

## **27 2000 VOICE DATA COMMUNICATIONS**

### **PART 1 GENERAL**

#### **1.1 SYSTEM DESCRIPTION**

- A. The owner will implement a comprehensive integrated communications distribution system, to provide wiring infrastructure which may be used to support the following services and systems:
  - 1. Data telecommunications
  - 2. Wireless systems
- B. The communications distribution system consists of the following major subsystems, as specified elsewhere:
  - 1. Campus Backbone: The campus backbone refers to all twisted-pair and fiber optic backbone communications cabling connecting the main building entrance facility room to each Main Distribution Frame room (MDF) in all buildings on the campus.
  - 2. Building Backbone: Building backbone refers to all twisted-pair and fiber optic backbone communications cabling connecting the Main Distribution Frame room (MDF) to each Intermediate Distribution Frame Room (IDF) in the buildings.
  - 3. Telecommunication Rooms (TR): Telecommunication Room is a general term referring to any Main Distribution Frame (MDF) room or Intermediate Distribution Frame (IDF) room.
  - 4. Horizontal Distribution: The horizontal distribution subsystem refers to all intra-building twisted-pair and fiber optic communications cabling connecting telecommunication rooms (TRs) to telecommunication outlets (TOs) located at individual work areas.
  - 5. Work Area Distribution Subsystem: Patch cords, adapters, and devices located between the TO and station equipment.

#### **1.2 DESIGN REQUIREMENTS**

- A. The following are incorporated into the design:
  - 1. Minimum communication room size for MDF room shall be no less than 14' x 12'.
  - 2. Minimum communication room size for an IDF room shall be no less than 10' x 12'.
  - 3. All pathways, conduits, cable trays, slots and sleeves shall have no less than 50% future fill capacity when project is completed.
  - 4. All pathways, conduits, cable trays, slots and sleeves shall not have other cabling (fire alarm, Audio Visual, security etc.) routed within or attached to them.
  - 5. The location of communication rooms is intended to restrict the maximum horizontal subsystem wiring length, which is defined as a channel between a telecommunications room cross-connect termination field and a served telecommunications outlet, to 295 feet.
  - 6. All communication rooms shall have cooling calculated at 4 Kw of power consumption for each open frame communications rack. 8 Kw of power for each Communication cabinet.
  - 7. It is the intent of this Standard to ensure security of communication rooms and sensitive information. Electrical panels, fire alarm panels, and security systems are not to be incorporated into communication room space, racks, cabinets or wall.
  - 8. Products shall be UL and CSA listed.

B. Sizing for racks and equipment:

1. One rack per room reserved for backbone terminations, backbone equipment, and battery systems.
2. Additional racks are part of the Horizontal cabling system; no more than six 48-port patch panels may populate a single rack. In certain circumstances, if needed, Owner may override this requirement.

C. Power requirements in MDF and IDF locations:

1. Two, 110v, 20A circuits for IT equipment per group of 5 racks each with at least 4 outlets placed no further than 12 feet from the furthest rack in the group of 5. Wall boxes placed at 48-inches from floor on the backboard. Wall boxes that power the racks must be about 12 inches behind the center of the row of racks on the backboard closest to the racks.
2. If the rack system is greater than 10-feet wide (5 racks or more), then power needs to be engineered differently.
3. 1 circuit for utility power - one 2-outlet box on each wall without a backboard placed at normal level for utility power.

D. Grounding:

1. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 Telecommunications Bonding and Grounding Standard.
2. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the TR or ER shall be grounded to the respective TGB or TMGB using a minimum #6 AWG green stranded copper bonding conductor and compression connectors.
3. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and busbars shall be identified and labeled in accordance with the System Documentation Section of this specification.

### 1.3 CONSTRUCTION SUBMITTALS

A. Specifications shall require the contractor to provide the following submittals prior to beginning construction:

1. Telecommunication Room layout, Telecommunication Room wall elevations, equipment rack elevations, cable routing, cable connecting diagrams, termination pin outs, supporting hardware details, block diagrams, riser diagrams, and cable pathways. Work may not begin until shop drawings are approved by Owner.

### 1.4 PROJECT RECORD DOCUMENTS

A. Provide detailed project record documentation.

1. Maintain separate sets of red-lined record drawings for the communications work which show the exact placement and identification of as-built system components.

2. Provide communication pathway record drawings which indicate exact placement and routing for all components, e.g., maintenance holes, hand holes, conduit, wireway, cable tray, pull boxes, enclosures, telecommunications outlet boxes, etc.
3. Provide communication room record drawings which indicate exact placement for all components; e.g., conduit, wireway, cable tray, backboards, equipment cabinets, equipment racks, cross-connect equipment, etc.
4. Provide communication wiring and cabling record "As-Built" drawings and schedules which indicate exact placement, routing, and connection details for all components, e.g., twisted-pair and fiber optic cables, splices, cable cross-connect termination locations, enclosures, telecommunications outlets, cross-connect jumpers, patch cords, etc.
5. Provide network schematics where appropriate.

## PART 2 PRODUCTS

### 2.1 TELECOMMUNICATIONS BACKBOARDS

- A. 3/4-inch minimum thickness, A/C grade or better, void-free plywood, fire treated backboard.

### 2.2 FREE STANDING EQUIPMENT RACKS

- A. 7-foot high, 19-inches wide, EIA free-standing rack, UL listed, black finish. Chatsworth 48353-703, B-Line SB556084XUFB, and Hoffman EDR19FM45U.

### 2.3 WALL MOUNT EQUIPMENT RACKS

- A. 38-1/2-inches high, 24-inches deep, 19-inches wide, swing gate, UL listed, black. B-Line SB708194425.
- B. 24" D X 41.2" H X 23" W, fixed wall-mount rack, UL listed, black finish, 20U equipment space. Chatsworth 15320-724, B-Line SB704193924FB

### 2.4 WALL MOUNT CABINETS

- A. 24-inches high, 24-inches deep, 24-inches wide, wall mounted cabinet with solid hinged door. Chatsworth 11840-724, B-Line VWM242424, Hoffman EMMW 242425.
- B. 8.63" D X 29" H X 27" W, wall-mount "knobs up" rack/cabinet, UL listed, black finish, 4U equipment space. Middle Atlantic WRS-4
- C. 12.13" D X 29" H X 27" W, wall-mount "knobs up" rack/cabinet, UL listed, black finish, 6U equipment space. Middle Atlantic WRS-6
- D. 15.63" D X 29" H X 27" W, wall-mount "knobs up" rack/cabinet, UL listed, black finish, 8U equipment space. Middle Atlantic WRS-8

### 2.5 FREE STANDING CABINETS

- A. 42U, 48-inches deep, 30-inches wide, free standing cabinet with hinged door. APC AR3350 rack, (4) APC AR8469 per rack, (.5) AR8452 per rack.
- B. 42U, 48-inches deep, 24-inches wide, free standing cabinet with hinged door. APC AR3300.

### 2.6 VERTICAL WIRE MANAGERS

- A. 7-feet high, 6-inches wide, 20-inches deep, double-sided with front doors and rear cable rings; and horizontal managers built in, black finish. Chatsworth 35571-703.

- B. 7-feet high, 6-inches wide, 24-inches deep, double-sided with front and rear doors; and horizontal managers built in, black finish. Chatsworth 35521-703.
- C. 7-feet high, 6-inches wide, 13-inches deep, single-sided with front doors; and horizontal managers built in, black finish. Chatsworth 35511-703.

## 2.7 HORIZONTAL WIRE MANAGERS

- A. 19-inches wide, two rack units high. NeatPatch NP2, Chatsworth 35441-702.
- B. 19-inches wide, one rack unit high. Chatsworth 35441-701.

## 2.8 POWER SUPPLIES

### A. Equipment required in each TR:

1. Two horizontal rack-mount PDUs per rack:
  - a. Description: APC Rack PDU, Basic, 1U, 15A, 120V
  - b. Specifications: 15A Rack 1U PDU 120V, 10-outlets
  - c. Model: AP9562
2. One UPS per IT equipment circuit:
  - a. Description: APC Smart-UPS 1500 LCD
  - b. Specifications: UPS, Rack-mountable, 1500 VA power capacity, 7.2 min battery run time (up to), 1 kW power provided, 120 V, 3 year warranty
  - c. Model: SMT1500RM2U
3. One 2-post Mounting Kit per UPS
  - a. Description: APC Rack Mounting Kit
  - b. Model: AP9625
4. One Management Card per UPS
  - a. Description: APC Network Management Card 2 with Environmental Monitoring - remote manage
  - b. Specifications: Remote management adapter - 10Mb LAN, 100Mb LAN - 10Base-T, 100Base-TX - for Smart-UPS 1000 LCD, 1500 LCD, 2200 LCD, 3000 LCD, 750 LCD; Smart-UPS X
  - c. Model: AP9631

## 2.9 TELECOMMUNICATIONS GROUNDING

- A. Telecommunications Main Grounding Busbar (TMGB): Solid copper bus bar kit, 20-inches long, 1/4-inch thick, wall mounted with standoffs. Chatsworth 40153-020, B-Line SB-476, or approved equivalent.
- B. Telecommunications Grounding Busbar (TGB): Solid copper busbar kit, 10-inches long, 1/4-inch thick, wall-mounted with standoffs. Chatsworth 13622-010, B-Line SB-477, or approved equivalent.
- C. Telecommunications Ground Terminal Block:

1. One-hole ground terminal block, holds two wires up to size #4. Chatsworth 08009-001, approved equivalent.
2. Two-hole ground terminal block, holds two wires up to size 2/0. Chatsworth 40167-001, approved equivalent.

#### 2.10 LADDER RACK CABLE RUNWAY

- A. Cable Runway: 12-inches wide, 10-foot lengths, steel construction. Chatsworth 11275-712, B-Line SB17U12BFB.
- B. Runway Wall Angle Support: Chatsworth 11421-712, B-Line SB211312 FB.
- C. Runway to Rack Mounting Bracket: Chatsworth 10595-712, B-Line SB213312FB.
- D. Cable Runway Junction - Splice Kit: Chatsworth 16302-701, B-Line SB2101AFB.
- E. Cable Runway Butt - Splice Kit: Chatsworth 16301-701, B-Line SB2107FB.
- F. Cable Runway Triangle Support Bracket: Chatsworth 11312-712, B-Line SB213AL12KFB.
- G. Cable Runway Radius Drop: Chatsworth 12100-712, B-Line SB21292FB.
- H. Cable Runway Radius (Stringer): Chatsworth 12101-701, B-Line SB2129SD12FB.
- I. Cable Runway Foot Kit: Chatsworth 11309-701, B-Line SB2106BFB.

## 2.11 BACKBONE CABLING AND TERMINATIONS

### A. Preferred Manufacturers:

1. Corning - fiber optic only
2. Belden
3. Berk-Tek
4. TE Connectivity/AMP
5. Hitachi

### B. Copper Backbone Cable

1. Intra-building Distribution, without overall shield: 100 ohm, CAT 3, 24 AWG, multi-pair cable.
  - a. Riser rated, CMR rated jacket.
  - b. Plenum rated, CMP rated jacket.
2. Intra-building Category 6 UTP: 100 ohm, Category 6, 4-pair unshielded twisted pair.
  - a. Riser rated, CMR rated jacket, color green.
  - b. Plenum rated, CMP rated jacket, color green.

### C. Fiber Optic Backbone Cable

1. Intra-building OM3 Multimode Riser: 24 strand, 50/125, micron, laser optimized distribution cable with maximum attenuation of 3.5dB/km at 850 nm and 1.5dB/km at 1300 nm. Minimum bandwidth is 500MHZ-km at 850 nm and 500MHZ-km at 1300 nm. OFNR rated.
2. Intra-building OM3 Multimode Plenum: 24 strand, 50/125, micron, laser optimized distribution cable with maximum attenuation of 3.5dB/km at 850 nm and 1.5dB/km at 1300 nm. Minimum bandwidth is 500MHZ-km at 850 nm and 500MHZ-km at 1300 nm. OFNP rated.
3. Intra-building Singlemode Riser: 24 strand, 8.3 micron, high performance low water peak distribution cable with maximum attenuation of .35dB/km at 1310 nm and .25dB/km at 1550 nm. OFNR rated.
4. Intra-building Singlemode Plenum: 24 strand, 8.3 micron, high performance low water peak distribution cable with maximum attenuation of .35dB/km at 1310 nm and .25dB/km at 1550 nm. OFNP rated.

### D. Copper Termination Hardware

1. Category 6 Modular Patch Panels:
  - a. 24 port, 8-position modular jack panel, high density, single port modules, Category 6, IDC terminals, T568A/B wiring scheme.
  - b. 48 port, 8-position modular jack panel, high density, single port modules, Category 6, IDC terminals, T568A/B wiring scheme.
2. Category 5e Modular Patch Panels:
  - a. 24 port, 8-position modular jack panel, high density, single port modules, Enhanced Category 5e, IDC terminals, T568A/B wiring scheme.

- b. 48 port, 8-position modular jack panel, high density, single port modules, Enhanced Category 5e, IDC terminals, T568A/B wiring scheme.
- 3. Category 3 Wall-Mount Termination Fields:
  - a. Wall mounted 110-style termination frames with legs.
  - b. Rack mounted 110-style termination frames without legs. Provide associated rack mounting hardware.

#### E. Fiber Optic Termination Hardware

- 1. High Density Fiber Termination Shelf:
  - a. 3.5-inch high shelf designed for mounting in 19-inch equipment racks and capable of accepting 6 adapter panels. The shelf will contain built-in slack management and be accessible from the front and rear with locking doors.
    - 1) 19-inch rack mount, 13-inches deep
    - 2) 19-inch rack mount, 19-inches deep
  - b. Fiber Adapter Panels:
    - 1) Adapter panel for high density termination shelf with 6 duplex (12-strand) LC multimode adapters with ceramic alignment sleeves.
    - 2) Adapter panel for high density termination shelf with 6 duplex (12-strand) LC singlemode adapters with ceramic alignment sleeves.
  - c. Preloaded Fiber Termination Shelf: 1.75-inch-high shelf designed for mounting in 19-inch equipment racks with 12 LC multimode phosphor-bronze alignment sleeves. The shelf will contain built-in slack management and be accessible from the front or rear.
  - d. Provide blank adapter panels to fill in unused slots.
- 2. Multimode LC Connector: Ceramic tip LC style capable of being terminated on 50/125 fiber with 900 micron buffer.
  - a. Singlemode LC Connector: Ceramic tip LC style capable of being terminated on 8.3/125 fiber with 900 micron buffer.

#### F. Copper Patch Cords

- 1. Category 6 modular Patch Cords: Factory terminated double ended, 8-position to 8-position, modular, stranded conductors, Category 6, 4 pair; color, boots and length to be coordinated with Owner.
- 2. Category 5e modular patch cords: Factory terminated double ended, 8-position to 8-position, modular, stranded conductors, Category 5e, 4 pair; color, boots and length to be coordinated with Owner.
- 3. Category 3 Cross-Connect Wire: Single-pair, 24 AWG twisted cross-connect wire. Coordinate color with Owner.

#### G. Fiber Optic Patch Cords

- 1. Multimode 62.5/125 Fiber Optic Jumpers: Factory terminated double ended, two strand multimode cordage with LC, ST, or SC connectors on each end, length and specific end connectors as defined by the Owner.

2. Multimode OM3 50/125 Fiber Optic Jumpers: Factory terminated double ended, two strand multimode cordage with LC connectors on each end, length as defined by the Owner.
3. Singlemode Fiber Optic Jumpers: Factory terminated double ended, two strand singlemode cordage with LC connectors on each end, length as defined by the Owner.

## 2.12 HORIZONTAL CABLING

### A. Preferred Manufacturers:

1. Corning - fiber optic only
2. Belden
3. Berk-Tek
4. TE Connectivity/AMP
5. Hitachi

### B. Station Cabling

1. Category 6 Unshielded Twisted Pair:
  - a. 100 ohm, Category 6, 23 AWG, 4-pair unshielded twisted pair, CMP rated jacket, color blue.
  - b. 100 ohm, Category 6, 24 AWG, 4-pair unshielded twisted pair, CMR rated jacket, color blue.

### C. Modular Jacks/Adapters

1. Category 6 Modular Jacks:
  - a. Eight-position modular jack, Category 6, IDC terminals, T568A/B wiring scheme.
  - b. Each jack must be stamped or have icons to identify it as CAT 6.
  - c. Coordinate color of plates and jacks with building finishes.

### D. Patch Panels

1. Category 6 Modular Patch Panels:
  - a. 24 port, 8-position modular jack panel, high density, single port modules, Category 6, IDC terminals, T568A/B wiring scheme.
  - b. 48 port, 8-position modular jack panel, high density, single port modules, Category 6, IDC terminals, T568A/B wiring scheme.
2. Universal Patch Panels:
  - a. 19-inch rack mounted panel with isolation capable of accepting up to 24 modular jacks.
  - b. 19-inch rack mounted panel capable of accepting up to 24 modular jacks.
  - c. 19-inch rack mounted panel with isolation capable of accepting up to 48 modular jacks.
  - d. 19-inch rack mounted panel capable of accepting up to 48 modular jacks.

### E. Wireless Access Point (WAP) Mounts:

1. Ceiling Mounts



- a. Aruba WAPs:
    - 1) Aruba AP-105 Ceiling Rail Adapter Kit. AP-105-MNT-C
    - 2) Aruba 220 Series Access Point Ceiling Mount Kit (rail adapters – interlude and silhouette styles). Color: black. AP-220-MNT-C2
    - 3) Suspended Ceiling Mount for Aruba Networks AP225. Oberon Wireless 1075-AP225
  - b. Multi-vendor
    - 1) Suspended Ceiling Enclosure for multi-vendor WAP, clear polycarbonate dome. Oberon Wireless 1075-CP
    - 2) Suspended Ceiling Enclosure for multi-vendor WAP, white ABS dome. Oberon Wireless 1075-WA
2. Wall or Box Mounts
- a. Aruba WAPs
    - 1) Aruba AP-105 Wall Mounting Kit. AP-105-MNT
    - 2) Aruba Access Point Flat-surface (wall) Mount Kit (secure box style). Color: white. AP-200-MNT-W2
    - 3) Aruba 220 Series Access Point Flat-surface (wall) Mount Kit (basic). Color: black. AP-220-MNT-W1
    - 4) Aruba 220 Series Access Point Flat-surface (wall) Mount Kit (secure box style). Color: black. AP-220-MNT-W2
    - 5) Aruba Access Point Flat-surface (wall) Mount Kit (secure box style). Color: white. AP-220-MNT-W2W
    - 6) Recess Wall/Ceiling Mount for Aruba Networks AP225. Oberon Wireless 1076-AP225
  - b. Multi-vendor
    - 1) Recess Wall/Ceiling Mount for multi-vendor WAP, clear polycarbonate dome. Oberon Wireless 1076-CP
    - 2) Recess Wall/Ceiling Mount for multi-vendor WAP, white ABS dome. Oberon Wireless 1076-WA

F. Patch Cords/Jumpers

- 1. Category 6 Modular Patch Cords
  - a. Work Area Patch Cords
    - 1) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color grey. 7-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-07G
    - 2) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color grey. 15-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-15G

- 3) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color grey. 20-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-20G
  - 4) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color orange. 1-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-20G (Custom order)
- b. Patch Panel Cords
- 1) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color yellow. 2-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-02Y (Custom order)
  - 2) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color orange. 2-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-02O (Custom order)
  - 3) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color red. 2-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-02R (Custom order)
  - 4) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color orange. 7-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-07O
  - 5) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color red. 7-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-07R
  - 6) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color blue. 7-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-07B
  - 7) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color blue. 15-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-15B
  - 8) Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, Category 6, 4-pair, color blue. 15-foot, with sentinel "Slim-line" snagless boots. Leviton 6D460-15B

## 2.13 ACCESS PANELS

- A. Provide flush mounting access panels for service of systems, equipment and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly. Ceiling access panels to be minimum of 24 x 24 required and approved size. Wall access panels to be minimum of 12 x 12 required and approved size.
1. Ceiling access panels to be minimum of 24-inch by 24-inch required and approved size.
  2. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
  3. Provide screwdriver operated catch.
  4. Drywall: Karp KDW.
  5. Plaster: Karp DSC-214PL.

6. Masonry: Karp DSC-214M.
7. 2 hour rated: Karp KPF-350FR.
8. Manufacturers: Milcor, Elmdor, Acudor, or approved equivalent.

## 2.14 FIRESTOPPING

- A. All Penetrations through fire-rated building structures (walls and floors) shall be sealed with an approved fire stop system approved by the local fire code. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire-rated structure). Any penetration item, such as riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. All equipment is to be installed in conformance to manufacturers' recommendations and installation instructions.
- B. Multi-pair copper cable shall be category 3, Pic-Filled, Black-jacketed cable with overall sheath. PE-89. Approved manufacturers are General, Essex, and Commscope.
- C. Equipment Rooms:
  1. Make floor penetrations no more than 4-inches from wall. Install conduit stubs to extend 4-inches from floor base. Cap conduits for protection.
  2. Fasten free-standing equipment racks to the server room floor using a minimum of four 1/2-inch concrete anchors. Secure racks mounted on raised floors to the concrete floor below.
  3. Position equipment racks according to drawings with a minimum of 3-feet of clearance in front and back. Field verify the dimensions of the room prior to installation of racks and report any discrepancies to the Owner.
  4. Bolt vertical wire managers for free-standing and 4-post equipment racks to the side of the rack using the manufacturers' recommended hardware.
- D. Ladder Rack Cable Tray:
  1. Tray should be located no less than 3-inches above the top of equipment racks. The locations shown may need to be adjusted slightly in the field to assure proper placement.
  2. Field cut to length tray sections with a minimum number of splice points. Make field cuts using the manufacturers' recommended equipment. Before cutting tray, ensure that radius drops will be properly positioned over vertical cable managers after installation.
  3. Deburr and file rough edges on cable tray.
  4. Provide seismic bracing for installed cable trays.
- E. Equipment Mounting Boards:
  1. Provide telecommunication backboards on wall of communication equipment rooms. The bottom of the backboards shall be placed approximately twelve inches above finished floor (AFF), and must extend to a minimum height of eight feet AFF. Mount backboards with the smooth side facing away from the wall, and paint the backboard with two coats of fire resistant

white paint prior to mounting. A minimum of six appropriate fasteners shall be used for every sixteen square feet of backboard.

F. Copper Cable Protection Units:

1. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG green copper bonding conductor between the protector ground lug and the TC ground point.

G. Fiber Optic Cable:

1. Terminate fiber optic cable in rack-mounted fiber optic terminated units at each end using standard SC, ST, LC, or MT-RJ style bulkhead connectors. Use LC connectors unless otherwise specified by Owner.

H. Riser Cable:

1. Voice and Data riser cable shall be plenum rated as detailed within project specifications and drawings. Pair counts shall also be project specific.
2. Voice riser cable shall be category 3, 24AWG and manufactured by Berk-Tek, General, or Essex.
3. Data riser cable shall be Corning plenum rated duplex LC, MTP-MTP, method A, factory pre-terminated fiber optic cable:
  - a. Corning OM3, colored aqua for Multimode and project specific
  - b. Corning singlemode, colored yellow for singlemode.
4. Fiber optic riser cable shall be routed in plenum, orange innerduct, labeled every 20 feet with "Caution Fiber Optics" warning label permanently attached to innerduct.
5. Innerduct shall have fixed machine-labeled, yellow fiber optic ID tags, with labeling information specified by Owner.

I. Campus Backbone Cable:

1. Multi-pair copper cable shall be category 3, Pic-Filled, Black jacketed cable with overall sheath. PE-89. Approved manufacturers are General, Essex, and Commscope.
2. Fiber Cable shall be graded index single mode fiber, non-conductive and be of loose tube construction. Strand counts shall also be project specific. Approved manufacturer Corning.
3. Corning duplex LC connectorized pre-polished pigtail assemblies will be fusion spliced onto all singlemode fiber optic cable. Field terminated LC connectors shall not be permitted.
4. Fusion splice all cables that requiring splicing as detailed in project specifications and drawings. Mechanical splices are not acceptable anywhere within the physical system.

J. Horizontal Cabling:

1. Cable tray which is installed for the building communications system is dedicated solely for that purpose. Other cabling systems must utilize their own cable tray, which may be run in parallel to the Communications cable tray, provided the other system does not interfere with the communications system in any way.
2. IT reserves the use of blue or green cabling for building communications backbone and horizontal cabling. Blue for "horizontal" cables which run from the jack (work area outlet) to the

TR. Green for "backbone" cables which run between TRs. Fiber optic cabling usually will have black, yellow, orange, or aqua jacketing; these colors are allowed for Fiber only, and are not exclusively reserved for IT use.

3. Minimum conduit size for in-wall data drops is 1-inch.
4. Bundle horizontal distribution cables in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

#### K. Patch Cable:

1. Provide one patch cord for each horizontal termination on the patch panel end, using the following rules:
  - a. one orange, 2-ft cord for every termination for WAP locations
  2. the remainder is to be determined by percentage: 75% yellow, 2-ft; 5% red, 2-ft; 5% red, 7-ft; 5% blue, 7-ft; 5% orange, 7-ft
3. Provide one patch cord for each termination on the station end for WAP locations: orange, 1-ft
4. Fiber Optic: Provide sufficient duplex fiber optic patch cords at each fiber termination point to cross-connect 75% of the number and type of fibers terminated there. Assume a minimum of 2 duplex fiber optic patch cords per termination point for a 6-strand optical fiber. Provide lengths for a neat appearance not to exceed 15-feet. Some patch cords may require LC to SC, or SC to ST connections to support existing or readily available hardware. Coordinate connector requirements with Owner or Owner's Representative.
5. Field terminated patch cords are not allowed.

#### L. Grounding:

1. Bond equipment racks to the each equipment room TGB (one per equipment room minimum) with #6 AWG or larger, stranded copper conductor.
2. Connect each TGB to the TMGB and building steel using a 3/0 AWG or larger, stranded copper conductor.
3. Connect each TMGB to the main electrical main distribution panel and building steel using a 3/0 AWG or larger, stranded copper conductor. Coordinate exact routing and connection points with the electrical contractor.

### 3.2 LABELING

#### A. Backbone Cabling:

1. Identifiers
  - a. Building    ex: BH (for Badgley Hall)
  - b. TR            ex: BH/111 (for room 111 in Badgley Hall)
  - c. rack         ex: BH/111/2 (for rack 2 in room 111 in Badgley Hall)
  - d. panel        ex: BH/111/2/A (for panel A in rack 2 in room 111 in Badgley Hall)
  - e. port         ex: BH/111/2/a/14 (for port 14 in panel A in rack 2 in room 111 in Badgley Hall)
2. Labeling Backbone Racks
  - a. Label the rack with its identifier.

- b. Rack labels are affixed to the front face of the top bar of the rack, left of center.
- c. Text of the label must be no less than 1-inch tall, and be oriented for left-to-right reading.
- 3. Labeling Backbone Patch Panels
  - a. Label the panel with its identifier.
- 4. Labeling Backbone Patch Panel Ports
  - a. Label must not cover manufacturer installed labels or identifiers
  - b. Label each port with the port identifier for the other end.
  - c. Labels for fiber ports may be affixed to the termination shelf, in a location that is visible when the shelf is loaded, and patch cords are installed.
- 5. Labeling Backbone Cables:
  - a. Labels are affixed at two locations on each end. Once at 12-inches from the termination point, and Once at 48-inches from the termination point.
  - b. Label must include the identifiers for both ends of the cable separated by a hyphen (-).
  - c. The label must be oriented so that the identifiers are closer to their respective end.

B. Horizontal Cabling:

- 1. Identifiers
  - a. Building    ex: BH (for Badgley Hall)
  - b. TR            ex: BH/111 (for room 111 in Badgley Hall)
  - c. rack         ex: BH/111/2 (for rack 2 in room 111 in Badgley Hall)
  - d. panel        ex: BH/111/2/A (for panel A in rack 2 in room 111 in Badgley Hall)
  - e. port         ex: BH/111/2/a/14 (for port 14 in panel A in rack 2 in room 111 in Badgley Hall)
  - f. In some cases, Owner may waive the need to include building identifier in horizontal cabling labels.
- 2. Labeling Horizontal Racks
  - a. Label the rack with its identifier.
  - b. Rack labels are affixed to the front face of the top bar of the rack, left of center.
  - c. Text of the label must be no less than 1-inch tall, and be oriented for left-to-right reading.
- 3. Labeling Horizontal Patch Panels
  - a. Label the panel with its identifier.
- 4. Labeling Horizontal Patch panel Ports
  - a. Only specific ports on horizontal panels must be labelled:
    - 1) ports used for emergency purposes, such as fire alarms or elevators
    - 2) ports used for building management or security purposes
    - 3) ports used for wireless access points labelled as "WAP"

- b. Labels must not cover manufacturer installed labels or identifiers
- 5. Labeling Horizontal Cables
  - a. Labels are affixed at two locations on each end. Once at 12-inches from the termination point, and Once at 48-inches from the termination point.
  - b. Label the cable with the identifier of the patch panel port the cable is terminated to.
- 6. Labeling Work Area Jacks
  - a. Each jack is to be labeled with the identifier of the patch panel port on the other end of the cable.

C. General Requirements:

- 1. Each label must be machine-printed, and materials must be appropriate for the surface to which it will be affixed.
- 2. Label text must use a basic, easily readable, sans-serif font.
- 3. Label elements are to be separated by a forward slash (/).
- 4. Label text must be no smaller than ¼-inches high.
- 5. All letters must be uppercase.
- 6. Numbers must not be zero-padded.
- 7. Text must be either white or black. Background must be opposite of the text. If using a clear background, the text color must be easily readable against the color of the surface to which it is affixed.

3.3 EQUIPMENT ACCESS AND LOCATION

- A. Install equipment requiring access so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

3.4 TESTING

- A. Test cables and termination hardware for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-C. Verify pairs of each installed cable prior to system acceptance. Repair or replace any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks in order to ensure 100 percent useable conductors in cables installed.
- B. Test cables in accordance with this document, the ANSI/TIA/EIA standards, the manufacturer's procedures and best industry practice. If any of these are in conflict, bring any discrepancies to the attention of the project team for clarification and resolution.
- C. Test Unshielded Twisted Pair Cables as Follows:
  - 1. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Test horizontal cabling using a Level III test unit for Category 6 performance compliance as specified in ANSI/TIA/EIA-568 C.1, C.2.
  - 2. Continuity - Test each pair of each installed cable using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Test shielded/screened cables with a

- device that verifies shield continuity in addition to the above stated tests. Record the test as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Correct or repair any faults in the wiring and retest the cable prior to final acceptance.
3. Length - Test each installed cable link for installed length using a TDR type device. Test the cables from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length will conform to the maximum distances set forth in the ANSI/TIA/EIA-568-C Standard. Record cable lengths, referencing the cable identification number and circuit or pair number. For multipair cables, record the shortest pair length as the length for the cable.
- D. Follow the Standards requirements established in ANSI/TIA/EIA-568-C.1, C.2.
- E. Perform testing with a Level IV tester. The basic tests required are:
1. Wire Map
  2. Length
  3. Attenuation
  4. NEXT (Near-end Crosstalk)
  5. Return Loss
  6. ELFEXT Loss
  7. Propagation Delay
  8. Delay Skew
  9. PSNEXT (Power Sum Near-end Crosstalk Loss)
  10. PSELFEXT (Power Sum Equal Level Far-end Crosstalk Loss)
- F. Provide test results in written format, with the following minimum information per cable:
1. Circuit ID
  2. Test result, "Pass" or "Fail"
  3. Date and Time of test
  4. Project Nam
  5. NVP
- G. Provide an electronic copy of the test results, in the native tester software format, to the Consultant along with the written test results.
- H. Provide a fully functional version of the tester software for use by the Consultant in reviewing the test results.
- I. Any failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs), must be reported in writing to the Consultant immediately, along with a copy of the test results.
- J. Labeling
1. Provide labeling information on the as-built drawings one week prior to cable installation