



## **DESIGN STANDARD FOR TELECOMMUNICATIONS**

### **Purpose:**

The purpose of this document is to standardize the basic elements of the telecommunications systems design process. The design standard has the purpose of creating a consistent application of telecommunications systems design throughout the Solano Community College (SCC) District, therefore achieving a standard of quality for maintenance and reliability throughout all renovation and new building projects. This standard serves as a supporting document part of the overall Solano Community College Technology Plan (2013-2015). Deviations from this standard shall be approved by SCC.

### **Telecommunications Systems-Related Support Staff and Committees:**

Chief Technology Officer  
Director, Technology Services & Support  
Desktop Services  
Network Services  
The Strategic Technology Advisory Committee (STAC)

## **PART 1 – GENERAL**

### **1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-16 or 26, Basic Materials and Methods sections apply to work specified in this section.

### **1.2 REFERENCE STANDARDS**

- A. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers
- B. ANSI/TIA-492.AAAD – Detail Specification for 850-nm Laser- Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber
- C. ANSI/TIA-492.CAAB – Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak. Current Edition
- D. ANSI/TIA-568.0-D – Generic Communications Cabling for Customer Premises
- E. ANSI/TIA-568.1-D – Commercial Building Communications Cabling Standard
- F. ANSI/TIA-568-C.2-1 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- G. ANSI/TIA-568.3-D – Optical Fiber Cabling and Components Standard



- H. ANSI/TIA-569-D – Telecommunications Pathways and Spaces
- I. ANSI/TIA-606-B.1 – Administration Standard for the Commercial Telecommunications Infrastructure.
- J. ANSI/TIA-607-C – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- K. ANSI/TIA-862-B – Structured Cabling Infrastructure Standard for Intelligent Building Systems
- L. ANSI/TIA-942-A – Telecommunications Infrastructure Standard for Data Centers
- M. NFPA 70 – National Electrical Code (NEC).
- N. BICSI–TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM)

### 1.3 GOVERNANCE

- A. The Electrical Code referred to in these specifications is the National Electrical Code as currently adopted by the State of California. All work will be provided in strict compliance with the Electrical Code and all regulations that may apply.
- B. Where standards exist, for a particular category, products used on this project will be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL), and be approved or listed for the intended service and application.
- C. These specifications do not undertake to repeat the requirements of codes, regulations or NRTL listing or labeling instructions. The Specifications or Drawings may require items or work beyond the requirements of applicable codes or regulations. The stricter, higher quality, greater quantity or higher cost will be allowed, and accommodations must be approved by District IT prior to procurement or installation. It is incumbent on the Installer, material and equipment suppliers to meet these specifications, applicable codes, regulations, and NRTL listing agency restrictions.
- D. The word "Manufacturer" will include the Manufacturer, the Manufacturer's Representative, the Distributor, the Fabricator, and the Supplier of the particular classification of equipment, system, product, and material.
- E. All work, equipment, and systems will be manufactured, provided, repaired, installed, and tested in accordance with the latest edition and all current amendments of the applicable publications and standards of the organizations listed below as of the date of the Contract Documents. When the Specification requirements exceed the requirements of these publications and standards the Specifications will govern:
  - 1. State Building Code (SBC)
  - 2. Building Department Inspectional Services
  - 3. American Society for Testing and Materials (ASTM)
  - 4. Underwriter's Laboratories, Inc. (UL)
  - 5. Insulated Cable Engineers Association (ICEA)
  - 6. National Electrical Manufacturers Association (NEMA)
  - 7. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
  - 8. American National Standards Institute, Inc. (ANSI)



9. National Fire Protection Association (NFPA)
  10. Local Electric Code
  11. Department of Public Safety (DPS)
  12. Building Officials and Code Administrators International, Inc. (BOCA)
  13. Department of Labor USA. Safety and Health Regulations for Construction (OSHA)
  14. Energy Codes
  15. National Electrical Contractors Association (NECA)
  16. National Bureau of Standards (NBS)
  17. Federal Communications Commission (FCC)
  18. Utilities Serving Project.
  19. Fire Department.
  20. Americans with Disabilities Act Applications Guidelines (ADAAG).
  21. Accessibility Guidelines for Buildings and Facilities.
  22. Any and all Federal, State and Local Standards, Codes and Authorities having Jurisdiction.
- F. In addition, all phases of the Structured Cabling System installation will adhere to applicable Local Area Network (LAN) Specifications of the IEEE, Electronics Industry Association/Telecommunications Industry Association (TIA/EIA), and Building Industry Consulting Service International (BICSI). The entire system and all components will be **Nationally Recognized Testing Laboratory (NRTL)** certified to appropriate TIA/EIA performance rating Category, Latest ANSI/TIA/EIA Standards 455-A, 492, 568, 569-A, 570, 606, 607 and 758 (latest revisions), and ANSI/TIA TSB 67, TSB 72, TSB 75, TSB 95 plus other standards as applicable.
- G. The Installer will have available at the job site at all times one copy of the latest edition of the Electrical Code, TIA and BICSI Standards applicable to the work as specified within this document.
- H. The above requirements will not in any way limit responsibility or requirements to comply with all other codes, standards and laws.
- I. Material, equipment, enclosures, and systems will be designed for use as required to suit the conditions, exterior or interior operation, dust tight, water tight, explosion-proof, or other special types.
- J. All materials shall be purchased from Distributors authorized by system Manufacturers to sell new and unused components.

#### 1.4 DESCRIPTION OF WORK:

- A. The extent of telephone/data system work is indicated and is hereby defined to include, but not be limited to cable, cable supports, raceway, connectors, racks, cabinets, panels, wire management, device plates, patch cords, backboard, grounding, firestop and miscellaneous items required for a complete, tested and operational system.
- B. Provide, install and test the complete cable and outlet system as indicated and described herein. Work includes procurement, project management, installation, labeling, termination, testing and cleanup of all cables installed under this project.
- C. Provide system testing, as-builts (redlines) of installed cables and numbering plan, Operations & Maintenance Manuals (O&M's), and processing of warranty registration



with Manufacturer.

- D. Project coordination with General Contractor, District IT, District ITs Representative, and other trades before, during and upon completion of project as necessary for a well-executed project.
- E. Refer to other Master Division sections, bid proposal and project responsibilities matrix for responsibility and requirements for raceways, boxes and fittings, wiring devices (plates), and supporting devices, and other sections, as applicable.
- F. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
- G. Horizontal copper cabling system consists of four twisted pairs of solid annealed copper. Each four pair cable is terminated onto 8 position 8 conductor ("RJ45", or 8P8C) connectors (jacks) using Insulation Displacement Conductors (IDCs). Color-coded connectors are placed into NEMA rated faceplates at the work area and placed into corresponding rack-mounted patch panels in the equipment / networking rooms. The jacks use state-of-the-art techniques to effectively eliminate Alien Crosstalk.
- H. Horizontal cabling may contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
- I. Bridged taps and/or splices will not be installed in the horizontal cabling.
- J. Communications cables shall be rated CMR or CMP. CMP cable ratings are required for cables passing through or contained within plenum air handling spaces, such as above drop ceilings and return or supply air shafts. The contractor is responsible for installing the correct cable type in the appropriate environment, and any failures to do so according to the District IT or the Authority Having Jurisdiction (AHJ) will result in the contractor removing the unsuitable cable and installing the correct cable, at their own expense.
- K. The maximum allowable horizontal cable length installed in the permanent link (jack to jack) is 295 feet (90 m). This maximum allowable length does not include an allowance for patch cords, maximum length of 16 feet (5 m) to the workstation equipment and of 16 feet (5 m) in the horizontal cross-connect.

### 1.5 QUALITY ASSURANCE:

- A. Comply with applicable portions of NEC as to type products used and installation of components. Provide products and materials, which have been UL-listed and labeled. Comply with NEMA, ANSI and TIA standards manufacturer's recommendations for horizontal cabling.

### 1.6 SUBMITTALS AND SUBSTITUTIONS

- A. The District has standardized on a unified, end-to-end copper system design based on Leviton jacks, patch panels and patch cords, as well as Berk-Tek field-terminable cables. Corning fiber systems is the preferred Fiber provider for the district. The District is satisfied that the products specified herein are qualified for the purpose intended, and has performed due diligence in establishing a consistent set of standards based on



performance and feature set.

- B. Products which are proposed in the bid response which are of an alternative solution are to be prequalified as “equal or better” by the Designer and District IT, in writing, prior to bid acceptance. If substitutions are allowed, they are at the discretion of the District IT and based on performance, suitability, quality, administrative requirements, warranty and other factors deemed important to the District IT. Written acceptance of substitutions from District IT must be included in bid package to avoid disqualification of bid.
- C. Submit manufacturer’s data and installation details for all devices, plates, cable, terminal blocks, patch cords, racks, wire management, labels and similar equipment which are not in accordance with District IT standards.
- D. Submit a copy of 3<sup>rd</sup> party testing and certification documents which prove they meet or exceed the requirements as set forth in this document, for any product or system not specified herein or proposed as an “equal” substitute for District IT-approved products. All products must have independent test data published prior to bid.
- E. Any substitutions must be approved by Designer, District IT and/or District IT’s Representative in writing prior to acceptance of bid.

#### **1.7 CONTRACTOR QUALIFICATIONS AND TRAINING**

- A. The contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:
  - 1. Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
  - 2. Provide references of the type of installation provide in this specification.
  - 3. Personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.
  - 4. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.
  - 5. Low Voltage or Telecommunications
  - 6. Been in installation business for a minimum of ten (10) years and possess a current California C7 license.
  - 7. Be an approved Member in good standing of the Certified Installer network associated with the products listed in this Specification and authorized for use in this Project. Contractor must be a member of this installer program before, during, and through completion of the system installation. Supporting documentation will be required as part of the submittal.
  - 8. Maintain a certified RCDD on staff and utilize Certified Installers for this project. Installers shall be certified by the manufacturer of the products installed, or by an Industry organization responsible for the certification of its membership base, such as BICSI.



9. Own the specified test equipment and be fully trained by the manufacturer in its operation.
10. Fiber Optics
  - a. Personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques.
  - b. Experience using an OLTS and OTDR.
  - c. Own a core alignment fusion splice machine

## 1.8 WARRANTY

- A. A Limited Lifetime Product & Performance Warranty covering all components, equipment and workmanship shall be provided to the District IT, submitted in writing with system documentation. The warranty period shall begin on the system's first use by the District IT.
  1. Horizontal channels shall be completed with Leviton Network Solutions factory-terminated copper and/or fiber optic patch cords in order to be eligible for the applicable Leviton Warranty with channel performance guarantees.
  2. Approved product shall be listed on the most recent version of the applicable Leviton data sheets for each listed Berk-Tek Leviton Technologies solution.
  3. The Contractor must pre-register the project with the Manufacturer before installation has begun. Following project completion, contractor is responsible for completing all warranty registration procedures on behalf of the District IT.
  4. Should the cabling system fail to perform its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the contractor shall promptly make all required corrections without cost to the District IT.
- B. Certified Installer shall provide labor, materials, and documentation in accordance with Leviton Network Solutions requirements necessary to ensure that the District IT will be furnished with the maximum available Manufacturer's Warranty in force at the time of this project.
- C. The installed structured cabling system shall provide a warranty guaranteeing the specified performance in the installed channel performance above the ANSI/TIA-568 requirements for Category 6, Augmented Category 6 (CAT 6A) cabling systems or ISO 11801 requirements for Class E and EA.
  1. Standards-compliant channel or permanent link performance tests shall be performed in the field with a Leviton-approved certification tester in the appropriate channel or permanent link test configuration.
- D. Necessary documentation for warranty registration shall be provided to the manufacturer by the installer (within 10 days) following 100 percent testing of cables.
  1. Installation Contractor shall submit test results to Leviton Network Solutions in the certification tester's original software files.



2. Installation Contractor shall ensure that the warranty registration is properly submitted, with all required documentation within 10 days of project completion.
  3. Certified Contractor/Integrator must adhere to the terms and conditions of the respective manufacturer's warranty programs.
- E. Manufacturer shall ensure that the District IT receives the project warranty certificate within 60 calendar days of warranty registration.

### 1.9 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- A. All conduit and EMT required for Communications cabling pathway in/out of cross connect closets and in/out of wall cavities at the work area. EMT or Conduit for pathways shall have no more than two 90 degree bends between pull boxes and no continuous section over 100'.
- B. All core holes through concrete, metal, finished hardwood or masonry; in-floor troughs ("Walker Duct"), and poke through devices in the floor for the installation of Communications cabling. Device plates for landing communication cables should be included in the Communications scope.
- C. All core holes and EMT sleeves between floors for the routing of Communications cabling.
- D. Back boxes for the mounting of NEMA rated faceplates.
- E. Drag line or pull string at the back boxes fished through existing EMT, conduit, or wall cavities ("Ring and String") to the accessible ceiling or other end of conduit, for installing 4 pair, multi-pair or fiber optic (horizontal and backbone) cables.
- F. Plywood Walls – To be installed in all telecom rooms, a minimum of 2 walls, ¾" x 4' x 8' fire-rated plywood, from 6" AFF to 8'-6" AFF. Coat with 2 coats of white paint. Do not paint over fire rating stamp.
- G. Basket tray or ladder racking to support main pathway cable bundles through hallways, open areas or exiting telecom rooms unless otherwise requested at time of bid.
- H. #2/0 ground wire or other size as appropriate, from Telecommunications Grounding Bus Bar(s) to Building Ground. Use of #6 ground wire, or smaller as allowed, for grounding of telecommunications equipment installed under this Scope is included within the Telecommunications scope of work.
- I. Electrical subcontractors may be required to provide additional lighting, power or grounding connections to the electrical panel, and to provide and install electrical devices as needed. It will be the responsibility of the Contractor to secure all required specialists and subcontractors in order to fully perform under the requirements for these projects

## Part 2- PRODUCTS

### 2.1 GENERAL

- A. Provide complete raceway, outlet boxes and miscellaneous items as required.



- B. Utilize 4-11/16" square outlet box (min) at each outlet location with single gang plaster or tile ring and 1" conduit to cable tray, backboard, or accessible ceiling or floor space.
- C. Provide a complete data cabling and device system as described herein.
- D. Work area connectors shall be of a non-proprietary "Keystone"-style port configuration, such that they fit into all furniture, panels, wallplates, raceways, floor monuments, poke-throughs and AV boxes without adapters. Maximum density of 6 CAT6A outlets shall be available in Decora footprint where required and 48 ports in a 1RU panel may be required in select high density locations.

**2.2 ACCEPTABLE MANUFACTURER SOLUTIONS:**

- A. Subject to compliance with requirements, provide products of the following:
  - 1. Leviton Manufacturing Co, Inc.
  - 2. Berk-Tek, a Nexans Company
  - 3. District IT Pre-approved equal

**2.3 UTP PIN/PAIR TERMINATION ASSIGNMENT**

- A. The UTP cabling system will have TIA/EIA T568B pin/pair termination assignment. All conductors provided will be properly and consistently terminated at both ends throughout the entire systems. Maintain proper untwist of pairs and removal of jacket per TIA, BICSI, and Manufacturer's recommendations.

**2.4 SYSTEM PERFORMANCE**

- A. Category 6A (CAT6A) Unshielded Twisted Pair (UTP) Systems
  - 1. Category 6A 23AWG UTP copper cabling system shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 10G Base-T (802.3an) and ISO/IEC 11801 Class EA applications for a total distance of 100 meters with equipment cords. System is guaranteed to meet all CAT6A requirements for short links and channels down to a 10-foot link (5 meter channel) with a guaranteed 5 dB margin of Alien Crosstalk. Field testing is not required for Alien Crosstalk clearance.
  - 2. Basis of Design is Berk-Tek Leviton Technologies CX6850 Cat6A Premium UTP System
  - 3. Category 6A Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N	PSANEXT	PSAACR-F
3%	5 dB	6 dB	10 dB	10 dB	4 dB	7 dB	7 dB	5 dB	11 dB

- B. Category 6 (CAT6) Shielded (F/UTP) Twisted Pair Systems
  - 1. Horizontal Shielded, F/UTP Category 6 23AWG copper cabling system shall be guaranteed to meet all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E





applications for a total distance of 100 meters with equipment cords.

2. Basis of Design is Berk-Tek Leviton Technologies CS6100 Cat6 Shielded System
3. CAT6 F/UTP Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N
2%	5 dB	6 dB	5 dB	6 dB	2 dB	6 dB	7 dB

C. Category 6 (CAT6) Unshielded Twisted Pair (UTP) Systems

1. Category 6 UTP 23AWG copper cabling system shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords.
2. Basis of Design is Berk-Tek Leviton Technologies CX6175 CAT6 UTP System.
3. CAT6 Performance Parameters, headroom over TIA-568 standard:

Insertion Loss	NEXT	PSNEXT	ACR-F (ELFEXT)	PSACR-F (PSELFEXT)	Return Loss	ACR-N	PSACR-N
3%	6 dB	7 dB	8 dB	9 dB	3 dB	8 dB	9 dB

2.5 HORIZONTAL CABLING SYSTEMS

A. CATEGORY-RATED DATA CONNECTORS (RJ45 JACKS)

1. Provide mission-critical, modular-type, information connectors/outlets (jacks) for 24-23 AWG copper cable. These connectors shall be individual snap-in style, and exceed compliance with TIA-568 specifications. The connectors shall comply with the following:
  - a. Shall be 8-position 8-conductor (8P8C) "RJ45"-style modular jack, Category 6 (CAT6) and Category 6A (CAT6A), with IDC terminals, T568A/B wiring scheme (use T568B), and utilize a non-punchdown simplified manual termination style.
  - b. Shall be encased in a die-cast housing to protect from potential EMI/RFI, and utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products.
  - c. CAT6A connectors shall exceed all component performance requirements for Augmented Category 6 in the ANSI/TIA-568 standard, as well as Class EA requirements as described in ISO/IEC 11801, from 1 MHz to 500 MHz to support the IEEE 802.3an standard for 10GBASE-T network performance.
  - d. CAT6 Connectors shall exceed all component performance requirements for Category 6 in the ANSI/TIA-568-C.2 standard, as well as Class E requirements as described in ISO/IEC 11801, from 1 MHz to 250 MHz.



- e. Shielded connectors shall utilize the same form factor, design, and tool-less installation process as the unshielded connectors in the product line.
- f. Shall be tested by an Independent testing body such as Intertek (ETL) for component compliance (i.e. "Component rated") to ANSI/TIA-568 and for POE+ applications. Test results shall be published and publicly available without special request.
- g. Shall be in compliance will all National Electrical Codes; compliant with ANSI/TIA-1096-A (formerly FCC Part 68); cULus Listed.
- h. When used in the plenum spaces, shall be plenum-rated per UL 2043, and all plastic components shall be made of high-impact, fire-retardant plastic rated UL 94V-0.
- i. Shall have a maximum depth of 1.31".
- j. Cable shall be terminated by the use of a snap-on wire manager that holds individual conductors in place during termination, and allows for termination without a complete untwist of each conductor pair. Cables shall terminate onto jack via a "clamshell" closure at rear of connector, affixing termination manager to connector IDC.
- k. Shall be terminated without the need for any punch down tool or other specialized or proprietary termination tool.
- l. Shall be reusable and support a minimum 20 termination and re-termination cycles and be facilitated by simple termination release levers.
- m. Shall utilize a method of tine tensioning using polymer springs above the tines ("Retention Force Technology" or similar functionality) that prevents six-position modular plug insertion from damaging either the cord or the module and promotes return of tines to original position.
- n. Shall fit the full manufacturer's range of telecommunications faceplates, outlets, and field-configurable patch panels. No separate product line or style of connectors shall be required for patch panels, faceplate, biscuit, furniture, raceway and/or floor feed applications.
- o. Shall be available in 13 TIA 606-B compatible colors and supplied with interchangeable icons (Voice, Data, A/V, and blank, color coded to match the connector face) for easy identification and tracking of data, voice, or other functions. Additional bulk Icons for the connector shall be available separately.
- p. Shall be available with an optional internal shutter to protect against dust and debris such as in above-ceiling and in-floor locations.
- q. Typical colors: Ivory CAT6, Blue CAT6 Shielded, and Yellow CAT6A.

Approved Products:

Leviton Atlas-X1 UTP Cat 6A Connector, no shutters, 6AUJK-R\*6

Leviton Atlas-X1 UTP Cat 6A Connector, with shutters, 6AUJK-S\*6

Leviton Atlas-X1 STP (Shielded) Cat 6 Connector, no shutters, 61SJK-R\*6



Leviton Atlas-X1 STP (Shielded) Cat 6 Connector, with shutters, 61SJK-S\*6  
Leviton Atlas-X1 UTP Cat 6 Connector, no shutters, 61UJK-R\*6  
Leviton Atlas-X1 UTP Cat 6 Connector, with shutters, 61UJK-S\*6  
Additional Icons: ICONS-IC\* (72 two-sided Icons)

Where

\* = one of 13 colors. See drawings or check with District IT for application.  
(W)=White, (T)=Light Almond, (A)=Almond, (I)=Ivory, (Y)=Yellow, (O)=Orange,  
(L)=Blue, (B)=Brown, (C)=Crimson, (R)=Dark Red, (P)=Purple (V)=Green, (G)=Grey,  
(E)=Black

## B. PATCH PANELS

1. Telecommunications Room Patch panels shall be manufactured with empty ports, which allow for the insertion of appropriately-graded and colored jacks. Panels shall be Shielded, standard density, and used for all CAT6 and CAT6A terminations at IDF and MDF locations. Panels shall be:
  - a. Shielded for both UTP and STP applications, and shall accept both styles of jacks in the same panel. Panels shall include star washers and grounding lug for flexibility in panel grounding, and/or hardware to accept standards-compliant grounding connectors.
  - b. Available in either 24- or 48-ports to protect data from electromagnetic and radio frequency interference.
  - c. Independently tested and verified by Intertek (ETL) to meet or exceed all TIA component, permanent link, and channel requirements of TIA-568 for Cat 5e, Cat 6, and Cat 6A, FCC part 68, and IEC 60603-7. An appropriate cable management bar shall be included.
  - d. QuickPort High-Density modular panels shall be available in 48-ports/1RU form factors for authorized situations.
  - e. Shall be sized to fit an EIA standard, 19-inch relay rack and hole pattern.
  - f. Shall utilize a universal Keystone-style insertion footprint as the manufacturer's main "flagship" line of products and receive the same jacks as are used in the workstation outlets. No special "Panel jack" shall be required.

### Approved Products:

Leviton 1RU QuickPort® Shielded Flat Patch Panel # 4S255-S24 (24-port)  
Leviton 2RU QuickPort® Shielded Flat Patch Panel # 4S255-S48 (48-port)  
Leviton 1RU QuickPort® Shielded Angled Patch Panel # 4S256-S24 (24-port)  
Leviton 2RU QuickPort® Shielded Angled Patch Panel # 4S256-S48 (48-port)

## C. FACEPLATES

1. Faceplates (wallplates) secure information outlets to the work area. Contractor shall provide and install single gang faceplate kits to house all jacks as required for all work area outlets, workstation base feeds, and furniture openings. Unused



telecom backboxes shall receive a solid blank faceplate. Telecommunications faceplates shall:

- a. Utilize a keystone-type (“QuickPort”) footprint to match the approved connectivity manufacturer, and be made by the same manufacturer as the connectors.
- b. Precisely match colors and materials of the power wiring device plates.
- c. Support any connectivity media type, including fiber, AV and copper applications.
- d. Have printable designation labels for circuit identification together with a clear plastic cover.
- e. Be available in single-gang and double-gang configurations.
- f. Have surface-mount boxes and standoff rings available for both single and double gang faceplates.
- g. Have single-port matching color blank inserts available in packs of 10.
- h. Color shall match nearby electrical devices exactly. Off-color ivories or whites will not be accepted.
- i. Furniture faceplates shall fit existing knockouts for telecom receptacles, and snap in without screw mounts.
- j. Wallplate colors are typically Ivory.

Approved Products:

Leviton QuickPort Single-Gang, Plastic, with ID Windows, # 42080-#xS  
Leviton QuickPort Single-Gang, Stainless Steel, with ID Windows, # 43080-1L#  
Leviton QuickPort Blank Inserts, pack of 10, #41084-BxB  
Leviton QuickPort Single-Gang SS Wall Phone faceplate, #4108W-OSP  
Leviton Blank Plate #zz014 (1-gang), xx025 (2-gang)  
Leviton Extended-Depth Furniture Faceplate, #49910-Ex4

Where:

# = number of ports: 1, 2, 3, 4, 6  
x = colors - White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)  
zz= 88 (White), 77 (Lt. Almond), 86 (Ivory), 88 (Stainless Steel)

**D. SURFACE-MOUNT BLOCKS (SMB)**

1. Surface-Mount Blocks (SMBs) are used to protect terminated CAT6 and CAT6A cables at the endpoints where they are not contained within walls or furniture. Example locations may be Wireless Access Points (WAPs), Group Work Areas fed by conduits run down columns, security cameras, or other network-enabled device locations.
2. Ceiling, WAP, Camera and other non-wallmount locations will use a 2-port plastic SMB.



3. Small Surface-Mount Boxes shall exhibit the following characteristics:
  - a. Outlet housings for WAPs and other devices shall be a high-density, low profile design with (2) or (4) field-configurable ports, snap-lock cover, and cable knockouts on back.
  - b. Housing cover shall have raceway knockouts for top and bottom entry. Base shall include Tie-wrap anchor points at all cable entrances.
  - c. The housing shall be mountable with screws, tape or a single magnet.
  - d. The cover shall provide the option of securing it to the base with a screw that is hidden under the outlet identification window.
  - e. Shall be constructed of high-impact self-extinguishing plastic rated UL 94V-0, and be UL Listed and compliant with FCC Part 68 and TIA-568 specifications.

Approved Products:

Leviton QuickPort Surface-mount Housing, White, #41089-#xP

Where

# = number of ports: 1, 2, 4, 6

x = colors - White (W), Ivory (I), Light Almond (T), Gray (G), Black (E)

E. DATA CABLES

1. Category 6A (CAT6A) Unshielded Twisted-Pair (UTP) cable
  - a. 100-Ohm, 23 AWG, Category 6A 4-pair balanced unshielded twisted pair solid annealed copper
  - b. Cable shall be characterized to 750 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as Intertek (ETL) Verified to TIA-568 Category 6A and ISO/IEC 11801 Class EA requirements for channel, link and component performance to support IEEE 10GBASE-T (802.3an) networks
  - c. Maximum Cable Outer Diameter: 0.275".
  - d. Documentation available from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.
  - e. Guaranteed cable balance improves overall performance and reduces emissions which results in error-free performance up to 10 Gigabit Ethernet with full duplex transmission
  - f. The unshielded twisted pair conductors are surrounded by a non-conductive aluminum/polyester tape and jacketed with flame-retardant polymer alloy to reduce alien crosstalk, reduce cable diameter and improve performance.
  - g. Provided on spools or reels-in-box to reduce risk of kinking cable upon deployment
  - h. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
  - i. Be made by an ISO 9001 and 14001 Certified Manufacturer.
  - j. Guaranteed to meet or exceed Channel margin guarantees as stated above



- under System Performance
- k. Color: Yellow, or as directed.
2. CAT6 Shielded twisted-pair cable (F/UTP)
    - a. 100 ohm, 23 AWG, solid annealed copper 4-pair unshielded twisted-pair solid annealed copper conductors with an overall foil shield.
    - b. Shielded with an overall polyester/aluminum foil with stranded tinned copper drain wire and ripcord and jacketed in flame-retardant PVC
    - c. Cable shall be UL/ETL Listed by the Manufacturer printed on the cable jacket and package, and ETL Verified to TIA-568 Category 6 and ISO/IEC 11801 Class D.
    - d. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
    - e. Outer Diameter: 0.235" max for CMP, .240" max for CMR
    - f. Color: White.
  3. Category 6 (CAT6) Unshielded Twisted-Pair (UTP) cable
    - a. 100-Ohm, 23 AWG, Category 6 4-pair balanced unshielded twisted pair solid annealed copper conductors
    - b. Cable shall be characterized to 550 MHz and UL/ETL Listed by the Manufacturer printed on the cable jacket and package, as well as ETL Verified to TIA-568 Category 6 and ISO/IEC 11801 Class E.
    - c. Cable shall be Plenum-rated (CMP) for any location where plenum cable is required.
    - d. Outer Diameter: 0.230" max.
    - e. Cable shall be guaranteed to exceed all TIA-568 link and channel performance requirements and be capable of supporting 1000Base-T (802.3ab) and ISO/IEC 11801 Class E applications for a total distance of 100 meters with equipment cords
    - f. Color: Blue.
  4. All category cabling manufacturers must be able to provide documentation from an independent third-party testing agency that verifies through random sampling that cable components perform at or above the levels contained on their product specifications, not simply at or above the standard.
  5. Cable may be CMR rated for areas not running through air handling spaces. CMP cable must be used if cable passes at any point through an air plenum or supply/return air handling space.

Approved Products:

Berk-Tek LANmark XTP, CAT6A CMP, Yellow, 1000' reel, # TBD  
Berk-Tek LANmark XTP, CAT6A CMR, Yellow, 1000' reel, # TBD  
Berk-Tek LANmark-6 FTP, CAT6 CMP, White, 1000' reel, # 10081255  
Berk-Tek LANmark-6 FTP, CAT6 CMR, White, 1000' reel, # 10122953  
Berk-Tek LANmark 1000, CAT6+ UTP, Blue, CMP, 1000' box, # 10032094  
Berk-Tek LANmark 1000, CAT6+ UTP, Blue, CMR, 1000' box, # 10032455  
Other colors as required



## F. COPPER PATCH CORDS

1. Copper patch cords for CAT6A UTP and FTP cable systems shall exhibit the following characteristics:
  - a. Slimline, integrated snag-less plug design without incorporating the use of a rubber molded boot for use at patch panel.
  - b. A narrow profile for less congestion in higher density applications and a strain relief boot ensures long-term network performance
  - c. Independently tested and verified by Intertek (ETL) for CAT 6A component performance.
  - d. Cable construction provides excellent alien crosstalk suppression and EMI/RFI protection.
  - e. Constructed of shielded 26 AWG stranded conductor cable for maximum flexibility and outside diameter of .240", for use in shielded and unshielded systems.
  - f. Patch cords in Plenum areas shall be Plenum-rated, and utilize solid conductors.
  - g. Complies with TIA 568-C.2-10 component requirements for connecting hardware from 1 MHz to 500 MHz, ISO 11801 Class EA, IEEE 802.3an to support 10GBASE-T networks and cULus listed.
  - h. Available Lengths: 3', 5', 7', 10', 15', or 20'.
2. Standard copper patch cords for CAT6 UTP user locations shall exhibit the following characteristics:
  - a. 26-gauge, unshielded, twisted pair, stranded conductor construction with a standard 8-position modular plug on both ends.
  - b. Plug contacts shall be plated with minimum of 50 micro-inches ( $\mu\text{m}$ ) of gold
  - c. Slimline, integrated snag-less molded plug design with integrated strain relief, without incorporating the use of any secondary or 2-piece rubber over-boot.
  - d. Maximum Outer Diameter of 0.24"
  - e. Power over Ethernet (PoE and PoE+) compatible
  - f. Support 1 Gigabit applications over 90-meter permanent links with up to 10 meters of cordage
  - g. Meets all applicable standards and listings: ANSI/TIA-1096-A (formerly FCC Part 68), RoHS compliant, IEEE 802.3, PoE: IEEE 802.3at – 2012
3. High-flex copper patch cords for CAT6 UTP cable systems used inside Telecom Enclosures, Rooms and racks shall exhibit the following characteristics:
  - a. 28-gauge, unshielded, twisted pair, stranded conductor construction with a standard 8-position modular plug on both ends.
  - b. Plug contacts shall be plated with minimum of 50 micro-inches ( $\mu\text{m}$ ) of gold



- c. Slimline, integrated snag-less molded plug design with integrated strain relief, without incorporating the use of an secondary or 2-piece boot.
  - d. Ultra narrow, highly flexible cord for less congestion in higher density applications
  - e. Maximum Outer Diameter of 0.15", minimum bend radius 0.60"
  - f. Power over Ethernet (PoE and PoE+) compatible
  - g. Support 1 Gigabit applications over 90-meter permanent links with up to 6 meters of cordage
  - h. Meets all applicable standards and listings: ANSI/TIA-1096-A (formerly FCC Part 68), RoHS compliant, IEEE 802.3, PoE: IEEE 802.3at – 2012
  - i. To be used at patch panel end of any CAT6 permanent link.
4. Provide and install only factory-assembled patch cords of the same or better Category rating of the permanent link cabling system, in quantities as described in Part 3 of this Specification.
  5. For color scheme of cabling, jacks, and patch cords, see section 27 00 00 3.4 D.

Approved Products:

Leviton Slimline Atlas-X1 CAT6A Component-rated Patch Cord, # 6AS10-xx\*  
Leviton Plenum-rated CAT6A Component-rated Patch Cord, # UAPPP-xx\*  
Leviton eXtreme CAT6/6A Shielded Patch Cord, # 6210G-xx\*  
Leviton High Flex 1G HD6 Patch Cord, for CAT6 systems, # 6H460-xx\*

Where:

xx = Length, in Feet.

\* = one of 13 colors - (W)=White, (Y)=Yellow, (L)=Blue, (R)= Red, (G)=Green, (S)=Slate Grey, (E)=Black

## **2.6 BACKBONE CABLING SYSTEMS**

### **A. GENERAL**

1. Copper cables allowed for use in the backbone include: 4-pair 100-ohm unshielded twisted-pair 100% annealed-copper solid-conductor cables, 100-ohm UTP multi pair copper cables. Fiber optic backbone cables shall be 9µm low-water peak singlemode optical fiber cables compliant with ITU-T G.652D (i.e. OS2). The cable shall support voice, data, and multimedia applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.

### **B. VOICE COPPER BACKBONE CABLE**

1. Power-Sum Multi-Pair Category 5e cable, 24 AWG solid-copper conductors in 25-pair binder groups to support Analog Voice or Digital Data communications





from 16Mhz-100Mhz.

2. Copper backbone cables shall be terminated onto a rack-mounted modular RJ45-style patch panel.
3. Terminate Category 5e cables onto Category 5e patch panels at 1 pair per port, with the last of the 25-pair cable coiled (full length) for future use. Use black outlet colors on patch panel for Category 5e connectivity.
4. At MPOE, 25-pair backbone copper cable will be terminated onto a lightning protector block with 110 punch block for cross connect.

Approved Products:

Leviton 24-port 110 punchdown patch panel, #5G596-U24  
Berk-Tek # 10059632, CAT5e 25-pr CMP, Gray.  
Berk-Tek # 10061456, CAT5e 25-pr CMR, Gray  
Circa 25-pr Lighting Protection panel, 110 style #1880ECA1-25, 25025-110-M110C  
Circa Gas Protection Modules #3B1E 175-3C1EW-NL

C. OPTICAL FIBER CABLE

1. SINGLEMODE Optical Fiber

- a. Optical fiber cables run shall be low-water-peak Singlemode (OS2), and meet all of the requirements delineated within the specifications of ANSI/TIA-568 and ANSI/TIA-492.AAAC-B.
- b. Indoor fiber optic cable shall be minimum 12 strands, tight buffered, and individual fiber strands shall be 900 micron jacketed.
- c. Outdoor or indoor/outdoor fiber optic cable used for building-to-building interconnections shall be minimum 24 strands, loose tube construction with 250 micron unjacketed fiber strands in a 12-strand buffer tube.
- d. Cables are typically OFNR rated for in-conduit applications, but must always be constructed of materials and rated appropriate for the environment in which it is installed (Indoor, Indoor/Outdoor, Outside Plant (OSP), OFNP or OFNR, OFCP or OFCR). In-slab conduits are considered a "wet environment" and require OSP or Indoor/Outdoor rating. Cables running at least a portion of the length through an open-air plenum or air handling space must be OFNP or OFCP (plenum) rated. Contractor is solely responsible for installation of the correctly-rated cable in the appropriate environment, as required by the AHJ or local ordinance
- e. Loose tube fibers shall utilize a fan-out kit to fit 250 micron fibers into a 900 micron protective sheath when terminating. Loose Tube cables are generally expected for outdoor environments.

Approved Products:

Corning 24 Strand SMFO Altos All-Dielectric OSP cable, 024EU4-T4701D20



Corning 36 Strand SMFO Altos All-Dielectric OSP cable, 036EU4-T4701D20  
Corning 12 Strand SMFO Riser Rated MIC cable, 012E81-33131-24  
Corning 12 Strand SMFO Plenum Rated MIC cable, 012E88-33131-29  
Leviton 12-fiber, 36" Fan-out Kit, # 49887-12L  
Corning 25" Fan-out Kit, #FAN-BT25-12

D. FIBER OPTIC ENCLOSURES, PANELS AND TRAYS

1. All Fiber enclosures shall provide cross connect, inter connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.
2. Fiber Adapter panel openings shall accept Fiber Adapter Plates (bulkheads), Splice Modules, and plug-n-play MTP modules/cassettes or any combination thereof.
3. All Fiber enclosures, panels and trays (units) shall provide cross connect, inter connect, and splicing capabilities and contain cable management for supporting and routing the fiber cables/jumpers.
4. Fiber enclosures shall exhibit the following characteristics:
  - a. Fiber enclosure shall be available in 1RU, 2RU or 4RU versions to accommodate fiber adapter plates, MTP Modules, and/or termination and splicing of fiber as needed
  - b. Enclosure shall inherently accept a 1-panel integrated splice cassette.
  - c. Enclosures shall have a sliding tray which can be removed completely from enclosure (from front or rear) to facilitate field terminations and splicing. Sliding tray glides forward and backward providing accessibility to front and rear bulkhead after installation.
  - d. Patch cord bend radius guides minimize macro bending.
  - e. Fiber Jumper saddles pivot for improved patch cord routing and organization
  - f. Fiber cable management shall allow for routing, storage, and protection of patch cords, tight-buffer fiber, and backbone cables.

Approved Products:

Corning Closet Connector housing, 1RU, # CCH-01U  
Corning Closet Connector housing 2RU, #CCH-02U  
Corning 24/48 Wall Mount Enclosure, 4RU, #WCH-04P  
Corning Single panel housing, #SPH-01P

E. FIBER TERMINATION PRODUCTS

1. FIBER OPTIC SPLICE CASSETTES AND MODULES
  - a. Use of fusion splice cassette assemblies shall be the standard means of terminating fiber optic cables at the enclosure.



- b. Fiber Optic Splices shall be done using fusion splice equipment. Mechanical splices are not permitted.
- c. Splice cassettes shall be offered in 12- or 24-fiber LC configurations in OS2 fiber type.
- d. Splice cassettes shall be pre-loaded and routed with respective 3-meter, color-coded pigtail assembly.
- e. Individual OS2 pigtails shall have maximum insertion loss of 0.3 dB. Return Loss shall be greater than 55 dB.
- f. Individual compartments shall provide slack storage and bend radius protection for incoming backbone fibers, 900  $\mu\text{m}$  tight-buffer fibers, and fusion-spliced fibers.
- g. OSP Splice closures shall be utilized as necessary, shown or directed.

Approved Products:

Corning 12F LC Duplex SMFO Pigtailed Cassette, #CCH-CS12-A9-P00RE  
Corning 24F LC Duplex SMFO Pigtailed Cassette, #CCH-CS24-A9-P00RE  
Corning Pigtailed CCH Adapter panel Duplex, UPC, 12 F, Single-mode (OS2),  
# CCH-CP12-A9-P03RH  
Commscope/TE OSP Splice Case FOSC 450 D, # FOSC450-D6-6-6-NT-0-DOV  
Commscope/TE FOSC 450 D Splice Tray 72f, #FOSC-ACC-D-Tray-72

**2. FIBER JUMPERS AND ARRAY CORDS**

- a. Fiber optic LC-LC patch cords, or jumpers, will make LC connections from the rack termination points to the equipment. The jumpers will meet the following requirements:
  - 1) Factory-manufactured using Singlemode OS2 optical fiber. Field terminations on fiber jumpers are not acceptable.
  - 2) Shall utilize A-B polarity.
  - 3) Exhibit <0.35 dB insertion loss and -50 dB return loss.
  - 4) Durable to withstand >500 matings
  - 5) Shall be available in standard lengths of 1, 2, 3, 5 and 10 meters and custom-orderable up to any length of feet or meters
  - 6) Provide factory assembled patch cords meeting or exceeding all criteria specified in the horizontal cabling standard
  - 7) Verify lengths, quantities and configuration with District IT prior to delivery.

Approved Products:

Leviton Economy series patch cord, LC-LC, SM, Yellow, xx meter, #UPDLC-Sxx



Corning or equal

Where:

xx = 01, 02, 03, 05, 10

## 2.7 FRAMES, RACKS AND CABINETS

### A. FLOOR-MOUNTED 4-POST CABINETS

1. 84" (2130mm) High, 39" (990mm) Deep, 27" (700mm) Wide. 45RMU height , with EIA/ECA-310-E universal 5/8" (16mm), 5/8" (16mm), 1/2" (13mm) hole pattern. Permanently stamped rack mount unit (RMU) markings and (50) #12-24 mounting screws included.
2. Load Rating: 2000 lb. (907kg) capacity, evenly distributed along rack height.
3. Include fan kit and vertical wire managers with each cabinet

#### Approved Products:

Chatsworth Megaframe Cabinet, t# M1040-732  
Chatsworth Megaframe Fan Kit, # 12480-701  
Chatsworth Vertical Wire Management, Megaframe X2, # 13171-700

### B. WALL-MOUNTED CABINETS

1. Horizontal Mount Wall Cabinet
  - a. 18RU usable space in 36" tall, 30" depth, 24" wide wall cabinet, 19" hole pattern, locking Plexiglass door.
  - b. Enclosure construction: steel.
  - c. Mounts to wall as left hinged or right hinged opening with Heavy duty, field reversible hinge and lock system.
  - d. Rear section can easily be separated from the cabinet for simple installation onto a wall and rear sections feature removable plates with either multiple knockouts for conduit or bushing installation, or a high-density foam gland plate for ease of installing pre-terminated patch panels.
  - e. Fully adjustable EIA/ECA-310-E compliant mounting rail system with #12-24 tapped rails. UL listed to the UL60950
  - f. 36" (914mm) high cabinets rated for 200 lb (91kg) load.
  - g. Include 115 VAC, 100 CFM fan kit with each cabinet.
2. Vertical Mount Wall Cabinet
  - a. 4RU usable space in Low profile cabinet to be 36"H x 26" W x 8.5" D.
  - b. Rated for 100 lb load



- c. Enclosure construction: steel.
- d. Include fan kit with each cabinet.

Approved Products:

Chatsworth Cube-it plus 36”H X30”D, # 12419-736  
Chatsworth Cube-it plus Fan Kit, # 12804-701  
Chatsworth ThinLine II 36”H X 26”W X 8.5”D, # 13050-722  
Chatsworth ThinLine II Fan Kit, # 13051-001

**C. HORIZONTAL WIRE MANAGERS**

- 1. Provide 2RU duct-style horizontal wire managers above and below or between every 2RU of flat patch panel, as space allows.
  - a. Cable managers shall be flat, covered duct style with front and rear channels.
  - b. Do not coil or wind patch cords inside wire managers.
  - c. Use recessed flat wire manager as needed within enclosed cabinets to route patch cords to opposite sides, where the rings of the flat wire managers would interfere with cabinet door closure.

Approved Products:

Leviton Horizontal Wire Manager, Black, 2RU, 492RU-HFR  
Leviton Horizontal Wire Manager, Black, 1RU, 491RU-HFR  
Leviton Recessed Flat Horizontal manager, 1RU, # 49253-RCM

**2.8 CABLE SUPPORTS**

**A. J-HOOKS**

- 1. All cable shall be supported above ceiling on dedicated cable support hardware.
- 2. Cable saddles and J-hooks shall be used where cable tray or wire basket is not available. These must be supported on their own ceiling wires, threaded rod, or affixed to building structure by use of beam clamps (on metal beams) or wood screws (on wood beams). Affixing communication cable supports to existing ceiling support wires is not allowed.

Approved Products:

B-Line Cable Hook, BCHxx  
B-Line Cable Hook, Cable to Beam Fastener, BCHxx-C2  
B-Line Cable Hook, Cable to Fastener, 2”, BCHxx-C442  
B-Line Cable Hook, Cable to Rod Fastener, 2”, BCHxx-W2

Where:



xx = 21 (1.25"), 32 (2"), or 64 (4")

## B. JACK/OUTLET BRACKETS

1. Above-ceiling cable termination locations shall be either wall-mounted or suspended from structure above the drop ceiling. Cables or terminations shall not rest on ceiling grid or equipment above ceiling grid.
2. For Wireless access Points and other above-ceiling-mounted communications devices, cables shall land in an above-ceiling bracket which is affixed to dedicated cable support hardware.
3. Two Category-rated jacks may be installed in each above-ceiling bracket. Each above-ceiling bracket will hold a 2-port Surface-Mount Box or 1-U MOS SMB for multimedia applications.
4. For wall-mounted device locations (above or below ceiling), devices needing to be mounted directly to a backbox will utilize the in-wall mounting bracket to secure the jack inside the backbox.
5. One Category-rated jack can be installed in each in-wall backbox jack mounting bracket. For devices requiring (2) Category-rated jacks, (2) in-wall brackets must be used.

### Approved Products:

Leviton QuickPort In-Ceiling Bracket, rod/wire hanger, 49223-CBC  
Leviton QuickPort In-Ceiling Bracket, accepts beam and screw mounts, 49223-CB0  
Leviton QuickPort In-Wall Bracket, 49223-BA5 (pack of 5)

## C. CABLE TRAY

1. In Telecom Rooms, cable tray (ladder runway) shall be installed to support all cable running to racks and cabinets.
2. Cable tray to be added to all Telecom Rooms in places where cable is run horizontally.
3. Cable tray shall be aluminum, with 9" rung spacing. Rungs can be removed or repositioned to accommodate specific project or building requirements.
4. Cable shall be combed and bundled in all exposed runs outside walls, in TR/TE, and inside cabinets and wire managers.
5. All appropriate cable tray support hardware including angle brackets, rack-to-runway brackets, wall-to-runway brackets, elevation kits, junction splices, butt splices, and grounding jumpers shall be used for a complete and professional installation.



Approved Products:

- Chatsworth, 12" Universal Cable Runway Black, #10250-712
- Chatsworth, Wall Angle Black, # 11421-712
- Chatsworth, Cable Runway Elevation Kit cabinet 2"-3", # 10506-712
- Chatsworth, Junction Splice, # 11302-701
- Chatsworth, Butt Splice, # 11301-701
- Chatsworth, End Caps, # 10642-001
- Chatsworth, Adjustable Junction Splice, # 10616-701
- Chatsworth, Vertical Wall Brackets, # 10608-001
- Chatsworth, Foot Kit, # 11309-001
- Any equivalent, associated mounting hardware and metals from B-Line

## **2.9 POWER DISTRIBUTION UNITS (PDU)**

- A. Provide (1) PDU per rack or wall cabinet. Unswitched, non-surge suppressed. 19" Horizontal for wall cabinets and 48" Vertical for floor-mounted cabinets.
- B. Utilize plug and receptacle style appropriate for installation circuits and equipment interfaces.

Approved Products:

- Leviton Horz. PDU, 19", 15A P1000 series, 5-15P straight-blade plug, #P1022-12L
- Leviton Vertical PDU, 48" P1000 series, 5-20P straight-blade plug, # P1043-10S

## **2.10 FIRESTOPPING**

- A. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur. Such devices shall:
  - 1. Meet the hourly rating of the floor or wall penetrated.
  - 2. Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
  - 3. Permit multiple devices to be ganged together to increase overall cable capacity.
  - 4. Allow for retrofit to install around existing cables.
  - 5. Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes
  - 6. Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:



- a. Opening or closing of doors.
  - b. Twisting an inner liner.
  - c. Removal or replacement of any material such as sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
7. Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.
  8. Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

Approved Products:

Specified Technologies, Inc. EZ-PATH series 22,33 & 44+ fire-rated pathway device  
Specified Technologies, Inc. EZ-FIRESTOP GROMMET

## 2.11 LABELING

### A. Cables

1. Horizontal and backbone cables shall be labeled at each end according to District IT labeling standards (see below). The cable or its label shall be marked with its identifier.
2. Cable labels shall be machine-generated wrap-around labels with multiple cable ID's printed such that it can be viewable in place without turning the cable.
3. Label cables within 6" of termination point at both ends.

### B. Faceplates

1. A unique location identifier shall be marked on each faceplate to identify its location in the cable plant.
2. Each port in the faceplate shall be labeled with its own unique identifier with machine-generated labels. No handwritten markings shall identify the location.

### C. Racks, Panels, Blocks

1. A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.
2. Each port on the connecting hardware shall be labeled with its own identifier to match the other end of the cable.





Approved Products:

Brother Labelers and P-Touch. TZ Polyester labels.  
Use clear tape with black lettering on ivory or stainless steel faceplates (3/8")  
Use white (or clear) tape with black letters on white faceplates and surfaces (3/8")  
Use black tape with white letters on black surfaces (as appropriate)  
Use Flexible ID, white tape with black letters on cables (1"), with several lines of repeating cable ID's for any-angle viewing.

## **PART 3 - EXECUTION**

### **3.1 ADDITIONAL INFORMATION**

A. Refer to Section 27 00 00 for the following Part 3 - Execution information

1. (THIS SECTION)
2. CABLE HANDLING / CABLE MANAGEMENT
3. SEPARATION OF DATA AND POWER CABLING
4. INSTALLATION OF STRUCTURED CABLING SYSTEM
5. VERIFICATION OF IDF ENVIRONMENT
6. TESTING
7. PROJECT CLOSEOUT
8. TRAINING

### **3.2 CABLE HANDLING / CABLE MANAGEMENT**

A. Proper cable handling is critical to maintaining the design integrity of high-performance cabling. Cable handling recommendations include:

1. Cable must be conditioned above 32 degrees F for 48 hours prior to installation.
2. Do not use excessive force when pulling cable. The maximum pull-force guideline for a 4-pair horizontal UTP should not exceed 110N (25lbf). Meeting this guideline avoids stretching conductors during installation and the associated transmission degradation.
3. The minimum bend radius for UTP should not exceed 4 times the cable outside diameter (O.D.) The O.D. of Cat 6A 100 ohm, balanced UTP cable is .30 in. (4 x .3 = 1.2 in. bend radius).
4. The minimum bend radius for fiber should not exceed 10x the cable outside diameter.
5. Traditional bundling of Category 6 and 6A cabling for a combed appearance is required in all exposed locations.
6. In TR, use appropriate horizontal cable management for patch cords on front of



patch panels. Also, use appropriate cable management bar(s) for support of terminated horizontal cable.

7. Do not use vinyl or plastic cable ties due to the potential for over-cinching of cable bundles which can alter the cable geometry and degrade the system cabling performance. Use only hook and loop ("Velcro") fasteners for bundling of horizontal cables.
8. Store cable slack in an extended loop configuration to alleviate cable stress. Excessive category-rated cable slack in bundled loops or traditional 'service loops' to provide additional cable length in TR has been shown to degrade cabling performance and are not recommended.

### **3.3 SEPARATION OF DATA AND POWER CABLING**

- A. Design cable pathways to avoid potential sources of EMI. Avoid installing cable near sources of EMI (X-ray equipment, large motors/generators, electrical power cabling and transformers, Radio frequency (RF) sources and transmitters, lighting, copiers, etc.).
- B. Physically separate power & data cabling according to relevant code and standard requirements when run in a common pathway.
  1. Never run data and Class 1 power cabling in parallel closer than 2".
  2. Avoid crossing cables if possible. If necessary, always cross cables at 90 degrees.
  3. Maintain a minimum of 5 in. separation between data cable and all ballast controlled lighting.
- C. Minimum separation distances of telecommunications cabling from potential sources of EMI exceeding 5kVA:
  1. 24" away from Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways
  2. 12" away from Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway
  3. 6" away from Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway
  4. 47" away from Electrical motors and transformers

### **3.4 INSTALLATION OF STRUCTURED CABLING SYSTEM**

#### **A. PRE-INSTALLATION CONFERENCE**

1. Schedule a conference a minimum of five calendar days prior to beginning work of this section.
2. Agenda: Clarify questions related to work to be performed, scheduling, coordination, etc.



3. Attendance: Communications system installer, General Contractor, District ITs Representatives and any additional parties affected by work of this section. District IT's Information Technology must be represented at a preconference meeting prior to scheduling of any work.
4. Copy of Leviton warranty application will be provided by Contractor.
5. Pre-Installation conference may be waived only by District IT.

#### B. WARRANTY

1. A lifetime performance warranty covering all components, equipment and workmanship shall be submitted in writing with system documentation. The warranty period shall begin on the system's first use by the District IT.
2. The project must be pre-registered with Leviton by the installation contractor before installation has begun, and shall be concluded by contractor with uploading of test results to Leviton and a full project closeout. Warranty paperwork will be delivered directly from Leviton to the District IT.
3. Should the cabling system fail to perform within its expected operation within this warranty period due to inferior or faulty material and/or workmanship, the Contractor shall promptly make all required corrections without cost to District IT.

#### C. DRAWINGS AND SPECIFICATIONS

1. The Contract drawings and specifications form an integral part of the contract documents. Neither the drawings nor the specifications shall be used alone. Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirements on drawings, or specifications shall not relieve the Contractor of his or her responsibility of properly completing the Contract.
2. The District IT's Project Manager has the option of changing the location of Electrical and Communication outlets to within 3 meters of designed location prior to rough-in stage at no extra cost to District IT. District IT and District IT's Representative requests a chalk/rough-in walk prior to installation to verify locations.
3. The Contractor is responsible to take field measurements where equipment and material dimensions are dependent upon building dimensions and to coordinate and provide a chalk/rough-in walk prior to installation to verify locations.
4. The Contractor shall coordinate with General, Mechanical and Electrical trades as well as Furniture Layout Designer for final workstation outlet locations.
5. Where conflict exists between drawings and specifications the Contractor shall, make allowance for provision of the component, system, or installation process in a manner which will provide the highest monetary cost components, systems, or installation process. Contractor shall inform the District IT's Project Managers of the conflict and obtain approvals prior taking corrective measures.



D. DISTRICT IT REQUIREMENTS AND STANDARDS

1. Two (2) CAT6 UTP cables and jacks shall be installed in all standard work area outlet locations on a 2-port ivory flush mounted faceplate, including employee offices, utility services, and other common telecommunications locations.
2. One (1) CAT6 UTP cable and jack shall be installed in all student station locations.
3. One (1) CAT6 UTP cable and jack shall be installed for every 20 student locations, for the use of a printer.
4. Two (2) CAT6A UTP cables and jacks shall be installed at all Wireless Access Point locations.
5. One (1) CAT6 UTP cable for each security camera location.
6. AV / Multimedia locations require CAT6 shielded cables and jacks, but may require fewer or more cables. Refer to drawings or contractor instructions for specific details.
7. Wallphone outlet locations require a single CAT6 cable and jack on a stainless steel studded wallplate. Other locations may require more cables and jack outlets. Refer to drawings for specific details.
8. Data and voice jacks shall be universally interoperable, and Ivory in color. All termination wiring shall be T568B.

	Cable	Jack	IDF cord	Workstation Area cord
<b>CAT6</b>	Blue	Ivory	Blue	Gray
<b>CAT6 Shielded</b>	White	Blue	Blue	White
<b>CAT6A</b>	Yellow	Yellow	Blue	Yellow

9. A minimum of 1 spare 4" inch fire rated pathway device must be present in each IDF. When spare device reaches 50% capacity, a new device must be installed. Sleeves for penetration of walls and floors shall be fire-stopped as per code. Contractor is to provide additional sleeves if the rooms do not meet or exceed minimum requirements.
10. The building shall have at least a 25pr copper feed from the city (or campus). The MPOE shall all copper feeds into the building terminated on a lightning protector block (with 110 punches for termination). If the MPOE is not a separate room from the MDF, then there shall be a CAT 5e 25pr cable fed directly from the protector block into the CPI cabinet and terminated on a 24 port RJ45 style patch panel, with one pair per port and the last pair unterminated (spare).
11. If there is an IDF in addition to the MDF, there shall be a CAT 5e 25pr cable ran between them. It shall be terminated in the CPI cabinet on a 24 port RJ45 style patch panel at each end, with one pair per port and the last pair unterminated (spare).



12. If the MPOE is separate from the MDF, the fiber shall be extended to the MDF and terminated in the CPI cabinet.
13. If there is an IDF in addition to the MDF, then there shall be a 12 strand single mode fiber ran between them. It shall be terminated in each CPI cabinet.
14. DEFINITIONS: MPOE (Minimum Point of Entry); MDF (Main Distribution Frame); IDF (Intermediate Distribution Frame)

#### E. PATHWAYS AND TOPOLOGY

1. Utilize "thin film" lubricants only! It has been shown that cable-pilling lubricants will affect your testing as the cable needs several weeks to dry before attenuation levels recover. Use of incorrect cable lubricants will erode cable jacket and void cable warranty.
2. All cable and wire shall be concealed in conduits, floor ducts, paneling, ceiling or similar areas except at mutually agreed upon areas.
3. Fill capacity in conduit, modular furniture and other horizontal pathways should not exceed 40%. A maximum of 60 % pathway fill is allowed to accommodate unplanned additions after initial installation. The Cat 6A cable is a larger O.D. (0.275" for CAT6A vs. .23" for Cat6). The increased diameter of Cat 6A cable will require appropriate design considerations when sizing conduit and other pathways. In most installations, conduit sizes may need to be increased in order to accommodate all of the cables being installed. This will impact the design and material selection of the project. To calculate the fill ratio, divide the sum of the cross-sectional area of all cables, by the most restricted cross-sectional area of the pathway.
4. Fill ratios for CAT6A cable requires 1" EMT for 4 cables and sized larger for additional cables as required to maintain a 60% fill ratio.
5. Flat-rung and/or solid bottom cable tray shall be utilized for large, high-density installations. J-hooks and other specific cable support hardware shall be used at all locations outside of cable tray.
6. Pathway design should not exceed (2) 90 degree bends between pull points or pull boxes (PB). If more than (2) 90 degree bends are required, install a pull box between bends.
7. Provide NEC-sized pullboxes for any run greater than 100 feet, or with more than two ninety-degree bends.
8. J-hooks should be randomly spaced 60" or less. Do not exceed J-hook capacity for size and weight limitations. Use J-hooks in all areas to keep cable supported away from ceiling, ductwork and other above-ceiling equipment.
9. Land wireless access cabling above ceiling, secured onto in-ceiling bracket. A slack loop in the horizontal cabling is not required. Utilize varying-length patch cords when installing wireless access point devices for flexibility in length.
10. Crimp-on plugs at wireless access points are not allowed. Terminate all WAP cabling onto jacks and ceiling-mount brackets and test all cables as appropriate.



11. Mixing of various Category cables in the same pathway is allowed as long as the applications are appropriate for each category of cable used.
12. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.
13. Maintain a distance of at least 12 inches from all power conduits and cables, and 6 inches from all fluorescent lighting fixtures. Do not install power feeders 100 amps or greater above or within 5 feet of telecommunications backboard. Do not install telecommunications conduits above power panels or switchboards.
14. The backbone subsystem shall include cable installed in a vertical manner between floor telecommunications room/closets (TCs or IDFs) and the main or intermediate cross-connect in a multi-story building and cable installed horizontally between telecommunications room/closets and the main or intermediate cross-connect in a long single story building.
15. Unless otherwise allowed by the District IT, all fiber cables will be encased in interlocking armor. All fibers will be terminated in the Telecom Rooms or Cabinets in rack-mounted enclosures equipped with sufficient ports to allow for growth, slack storage space and splice trays if required to terminate and secure all fibers.
16. Adequate riser sleeve/slot space shall be available with the ability to ingress the area at a later date in all Telecommunications rooms/closets, such that no drilling of additional sleeves/slots is necessary. Sleeves and firestopping devices will need to be provided and installed under the scope of this Project.
17. The backbone cables shall be installed in a star topology, emanating from the main cross-connect to each telecommunications room/closet. An intermediate cross-connect may be present between the main cross-connect and the horizontal cross-connect.
18. For voice or data applications, 4 pair UTP or fiber optic cables shall be run using a star topology from the telecommunications room/closet serving that floor to every individual information outlet.
19. Backbone and Horizontal pathways shall be installed or selected such that the minimum bend radius is maintained both during and after installation.
20. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
21. Install  $\frac{3}{4}$ " x 4' x 8' fire-rated plywood across two walls in telecom rooms, from 6" AFF to 8'-6" AFF. Coat with 2 coats of white paint. Do not paint over fire rating stamp.
22. Contractor shall firestop all used pathways which enter or leave the telecom rooms via conduit, cable tray or slot. Contractor is responsible for installing sleeves at each wall or partition penetration, and firestopping all fire-rated penetrations. Appropriate fill ratios must be followed when penetrating fire-rated



walls. Intumescent caulk shall be applied around the outside of each sleeve, and intumescent putty inside the sleeve or conduits around the cables for existing sleeve penetrations. Firestop pathway devices will be used for all new penetrations except as allowed by District.

23. Do not run fiber cables in conduits which are less than 2" in diameter.
24. Abandoned cable shall be removed from pathways (i.e., from tunnels, manholes, plenum spaces, and conduit) under scope of this project. Previously unknown or unidentified cable which is apparently abandoned prior to work shall be brought to the attention of the District IT for authorization prior to removal.

#### F. GROUNDING:

1. Refer to section 27 05 26 for specifications on Grounding and Bonding.
2. All grounding (earthing) and bonding shall be done to applicable codes, standards and regulations.
3. All shielded and armored cables shall be bonded to a telecom grounding system via shielded patch panels at the rack locations and/or connections to the Telecommunications Grounding Busbar. Shielded Category-rated connectors must be properly installed to maintain electrical ground conductivity along entire length of cable and at both ends of the cable. UTP connectors shall not be used on shielded cables at either end.
4. Shielded Patch cords shall be provided for use and employed at each outlet utilizing shielded cable. Shielded patch cords can be identified by their white color and metallic RJ45 plug. Shielded patch cords are required at the patch panels.
5. Telecom Contractor shall bond and ground all telecom room metals. Telecom Contractor shall provide and install TIA-rated Telecommunications Grounding Busbar (TGB) at all MDF and IDF locations, and an in-cabinet grounding busbar at each remote wall-mounted cabinet or telecom enclosure. All ground lugs shall be 2-hole make-up.
6. Electrician will provide connection between TGB and building ground; Telecom contractor (if separate, otherwise electrician) will provide a busbar and ground all equipment and telecom metals to the busbar.
7. Telecom installer will ground and bond all armored and/or shielded cables, racks, cabinets, cable tray, ladder racking, and shielded panels to telecom grounding busbar.

#### G. CABLES AND TERMINATIONS:

1. Check plans and symbology for final determination of faceplate constitution or consult with District IT prior to bid.
2. Install cables at drop locations and in quantities indicated on the drawings. Do not exceed manufacturers' recommendations for maximum allowable pulling tension, side wall pressure or minimum bending radius. Use pulling compound



as recommended by cabling manufacturer.

3. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.
4. The combined length of jumpers, or patch cords and equipment cables in the telecommunications room/closet and the work area shall not exceed 10m (33 ft).
5. The Contractor shall observe the bending radius and pulling strength requirements of the 4 pair UTP and fiber optic cable during handling and installation.
6. No run of UTP cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall contain splices.
7. In a false ceiling environment, a minimum of 3 inches (75 mm) shall be observed between the cable supports and the false ceiling. Minimum 6" is preferred.
8. J-hooks shall be provided for all suspended cable, at a semi-irregular spacing not to exceed 5 feet between supports. Cables shall be supported by dedicated low-voltage cable support hardware. Support of cables or hanging hardware by means of supports or surfaces related to other trades or applications is not allowed.
9. Provide a full-size service loop (at least once around the inside edge of the box) in each J-box in the communications system.
10. Install all cable in plenum spaces with J-hooks of at least 1" in width to disperse the weight on the bottom cables. Homerun all cable to nearest TR Cabinet.
11. Comply with ANSI/TIA-569 for conduit and splice box sizing.
12. Install modular jacks at all outlets shown; one data jack for each data cable at each faceplate or termination point. Install cables and modular jacks as indicated on the drawings. Do not "split pairs" between different jacks.
13. Terminate cables at each jack location and at termination board or patch panel. Follow industry guidelines and manufacturers' recommendations and procedures as required. All termination hardware shall be rated to exceed their associated Category rating as specified above.
14. For enclosed ceiling WAP locations, install and terminate CAT6A cables to approximate location as shown on plans. For open-ceiling environments, secure cables and surface-mount boxes to nearest appropriate support structure.
15. For in-ceiling WAP locations, secure jacks inside a surface-mount block mounted to in-ceiling metal assembly, and provide a 5' patch cord or longer, as needed, to connect device to its final determined location in ceiling.
16. For wall-mounted device locations, utilize an in-wall bracket in lieu of faceplate as described above. Secure mounting bracket and device hardware directly over backbox. Connect device with 1' CAT6A cord (WAP), or 1' high-flex CAT6 patch cord for other CAT6-based devices. Coil patch cord inside backbox.





17. Label and identify each outlet and cable for data circuits. Label at outlet end and at termination board or patch panel with matching designations.
18. Provide data outlets in surface raceway at 26" on center unless otherwise indicated.
19. Extreme care must be taken not to nick any of the copper conductors when removing jacket. Use rip cord to expose pairs for termination onto Insulation Displacement Contacts. You can also use a precision stripper that allows the technician to set the depth of the blade.
20. Maintain twists as close as possible to the point of termination. Untwisting of copper pairs should not exceed  $\frac{1}{4}$ " to the termination point.
21. Manage the cable bundles in a symmetrical orientation. For example, in a 48-port patch panel, distribute 24 cables through the vertical cable management on the left rear side of the rack and 24 cables through the vertical cable management on the right rear side of the rack.
22. Do not dress cables in bundles larger than 24 cables. Multiple 24-cable bundles may be run in parallel with evenly-spaced Velcro cable ties in an orderly sequence.
23. For cable management on rear of patch panel, cable shall sweep into termination points and be supported by appropriate rear cable management.
24. Horizontal patch cord management is required on all installations which do not use angled patch panels.
25. Maintain cable bend radius 4X outer diameter (UTP only) when mounting faceplate onto EMT backbox, box-eliminators or furniture knock-outs.
26. Faceplates and SMBs shall be fully installed and labeled prior to testing.

#### H. ABOVE CEILING & WALL MOUNTED WIRELESS ACCESS POINTS & DEVICES

1. All building projects must include installation of wireless access points to cover the interior & exterior of the building (location/heat maps will be supplied by the district).
2. All WAP locations shall receive (2) Category 6A cables from the nearest TE or TR (IDF). Multimedia, security and other video devices shall receive CAT6A cables as shown on drawings, documents and details.
3. Clock/Speakers and other low-bandwidth mounted devices shall receive (1) CAT6 cable.
4. WAP, IP Camera and other communications cables shall terminate on patch panels in the TE/TR (IDF).
5. WAP cables shall terminate on Category 6A information outlets and shall be supported by an in-ceiling termination bracket. Affixing of a 2-port SMB to the bracket is recommended.
6. Surface Mount Block (SMB), jacks, and patch cords used in plenum spaces shall



be plenum-rated.

7. SMB shall be mounted in the ceiling on a specially-designed clip attached to a cable support ceiling wire or threaded rod support per cable management section in Part 2. SMB shall not be tie wrapped to supports, or left on ceiling tiles or other equipment located above the ceiling.
8. Wall-mounted devices not requiring faceplates will be mounted directly to the backbox. Jacks will be secured inside backbox on a specially-designed in-wall bracket clip per cable management section in Part 2.
9. Contractor shall mount Access Point (AP) electronics to the drop-ceiling suspended T-grid system. (AP and mounting hardware provided by District IT). Contractor to provide and install (2) white Cat 6A patch cords (shielded or unshielded, as required to match cable system) from the overhead WAP outlets to the AP. Contractor shall neatly cut holes into the ceiling tile and finish the holes with grommets or other industry-standard finishing piece for a professional look. The District will address all other non-standard installations (wall mount, hard ceiling, etc).

#### I. FURNITURE CABLING

1. The contractor will pull all voice and data cables in advance of the installation of the modular furniture workstations, and coil at basefeed or above ceiling for power pole feeds. Upon furniture arrival, the contractor will feed the cables through power poles or base feed/wall connected data/telecom conduit, and terminate as specified on the floor plans.
2. Contractor to coordinate with Owner's furniture vendor for timing of the installation of systems furniture, and installation of electrical and voice/data cabling. Overtime may be required for this and other phases of the project work, and bids, plans and schedules must reflect actual work demands. Contractor shall consider all costs in their bids for installation.

#### J. TERMINAL BLOCKS AND PATCH PANELS:

1. Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.
2. Dress and comb all incoming cable bundles in groups of 24 cables each. Eliminate crossed cables and "divers".
3. Ground all shielded patch panels to telecom ground source via paint-piercing washers to a grounded rack, or via direct ground wire to telecom bus bar.

#### K. DATA AND TELCO ROOMS

1. The Data and Telco Rooms are a transition point between the backbone and horizontal distribution pathways. The rooms shall be able to contain data or telecommunications' equipment, cable terminations and associated cross-connection wiring. Closet spaces are not to be shared with electrical installations, other than those directly for telecommunications, video, security and



information systems equipment. The rooms are not to be shared with other unrelated building service, for example plumbing, EMS, or FACP. Any conflicts with these specifications require the approval of the District IT's project manager.

2. Contractor shall submit a drawing of the IDF room showing layout of all components including necessary and required electrical outlets, conduits, environmental requirements and wire termination fields prior to start of the job. Any jack densities noted in these specifications are estimates only. The drawing will designate the most effective, scalable, jack termination cabling design to facilitate data/telecom outlets shown on the lease exhibits. District IT's Project Managers must approve drawings prior to installation.
3. All racks, panels, and equipment finished shall be anchored to meet local seismic zone requirements and industry standards. The equipment racks are to be anchored to the concrete floors via "Unistrut or equal metal framing strut systems", threaded rod, concrete anchors, and/or concrete bolts washers.
4. The overhead cable ladder system will provide a route for the Category 6 and 6A, and other communication cables while providing stability to the equipment racks.
5. The vendor is responsible to provide and install the specified count of 19" EIA racks, Black, as required in the new IDFs or as expansion requirements dictate in existing telecom rooms. The vendor is responsible for submitting IDF layout drawings to District IT for approval prior to installation.
6. The contractor shall provide high capacity horizontal and vertical cable manager channels are required in all data and equipment racks, and the racks will contain sufficient vertical and horizontal cable managers to facilitate the patch panel density and placement installed by the contractor.
7. Contractor will install raceways, boxes, managers, and enclosures as indicated according to manufacturer's written instructions. Securely fasten each component to the surface to which it is mounted and remove burrs and sharp edges from all cable tray.
8. A minimum 12" ladder rack system is required and will be provided by the contractor and installed in the IDF to provide cable support to the rack system. This includes all of the required ladder rack support items such as rack to runway kits, wall angle brackets, ceiling supports, splices (junction and butt), radius drops and j-bolts. The final ladder rack layout will be included in the IDF layout drawing described above.
9. Provide and install as needed in the IDF room 4' x 8" x 3/4" fire-rated plywood board and labeled with fire rating stamp facing into the room to accommodate rack ladder support, cabling support, grounding platform, data and voice equipment. Paint backboard white (leave stamp visible) to match existing backboard in room, if appropriate. Location of installation is to be determined with approval by District IT.
10. The CPI rack layout shall be as follows: LIU shall be mounted at the top of the rack, which shall be followed by CAT 6 UTP with 2U wire management between each 48 port patch panel. CAT 6A shielded/unshielded cables shall be terminated next, also with 2U wire management between each patch panel. And



finally, a 25 pair CAT 5e cable shall be terminated on a 24 port patch panel with a 1U wire management between the last CAT 6 or CAT 6A patch panel.

#### L. PATCH CORDS:

1. Contractor to provide fiber and copper patch cords in quantities as described below. Neatly install patch cords at WAP locations in lengths as appropriate, and provide all other patch cords to district in original packaging.
2. Provide all remaining patch cords, and those as below, to District IT in original packaging.
3. Use the following guidelines for project bid. Verify all lengths with District IT prior to purchase:
  - a. One (1) Blue CAT6 High-Flex patch cord per installed CAT6 UTP and Shielded jack in the Telecom room. Quantities and lengths to be determined by District IT.
  - b. One (1) Gray CAT6 10-foot patch cord per installed CAT6 UTP cable for use at workstation outlet.
  - c. One (1) White CAT6 Shielded patch cord per installed cable, average length 5'.
  - d. One (1) 7-foot patch cord per installed cable, Gray color (Data Workstation Use)
  - e. One (1) 2-meter patch cord and one (1) 3-meter patch cord shall be supplied per installed duplex LC connector pair (one for either end).
4. All fiber patch cords and required workstation/equipment patch cords not installed shall be provided in hand to District IT's Representative prior to project closeout.

#### M. LABELING

1. Provide machine-generated labels appropriate for all components supplied and installed. Under no circumstances shall hand written labels be used as a final product.
2. The labeling scheme shall not include duplicates of existing cable identification.
3. Labeling procedure will meet TIA-568, TIA-606 (Class 2 Administration) and BICSI Standards.
4. The labeling scheme will be provided as follows at all locations within the cable infrastructure:
5. Labeling will be as follows:
  - a. Labeling standard is Room# - drop# (i.e. 128-10). Drop number starting in left corner of room beginning at main door, and moving clockwise around room. Drop numbers are sequential from room to room (i.e. 128-20, 129-21, etc.) and do not restart within the same floor or building.



- b. Cable numbering to be determined by sequence: floor, closet #, drop number. Two drop locations to be labeled 1/2 and three plus drop locations to be labeled 1-3. Example: 1st floor closet # 1 would read: 1.1.1/2 or 1.1.1-3.

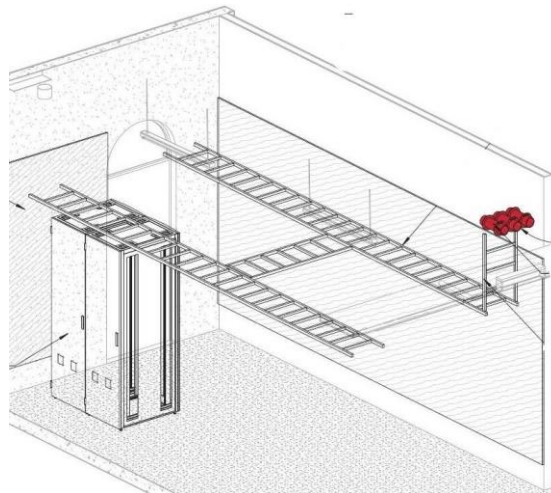
### 3.5 VERIFICATION OF IDF ENVIRONMENT

- A. All inspections which expose existing conditions not meeting District IT standards as described must be reported to the District IT prior to installation. District IT may require additional work to bring existing site conditions up to Standard. Areas to explore shall include, but not be limited, to the following items:
  1. Minimum size of the IDF is to be 8' x 9'.
  2. Minimum size of the MDF is to be 10' x 13' and shall not be co-located with electrical equipment due to EMI-mechanical noise transmitted from the electrical equipment.
  3. IDF should have a hard ceiling for security purposes.
  4. Room must be well lit. Lighting fixtures shall be coordinated with any horizontal cable tray or other ceiling mounted equipment.
  5. No equipment other than that related to the voice/data network should be located in the IDF's/MDF's. This includes but not limited to FACP, lighting control equipment, electrical panels, EMS, etc.
  6. It is recommended to recess any existing or new fire sprinklers in the IDF to prevent accidental damage and associated risks.
  7. In the IDF room, a minimum of **two (2) 30amp dedicated electrical outlets with L5-R30 receptacles** to be installed @ top of rack height inside cabinet.
  8. Duplex convenience outlets shall be installed throughout the IDF and connected to a dedicated circuit breaker. Each dedicated electrical circuit shall be 20-amp, 110V, 60 HZ type. All outlets shall be labeled with panel and circuit information and shall be spaced every 6' at 18" AFF.
  9. All existing racks, cable tray and metal structures shall be appropriately anchored and bonded to telecom ground and in sufficient size, quantity and configuration according to District IT Standards.
  10. During installation, any penetration of fire wall shall be sealed with approved firestop material by the end of each working day; that is, fire walls shall not be left with a vulnerable point overnight.
  11. Some form of standalone air conditioning must be provided to adequately cool the space when fully equipped. Cooling capacity shall be calculated taking into account all equipment planned for the room. Rooms should not be on building Air system.
  12. There should be 3' of clear space on all 4 sides of the 2' x 3.25' cabinet. If necessary for placement of an additional cabinet or future placement of an

additional cabinet this requirement can be modified to 3' of clear space in the front, rear and one side of the cabinet.

13. Lock to IDF/MDF must be uniquely keyed and only Technology Services & Support staff is to be issued keys. In cases where an IDF is shared with Maintenance & Operation (M&O), only essential M&O staff is to have keys to the IDF/MDF (i.e. Engineers, Director, and Assistant Director). Before issuing a key to anyone for any IDF/MDF the Chief Technology Officer must be consulted.
14. Where possible, doors to the IDF/MDF should not have windows or signage other than room numbers (for security purposes). If IDF/MDF doors must have windows, windows are to be blacked out.
15. A phone is to be located on one wall of the IDF/MDF room, typically on the door wall.

#### B. Typical IDF Room Layout



### 3.6 TESTING

#### A. COPPER TESTING

1. Test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of attenuation and NEXT across all splices and devices installed in the field and shall meet latest requirements of EIA/TIA. Re-terminate any cable or connection found to be defective.
2. Tester is to be a Level IIIe device or better, and configured with the specific cable installed, and the Permanent Link test will be performed according to the Category's standard methodology. All parameters must exhibit a PASS test result



prior to project completion. PASS\*, FAIL\* or FAIL test results will not be accepted.

3. Only a permanent link test for Category 6A will be required. If situations demand a "hybrid", "Mixed" or a standard "Channel" design, approval must be obtained for those specific circumstances prior to testing.

#### B. FIBER OPTIC TESTING

1. Each pre-terminated fiber strand shall be tested for continuity and attenuation with an Optical Power Meter and light source for actual length and splice/connector loss. Each field-terminated fiber strand (if any) shall be tested for attenuation with an Optical Power Meter and light source and with an Optical Time Domain Reflectometer (OTDR) for actual length and splice/connector loss.
2. Cable length shall be verified using sheath markings. The guidelines and procedures established for Tier 1 testing in TIA/TSB-140 shall apply.
3. All fiber optic cables shall be tested from the site's MDF to each fiber terminals located in the IDF.
4. The Contractor shall conduct a power meter (loss) test of each fiber optic station and riser cable at both wavelengths, 850/1300nm for MM and 1310/1550nm for SM, A to B, B to A, and OSPL (OSPL is defined as  $L_a + L_b$ ). The results of OTDR testing to define the length of each riser cable shall be documented.
5. No individual station or riser fiber link segment (including connectors) shall measure more than 2.0 dB loss for LC, and 1.5dB loss for MTP. LC links shall be tested with LC jumpers from the LC cassette to the tester. MTP links shall be tested either with an MTP tester and array cord, or with an MTP-LC breakout harness and LC duplex fiber tester.
6. Tests shall be conducted using ANSI/TIA-526-14A, Method B. Test results evaluation for the panel to panel (backbone) shall be based on the values set forth in ANSI/TIA-568.
7. The Contractor shall provide an electronic printout for each strand tested with the Power Meter and the OTDR.
8. Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between the District IT and the Contractor prior to the start of the test.
9. All installed cables must meet or exceed the defined standards for performance. The Contractor shall take all steps and all expense necessary to clean, repair or replace any link not meeting the standard.

#### C. TEST RESULTS

1. Repair and resolve any shortcomings in the test results. Mitigation efforts may



require re-termination or replacement of the jack, outlet or cable. Repairs or attempts to resolve test failures will be completed solely at the expense of the Contractor.

2. Provide test results to Manufacturer and District IT representative in PDF and native Tester format. Upon request, provide a copy of the tester software and license, if needed, at no charge to District IT representative.
3. Include PDF of full test results, summary index in electronic format on CD or memory stick in the O&M package upon project completion.
4. Cabling systems shall meet or exceed the electrical and transmission characteristics of the systems specified and their associated guarantees. Clean, re-terminate or replace any connector or cable as needed until a full PASS result is obtained.
5. Cable segments and links shall be tested from both ends of the cable for each of the construction phases. (Verify that cable labeling matches at both ends).
6. The system shall not be considered certified until the tester has acknowledged that the performance of the physical layer of the system has been fully tested and is operational at the completion of the installation phase.
7. After the installation is complete, in addition to any other required testing as described herein, and at such times as the District IT/Engineer directs, the Contractor shall be present while the District IT conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.
8. After review of the completed test results, the District IT reserves the right to retest cables, utilizing the Contractor's tester and the Contractor's labor.
9. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The tester shall be capable of storing test data in either internal or external memory. The external media used shall be left to the discretion of the user.
10. Test results saved by the tester shall be transferred into a Windows based database utility that allows for maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered as well as any printed reports generated from the software application.
11. Test results shall be provided in both native Tester format as well as comma separated variable (.csv), Portable Document File (.pdf), plain text (.txt), or hypertext markup language (.html/.htm). A copy of the tester native test software must be provided to District IT or District IT's representative for comparison of results.
12. Test Results for CAT6 shall include the following:
  - a. Applicable room number of jack location (room number per Contract Documents)





- b. Applicable Telecommunications Room number
  - c. Circuit I.D. number with corresponding jack identifier
  - d. Wire Map – shall include the following:
    - i. Continuity to the remote end
    - ii. Shorts between any two or more conductors
    - iii. Crossed pairs
    - iv. Reversed pairs
    - v. Split pairs
    - vi. Any other mis-wiring
  - e. Length
  - f. Insertion Loss
  - g. Near-end Crosstalk (NEXT) Loss
  - h. PS-NEXT (Power Sum Near End Cross Talk)
  - i. FEXT (Far End Crosstalk)
  - j. ELFEXT (Equal Level Far End Cross Talk)
  - k. PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)
  - l. Propagation Delay
  - m. Delay Skew
  - n. Return loss
  - o. PSFEXT (Power Sum Far End Crosstalk)
  - p. PSACRF (Power Sum Attenuation to Crosstalk Ratio, Far End)
13. Test Results for CAT6A shall include all of the above, plus the following:
- a. AACRF (Alien Attenuation to Crosstalk Ratio, Far End)
  - b. AFEXT (Alien Far End Crosstalk)
  - c. ANEXT (Alien Near End Crosstalk)
  - d. PSANEXT (Power Sum Alien Near End Crosstalk)
  - e. PSAACRF (Power Sum Alien Attenuation to Crosstalk Ratio, Far End)

Approved Tester Products:

Softing WireXpert 4500  
Fluke DTX or VERSIV platform Cable Certification testers

**3.7 PROJECT CLOSEOUT**

- A. Operating and maintenance manuals shall be submitted prior to testing of the system. A total of (4) manuals shall be delivered to the District IT. Manuals shall include all service, installation, and programming information.
- B. Provide a full set of “as-built” (redline) drawings in AutoCAD DWG and PDF format. Drawings to depict final location and drop/cable identification numbers and labels which match the test reports. Include (1) hard copy paper format of all as-builts in 30”x42” size or equivalent, posted in each telecom room involved in the project.
- C. Contractor to provide all warranty information to Leviton for processing. Leviton will send warranty document direct to District IT.



**3.8 TRAINING**

- A. Provide four (4) hours training on the operation and installation of the data system, at job site, at no cost to District IT, if requested/needed.