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27 00 00	COMMUNICATIONS
27 01 00	Operation and Maintenance of Communications Systems

Part 1 – General

It is the responsibility of the Owner (Information Technology Services department) to ensure that a fully compliant and efficient communication infrastructure is in place for the Owner’s needs. These standards are in place to accomplish that goal. These standards are for the use of all campus departments as well as all Design Professionals, developers and Contractors involved in construction on campus. All Work shall be in accordance to Building Industry Consulting Services International (BICSI) recommended installation practices and standards/ codes stated below. Coordination with Owner (Project Manager and ITS department) shall be required prior to actual construction and wiring placement. The term “PON” for Passive Optical Network, shall be used to reference the following SDN/ technological applications or terms; GPON, XGSPON, POL. All sections under NAU Division 27 shall be used interchangeably as needed for the PON communications infrastructure.

Quality Assurance

The following requirements must be met by the telecommunications contractor, whether that contractor is hired directly by Owner as the prime Contractor or hired by the Contractor as a subcontractor.

- A. The telecommunications contractor shall have a Registered Communications Distribution Designer (RCDD) with Outside Plant (OSP) Design Certification as a company employee for the company and on project staff, and shall be an approved Belden Certified Installer.
- B. The A/V contractor shall have on staff CTS and CTS-I certified employees employed onsite during the project installation duration
- C. The PON Integrator designer shall have an RCDD as a company employee for the company and on project staff.
- D. A copy of the certification documents of the firm and the installers must be submitted to Owner for verification that certification requirements are met prior to receipt of bids.
- E. All price quotes with the specified warranty solution submitted to Owner for approval shall have all the part numbers and documents pertaining to the specifications of the materials being used for the project being quoted along with as-builts pertaining to BDF/IDF layouts.
- F. The PON/ telecommunications system shall be designed by a RCDD/OSP certified designer.
- G. The PON/ telecommunications system installer shall perform overall project management/installation oversight by a BICSI certified RCDD/ OSP on a weekly basis.
- H. The PON/ telecommunications system installer shall have a certified BICSI Technician as the lead technician, employed on staff and on-site during

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project construction at all times. The lead technician shall be OSHA 30 trained and verified.

- I. All PON/ telecommunications installers/technicians shall be BICSI certified or enrolled in a State authorized apprenticeship program. New members added to the AV and telecommunications installation team must be approved by Owner (ITS). All A/V CTS/ CTS-I installers and telecommunications installers shall be OSHA 10 trained. A copy of current certifications of all members of the installation team shall be submitted with the quote.
- J. A system warranty for 25 years covering all components, equipment and workmanship shall be submitted in writing with system documentation as part of the closeout process. Owner has pre-approved the following solutions to be in compliance with these standards: SureBit, ChannelMate.
- K. Should the cabling system fail to perform its expected operation within the contractor warranty period due to inferior or faulty installation and/or workmanship, the contractor shall promptly make all required corrections without cost to Owner.
- L. Telecommunications System shall be complete Belden SureBit/ChannelMate Solution System. The PON/ PoE (Class2) wiring and passive cabling/ hardware infrastructure shall be Belden. No mixing of warranty solutions will be allowed in a building. Faulty materials shall be promptly corrected by the manufacturer at no cost to Owner.
- M. A/V cabling shall be Creston Digital Media for Crestron systems.
- N. Verify with Owner for intended warranty on a per job basis.
- O. Fiber optics shall be Belden.
- P. No portion of the telecommunications cabling contract may be subbed out to another entity unless prior approval is granted by Owner.
- Q. All subcontractors/ contractors shall wear in plain sight photo ID at all times during project construction stating company name, employee name and current BICSI or AV credential.
- R. Removal of all abandoned cabling shall be included in all PON/ Telecommunications installations and upgrades.
- S. Owner has pre-approved the following manufacturers to be in compliance with these standards: PON/ Telecommunications (Belden) A/V (Crestron)

Note: Preliminary as-builts shall be included in Contractor’s quote and provided prior to Substantial Completion of project.

Prior to sign-off of the FS #15 at time of Substantial or Final completion and release of payments: Owner reserves the right to test and verify compliance of all fiber and copper cables installed under contract.

Codes and Standards Compliance

- A. Reference Division 01 41 13 for applicable codes.

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B.	All materials and installation practices shall comply with the applicable sections of the following telecommunications industry standards and all applicable addendums:
1.	ANSI/TIA/EIA-569-C.0-2009+A1:2010+A2:2012,Generic Telecommunications Cabling for Customer Premise Standard
2.	ANSI/TIA/EIA-568-C.1-2009+A1:2012, Commercial Building Telecommunications Cabling Standard,
3.	ANSI/TIA/EIA-568-C.2-2009+A1:2010, Balanced Twisted Pair Telecommunications Cabling and Components Standard
4.	ANSI/TIA/EIA-568-C.3-2009+A1:2010,Optical Fiber Telecommunications Cabling Systems Standard
5.	ANSI/TIA/EIA-568-C.3-2009+A1:2011, Optical Fiber Cabling and Components Standard
6.	ANSI/TIA/EIA-568-B.2-1: Transmission Performance Specification for 4-Pair 100 Ω Category 6 Cabling (Standard).
7.	ANSI/TIA/EIA-569-C-2012, Commercial Building Standards for Telecommunications Pathways and Spaces
8.	ANSI/TIA/EIA-570-C-2012, Residential Telecommunications Infrastructure Standard
9.	ANSI/TIA/EIA-606-B-2012, The Administration Standard for Commercial Telecommunications
10.	ANSI/TIA/EIA-607-B-2013, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
11.	ITU-T G.984.1 2012- Gigabit-Capable Passive Optical Networks (PON): General Characteristics
12.	ITU-T G.987.1 2012- 10 Gigabit- Capable Passive Optical Network (XG-PON) Systems: General Requirements
13.	ITU-T G.9807.1 2016- 10 Gigabit-Capable Symmetric Passive Optical Network (XGS-PON) General Requirements
14.	NECA/BICSI 607-2011 or current revision, Standard for Bonding and Grounding Planning and Installation Methods for Commercial Buildings.
15.	ANSI/TIA/EIA-758-B-2012, Customer Owned Outside Plant Telecommunications Infrastructure Standard
16.	TIA/EIA-1005-A-2012 Telecommunications Infrastructure Standard for Industrial Premises
17.	BICSI/NECA-607 Telecommunications Bonding and Grounding, Planning and Installation Methods for Commercial Buildings
18.	TIA/EIA-942-A-2012 Telecommunications Infrastructure Standard for Data Centers
19.	TIA-TSB-190, 2011 Guidelines on Shared Pathways and Shared Sheath

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20.	NFPA 780- Standard for Installation of Lightning Protection Systems, latest issue
21.	<p>Telecommunications designers/ Contractors and installers shall have read the above documents and must be familiar with the requirements that pertain to this installation. The documents may be obtained from:</p> <p style="margin-left: 40px;">IEEE-Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY, 10017-2394, 800-678-IEEE, fax: 732-981-9667, http://standards.ieee.org/</p>

For any questions or further information on Owner’s ITS cabling standards, designs and layouts, please contact Owner for clarification.

Part 2 – Products

N/A

Part 3 – Execution

Any design or installation that does not meet all applicable codes and standards shall be remediated by the Contractor at no charge to Owner.

27 01 10	<p>Operation and Maintenance of Structured Cabling and Enclosures</p> <p>The operation and maintenance of all structured cabling systems are the responsibility of Owner and any and all changes or modification shall be coordinated with Owner (NAU ITS).</p>
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27 01 20	<p>Operation and Maintenance of Data Communications</p> <p>The operation and maintenance of all data communications are the responsibility of Owner and any and all changes or modification shall be coordinated with Owner (NAU ITS).</p>
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27 01 30	<p>Operation and Maintenance of Voice Communications</p> <p>The operation and maintenance of all voice communications are the responsibility of Owner and any and all changes or modification shall be coordinated with Owner (NAU ITS).</p>
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27 05 00 Common Work Results For Communications

27 05 13	<p>Communication Services</p> <p>All voice and data communication services to be supplied by or coordinated with Owner (NAU ITS). This includes dial tone services, T1 services, DSL services, Network services.</p>
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27 05 13.43	Cable Services

Cable Television Equipment and Signal;

The system shall meet or exceed ALL technical standards set forth in FCC Rules & Regulations Part 76;

http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&sid=3100d6c36aa8d24cb14d0de0e94df597&tpl=/ecfrbrowse/Title47/47cfr76_main_02.tpl

Band width of ALL active and passive devices shall have a minimum of 54 MHz to 860 MHz (forward/downstream) and 5 MHz to 42 MHz (reverse/upstream).

All CATV/ TV locations shall consist of (2) station cable and (1) drop cable as listed below

Station Location

All Category 6 cables to TV locations shall consist of a minimum two (2) Category 6 100ohm White cable terminated in the BDF on its own Category 6 Patch Panel. If distance is an issue than the cable will terminate in the closest IDF/ TR within the distance limitation.

Drop Cable

RG-6 series with a minimum 60% braid (minimum SCTE standard); 18 AWG copper covered steel center conductor; foam dielectric material (FEP); inner shield aluminum-poly, bonded – 100% aluminum laminated tape with overlap bonded to dielectric; outer shield of 34 AWG bare aluminum braid wire; jacket of polyvinyl chloride (PVC) plenum rated material.

Feeder Cable;

0.500 P3 series copper clad aluminum center conductor: expanded polyethylene dielectric; solid aluminum sheath; outer jacketed of black high molecular weight polyethylene.

Trunk Cable;

0.750 P3 series copper clad aluminum center conductor; expanded polyethylene dielectric; solid aluminum sheath; outer jacket of black high molecular weight polyethylene.

Connectors;

Drop cable; RG-6 compression type. CROSS REFERENCE: ICM F-CONN#FS6PL2/Corning-Gilbert#GF-UR-6-PL.

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Feeder cable; .500 pin type Gilbert #GRS 500CH-DU-01

Trunk cable; .750 pin type Gilbert #GRS 750CH-DU-01.

Fiber (single mode); “APC” type SC/FC (min.-60dB return-loss).

Distribution, fiber nodes, RF Amplifiers:

All equipment shall be installed & labeled in appropriate equipment rooms as designated by project/design. All cable drops shall be home runs to the designated equipment rooms and labeled with its corresponding room number. Fiber nodes/RX’s and RF amplifiers shall be premise power type (115VAC). It is recommended that these active components be of the same manufacturer/model type currently being utilized throughout the campus CATV system. CROSS REFERENCE: Scientific Atlanta mod. #90090 (fiber Rx/amplifier), Blonder Tongue mod. #FRDA/FRRRA (wall/rack mount fiber Rx/amplifier), Blonder Tongue mod. #BIDA (RF distribution amplifier).

Back-up/spare “active” equipment shall be provided by the Contractor.

ALL active/passive components as well as any other equipment or specifications outlined in this standards sheet should be discussed with Owner personnel prior to any design, purchase and/ or implementation.

Note: As-builts shall be included in contractors quote and provided prior to Substantial Completion of project.

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Grounding and Bonding for Communications Systems

A Telecommunications Main Grounding Bus bar (TMGB) connected to the electrical grounding system is required in all buildings. All communication equipment spaces require a Telecommunication Grounding Bus bar (TGB) connected to the TMGB and bonded to approved building ground. All connections bonded with a minimum 6 AWG conductor. All cable tray, equipment racks, and equipment cabinets bonded to TGB. All Telecommunication protectors and associated metallic cable sheaths to be grounded to selected TGB with a minimum 6 AWG insulated conductor. All copper pairs to be protected at building entrance facility with gas tube type 350VDC protector modules.

27 05 28

Pathways for Communications Systems

All communication cabling shall be routed in a designed and approved pathway system per ANSI/TIA/EIA-569-C, (Commercial Building Standard for Telecommunications Pathways and Spaces) and meet or exceed all National, State and Local codes and standards. Pathways shall run parallel to the building design.

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Design shall be documented in floor plans and have built in flexibility for tenant movement and expansion and designed for maintenance and relocation of cables as easy as possible. Any and all pathway sleeves shall be rigidly secured on both sides of the wall. ISP and OSP fiber optic cabling that is not in conduit shall be placed inside plastic inner-duct unless an armored cable is used for safety, identification and protection of the fiber. Pathways shall not exceed 40% initial fill volume when installed. Pathways shall not exceed 40% initial fill volume when installed. When necessary additional sleeves and pathways shall be installed to meet the standard to not exceed 40% initial fill volume. A free and clear pull-line with minimum 200lb pull rating will be available for future use will be left in all main bundles/pathways and conduits. All cable colors to be bundled separately in the ceiling and in all BDF's/ IDF's or TR's.

When cables enter the closets, they will be packed neatly (i.e. cigarette packing)

OSP pathways refer to Div. 33 80 00 for standards for pathways.

Fire Wall penetrations shall be installed in accordance with the current Division 21 specifications. Owner has pre-approved the following manufacturers for pre-fabricated fire stop solutions to be in compliance with these standards: 3M, Hilti and STI (Specified Technologies Inc.).

27 05 28.29 Hangers and Support for Communications Systems

All cable supports shall be located on maximum of 48" on center and attached to both sides and ends of cable tray. All cable tray systems shall be comprised of the manufacturers recommended hardware for a complete system. All cable supports shall be rated for Fiber Optic, Category 6 and 6a structured cabling system. In a ceiling distribution design a minimum of 3" clearance between ceiling tile and cable or the lowest point in the support/anchoring of the communications system. All hangers and supports must be suspended from or attached to the structural ceiling or walls with hardware designed to support the tray's maximum load bearing rate. Only Velcro-type cable straps shall be used for dressing or securing Fiber Optics, Category 6 and 6a Cabling. J-Hook or straps for the support system shall be installed no greater than 48" on center and in accordance with all BICSI Design standards and best practices.

27 05 28.33 Conduits and Back Boxes for Communication Systems

All conduits shall be rigid. Flexible conduit is not acceptable for any application. Design and installation of conduits shall be run in most direct route possible with no more than two 90-degree bends and should not contain any electrical condulets (LB's). Conduit should not be placed over or adjacent to boilers, incinerators, hot water lines, electrical convertors/rectifiers/panels or steam lines. Conduits 2" or

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smaller require a bend radius of 6 times the internal conduit diameter, more than 2" require 10 times the internal conduit diameter. All conduit ends should be reamed and fitted with insulated bushing. Specify a minimum two 1" conduits to each office type room on opposite walls and stubbed out to accessible location in the same room. All other rooms (labs, classrooms, etc.) require consultation with Owner. Conduits to terminate in a 5"x5" double gang box and PON boxes shall be a 4"x6" gang box with a single gang device cover and routed to communication cable tray or stubbed to accessible location. Equip all conduits with a pull cord that has a minimum test rating of 200 lb. All conduits dedicated to communication structured cabling system and shall not be shared with any other services. Underground conduits that contain telecommunications cables shall terminate with Conduit End Bells inside the BDF/IDF, vault or manhole and sealed after, whether in use or not. Conduits seals shall be re-enterable. Type of seal shall be approved by Owner. No rigid foams permitted.

27 05 28.36 Cable Trays for Communications Systems

Type and design of cable tray distribution system shall be pre-approved by Owner. Cable tray installation must be installed to meet NEC article-392 and all state and local codes. Cable tray shall be dedicated to telecommunication use only and not shared with electrical. A/V (Audio/ Video) and Security may reside in the same pathway as Telecommunications **ONLY** with prior approval through Owner. Physical separation shall be required when multiple applications other than telecommunications reside in the same tray. Design should be such that all requirements for a maximum 40% initial fill volume and a certified Category 6 and 6a structured cabling system will be met (i.e., bend radius, clearances and distances etc.). Minimum (2) supports per section of cable tray and attached to both sides shall be maintained throughout the entire system.

Cable tray to be sized so as not to exceed the allowable initial maximum fill volume of 40% for all services residing in the cable tray or support system. All metallic cable trays shall be grounded and clearly marked in accordance with ANSI/TIA/EIA-606-A and ANSI J-STD-607-B-2013.

In a PON environment, the power conduits for the zone boxes only, may reside underneath the cable tray and shall attach to the cable tray supports only, not the cable tray itself.

Due to the collapsed nature of the PON architecture, no other services shall reside in, on or attach to the PON support systems and cable trays.

PON Cable trays and supports shall be reduced and sized accordingly to maintain the 40% initial fill due to the collapsed architecture.

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27 05 28.39	Surface Raceways for Communications Systems

Surface raceway should only be considered as last resort and with prior coordination with Owner. Raceway design should be of a type that conforms to Category 6 and 6a certification for bend radius, interference and separation. Raceway must be capable of accepting the specified warranty solution's wiring products including jacks and faceplates. If electrical power and telecommunications services are both run in raceway separate compartments are required and must comply with applicable electrical codes. If a metallic barrier is provided, it must be bonded to ground. Raceway shall be sized so as not to exceed 40% initial fill rating.

All raceway shall be secured to surfaces via anchors of the appropriate type for the wall being attached to. Color of raceway shall match the wall being attached to.

27 05 28.40	Furniture Raceways and Pathways
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All furniture pathways to adhere to ANSI/TIA/EIA-569-C current standards. Maximum pathway fill shall be 40%. Minimum size pathway shall not force the cable into a bend radius less than 1" under condition of maximum fill. Any parallel pathway to electrical must have proper separation. All furniture pathways must be capable of accepting the approved warranty products brand termination hardware.

27 05 43	Underground Ducts and Raceways for Communication Systems
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See Division 33 for site communications ducts and manholes. Under floor ducts systems shall be dedicated space for telecommunication cables and not shared with any other utility. The guideline for planning duct capacity is 1 in² of cross section for each 100 ft² of useable floor space. Junction boxes shall be placed at a maximum of 60 ft to allow access for cable placement. All distribution ducts must be physically linked to a telecommunication room directly or through no more than one feeder duct. Ducts entering the telecommunications room must terminate in either a slot or elbow.

27 10 00 STRUCTURED CABLING

In order for Owner (ITS) to maintain ease of available stock, maintenance and administration, Belden systems will be installed.

Complete Belden ChannelMate solution for the structured cabling system to conform to all TIA/EIA Telecommunications Building Wiring Standards, latest edition of BICSI Telecommunications Method Manual and are covered by the ChannelMate System Performance Warranty shall be installed. A Belden Certified Installer will perform the telecommunications and AV structured cabling tasks.

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Belden ChannelMate System Solution Warranty shall be required for all work performed on campus.
Berk-Tek Leviton may be used as a substitution of Belden when unavailable.

Structured Cabling color codes:

Application	Color
Voice	Yellow
Data	Yellow
Wireless	Yellow
Security,	Yellow
Card Reader,	Yellow
Attendance Reader	Yellow
CATV, A/V	Yellow
PON Backbone	Yellow
PON Riser Cable	Yellow
PON Fiber Jumpers	Yellow
PON ONT Patch Cord	Yellow
PON DC (Power)	White
PON Patch Cords	Yellow
PON Cat6 Jack	Yellow
PON APC Connector	Green

Cooper B-Line Wire Management and Racking: (Black finish only unless otherwise specified)

19" Rack	SB556084XUFB
Vertical Management	SB86086D084FB (Used for the outside management in a multiple rack design) SB860810D084FB (Used in between racks in a multiple rack design)

PON Fiber/ Battery dist.	SB55608423U6FB	(23"Wx 84"Hx 6"D rack, black)
PON Zone Box (Snake Tray)	CMK708-SK-0633	(24"L x 24"W x 12"D)

(Vertical Management shall run the entire length of the rack)

(Doors, spools and hinges for a complete solution shall be included)

Horizontal Management	SB87019S1FB and SB87019S2FB
Ladder Rack	SB13AL12FB and SB13AL18FB
Elevation Kits	SB227R6FB
Radius Drops	SB13ALDO12FB and SB13ALDO18FB

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(All hardware kits for connectivity and support shall be included for a complete install)

Category 6 cabling is the minimum category cable for all communication designs and plenum in type.

For networks with higher bandwidth needs, Owner recommends a PON or Category 6a structured cabling solution.

PON network cabling shall be a Single-Mode OS2 rated cable yellow in color and Plenum in type.

PON DC Plant remote line power cable shall be a minimum 16awg x 2 solid conductor cable white in color and Plenum in type.

PON fiber cabling shall be terminated with a SC/ APC and LC/APC connectors and fusion spliced.

Star topology is required for all building layouts. Consult with Owner before following any format that is not a star topology for a building overview with recommendations.

Zone Distribution topology shall be required for all PON building layouts. Consult with Owner before following any format that is not a zone distribution topology for a PON infrastructure.

27 11 00**Communications Equipment Room Fittings**

All buildings shall have at least one (depending on building size, footprint and design possibly more) telecommunications room per floor. Building design shall be such that no permanent link horizontal cable run exceeds 90 meters. Design should be that telecommunications rooms are as close to the core of the building as possible. Multiple story buildings shall stack the telecommunications rooms. A minimum of two 4"-conduits from each room to main Building Distribution Frame (BDF) is required. The space shall be dedicated to telecommunications equipment and not shared with electrical or any other building system. Equipment not related to the support of telecommunications closet (e.g., piping, ductwork, etc.) shall not be installed in, pass through, or enter the telecommunications room. Minimum size shall be 10'X12' with no ceiling. Wall finish shall be white in color. Lighting shall be a minimum of 500 lx measured 3ft. above finished floor. Room shall be environmentally controlled to maintain 72° F or lower 24/7. Flooring shall be static free, no carpeting. Power requirements are based on individual building design and need approval of Owner but a minimum of 2 120V quad convenience outlets are required. Each telecommunications room shall be equipped with a grounding bus bar connected to the building telecommunications main grounding busbar (TMGB).

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All walls shall be covered with 3/4" fire rated A-C plywood painted with (2) coats of white fire retardant paint on all (6) sides. Entrance door shall be minimum of 36" opening outward. Backbone and horizontal cable pathways shall terminate into room. Room cable management shall consist of ladder racks above all wall mount frames and all equipment racks.

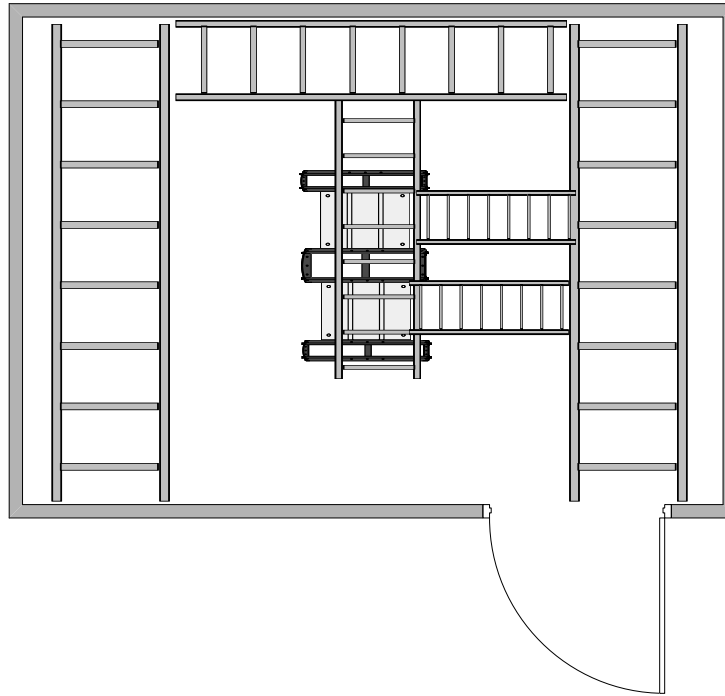
Required BDF/ IDF Layout

Rack Mount 110 Blocks for CAT 6 backbone cabling. Cable bundles to the patch panel shall be no greater than 24 cables.

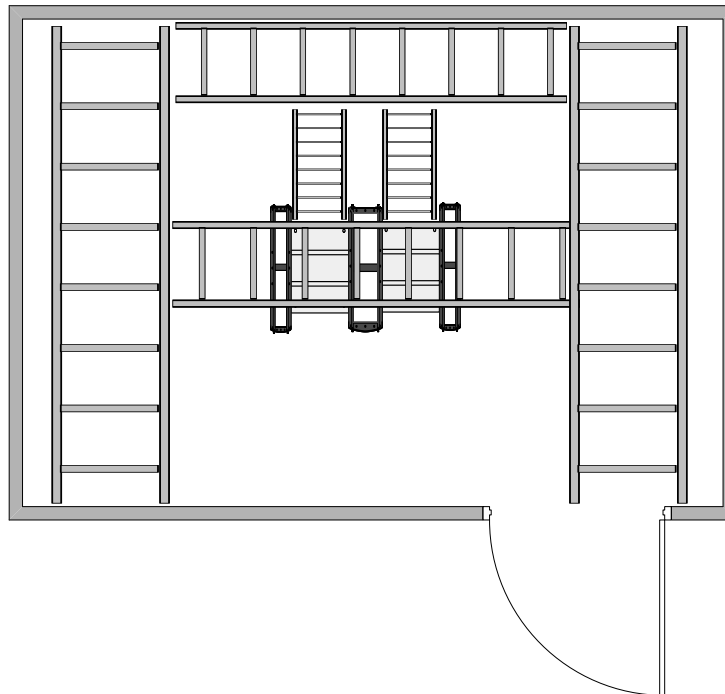
All cable colors to be bundled separately in the ceiling and all closets. When cables enter the BDF/IDF they will be packed neatly (i.e.: cigarette packing).

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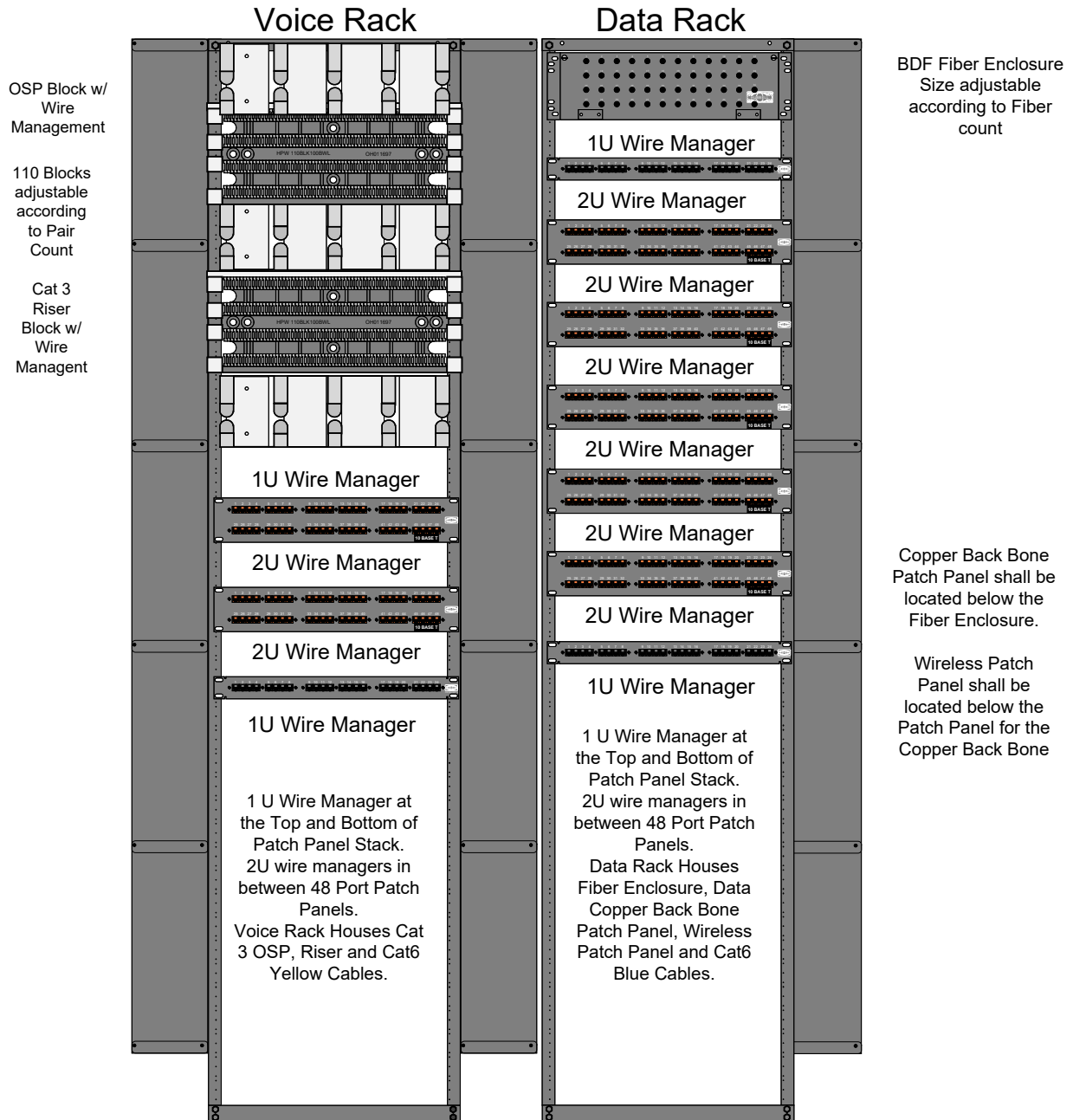
Typical BDF/ IDF Rm. for VoIP Layout.
Cat3 OSP/ ISP Riser and Voice Panels (Yellow Cables) in the Left Rack.
Fiber/ Data Back Bone, WAPs and Data Panels (Blue Cables) in the Right Rack.
Ladder Racking within the Telco Rms shall be 18" wide
Layout is Diagrammatical only.



Typical BDF/ IDF Rm. for VoIP Layout.
Cat3 OSP/ ISP Riser and Voice Panels (Yellow Cables) in the Left Rack.
Fiber/ Data Back Bone, WAPs and Data Panels (Blue Cables) in the Right Rack.
Ladder Racking within the Telco Rms shall be 18" wide
Layout is Diagrammatical only.



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Typical BDF Rack Layout. Diagrams are for Layout Purposes only, Refer to Part Numbers related to warranty being installed
Bottom Wire Manager shall not drop below the #16 RU Marking. Space below this RU is reserved for Switches, Rack Mount Power Strips and UPS's. If Necessary install a Third rack for Network Equipment

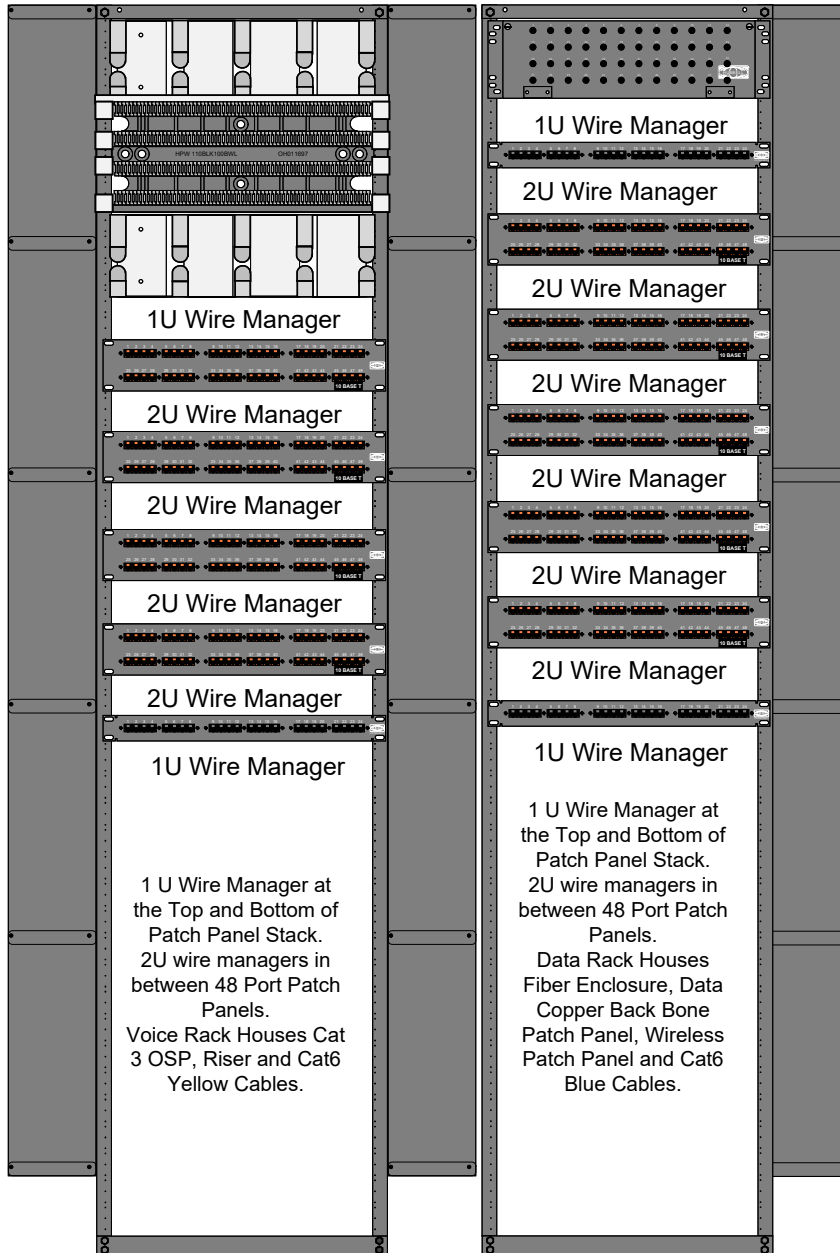
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110 Blocks adjustable according to Pair Count

Cat 3 Riser Block w/ Wire Managent

Voice Rack

Data Rack



IDF Fiber Enclosure Size adjustable according to Fiber count

Copper Back Bone Patch Panel shall be located below the Fiber Enclosure.

Wireless Patch Panel shall be located below the Patch Panel for the Copper Back Bone

1 U Wire Manager at the Top and Bottom of Patch Panel Stack.
2U wire managers in between 48 Port Patch Panels.
Voice Rack Houses Cat 3 OSP, Riser and Cat6 Yellow Cables.

1 U Wire Manager at the Top and Bottom of Patch Panel Stack.
2U wire managers in between 48 Port Patch Panels.
Data Rack Houses Fiber Enclosure, Data Copper Back Bone Patch Panel, Wireless Patch Panel and Cat6 Blue Cables.

Typical IDF Layout. Diagrams are for Layout Purposes only, Refer to Part Numbers related to warranty being installed

Bottom Wire Manager shall not drop below the #16 RU Marking. Space below this RU is reserved for Switches, Rack Mount Power Strips and UPS's. If Necessary install a Third rack for Network Equipment

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27 11 13	<p>Communications Entrance Protection</p> <p>All copper entrance cable to be terminated on a stub-in and stub-out building entrance terminal, (710 Splicing Only for Stubs In and Out) or a comparable substitute pre-approved by Owner. The Building Entrance Terminal (BET) requires protection by a gas tube type module, capable of handling surges higher than 300 volts, sneak currents and incorporates a positive temperature coefficient self-resetting current limiter as is UL497 listed. Circa 1900-100K series Stub In/ Out 100 pair BETs with covers recommended. Consult with Owner for recommendations and approval on B.E.T.'s.</p>
27 11 16	<p>Communications Cabinets, Racks, Frames, and Enclosures</p> <p>All network and telecommunication equipment will be housed in 7' 19" Black equipment racks. All PON and DC power plant equipment shall be housed in an 8'H x 23"W black equipment rack. Any other enclosure type requires pre-approval of Owner (NAU/ITS). Equipment rack shall meet ANSI/EIA-310-D standard. All metallic communications cabinets, racks, frames, zone boxes and enclosures are secured and grounded per manufacturers and all applicable codes. Racks shall be positioned a minimum 4' from any wall in front of or behind it and minimum of 3" from the sidewire manager to the wall. Rack equipped with horizontal cable management above and below all patch panels. Vertical cable management required on both sides of the rack and on all rack designs. Racks shall be equipped with rack mount 19" or 23" power strip 20A/120v with minimum of 8 NEMA5 -20R receptacles. Rack configuration requires pre- approval of Owner.</p>
27 11 19	<p>Communications Termination Blocks and Patch Panels</p> <p>All OSP twisted pair to be terminated on a stub-in and stub-out building entrance terminal with the stub in and out spliced with 710 modules. BET type must be pre-approved before installation.</p> <p>All Category 3 OSP cabling shall be terminated on BETs with stub in and stub out tails then transitioned to or directly terminated on Rack Mount 110 blocks. Category 6 and 6a cabling to terminate on the same category type patch panels. Any analog or dial tone services shall terminate on 110 blocks in the Telco closets. No 66 Blocks.</p>
27 11 23	<p>Communications Cable Management and Ladder Rack</p> <p>All cable management to conform to industry standards and comply with the specified warranty solution for fiber optic, Category 6 and 6a systems. All active and passive rack mount equipment to be separated by horizontal cable management. Vertical cable management required in all rack designs. Ladder rack required to all racks and for cable entrance into all telecommunication rooms (18" wide Ladder</p>

Section Number	Title
	Rack in the BDF/ IDF's). All Category 3 OSP cable termination fields require transitioning to Rack Mount 110 blocks for a cross connect field with horizontal management above and below.
27 11 26	<p>Communications Rack Mounted Power Protection and Power Strips</p> <p>Minimum of one horizontal power strip 20A/120V with 8 NEMA5-20R receptacles. Power cord length shall be a minimum 8' with NEMA5-20R plugs.</p>
27 13 00	Communications Backbone Cabling
	See Division 33 82 00 for site communications distribution and outside plant requirements. All campus buildings will be fed with via a media type consisting of either twisted pair copper, 8.3 micron single-mode fiber OS2, and 50 micron Laser optimized multi-mode fiber OM3. Number of conductors to be determined by Owner on a per project basis. 20' service loops shall be placed in all vaults, manholes and termination points. Minimum 48 strands of SM OS2 to each building. All fiber optic and copper communications backbone cabling shall be labeled at every corner and at all spans greater than 100' throughout
27 13 13	Communications Copper Backbone Cabling
27 13 13.01	<p>Intra Building Copper Backbone</p> <p>Building voice backbone cabling shall consist of Category 6 (4)pr cabling certified to Category 6 specification and be compliant for the building system performance warranty. All cable will be homerun and terminated at both ends on Rack Mount 110 blocks. All pairs tested for continuity, shorts grounds and wire map.</p> <p>Building Data backbone will consist of 8.3 micron single-mode fiber OS2, and/ or 50 micron Laser optimized multi-mode fiber OM3 for data intra building backbone cabling. White Category 6 cables certified at Category 6 specifications and be compliant for system performance warranty specified for that job along.</p>
27 13 13.02	<p>Inter Building Copper Cable Backbone</p> <p>Copper cable shall be PE 39 type and meet the following requirements:</p> <ul style="list-style-type: none"> • 24 AWG pair count determined by NAU/ITS per project • Cable shall meet the requirements of ANSI/CEA S-84-608. • Buried service wire to conform to ANSI/CEA S-86-634. • The transmission requirements of connecting hardware used in the OSP shall comply with the connecting hardware requirements of ANSI/TIA/EIA 568-A.

Section Number	Title
27 13 13.13	Communications Copper Cable Splicing

All splicing and splice closures to conform to TIA/EIA-758 and be of the water tight and re-enterable type unless otherwise approved by Owner. All splicing shall be completed with 710 type multiple pair connectors only. No bridge-taps, and 25-pair binder groups shall not be split between termination points. All splices housed in a closure compatible with all materials used in the construction of cable, filling compounds, bonding and grounding devices, chemicals, and sealants that the closure would come in contact under normal conditions. Closure construction shall be reusable and re-enterable without factory refurbishing. All closures to be filled with filling compound. Replacement parts shall be readily available.

27 13 13.14	Copper Cable Testing
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All Category 3 OSP twisted pair cable to be tested with complete wire map and 100 % pass rate for following:

- DC loop resistance
- Wire map
- Continuity to remote end
- Shorts between two or more conductors
- Crossed pairs
- Reversed pairs
- Split pairs
- Any other miss-wiring

All Voice and Data Category 6 and 6a twisted pair cables will be tested with a 100% pass rate to the cable categories applicable standard for the following in accordance to Amendment 10 of the TIA/EIA-568-B.2 document:

- Insertion Loss (IL)
- Near End Crosstalk (NEXT)
- Power Sum Near End Crosstalk (PSNEXT)
- Attenuation to Crosstalk Ratio (ACR)
- Power Sum Attenuation to crosstalk Ratio (PSACR)
- Far End Crosstalk (FEXT)
- Equal Level Far End Crosstalk (ELFEXT)
- Power Sum Equal Level Far End Crosstalk (PSELFEXT)
- Return Loss (RL)
- Wire Map
- Propagation Delay
- Delay Skew
- Length

Section Number 27 13 23	Title Communications Optical Fiber Backbone Cabling Fiber optic cabling system shall be Belden.
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Fiber- SM

Maximum fusion splice loss shall be no greater than .03db. A germania-doped silica core surrounded by a concentric silica glass cladding shall comprise each optical fiber. The fiber shall be a matched clad design manufactured by the outside vapor deposition process (OVD). Each optical fiber refractive index profile shall be step index.

Each fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m²). The fiber shall be coated with a dual acrylate protective coating and the coating shall be in physical contact with the cladding surface. The single-mode fiber shall meet EIA/TIA-492CAAB, "Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak," and ITU-T G.652.C, "Characteristics of Single-Mode Optical Fiber Cable." Fiber shall have a mode field diameter of $9.20 \pm 0.40 \mu\text{m}$ at 1310 nm and $10.40 \pm 0.50 \mu\text{m}$ at 1550 nm. Fiber core-clad concentricity shall be $\leq 0.5 \mu\text{m}$. Fiber cladding diameter shall be $125.0 \pm 0.7 \mu\text{m}$. Fiber cladding non-circularity shall be $\leq 0.7\%$. Fiber coating diameter shall be $245 \pm 5 \mu\text{m}$.

The attenuation specification shall be a maximum value for each cabled fiber at $23 \pm 5^\circ\text{C}$ on the original shipping reel. The cabled fiber attenuation for Loose Tube and Ribbon cable constructions shall be $< 0.4 \text{ dB/km}$ at 1310 nm and $< 0.3 \text{ dB/km}$ at 1550 nm. For tight buffered constructions, the cabled fiber attenuation shall be $< 1.0 \text{ dB/km}$ at 1310 nm and $< 0.75 \text{ dB/km}$ at 1550 nm. The attenuation at the water peak (1383 nm) shall not exceed the 1310 nm attenuation value. The cabled fiber shall be capable of operating in the 1360 nm to 1480 nm water peak region.

The attenuation due to 100 turns of fiber around a $50 \pm 2 \text{ mm}$ diameter mandrel shall not exceed 0.05 dB at 1310 nm and 0.10 dB at 1550 nm. The attenuation due to 100 turns of fiber around a $75 \pm 2 \text{ mm}$ diameter mandrel shall not exceed 0.10 dB at 1625 nm. There shall be no point discontinuities greater than 0.10 dB at 1310 nm and 1550 nm.

The maximum dispersion shall be $\leq 3.2 \text{ ps}/(\text{nm}\cdot\text{km})$ from 1285 nm to 1330 nm and shall be $\leq 18 \text{ ps}/(\text{nm}\cdot\text{km})$ at 1550 nm. The cabled fiber shall support Gigabit Ethernet (GbE) operation according to the 1000BASE-LX (1310 nm) specifications up to 5000 m in accordance with the GbE standard. The cabled fiber shall support laser-based 10 Gigabit Ethernet (10GbE) operation according to the 10GBASE-LX4 (1300 nm region), 10GBASE-L (1310 nm) and 10GBASE-E (1550 nm) specifications for distances of 10 km, 10 km and 40 km, respectively.

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The cabled optical fiber shall support industry-standard multi-gigabit fiber channel physical interface specifications.

Fiber MM 50um Laser Optimized OM3

Each fiber in the cable must be usable and meet required specifications. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical and environmental requirements of this specification. A germania-doped silica core surrounded by a concentric silica glass cladding shall comprise each optical fiber. The fiber shall be a matched clad design manufactured by the outside vapor deposition process (OVD). Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m²). The fiber shall be coated with a dual-layer acrylate protective coating. The coating shall be in physical contact with the cladding surface. The attenuation specification shall be a maximum value for each cabled fiber at 23 ± 5°C on the original shipping reel. The multimode fiber shall meet TIA-492AAAC, "Detail Specification for 850-nm Laser-Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers."

The core diameter shall be 50.0 ± 2.5 µm. The cladding diameter shall be 125.0 ± 2.0 µm. The cladding non-circularity shall be = 1.0%. The core-clad concentricity shall be = 1.5 µm. The coating diameter shall be 245 ± 5 µm. The optical fiber refractive index profile shall be graded. The numerical aperture of the fiber shall be 0.200 ± 0.015.

The maximum cabled fiber attenuation shall be 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm for all cable types. The cabled optical fiber shall have a minimum effective modal bandwidth (EMB) of 2000 MHz•km at 850 nm in accordance with FOTP-220 for 10 Gigabit Ethernet. The cabled optical fiber shall have a minimum over-filled launch (OFL) bandwidth of 1500/600 MHz•km at 850/1300 nm. The cabled optical fiber shall have a minimum restricted mode launch (RML) bandwidth of 1400 MHz•km at 850 nm in accordance with FOTP-204 for Gigabit Ethernet.

The cabled optical fiber shall support industry-standard IEEE 802.3 10GBASE-S (10 Gigabit Ethernet at 850 nm) physical layer specifications for 300 m. The cabled optical fiber shall support industry-standard IEEE 802.3 1000BASE-SX (Gigabit Ethernet at 850 nm) physical layer specifications for 1000 m and 1000BASE-LX (Gigabit Ethernet at 1300 nm) for 600 m. The cabled optical fiber shall support industry-standard multi-gigabit Fibre Channel physical interface specifications.

There shall be no point discontinuity greater than 0.2 dB. The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 3.0 dB/km. The attenuation due to 100 turns of fiber around a 75 mm diameter mandrel shall not exceed 0.5 dB at 850 nm and 1300 nm.

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27 13 23.01	Building Optical Fiber Cable Backbone

Single-Mode OS2 and/ or 50 Micron Laser optimized Multi-mode OM3 fiber optic backbone required between the BDF and all IDF locations. All cable to be homerun with no splices and installed in a 1" plenum or riser rated (depending on the application) suitable inner duct unless armored type is used. Strand count to be determined by Owner on a per project basis.

PON building backbone shall consist of either a single 48 Strand Single-Mode OS2 OSP rated cable or (2) 24 Strand Single-Mode OS2 OSP rated cables fed into different conduits to each building and homerun from the closest campus node (distribution point). 12 strands per buffer tube only.

PON building riser backbone shall consist of a single Plenum rated 12 Strand Single-Mode OS2 cabling homerun from the building BDF to all zone box locations.

ISP Cable- MIC 2-24 fibers plenum

Cable shall be plenum-rated, all-dielectric, with two to twenty-four $900 \pm 50 \mu\text{m}$ tight-buffered fibers. Owner has pre-approved the following product to be in compliance with these standards: TBII® Tight-Buffered Fiber shall be made of a PVC material and shall have a UV-cured acrylate coating (low-friction slip layer) between the acrylate coating of the optical fiber and the PVC buffer.

The fiber coating, low-friction slip layer and PVC buffer shall be removable with commercially available stripping tools in a single pass for termination or splicing. The individual fibers shall be color-coded for identification. The optical fiber color coding shall be in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding." Fibers shall be stranded together around jacketed or non-jacketed dielectric strength members via reverse oscillation and surrounded with dielectric strength members and a ripcord. Cables containing 12 to 24 fibers shall have a dual-layer stranded design. The cable jacket color shall be orange for cables containing all multimode fiber, except for cables containing 50/125 μm , 850 nm laser optimized fiber, which shall have an aqua colored outer jacket. The cable jacket color shall be yellow for cables containing all single mode fiber. Cable shall have a storage temperature range of -40° to 70°C on the original shipping reel, installation temperature range of 0° to 60°C , and an operating temperature range of 0° to 70°C . Cable manufacturer shall be ISO 9001 registered.

ISP Cable- UMIC 24-144 fibers plenum

Cable shall be all-dielectric and contain 36 to 144 $900 \pm 50 \mu\text{m}$ tight-buffered fibers. TBII® Tight-Buffered Fiber shall be made of a PVC material and shall have a UV-cured acrylate coating (low friction slip layer) between the acrylate coating of the optical fiber and the PVC buffer. The fiber coating, low friction slip layer and PVC buffer shall be removable with commercially available stripping tools in a single pass for

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termination or splicing. The individual fibers shall be color-coded for identification. The optical fiber color coding shall be in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding." Fibers shall be stranded via reverse oscillation with dielectric strength members and a ripcord in either 6-fiber or 12 fiber subunits. Cable with < 60 fibers shall contain 6-fiber subunits, otherwise cable shall contain 12-fiber subunits. Subunits shall be stranded together in a planetary configuration around a jacketed or bare glass reinforced plastic (GRP) dielectric central member. Cable shall contain a ripcord underneath outer cable jacket to facilitate jacket removal. Each subunit jacket shall be made of a PVC material and shall be identified with a unique number at periodic intervals. Subunit color containing multimode fiber shall be orange. Subunit color containing 50/125 μm , 850 nm laser optimized fiber shall be aqua. Subunit color containing single-mode fiber shall be yellow. A dual-layer subunit design shall be used for cables containing 108 to 144 fibers. The cable jacket color shall be orange for cables containing all multimode fiber, except for cables containing 50/125 μm , 850 nm laser optimized fiber, which shall have an aqua colored outer jacket. The cable jacket color shall be yellow for cables containing all single mode fiber. Hybrid cables (containing more than one type of fiber) shall have an outer jacket with the color corresponding to the greatest percentage of total fibers within the cable, except for hybrid cables containing 50/125 μm , 850 nm laser optimized fiber, which shall have an aqua colored outer jacket. Cable shall be listed OFNP/FT-6 and be fully compliant with ICEA S-83-596. Cable outer jacket shall be marked with the manufacturer's name or ETL file number, date of manufacture, fiber count, fiber type, flame rating, listing symbol, and sequential length markings every two feet (e.g., "NAME BRAND CABLE - 01/00 – 72 SM– TB2 - OFNP (ETL) OFN FT6 (CSA) 0001 FEET"). The marking shall be in contrasting color to the cable jacket.

Cable shall have a storage temperature range of -40°C to $+70^{\circ}\text{C}$, installation temperature range of 0°C to $+60^{\circ}\text{C}$, and an operating temperature range of 0°C to $+70^{\circ}\text{C}$. Cable manufacturer shall be ISO 9001 registered.

27 13 23.02 Inter Building Optical Fiber Cable

Fiber Optic cable shall meet following requirements:

Cable shall be all-dielectric, stranded loose-tube design with dry water blocking for outdoor duct and aerial installations in fiber counts from two to 288. Each fiber shall be distinguishable by means of color-coding in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding." The fibers shall be colored with ultraviolet (UV) curable inks. Buffer tubes shall be made from polypropylene. Each buffer tube shall contain a water swellable yarn for water blocking protection. The water-swellable yarn shall be non-nutritive to fungus, electrically non-conductive, and homogeneous. It shall also be free from dirt or foreign matter. This yarn will preclude the need for other water blocking material; the buffer tube shall be gel free. The optical fibers shall not require cleaning before placement into a splice tray or fan out kit. The buffer tube shall be manufactured to a standard 3.0 mm in size, regardless of fiber count,

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to reduce the number of required installation and termination tools. Buffer tubes containing fibers shall be color coded with distinct and recognizable colors in accordance with TIA/EIA-598-B. Buffer tube colored stripes shall be inlaid in the tube by means of co extrusion when required. The nominal stripe width shall be 1 mm. Buffer tubes in a hybrid cable (cable containing more than one type of fiber) shall contain only one fiber type. Identification of fiber types in a hybrid cable shall correspond to fiber core diameter (or mode field diameter) from smallest to largest in accordance with TIA/EIA-598-B. Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation stranding process. Two polyester yarn binders shall be applied contra helically with sufficient tension to secure each buffer tube layer to the dielectric central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking, and dielectric with low shrinkage. Water swellable yarn(s) shall be applied longitudinally along the central member during stranding. For dual-layer cables, a second (outer) layer of buffer tubes shall be stranded over the original core to form a two-layer core. A water swellable tape shall be applied longitudinally over both the inner and outer layer. The water-swellable tape shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter. Cable shall be comprised of water-swellable yarns and/or tapes, dielectric strength members (as required), ripcord(s) and an MDPE jacket containing carbon black to provide ultraviolet light protection while inhibiting the growth of fungus. Cable jacket shall be marked with the manufacturer's name, month and year of manufacture, sequential meter or foot markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®), fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing one or more coextruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm. Cable shall contain reverse oscillation lay (ROL) markings as needed. Cable shall have a storage temperature range of -40° to 70°C, an installation temperature range of -30 to 70°C, and an operating temperature range of -40° to 70°C. Cable shall have a short-term tensile rating of 2700 N. No fiber strain shall occur over the service life of the cable when subjected to a maximum, long-term tensile rating of 890 N. Cable shall meet the functional requirements of Rural Utilities Service (RUS) 7 CFR 1755.900 and be fully compliant with ICEA S-87-640. Manufacturer shall be ISO 9001 and TL 9000 registered.

27 13 23.13 Optical Fiber Splicing and Terminations and Testing

Rack mount Housings:

Housing shall be of the same specified warranty as the structured cabling provided. Housings shall be mountable in an EIA-310 compatible 465- or 592 mm rack. Housings shall be available in both 1U ,2U and 4U sizes. One EIA rack space or panel height (denoted as 1U) is defined as being 44.45 mm in height. The unit shall meet

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all applicable design requirements listed in ANSI/TIA/EIA-568, ANSI/TIA/EIA-942, and the polymer compounds flammability requirements of UL 94 V-0. Manufacturer shall be ISO 9001 and TL 9000 registered. Housings shall be manufactured using 16-gauge aluminum or equivalent for structural integrity and shall be finished with a black powder coat for durability. All joints shall be welded and finished in a workman-like manner. Installation fasteners shall be included and shall match the housing color. The unit shall include a cable clamping mechanism to provide cable strain-relief.

The front and rear doors shall be lockable when used with an optional key lock kit. The connector housings shall have a labeling scheme that complies with ANSI/TIA/EIA-606. The housings shall be available with factory-installed connectorized cable stubs in multiple cable and connector types. The housing shall have the ability to accommodate fusion splicing with additional hardware. The housing shall be 16 inches deep for extra cable routing.

All fiber optic terminations/splices shall be fusion spliced.

All fiber optic connectors shall comply with all ANSI/ TIA/ EIA standards.

Connectors SC/ APC SM

Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with the TIA/EIA Fiber Optic Connector Inter-mate ability Standard (FOCIS) document, TIA/EIA-604-2. The connector shall be factory connectorized/ polished and the installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 µm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall be installable upon single-mode optical fiber. Ferrule material shall be ceramic. Connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be measured after manufacture to be less than or equal to -40/-55 dB angled physical contact (APC). Manufacturer shall be ISO 9001 and TL 9000 registered. The manufacturer shall have an in-depth knowledge, and more than 10-year history, of manufacturing and supporting connector technology that does not require epoxy or polishing in the field.

Approved manufacturers are "Belden FX Fusion Splice on Connector" and "Sumitomo Lynx2 Splice on Connector" (Sumitomo for loose tube OSP applications only).

Connectors LC/ APC SM

Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with the TIA/EIA Fiber Optic Connector Inter-mate ability

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	<p>Standard (FOCIS) document, TIA/EIA-604-2. The connector shall be factory connectorized/ polished and the installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 μm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall be installable upon single-mode optical fiber. Ferrule material shall be ceramic. Connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be measured after manufacture to be less than or equal to -40/-55 dB angled physical contact (APC). Manufacturer shall be ISO 9001 and TL 9000 registered. The manufacturer shall have an in-depth knowledge, and more than 10-year history, of manufacturing and supporting connector technology that does not require epoxy or polishing in the field.</p> <p>Approved manufacturers are "Belden FX Fusion Splice on Connector" and "Sumitomo Lynx2 Splice on Connector"(Sumitomo for loose tube OSP applications only).</p>

Connectors LC/UPC SM

Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with the TIA/EIA Fiber Optic Connector Inter-mate ability Standard (FOCIS) document, TIA/EIA-604-2. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 μm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall be installable upon single-mode optical fiber. Ferrule material shall be ceramic. Connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be measured after manufacture to be less than or equal to -40/-55 dB ultra physical contact (UPC). Manufacturer shall be ISO 9001 and TL 9000 registered. The manufacturer shall have an in-depth knowledge, and more than 10-year history, of manufacturing and supporting connector technology that does not require epoxy or polishing in the field.

Connectors LC/ UPC MM 50um

Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with TIA/EIA Fiber Optic Connector Inter-mate ability Standard (FOCIS) document, TIA/EIA-604-2. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 μm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall be installable upon 50/125 μm multimode optical fiber. Ferrule material shall be ceramic. The connector crimp on

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mechanism shall protect the bare fiber from the ingress of air or waterborne contaminants. Connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be less than or equal to -20 dB. Manufacturer shall be ISO 9001 and TL 9000 registered.

Connectors LC/ UPCMM 50um Laser Optimized OM3

Connector shall be compliant with industry standard ANSI/TIA/EIA-568-B.3. The connector shall comply with TIA/EIA Fiber Optic Connector Inter-mate ability Standard (FOCIS) document, TIA/EIA-604-2. The connector installation shall not require the use of epoxies, adhesives or ovens. The connector shall be installable upon 900 µm buffered fiber in one minute or less and upon 2.9 mm jacketed cable in three minutes or less total time. The connector shall be installable upon 850-nm laser-optimized 50 µm multimode optical fiber. Ferrule material shall be ceramic. The connector crimp on mechanism shall protect the bare fiber from the ingress of air or waterborne contaminants. Connector shall be consistently capable of insertion losses of 0.3 dB (typical) and shall be 0.75 dB (maximum) when installed in accordance with the manufacturer's recommended procedure and tested in accordance with FOTP-171. Connector reflectance shall be less than or equal to -20 dB. Manufacturer shall be ISO 9001 and TL 9000 registered.

Splice cases:

The fiber splice enclosures shall be available in canister (butt) and in-line styles to fit most applications. All end-caps feature two express ports for uncut feeder cables.

Splice case shall be resistant to solvents, stress cracking and creep. The housing materials shall also be compatible with chemicals and other materials to which they might be exposed in normal applications. The optical fiber closure shall be capable of accepting any optical fiber cable commonly used in interoffice, outside plant and building entrance facilities. As an option, the ability to double the cable capacity of an installed canister splice closure by use of a kit shall be available. Such a conversion shall not disturb existing cables or splices.

Encapsulation shall not be required to resist water penetration. The splice closure shall be re-enterable. The closure end-cap shall be capable of accepting additional cables without removal of the sheath retention or strength-member-clamping hardware on previously installed cables or disturbing existing splices. The optical fiber splice closure shall provide a clamping mechanism to prevent pistoning of the central member or strength members and to prevent cable sheath slip or pullout. The splice closure shall have appropriate hardware and installation procedures to facilitate the bonding and grounding of metal components in the closure and the

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armored cable sheath. The cable bonding hardware shall be able to accommodate a copper conductor equal to or larger than 6 AWG.

Aerial splice closures shall have available the necessary hardware to attach and secure the closure to an aerial strand. The closure shall accommodate splice trays suitable for single- fiber, single fiber heat-shrink, mechanical or ribbon heat-shrink splices. The small splice closure shall accommodate up to 72 single- fiber splices or 144 ribbon fiber splices using 12-fiber ribbons. The medium-sized closure shall accommodate up to 288 single-fiber splices or 432 ribbon-fiber splices. The large closure shall accommodate up to 480 single-fiber splices or 864 ribbon-fiber splices. The installation of the splice closure shall not require specialized tools or equipment, other than those normally carried by installation crews.

All fibers (inter and intra building) tested for continuity and tagged at both ends with building number and ID number. All fibers tested for insertion loss, both directions, at 850nm and 1350nm on multi-mode, and at 1310nm and 1550nm on single-mode bi-directionally. All results documented and provided electronically. OTDR signature trace documents on all fibers with pertinent points documented (splice, endpoints, etc.) Only test results with Owner (ITS) personnel present will be accepted.

- 27 15 00 Communications Horizontal Cabling**
- 27 15 01 Communications Horizontal Cabling Applications
- 27 15 01.16 Voice Communications Horizontal Cabling

All work stations shall be fed by one (1) 4-pair 100 ohm balanced Category 6 plenum rated with yellow jacket cable with matching color jacks. No horizontal permanent link cable run shall exceed 90 meters. Cable shall be terminated at the work station on one (1) Category 6 yellow jack capable of Gigabit Ethernet (GbE). All Voice jacks should have Gigabit Ethernet (GbE) capability.

All Terminations shall be 568-A.

All work stations shall consist of one (1) yellow Cat6 and one (1) blue Cat6 cables with matching color jacks. All cable colors to be bundled separately in the ceiling and all closets. When cables enter the closets they will be packed neatly (i.e. cigarette packing).

- 27 15 01.19 Data Communications Horizontal Cabling

All work stations shall be fed by one (1) 4-pair 100 ohm balanced Category 6 plenum rated with blue jacket cable with matching color jack. **Manufacturer of cable must be accepted by the proposed warranty.** No horizontal cable run shall exceed 90 meters. Cable shall be terminated at workstation on Category 6 jack and terminated

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	<p>at the BDF/IDF on Category 6 patch panel. All cables tested and certified to Category 6 standard. All data jacks should have a Gigabit Ethernet (GbE) capability. Computer labs, classrooms, and all other special applications require the input of Owner on number and location of drops. Only Velcro type cable ties shall be used with Category 6 and 6a cabling. All Terminations shall be 568-A.</p> <p>All work stations shall consist of one (1) yellow Cat6 and one (1) blue Cat6 cable with matching color jacks.</p> <p>All PON workstations shall consist of a single or dual strand, plenum rated SM OS2 cable and a single (2) conductor minimum 16/2 wire for power to the ONT.</p> <p>All PON cabling from the ONT to a faceplate and jack shall consist of a yellow Cat6 cable with matching color jack and terminated 568-A when placed into a faceplate on a wall or cubicle. All other network devices shall be connected via a direct link (patch cord style) from the ONT port to the device served. All workstations and devices shall be allocated (1) PON port with the exception of WAPs (Wireless Access Points).</p> <p>All cable colors to be bundled separately in the ceiling and all closets. When cables enter the closets or zone boxes they shall be packed neatly (i.e. cigarette packing).</p>

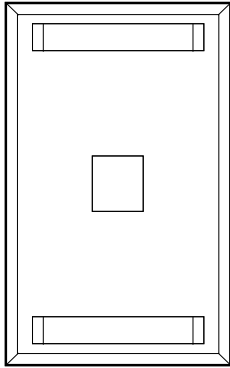
27 15 01.20 Wireless Data Communication Horizontal Cabling

Owner shall specify the wireless solution for the project/ area served. Internal and external antennae (Cisco Aironet 2.4-GHz/5-GHz xMIMO 4-Element 802.11ax or as specified. Patch Antenna) 802.11ax access points utilizing WISM 2 Controllers. Horizontal cabling shall be designed to meet minimum -67db signal strength in all areas. This is generally achieved with AP locations placement at a 35' radius. Wireless design should be completed using the planning mode of the Ekahau Survey/ Planning tool to generate the locations that meet these parameters as well as any user requirements such as increased client density loads found in classroom and large capacity spaces.

WAP locations should be located so that horizontal mounting will be allowed. All WAP locations shall consist of (2) Category 6a gray cables with matching color jacks. In a PON architecture, all WAP locations shall consist of (2) Category 6a yellow cables with matching color jacks. No permanent link run shall exceed 80 meters (242') including the 30' service loop at the device end. All installations shall be installed in accordance to current TIA TSB-162-A. Wireless Cables shall be terminated 568-A on Cat6a Patch Panels separate from the station cable Patch Panels. All wireless cabling shall terminate in the BDF unless distance is an issue. Telecommunications installing contractor is responsible for the mounting of all WAPs and the telco room/ station side patching on all installations. The installing contractor is required to provide an

Section Number	Title
	Excel spreadsheet depicting the location, WAP ID, MAC Address and the ONT or switch port ID.
27 15 43	<p data-bbox="375 310 946 342">Communications Faceplates and Connectors</p> <p data-bbox="375 390 1459 579">Consult with Owner for specified port openings per faceplate. Workstation locations fed by two (2) Category 6 4-pair cables (color and material of the face plate to be determined by Owner) with two (2) Category 6 modular jacks and one blank with matching color to the face plate if necessary. (Category 6 and Category 6a cables and jacks terminated T568A).</p> <p data-bbox="375 621 1459 695">Workstations and devices (except WAPs) within a PON infrastructure, shall be fed by a yellow Cat6 cable with matching color jack terminated 568-A.</p> <p data-bbox="375 737 1459 848">Owner recommended faceplate is white with modular jack colors matching the cable jacket colors. All work stations shall consist of one (1) yellow Cat6 and one (1) blue Cat6 cable with matching color jacks terminated 568-A.</p>

Section Title
Number

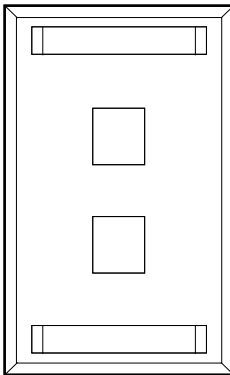


1 Port Jack Color Layout
Yellow

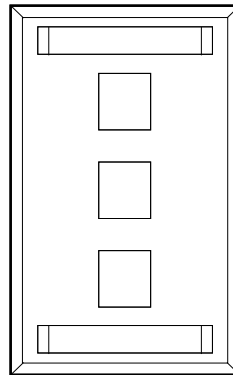
All workstations shall consist of:
(1) Double Gang Outlet box with Reducing Cover/ No Reducing Cover for double gang face plates

- (1) Yellow Cat6 Jack
- (1) Blue Cat6 Jack

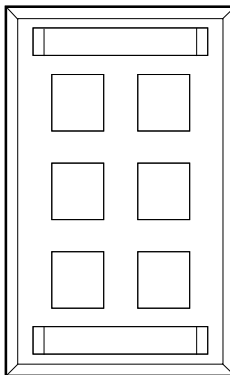
All data only locations shall have the colors split (eg: 2 data only shall consist of one yellow and one blue cables and jacks
4 data only shall consist of 2 yellow and 2 blue cables and jacks)



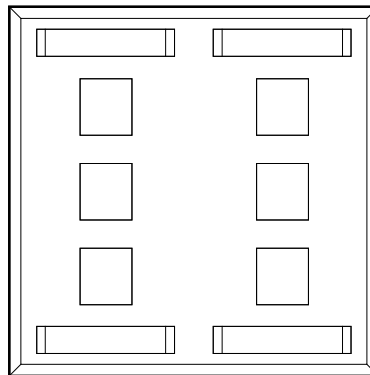
2 Port Jack Color Layout
Yellow
Blue



3 Port Jack Color Layout
Yellow
Blue
Blank



6 Port FP Jack Color Layout
Station 1 Station 2
Yellow Blue
Yellow Blue
Yellow Blue



In a PON architecture all copper cabling and jacks shall be yellow in color.

Section Number	Title
27 16 00	Communications Connecting Cords, Devices, and Adapters
27 16 13	Communications Custom Cable Assemblies All custom-built cable assemblies shall be tested and certified to appropriate category level and meet performance level of all applicable codes and standards.
27 16 16	Communications Media Converters, Adapters, and Transceivers Furnished by Owner.
27 16 19	Communications Patch Cords, Stations Cords, and Cross Connect Wire Patch cords, equipment cords, and work area cords must be manufactured by the approved warranty provider and meet the applicable performance requirements in ANSI/TIA/EIA-568-B.2. All cords associated with the data horizontal cable system must be 4-pair Category 6 or Category 6a rated, factory terminated, meet horizontal cable specifications and shall be included in the System Warranty. All patch cords sized to provide a neat appearance. Patch cord colors shall match the designated application it is being used for.
27 20 00	DATA COMMUNICATIONS
27 21 00	Data Communications Network Equipment All Data Communication Equipment furnished by Owner.
27 30 00	VOICE COMMUNICATIONS SWITCHING AND ROUTING EQUIPMENT
27 31 00	Voice Communications Switching and Routing Equipment All equipment furnished by Owner.
27 32 00	Voice Communications Telephone Sets, Facsimiles, and Modems
	All telephone sets and ancillary equipment furnished by Owner except emergency telephones.
27 32 23	Elevator Telephones All models shall be all-campus alert (ACA) capable and must be pre-approved by Owner (ITS). All site located emergency phones to be fed by a minimum (1) 1" conduit suited for its environment and (1) Category 6 rated cable suited for its environment with station protection and routed to the closest equipment room. Enclosure shall have electrical ground installed within 20 feet and the use of a gas discharge type lightning arrestor is required. The response time should be 1ns or less. If additional sure protection is needed, Surge Arrestor, Pt 800-1018 is required. Housing associated with elevator phones shall be grounded.

Section Number	Title
	Owner has pre-approved the following manufacturer to be in compliance with these standards: Ramtel.
27 32 26	<p>Ring-Down Emergency Telephones VoIP</p> <p>All models shall be all-campus alert (ACA) capable and must be pre-approved by Owner (ITS). All site located emergency phones to be fed a minimum (1) 1" conduit suited for its environment and (1) Category 6 rated cable suited for its environment with station protection and routed to the closest telecommunications equipment room. Enclosure and columns shall have electrical ground installed within 20 feet and the use of a gas discharge type lightning arrestor is required. The response time should be 1ns or less. If additional surge protection is required, Surge Arrestor, Pt 800-1018 is required. Owner has pre-approved the following manufacturer to be in compliance with these standards: Ramtel.</p>
27 33 00	<p>Voice Communications Messaging All services provided and maintained by Owner.</p>
27 34 00	<p>Call Accounting All services provided and maintained by Owner.</p>
27 35 00	<p>Call Management All services provided and maintained by Owner.</p>
27 40 00	<p>AUDIO-VIDEO COMMUNICATIONS All services provided and maintained by Owner (NAU ITS). All AV installations and services shall be designed and installed in accordance to Division 27. See Design Guidelines for additional information on classroom standards.</p>
27 50 00	<p>SUMMARY: PON CABLING SOLUTION</p> <p>Design and standards listed below are not intended to be the only requirements for the installation of a PON infrastructure but to be used in conjunction with Division 27 in its entirety.</p>
27 50 01	<p>PON Installation Summary</p> <ul style="list-style-type: none"> • Furnish, install, test and place into satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete ANSI/TIA/EIA, NECA/NEIS and ISO/IEC compliant communications XGS/ Gigabit Passive Optical Network as hereinafter specified and/or shown on the Contract Documents. The system is intended to be capable of integrating

Section Number	Title
	<p>voice, data, and video signals onto a common medium, and shall be tested for and be capable of 1 and 10 Gigabit Ethernet operation as specified in:</p> <ul style="list-style-type: none"> ○ TIA/EIA 568-B.2-10 and ISO/IEC 11801:2002/Amd 1:2008. ○ ITU-T G.984.1 2012- Gigabit-Capable Passive Optical Networks (PON): General Characteristics ○ ITU-T G.987.1 2012- 10 Gigabit- Capable Passive Optical Network (XG-PON) Systems: General Requirements ○ ITU-T G.9807.1 2016- 10 Gigabit-Capable Symmetric Passive Optical Network (XGS-PON) General Requirements <ul style="list-style-type: none"> ● The work shall include all materials, equipment and apparatus not specifically mentioned herein or noted on the plans but which are necessary for a complete working ANSI/TIA/EIA and ISO/IEC compliant PON. ● Provide coordination with cabling system manufacturer’s representatives to ensure that the manufacturer’s inspectors are available to schedule site visits, inspections, and certification of the system. Provide and coordinate any modifications required by the manufacturer and have the manufacturer re-inspect and certify the system prior to the scheduled use of the system by the Owner. ● Contractor is solely responsible for all costs associated with scheduling the manufacturer inspection, the inspection itself and any manufacturer-required re-inspections, and for any modifications to the installation as required by the manufacturers. ● Sequencing: <ul style="list-style-type: none"> ○ Include any requirements for coordinating work with potentially unusual or specifically required sequencing. NAU may choose to construct a project under two bid packages - one for pathways and spaces (perhaps under a General Contract), and a second bid package for the Structured Cabling System (perhaps using the NAU/ ITS RFP). The Designer must coordinate with Owner to determine if two bid packages will be used and include verbiage in the appropriate specification sections requiring the contractors to coordinate construction phasing and schedules.
27 50 02	PON Fiber Optic Architecture

For buildings designed with a PON infrastructure, the main telecommunications room shall have an open ceiling and be large enough to serve the entire building. Room size is scalable per building size.

Section Number	Title
	<ul style="list-style-type: none"> • The OSP plant for the PON architecture shall consist of OSP rated, non-dielectric cable(s) with a minimum 48 strands of SM OS2 routed in an approved pathway by Owner. • The inside plant for the PON architecture shall be designed in a zone distribution that will serve areas of a floor. The distribution backbone will consist of Single-mode OS2 fiber optic cable for zone distribution cabling. This fiber optic distribution backbone shall be homerun (no splices shall be allowed) from the building BDF, consist of a minimum 12 strands and terminated with SC/ APC connectors. Once terminated and tested, the Blue and Orange strands from the distribution backbone cable shall be patched to the inputs of the splitter cassette and labeled/ connected per instructions. These two fiber jumpers shall be long enough that the cassette can be removed without interrupting IP connectivity. The remaining fibers and any slack to be secured behind the cassette in the fiber LAN housing. • A factory made/ certified workstation fiber jumper shall be a Single-mode OS2 Simplex (1' in length) and terminated with LC/APC connectors only, to connect from the zone box fiber splitter to the workstation bulkhead. • From the zone distribution boxes to the workstation, the horizontal cabling shall consist of a single or dual strand SM OS2 and terminated with SC/APC connectors at the ONT or workstation side and LC/ APC connectors at the zone/ distribution box side. • Typically, splitters shall be placed in the zone/ distribution box of the area for the offices, workstations or other applications being served. No mechanical splices of any type shall be allowed. Fusion splice type terminations only with factory polished ends. All strands installed shall be terminated, tested and certified prior to substantial completion sign off. • Only (1) ONT port per for workstations and all devices such as security cameras, A/V units, access control devices, etc. with the exception of WAPs and or unless otherwise required by design. Only (1) BDF per building to serve all zone/ distribution boxes unless required by design and or specified by NAU/ITS. Wherever possible, ONTs shall utilize local power with the exception for devices located in the ceilings. Devices located in the ceiling shall be fed via distributed remote line power from the zone boxes. • The fiber optic cable and the remote line power cable for the ONTs shall originate from the same zone box or distribution shelf. No splitting of workstation cabling (fiber optic and RLP wires) will be allowed under any circumstances. • Minimum 1" EMT conduit reamed and with a plastic bushing shall be placed for all locations passing through, within or stubbing out from a wall, floor or ceiling. • All components of the PON architecture shall have a machine or computer printed labels and consist of the following: <ul style="list-style-type: none"> ○ On the Zone/ Distribution box: (a) BDF Rm #/ (b) Zone Box ID:aaaaa/bbbbb

Section Number	Title
	<ul style="list-style-type: none"> ○ On the fiber Patch Panels: (a), (b), (c) Patch Panel ID: aaaaa/bbbbbb/ccccc ○ On the Splitter: (a), (b), (X) Splitter ID: aaaa/bbbbbb/ XXXXX ○ On the RLP Unit: (a), (b), (x) RLP Unit ID: aaaaa/bbbbbb/xxxxx ○ On station cabling at the zone/ distribution box: <ul style="list-style-type: none"> ▪ (b), (c) (d) ONT ID: bbbbbb/ ccccc/ ddddd ○ On station cabling at the ONT: (b), (c),(d) : bbbbbb/ ccccc/ ddddd ○ On the ONT: (b), (c), (d) ONT ID: bbbbbb/ ccccc/ ddddd <ul style="list-style-type: none"> ▪ For ONTs located within a concealed ceiling space, an additional label shall be affixed the ceiling structure in the location where the ONT resides. The smallest font size shall be used so it is visible/ readable from the floor. ○ On the workstation faceplate if cabling has been extended from the ONT to a faceplate on a wall or cubicle: (d), (e) ONT Port #: ddddd/eeee
27 50 03	<p>PON Horizontal/ Intra/ Inter- Fiber Optical Cabling</p> <ul style="list-style-type: none"> ● Horizontal optical cabling shall consist of a single or dual strand SM OS2 Plenum rated cable homerun from the zone/ distribution box serving the area of need to the workstation. ● Intra-Backbone optical cabling shall consist of a single homerun SM OS2 Fiber optic cable consisting of no less than 12 strands. Riser fiber optic cabling shall be Plenum rated and armored in construction or reside in a fiber optic inner-duct and labeled accordingly. ● The Inter-Backbone optical cabling shall consist of an OSP rated, non-dielectric cable(s) with a minimum 48 strands of SM OS2 routed in an approved pathway by Owner. <ul style="list-style-type: none"> ○ If redundancy is required, the inter-backbone optical cabling may consist of (2) separate 24 strand SM OS2 cables routed to either the same or different nodes. ● <i>For horizontal cable support requirements, see section 27 05 28.29.</i> ● Connectors shall be factory terminated and fusion spliced to the horizontal/ riser cable. All strands installed shall be terminated, tested and certified prior to substantial completion sign off.
27 50 04	<p>PON Horizontal PoE/ Remote Line Power Cabling</p>

Section Number	Title
	<ul style="list-style-type: none"> • Green Field: <i>See notes below</i> • Brown Field: <i>See notes below</i> • All ONTs located within the ceiling, plenum or riser spaces shall be fed via distributed remote line power DC power plant 16/2 white cable with a Phoenix power connector homerun to the closest zone/ distribution box. • All ONTs located in walls (i.e. ONT140W) shall be fed via 2 conductor wire with a Phoenix power connector fed from the closest companion electrical outlet or by a 2 conductor 16/2 white cable with a Phoenix power connector homerun to the closest zone box. Input at ONT shall be (Volts) 48-56Vdc. • All ONTs located at cubicle workstations shall be fed via ONT Power Connector Type-B to utilize the local power from the cubicle station. • All ONTs operating public safety services shall be fed separately to a dedicated power supply and or UPS (uninterruptable power supply) for back up capability to maintain code compliance. • No other power options will be accepted unless otherwise approved in writing by the manufacturer of the electronics stating this an acceptable and warrantable solution by the manufacturer and the NAU AHJ. • All PON/ PoE conducting cables shall not be installed with a service loop. Service slack shall be installed.
27 50 05	<p>Zone Box Location/ Power Feed</p> <ul style="list-style-type: none"> • Zone boxes on the first floor shall be located no more than 45' from an exterior wall to serve any future outside data connectivity needs. • Zone boxes shall be located in an accessible area with minimum 24" of clearance on all 6 sides of the zone box. • Zone boxes shall be located centrally or within the area being served. <ul style="list-style-type: none"> ○ <i>For zone/ distribution/box power requirements, see NAU Division 26.</i>
27 50 06	<p>PON Connecting Hardware, Racks and Zone Boxes</p> <ul style="list-style-type: none"> • Node/ BDF LIU: ECX-4U • Zone Box LIU: ECX-1U • Splitters: SCSX1232SLF • Node/ BDF LIU Bulkhead: FFSX12SB(SC/APC) • Zone box Bulkheads: FFSX16LA(LC/APC)

Section Number	Title
	<ul style="list-style-type: none"> • Fiber/ DC Plant Racks: SB55608423U6FB (23"Wx 84"Hx 6"D rack, black) • Zone Boxes: xxxxxxxxxxxxxxxxxxxxxxx • Fiber Connectors: <ul style="list-style-type: none"> ○ OLT: FTSSC900FS01 (SC/UPC) FX Fusion ○ Distr. BB: FTSSB900FS01 (SC/APC) FX Fusion ○ Zone Box: FTSLB900FS01 (LC/APC) FX Fusion ○ Workstation: FTSSB900FS01 (SC/APC) FX Fusion ○ OSP cabling: SCAPCSM900LT (SC/APC) Sumitomo • Fiber Jumper types: <ul style="list-style-type: none"> ○ OLT: SC/UPC-SC/APC Simplex SM OS2 (sized accordingly) ○ Distr. BB: SC/APC-SC/APC Simplex SM OS2 (sized accordingly) ○ Zone Box: LC/APC-LC/APC Simplex SM OS2 (sized accordingly) • Racks: All racks and accessories shall be black in color with vertical wire management and attached to ladder secured to the wall for rack support. • Fiber Distr.: 23"w x 8'h • Bldg. DC Plant: 23"w x 8'h • Electronics (PON): Tellabs • Electronics (PoE): Alpha Technologies (eLimiter+) RLP
27 50 07	<p>PON Academic and Administrative Buildings</p> <ul style="list-style-type: none"> • The designer shall inquire with the NAU ITS department to get instructions regarding the number of ONT ports to allocate to each office, workstation and other applications. • See NAU DGTS regarding the number of ONT ports for AV requirements such as instructor podiums, TVs, projectors, etc.
27 50 08	<p>PON Residence Halls</p> <ul style="list-style-type: none"> • The telecommunications infrastructure for all residence halls shall be designed as a PON and shall be capable of television distribution via PON. • The designer shall inquire with the director of NAU Housing and Residence Life to get instructions regarding the number of ONT ports to allocate to each person, room or apartment space in each residence hall.
27 50 09	<p>PON Outlets</p> <ul style="list-style-type: none"> • Owner requires the installing contractor to install, power up all ONT devices within the defined scope of work and to verify that the data link light is active. NAU/ITS will configure all ONT devices after the installing contractor has established successful operation of all ONTs.

Section Number	Title
	<ul style="list-style-type: none"> • The PON infrastructure designer shall define the locations/ types of ONTs needed for each project with Owner approval. • The contractor shall also be required to provide a spreadsheet report along with the as-built for the project identifying the ONTs with the ONT ID and room name/ number. • The designer shall include this requirement in the Contract Documents. • NAU/ ITS will procure all PON (GPON/ XGSPON) electronics and provide to the installing contractor for installation and powering up of ONTs. • The installing contractor is not responsible for procurement or installation of any OLT (headend) PON cards.
27 50 10	PON Cable Trays <ul style="list-style-type: none"> • <i>For cable tray requirements, see section 27 05 28.36</i>
27 05 11	PON Special Applications <ul style="list-style-type: none"> • Permanent/ Temporary Office Spaces and workstations: • Permanent office spaces can maintain a (2) data outlet per workstation when desired for additional peripheral devices such as printers, special devices etc. For these applications only (2) options may be deployed. <ul style="list-style-type: none"> ○ Wall mount ONTs with (4) Ethernet ports located at standard height, next to a companion electrical outlet and free from any obstruction in front of it with easy accessibility for maintenance. ○ ONT situated in the ceiling of the office being served with permanent Category 6 cabling extending from the ONT to the workstation and located a standard height next to a companion electrical outlet. • Any deviations from these methods shall be approved by NAU/ ITS prior to installation. • Temporary Offices/ workstations <ul style="list-style-type: none"> ○ Temporary offices and workspaces may be connected by any combination of the approved methods as stated above in Division 27 section 27 50 11 but should maintain a single data port per workstation when applicable.

****END OF SECTION****