

Project Manual

Bid Package 2
Addendum No.03
Volume 2
Divisions 27

Cherokee Nation WILMA P. MANKILLER HEALTH CENTER EXPANSION

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Division	Section Title	Pages
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PROCUREMENT AND CONTRACTING DOCUMENTS GROUP

SPECIFICATIONS GROUP

Facility Services Subgroup

DIVISION 27 - COMMUNICATIONS

27 0000 CNIS Network Construction Standards and Requirements

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Cherokee Nation Information Technology
Network Construction Standards and Requirements

INTRODUCTION

The following Network Construction Standards and Requirements pertain to the requirements of the Cherokee Nation Information Technology Network Section. All preceding documentation is superseded by this document and shall be used until replaced.

This is our requirements that we require to be followed when designing, constructing, or refurbishing any building that requires a network to be installed or upgraded. If there are any questions please contact Cherokee Nation Information Technology Network Group.

PART 1 – GENERAL

1) SECTION REQUIREMENTS

- a) Summary: Furnish and install complete with all accessories a Structured Cabling System (SCS). The SCS shall serve as a vehicle for transport of data, video and voice telephony signals throughout the network from designated demarcation points to outlets located at various desks, workstation and other locations as indicated on the contract drawings and described herein.
- b) Submittals
 - i) Product Data
 - (1) Owner is providing a list of standard parts required for the contract. Any additional parts used the vendor/contractor will provide manufacture's catalog information showing dimensions, colors and configurations.
 - (2) Submittals shall include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets for the following:
 - (a) All balanced twisted pair cable.
 - (b) All connectors and required tooling.
 - (c) All termination system components for each cable type.
 - (d) All test equipment to be used for balanced twisted pair channels.
 - (3) A Performance Specification showing manufacturer's Guaranteed Published Channel Performance over the full swept frequency range.
 - (4) Technical data sheets shall include the physical specifications as well as the following electrical and transmission characteristics for balanced twisted pair channels:
 - (a) Mutual Capacitance
 - (b) Characteristic Impedance
 - (c) DC Resistance
 - (d) Insertion Loss (IL)
 - (e) Pair-to-Pair Near End Crosstalk (NEXT)
 - (f) Power Sum Near End Crosstalk (PSNEXT)
 - (g) ELFEXT (ELFEXT)
 - (h) Power Sum ELFEXT (PSELFEXT)
 - (i) Return Loss (RL)
 - (j) Propagation delay
 - (k) Delay Skew
 - ii) Samples
 - (1) Prior to installation, samples of cable and components shall be provided to the Owner, its

Consultants and Construction Manager for evaluation prior to Installation

- (a) Submit samples of each type of cable
 - (i) Three (3) 24" long samples of each type of cable, copper (6e & 6a) and fiber (SM & MM). For the copper, the sample cannot be from the same box/reel. Must take from three separate boxes/reels.
 - (ii) Three (3) samples of each connector.
 - (iii) One each 100ft terminated copper of the 6e & 6a cable in a bag for test reference and permanent storage in the Main Closet. Each should start at the lowest footage mark.
- iii) Manufacturer's Instructions
 - (1) Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
 - (2) Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
- iv) Material Guarantee
 - (1) The wiring vendor/contractor (installer) shall guarantee at the time of the bid that all Category 6A and 6E cabling and components meet or exceed specifications (including installation) as referenced in 1.2.
 - (2) The successful wiring vendor/contractor (installer) will insure that all correct parts are ordered per Products Section of this document and installed in accordance with manufacturers design and installation guidelines. Vendor/contractor shall submit complete parts and part numbers to the Construction Manager prior to installation of equipment.
 - (3) Test Fiber optic cables upon receipt at Project site:
 - (a) Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
 - (b) Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in final documentation.
- v) Quality Assurance
 - (1) For Cat 6a and 6e copper and Fiber optic the following will be provided:
 - (a) System:
 - (i) The successful Bidder shall warrant that all materials and equipment furnished within the channel, under the contract are new, in good working order, free from defects, and in conformance with the Structured Cabling SYSTEM specifications. All installed equipment must conform to the manufacturer's official published specifications. The warranty shall begin at the Structured Cabling System acceptance date and remain in effect for a period of twenty-five year from that date. The successful Bidder shall agree to repair, adjust, and/or replace (as determined by the Purchaser to be in its best interest) any defective equipment, materials, or other parts of the Structured Cabling System at the successful Bidder's sole cost. The Purchaser will incur no costs for service or replacement of parts within the channel during the warranty period of 25 years.
 - (ii) Selected vendor must provide a Structured Cabling System warranty for a minimum of 25 years. The Structured Cabling System warranty must guarantee the electrical performance to meet or exceed the requirements as outlined in documents TIA/EIA 568A and ISO DIS 11801 and offer a twenty five (25) year warranty within the Structured Cabling SYSTEM Channel, beginning at acceptance by the Purchaser. The warranty must include complete parts and labor replacement of defective products. The products must be warranted for a minimum of 20 years by the manufacturer. The Structured Cabling System warranty must have provisions for replacing the contracting

organization at no cost to the customer should the contractor lose his status as an authorized installer or otherwise not fulfill his obligation to the customer as outlined in the Structured Cabling System warranty program.

(iii) The successful Bidder shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the National Electric Code, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

(b) Application:

(i) Minimum twenty (20) year application assurance: The application assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future for a minimum twenty (20) year period.

vi) Certifications

- (1) The successful vendor/contractor shall meet the current year Panduit Business Partner Agreement – Panduit Certified Installer (and/or Addendum), and shall provide a copy of the PCI certificate before awarding contract.
- (2) A copy of certification not less than 6 months from expiration for the vendors/installer Panduit Certified Copper and Fiber Technicians (PCT) shall be submitted upon awarding of contract before first cable is pulled and or installed.
- (3) If the successful vendor/contractor subcontracts the job (and so on), then each awarded vendor/installer shall comply with the same certifications as above.

2) STANDARDS AND CODE COMPLIANCE REFERENCES

a) The following industry standards are the basis for the structured cabling system described in this document:

i) TIA/EIA

- (1) ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises, February 2009
- (2) ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, February 2009
- (3) ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components
- (4) Standards, August 2009
- (5) ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, June 2008.
- (6) TIA/EIA569A Commercial Building Standard for Telecom Pathways and Spaces
- (7) TIA/EIA606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- (8) TIA/EIA607 Commercial Building Grounding/Bonding Requirements
- (9) TIA/EIA942 Telecommunications Infrastructure Standard for Data Centers
- (10) IEEE Std 802.3(tm)-2008 Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- (1) IEEE Std 802.3(tm)-2008 Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications. IEEE 802.3bc-2009, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications. Amendment 2: Ethernet Organizationally Specific Type, Length, Value (TLVs).

ii) NFPA70 National Electric Code (NEC) 2005

iii) ISO/IEC· ISO/IEC 11801 Generic Cabling for Customer Premises

iv) BICSI ITSIM, Chapter. 4, "Pulling Cable."

3) ADDITIONAL SUPPPORT

- a) Cherokee Nation Information Technology Network Construction Standards and Requirements – this document.
- b) Notes, drawings and instructions from Owner as needed.
- c) Panduit Certification PLUSSM System Warranty Program, Panduit Warranty Guide.
- d) Successful vendor/contractor is invited to review an existing network to see how Owner would like to see how the network should look upon completion.

- 4) The most recent versions of all documents apply to this project. If there is a conflict between applicable documents, the order above (section 2 and 3) shall dictate the order of precedence in resolving the issue unless an enforceable local or national code is in effect.

PART 2 – PRODUCTS

1) SYSTEM REQUIREMEMNTS

- a) Expansion Capability: Provide spare conductor pairs in telecommunication cables, positions in cross-connect and patch panels, terminal strips to accommodate 20 percent future increase in the number of workstations shown on Drawings. All components and cabling shall be capable of 10G Bandwidth speed throughout the entire system.

2) CABLE TRAY

a) Installation:

- i) Cable tray will be the Chatsworth part no. 10250-718, {Standard length is 9'11-1/2"}. Cable Tray shall be installed with side stringers facing up so that the ladder forms a U-shape.
- ii) Cable Tray shall be secured to the structural ceiling, building truss system, wall, floor or the tops of equipment racks and/or cabinets using the manufacturer's recommended supports and appropriate installation hardware and methods as defined by local code or the authority having jurisdiction (AHJ). Cable Tray shall be supported every 5' or less in accordance with TIA-569-B. Cable Tray shall be supported within 2' of every splice and within 2' on both/all sides of every intersection. Support Cable Tray within 2' on both sides of every change in elevation. Cable tray support will use the Threaded Ceiling kit (11310-003) or a combination of Runway Support Bracket (11408-003) with 5/8 All-Thread Rod on the outside, Ceiling Support Bracket (11406-002), Threaded Rod I-Beam Clamps (10557-003), or appropriate hex nuts, split lock washers and plain washers through the bottom chord of the joists. Cable Tray splices will be made in mid-span, not over a support, with the manufacturer's recommended splice hardware.
- iii) Cable Tray shall be installed with a minimum clearance of 12" above the Cable Tray. Leave a minimum of 12" in between Cable Tray and ceiling/building truss structure. When located above an acoustical drop ceiling, leave a minimum of 3" clearance between the top of the drop ceiling tiles and the bottom of the Cable Tray.
- iv) Connections between tray sections shall be with the Butt-Splice kit (11301-001). If a redirection of up or down is required to go over or under utilities, use the Butt Swivel Splice kit (1 0487 -001). For the up or down movement of tray do not exceed more than 30 degrees so the cable will lie on the tray. **The use of cut up tray sections/pieces on joints shall not be used. Manufacture parts shall be used.**
- v) Intersections (T or X shaped) shall be made using the Junction Splice Kit (11308-001), with Cable Runway Corner Bracket (11595-715) added to create a radius for the cable to lay on when making turns. For an L-turn use the Cable Runway E-Bend (10822-709).
- vi) The cable tray is offset the length of the room to accommodate the rack, for all the cable to come off the track within 4 feet of the left hand wall when standing in the doorway.

- vii) Cover the exposed ends of cable runway that do not terminate against a wall or the ceiling with Protective End Caps (10643-001) or an End Closing Kit (11700-709).
- viii) The installer will provide touch-up paint color-matched to the finish on the Cable Tray and will correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the Cable Tray system. Paint listed in parts list.

b) Grounding

- i) Grounding will be in accordance with the Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications J-STD-607 -A. Within the telecommunications room/s and throughout the building, the Cable Tray shall be bonded together, electrically continuous, and bonded to the TGB. Cable Tray and turns shall be bonded across each splice with a bonding kit (40164-001 or 025). Cable Tray shall be bonded to the Telecommunications Grounding Buss bar (TGB) using an approved ground lug on the Cable Tray and a minimum #6 grounding wire. Remove paint from the Cable Tray where bonding/ground lugs contact the Cable Tray so that the lug will contact bare metal. Use antioxidant joint compound in between the bare metal on the Cable Tray and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual Cable Tray sections and turns and through the bond to the TGB.
- ii) **The use of cut up tray sections/pieces on joints shall not be used as a grounding bond between the joints.**

3) IT ROOM

- a) Server room shall be Air Conditioned with a separate unit on a separate thermostat.
- b) The HVAC shall be provided on a 24 hours-per-day, 365 days-per year basis. If a standby power source is available in the building, consideration should be given to connecting the HVAC system serving the telecommunications equipment room to the standby supply.
- c) The temperature and humidity shall be controlled to provide continuous operating ranges of 18deg C (64deg F) to 24 "C (75deg F) with 30% to 55% relative humidity. Humidification and dehumidification equipment may be required depending upon local environmental conditions
- d) A positive air pressure differential with respect to surrounding areas should be provided.
- e) Need 120v power receptacles on all walls with dedicated circuits. The rack vertical management will have twist lock and quad receptacles as request by the owner and Drawings.
- f) Wall - 3/4" void free A-C grade (or better) plywood with 2 coats of fire retardant paint.
- g) Equipment not related to the support of the equipment room (e.g., piping, ductwork, pneumatic tubing, etc.) shall not be installed in; pass through, or enter the equipment room.

4) MOUNTING ELEMENTS

- a) Use the following charts to reference which equipment will be used.

Chart 1

Line item	P/N	Description	Qty
1	4220W	Dell 42U enclosure, wide (4220W): 750mm wide x 1070mm deep	
2	PRV15	Panduit Vertical Cable manager	
3	CMR4P84	Panduit 4-Post rack	
4	PRD15	Panduit Dual hinged door	

5	PREP	Panduit End Panel	
6	RGRB19U	Panduit ground bar	
7	GB2B0312TPI-1	Panduit Telecommunications ground bar	
8	10250-724	Chatsworth Universal cable runway, Black – 24 Inch Wide	Reference
9	11301-702	Chatsworth Butt Splice Kit, 2" Stringer, Black	Reference
10	10724-724	Chatsworth Cable runway radius bend – 24inch Wide	Reference
11	11309-701	Chatsworth Foot kit, cable runway	Reference
12	11421-724	Chatsworth Wall angle support kit, cable runway – 24inch Wide	Reference
13	31470-712	Chatsworth Cable runway standoff support kit	Reference
14	10506-702	Chatsworth Cable runway elevation kit	Reference
15	11302-701	Chatsworth Junction-splice kit	Reference
16	10723-724	Chatsworth Cable runway radius bend	Reference
17	11959-724	Chatsworth Corner Bracket 24 inch Radius,	Reference
18	11746-724	Chatsworth Triangular Supports Bracket, steel	Reference

Chart 2

Line item	Qty	P/N	Description	Purpose	Notes
1		CJ6X88TGBU	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Blue	Closet A Zone	
2		CJ6X88TGOR	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Orange	Closet B Zone	
3		CJ6X88TGGR	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Green	Closet C Zone	
4		CJ6X88TGRD	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Red	Closet D Zone	
5		CJ6X88TGIW	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Off White	Closet E Zone	
6		CJ688TGYL	Panduit Category 6, RJ45, 8-position, 8-wire universal module, Yellow	Camera Systems	
7		CJ688TGVL	Panduit Category 6, RJ45, 8-position, 8-wire universal module, Violet	Multimedia	
8		CJ6X88TGBU-24	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Blue (24-Pk)	Closet A Zone	
9		CJ6X88TGOR-24	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Orange (24-Pk)	Closet B Zone	
10		CJ6X88TGGR-24	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Green (24-Pk)	Closet C Zone	
11		CJ6X88TGRD-24	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Red (24-Pk)	Closet D Zone	
12		CJ6X88TGIG-24	Panduit Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Int Gray (24-Pk)	Closet E Zone	
13		CJ688TGYL-24	Panduit Category 6, RJ45, 8-position, 8-wire universal module, Yellow (24-Pk)	Camera Systems	
14		CJ688TGVL-24	Panduit Category 6, RJ45, 8-position, 8-wire universal module, Violet (24-Pk)	Multimedia	
15		PUR6004BU-UY	Panduit TX6000 Cat6 UTP riser copper cable	Camera Systems and Multimedia	
16	50	UTP6A7BU	Cat 6a 10Gb UTP patch cable, 7ft, Blue	Closet A network room connection	
17	70	UTP6A14BU	Cat 6a 10Gb UTP patch cable, 14ft, Blue	Closet A network room connection	
18	70	UTP6A20BU	Cat 6a 10Gb UTP patch cable, 7ft, Blue	Closet A network room connection	
19	70	UTP6A7OR	Cat 6a 10Gb UTP patch cable, 7ft, Orange	Closet B network room connection	
20	50	UTP6A7GR	Cat 6a 10Gb UTP patch cable, 7ft, Green	Closet C network room connection	
21	50	UTP6A7RD	Cat 6a 10Gb UTP patch cable, 7ft, Red	Closet D network room connection	
22	30	UTP6A7	Cat 6a 10Gb UTP patch cable, 7ft, Off White.	Closet E network room connection	
23	120	UTP6A5YL	Cat 6a 10Gb UTP patch cable, 5ft, Yellow	Security Cameras	
24	10	UTP6A3YL	Cat 6a 10Gb UTP patch cable, 3ft, Yellow	Security Cameras lamp posts	
25	30	UTP6A3VL	Cat 6a 10Gb UTP patch cable, 3ft, Violet	Multimedia	
26		Vendor specific	Panduit Mini-Com Snap-On Modular furniture faceplates	Modular Furniture	Check Panduit's catalog. Must have a label. Vendor specific faceplate.
27		CBIW	Panduit Single gang faceplate frame accepts two 1/2 size module inserts or three 1/3 size module inserts.	Multimedia plates	For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black)
28		CHS2IW-X	Panduit Two module space, 1/2 size, sloped insert accepts two Mini-Com modules	Multimedia plates	For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black)
29		CHB2IW-X	Panduit 1/2 Blank Insert	Multimedia plates	For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black)
30		KWPY	Panduit Stainless steel phone plate	Wall phones	The cable is terminated and left in the wall box.
31		CFPL2IWY	Single gang, vertical faceplate accepts two Mini-Com modules	Network wall plates	For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black)
32		CFPL3IWY	Single gang, vertical faceplate accepts three Mini-Com modules	Network wall plates	For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black)
33		CFPL4IWY	Single gang, vertical faceplate accepts four Mini-Com modules	Network wall plates	For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black)
31		CMBIW-X	Mini-Com blank module	Network wall plates	For other colors replace suffix IW (Off White) with EI (Electric Ivory), WH (White), IG (Int Gray) or BL (Black)
32		TTS-35RX0	Panduit Tak-Tape (10 PK)	All network binding	
33		FOOPRX24Y	Panduit Opti-Core 24-Fiber indoor interlocking armored cable	All Back bone	
34		EZDP44	Fire Barrier CBL Pathway Single EZ Path W/WPLT Series 44		
35		RGESD2-1	Panduit Two-hole ESD port with 5/8" hole spacing		
36		11310-003	Chatsworth Threaded Ceiling Kit, Cable Runway		

37	11421-712	Chatsworth Wall Angle Support Kit, Cable Runway		
38	10250-712	Chatsworth Universal Cable Runway – 12 inch wide		
39	10723-712	Chatsworth Cable Runway Radius Bend 90-Degree Outside Bend – 12 inch Wide		
40	10724-712	Chatsworth Cable Runway Radius Bend 90-Degree Inside Bend – 12 inch Wide		
41	11301-702	Chatsworth Butt-Splice Kit		
42	11298-701	Chatsworth Heavy Duty Junction-Splice Kit		
43	10642-001	Chatsworth Chatsworth Protective End Caps For Runway		
44	10622-010	Chatsworth Standard Busbar 4"Wx1/4"Hx10"L		
45	40164-001	Chatsworth #6AWG Ground Strap		
46	10250-718	Chatsworth Universal Cable Runway		
47	10723-718	Chatsworth Cable Runway Radius Bend 90 degree Outside Bend		
48	10724-718	Chatsworth Cable Runway Radius Bend 90 degree Inside Bend		
49	11421-718	Chatsworth Wall Angle Support Kit, Cable Runway		
50	11304-000	Chatsworth J-bolt Kit		
51	11301-001	Chatsworth Butt-Splice Kit		
52	10506-706	Chatsworth Cable Runway Elevation Kit 6"		
53	1201-701	Chatsworth Cable Runway Radius Drop Stringer		
54	12100-718	Chatsworth Cable Runway Radius Drop Cross Member		
55	JMDWB-1-X	Panduit Drop Wire brackets for J-hooks		
56	JMJH2-X20	Panduit J Hook		
57	FOPRX24Y	Panduit Opti-Core 24-Fiber 10gig indoor interlocking armored cable		
58	RGTBSG-C	Panduit Green thread-forming bonding screw, #12-24 x 1/2" (pkg 100)		

5) UNSHIELDED TWISTED-PAIR CABLING

- a) Backbone Fiber Cable:
 - i) Panduit Opti-Core 24-Fiber 10gig indoor interlocking armored cable, p/n FOPRX24Y
 - ii) Comply with TIA/EIA 568-B.1 & 3, and 598-B
 - iii) NFPA 70
- b) Horizontal Copper cable:
 - i) For Security Cameras and Multimedia:
 - (1) NO. 23 AWG, 100 ohm, four pair. Panduit PUR6004BU-UY
 - (2) Comply with TIA/EIA-568-B.2 and ANSI/TIA-568-C.2, Category 6e
 - (3) NFPA 70, types CMG and CMP
 - ii) For Main Network:
 - (1) NO. 23 AWG, 100 ohm, four pair. Panduit PUR6X04BU-UY
 - (2) Comply with TIA/EIA-568-B.2 and ANSI/TIA-568-C.2, Category 6A
 - (3) NFPA 70, types CMG and CMP
- c) Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, using modules designed for punch-down caps or tools.
 - i) IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
- d) Cross-Connect Panel: Modular array of IDC terminal blocks arranged to terminate building cables and permit interconnection between cables.
 - i) Number of Terminals per Field: One for each conductor in assigned cables plus 25 percent spare.
 - ii) Number of Jacks per Field: One for each four-pair UTP cable indicated.
- e) Jacks and Jack Assemblies: As referenced in Charts 1 and 2.
- f) Patch Cords: Factory made, four pair cables, to length as stated in parts reference, matching color to closet zone as referenced in Charts 1 and 2.

6) MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY

- a) Modular unit suitable for terminating single or multiple horizontal cables in one central location, providing an intermediary point between telecommunications closet and workstation.
 - i) NRTL listed as complying with UL 50 and UL 1863.
 - ii) Number of Terminals per Field: One for each conductor in assigned cables.
 - iii) Number of Connectors per Field:
 - (1) One for each four-pair UTP cable indicated.
 - (2) One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
- b) Mounting: Owner furnished Modular Walls and Furniture: As provide by modular furniture manufacturer. Reference Charts 1 and 2.

7) WORKSTATION OUTLETS

- a) Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIA/EIA-568-B.1.
- b) Workstation Outlets: Single, dual, triple or quad jack connector mounted in a single or multi-gang faceplate as shown in the prints.
 - i) Jacks will be the color of the Closet/ Zone they are in. See prints.
 - ii) Faceplate: Flush; high impact plastic; color determined by Architect and or Owner. Part numbers listed in Part Reference.
 - iii) Legend: Contractor printed labels showing Closet then cable number, i.e. A001, A002, B101, C125.

8) MULTIMEDIA OUTLET

- a) Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIA/EIA-

568-B.1.

- b) Workstation Outlets: dual connector mounted in a single faceplate as shown in the prints.
 - i) Jacks will be the color of Violet. See Charts 1 and 2.
 - ii) Faceplate: Flush; high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 Part Reference.
- c) Legend: Contractor printed labels showing Closet, M (for MultiMedia) then cable number, i.e. AM01.

9) SECURITY CAMERA OUTLETS

- a) Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, modular, RJ-45. Comply with TIA/EIA-568-B.1.
- b) Workstation Outlets: dual connector mounted in a single faceplate as shown in the prints.
 - i) Jacks will be the color of Yellow. See Charts 1 and 2.
 - ii) Legend: Contractor printed labels showing Closet, S (for Security) then cable number, i.e. AS01.
 - iii) Outlets will be either in the following configurations according to drawings.
 - (1) If internal wall mount then terminated jack will be placed in the box with a blank faceplate, flush; high impact plastic; color determined by Architect and or Owner.
 - (2) If external wall mount then the terminated jack will be placed on or in the internal inside wall close to the camera mount in a single ganged box with:
 - (a) Faceplate: Flush; high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 Part Reference.
 - (3) If ceiling mounted then the terminated jack will be placed on top plate of the nearest wall in a single ganged box with:
 - (a) Faceplate: Flush; high impact plastic; color determined by Architect and or Owner. Part numbers listed in Charts 1 and 2 Part Reference.

10) GROUNDING AND BONDING

- a) Materials: Comply with NFPA 70, TIA/EIA-607, and UL 467.
- b) Reference Charts for what type of hardware is to be used in each Closet.
- c) Reference Manufacturer instructions on what and how grounding should be done if not referenced in this section.
- d) Reference drawings for location of hardware on equipment racks.
- e) Reference Part 2, section 2b), Cable Tray Grounding.

11) IDENTIFICATION PRODUCTS

- a) Reference Steps 7-9 above for labeling legend.
- b) Adhesive-Backed Cable Labels: Use a label-making machine or printer to construct adhesive-backed label tabs from plastic or paper strips. Labels shall be over laminating type in order to protect type-face information with clear Mylar film. Handwritten labels are prohibited
- c) Four-pair UTP cable shall have labels affixed directly to cable jacket:
 - i) Within 3 inches from jack all outlets listed in steps 8-10.
 - ii) Within 6 from jack at patch panels
 - iii) Within 6 from entry into blocks.
- d) Fiber Optic Cables:
 - i) Shall have labels affixed to a label carrier that protects the cable and allows the re-positioning and rotation of the identification label.
 - ii) Warning Label shall be affixed along the consistent distance apart identifying that the cable is an optical fiber.
- e) Wiring Block Labels: Cardboard-like strips or adhesive labels that slip inside or onto clear plastic designation strips or label holders located on protector panels and wiring blocks

- f) Telecommunications Outlet (TO) Labels/Workstations: Use a label-making machine to construct label tabs from plastic or paper strips or adhesive labels. Handwritten labels are unacceptable

12) CONDUIT SIZING SCHEDULE

SCHEDULE 0 – Conduit Trade Size	SCHEDULE 1 - Max Number of Cables based upon allowable fill.			
	SCHEDULE 2 - Cable outside Diameter, mm (in), [a=Category 3, 6e] or [b=6A, 10Gig]			
	SCHEDULE 3 - 6.1 (2.4) [a]	SCHEDULE 4 - 7.9 (.31) [b]	SCHEDULE 5 - 9.4 (.37) [b]	SCHEDULE 6
SCHEDULE 7 - 27 (1 ")	SCHEDULE 8 - 4	SCHEDULE 9 - 2	SCHEDULE 10-2	SCHEDULE 11
SCHEDULE 12 - 35 (1-1/4")	SCHEDULE 13-5	SCHEDULE 14-4	SCHEDULE 15 - 3	SCHEDULE 16
SCHEDULE 17 - 41 (1-1/2")	SCHEDULE 18-6	SCHEDULE 19-4	SCHEDULE 20 - 4	SCHEDULE 21

13) CONDUIT RUNS

- a) Conduits from any Telecommunication closet, cable tray, horizontal pathway is not allowed except in the following:
- i) Conduit can be from the TO to the top of the wall with a minimum of 4 inches exposed. Preferred is 1 foot above the wall with 90 degree bend so that the cable repair margin can be Velcro wrapped into the bend of the conduit. All exposed ends of conduits will have a EMT screw connector with plastic bushing to protect the cable from nicks.
 - ii) A 2-inch conduit is required to each wall-mounted box that supports a multi-user telecommunications outlet assembly (MUTOA). A MUTOA is a special type of telecommunications outlets that can support up to 12 voice/data jacks. It is suitable for use in locations where there is a cluster of machines where each one is within 15 feet from the MUTOA.
 - iii) Flexible conduits such as metallic flexible conduit are not to be used as pathways for telecommunications cables to avoid sheath damage to the cables. Therefore, the use of flexible conduits as pathway for telecommunications cables must be avoided at all times.
 - iv) Minimize the amount of turns/curve in the conduit from the top of wall to the gang box. If under a window or opening, reroute conduit to place straight down next to window or opening.

14) TELECOMMUNICATIONS EQUIPMENT ROOM (T-E-R)

- a) A telecommunications equipment room (T-E-R) is where the entrance conduits terminate. It is usually located on the ground floor but may also be located in the basement. A T-E-R typically functions as the main cross-connect (MCC). It is the main telecommunications serving point for the building. It will contain telecommunications equipment, much of it mounted on 19" - 4 post racks. Cables will be spliced and terminated on the walls. It is important that the entrance conduits stub up in the T-E-R as close to a corner as possible.
- b) When designing the T-E-R floor space, allowance shall be made for non-uniform occupancy, throughout the building. The practice is to provide 0.07 m² (0.75 ft²) of equipment room space for every 10 m² (100 ft²) of work area space. The equipment room shall be designed to a minimum of 14 m² (150 ft²). See section 8.2 of TIA/EIA-569 pg.72 for more information. In the case of smaller buildings see annex B.3 of the TIA/EIA-569.
- c) In certain buildings, the T-E-R will be further designated as a Node Room. A Node Room is used as a

cabling hub not just for that building but for other buildings in that neighborhood of the campus. A Node Room requires additional space, air conditioning, and additional entrance conduits. It may require 30 amp outlets. In some cases, where a Node Rooms is designated in a building, a separate TR on the same floor as the Node Room may be required.

- d) CN-NTD will advise FD&C and the architect in the initial planning stage if a Node Room has been designated, No water sprinklers may be installed in a Node Room. A separate fire suppression system, based on one of the approved replacements for Halon, must be installed in coordination with CN Risk Management
- e) A Node Room will house PBX telephone switching equipment, large wet- or dry-cell batteries, routers for campus wide area network (WAN), related local area network (LAN) switches, optical fiber cross connects and optical communications gear. Hence, it should be located so that it is accessible for the delivery of large equipment throughout its useful life. It must be at least 10' from a potential source of EMI (motors, transformers, photocopying equipment, etc.).

15) TELECOMMUNICATIONS ROOMS (TRS)

- a) TRs are smaller than T-E-Rs. They are the cabling hubs for floors within a building. They also contain network electronics, typically mounted in 19" - 4 post racks. See table 7.2-1 of TIA/EIA. 569 pg. 66 for more information.

16) ELEVATOR PHONES

- a) Elevator phones are cabled to each elevator equipment room. There must be at least one TO in the elevator equipment room that is cabled to the Main telecom room. There must be a dedicated number of jacks on the TO so to accommodate all elevators in the building. Recommend that there be one phone block dedicated to Safety and Security to be easily identified.

PART 3 – EXECUTION

1) INSTALLATION STANDARDS

- a) Reference Part 1 –General,
 - i) Section 2) STANDARDS AND CODE COMPLIANCE REFERENCES
 - ii) Section 3) ADDITIONAL SUPPPORT
- b) The most recent versions of all documents apply to this project. If there is a conflict between applicable documents, the order above shall dictate the order of precedence in resolving the issue unless an enforceable local or national code is in effect.

2) APPLICATION OF MEDIA

- a) Backbone Cable for Data Service: 10Gig 24 fiber cable for runs between equipment rooms and wiring closet and for runs between closets.
- b) Backbone Cable for Multimedia Service: UTP Category 6e cable to be run from Closet “A” Multimedia panel to each of the other closet multimedia patch panels, i.e. A to B, A to C, A to D, A to E. The cable will be terminated as the last port on the patch panel, i.e 21, 22, 23, 24.
- c) Backbone Cable for Telecommunications to run from Telecom Entrance Room to each closet, terminated at the Telecom patch panel, reference locations on drawings.
- d) Horizontal Cable for Data Service: 10Gig UPT Category 6A cable for runs between wiring closets and workstation outlets.
- e) Horizontal Cable for Security Cameras:
 - i) UTP Category 6e cable for runs between wiring closets and equipment. Starting at port 1 on Security Camera patch panel.
 - ii) Fiber Optic 6-fiber cable for runs from closet to lamp posts in parking lot. Terminating in fiber box.

- f) Horizontal cable for Multimedia Service: UTP Category 6e cable for runs between wiring closets and equipment. Starting at port 1 on Multimedia patch panel.

3) WORKMANSHIP

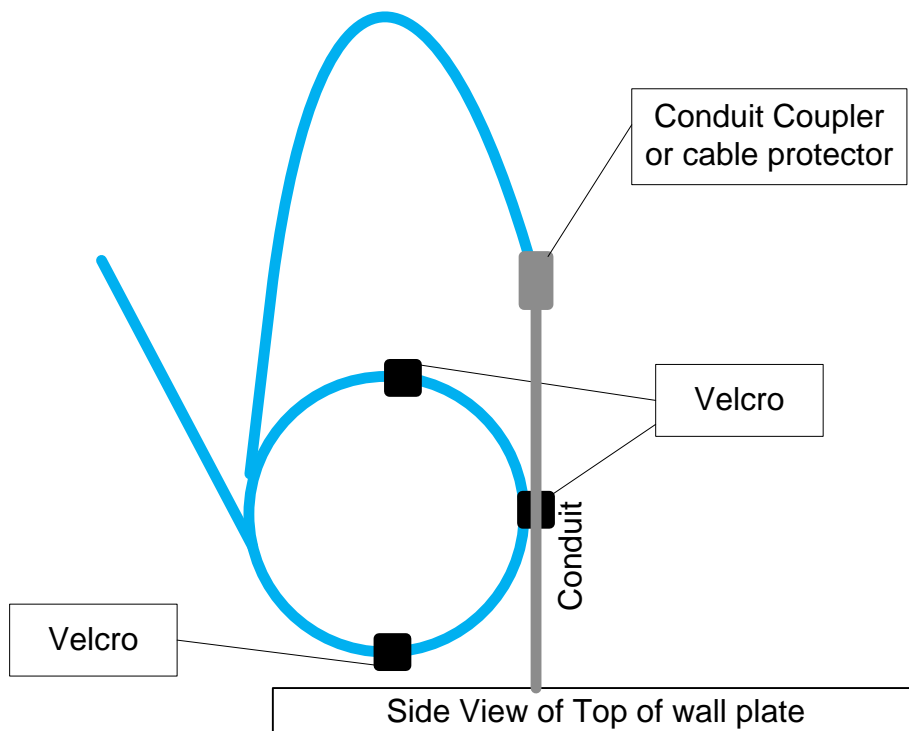
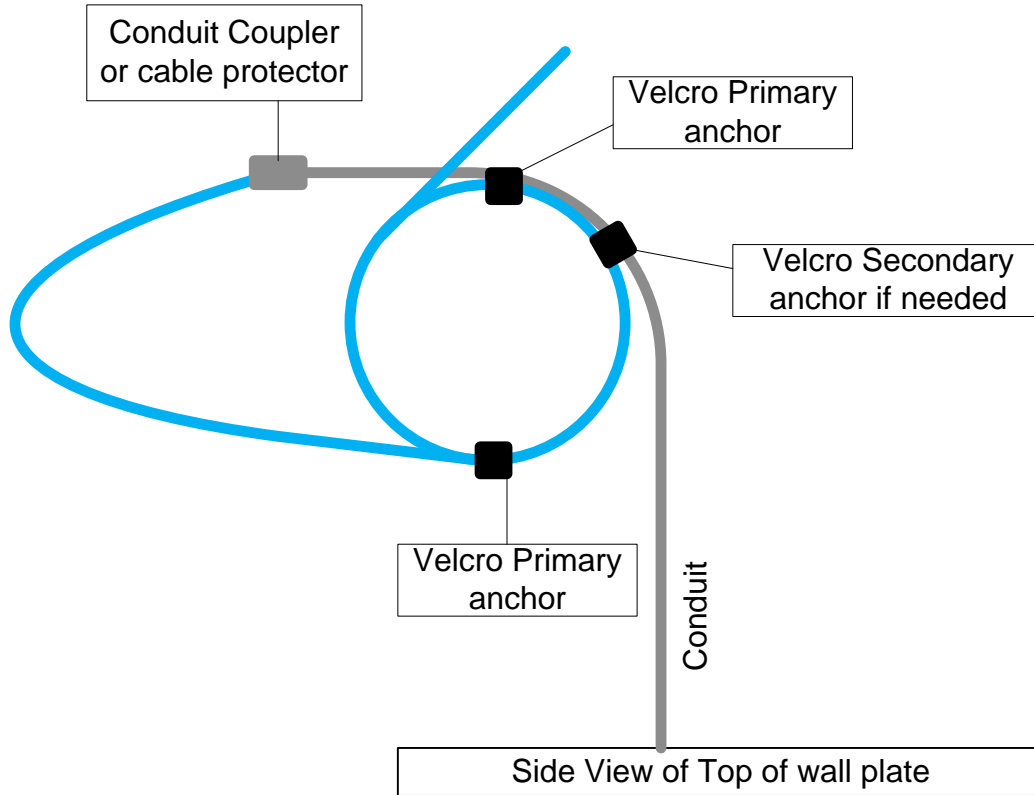
- a) Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.
- b) The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards. All work shall be performed in a high quality manner and the overall appearance shall be clean, neat and orderly.
- c) The vendor/contractor and subcontractor will have the following personnel on site during install:
 - i) Supervisor for every 4 Panduit Certified Copper and Fiber Technicians (PCT)
 - (1) If the supervisor is a PCT, the supervisor can also have up to a maximum of 4 non-certified PCT's.
 - ii) A PCT can have up to a maximum of 4 non-certified PCT's.
 - iii) If subcontracted, each supervisor is responsible to the primary site vendor/contractor.
 - (1) Primary supervisor has no limit to subcontractor supervisor to manage.
 - (2) Primary supervisor will then have an assistant supervisor who will supervise as follows:
 - (a) If the assistant supervisor is a PCT, the supervisor can also have up to a maximum of 4 non-certified PCT's.
- d) Inspection
 - i) The Contractor must allow Owner, its Consultants, Construction Manager, CNIT, their agents and the manufacturer's agent to observe and evaluate workmanship and can have problems corrected or work halted until corrected.
 - ii) On-going inspections shall be performed during construction by the project manager Owner, its Consultants, Construction Manager, CNIT their agents. All work shall be performed in a high quality manner and the overall appearance shall be clean, neat and orderly.

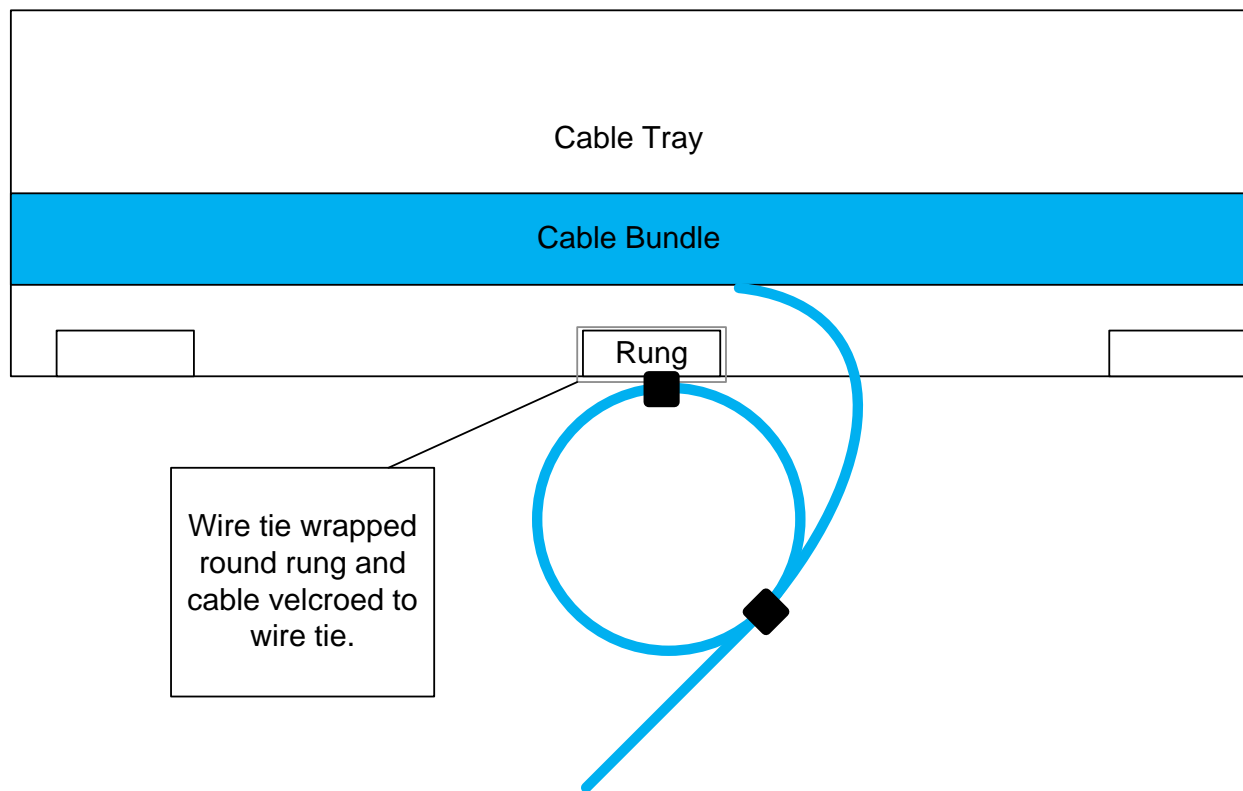
4) INSTALLATION

- a) Comply with:
 - i) Reference Part 1 –General,
 - ii) Section 2) STANDARDS AND CODE COMPLIANCE REFERENCES
 - iii) Section 3) ADDITIONAL SUPPPORT
 - iv) The most recent versions of all documents apply to this project. If there is a conflict between applicable documents, the order above shall dictate the order of precedence in resolving the issue unless an enforceable local or national code is in effect.
- b) Wiring Method: Install cables in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces. Cable trays shall be as standardized by CNIT using ladder type cable trays.
- c) The path for the cable tray shall be clear of obstructions, such as HVAC ducts, large pipes and structural beams within the building. Use of enclosed tray and conduits is not allowed. Elevations of trays will be minimized as to not have a stair step effect. Where fire or smoke barriers are penetrated by the ladder tray, they shall be fire stopped to maintain the rating of the barrier. Alternatively, EZ- Path Systems may be used through the penetrations. The number of sleeves required depends on the number of cables and size of tray. Use 50% fill ratio to determine the number of sleeves. Two additional spare sleeves should be installed to accommodate future cable placement.
- d) Place cable trays above drop ceilings in corridors. Do not place them above offices, patient/treatment rooms or inaccessible spaces. There must be at least 4 inches of vertical space between the suspended ceiling tile and the bottom of the cable tray; 12 inches of vertical clearance from the top of the cable tray

- to the true ceiling; and 2' total side clearance (i.e. if the cable tray is wall mounted and there is no clearance on one side, then minimum clearance on the other side should be 2'.
- e) It is desirable that the cable tray originates from the TR. If the TR is surrounded with smoke or fire rated walls then EZ-Path systems will be installed
 - f) Access ceiling panels must be installed at 5-foot interval if cable tray is passing through a hard or solid ceiling. The panels should be within 1-1/2 feet from the cable tray. They shall not be mounted directly underneath the cable tray. Trays shall not change level or change direction if placed above a hard or solid ceiling.
 - g) All metallic cable trays must be grounded but should not be used as grounding conductor for equipment.
 - h) Wiring Method: Install cables in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.
 - i) Wiring within Wiring Closets and Enclosures:
 - i) Install 3/4" void free A-C grade (or better) plywood with 2 coats of fire retardant paint on walls of equipment rooms and wiring closet from floor to ceiling.
 - ii) Mount patch panels, terminal strips, and other connecting hardware on floor-mounted racks. Reference drawings for placement.
 - j) Horizontal Fiber Optic to the parking lot lampposts:
 - i) Pull will be from the rack mount fiber box designated for security systems to the lamppost.
 - ii) Terminate each fiber at rack end and mount into fiber box.
 - iii) At lamp post leave the equivalent of twice the pole height inside the base opening. Do not terminate cable. Seal cable with weather proof tape. Cable will be terminated and tested by owner.
 - k) Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated cross-connects, patch panels, workstations or locations as indicated in the Drawings.
 - l) Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - m) Lacing/tie wraps will be accomplished by Velcro strapping. The strap must be able to be rotatable without slipping. **NO WIRE TIES WILL BE USED ON ANY CABLE OR CABLE BUNDLES.**
 - n) Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - o) Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Use lacing bars and distribution spools.
 - p) Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - q) Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
 - r) In the communications equipment room, install a 3-5 foot long service loop on each end of cable neatly stored inside the Vertical management.
 - s) Pulling Cable: Comply with BICSI ITSIM, Chapter. 4, "Pulling Cable." Monitor cable pull tensions.
 - t) Only anchor the cable bundles at the network room cable trays starting at the top when it comes down into the room down to the racks.
 - u) When cable drops come off the tray it will go between the rungs. No cable will come over the top and bent over the edge. If the cable is to be pulled through the red iron the cable will go through the bottom of the cable tray between the rungs then up to the red iron. The only time cable will go over the edge of the cable tray is if another tray is connected at an angle to that tray and the cable is changing directions.

- v) When the cable is installed there will be a minimum of 3ft of cable at drop location end for repair margin. If the drop is within 10ft of the cable tray, the repair margin can be anchored under the cable tray to one of the rungs. If more than 10ft then the repair margin will be anchored to the drops conduit above the wall. If there is not enough conduit then the margin can be anchored to the nearest red iron. Do not anchor to an electrical conduit. See drawings. When anchoring to the cable tray, wrap a plastic wire tie around the rung with the ratchet head below the rung. Then secure the repair margin to the wire tie with Velcro. See drawings:





w) Separation from EMI Sources:

- i) NO CONDUITS, POWER CABLE/CONDUCTORS OR EQUIPMENT SHALL BE LAID IN, THROUGH OR ACROSS THE TOP (WITHIN 12 INCHES) THE CABLE TRAY. IF CONDUITS, POWER CABLE/CONDUCTORS OR EQUIPMENT ARE UNDER THE TRAY, STEPS ii-vi BELOW WILL BE FOLLOWED.
- ii) Comply with BICSI TDMM and TIA/EIA-5 69-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
- iii) Separation between open communications cables, cables in nonmetallic raceways or fiber optic cable in armored cable and unshielded power conductors and electrical equipment shall be as follows:
 - (1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 6 inches.
 - (2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - (3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
- iv) Separation between communications cables in grounded metallic raceways/conduit and unshielded power lines or electrical equipment shall be as follows:
 - (1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 6 inches.
 - (2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - (3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
- v) Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - (1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 1 inch.
 - (2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - (3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
- vi) Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
- vii) Separation between Communications Cables and Fluorescent Fixtures:

- (1) A minimum of 6 inches if cable is running perpendicular (90deg) to the fixture.
- (2) A minimum of 2ft if running parallel to the fixture (including cable tray). If less than, reroute cable from another direction or have fixture moved.

5) GROUNDING

- a) Grounding will be in accordance with the Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications J-STD-607 -A. Within the telecommunications room, Cable Tray should be bonded together, electrically continuous, and bonded to the TGB. Cable Tray and turns shall be bonded across each splice with a bonding kit (40164-001 or 025). Cable Tray shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the Cable Tray and a minimum #6 grounding wire. Remove paint from the Cable Tray where bonding/ground lugs contact the Cable Tray so that the lug will contact bare metal. Use antioxidant joint compound in between the bare metal on the Cable Tray and ground lug. Use antioxidant joint compound in between the bus bar and the ground lug. Verify continuity through the bonds at splices and intersections between individual Cable Tray sections and turns and through the bond to the TGB.
- b) Reference NFPA 70 (latest Edition) Article 250 for other grounding requirements.
- c) Grounding of patch panels, fiber boxes or equipment brackets to the racks can be accomplished by one Panduit bonding screw (reference Charts 1 and 2) on each side securing the bracket to the rack. Use of antioxidant paste is required.

6) IDENTIFICATION

- a) Comply with TIAEIA-606-A.
 - i) Administration class for this Project shall be Class 4.
 - ii) Color-code cross-connect and telecom fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- b) Use logical and systematic designations for facility's architectural arrangement and nomenclature, and a consistent color-coded identification of individual conductors.
 - i) Jacks will be the color of the Closet/ Zone they are in. See Drawings.
 - (1) Closet "A" – Blue
 - (2) Closet "B" – Orange
 - (3) Closet "C" – Green
 - (4) Closet "D" – Red
 - (5) Closet "E" – Off White
 - (6) Security Cameras – Yellow
 - (7) Multimedia – Violet
- c) Reference Part 2 – Products, Section 12.
- d) Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
- e) Label each terminal strip and screw terminal in each cabinet, rack, or panel if applicable.
- f) Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- g) Cabling Administration Drawings: Show building floor plans with cable administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIAEIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

7) FIELD QUALITY CONTROL

- a) Perform the following field tests and inspections and prepare test reports following the Standards and Code Compliance References for the following:
 - i) Category 6a UTP Cabling Tests:
 - (1) Test instruments shall meet or exceed applicable requirements as defined in the TIA Cat 6A Standard. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration. Owner prefers that tester be the Fluke DTX-1800 as owner can except all test reports in the LinkWare file format. The tester will have current calibration sticker attached and a copy of sticker or calibration certificate attached to final documentation.
 - (2) Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - (3) Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
 - (4) Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with guaranteed channel performance up to 500MHz.
 - (5) Alien Crosstalk will not be required.
 - ii) Category 6a UTP Cabling Tests:
 - (1) Test instruments shall meet or exceed applicable requirements as defined in the TIA Cat 6A Standard. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration. Owner prefers that tester be the Fluke DTX-1800 as owner can except all test reports in the LinkWare file format. The tester will have current calibration sticker attached and a copy of sticker or calibration certificate attached to final documentation.
 - (2) Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - (3) Wire-map test that reports open circuits, short circuits, crossed pairs, reversed pairs, split pairs, and improper terminations.
 - (4) Channel and permanent link tests for cable length, insertion loss, near-end crosstalk loss, power sum near-end crosstalk loss, equal-level far-end crosstalk loss, power sum equal level far-end crosstalk, return loss, propagation delay, and delay skew. Performance shall comply with guaranteed channel performance up to 500 MHz.
 - iii) Back Bone Fiber Cable
 - (1) Test instruments shall meet or exceed applicable requirements. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration. Owner prefers that tester be the Fluke DTX-1800 as owner can except all test reports in the LinkWare file format. The tester will have current calibration sticker attached and copy of sticker or calibration certificate attached to final documentation.
 - (2) Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components. Inspect cabling terminations in communications equipment rooms for compliance with color-coding.
 - (3) Optical Fiber Cable Tests:
 - (a) Field-test instruments shall have the latest software and firmware installed.
 - (b) Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

- (c) Fiber end-faces shall be inspected at 200X or 400X magnification. 200X magnification is suitable for inspecting multimode and singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers. Scratched, pitted or dirty connectors shall be diagnosed and corrected.
 - (i) If possible it is preferable that the end-face images be recorded in the memory of the test instrument for subsequent uploading to a PC and reporting.
- (d) Testing shall be performed on each cabling segment (connector to connector).
- (e) Testing shall be performed on each cabling channel (equipment to equipment) that is planned for use per the owner's instructions.
- (f) Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 m in length. The test cords for OTDR testing shall be approximately 100 m for the launch cable and at least 25 m for the receive cable.
- (g) Optical loss testing
 - (i) Backbone link
 1. Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper or the equivalent method.
 2. Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 3. Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526- 1 4A, Method B and ANSI/TIA/EIA-526-7, Method A. 1 or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.
- (h) OTDR Testing
 - (i) Backbone, horizontal and centralized links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.
 - (ii) Backbone multimode: 850 nm and 1300 nm
 - (iii) Each fiber link and channel shall be tested in one direction.
 - (iv) A launch cable shall be installed between the OTDR and the first link connection.
 - (v) A receive cable shall be installed after the last link connection.
- (i) Magnified Endface Inspection
 - (i) Fibers shall be inspected at 250X or 400X magnification. The 250X magnification is suitable for inspecting multimode and singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers.
- (j) Length Measurement
 - (i) The length of each fiber shall be recorded.
 - (ii) It is preferable that the optical length be measured using an OLTS or OTDR.
- (k) A Fail or Fail* result must be diagnosed corrected and retested.
 - (i) If not able to be corrected then remove, replace cabling and retest where test results indicate that they do not comply with specified requirements and the cost shall be borne by the installation contractor
 - (ii) If the results cannot be corrected then the installation contractor may bring in the manufacture's agent, technician or engineer and the cost shall be borne by the installation contractor. If determined that the problem cannot be corrected then under supervision of

the end-user, the representative shall repeat 100% removal, reinstallation and testing and the cost shall be borne by the installation contractor.

- iv) Horizontal Fiber Optic to the parking lot lampposts.
 - (1) Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components. Inspect cabling terminations in communications equipment rooms for compliance with color-coding.
 - (2) Visual light test connection with bright light or visible light.
 - (a) If not visible, terminate cable and test as an iii) Back Bone Fiber Cable to trouble shoot. If fail must be diagnosed corrected and retested.
 - (i) If not able to be corrected then remove, replace cabling and retest where test results indicate that they do not comply with specified requirements and the cost shall be borne by the installation contractor
 - (ii) If the results cannot be corrected then the installation contractor may bring in the manufacture's agent, technician or engineer and the cost shall be borne by the installation contractor. If determined that the problem cannot be corrected then under supervision of the end-user, the representative shall repeat 100% removal, reinstallation and testing and the cost shall be borne by the installation contractor.
 - (3) Cable will be final tested by Owner at a later date.
- v) Cable Samples, the 6a & 6e cable will be tested and added to documentation and warranty.
 - (1) Use the samples to check verification of manufacturer recommendations for setting the testers.
- b) Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals). A copy of the certification will be attached to final documentation.
- c) One hundred percent of the installed cabling links must pass the requirements of the standards mentioned above except as noted. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation.
- d) The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the Manufacturer. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
- e) The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section I.2.2 of ANSI/TIA/EIA-568-B.2). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
 - i) A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. To which extent '*' results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification, or agreed on as a part of a contractual specification.
 - ii) A Fail or Fail* result must be diagnosed corrected and retested.

- (1) If not able to be corrected then remove, replace cabling and retest where test results indicate that they do not comply with specified requirements and the cost shall be borne by the installation contractor
- (2) If the results cannot be corrected then the installation contractor may bring in the manufacture's agent, technician or engineer and the cost shall be borne by the installation contractor. If determined that the problem cannot be corrected then under supervision of the end-user, the representative shall repeat 100% removal, reinstallation and testing and the cost shall be borne by the installation contractor.

f) Additional Requirements:

- i) A representative of the end-user shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing commences.
- ii) At an agreed time a representative of the end-user will select a random sample of 10% of the installed links. The representative (or his authorized delegate) shall test these randomly selected links and the results are to be stored in a separate documentation that will be attached with final documentation (but does not have to be submitted for warranty). The results obtained shall be compared to the data provided by the installation contractor. If more than 3% of the sample results differ in terms of the pass/fail determination:
 - (1) The installation contractor under supervision of the end-user representative shall repeat 100% testing and the cost shall be borne by the installation contractor.
 - (2) If the results cannot be corrected then the installation contractor may bring in the manufacture's agent, technician or engineer and the cost shall be borne by the installation contractor. If determined that the problem cannot be corrected then under supervision of the end-user, the representative shall repeat 100% removal, reinstallation and testing and the cost shall be borne by the installation contractor.

8) TEST RESULTS DOCUMENTATION

- a) The test results/measurements shall be transferred into a WindowsTM-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time. The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used. Owner prefers that the test results/measurements be in the LinkWare file format.
- b) The database for the completed job shall be stored and delivered on CD-ROM or DVD including the software tools required to view, inspect, and print any selection of test reports.
- c) A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information
 - i) The identification of the link in accordance with the naming convention defined in the overall system documentation
 - ii) The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number
 - iii) The date and time the test results were saved in the memory of the tester.
- d) General Information to be provided in the electronic data base with the test results information for each link:
 - i) The identification of the customer site as specified by the end-user
 - ii) The name of the personnel performing the test
 - iii) The identification of the link in accordance with the naming convention defined in the overall system documentation

- iv) The overall Pass/Fail evaluation of the link-under-test
 - v) The name of the standard selected to execute the stored test results
 - vi) The date and time the test results were saved in the memory of the tester
 - vii) The brand name, model and serial number of the tester
 - viii) The identification of the tester interface
 - ix) The revision of the tester software and the revision of the test standards database in the tester
 - x) The test results information must contain information on each of the required test parameters that are listed.
- e) For all copper (6a & 6e)
- i) The cable type and the value of NVP used for length calculations
 - ii) In-link (In-Channel) detailed test results. The detailed test results data to be provided in the electronic database for must contain the following information:
 - iii) For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
 - (1) Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m (1) and the test limit value.
 - (2) Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
 - (3) Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value.
 - (4) Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair.
 - (5) Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link.
 - (6) NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.
 - (7) PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link.
- iv) Between-Link (Between-Channel) Test Results Data
- v) A test report shall be provided for each disturbed link included in the Alien Crosstalk sample test. This test report must contain:
- (1) PS ANEXT results at each frequency (See Table 1) for each wire pair in a victim link as well as the PS ANEXT results for the average of these four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS ANEXT shall be measured and tested from the end of the link or channel where all cables are terminated at a distribution panel. In case the cabling runs from panel to panel (data center) where the worst case PS ANEXT margin is less than 2 dB, the PS ANEXT test results for each disturbed link shall be collected and saved from both ends (both panels) of the disturbed link.

(2) PS AACR-F results at each frequency tested for each wire pair in a disturbed link as well as the PS AACR-F results for the average of the four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS AACR-F only needs to be measured and tested from one end of the link or channel.

f) Fiber tests:

- i) The fiber identification number.
- ii) The length for each optical fiber.
 - (1) Optionally the index of refraction used for length calculation when using a length capable OLTS.
- iii) Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
- iv) Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).
- v) The length for each optical fiber as calculated by the OTDR.
- vi) The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.
- vii) A picture or image of each fiber end-face if done.
- viii) A pass/fail status of the end-face based upon visual inspection.

9) CONSTRUCTION REVIEW

- c) The following shall be examined and shall comply satisfactorily in all instances.
 - i) Design documentation complete.
 - ii) All cables properly labeled, from end-to-end.
 - iii) All terminated cables been properly tested in accordance with the specifications for the specific category as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage.
 - iv) The cable type suitable for its pathway.
 - v) The cables bundled in parallel.
 - vi) The pathway manufacturer's guidelines been followed.
 - vii) All cable penetrations installed properly and fire stopped according to code.
 - viii) The Contractors avoided excessive cable bending.
 - ix) Potential EMI and RFI sources been considered.
 - x) Table Fill is correct.
 - xi) All hanging supports are within 1.5 meters (5 feet).
 - xii) Hanging cable exhibit some sag.
 - xiii) IDF room terminations are compatible with applications equipment.
 - xiv) Patch Panel instructions been followed:
 - (1) Jacket removal point
 - (2) Termination positions
 - (3) All pair terminations tight with minimal pair distortions
 - (4) Twists maintained up to Index Strip
 - xv) Modular Panel instructions been followed:
 - (1) Cable dressing first
 - (2) Jackets remain up to the Connecting Block
 - (3) All pair terminations tight and undistorted
 - (4) Twists maintained up to the Connecting Block

- xvi) Connectors are properly turned right side up in the Jack Panels without cables wrapped or twisted around the Mounting Collars.
 - xvii) The correct outlet connectors have been used
 - xviii) Outlets have been wired correctly (T568B)
 - xix) The cable jacket maintained up to the Jack.
 - xx) Identification markings uniform, permanent and readable.
- d) The Owner, its Consultants, Construction Manager, CNIT, and their agents will review and observe installation work to ensure compliance by the contractor with requirements of the Contract Documents.
 - e) The contractor shall inspect and test completed communications installations to demonstrate specified performance levels including the following:
 - i) Furnish all instruments and personnel required for the inspections and tests.
 - ii) Perform tests in the presence of the Engineer and Owner when required.
 - iii) Demonstrate that the system components operate in accordance with the Contract Documents.
 - f) Review, observation, assistance, and actions by the Owner, its Consultants, Construction Manager, CNIT, and their agents shall not be construed as undertaking supervisory control of the work or of methods and means employed by the contractor. The Owner, its Consultants, Construction Manager, CNIT, and their agents review and observation activities shall not relieve the contractor from the responsibilities of these Contract Documents.
 - g) The fact that Owner, its Consultants, Construction Manager, CNIT, and their agents does not make early discovery of faulty or omitted work shall not bar the Owner from subsequently rejecting this work and withholding payment until the contractor makes the necessary corrections.
 - h) Regardless of when discovery and rejection are made, and regardless of when the contractor is ordered to correct such work, the contractor shall have no claim against the Owner, its Consultants, Construction Manager, CNIT, and their agents for an increase in the Subcontract price, or for any payment on account of increased cost, damage, or loss.

10) DEFINITION OF ACCEPTANCE

- a) System acceptance shall be defined as that point in time when the following requirements have been fulfilled:
 - i) The complete system has successfully completed all testing requirements.
 - ii) All punch list items have been corrected and accepted.
 - iii) All submittals and documentation have been submitted, reviewed, and approved. Including:
 - (1) A list of the documentation showing what was submitted to Panduit for the CERTIFICATION PLUSSM SYSTEM WARRANTY PROGRAM according to the Panduit Warranty Guide.
 - (a) A copy of the E-form, or Fax is acceptable. Or
 - (b) If mailed, a copy of the package Tracking number is acceptable.
 - (2) Verification of delivery will be done by Owner, its Consultants, CNIT, and their agents with Panduit. If:
 - (a) Verified as delivered then acceptance can continue.
 - (b) Verified as NOT delivered, then the acceptance is not complete.

