PART 1 - GENERAL

1.1. SUMMARY

A. The work covered under this Section shall consist of a design, furnishing of all material, labor, and installation for completion of an operable end to end backbone structured cabling system throughout the campus and premises. This includes - but is not limited to - furnishing and installing cable, cable supports, cable ties, innerduct and termination components, ancillary equipment, testing, labeling and documentation of cables and connectors.

B. Complete product procurement and installation shall comply with the campus or owner's latest telecommunication and Information Technology standards documents.

PART 2 - PRODUCTS

2.1. MANUFACTURER(S) AND SOLUTIONS

A. Acceptable backbone voice copper (interbuilding and intrabuilding) manufacturers:

1. Berk-Tek

B. Acceptable backbone (indoor and outdoor) coaxial television cable and components manufacturer:

1. Commscope 540 Series.
2. Commscope 540 Series Termination Systems.

C. Acceptable fiber optic (interbuilding and intrabuilding) manufacturers:

1. Corning Altos Composite.

2.2. BASIC ENVIRONMENTAL REQUIREMENTS

A. Cabling shall be suitable for environment in which they are to be installed.

B. Cabling shall be plenum-rated within interior premise installations.

C. Cabling shall be outdoor rated within exterior installations subject to outdoor environmental conditions.

2.3. INTRABUILDING COPPER CABLING (VOICE)

A. Backbone Cable shall incorporate 24 AWG solid annealed copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene. Conductors shall be twisted to form pairs and fully color-coded. Cable shall be available in 25, 50, 100, 200 or more pairs.

B. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with the latest ICEA publication of S-80-576.

C. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair sub-units. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.

D. The cables shall contain an overall corrugated, coated aluminum shield that is electrically continuous over its entire length.

E. Provide one full 500-foot spool of 24-AWG two-pair jumper wire on a spool holder for additional cross connects by owner.

2.4. INTERBUILDING COPPER CABLING (VOICE)

A. Cables shall incorporate 24 AWG solid, annealed, bare copper conductors insulated with a polyvinyl chloride skin over expanded polyethylene.

B. Conductors shall be twisted to form pairs and fully color-coded. Cable shall be available in 25, 50, 100, 200 or more pairs.

C. Cables shall be designated RUS/REA PE-89 suitable for duct or direct burial applications. Cables shall be Aluminum Steel with Polyethylene (ASP) filled core cables.

D. Conductors shall be insulated with a thermoplastic skin. Maximum diameter of the insulated conductor shall be 0.048 in (1.22 mm). Insulated conductors shall be stranded into pairs of varying lengths in order to minimize cross-talk.

E. Conductors shall be identified by the insulation color of each conductor. The color code shall follow the industry standard composed of ten (10) distinctive colors to identify 25 pairs in accordance with the latest ICEA publication of S-80-576.

F. When cables of larger than 25 pairs are required, the core shall be assembled into 25-pair sub-units. Cables with over 600 pairs shall have 25-pair binder groups combined into super units. These super units shall be wrapped with a solid color thread that follows the primary color scheme of white, red, black, yellow and violet. Binder color code integrity shall be maintained wherever cables are spliced.

G. Cable shall meet the physical and electrical requirements of 100 Ohm twisted pair cable as defined by standards. Cable shall conform to Category 3 performance specifications or better.

H. A flooding compound shall be applied over the core and to all surfaces of the shield/armor to resist moisture entry and to inhibit corrosion.

I. The cable core shall be filled with a waterproofing compound and wrapped with a non-hydroscopic core tape.

J. The cables shall contain an overall corrugated, coated aluminum shield, which is electrically continuous over its entire length.

K. The cable shall be finished with a polyethylene jacket, which is sequentially printed with a footage marker at regular intervals.

2.5. VOICE TERMINATION FIELD

A. Voice terminations shall utilize 110 style termination block hardware with 25 pairs per row.

B. The mechanical termination shall be capable of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.

C. 4-pair connecting blocks shall be utilized to make electrical connection between terminated cables and cross connect wires. The blocks shall be designed to maintain the cable pair twists as closely as possible to the point of mechanical termination.

D. Base shall employ standoff legs to allow cable routing behind base.

E. Base shall have integral label holder to identify location of cable.

F. Horizontal management shall be via jumper troughs furnished with standoff legs.

G. Provide a punchdown tower kit system for mounting the 110 block units. System shall include jumper troughs and provide horizontal cable management.

H. Vertical cable management shall be via multi pair vertical cable managers designed for use with the tower system.

2.6. INTRABUILDING FIBER OPTIC CABLE

A. This cable shall be suitable for indoor installation in free-air, conduit, tray and/or in innerduct. Cable shall carry on OFNP rating.

B. Cable materials shall be all dielectric.

C. Cable shall be composite.

D. Outer sheath shall be marked with the manufacturer's name, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet. All coatings shall be mechanically strippable without damaging the optical fiber.

E. The glass fiber shall be doped silica core surrounded by a concentric glass cladding. The fiber shall have a graded index. The overall cladding diameter shall be 125 ± 2µm.

F. Multi-mode optical fibers in each cable shall meet the following specifications:

1.	Transmission Windows	850nm, 1300nm, and minEMBc (Laser)
2.	Core Diameter	50.0 ± 3µm
3.	Maximum Attenuation	3.0 dB/km @ 850nm; 1.0 dB/km @ 1300nm
4.	Minimum Bandwidth	3500 MHz/km @ 850nm 500 MHz/km @ 1300nm 4700 MHz/km @ minEMBc (Laser)
5.	Fiber Classification	OM4

G. Single-mode optical fibers in each cable shall meet the following specifications:

1.	Transmission Windows	1310nm, 1383nm and 1550nm
2.	Core Diameter	8.3µm
3.	Maximum Attenuation	0.5 dB/km @ 1310nm 0.5 dB/km @ 1383nm 0.5 dB/km @ 1550nm
4.	Fiber Classification	OS2

2.7. INTERBUILDING FIBER OPTIC CABLE

A. Cable shall be suitable for direct burial or duct applications.

B. Cable shall incorporate a corrugated steel armor tape to provide rodent resistance. Other cable materials shall be all dielectric.

C. Cable shall be composite.

D. Cable shall be constructed with a dry or gel-filled water-blocking material.

E. Cable shall be of loose tube construction.

F. Outer sheath shall be polyethylene (PE).

G. The outer sheath shall be marked with the manufacture name, words identifying the cable as fiber optic cable, and sequential length markings. The marking shall be in a contrasting color to the cable jacket.

H. Quantity and type of standards shall be as indicated on the drawings.

1.	Transmission Windows	850nm, 1300nm, and minEMBc (Laser)
2.	Core Diameter	50.0 ± 3µm
3.	Maximum Attenuation	3.0 dB/km @ 850nm; 1.0 dB/km @ 1300nm
4.	Minimum Bandwidth	3500 MHz/km @ 850nm 500 MHz/km @ 1300nm 4700 MHz/km @ minEMBc (Laser)
5.	Fiber Classification	OM4

I. Single-mode optical fibers in each cable shall meet the following specifications:

1.	Transmission Windows	1310nm, 1383nm and 1550nm
2.	Core Diameter	8.3µm
3.	Maximum Attenuation	0.5 dB/km @ 1310nm 0.5 dB/km @ 1383nm 0.5 dB/km @ 1550nm
4.	Fiber Classification	OS2

2.8. INDOOR/OUTDOOR FIBER OPTIC CABLE

A. Cable shall be provided wherever it shall run within a wet environment or where it would be exposed to an outdoor condition.

B. Cable shall be suitable for installation both indoors and outdoors.

C. Cable shall retain an OFNP plenum rating to meet the listing requirements per CEC for use within building premises.

D. Cable shall be loose tube construction.

E. Cable shall constructed with a dry of gel-filled type water blocking material.

2.9. FIBER OPTIC TERMINATION PANELS

A. All fibers shall be terminated on Duplex-LC couplings mounted on enclosed patch panels. Couplers shall be mounted on a panel that snaps into the enclosure.

B. The enclosure shall be designed to accommodate a changing variety of connector types by changing panels on which connector couplings are mounted.

C. The panel enclosure shall be sized to accommodate the total quantity of fiber strands as described in the specifications and drawings.

D. Termination panels shall be enclosed assemblies. The enclosures shall incorporate a hinged or retractable front cover designed to protect the connector couplings and fiber optic jumpers.

E. The patch panel enclosure shall provide for strain relief of incoming cables and shall incorporate radius control mechanisms to limit bending of the fiber to the manufacturers recommended minimums.

F. Access to the inside of the patch panel enclosure during installation shall be from the front and rear.

G. The patch panel enclosure shall be configured to require only front access when patching. The enclosure shall provide a physical barrier to access of backbone cables.

H. The enclosure shall incorporate a storage cassette, tray, or other mechanism designed to allow identification, access and termination of individual fibers.

I. The fiber optic patch panel shall be rated to match or exceed the ANSI/TIA/EIA rated wiring terminated on the panel.

J. Provide Corning CCH Termination Panels for CCH Enclosures.

2.10. FIBER OPTIC CONNECTOR

A. The Optical Connector shall be Duplex-LC type modular jack. Completed cable assembly shall interface with fiber optic terminal bulkhead feed-through receptacle on Fiber Optic Patch Panel. Supply and install dust caps for terminated fibers.

B. The connector ferrule shall be ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive [or mechanical connection].

2.11. FIBER OPTIC PATCH CORDS

A. The fiber optic patch cables shall match the core size and type of fiber being patched. The fiber optic patch cables shall utilize tight buffer construction.

B. Fiber Optic jumpers shall incorporate connectors that match the terminations of the fiber being patched. Connector body shall be of materials similar to that used in the proposed couplings.

C. Provide patch cords with connectors compatible with equipment being patched. Verify connector type of active electronic equipment with owner.

D. Provide one optical fiber patch cord per optical fiber strand installed.

E. For the TR patch cords, 80% shall be 3 meters, 10% shall be 4 meters and 10% shall be 7 meters in length from the total number.

2.12. FIBER OPTIC SPLICE ENCLOSURE

A. Splices shall be allowed where required to transition between different fiber optic cable types.

B. The splice enclosure shall be designed specifically for use in the splicing of fiber optic cables and incorporate splice trays. One splice tray shall be used for each fiber bundle. The enclosure and the splice trays shall be designed to organize adequate slack to allow for re-splicing.

C. The splice enclosure shall incorporate strain relief for the incoming cables.

D. Splice enclosure shall be re-usable for system expansion or repair.

E. Provide Corning CCH-01U at each end of the run. 2 cables have a total of 4 housings. Each housing will have (1) CCH-CP24-D3 for multimode fiber and (1) CCH-CP24-A9 for singlemode fiber.

2.13. TELEVISION INDOOR BACKBONE COAX

A. Center conductor - 0.124”

B. Outer diameter - 0.514”

C. Impedance 75-Ohms

D. Velocity of propagation 88%

E. Maximum attenuation (per 100-feet)

1. at 55-MHz 0.48 dB
2. at 750-MHz 1.85 dB

2.14. TELEVISION OUTDOOR BACKBONE COAX

A. Center conductor - 0.124”

B. Outer diameter - 0.610”

C. Impedance 75-Ohms

D. Velocity of propagation 88%

E. Maximum attenuation (per 100-feet)

1. at 55-MHz 0.48 dB
2. at 750-MHz 1.85 dB

F. Cable shall employ a water blocking material

2.15. COAX CABLE TAPS, DIRECTIONAL COUPLERS, AND SPLITTERS

A. All directional couplers and splitters shall support a video bandwidth of 1 GHz.

2.16. COAX TERMINATION END

A. F connector shall be male type connector impedance matched to the cable that is terminated.

B. Connector shall be single piece construction and incorporate a ½" crimp ring with a hex crimp.

C. Female type connectors shall be matched to male connectors.

PART 3 - EXECUTION

3.1. INTRABUILDING COPPER CABLING (VOICE)

A. Follow cable manufacturer's cable pulling recommendations. Recommended pulling tensions and pulling bending radii shall not be exceeded. Any cable bent beyond minimum bending radius shall not be installed.

B. All cable shall be free of tension at both ends. A ten foot service loop shall be provided with each backbone cable.

C. Avoid abrasion and other damage to cables during installation.

D. Pulling Lubricant shall be used to ease pulling tensions. Lubricant shall not damage or degrade cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.

E. Termination of Backbone Voice cabling shall be accomplished by using five-pair clips.

F. Cables shall be installed in conduit, cable tray, or on J-hooks as shown on the Drawings.

3.2. INTERBUILDING COPPER CABLING (VOICE)

A. All conductors shall be continuous and splice free.

B. Bridge taps shall not be allowed.

3.3. VOICE TERMINATION FIELD

A. Horizontal wiring troughs shall be positioned at the top of each column of termination blocks and between each 100-pair wiring block.

B. Vertical cable managers incorporating metal distributing rings shall be provided for vertical routing of jumper and/or cross-connect wire.

C. Utilize multiple 300 or 900 pair tower systems and corresponding vertical cable managers to create termination fields.

D. Blocks shall identify each pair position by a different color designation. Integral label holders shall allow for easy identification of each location.

E. The Contractor shall be responsible for the cross connect between the station and backbone cabling.

F. Cross connect the center two pair of each station cable to the backbone cable. Use single or two pair cross connect wire for this purpose.

G. Fastening cables directly to support brackets with wire or plastic ties will not be accepted. All cabling shall be neatly laced, dressed and supported. Retainer shall be used on each 110-type block to secure jumper wires on the wiring block(s).

H. Termination blocks shall have a minimum capacity of 20% spare pairs after all horizontal cabling is terminated.

3.4. FIBER OPTIC CABLE

A. Cable shall be continuous and free of splices except in specified splice trays in TR or ER locations. Factory optical fiber splices are not allowed.

B. The fiber manufacturer shall subject all fibers to a minimum tensile proof test equivalent to 100-kpsi. All fibers in each cable shall be guaranteed to meet the stated specifications.

C. Backbone intra-building fiber optic cabling shall be installed via conduit and/or in innerduct in cable tray as illustrated on the drawings.

D. Provide 15 feet of slack in each backbone fiber optic cable. The cable slack shall be coiled and stored in a location to protect it from damage in the TR or ER in the case of inter-building cables. The slack shall be stored in a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.

E. Maintain bending radius of twenty times the outside diameter of the cable during installation and ten times the outside diameter with no load.

F. Backbone Fiber Optic Cable shall be installed in protective innerduct where cable is susceptible to damage. This includes areas cable tray and transitions between pathways. The innerduct should extend into the termination and/or storage enclosure(s) at system endpoints.

3.5. FIBER OPTIC CONNECTOR

A. The fiber optic connector shall be installed per manufacturer's written instructions.

3.6. FIBER OPTIC PATCH PANEL

A. Fiber optic patch panels shall be rack mounted.

B. Install fiber optic patch panels in topmost rack position.

C. Transition outdoor to indoor cables either by splicing factory-terminated pigtails or by the use of a "fan-out" kit. Secure individual fibers in an aramid reinforced tube.

D. Termination hardware shall incorporate a mechanism to secure cable and sub-assemblies and prevent damage.

E. Splicing shall be by the "fusion" method.

F. Direct termination of 250 µm coated fibers shall not be permitted.

3.7. FIBER OPTIC PATCH CORDS

A. The fiber optic patch cords shall be installed per manufacturer's written instructions.

B. Contractor must coordinate with the owner for installing all patch cords within the TR.

C. Any left-over patch cords which are not used for the initial installation shall be placed in a box and handed over to the owner. Patch cords must be new and within the original unopened package.

3.8. FIBER OPTIC SPLICE ENCLOSURE

A. The fiber optic splice enclosure shall be installed per manufacturer's written instructions.

3.9. COAX DIRECTIONAL COUPLERS, SPLITTERS

A. The contractor shall provide all hard-line coaxial directional couplers or splitters to provide adequate distribution of all horizontal coaxial cable in each IDF and MDF.