CSA C22.2 approved.
2. Provide EIA/TIA 606 compliant color-coded icons or color-coded designation label strips for all patch panels. Identify voice or data functionality as required.
3. Provide 48 port panels, unless otherwise noted

Z. Paired punch down sequence to allow pair twist within ½" of the termination.

AA. Shall have port identification numbers on front and rear of the panel.

BB. Density must accommodate at least 24 port per single rack unit (1.75" or 44.5mm)

CC. Have mounting slots compatible with ANSI/EIA-310.

DD. Allows the modular insert to accept 66-style patch plugs as a means of termination.

EE. Shall be T-568A Wired.

FF. Provide port configurations and densities as called for on drawings.

GG. Provide rear cable management bar(s) as recommended by the manufacturer.

HH. Shall be Insulation Displacement Connector 66 style terminations.

II. Provide rear stress relief components as recommended by the manufacturer.

JJ. Be UL verified for TIA/EIA Category 6 electrical performance.

KK. Acceptable Manufacturers:

1. Siemon
2. Hubbell
3. Panduit
4. Or approved equal

2.8 FIBER OPTIC PANELS - WALL MOUNT BOX

A. All panels and trays (units) shall provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

B. The wall mount interconnect center shall:

1. Be available in 12,24 port termination densities for single door applications
2. Be available in 12,24 and 48 port termination densities for dual door applications
3. Accommodate various simplex connectors including ST®, SC, FC and LX.5
4. Have single or dual hinged doors.
5. Have the ability to mount the cable clamp on the interior of the panel
6. Feature adapters which are angled
7. Have radiused outer edges and be putty white in color
8. Offer factory termination of the optical cable as an option
9. Be made by an ISO 9001 certified manufacturer
10. Provide port configurations and densities as called for on drawings.

2.10 FIBER OPTIC PANELS - RACK mount (low fiber count)

A. All panels and trays (units) shall provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

B. Shall be available in 12 and 24 port with no splicing.

C. Be available in 24 port configuration for splicing.

D. Allow mounting in either 19” or 23” equipment bays.

E. Allow flush or 5” recess mounting.

F. Use adapter plates that house 6 adapters each.

G. Have adapters angled to the left and right of the panel.

H. Be available in black.

I. Be made by an ISO 9001 certified manufacturer.

J. Shall meet or exceed all TSB-72 requirements.

K. Provide port configurations and densities as called for on drawings.

L. Shall be wall or rack mountable.

M. Shall have a hinged removable front cover.

N. Shall feature a front access design with a hinged bulkhead plate.

O. Shall house 6 adapters per adapter plate.

2.11 FIBER OPTIC PANELS/FRAMES - RACK MOUNT (MODERATE FIBER COUNT)

A. All panels and trays (units) shall provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

B. Shall be available in 12, 24, 48, 72 and 96 port configurations.

C. Feature a front access design with hinged bulkhead plate.

D. Use adapter plates that house 6 adapters each.

E. Have a hinged removable front cover.

F. Have adapters that are angled to the left of the panel.

G. Have an integrated vertical cableway on one side of the panel.

H. Be mountable in flush, 1”2” and 5” recess options.

I. Be 19” and 23” rack mountable.

J. Have storage and splicing options as part of the product offering.

K. Support the addition of optical components such as WDM’s and splitters to the product offering.

L. Be available in putty.

M. Be made by an ISO 9001 certified manufacturer.

N. Provide port configurations and densities as called for on drawings.

2.12 FIBER OPTIC FRAMES - RACK MOUNT (HIGH FIBER COUNT)

A. All panels and trays (units) shall provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

B. Shall be available in putty, and made of 12-gauge aluminum alloy.

C. Available in up to 24, 32, 48, and 72 port versions with ST® fiber adapters preloaded into adapter plates or 48, 64, 96 and 144 port versions using quad SC fiber adapters preloaded into adapter plates.

D. Have preloaded adapter plates with SC, ST®, or LX.5 fiber adapters in 6 and 8 port versions as well as a 12 port version for the SC adapter.

E. Have blank adapter plates for future growth of the fiber infrastructure.

F. Have fiber managers to effectively store fiber cable slack and comply with fiber bend radius requirements.

G. Have six and eight port fiber adapter plates, which allow for color coding connectors.

H. Have fiber adapter plates with snap-in installation.

I. Accommodate stackable splice trays, each tray manages a total of 24 splices.

J. Have an adapter plate-mounting bracket, which slides out to the front and to the rear of the unit for increased access.

K. Have cable access points for fiber jumpers entering and exiting the unit with rotating grommets to facilitate cable loading and to minimize micro bending stress.

L. Have anchor points for fiber cable(s) entering the unit.

M. Have labeling which meets or exceed ANSI/TIA/EIA-606 requirements and also be laser printable.

N. Be able to mount both 19-inch and 23-inch rack/cabinets.

O. Be UL C22.2 approved.

P. Be made by an ISO 9001 Certified Manufacturer.

Q. Provide port configurations and densities as called for on drawings.

2.13 FIBER OPTIC FRAMES - (HIGH FIBER COUNT)

A. All panels and trays (units) shall provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

B. Shall be available in 72 and 96 port configurations.

C. Feature termination panels with individual adapter retainers.

D. Feature termination panels with angled adapter retainers with ½ the panel angled to the left and ½ the panel to the right.

E. Have various termination, splice and storage units available that can be mixed and matched within a common frame.

F. Support termination densities up to 864 per frame.

G. Offer connector styles of SC, FC, ST® and LX.5.

H. Be made by an ISO 9001 certified manufacturer.
I. Provide port configurations and densities as called for on drawings.

2.14 FIBER OPTIC TRAYS - RACK MOUNT

A. All panels and trays (units) shall provide cross-connect, inter-connect, splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.

B. Rack-Mounted Fiber Tray

C. The rack mounted fiber tray shall:

1. Be made of 18-gauge steel with a black finish.
2. Available in 16-, 24-, 28-, 32- and 48-port configurations, and be able to double that port count utilizing 6-port adapters.
3. Accommodate SC, ST®, and LX.5 adapters.
4. Accommodate hybrid adapter bezels for ST®-to-SC or SC-to-ST® connections.
5. Have changeable ports, which are removed from the front of the unit to allow custom configuration or modification.
6. Have silk-screened port identification numbers provided on both the front and rear of the panel.
7. Include fiber managers that manage slack storage so as to comply with fiber bend radius requirements and slack storage length recommendations.
8. Accommodate stackable splice trays, which manage up to 24 splices per tray.
9. Have a smoked polycarbonate cover with quarter turn screws for easy access.
10. Not exceed a 254 mm (10 in) depth for mounting in standard cabinets and enclosures.
11. Be provided with strain relief lugs for the fiber cable entering the unit from the side or back.
12. Be made by an ISO 9001 Certified Manufacturer.
13. Provide port configurations and densities as called for on drawings.

2.15 BACKBOARDS

A. Shall be 4 x 8 x ¾" ACX or BCX, exterior grade, fire rated plywood.

B. Shall be painted – gray, acrylic, interior, fire retardant paint.

C. Provide adequate support and dress horizontal cabling between ladder rack and 66 wiring blocks as necessary or as shown on the drawings. Review cable routing plan for the Telecommunications Rooms, in the field, before installation of cabling commences.

2.16 MODULAR 66M SYSTEM BLOCKS

A. The connecting hardware block shall support the appropriate Category 6, applications and facilitate cross-connection and/or inter-connection using either approved cross-connect wire or patch cords.

B. Shall be modular 66M System IDC style blocks.

C. Be UL VERIFIED or equivalent for TIA/EIA proposed Category electrical performance.

D. Be ANSI/TIA/EIA-568-A and ISO/IEC 11801 Category 6 compliant.

E. The following requirements shall also be met (NEXT Loss and FEXT tested in both Differential and Common Mode):

Parameters	Performance @ 100 MHz
NEXT Loss	43.0 dB
FEXT	35.1 dB
Insertion Loss (Attenuation)	.4 dB
Return Loss	20 dB

F. Be UL VERIFIED or equivalent for TIA/EIA proposed Category electrical performance.

G. Be CSA C22.2 approved or equivalent.

H. Be made of flame-retardant thermoplastic.

I. Be available in 50-, 100-, and 300-pair sizes.

J. Have 50-, 100, - and 300 pair blocks available without legs while the 100, and 300 pair blocks are available without legs.

K. Blocks shall include means to identify cables/services per ANSI/TIA/EIA-606.

L. Have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert labels provided with the product shall contain vertical lines spaced on the basis of circuit size (3-, 4- or 5-pair) and shall not interfere with running, tracing or removing jumper wire/patch cords. Label holders must be capable of mounting in the under portion of the wiring block.

M. Have connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. The connecting blocks shall be available in 3-, 4- and 5-pair sizes. All connecting blocks shall have color-coded tip and ring designation markers and be of single piece construction.

N. Have connecting blocks with a minimum of 200 re-terminations without signal degradation below standards compliance limit.

O. Support wire sizes: Solid 22-26 AWG (0.64 mm - 0.40 mm), and 7-strand wires.

P. Be made by an ISO 9001 Certified Manufacturer.

Q. Shall be 300 pair blocks, typical for feed and station cable, unless otherwise noted.

R. Provide keep-off indicator buttons on all active cross-connected pairs used for alarm and security purposes. Coordinate the color and use with the Authority's representative.

S. Provide connecting block designation label strips of the colors conforming to EIA/TIA 606, including but not limited to the following:

2.17 CROSS CONNECT

A. Provide modular 66M cross connect blocks for all backbone terminations.

B. Cross-connects shall be made with wire of equal gauge to that of the feed cable, which it is being connected to.

C. Shall be UL listed

D. Provide (1) roll of 1 pair and (1) roll of 2 pair per Telecommunications Room (TR). Coordinate color code of one and two pair with the Authority's representative.

2.18 POWER STRIP

A. Shall be 20 amp, 115V.

B. Shall be rack mounted.

C. Shall be non-switched.

D. Shall provide a minimum of one power strip per rack that contains active electronics, or as detailed on the drawings.

E. Shall be surge suppressed.

F. Shall have a minimum of 6 outlets – transformer spaced where possible.

G. Must have 20 amp twist lock plug.

H. Shall have a 10' cord, minimum.

I. Shall be UL listed and must meet UL 1363 and 1449 requirements.

2.19 OPTICAL FIBER PATCH CORDS - Multimode

A. Shall be available in standard lengths of 1, 3, and 5 meters, custom lengths shall also be available, and shall meet or exceed standards as defined in ANSI/TIA/EIA-568-A and ISO/IEC 11801.

B. Utilize duplex optical fiber cable that is 62.5/125 or 50/125 micron multimode, OFNR riser grade, and meets the requirements of UL 1666.

C. Utilize optical fiber cable where the attenuation shall not exceed 3.5 dB/km @ 850 nm wavelength or 1.0 dB/km @ 1300 nm.

D. Have a cable jacket color for 62.5/125 in gray and 50/125 in orange.

E. Be equipped with SC or ST® in accordance with TIA/EIA-568-A and must include a ceramic ferrule.

F. Have ST® connectors with a metal coupling nut.

G. Have terminated connectors exhibit a maximum insertion loss of 0.75 dB with an average of 0.40dB when tested at either 850 nm or 1300 nm wavelengths for 62.5/125 □m.

H. Have terminated connectors exhibit a maximum insertion loss of 0.75 dB with an average of 0.50dB when tested at either 850 nm or 1300 nm wavelengths for 50/125 □m.

I. Have a minimum return loss of 20 dB (25 dB typical) at both 850 nm & 1300 nm.

J. Be made by an ISO 9001 Certified Manufacturer.

K. Be UL 1666 approved.

L. Shall be a duplex fiber cable meeting or exceeding the transmission characteristics of the optical fiber horizontal cable.

M. Connectors shall be either LX.5 or duplex T568SC, as specified on the drawings or equipment schedules.

N. Jackets shall be orange in color for multi-mode connections and yellow for single mode connections.

O. The following configurations may be required:

1. ST/ST
2. SC/SC
3. LX.5/LX.5
4. ST/SC
5. SC/LX.5
6. ST/LX.5

2.20 CATEGORY 6 PATCH CORDS - MATCH COLOR OF VOICE CABLES

A. Shall be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted-pairs within a flame-retardant jacket.

B. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.

C. Use modular plugs, which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications, and have 50 microinches minimum of gold plating over nickel contacts.

D. Be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants.

E. Utilize cable that exhibits power sum NEXT performance.

F. Be available in several colors with or without color strain relief boots providing snagless design.

G. Meet the flex test requirements of 1000 cycles with boots and 100 cycles without boots.

H. Be available in any custom length and standard lengths of meters (3, 5, 7, 10, 15, 20, and 25 feet).

I. Be made by an ISO 9001 Certified Manufacturer.

J. Electrical Specifications:

1. Input impedance without averaging 100 + 15% from 1 to 100 MHz.

2. 100% transmission tested for performance up to 100 MHz. Manufacturer shall guarantee cords are compatible with Category 6 links.
3. Utilize cable that is UL VERIFIED (or equivalent) for TIA/EIA proposed Category 6 electrical performance.
4. UL LISTED 1863.

2.21 CATEGORY 6 PATCH CORDS - MATCH COLOR OF DATA CABLE

A. Shall be round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted-pairs within a flame-retardant jacket.

B. Be equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring.

C. Be backwards compatible with lower performing categories.

D. Use modular plugs, which exceed FCC CFR 47 part 68 subpart F and IEC 60603-7 specifications, and have 50 microinches minimum of gold plating over nickel contacts.

E. Have matching color strain relief boot with a snagless design which shall meet the flex testing as called out in1000 cycles with boots and 100 cycles without boots.

F. Be resistant to corrosion from humidity, extreme temperatures, and airborne contaminants.

G. Utilize cable that exhibits power sum NEXT performance.

H. Be available in any custom length and standard lengths of (3, 5, 7, 10, 15, 20, and 25 feet).

I. Be made by an ISO 9001 Certified Manufacturer.

J. Electrical Specifications:

1. Have input impedance without averaging: 100 + 15% from 1 to 100 MHz, + 22% from 100 to 200 MHz and + 32% from 200 to 250 MHz.
2. Be 100% transmission tested for performance up to 250 MHz. Manufacturer shall guarantee cords are compatible with proposed Cat-6 links.
3. Utilize cable that is UL VERIFIED (or equivalent) for TIA/EIA proposed Category 6 electrical performance.
4. Be UL LISTED 1863.

2.23 UNINTERUPPTABLE POWER SUPPLY (UPS)

A. Input and Output connections of the UPS units shall be configured in accordance with the devices the unit is intended to power.

B. Individual UPS units shall be sized to provided two (2) hours of operation for the equipment it powers.

C. UPS units shall comply with the following specification:

1. Waveform Type shall be sine wave.
2. Battery Type Sealed Lead-Acid battery
3. Interface Port: DB9, RS232
4. Mgmt. Software Windows based with Server Shut down

5. Rack Mounted.
6. Acceptable Manufacturers:
    a. APC
    b. Tripp Lite
    c. Best Power
    e. Or approved equal

PART 3 - EXECUTION

3.1 FLOOR MOUNTED RELAY RACKS

A. All racks shall be anchored to the floor.

B. Provide vertical and horizontal cable as shown on drawing.

C. Mount with a minimum of 36" feet clear access behind and front of rack from the wall to a rack.

D. Ground the rack to the equipment ground bar with a #6 copper wire.

E. Communication grounding/earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of IEC 1000-5-2, ANSI/TIA/EIA-607, or both be observed throughout the entire cabling system.

3.2 WALL MOUNTED RELAY RACKS

A. Secure Wall Mounted Relay Racks to building structure with approved anchoring means.

B. Verify all existing wall construction and submit proposed anchoring methods for approval.

C. Provide vertical and horizontal cable management both front and rear wherever available.

3.3 LADDER RACK

A. Ladder Rack shall be secured to walls and top of equipment rack.

B. Communication grounding/earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of IEC 1000-5-2, ANSI/TIA/EIA-607, or both be observed throughout the entire cabling system.

3.4 CABLE MANAGEMENT

A. Provide horizontal and vertical cable management in each cabinet; with horizontal cable management between each piece of electronics.

B. A horizontal crossover cable manager shall be provided at the top and bottom of each relay rack, with a minimum height of 2 rack units each.

C. A horizontal crossover cable manager shall be provided near the center of each relay rack, with a minimum height of 4 rack units.

D. Provide two rear cable management bars and reusable Velcro-type hook and loop straps in each rear vertical channel. Reusable straps shall be of varying sizes (each allowing 50% spare future expansion) and of adequate quantity to secure cable bundles at least every 4 rack units.

E. Secure cable managers, slack managers, support bars, hook and loop straps per manufacturer recommendations.

3.5 CATEGORY 6 PATCH PANELS – VOICE

A. Install and label as recommended by manufacturer per all EIA/TIA 606.

B. Install rear cable management bar(s) as recommended by manufacturer.

C. Install EIA/TIA 606 compliant color-coded icons or color-coded designation label strips for all patch panels. Identify voice functionality.

3.6 CATEGORY 6 PATCH PANELS – DATA

A. Install and label as recommended by manufacturer, per all EIA/TIA 606.

B. Install rear cable management bar(s) as recommended by manufacturer.

C. Install EIA/TIA 606 compliant color-coded icons or color-coded designation label strips for all patch panels. Identify Data functionality.

3.7 OPTICAL FIBER PATCH PANELS

A. Install as shown on drawings.

B. Furnish and Install labels for each strand, as per the Authority's instruction in the field or as shown on drawings.

C. Install blank adapter panels in all positions not used at time of installation for fiber terminations.

3.8 CABLE SUPPORTS

A. Provide "D" rings on 2 ft. center for all exposed wall mounted vertical Category 6 cable runs.

B. Keep horizontal wall mounted cable runs to a minimum. In general, horizontal runs shall be on wall mounted ladder rack.

C. Provide cable brackets 3' on center supported to building structure for all cable runs not supported by cable tray.

3.9 BACKBOARDS

A. Linear wall space used for anchoring equipment shall be lined for the full room width with plywood, per the drawings.

B. Plywood for mounting termination equipment on shall be installed vertically, side by each, a minimum of 6" above finished floor. Mounting shall be sufficient enough to support the equipment.

C. Plywood for supporting backbone riser cables shall be installed vertically, resting directly on the finished floor. Anchoring and mounting techniques of plywood used to support backbone riser cables shall be sufficient to support a minimum of 1000 pounds of weight.

D. In no cases shall the heads of mounting screws protrude past the face of any plywood.

E. Install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

3.10 MISCELLANEOUS REQUIREMENTS

A. All cables shall be neatly “dressed out” in equipment rooms.

B. Provide service loops on all cables terminated in the telecommunications rooms, per the drawings.

C. Firestop all sleeves and conduits openings after the cable installation is complete.

3.11 MODULAT 66M SYSTEM BLOCKS

A. Installed on plywood backboard so that top of 300 pair block is 5’6” AFF, or a noted on the drawing.

B. Mount Blocks with steel, zinc plated 5/16" slotted hex head #10 x 3/4" drill screws, minimum four screws per block.

C. Install designation strips color-coded in conformance with EIA/TIA 606 standard.

D. Install insulator clips (sometimes called keep-offs) on all Life and Safety special circuits in the Telecommunications Rooms (MDF/IDF), coordinate desired color code requirements with the Authority’s representative.

END OF SECTION 276600